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Publications in this series have not been edited; they are reviewed internally and released as submitted by the author.

TABLE OF CONTENTS

TABLE OF FIGURES

1 TRI-TERRITORIAL BEDROCK DATABASE: DESIGN OVERVIEW

The Tri-territorial (TriT) Bedrock Database (TBDB) contains two significant components: (1) an ongoing compilation of the bedrock geology of the Canadian North that can rapidly evolve with new mapping, and (2) source maps used to generate the compilation. Together, these holdings constitute a comprehensive and authoritative source of knowledge for the geology of the Canadian North. Incuded are extensive descriptions of geological features, primarily units and structures, captured from regional maps ranging in scale from 1:200,000 to 1:5,000,000, and from a variety of other materials such as journal papers and government reports. Source maps are not limited to this range of scale, as maps of any scale can conceivably be integrated into the compilation; however, small-size features are less likely to be included. Source maps retain their original cartographic representation upon insertion into the database, however the cartographic representation of a copy of some features will be altered once they are merged into the compilation. Because of the depth and breadth of its information, it is anticipated the database will become widely useful to scientists, educators, and other professionals. This report describes the motivation, principles, and technical design of the TBDB.

1.1 Motivation

The TBDB aims to provide information about the bedrock geology of the Canadian North in a timely, comprehensive, and effective manner:

- ***Timeliness*** includes several aspects: for new mapping by the Geological Survey of Canada (GSC) and its partners, it involves enabling rapid online access to the new information, *in context with prior mapping*; for the compilation of the North, it involves swift integration of source information into the ongoing synthesis, avoiding the long update cycles characteristic of traditional map compilation methods. Timeliness therefore implies an “evergreen” or “live” approach to geological map information, where new information is rapidly available online and where it is quickly added to the ongoing compilation as new regional mapping is completed.

- ***Comprehensiveness*** refers to information depth, breadth, and integrity: with the aim of being an authoritative source, comes the need to gather as much information as possible and place it into a coherent scientific and technical framework. The database should contain sufficient details about relevant geological features (depth), and also cover the full range of key features in the North (breadth), such that each feature fits appropriately into a uniformly applied scientific framework (integrity). This is achieved in part via a database design that finely delineates descriptive attributes and their associated values, for example, a lithology attribute and a corresponding list of lithology terms. Each list of terms constitutes a specific vocabulary, while the attributes and vocabularies together constitute a standard science language for the database, also known as a data dictionary or sometimes as an ontology. Importantly, this standard science language is a reflection of a uniform and encompassing scientific approach to the geology at the scale of the whole of the North. Achieving both depth and breadth in a scientifically consistent manner within TBDB contrasts with typical approaches, in which information depth decreases with geographical breadth, and where information is fragmented scientifically and technically across organizations and systems.

- ***Effectiveness*** refers to accessibility and usability: how easy is it to find and view the information, to query it for specific purposes, and to download both maps and query results for manipulation by local systems? As contemporary approaches to accessibility and usability rely on web-based approaches, it is vital that online tools can adequately manipulate the information. In particular, this refers to the ability to search for geological information across multiple geology maps spanning the whole of the Canadian North—until now such search was restricted to querying single geological maps from specific regions. Effectiveness also refers to computer-driven approaches to map compilation, in which the geological knowledge embedded in the database can be leveraged to help semi-automate the compilation process, facilitating the generalization and simplication of map units.

1.2 Database Design Principles

Unity is the overriding design principle adopted for the TBDB. It refers to the notion that each data piece functions as part of a whole, i.e. as part of the Northern compilation. This is in contrast to most geological map databases in which maps are treated as distinct silos, with isolated contents, such that operations must be carried out on each map individually. There are several implications from this unified approach:

- ***Map multiplicity***: most fundamentally, unity implies that the database contains multiple maps, which can be manipulated as discrete entities or as part of a single integrated whole.

- ***Cartographic multiplicity***: refers to the fact that a geological feature can be symbolized variously across multiple map representations due to diverse symbol schemes, or because portrayal of the source features might be altered on a compilation map, for example, if they are portrayed as part of a greater whole (bigger unit).

- ***Informatics multiplicity***: refers to the fact that the shape, boundary, location and geological description of a feature might vary from map to map, due to heterogeneity in the spatial distribution of physical properties, the use of different scientific conventions, or due to the particular focus of the mapper. This implies a need to maintain prototypical unit descriptions, that are generally characteristic of all local variations. It also refers to the fact that a feature can be classified diversely, particularly in compilations: for example, when a stratigraphic formation on one map is generalized to a higher ranked unit, such as a stratigraphic group, on a compilation map.

1.3 Database Design

Classical database design recommends the creation of three interdependent schema for any database: conceptual, logical, and physical. In terms of this classical approach, the TBDB design described here is a blended logical and physical schema. The applicable conceptual schema is NADM C1 (NADM 2004): it governs the overall design of the TBDB, such that TBDB can be considered an implementation of it. This is analogous to how the GeoSciML (Sen & Duffy, 2005) data exchange standard is a logical implementation of NADM C1. TBDB also borrows from GeoSciML several properties used to describe geological units and structures, including parts of their vocabularies. TBDB is thus directly indebted to NADM C1 and GeoSciML for major conceptual and logical design elements, respectively, and indirectly indebted to key underlying conceptual foundations (Brodaric & Hastings, 2002; Brodaric & Gahegan, 2006). TBDB varies from these building blocks primarily in its more extensive description of geological setting, in its simplification or partial adoption of certain temporal elements, and in its ammendments to existing vocabularies. It both extends some GeoSciML vocabularies with additional terms, e.g. the lithology and mineral vocabularies, and introduces new vocabularies where required, e.g. for geological settings. The TBDB physical schema is an Oracle implementation of the schema described herein.

The three principles outlined in Section 1.2 govern the database design illustrated in Figures 1-9. These figures are expressed in the Unified Modeling Language (UML; Booth *et al.*, 2004), and deviate from a standard logical UML diagram in several respects: (1) roles (the named end of lines) are duplicated as a foreign key within the source entity; (2) primary keys (a unique identifier for each entity) are prefaced with an asterisk, (3) foreign keys (a link to another entity) are suffixed with "_ID", and by definition are not primary keys, and (4) datatypes refer to concrete types (e.g. int, float, char) except to specify vocabularies. The identification of primary and foreign keys and the lack of non-concrete datatypes, orients this schema to a physical design, however, the absence of database constraints and other physical specifications, as well as the inclusion of vocabulary datatypes, suggests the database design is a blend of the physical and logical. Note that each foreign key denotes a unidirectional relation to another enity. Only some of these relations are explicity shown as lines in Figures 1-9 in Section 2, though a comprehensive list of all relations is expressed in the tables in Section 3.

The following subsections outline the major components of the database design. These are described in greater detail as diagrams and associated tables in subsequent sections. Note that not all elements of the design are currently populated in the database: geological structures are not yet incorporated, but will be, and a few attributes currently sit empty and their continued inclusion is to be re-assessed.

1.3.1 Geographical Feature

A geographical feature (geo-feature) is a classified geometric entity, such as a point, line, polygon, or volume, as shown in Figure 2. Geometric entities can be classified as cartographic features or geological features, with the latter being either structures or units. A geometric entity might be associated with multiple classifications, such as when a polygon (geological unit) from a source map is re-classified to a higher ranked unit in a compilation map; however, each geo-feature has a single associated geometry, classification, and description. Classification binds a geo-feature to a prototypical description, denoting it to be one instance amongst possibly many for that type of feature. In contrast, an individual description is a unique characterization of that particular geo-feature, which might differ from other similarly classified geo-features. For example, a particular polygon might be classified as formation X, but its individual description might differ slightly from other polygons classified as X, due to spatial heterogeneity. It might also vary somewhat from the prototypical description of X, which might be more synoptic. Prototypes in this sense are related to the geological notions of stratotype, type locality, and similar concepts, but are more general: a prototype consists of variably typical characteristics of a unit, i.e. that can grade from uncommon to necessary, while a stratotype is a reference description consisting of very typical or necessary characteristcs of a unit, usually derived from a specific geographic location designated as its type locality. A prototype can thus encompass both reference descriptions and regional variants. Note that “type” and “prototype” will be used interchangeably herein.

1.3.2 Map and Legend

A map is defined as a collection of symbolized geo-features (called map features) that are linked to an accompanying legend, as shown in Figure 3. The legend describes the types of geological features presented on the map, and includes a textual description as well as a cartographic symbol. Symbolization of map features can be type-based or instance-based. Type-based symbolization enables every instance of a feature type to be symbolized identically: e.g. a map legend might specify that all instances of formation X are colored in solid blue. Instance-based symbolization, on the other hand, enables individual instances of some feature type to be represented with different symbols: e.g. the orientation of structural symbols varies from one instance to another, or some polygons of formation X could be symbolized differently (not blue, or overprinted with a pattern) to highlight disparate properties. In TBDB, symbolization is usually determined by the feature type in the legend, but can be overridden by the instance where required.

1.3.3 Geological Time Scale

The TBDB design accommodates multiple time scales, as shown in Figure 4. Each time scale is a collection of chronostratigraphic ages, such as Devonian or Permian, and each age has a minimum and maximum absolute date associated with it. Each age can also participate in a part hierarchy, i.e. it can be part of a broader age or be subdivided into finer age parts. Despite this flexibility, the data in TBDB references a single time scale, which at present is a modified version of the ICS standard (Sept 2010).

1.3.4 Geological Event and Age

Following GeoSciML, events and ages are tightly linked—the age of a geological feature, such as a unit or structure, is typically obtained by dating an event associated with the feature; therefore, describing the age of a feature in TBDB involves describing one or more associated events. Four types of description are provided, as shown in Figure 5: age type, setting, chronostratigraphic age (relative), and chronologic age (absolute). Age type distinguishes the dating of a protolith from metamorphic events. A setting description has two parts, a synoptic part containing broadly applicable information, for example,

type of climate or crustal position, and a specific part in which multiple local environments can be characterized. A relative age consists of a chronostratigraphic interval, e.g. Early Cretaceous to Late Cretaceous (whose numeric age values could shift over time), whereas an absolute age consists of a specific numeric interval measured in millions of years (Ma), e.g. 114-88 Ma. Both relative and absolute ages include relevant metadata, such as an uncertainty qualifier and a description of the pertinent dating method. Finally, events can be sequenced to account for a linear chain of geological events.

1.3.5 Geological Unit and Structure

Both units and structures can be nested in part hierarchies, such that a unit or structure can be part of another unit or structure, respectively (Figure 6). An entry in TBDB for a unit or structure can describe either an instance or a type: for example, a geological unit entry could describe an individual polygon, or the prototype used to classify the polygon, such as formation X. At present, all unit descriptions in TBDB describe prototypes. Apart from lithologic and mineral composition descriptions, which follow below, unit descriptions include characteristics such as rank, thickness, morphology, colour, deformation and metamorphic properties, among others. Structure descriptions cover a broad range of geological structures occurring over a wide range of geographical scales, including outcrop-scale field measurements to continental-scale faults. These structure descriptions are derived from examination of many digital geological maps, and consist of a simplified version of some GeoSciML structural entities.

1.3.6 Lithology and Mineral

The TBDB design in Figure 7 shows that a geological unit can be composed of one or more lithologies, which can be composed of several minerals. A lithology description can be re-used by multiple units, with varying abundance: for example, a subunit such as a regional variant might be composed of a different amount of a lithology. The amount of composition can be described qualitatively (i.e. major, minor, trace) as well as quantitatively as a percentage of the unit—at present only the qualitative approach is used. Lithologies are described primarily in terms of key properties, related to bedding, colour, particles, fabric, primary structure, and metamorphism, and can be nested in part hierarchies. Minerals are associated with a lithology, possess metadata (e.g. economic, metamorphic, basic composition), as well as a qualitative and quantitative composition amount.

1.3.7 Vocabulary

Vocabularies refer to the terms and associated meanings that populate attributes in the TBDB. As illustrated in Figure 8, vocabularies consist of collections of concepts, which are definitions with corresponding English names, with an option (unused) to include French names. The same concept can exist in multiple vocabularies, each possibly with unique hierarchies—thus the same concept could have different parents or children in different vocabularies. All property ranges that are prefixed with “vocab_” in the TBDB design are restricted to terms from an associated vocabulary.

1.3.8 Publication and Edit

Publications refer to published sources that are referenced in the TBDB. Each publication is described using typical properties such as author, title, year, media type, publisher, and so on. Publications are cited in various places in the TBDB. Each citation is documented as a `Published_Item`, which links a publication to a particular record in the database. Changes to data content are somewhat analogous, in the sense that any such change is documented in `Edit`, which provides a link to the changed entity. Figure 9 depicts the design for publications and edits.

2 TRI-TERRITORIAL BEDROCK DATABASE: DIAGRAMS

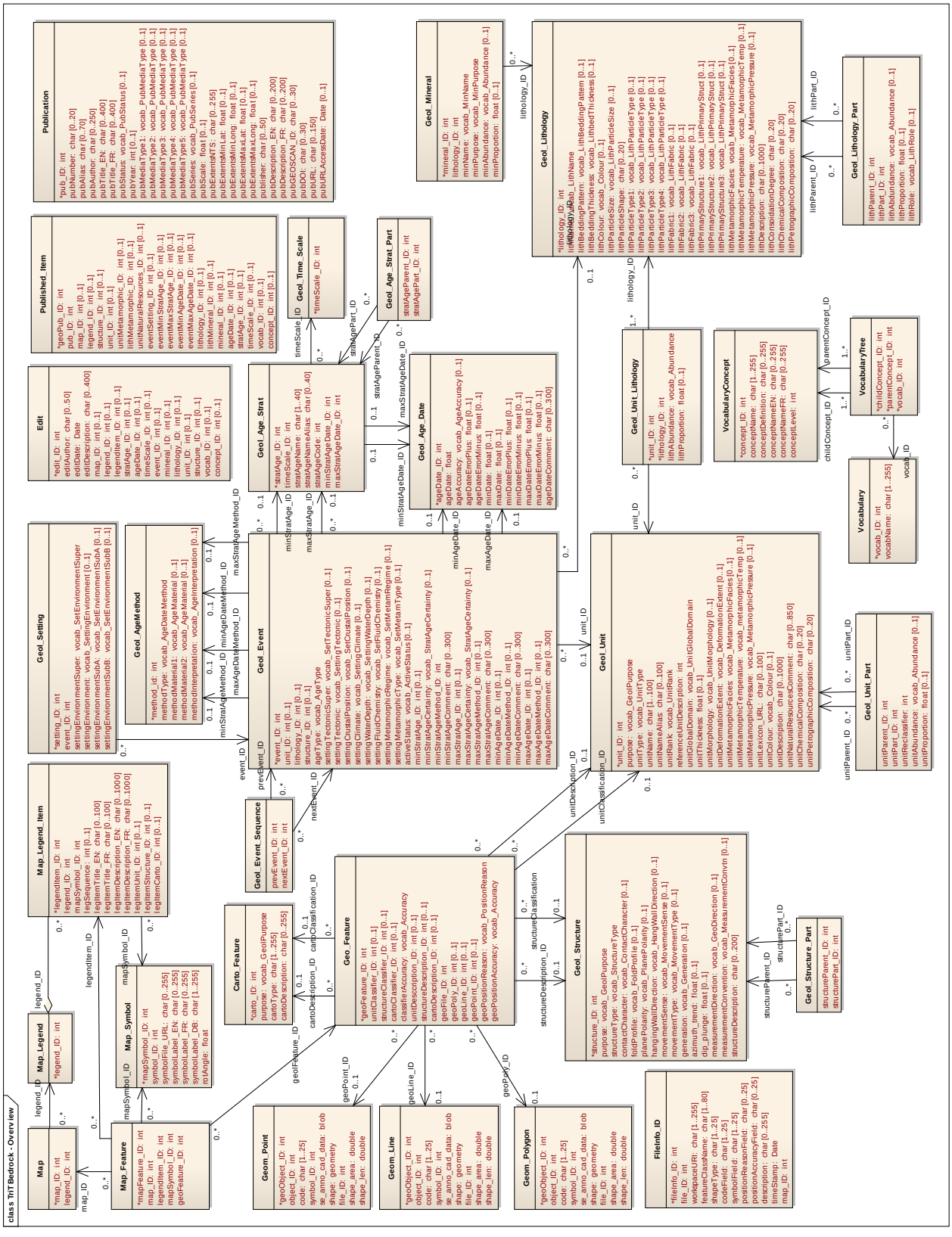

Figure 1: Tri-territorial (TriT) Bedrock - Overview

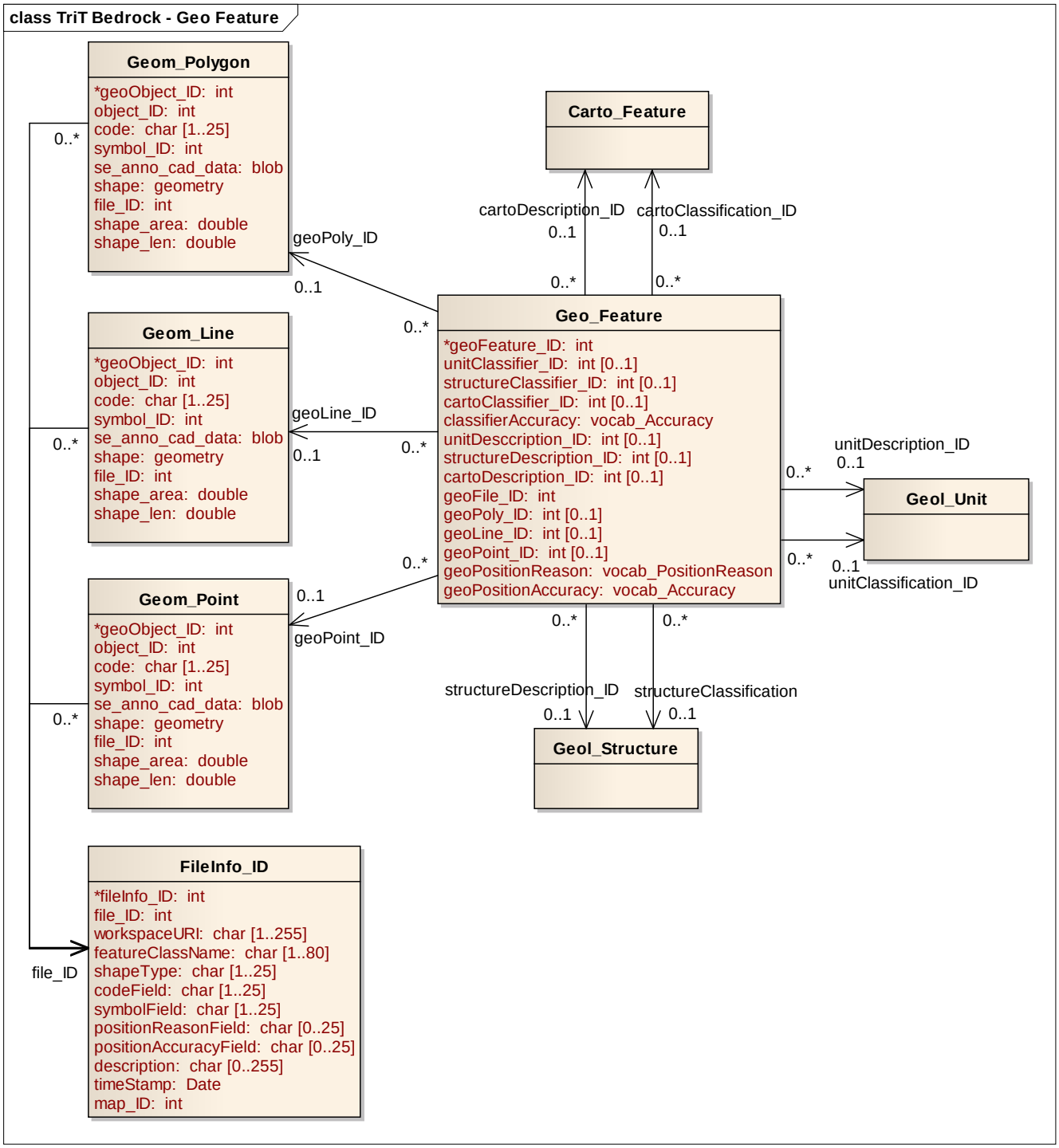

Figure 2: Tri-territorial (TriT) Bedrock - Geographical Feature

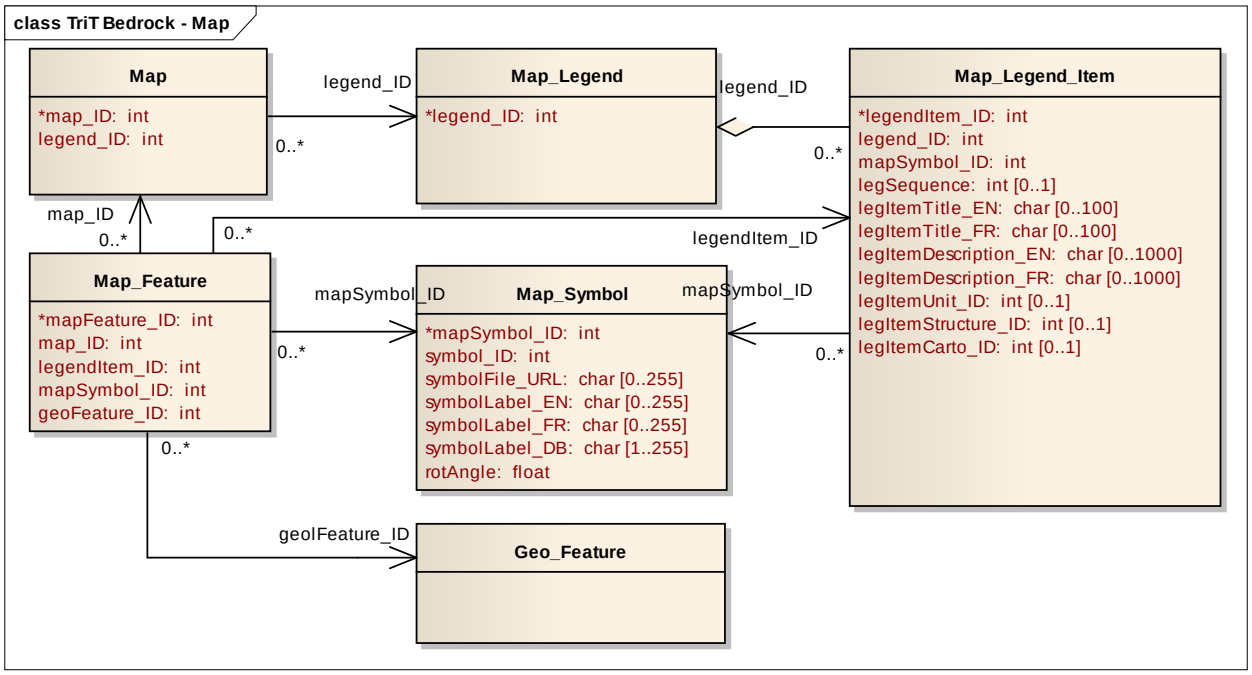

Figure 3: Tri-territorial (TriT) Bedrock - Map and Legend

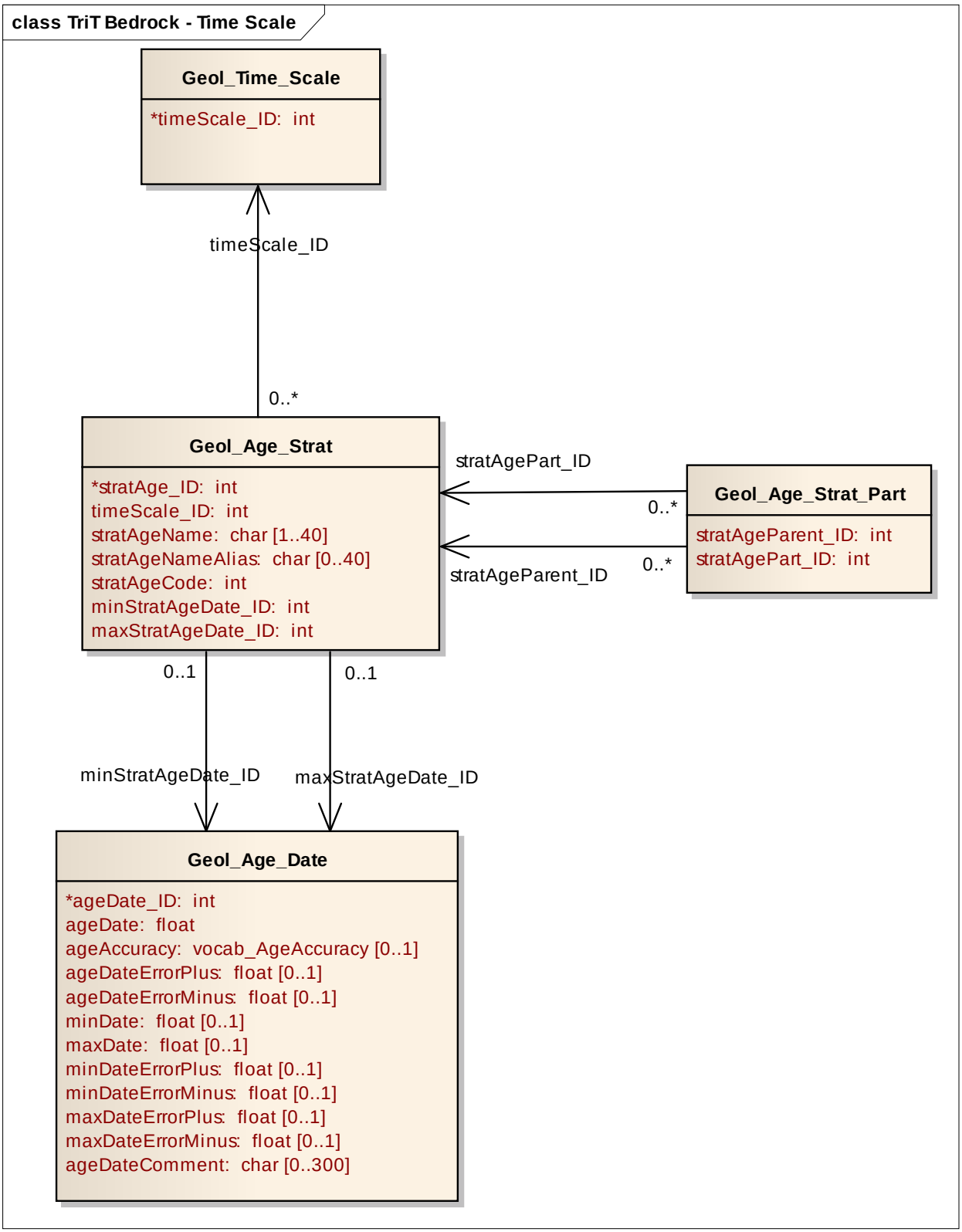

Figure 4: Tri-territorial (TriT) Bedrock - Time Scale

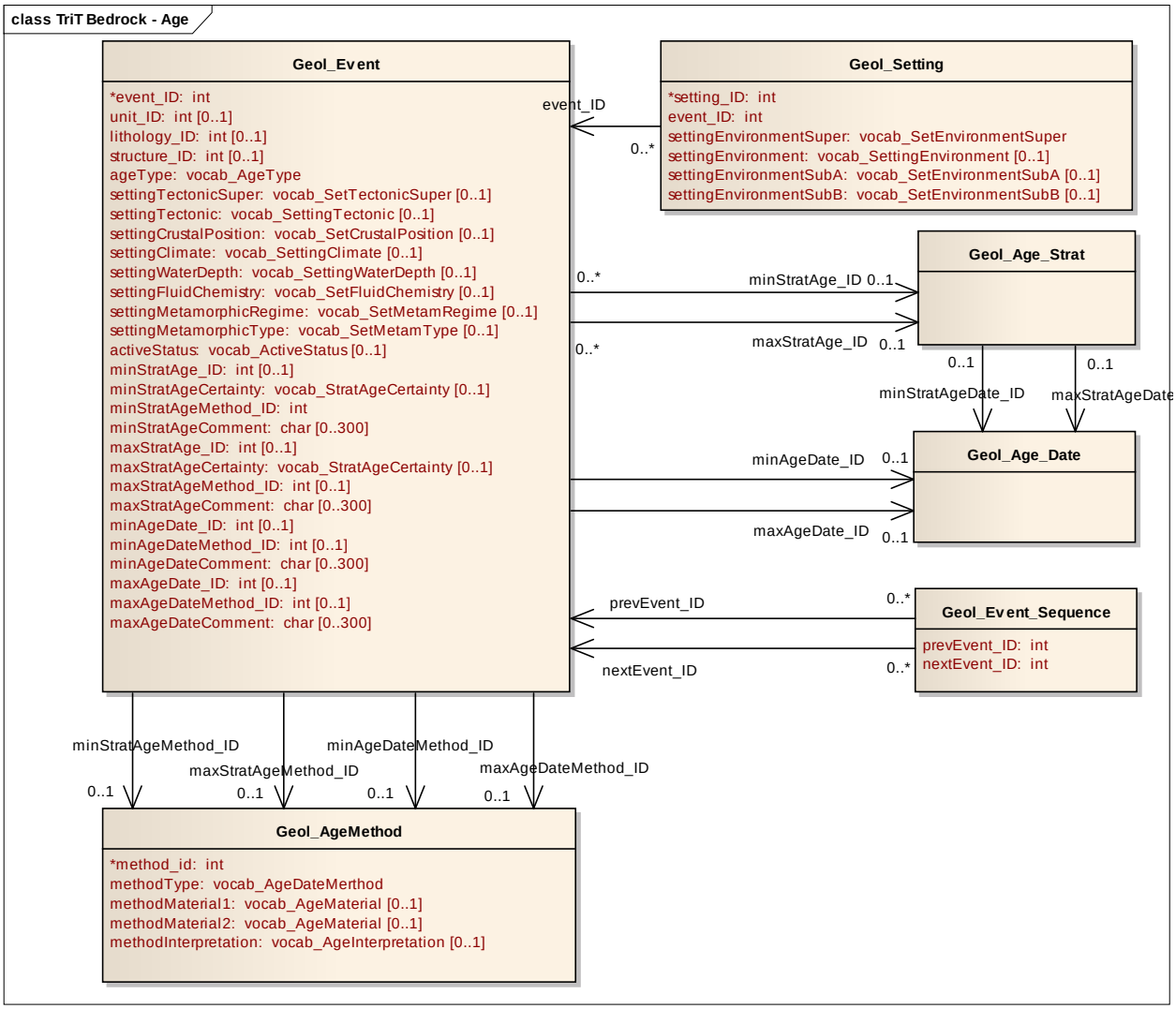

Figure 5: Tri-territorial (TriT) Bedrock - Event and Age

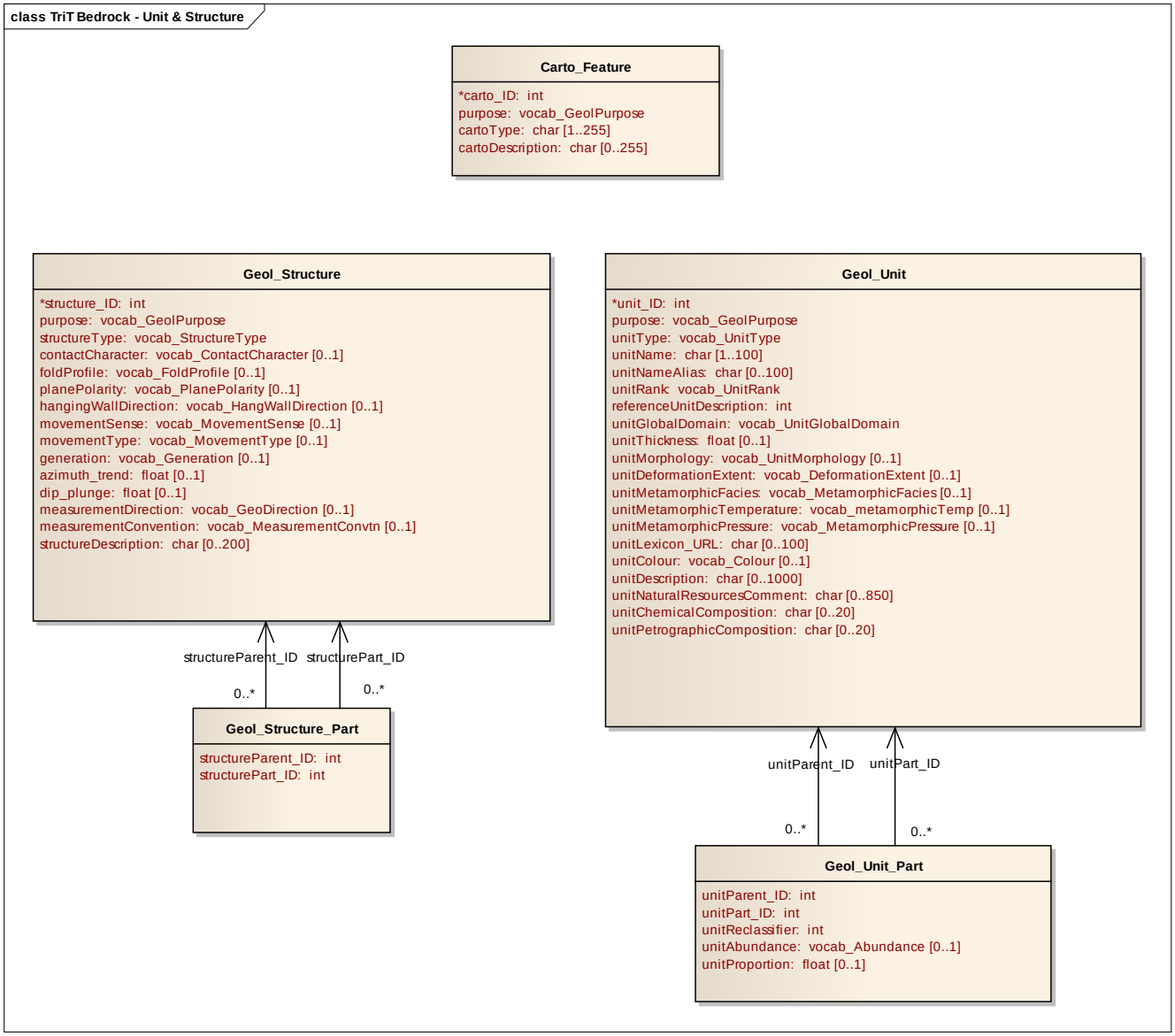

Figure 6: Tri-territorial (TriT) Bedrock - Unit, Structure and Carto features

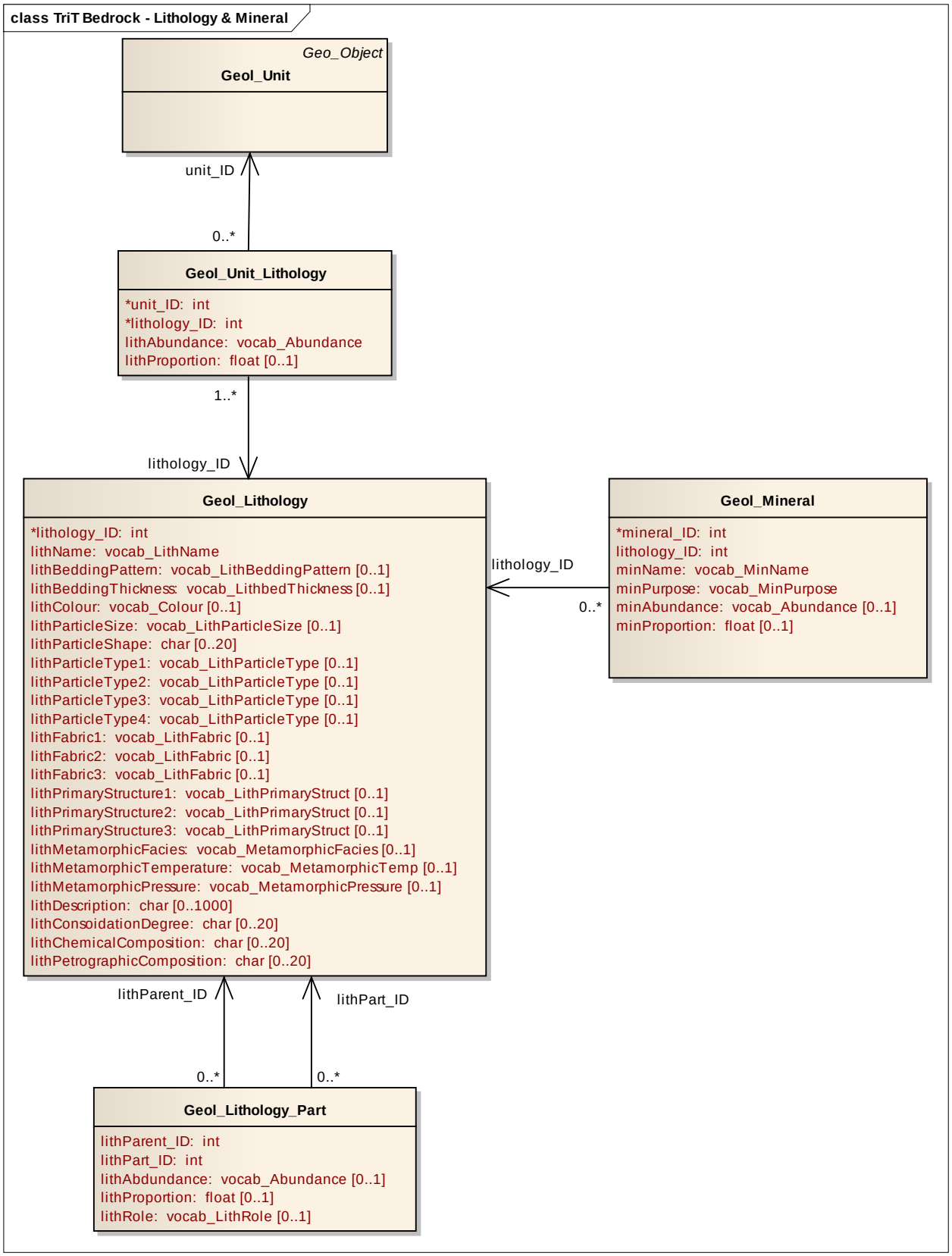

Figure 7: Tri-territorial (TriT) Bedrock - Lithology and Mineral

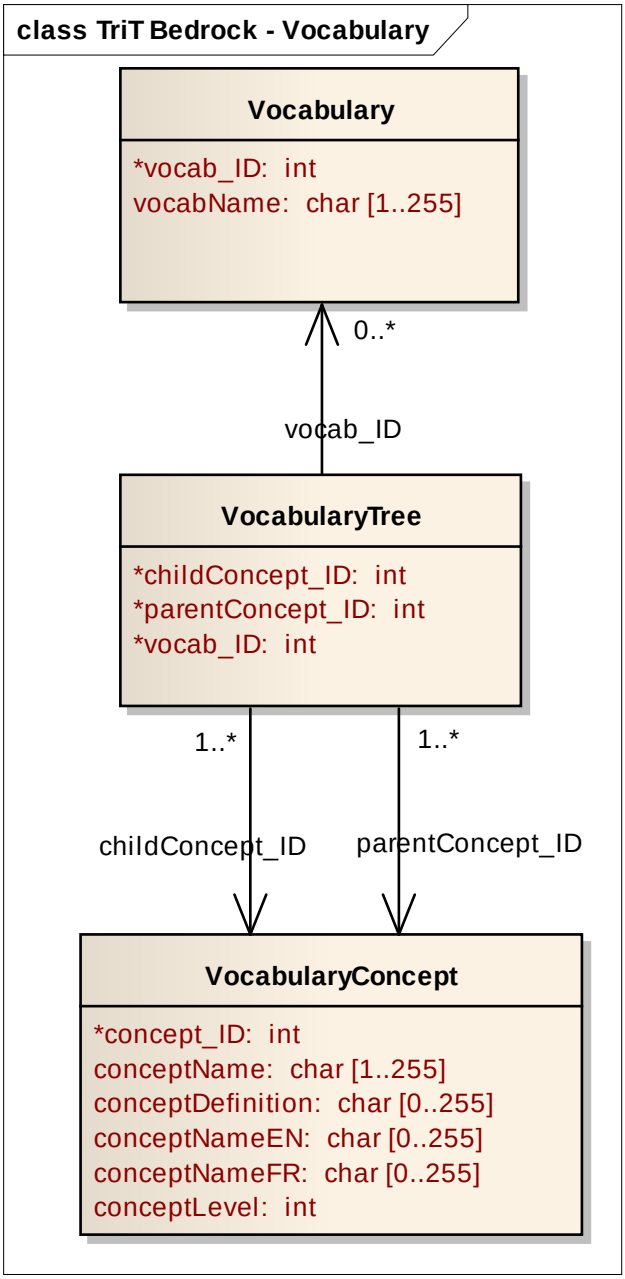

Figure 8: **Tri-territorial (TriT) Bedrock - Vocabulary**

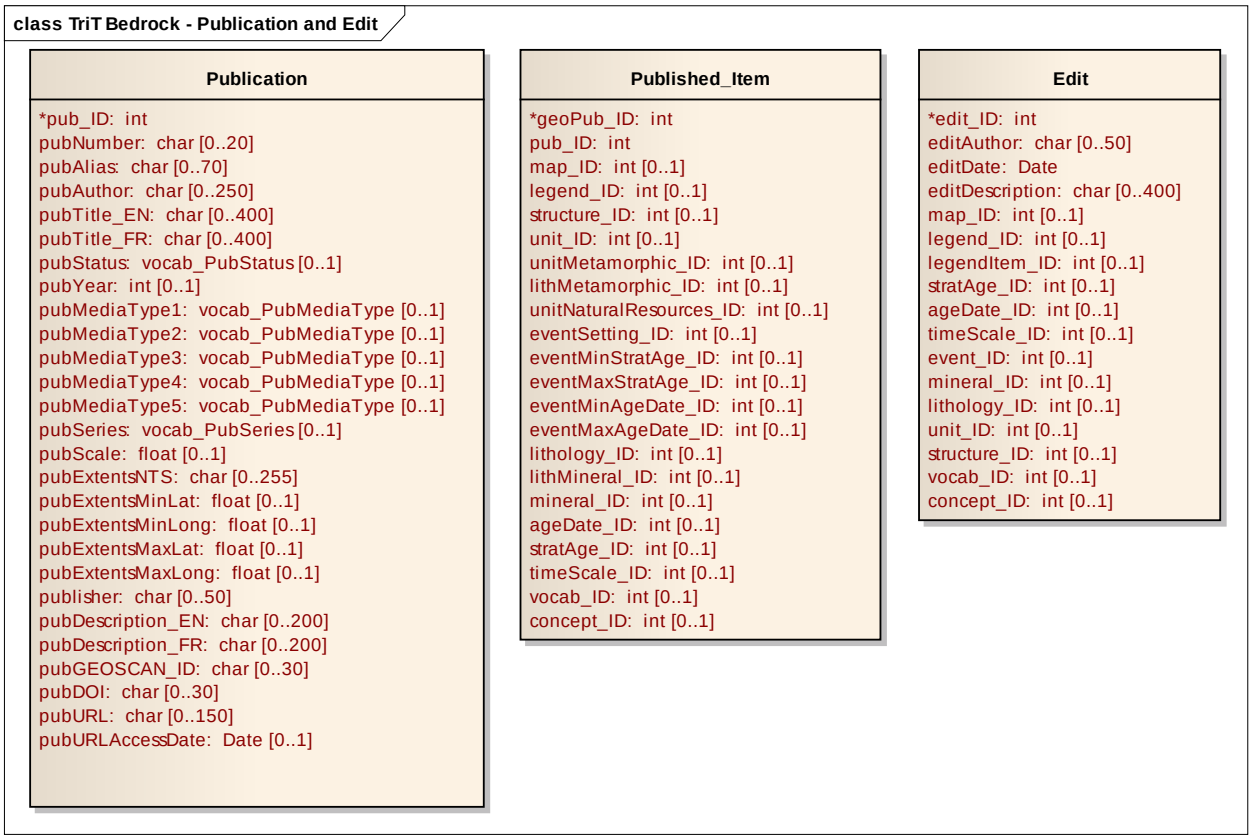

Figure 9: Tri-territorial (TriT) Bedrock - Publication and Edit

3 TRI-TERRITORIAL BEDROCK DATABASE: ENTITIES & RELATIONS

3.1.1 Carto_Feature

An entity present on a map strictly for cartographic or other non-geologic reason, e.g. a map or water boundary.

Attribute	Type and Multiplicity	Definition
**carto_ID*	int	A unique internal identifier for the carto feature.
purpose	vocab_GeolPurpose	Denotes whether the entry describes an instance or type.
cartoType	char [1..255]	The type of cartographic feature.
cartoDescription	char [0..255]	A textual description of the cartographic feature.

Relation	Source	Target	Direction
Association	*Entity*: Carto_Feature *Role*: cartoClassification_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association	*Entity*: Carto_Feature *Role*: cartoDescription_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association	*Entity*: Map_Legend_Item *Role*:	*Entity*: Carto_Feature *Role*: legItemCarto_ID	Source -> Destination

3.1.2 Edit

Records metadata about a specific change to an entity, enabling capture of a history of changes (provenance). Contains some simple metadata, i.e. author, date and description of the change, and a link (foreign key) to the entity that was changed. Only one of the foreign keys should be populated. i.e. the edit can only apply to one entity.

Attribute	Type and Multiplicity	Definition
**edit_ID*	int	Unique internal identifier for the edit.
editAuthor	char [0..50]	Author of the edit.
editDate	Date	Date of edit.
editDescription	char [0..400]	Description of the edit.
map_ID	int [0..1]	Map that was edited (foreign key to Map).
legend_ID	int [0..1]	Legend that was edited (foreign key to Map_Legend).
legendItem_ID	int [0..1]	Legend item that was edited (foreign key to Map_Legend_Item).
stratAge_ID	int [0..1]	Strat age that was edited (foreign key to Geol_Age_Strat).
ageDate_ID	int [0..1]	Age date that was edited (foreign key to Geol_Age_Date).
timeScale_ID	int [0..1]	Time scale that was edited (foreign key to Geol_Time_Scale).
event_ID	int [0..1]	Event that was edited (foreign key to Geol_Event).
mineral_ID	int [0..1]	Mineral that was edited (foreign key to Geol_Mineral).
lithology_ID	int [0..1]	Lithology that was edited ((foreign key to Geol_Lithology)).
unit_ID	int [0..1]	Geologic unit that was edited (foreign key to Geol_Unit).

Attribute	Type and Multiplicity	Definition
structure_ID	int [0..1]	Geologic structure that was edited (foreign key to Geol_Structure).
vocab_ID	int [0..1]	Vocabulary that was edited (foreign key to Vocabulary).
concept_ID	int [0..1]	Vocabulary term that was edited (foreign key to VocabularyConcept).

Relation	Source	Target	Direction
Association	*Entity*: Edit *Role*:	*Entity*: Map *Role*: map_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Map_Legend_Item *Role*: legend_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAge_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Age_Date *Role*: ageDate_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Time_Scale *Role*: timeScale_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Event *Role*: event_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Mineral *Role*: mineral_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Unit *Role*: unit_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Structure *Role*: structure_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Vocabulary *Role*: vocab_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: VocabularyConcept *Role*: concept _ID	Source -> Destination

3.1.3 FileInfo_ID

Each entry in FileInfo_ID contains information about an external spatial file (point, line, or polygon) loaded into the database, including a unique file identifier (which is generated at load time). Note that a map usually consists of several files, for various points, lines, and polygons.

Attribute	Type and Multiplicity	Definition
**fileInfo_ID*	int	A unique internal identifier for the file.
file_ID	int	A unique external identifier for the file. It is used to create unique identifiers for points, lines, and polygons.
workspaceURI	char [1..255]	A link to the workspace hosting the file.
featureClassName	char [1..80]	Name of the type of entity, typically geologic unit, structure, or carto feature.
shapeType	char [1..25]	The type of geometry, i.e. point, line, or polygon.
codeField	char [1..25]	Indicates the name of the field containing the map unit label.
symbolField	char [1..25]	Indicates the name of the field containing a symbol value referenced to a style file, i.e. polygon colour.
positionReasonField	char [0..25]	Indicates the name of the field containing the reason for the presence of the entity, with values including: mapped, map boundary, feature boundary (e.g. water body boundary).
positionAccuracyField	char [0..25]	Indicates the name of the field containing the spatial accuracy of the entity.
description	char [0..255]	Modified publication name: e.g. CGM3_CARTO.
timeStamp	Date	Date the file is loaded.
map_ID	int	The identifier of the map to which the file belongs.

Relation	Source	Target	Direction
Association	*Entity*: Geom_Polygon *Role*:	*Entity*: FileInfo_ID *Role*: file_ID	Source -> Destination
Association	*Entity*: Geom_Line *Role*:	*Entity*: FileInfo_ID *Role*: file_ID	Source -> Destination
Association	*Entity*: Geom_Point *Role*:	*Entity*: FileInfo_ID *Role*: file_ID	Source -> Destination

3.1.4 Geo_Feature

A Geo_Feature is essentially a classified geometry, e.g. a polygon classified as a specific geologic unit, or a line classified as a specific geologic structure. Some notes about Geo_Features:

- a geometry can be classified multiple times, e.g. as a geologic unit or tectonic unit, but each classification is a distinct Geo_Feature.
- classification involves relating the geometry to a type, instance, or both; e.g. to a geologic unit description of a specific polygon (instance), and/or to a geologic unit description that applies to all its polygons on any map (type). This enables local instance variations to be described within broader types.
- each Geo_Feature can exist on multiple maps (each occurrence on a different map is a unique Map_Feature).
- a GeoFeature must be classified, and classified as only one of carto, structure, or unit feature.
- a GeoFeature can optionally also describe one specific instance of the same type as its classifiation, e.g. if a Geo_Feature is a unit, then the instance description is a unit description.
- a GeoFeature must be related to one, and only one, geometry (point, line, polygon).

Attribute	Type and Multiplicity	Definition
**geoFeature_ID*	int	Unique internal Geo_Feature identifier.
unitClassifier_ID	int [0..1]	A link to a description that applies to all (polygon, line, point) instances of a specific geologic unit (foreign key to Geol_Unit).
structureClassifier_ID	int [0..1]	A link to a description that applies to all (polygon, line, point) instances of a specific geologic structure (foreign key to Geol_Structure).
cartoClassifier_ID	int [0..1]	A link to a description that applies to all (polygon or line) instances of a specific cartographic feature (foreign key to Carto_Feature).
classifierAccuracy	vocab_Accuracy	The degree of certainty in the classification for linear structures, e.g. defined, approximate.
unitDesccription_ID	int [0..1]	A link to a description that applies to only one (polygon, line, point) instance of a specific geologic unit (foreign key to Geol_Unit).
structureDescription_ID	int [0..1]	A link to a description that applies to only one (polygon, line, point) instance of a specific geologic structure (foreign key to Geol_Structure).
cartoDescription_ID	int [0..1]	A link to a description that applies to only one (polygon, line, point) instance of a specific cartographic feature (foreign key to Carto_Feature).
geoFile_ID	int	The identifier of the file that originally contained the geospatial entity.
geoPoly_ID	int [0..1]	The identifier of the polygon being classified (foreign key to Geom_Polygon).
geoLine_ID	int [0..1]	The identifier of the line being classified (foreign key to Geom_Line).
geoPoint_ID	int [0..1]	The identifier of the point being classified (foreign key to Geom_Point).
geoPositionReason	vocab_PositionReason	The reason for the presence of the entity: e.g. mapped, map boundary, feature boundary (e.g. water body boundary).
geoPositionAccuracy	vocab_Accuracy	The spatial accuracy of the geospatial entity, e.g. defined, approximate.

Relation	Source	Target	Direction
Association	*Entity*: Map_Feature *Role*:	*Entity*: Geo_Feature *Role*: geolFeature_ID	Source -> Destination
Association Links a GeoFeature to a carto description.	*Entity*: Carto_Feature *Role*: cartoDescription_ID	*Entity*: Geo_Feature *Role*: carto_ID	Destination -> Source
Association Links a GeoFeature to a structure description. .	*Entity*: Geol_Structure *Role*: structureDescription_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source

Relation	Source	Target	Direction
Association Links a GeoFeature to a unit description.	*Entity*: Geol_Unit *Role*: unitDescription_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association Links a GeoFeature to a carto classification.	*Entity*: Carto_Feature *Role*: cartoClassification_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association Links a GeoFeature to a structure classification.	*Entity*: Geol_Structure *Role*: structureClassification_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association Links a GeoFeature to a unit classification.	*Entity*: Geol_Unit *Role*: unitClassification_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association Links a GeoFeature to a polygon.	*Entity*: Geom_Polygon *Role*: geoPoly_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association Links a GeoFeature to a line.	*Entity*: Geom_Line *Role*: geoLine_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association Links a GeoFeature to a point.	*Entity*: Geom_Point *Role*: geoPoint_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source

3.1.5 Geol_AgeMethod

Method used to obtain a stratigraphic or absolute age value.

Attribute	Type and Multiplicity	Definition
**method_id*	int	Unique internal identifier for a description of the method used to obtain an age value.
methodType	vocab_AgeDateMerthod	Type of method used to obtain the age value, e.g. biostratigraphy, Ar-Ar, etc.
methodMaterial1	vocab_AgeMaterial [0..1]	The type of material being dated: e.g., zircon, biotite, trace fossil, whole rock, etc.
methodMaterial2	vocab_AgeMaterial [0..1]	The type of material being dated: e.g., zircon, biotite, trace fossil, whole rock, etc.
methodInterpretation	vocab_AgeInterpretation [0..1]	The underlying interpretation of a geologic process used during the dating.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: maxStratAgeMethod_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: minAgeDateMethod_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: minStratAgeMethod_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: maxAgeDateMethod_ID	Source -> Destination

3.1.6 Geol_Age_Date

An absolute (numeric) age date in millions of years, usually obtained by laboratory assessment. Includes a single error range for that value, as well as possibly a minimum and maximum interval with error ranges for that value. Currently, only the single error range is entered for each age date.

Attribute	Type and Multiplicity	Definition
**ageDate_ID*	int	A unique internal identifier for the age date.
ageDate	float	A numeric value for the age in millions of years.
ageAccuracy	vocab_AgeAccuracy [0..1]	A categorical estimate of the accuracy of the age date, i.e. defined, approximate, well-defined.
ageDateErrorPlus	float [0..1]	A numeric value for the plus end of the error range, in millions of years.
ageDateErrorMinus	float [0..1]	A numeric value for the minus end of the error range, in millions of years.
minDate	float [0..1]	The minimum age associated with this age date.
maxDate	float [0..1]	The maximum age associated with this age date.
minDateErrorPlus	float [0..1]	The plus value for the error range of the minimum date.
minDateErrorMinus	float [0..1]	The minus value for the error range of the minimum date.
maxDateErrorPlus	float [0..1]	The plus value for the error range of the maximum date.
maxDateErrorMinus	float [0..1]	The minus value for the error range of the maximum date.
ageDateComment	char [0..300]	A comment about the age date.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Date *Role*: maxAgeDate_ID	Source -> Destination
Association	*Entity*: Geol_Age_Strat *Role*:	*Entity*: Geol_Age_Date *Role*: maxStratAgeDate_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Date *Role*: minAgeDate_ID	Source -> Destination

Relation	Source	Target	Direction
Association	*Entity*: Geol_Age_Strat *Role*:	*Entity*: Geol_Age_Date *Role*: minStratAgeDate_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Age_Date *Role*: ageDate_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Age_Date *Role*: ageDate_ID	Source -> Destination

3.1.7 Geol_Age_Strat

A named age interval within a geologic time scale, e.g. Devonian. Usually obtained stratigraphically in relation to other such intervals.

Attribute	Type and Multiplicity	Definition
**stratAge_ID*	int	A unique internal identifier for the stratigraphic age.
timeScale_ID	int	The time scale containing the stratigraphic age (Foreign key to Geol_Time_Scale).
stratAgeName	char [1..40]	The name of the stratigraphic age within the time scale: e.g. "Devonian".
stratAgeNameAlias	char [0..40]	An alternate name for the stratigraphic age, within the time scale.
stratAgeCode	int	A typical abbreviation for the stratigraphic age.
minStratAgeDate_ID	int	The minimum absolute age for the age interval (foreign key to Geol_Age_Date).
maxStratAgeDate_ID	int	The maximum absolute age for the age interval (foreign key to Geol_Age_Date).

Relation	Source	Target	Direction
Association	*Entity*: Geol_Time_Scale *Role*: timeScale_ID	*Entity*: Geol_Age_Strat *Role*:	Destination -> Source
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Strat *Role*: minStratAge_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Strat *Role*: maxStratAge_ID	Source -> Destination
Association	*Entity*: Geol_Age_Strat_Part *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAgeParent_ID	Source -> Destination
Association	*Entity*: Geol_Age_Strat *Role*:	*Entity*: Geol_Age_Date *Role*: maxStratAgeDate_ID	Source -> Destination
Association	*Entity*: Geol_Age_Strat_Part *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAgePart_ID	Source -> Destination
Association	*Entity*: Geol_Age_Strat *Role*:	*Entity*: Geol_Age_Date *Role*: minStratAgeDate_ID	Source -> Destination

Relation	Source	Target	Direction
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAge_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAge_ID	Source -> Destination

3.1.8 Geol_Age_Strat_Part

Organizes a time scale into a nested hierarchy using whole-part relations: e.g. a specific period (Devonian) is part of a particular era (Paleozoic) which is part of a specific eon (Phanerozoic).

Attribute	Type and Multiplicity	Definition
stratAgeParent_ID	int	The 'whole' in a whole-part relation: e.g. refers to 'Paleozoic' in the relation 'Devonian is-part-of Paleozoic'. Forms a foreign key into Geol_Strat_Age.
stratAgePart_ID	int	The 'part' in a whole-part relation: e.g. refers to 'Devonian' in the relation 'Devonian is-part-of Paleozoic'. Forms a foreign key into Geol_Strat_Age.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Age_Strat_Part *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAgeParent_ID	Source -> Destination
Association	*Entity*: Geol_Age_Strat_Part *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAgePart_ID	Source -> Destination

3.1.9 Geol_Event

Geol_Event describes the age and setting of a geologic unit, lithology, or structure. It follows GeoSciML in principle, but does not explicitly identify the process or event associated with the date. Each entry must refer to only one item being dated, e.g. a unit, structure, or lithology, and must contain one date range, either stratigraphic or absolute (geochronologic).

Attribute	Type and Multiplicity	Definition
**event_ID*	int	Unique internal identifier for a geologic event.
unit_ID	int [0..1]	The geologic unit being dated, if any. Denotes a foreign key to Geol_Unit.
lithology_ID	int [0..1]	The lithology being dated, if any. Denotes a foreign key to Geol_Lithology.
structure_ID	int [0..1]	The geologic structure being dated, if any. Denotes a foreign key to Geol_Structure.
ageType	vocab_AgeType	Indicates whether the age is related to the protolith or to metamorphism.
settingTectonicSuper	vocab_SetTectonicSuper [0..1]	The most general tectonic setting, e.g. intraplate-continental, convergent, divergent, etc.
settingTectonic	vocab_SettingTectonic [0..1]	A more regional tectonic setting, e.g. basin, forearc, back arc, oceanic rift, etc.
settingCrustalPosition	vocab_SetCrustalPosi	The position relative to the crust, e.g. on crust, within

Attribute	Type and Multiplicity	Definition
	tion [0..1]	crust, within mantle.
settingClimate	vocab_SettingClimate [0..1]	The overall climatic environment, e.g. boreal, polar, tropical, etc.
settingWaterDepth	vocab_SettingWaterDepth [0..1]	An indication of the water dynamics, e.g. intertidal, peritidal, abyssal-hadal, etc.
settingFluidChemistry	vocab_SetFluidChemistry [0..1]	A qualitative statement about the water quality/ composition, e.g. acidic, anoxic, saline, etc.
settingMetamorphicRegime	vocab_SetMetamRegime [0..1]	The general metamorphic environment, i.e. strike-slip, extensional, compressional.
settingMetamorphicType	vocab_SetMetamType [0..1]	The type of metamorphism, e.g contact, burial, hydrothermal, etc.
activeStatus	vocab_ActiveStatus [0..1]	The level of activity for the dated entity, i.e. active or inactive.
minStratAge_ID	int [0..1]	Minimum stratigraphic age, e.g. Devonian, within a specific time scale. A foreign key to Geol_Age_Strat.
minStratAgeCertainty	vocab_StratAgeCertainty [0..1]	Degree of confidence in the assignment of the minimum stratigraphic age, i.e. certain or uncertain.
minStratAgeMethod_ID	int	Method used to determine the minimum stratigraphic age. A foreign key to Geol_AgeMethod.
minStratAgeComment	char [0..300]	Comment about the minimum stratigraphic age.
maxStratAge_ID	int [0..1]	Maximum stratigraphic age, e.g. Devonian, within a specific time scale. A foreign key to Geol_Age_Strat.
maxStratAgeCertainty	vocab_StratAgeCertainty [0..1]	Degree of confidence in the assignment of the maximum stratigraphic age, i.e. certain or uncertain.
maxStratAgeMethod_ID	int [0..1]	Method used to determine the maximum stratigraphic age. A foreign key to Geol_AgeMethod.
maxStratAgeComment	char [0..300]	Comment about the maximum stratigraphic age.
minAgeDate_ID	int [0..1]	Minimum absolute (numeric) age date. A foreign key to Geol_Age_Date.
minAgeDateMethod_ID	int [0..1]	Method used to determine the minimum age date. A foreign key to Geol_AgeMethod.
minAgeDateComment	char [0..300]	Comment about the minimum age date.
maxAgeDate_ID	int [0..1]	Maximum absolute (numeric) age date. A foreign key to Geol_Age_Date.
maxAgeDateMethod_ID	int [0..1]	Method used to determine the maximum age date. A foreign key to Geol_AgeMethod.
maxAgeDateComment	char [0..300]	Comment about the maximum age date.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Strat *Role*: minStratAge_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Strat *Role*: maxStratAge_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*: event_ID	*Entity*: Geol_Setting *Role*:	Destination -> Source
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*:	Source -> Destination

Relation	Source	Target	Direction
		maxStratAgeMethod_ID	
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: minAgeDateMethod_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: minStratAgeMethod_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Structure *Role*: structure_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Unit *Role*: unit_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_AgeMethod *Role*: maxAgeDateMethod_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Date *Role*: maxAgeDate_ID	Source -> Destination
Association	*Entity*: Geol_Event_Sequence *Role*:	*Entity*: Geol_Event *Role*: nextEvent_ID	Source -> Destination
Association	*Entity*: Geol_Event_Sequence *Role*:	*Entity*: Geol_Event *Role*: prevEvent_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Age_Date *Role*: minAgeDate_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventSetting_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMinStratAge_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMaxStratAge_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMinAgeDate_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMaxAgeDate_ID	Source -> Destination

Relation	Source	Target	Direction
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Event *Role*: event_ID	Source -> Destination

3.1.10 Geol_Event_Sequence

Denotes a transition from one event to the next event.

Attribute	Type and Multiplicity	Definition
prevEvent_ID	int	Denotes the origin in a transition between events, i.e. the 'from' event. A foreign key into Geol_Event.
nextEvent_ID	int	Denotes the destination in a transition between events, i.e. the 'to' event.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Event_Sequence *Role*:	*Entity*: Geol_Event *Role*: nextEvent_ID	Source -> Destination
Association	*Entity*: Geol_Event_Sequence *Role*:	*Entity*: Geol_Event *Role*: prevEvent_ID	Source -> Destination

3.1.11 Geol_Lithology

Description of a lithology.

Attribute	Type and Multiplicity	Definition
**lithology_ID*	int	A unique internal identifier for a lithology within a unit.
lithName	vocab_LithName	The name of the lithology, e.g. sandstone, selected from a lithology vocabulary.
lithBeddingPattern	vocab_LithBeddingPattern [0..1]	The bedding pattern, e.g. cross-bedded, banded, fissile, planar, etc.
lithBeddingThickness	vocab_LithbedThickness [0..1]	The bedding thickness, e.g. thinly laminated, massive bedded, etc.
lithColour	vocab_Colour [0..1]	The colour of the lithology.
lithParticleSize	vocab_LithParticleSize [0..1]	The size of the particles constituting the lithology, e.g. fine to medium grained.
lithParticleShape	char [0..20]	The shape of the particles constituting the lithology -- unused.
lithParticleType1	vocab_LithParticleType [0..1]	A type of particle constituting a lithology: phenocryst, xenolith, clast, pebble, etc.
lithParticleType2	vocab_LithParticleType [0..1]	A type of particle constituting a lithology: phenocryst, xenolith, clast, pebble, etc.
lithParticleType3	vocab_LithParticleType [0..1]	A type of particle constituting a lithology: phenocryst, xenolith, clast, pebble, etc.
lithParticleType4	vocab_LithParticleType [0..1]	A type of particle constituting a lithology: phenocryst, xenolith, clast, pebble, etc.
lithFabric1	vocab_LithFabric [0..1]	A type of fabric occurring within a lithology, e.g. aphanitic, porphyritic, hyaloclastic, etc.
lithFabric2	vocab_LithFabric [0..1]	A type of fabric occurring within a lithology, e.g. aphanitic, porphyritic, hyaloclastic, etc.
lithFabric3	vocab_LithFabric [0..1]	A type of fabric occurring within a lithology, e.g.

Attribute	Type and Multiplicity	Definition
		aphanitic, porphyritic, hyaloclastic, etc.
lithPrimaryStructure1	vocab_LithPrimaryStruct [0..1]	A primary structure, e.g. channel, pillow flow, ripple mark, etc.
lithPrimaryStructure2	vocab_LithPrimaryStruct [0..1]	A primary structure, e.g. channel, pillow flow, ripple mark, etc.
lithPrimaryStructure3	vocab_LithPrimaryStruct [0..1]	A primary structure, e.g. channel, pillow flow, ripple mark, etc.
lithMetamorphicFacies	vocab_MetamorphicFacies [0..1]	The metamorphic facies attributed to the lithology, e.g. amphibolite, greenschist, etc.
lithMetamorphicTemperature	vocab_MetamorphicTemp [0..1]	The metamorphic temperature attributed to the lithology, e.g. low, medium, high, etc.
lithMetamorphicPressure	vocab_MetamorphicPressure [0..1]	The metamorphic pressure attributed to the lithology, e.g. low, medium, high, etc.
lithDescription	char [0..1000]	An abstract for the lithology.
lithConsolidationDegree	char [0..20]	Level of compaction-- unused.
lithChemicalComposition	char [0..20]	The chemical composition of the lithology -- unused.
lithPetrographicComposition	char [0..20]	The petrographic composition of the lithology -- unused.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Lithology *Role*: lithology_ID	*Entity*: Geol_Mineral *Role*:	Destination -> Source
Association	*Entity*: Geol_Lithology *Role*: lithParent_ID	*Entity*: Geol_Lithology_Part *Role*:	Destination -> Source
Association	*Entity*: Geol_Lithology_Part *Role*:	*Entity*: Geol_Lithology *Role*: lithPart_ID	Source -> Destination
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Geol_Unit_Lithology *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Lithology *Role*: lithMetamorphic_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Lithology *Role*: lithMineral_ID	Source -> Destination

3.1.12 Geol_Lithology_Part

Organizes lithologies into a nested hierarchy using whole-part relations, e.g. a specific lithology can be part of another lithology -- unused currently.

Attribute	Type and Multiplicity	Definition
lithParent_ID	int	The whole (parent) in a whole-part relation: e.g. refers to the lithology that has other lithologies as parts. Forms a foreign key into Geol_Lithology.
lithPart_ID	int	The part in a whole-part relation: e.g. refers to a lithology that is part of another lithology. Forms a foreign key into Geol_Lithology.
lithAbundance	vocab_Abundance [0..1]	A qualitative measure of the presence of one lithology within another, i.e. major, minor, trace.
lithProportion	float [0..1]	A quantitative measure of the presence of a lithology part within a whole lithology, expressed as percentage of the whole lithology.
lithRole	vocab_LithRole [0..1]	The role played by the part.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Lithology *Role*: lithParent_ID	*Entity*: Geol_Lithology_Part *Role*:	Destination -> Source
Association	*Entity*: Geol_Lithology_Part *Role*:	*Entity*: Geol_Lithology *Role*: lithPart_ID	Source -> Destination

3.1.13 Geol_Mineral

An individual mineral present within a specific lithology in a unit.

Attribute	Type and Multiplicity	Definition
**mineral_ID*	int	A unique internal identifier for the mineral.
lithology_ID	int	The lithology hosting the mineral (foreign key to Geol_Lithology).
minName	vocab_MinName	The name of the mineral (from a vocabulary).
minPurpose	vocab_MinPurpose	The significance for noting the mineral, e.g. economic, metamorphic, compositional.
minAbundance	vocab_Abundance [0..1]	A qualitative measure of the presence of a mineral within a lithology, i.e. major, minor, trace.
minProportion	float [0..1]	A quantitative measure of the presence of a mineral within a lithology expressed as percentage of the lithology.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Lithology *Role*: lithology_ID	*Entity*: Geol_Mineral *Role*:	Destination -> Source
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Mineral *Role*: mineral_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Mineral *Role*: mineral_ID	Source -> Destination

3.1.14 Geol_Setting

The geologic environment in which an event occurs / to which an age is related. Described in terms of the relevant processes or features that are significant within the environment at a certain time, and which are applicable at different geographic scales or levels of generality.

Attribute	Type and Multiplicity	Definition
**setting_ID*	int	Unique internal identifier for a setting.
event_ID	int	Event to which the setting applies. A foreign key to Geol_Event.
settingEnvironmentSuper	vocab_SetEnvironmentSuper	General geologic process associated with the setting, e.g. marine, extrusive, sedimentary, etc.
settingEnvironment	vocab_SettingEnvironment [0..1]	Broad-scale feature or process involved in the setting, e.g. batholith, fluvial, glacial, oceanic island, etc.
settingEnvironmentSubA	vocab_SetEnvironmentSubA [0..1]	Regional process, event, or feature involved in the setting: e.g. alluvial fan,, glacio-fluvial, intertidal, platform, etc.
settingEnvironmentSubB	vocab_SetEnvironmentSubB [0..1]	Local feature involved in the geologic setting: e.g. backreef, dune, seamount, turbidite, etc.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Event *Role*: event_ID	*Entity*: Geol_Setting *Role*:	Destination -> Source

3.1.15 Geol_Structure

A description of a geologic structure, regardless of its geometric representation as a point, line, or polygon, e.g. contact, fault, fracture, fold, foliation, etc. This class is preliminary, thus far unused, and likely to be revised.

Attribute	Type and Multiplicity	Definition
**structure_ID*	int	A unique internal identifier for a geologic structure.
purpose	vocab_GeolPurpose	Indicates whether the structure description refers to an instance or a type.
structureType	vocab_StructureType	The type of geologic structure selected from a vocabulary, e.g. contact, fault, fracture, fold, foliation, etc.
contactCharacter	vocab_ContactCharacter [0..1]	The nature of the contact, e.g. sharp, gradational, etc.
foldProfile	vocab_FoldProfile [0..1]	The type of fold profile, e.g. antiform, synform, anticline, syncline, monocline, ptygmatic.
planePolarity	vocab_PlanePolarity [0..1]	From GeoSciML: "Indicates whether the planar orientation is associated with a directed feature that is overturned, upright, vertical etc." http://www.geosciml.org/geosciml/3.2/documentation/html/index.htm
hangingWallDirection	vocab_HangWallDirection [0..1]	For a displaced structure: the hanging wall direction,.
movementSense	vocab_MovementSense [0..1]	For a displaced structure: the movement sense, e.g. dextral, sinistral, normal, etc.
movementType	vocab_MovementType [0..1]	For a displaced structure: the type of movement, e.g. transform, dip slip, oblique slip, etc.
generation	vocab_Generation [0..1]	The generation of the structure: e.g. D1, D2, D3, etc.

Attribute	Type and Multiplicity	Definition
azimuth_trend	float [0..1]	The azimuth of a planar structure, or the trend of a linear structure.
dip_plunge	float [0..1]	The dip of a planar structure, or the azimuth of a linear structure.
measurementDirection	vocab_GeoDirection [0..1]	A qualitative value for geographic direction, e.g. North, West, North-West, etc.
measurementConvention	vocab_MeasurementConvtn [0..1]	Method used to measure the geologic structure, i.e. dip-direction, strike-dip (right hand rule).
structureDescription	char [0..200]	A text description of the geologic structure.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Structure_Part *Role*:	*Entity*: Geol_Structure *Role*: structurePart_ID	Source -> Destination
Association	*Entity*: Geol_Structure *Role*: structureClassification_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association	*Entity*: Geol_Structure *Role*: structureDescription_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association	*Entity*: Geol_Event *Role*:	*Entity*: Geol_Structure *Role*: structure_ID	Source -> Destination
Association	*Entity*: Geol_Structure_Part *Role*:	*Entity*: Geol_Structure *Role*: structureParent_ID	Source -> Destination
Association	*Entity*: Map_Legend_Item *Role:*	*Entity*: Geol_Structure *Role*: legItemStructure_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Structure *Role*: structure_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Structure *Role*: structure_ID	Source -> Destination

3.1.16 Geol_Structure_Part

Organizes a geologic structure into whole-part relations, e.g. a fault (whole) might be segmented into several parts.

Attribute	Type and Multiplicity	Definition
structureParent_ID	int	The whole in a whole-part relation, e.g. the fault and not its segments. Forms a foreign key into Geol_Structure.
structurePart_ID	int	The part in a whole-part relation, e.g. a segment of a fault. Forms a foreign key into Geol_Structure.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Structure_Part *Role*:	*Entity*: Geol_Structure *Role*: structurePart_ID	Source -> Destination
Association	*Entity*: Geol_Structure_Part *Role*:	*Entity*: Geol_Structure *Role*: structureParent_ID	Source -> Destination

3.1.17 Geol_Time_Scale

Each entry in Geol_Time_Scale refers to a distinct time scale.

Attribute	Type and Multiplicity	Definition
**timeScale_ID*	int	The unique internal identifier for a time scale.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Time_Scale *Role*: timeScale_ID	*Entity*: Geol_Age_Strat *Role*:	Destination -> Source
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Time_Scale *Role*: timeScale_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Time_Scale *Role*: timeScale_ID	Source -> Destination

3.1.18 Geol_Unit

A description of a geologic unit, such as a lithostratigraphic unit or a tectonic unit. Excludes geologic time units such as those found in a time scale (e.g. Devonian unit). Describes either a specific geographically distinct fragment of a unit (an instance, e.g. a specific polygon on a map), or the unit as a whole (the type, i.e. a synopsis of typical properties associated with all polygons, lines, points denoting the unit).

Attribute	Type and Multiplicity	Definition
**unit_ID*	int	A unique internal identifier for the unit.
purpose	vocab_GeolPurpose	Indicates whether the description refers to an instance or a type. An instance describes a specific fragment of a unit (e.g. a specific polygon on a map). The type describes the unit as a whole (i.e. all polygons, lines, points, associated with the unit).
unitType	vocab_UnitType	The type of geologic unit, e.g. lithologic , lithostratigraphic, deformation (tectonic), etc.
unitName	char [1..100]	The formal or informal name of the geologic unit.
unitNameAlias	char [0..100]	An alternate name for the geologic unit.
unitRank	vocab_UnitRank	The rank of a geologic unit, such as group, formation, member, suite, etc.
referenceUnitDescription	int	Indicates whether the entry refers to an archetypical (global) description of a unit versus a local description (e.g. valid for a specific map).
unitGlobalDomain	vocab_UnitGlobalDomain	The geographic domain containing the unit, e.g. N. American Continent, Arctic Ocean, Atlantic Ocean, etc.
unitThickness	float [0..1]	The typical thickness of the geologic unit.

Attribute	Type and Multiplicity	Definition
unitMorphology	vocab_UnitMorphology [0..1]	The morphology of the unit, e.g. block, cone, cylinder, planar sheet, etc.
unitDeformationExtent	vocab_DeformationExtent [0..1]	Indicates whether the unit is deformed, or deformed and extends beyond the specified main global domain (e.g. extends beyond the North American Continent into the Arctic Ocean).
unitMetamorphicFacies	vocab_MetamorphicFacies [0..1]	The metamorphic facies attributed to the unit, e.g. amphibolite, greenschist, etc.
unitMetamorphicTemperature	vocab_metamorphicTemp [0..1]	The metamorphic temperature attributed to the unit, e.g. low, medium, high, etc.
unitMetamorphicPressure	vocab_MetamorphicPressure [0..1]	The metamorphic pressure attributed to the unit, e.g. low, medium, high, etc.
unitLexicon_URL	char [0..100]	A url linking to a supplemental description of the geologic unit held in the GSC Lexicon.
unitColour	vocab_Colour [0..1]	The typical colour of the unit.
unitDescription	char [0..1000]	An textual abstract describing the unit.
unitNaturalResourcesComment	char [0..850]	A comment about the unit's potential for natural resource usage.
unitChemicalComposition	char [0..20]	The chemical composition of the unit -- unused.
unitPetrographicComposition	char [0..20]	The petrographic composition of the unit -- unused.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Unit *Role*: unitPart_ID	*Entity*: Geol_Unit_Part *Role*:	Destination -> Source
Association	*Entity*: Geol_Unit_Part *Role*:	*Entity*: Geol_Unit *Role*: unitParent_ID	Source -> Destination
Association	*Entity*: Geol_Unit *Role*: unitClassification_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association	*Entity*: Geol_Unit *Role*: unitDescription_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source
Association	*Entity*: Geol_Unit_Lithology *Role*:	*Entity*: Geol_Unit *Role*: unit_ID	Source -> Destination
Association	*Entity*: Geol_Unit *Role*: unit_ID	*Entity*: Geol_Event *Role*:	Destination -> Source
Association	*Entity*: Map_Legend_Item *Role*:	*Entity*: Geol_Unit *Role*: legItemUnit_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Geol_Unit *Role*: unit_ID	Source -> Destination
Association	*Entity*: Published_Item	*Entity*: Geol_Unit	Source -> Destination

Relation	Source	Target	Direction
	Role:	*Role*: unit_ID	
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Unit *Role*: unitMetamorphic_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Unit *Role*: unitNaturalResources_ID	Source -> Destination

3.1.19 Geol_Unit_Lithology

Describes the abundance and proportion that a lithology occurs within a unit.

Attribute	Type and Multiplicity	Definition
**unit_ID*	int	The unit containing a specific lithology (foreign key into Geol_Unit).
**lithology_ID*	int	The lithology part of a specific unit (foreign key into Geol_Lithology).
lithAbundance	vocab_Abundance	The qualitative amount that a lithology is part of a unit, i.e. major, minor, trace.
lithProportion	float [0..1]	The percentage amount that a lithology constitutes a geologic unit.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Unit_Lithology *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Geol_Unit_Lithology *Role*:	*Entity*: Geol_Unit *Role*: unit_ID	Source -> Destination

3.1.20 Geol_Unit_Part

Organizes geologic units into a nested hierarchy using whole-part relations, e.g. a specific group (whole) has several formations as parts.

Attribute	Type and Multiplicity	Definition
unitParent_ID	int	The whole (parent) in a whole-part relation, e.g. refers to the group in a relation between a group and a formation. Forms a foreign key into Geol_Unit.
unitPart_ID	int	The part in a whole-part relation, e.g. refers to the formation in a relation between a group and a formation. Forms a foreign key into Geol_Unit.
unitReclassifier	int	Indicates whether the whole (parent) unit in a whole-part relation is to be used to reclassify the part for a (generalized) compilation map. This is required because, e.g. a formation can be part of several groups, but the formation can only be generalized to one of the groups on a compilation map. The basis for selecting a general unit involves a number of factors, such as the maximum abundance, e.g. the formation occurs primarily within one group, and only in minor

Attribute	Type and Multiplicity	Definition
		amounts in other groups.
unitAbundance	vocab_Abundance [0..1]	The (qualitative) amount that the part is present in the whole, i.e. major, minor, trace. E.g. a formation is a major part of a group.
unitProportion	float [0..1]	A percentage amount that a part constitutes a whole, e.g. a formation makes up some percentage of a group.

Relation	Source	Target	Direction
Association	*Entity*: Geol_Unit *Role*: unitPart_ID	*Entity*: Geol_Unit_Part *Role*:	Destination -> Source
Association	*Entity*: Geol_Unit_Part *Role*:	*Entity*: Geol_Unit *Role*: unitParent_ID	Source -> Destination

3.1.21 Geom_Line

Geom_Line is the repository for all lines. Unused for now, but will eventually be expanded to resemble Geom_Polygon.

Only Geo_Features (units, structures, carto features) are geospatially located and can be related to a geometry.

A unique identifier (GeoObject_ID) for each geometry is created by joining the unique id of the file with the unique id of the entity within the file (file id + entity id). This identifier (GeoFile_ID) is used to link to a Geo_Feature. File ids are generated and assigned when a new external file is ingested into the database. Note that a map usually consists of several files, for various points, lines, and polygons.

Attribute	Type and Multiplicity	Definition
**object_ID*	int	A unique internal identifier for the line.
geoObject_ID	int	A unique internal identifier for the line, generated from the file id + original id, which can be recovered if necessary. This solution is required because points loaded from different files will have overlapping original ids.
code	char [1..25]	Original short unique (within the original file) label for the line.
symbol_ID	int	Original symbol assigned to the line.
se_anno_cad_data	blob	Internal ESRI field related to geometry storage.
shape	geometry	The geometric shape and geographic location of the line.
file_ID	int	The unique id of the original input file (foreign key to FileInfo_ID).
shape_area	double	N/A
shape_len	double	The length of the line.

Relation	Source	Target	Direction
Association	*Entity*: Geom_Line *Role*:	*Entity*: FileInfo_ID *Role*: file_ID	Source -> Destination
Association Links a GeoFeature to a line.	*Entity*: Geom_Line *Role*: geoLine_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source

3.1.22 Geom_Point

Geom_Point is the repository for all point geometries. Unused for now, but will eventually be expanded to resemble Geom_Polygon.

Only Geo_Features (units, structures, carto features) are geospatially located and can be related to a geometry.

A unique identifier (GeoObject_ID) for each geometry is created by joining the unique id of the file with the unique id of the entity within the file (file id + entity id). This identifier (GeoFile_ID) is used to link to a Geo_Feature. File ids are generated and assigned when a new external file is ingested into the database. Note that a map usually consists of several files, for various points, lines, and polygons.

Attribute	Type and Multiplicity	Definition
**object_ID*	int	A unique internal identifier for the point.
geoObject_ID	int	A unique internal identifier for the point, generated from the file id + original id, which can be recovered if necessary. This solution is required because points loaded from different files will have overlapping original ids.
code	char [1..25]	Original short unique (within the original file) label for the point.
symbol_ID	int	Original symbol assigned to the point.
se_anno_cad_data	blob	Internal ESRI field related to geometry storage.
shape	geometry	The geometric shape and geographic location of the point.
file_ID	int	The unique id of the original input file (foreign key to FileInfo_ID).
shape_area	double	N/A
shape_len	double	N/A

Relation	Source	Target	Direction
Association	*Entity*: Geom_Point *Role*:	*Entity*: FileInfo_ID *Role*: file_ID	Source -> Destination
Association Links a GeoFeature to a point.	*Entity*: Geom_Point *Role*: geoPoint_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source

3.1.23 Geom_Polygon

Geom_Polygon is the repository for all polygons.

Only Geo_Features (units, structures, carto features) are geospatially located and can be related to a geometry.

A unique identifier (GeoObject_ID) for each geometry is created by joining the unique id of the file with the unique id of the entity within the file (file id + entity id). This identifier (GeoFile_ID) is used to link to a Geo_Feature. File ids are generated and assigned when a new external file is ingested into the database. Note that a map usually consists of several files, for various points, lines, and polygons.

Attribute	Type and Multiplicity	Definition
**object_ID*	int	A unique internal identifier for the polygon.
geoObject_ID	int	A unique internal identifier for the polygon, generated from the file id + original id, which can be recovered if necessary. This solution is required because polygons loaded from different files will have overlapping

Attribute	Type and Multiplicity	Definition
		original ids.
code	char [1..25]	Original short unique (within the original file) label for the polygon.
symbol_ID	int	Original symbol assigned to the polygon.
se_anno_cad_data	blob	Internal ESRI field related to geometry storage.
shape	geometry	The geometric shape and geographic location of the polygon.
file_ID	int	The unique id of the original input file (foreign key to FileInfo_ID).
shape_area	double	The original area of the polygon.
shape_len	double	The original length of the polygon.

Relation	Source	Target	Direction
Association	*Entity*: Geom_Polygon *Role*:	*Entity*: FileInfo_ID *Role*: file_ID	Source -> Destination
Association Links a GeoFeature to a polygon.	*Entity*: Geom_Polygon *Role*: geoPolygon_ID	*Entity*: Geo_Feature *Role*:	Destination -> Source

3.1.24 Map

Map contains one entry for every map in the database. Conceptually, each map has one legend, a collection of map features (symbolized and classified geospatial entities), and some publication metadata.
This approach implies that a new map results from the application of a new legend to the same geospatial entities -- e.g. a tectonic map can be created when the geospatial entities on a geologic map (typically classified as lithostratigraphic units) are re-classified as tectonic units with new symbols.

Attribute	Type and Multiplicity	Definition
**map_ID*	int	Unique internal map identifier.
legend_ID	int	The map legend -- each maps has one legend (foreign key to Map_Legend).

Relation	Source	Target	Direction
Association	*Entity*: Map *Role*: map_ID	*Entity*: Map_Feature *Role*:	Destination -> Source
Association	*Entity*: Map *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Map *Role*: map_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Map *Role*: map_ID	Source -> Destination

3.1.25 Map_Feature

A Map_Feature is a geospatial entity, such as a line or polygon, that appears on map, and which is symbolized and classified. Classification (e.g. as a specific geologic unit) occurs via a Geo_Feature, hence a Map_Feature's primary function is to add one or more map-specific symbolizations to a Geo_Feature.

Attribute	Type and Multiplicity	Definition
**mapFeature_ID*	int	Unique internal identifier for a map feature.
map_ID	int	The map containing the map feature. Each map feature is part of one map only (foreign key to Map).
legendItem_ID	int	The legend description for the map feature (foreign key to Map_Legend).
mapSymbol_ID	int	The symbol applied to the map feature (foreign key to Map_Symbol). Note this could differ from the symbol identified in the legend, for exceptional instances.
geoFeature_ID	int	The classified geospatial entity being symbolized (foreign key to Geo_Feature).

Relation	Source	Target	Direction
Association	*Entity*: Map_Feature *Role*:	*Entity*: Geo_Feature *Role*: geolFeature_ID	Source -> Destination
Association	*Entity*: Map *Role*: map_ID	*Entity*: Map_Feature *Role*:	Destination -> Source
Association	*Entity*: Map_Feature *Role*:	*Entity*: Map_Legend_Item *Role*: legendItem_ID	Source -> Destination
Association	*Entity*: Map_Feature *Role*:	*Entity*: Map_Symbol *Role*: mapSymbol_ID	Source -> Destination

3.1.26 Map_Legend

Map_Legend contains one entry for each map legend. A map legend contains a collection of legend items, which are descriptions of entities that appear on a map.

Attribute	Type and Multiplicity	Definition
**legend_ID*	int	Unique internal identifier for the map legend.

Relation	Source	Target	Direction
Aggregation	*Entity*: Map_Legend_Item *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Map *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Edit *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination

3.1.27 Map_Legend_Item

Map_Legend_Item contains one entry for each type of entity appearing on a map legend. Each legend item contains a geologic description (as text), a cartographic description (its symbolization), optionally a sequence number (within the legend), and a link to a feature type (i.e. to only one of carto feature, geologic unit or structure).

Attribute	Type and Multiplicity	Definition
**legendItem_ID*	int	Unique internal identifier for the map legend item.
legend_ID	int	The legend containing this item (foreign key to Map_Legend).
mapSymbol_ID	int	The symbol used to portray the legend item on a map (foreign key to Map_Symbol).
legSequence	int [0..1]	The order in which the legend item appears in a legend.
legItemTitle_EN	char [0..100]	The title of the legend item in English, e.g. the name of a geologic unit, the type of geologic structure or cartographic feature.
legItemTitle_FR	char [0..100]	The title of the legend item in French, e.g. the name of a geologic unit, the type of geologic structure or cartographic feature.
legItemDescription_EN	char [0..1000]	A free-text description of the legend item in English.
legItemDescription_FR	char [0..1000]	A free-text description of the legend item in French.
legItemUnit_ID	int [0..1]	The geologic unit (if any) represented by the legend item.
legItemStructure_ID	int [0..1]	The geologic structure (if any) represented by the legend item.
legItemCarto_ID	int [0..1]	The cartographic feature (if any) represented by the legend item.

Relation	Source	Target	Direction
Aggregation	*Entity*: Map_Legend_Item *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Map_Feature *Role*:	*Entity*: Map_Legend_Item *Role*: legendItem_ID	Source -> Destination
Association	*Entity*: Map_Symbol *Role*: mapSymbol_ID	*Entity*: Map_Legend_Item *Role*:	Destination -> Source
Association	*Entity*: Edit *Role*:	*Entity*: Map_Legend_Item *Role*: legend_ID	Source -> Destination
Association	*Entity*: Map_Legend_Item *Role*:	*Entity*: Geol_Unit *Role*: legItemUnit_ID	Source -> Destination
Association	*Entity*: Map_Legend_Item *Role*:	*Entity*: Geol_Structure *Role*: legItemStructure_ID	Source -> Destination
Association	*Entity*: Map_Legend_Item *Role*:	*Entity*: Geol_Carto *Role*: legItemCarto_ID	Source -> Destination

3.1.28 Map_Symbol

Map_Symbol describes how each map feature / map legend item is symbolized. It is specified as a symbol with a label and rotation angle, within a specific file. Note that symbols can apply to both types and instances: symbols are applied to specific geospatial instances on a map (e.g. polygons) and to the types used to classify them in a legend (e.g. geologic units). Types and instances are typically coordinated, e.g. the instances (polygons) of a geologic unit refer to the same symbol as the legend item for the geologic unit. However, they might diverge for exceptions, when some instance is to be symbolized differently from all other instances of that type.

Attribute	Type and Multiplicity	Definition
**mapSymbol_ID*	int	Unique internal identifier for the symbol.
symbol_ID	int	The unique external identifier of the symbol within the symbol file.
symbolFile_URL	char [0..255]	The online location of the symbol file.
symbolLabel_EN	char [0..255]	The label appearing on the map beside the symbol, in English: e.g. a geologic unit label, the dip/plunge value for a structural measurement, the name of a mine, or value of an age date.
symbolLabel_FR	char [0..255]	The label appearing on the map beside the symbol, in French: e.g. a geologic unit label, the dip/plunge value for a structural measurement, the name of a mine, or value of an age date.
symbolLabel_DB	char [1..255]	The internal label for the symbol -- serves as an alternate unique external identifier.
rotAngle	float	The rotation angle of the symbol, if any, e.g. the azimuth of a structural measurement.

Relation	Source	Target	Direction
Association	*Entity*: Map_Feature *Role*:	*Entity*: Map_Symbol *Role*: mapSymbol_ID	Source -> Destination
Association	*Entity*: Map_Symbol *Role*: mapSymbol_ID	*Entity*: Map_Legend_Item *Role*:	Destination -> Source

3.1.29 Publication

Publication contains summary details for each publication referenced in the database. Publications are referenced from numerous tables, including: geologic units, events, setting, age dates, time scale, lithology, and minerals.

Attribute	Type and Multiplicity	Definition
**pub_ID*	int	Unique internal identifier for the publication.
pubNumber	char [0..20]	The external identifying number for the publication.
pubAlias	char [0..70]	An internal short name for the publication.
pubAuthor	char [0..250]	The authors of the publication.
pubTitle_EN	char [0..400]	The publication title in English.
pubTitle_FR	char [0..400]	The publication title in French.
pubStatus	vocab_PubStatus [0..1]	The status of the publication, e.g. unpublished, published, in press, in prep.
pubYear	int [0..1]	Year published.
pubMediaType1	vocab_PubMediaType [0..1]	Type of publication media, e.g. paper, online, digital, CD-ROM, DVD, etc.
pubMediaType2	vocab_PubMediaType [0..1]	Type of publication media, e.g. paper, online, digital, CD-ROM, DVD, etc.
pubMediaType3	vocab_PubMediaType	Type of publication media, e.g. paper, online, digital,

Attribute	Type and Multiplicity	Definition
	[0..1]	CD-ROM, DVD, etc.
pubMediaType4	vocab_PubMediaType [0..1]	Type of publication media, e.g. paper, online, digital, CD-ROM, DVD, etc.
pubMediaType5	vocab_PubMediaType [0..1]	Type of publication media, e.g. paper, online, digital, CD-ROM, DVD, etc.
pubSeries	vocab_PubSeries [0..1]	The series of the publication.
pubScale	float [0..1]	The scale of the publication, if applicable. E.g. 250000 denotes 1:250,000, likely for a map.
pubExtentsNTS	char [0..255]	Topographic map sheet(s) to which the publication applies.
pubExtentsMinLat	float [0..1]	Lower latitude of bounding box encompassing the area covered by the publication.
pubExtentsMinLong	float [0..1]	Lower longitude of bounding box encompassing the area covered by the publication.
pubExtentsMaxLat	float [0..1]	Upper latitude of bounding box encompassing the area covered by the publication.
pubExtentsMaxLong	float [0..1]	Upper longitude of bounding box encompassing the area covered by the publication
publisher	char [0..50]	Name of publisher.
pubDescription_EN	char [0..200]	Abstract of the publication in English.
pubDescription_FR	char [0..200]	Abstract of the publication in French.
pubGEOSCAN_ID	char [0..30]	GEOSCAN identifier.
pubDOI	char [0..30]	Digital Object Identifier (DOI).
pubURL	char [0..150]	Online location of the publication.
pubURLAccessDate	Date [0..1]	Last known valid date for the online address of the publication.

Relation	Source	Target	Direction
Association	*Entity*: Published_Item *Role*:	*Entity*: Publication *Role*: pub_ID	Source -> Destination

3.1.30 Published_Item

Published_Item links a publication with a particular entity (e.g. Lithology), a specific entity attribute, or group of attributes (e.g. Lithology, Metamorphic) that reference that publication. It primarily consists of ids (foreign keys) to other tables: each Published_Item should have exactly three fields populated with values: a unique identifier for the Published_Item, the publication id, and only one of the remaining entity ids which cite the publication.

Attribute	Type and Multiplicity	Definition
**geoPub_ID*	int	Unique internal identifier for the published item.
pub_ID	int	The publication being referenced (foreign key to Publication).
map_ID	int [0..1]	The map that references the publication -- typically the actual map publication itself (foreign key to Map).
legend_ID	int [0..1]	The legend that references the publication -- typically refers to a publication in which the legend is published independently of a map (foreign key to Map_Legend).
structure_ID	int [0..1]	The geologic structure that references the publication (foreign key to Geol_Structure).
unit_ID	int [0..1]	The geologic unit that references the publication (foreign key to Geol_Unit).

Attribute	Type and Multiplicity	Definition
unitMetamorphic_ID	int [0..1]	The geologic unit metamorphism that references the publication (foreign key to Geol_Unit).
lithMetamorphic_ID	int [0..1]	The lithology metamorphism that references the publication (foreign key to Geol_Lithology).
unitNaturalResources_ID	int [0..1]	The geologic unit economic comment that references the publication (foreign key to Geol_Unit).
eventSetting_ID	int [0..1]	The event setting that references the publication (foreign key to Geol_Event).
eventMinStratAge_ID	int [0..1]	The minimum stratigraphic age that references the publication (foreign key to Geol_Event).
eventMaxStratAge_ID	int [0..1]	The maximum stratigraphic age that references the publication (foreign key to Geol_Event).
eventMinAgeDate_ID	int [0..1]	The minimum absolute age that references the publication (foreign key to Geol_Event).
eventMaxAgeDate_ID	int [0..1]	The maximum absolute age that references the publication (foreign key to Geol_Event).
lithology_ID	int [0..1]	The lithology that references the publication (foreign key to Geol_Lithology).
lithMineral_ID	int [0..1]	The lithology mineral that references the publication (foreign key to Geol_Mineral).
mineral_ID	int [0..1]	The mineral that references the publication (foreign key to Geol_Mineral).
ageDate_ID	int [0..1]	The absolute age date that references the publication -- typically from a time scale definition (foreign key to Geol_Age_Date).
stratAge_ID	int [0..1]	The stratigraphic age date that references the publication -- typically from a time scale definition (foreign key to Geol_Age_Strat).
timeScale_ID	int [0..1]	The time scale that references the publication (foreign key to Geol_Time_Scale).
vocab_ID	int [0..1]	The controlled vocabulary that references the publication (foreign key to Vocabulary).
concept_ID	int [0..1]	The term in the controlled vocabulary that references the publication (foreign key to VocabularyConcept).

Relation	Source	Target	Direction
Association	*Entity*: Published_Item *Role*:	*Entity*: Publication *Role*: pub_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Map *Role*: map_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Map_Legend *Role*: legend_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Structure *Role*: structure_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Unit *Role*: unit_ID	Source -> Destination

Relation	Source	Target	Direction
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Unit *Role*: unitMetamorphic_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Lithology *Role*: lithMetamorphic_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Unit *Role*: unitNaturalResources_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventSetting_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMinStratAge_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMaxStratAge_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMinAgeDate_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Event *Role*: eventMaxAgeDate_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Lithology *Role*: lithology_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Lithology *Role*: lithMineral_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Mineral *Role*: mineral_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Age_Date *Role*: ageDate_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Age_Strat *Role*: stratAge_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Geol_Time_Scale *Role*: timeScale_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Vocabulary *Role*: vocab_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: VocabularyConcept *Role*: concept _ID	Source -> Destination

3.1.31 Vocabulary

A container for a set of hierarchically arranged concepts, with English and French terms. The hierarchical arrangement is specific to a particular vocabulary, and might be different in another. The hierarchical relation means ISA, e.g. granite ISA igneous_rock.

Attribute	Type and Multiplicity	Definition
**vocab_ID*	int	A unique internal identifier for a vocabulary.
vocabName	char [1..255]	The vocabulary name.

Relation	Source	Target	Direction
Association	*Entity*: Vocabulary *Role*: vocab_ID	*Entity*: VocabularyTree *Role*:	Destination -> Source
Association	*Entity*: Edit *Role*:	*Entity*: Vocabulary *Role*: vocab_ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: Vocabulary *Role*: vocab_ID	Source -> Destination

3.1.32 VocabularyConcept

An individual concept within a vocabulary, expressed using FR and EN terms.

Attribute	Type and Multiplicity	Definition
**concept_ID*	int	A unique internal identifier for the concept.
conceptName	char [1..255]	An internal name for the concept.
conceptDefinition	char [0..255]	Text definition / description of the concept.
conceptNameEN	char [0..255]	The external EN term for the concept.
conceptNameFR	char [0..255]	The external FR term for the concept.
conceptLevel	int	A numeric value indicating the hierarchical depth of a concept within a vocabulary. General concepts have a lower value, and specific concepts have a higher value. E.g. in the vocabulary for unit rank, 'Formation' (540) has a higher value than 'Group' (520), indicating its lower depth in the unit rank hierarchy.

Relation	Source	Target	Direction
Association	*Entity*: VocabularyConcept *Role*: parentConcept_ID	*Entity*: VocabularyTree *Role*:	Destination -> Source
Association	*Entity*: VocabularyConcept *Role*: childConcept_ID	*Entity*: VocabularyTree *Role*:	Destination -> Source
Association	*Entity*: Edit *Role*:	*Entity*: VocabularyConcept *Role*: concept _ID	Source -> Destination
Association	*Entity*: Published_Item *Role*:	*Entity*: VocabularyConcept *Role*: concept _ID	Source -> Destination

3.1.33 VocabularyTree

Organizes concepts and related terms into a nested hierarchy for a specific vocabulary. This enables concepts/terms to be re-used in multiple vocabularies, and for their nesting to vary from one vocabulary to another, if required. The nesting relation expressed here is ISA, which stands for "is a kind of", e.g. granite ISA igneous_rock stands for granite is a kind of igneous rock.

Attribute	Type and Multiplicity	Definition
**childConcept_ID*	int	The child in the hierarchical ISA relation, e.g. 'granite' in 'granite ISA igneous_rock'. A foreign key to VocabularyConcept.
**parentConcept_ID*	int	The parent in the hierarchical ISA relation, e.g. 'igneous_rock' in 'granite ISA igneous_rock'.
**vocab_ID*	int	The vocabulary containing the hierarchical relation (a foreign key to Vocabulary).

Relation	Source	Target	Direction
Association	*Entity*: VocabularyConcept *Role*: parentConcept_ID	*Entity*: VocabularyTree *Role*:	Destination -> Source
Association	*Entity*: VocabularyConcept *Role*: childConcept_ID	*Entity*: VocabularyTree *Role*:	Destination -> Source
Association	*Entity*: Vocabulary *Role*: vocab_ID	*Entity*: VocabularyTree *Role*:	Destination -> Source

4 ANNEX A – TRI-TERRITORIAL BEDROCK DATABASE: VOCABULARIES

This Annex itemizes the possible categorical values for specific attributes. Each list of values is a distinct vocabulary, and each term within a vocabulary is defined and possibly referenced to a published source. Note that definitions with accompanying references are directly extracted from the cited publication, typically without modification, and undefined terms are assumed to be self-explanatory. The collection of vocabularies described herein constitutes the science language for the TBDB.

4.1.1 vocab_Abundance

Categories denoting the (qualitative) amount that the part is present in the whole, e.g. the amount a formation is a part of a group.

Term	Definition	Reference
major	most significant	Oxford English Dictionary, Oxford Press, 2015
minor	of lesser importance	Oxford English Dictionary, Oxford Press, 2015
trace	a very small quantity	Oxford English Dictionary, Oxford Press, 2015

4.1.2 vocab_Accuracy

Categories denoting the degree of certainty associated with some entity.

Term	Definition	Reference
defined	Clearly established boundaries	Oxford English Dictionary, Oxford Press, 2015
approximate	Close to the actual but not completedly exact	Oxford English Dictionary, Oxford Press, 2015

4.1.3 vocab_ActiveStatus

Categories denoting the level of activity for a dated entity.

Term	Definition	Reference
active	A volcano that has erupted in historical times	Oxford English Dictionary, Oxford Press, 2015
inactive	A volcano that has not erupted in historical times	Oxford English Dictionary, Oxford Press, 2015

4.1.4 vocab_AgeAccuracy

Categories for estimating the accuracy of an age date.

Term	Definition	Reference
defined	See above vocab_Accuracy	
approximate	See above vocab_Accuracy	
well defined	Concatenated term (see “defined”)	

4.1.5 vocab_AgeDateMethod

Categories denoting the type of method used to obtain a stratigraphic or absolute age value.

Term	Definition	Reference
Ar-Ar	**argon-40/argon-39 age method** A variation of the *potassium-argon age method* in which the sample to be dated is first irradiated with neutrons, converting some potassium-39 to argon-39. Argon is then extracted from the sample (either in one step or incrementally), and its isotopic composition analyzed. The amount of argon-39 is a measure of potassium content, and the ratio of radiogenic argon-40 to argon-39 is a function of age. It is sometimes possible to detect extraneous argon, and to determine whether or not the dated material has been disturbed by later thermal or chemical events (Miller, 1972).	Glossary of Geology, Fifth Edition (revised), 2011
biostratigraphy	The element of stratigraphy that deals with the distribution of fossils in the stratigraphicc record and the organization of strata into units of the basis of their contained fossils. The term was apparently proposed by Louis Dollo, Belgian paleontologist, in 1904 in a wider sense for the entire research field in which paleontology exercises a significant influence upon historical geology. Cf: *stratigraphic paleontology*.	Glossary of Geology, Fifth Edition (revised), 2011
C14	**carbon-14 dating** A method of determining an age in years by measuring the concentration of carbon-14 remaining in an organic material, usually formerly living matter, but also dissolved bicarbonate, etc. The method, worked out by Willard F. Libby, U.S. chemist, in 1946-1951, is based on the assumption that assimilation of carbon-14 ceases abruptly upon removal of the material from the Earth's carbon cycle (i.e., on the death of an organism) and that it thereafter remains a closed system. Most carbon-14 ages are calculated using a half-life of 5,730 ± 40 years or 5,568 ± 30 years. Thus the method is useful in determining ages in the range of 500 to 30,000 or 40,000 years, although it may be extended to 70,000 years by using special techniques involving controlled enrichment of the sample in carbon-14. Syn: *radiocarbon dating; carbon dating.*	Glossary of Geology, Fifth Edition (revised), 2011
fission track	A method of calculating an age in years by determining the ratio of the spontaneous fission-track density to induced fission tracks. The method, which has been used for ages from 20 years to 1.4×10^9 years, works best for zircon, apatite, and glass and is also useful for determining the amount and distribution of the uranium in the sample. Syn: *fission-track method; spontaneous fission-track dating.*	Glossary of Geology, Fifth Edition (revised), 2011
K-Ar	**potassium-argon age method** Determination of the age of a mineral or rock in years, based on measurement of the ratio of radiogenic argon-40 to potassium-40 and the known radioactive decay rate of potassium-40 to argon-40. Cf: *argon-40/argon-39 age method*. Abbrev: K-Ar	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	age method. Syn: *potassium-argon dating.*	
magnetostratigraphy	The element of stratigraphy that deals with the magnetic characteristics of rock units (ISSC, 1994, p.70).	Glossary of Geology, Fifth Edition (revised), 2011
Nd-Nd	A type of model age, which is a measure of the length of time a sample has been separated from the mantle from which it was originally derived. In the case of neodymium isotopes there are two frequently quoted models for the mantle reservoir: CHUR (the Chondritic Uniform Reservoir) and Depleted Mantle (DM).	Rollinson, H., 1993. Using geochemical data: evaluation, presentation, interpretation. Longman Group UK Limited, 352 p..
not available	Age date method is unavailable	
Os-Re	**rhenium-osmium age method** The determination of an age in years based on the known radioactive decay rate of rhenium-187 to osmium-187. The low crustal abundance of rhenium limits the application of this method to problems related to core-mantle evolution.	Glossary of Geology, Fifth Edition (revised), 2011
Pb-Pb	**lead-lead age** An age in years calculated from the ratio of lead-207 to lead-206, a by-product of the *uranium-thorium-lead age method*. Syn: *lead-isotope age.*	Glossary of Geology, Fifth Edition (revised), 2011
Rb-Sr	**rubidium-strontium age method** Determination of an age for a mineral or rock in years based on the ratio of radiogenic strontium-87 to rubidium-87 and the known radioactive decay rate of rubidium-87. If ratios are measured for more than one phase of a single rock, or for a number of related rocks that differ in rubidium content, an isochron may be drawn. Syn: *rubidium-strontium dating; Rb-Sr age method.*	Glossary of Geology, Fifth Edition (revised), 2011
Sm-Nd	**samarium-neodymium age method** A method of age determination based on the alpha decay of samarium-147 to neodymium-143 (λ=6.54 $\times$ $10^{-12}yr^{-1}$). The ratios $^{147}Sm/^{144}Nd$ and $^{143}Nd/^{144}Nd$ are measured and plotted on an *isochron* diagram.	Glossary of Geology, Fifth Edition (revised), 2011
U-Pb	**uranium-lead age method** Calculation of an age in years for geologic material based on the known radioactive decay rate of uranium-238 to lead-206 and uranium-235 to lead-207. It is part of the more inclusive *uranium-thorium-lead age method* in which the parent-daughter pairs are considered simultaneously. Syn: *lead-uranium age method.*	Glossary of Geology, Fifth Edition (revised), 2011

4.1.6 vocab_Age Interpretation

Categories denoting the underlying interpretation of a geologic process used during age dating.

Term	Definition	Reference
cooling	The processes resulting in heat loss	Oxford English Dictionary, Oxford Press, 2015
depositional	(a) Pertaining to the process of deposition; e.g. a "depositional basin" or a "depositional surface". (b) Formed by the process of deposition; e.g. a "depositional topography".	Glossary of Geology, Fifth Edition (revised), 2011
detrital	Pertaining to or formed from *detritus;* said esp. of	Glossary of Geology, Fifth

Term	Definition	Reference
	rocks, minerals, and sediments. The term may indicate a source outside the depositional basin (Krynine, 1948, p.133) or a source within it.	Edition (revised), 2011
diagenetic	Pertaining to or caused by *diagenesis*; e.g. a "diagenetic change" resulting from compaction, a "diagenetic structure" (such as a stylolite) formed after deposition, a "diagenetic deposit" (such as dolomitized limestone or one consisting of manganese nodules), or a "diagenetic environment" of rock consolidation.	Glossary of Geology, Fifth Edition (revised), 2011
igneous crystallization	The process by which matter becomes crystalline, from a gaseous, fluid, or dispersed state.	Glossary of Geology, Fifth Edition (revised), 2011
inheritance	To derive features from a parental material	Oxford English Dictionary, Oxford Press, 2015
metamorphic	Relating to a rock body that has undergone transformation by heat and pressure	Oxford English Dictionary, Oxford Press, 2015
not available	Age interpretation is unavailable	
peak metamorphic	Maximum intensity or rank of metamorphism, measured by the amount or degree of difference between the original parent rock and the metamorphic rock. It indicates in a general way the P-T environment in which the metamorphism took place.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.7 vocab_AgeMaterial

Categories denoting the type of material being dated.

Term	Definition	Reference
algae	A polyphyletic grouping of eukaryotic, photosynthetic, and almost entirely aquatic organisms, ranging from unicellular to complex, multicellular organisms (such as giant kelps). Groups are differentiated by photosynthetic pigments, biochemistry, and life cycles. Sing: alga. Cf: *brown algae*; *charophytes*; *green algae*; *red algae*; *yellow-green algae*.	Glossary of Geology, Fifth Edition (revised), 2011
allanite	A sub-metallic pitchy brownish-black monoclinic mineral of the *epidote* group: $CeCa(Al,Fe)_3O(O,OH)(SiO_4)[Si_2O_7]$. It is typically an accessory mineral in igneous rocks (granite, syenite, diorite, pegmatite) and in their metamorphic equivalents. Syn: *orthite*; *cerine*; *bucklandite*; *treanorite*.	Glossary of Geology, Fifth Edition (revised), 2011
ammonite	**ammonite [paleont]** (am'-mo-nite) Any ammonoid belonging to the suborder Ammonitina, characterized by a thick, strongly ornamented shell with sutures having finely divided lobes and saddles. Range, Jurassic to Cretaceous. **ammonite [sed]** An obsolete term, applied in the 17th and 18th centuries to a sedimentary rock now known as oolite. Syn: *ammite*.	Glossary of Geology, Fifth Edition (revised), 2011
ammonoid	Any extinct cephalopod belonging to the order Ammonoidea, characterized by an external	Glossary of Geology, Fifth Edition (revised), 2011

	shell that is symmetrical and coiled in a plane and has a bulbous protoconch, septa that form angular sutural flexures, and a small marginal siphuncle. Range, Lower Devonian to Upper Cretaceous.	
amphibole	(a) A group of dark rock-forming ferromagnesian silicate minerals, closely related in crystal form and composition and having the general formula: $A_{2\text{-}3}B_5(Si,Al)_8O_{22}(OH)_2$, where *A* = Mg, Fe^{2+}, Ca, or Na, and *B* = Mg, Fe^{2+}, Fe^{3+}, Li, Mn, or Al. It is characterized by a cross-linked double chain of tetrahedra with a silicon:oxygen ratio of 4:11, by columnar or fibrous prismatic crystals, and by good prismatic cleavage in two directions parallel to the crystal faces and intersecting at angles of about 56° and 124°; colors range from white to black. Most amphiboles crystallize in the monoclinic system, some in the orthorhombic. They constitute an abundant and widely distributed constituent in igneous and metamorphic rocks (some are wholly metamorphic), and they are analogous in chemical composition to the *pyroxenes*. (b) A mineral of the amphibole group, such as hornblende, anthophyllite, cummingtonite, tremolite, actinolite, riebeckite, glaucophane, arfvedsonite, etc. (c) A term sometimes used as a syn. of *hornblende*. Etymol: Greek "amphibolos", "ambiguous, doubtful", in reference to its many varieties.	Glossary of Geology, Fifth Edition (revised), 2011
apatite	(a) A group of variously colored hexagonal minerals consisting of calcium phosphate together with fluorine, chlorine, hydroxyl, or carbonate in varying amounts and having the general formula: $Ca_5(F,OH,Cl)(PO_4,CO_3)_3$. Also, any mineral of the *apatite* group, such as fluorapatite, chlorapatite, hydroxylapatite, carbonate-apatite, and francolite; when not specified, the term usually refers to *fluorapatite*. The apatite minerals occur as accessory minerals in almost all igneous rocks, in metamorphic rocks, and in veins and other ore deposits; and most commonly as fine-grained and often impure masses as the chief constituent of phosphate rock and of most or all bones and teeth. Syn: *calcium phosphate*. (b) A group of hexagonal minerals having the general formula: $A_5(F,OH,Cl)(RO_4)_3$, where A = Ca, Sr, or Pb, and R = P, As, V, or less commonly Si. Examples include svabite, hedyphane, mimetite, pyromorphite, and vanadinite. [**image**]	Glossary of Geology, Fifth Edition (revised), 2011
archaeocyathid	Any marine organism belonging to the phylum Archaeocyatha and characterized chiefly by a cone-, goblet-, or vase-shaped skeleton composed of calcium carbonate. The archaeocyathids have been variously classified as corals, sponges, protozoans, and calcareous algae. Range, Lower to Middle	Glossary of Geology, Fifth Edition (revised), 2011

	Cambrian; worldwide in distribution.	
baddeleyite	A colorless, yellow, brown, or black monoclinic mineral: ZrO_2. It may contain some hafnium, titanium, iron, and thorium.	Glossary of Geology, Fifth Edition (revised), 2011
belemnite	Any member of an order of coleoid cephalopods characterized by a well-developed internal shell consisting of a guard, phragmocone, and forward-projecting daggerlike or spadelike proostracum. The body has a ten-armed crown, each arm equipped with a double row of arm hooks. Fossil phragmocones are cigar-shaped. Range, Mississippian to Eocene.	Glossary of Geology, Fifth Edition (revised), 2011
biotite	a) A widely distributed and important rock-forming mineral of the mica group: $K(Mg,Fe^{2+})_3(Al,Fe^{3+})Si_3O_{10}(OH,F)_2$. It is generally black, dark brown, or dark green, and occurs in various monoclinic polytypes. It forms a constituent of crystalline rocks (either as an original crystal in igneous rocks of all kinds or a product of metamorphic origin in gneisses and schists) or a detrital constituent of sandstones and other sedimentary rocks. Biotite is useful in the potassium-argon method of age determination. (b) A general term to designate all ferromagnesian micas. Syn: *black mica; iron mica; magnesia mica*.	Glossary of Geology, Fifth Edition (revised), 2011
brachiopod	Any solitary marine invertebrate belonging to the phylum Brachiopoda, characterized by a lophophore and by two bilaterally symmetrical valves that may be calcareous or composed of chitinophosphate and that are commonly attached to a substratum but may also be free. Range, Lower Cambrian to Holocene. Syn: *brach; lamp shell*.	Glossary of Geology, Fifth Edition (revised), 2011
charophyte	A member of a group of complex, mainly freshwater *green algae* of the phylum Charophyta (stoneworts). Their range is Late Silurian to the present, and they are the probable ancestors of the land plants. The egg-containing structure or oogonium of these algae is commonly fossilized and termed a *gyrogonite*.	Glossary of Geology, Fifth Edition (revised), 2011
conodont	One of a large number of small, disjunct fossil elements assigned to the order Conodontophorida, phosphatic in composition, and commonly toothlike in form but not necessarily in function; produced in bilaterally paired, serial arrangement by small vagile marine Chordata. See: Hass (1962). Range, Cambrian (possibly Late Precambrian) to Upper Triassic; commonly abundant, widespread, and useful biostratigraphically.	Glossary of Geology, Fifth Edition (revised), 2011
diatom	A microscopic, single-celled *alga* of the class Bacillariophyceae (ochrophytes), which lives in freshwater or marine environments. Diatoms secrete walls of silica, called *frustules*. Although diatoms are known from the Jurassic, they first become abundant in the Cretaceous, ranging to the present.	Glossary of Geology, Fifth Edition (revised), 2011

dinoflagellate	A member of the group of primarily single-celled organisms that during some part of their life cycle have a free-swimming stage with two dissimilar flagella. The vast majority of these organisms have a special type of nucleus in which the chromosomes remain condensed even when the cell is not dividing. Some are plantlike, containing chloroplasts and producing organic compounds by photosynthesis, and some are animal-like, ingesting other organisms for food. Dinoflagellates are considered to represent their own division (phylum), the Dinoflagellata. Certain dinoflagellates have a theca or *test [paleont]* that is resistant to decay; it may be simple and smooth or variously sculptured and divided into characteristic plates and grooves. Others produce a resting stage or *cyst [palyn]* with a resistant organic wall that is often spiny and may differ markedly from the theca of the same species. Cysts exist abundantly as fossils, and have a range primarily Triassic to present. Dinoflagellates also have been reported from the Paleozoic, but are mainly important for correlating and dating Jurassic, Cretaceous, and Tertiary deposits. They inhabit all water types and are capable of extensive diurnal vertical migrations in response to light; they constitute a significant element in marine plankton, including certain brilliantly luminescent forms and those that cause *red tide*. See also: *hystrichosphaerid*.	Glossary of Geology, Fifth Edition (revised), 2011
fish	A class of vertebrate animals, provided with gills throughout life, and cold-blooded; the limbs, if present, are modified into fins, and supplemented by unpaired median fins.	Oxford English Dictionary, Oxford Press, 2015
foraminifera	Any protozoan belonging to the subclass Sarcodina, order Foraminiferida, characterized by the presence of a test of one to many chambers composed of secreted calcite (rarely silica or aragonite) or of agglutinated particles. Most foraminifers are marine but freshwater forms are known. Range, Cambrian to Holocene. Colloquially shortened to *foram* Pl: foraminifera (fo-ra-mi-nif'-era); informally foraminifers.	Glossary of Geology, Fifth Edition (revised), 2011
fusulinid	Any foraminifer belonging to the suborder Fusulinina, family Fusulinidae, characterized by a multichambered elongate calcareous microgranular test, commonly resembling the shape of a grain of wheat. Range, Middle Pennsylvanian to Upper Permian. Syn: *fusuline*. See also: *alveolinid*.	Glossary of Geology, Fifth Edition (revised), 2011
galena	(a) A bluish-gray to lead-gray mineral: PbS. It frequently contains included silver minerals. Galena occurs in cubic or octahedral crystals, in masses, or in coarse or fine grains; it is often associated with sphalerite as disseminations in veins in limestone, dolomite, and sandstone. It has a shiny metallic luster,	Glossary of Geology, Fifth Edition (revised), 2011

	exhibits highly perfect cubic cleavage, and is relatively soft and very heavy. Galena is the most important ore of lead and one of the most important sources of silver. Syn: *galenite; lead glance; blue lead [mineral]*. (b) A group name for cubic minerals with the formula *AX*, where *A* = Mg, Ca,Mn, (AgSb) or (AgBi), and *X* = S, Se or Te.	
garnet	(a) A group of minerals of formula: $A_3B_2(SiO_4)_3$, where *A* = Ca, Mg, Fe^{2+}, or Mn^{2+}, and *B* = Al, Fe^{3+}, Mn^{3+}, V^{3+}, or Cr^{3+}. (b) Any of the minerals of the *garnet* group, such as the end members almandine (Fe-Al), andradite (Ca-Fe), grossular (Ca-Al), pyrope (Mg-Al), spessartine (Mn-Al), uvarovite (Ca-Cr), and goldmanite (Ca-V). Garnet is a brittle and transparent to subtransparent mineral, having a vitreous luster, no cleavage, and a variety of colors, dark red being the most common. It occurs as an accessory mineral in a wide range of igneous rocks, but is most commonly found as distinctive euhedral cubic crystals in metamorphic rocks (gneiss, mica schist, marble); it may also be massive or granular. Garnet is used as a semiprecious stone and as an abrasive.	Glossary of Geology, Fifth Edition (revised), 2011
graptolite	Any colonial marine organism belonging to the class Graptolithina, variously assigned to the phylum Coelenterata or to the Hemichordata, characterized by a cup- or tube-shaped, highly resistant exoskeleton of organic composition, arranged with other individuals along one or more branches (stipes) to form a colony (*rhabdosome*). Graptolites commonly occur in black shales. Range, Middle Cambrian to Carboniferous. Adj: graptolithine; graptolitic.	Glossary of Geology, Fifth Edition (revised), 2011
hornblende	(a) The commonest mineral of the *amphibole* group: $(Ca,Na)_{2-3}(Mg,Fe^{+2},Fe^{+3},Al)_5(OH)_2[(Si,Al)_8O_{22}]$. It has a variable composition, and may contain potassium and appreciable fluorine. Hornblende is commonly black, dark green, or brown, and occurs in distinct monoclinic crystals or in columnar, fibrous, or granular forms. It is a primary constituent of many acid and intermediate igneous rocks (granite, syenite, diorite, andesite) and less commonly of basic igneous rocks, and it is a common metamorphic mineral in gneiss and schist. (b) A term sometimes used (esp. by the Germans) to designate the *amphibole* group of minerals. The term "Hornblende" is an old German name for any dark, prismatic crystal found with metallic ores but containing no valuable metal (the word "Blende" indicates "a deceiver"). Obsolete syn: *hornstone*.	Glossary of Geology, Fifth Edition (revised), 2011
illite	The term illite is used in two ways: In the general sense that Grim et al. (1937) introduced it, it is the 2:1 muscovite-like monoclinic or rhombohedral mineral in the clay-size fraction, but which has less K and more water than muscovite and gives a 10 Å	Glossary of Geology, Fifth Edition (revised), 2011

	d(001) from X-ray diffraction: $(K,H_3O)Al_2(Si_3Al)O_{10}(H_2O,OH)_2$. As a specific mineral, illite is an end-member of a series just as albite is the end-member of the *plagioclase* series. Because less than 5% of interstratified material in illite is difficult to detect by conventional X-ray methods, illite in the sense of a specific mineral, may contain up to 5% of an interstratified component. This component will be the other end of a compositional series. It is most commonly smectite, but can be vermiculite or perhaps chlorite. Srodon et al. (1992) concluded that illite has a layer charge of -0.89. However, others find values as low as -0.70. In the treatment here, the term illitic material covers the original, general intention of Grim et al. (1937), and the term illite should be used when referring to a specific mineral (Moore and Reynolds, 1996). In soil taxonomy, the presence of a 1nm X-ray diffraction peak and >&eq;4% K_2O is used to denote the presence of illite. Syn: *hydromuscovite*.	
inoceramid	Family of prehistoric clams. Inoceramids tended to live in upper bathyal and neritic environments. In Alaska's Matanuska Formation, the most abundant mollusks in the quarry containing the Talkeetna Mountains Hadrosaur were inoceramids.	http://www.falw.vu/~smit/inoceramus/ino_inleiding/inoceramids.htm
lazulite	An azure-blue to violet-blue or bluish-green mineral: $MgAl_2(PO_4)_2(OH)_2$. It is isomorphous with scorzalite, and occurs in small masses or in monoclinic crystals. Syn: *blue spar; false lapis; berkeyite*. Not to be confused with *lazurite*.	Glossary of Geology, Fifth Edition (revised), 2011
macrofauna	(a) Living or fossil animals large enough to be seen with the naked eye; benthic animals larger than 0.5 mm. (b) An obsolete term for the animals occupying a broad area of uniform characteristics; a large or widespread group of animals. Cf: *microfauna; megaflora*. Syn: *megafauna.*	Glossary of Geology, Fifth Edition (revised), 2011
macroflora	(a) Plants large enough to be seen with the naked eye. (b) An obsolete term for the plants of a large habitat; a large, widespread group of plants. Cf: *microflora; macrofauna*. Syn: *macroflora.*	Glossary of Geology, Fifth Edition (revised), 2011
monazite	A yellow, brown, or reddish-brown monoclinic mineral: $(Ce,La,Nd,Th)(PO_4,SiO_4)$. It is a rare-earth phosphate with appreciable substitution of thorium for rare earths and silicon for phosphorus; thorium-free monazite is rare. It is widely disseminated as an accessory mineral in granites, gneisses, and pegmatites, and it is often naturally concentrated in detrital sand, gravel, and alluvial tin deposits. Monazite is a principal ore of the rare earths and the main source of thorium. Several end-members of the lanthanide elements are known, and they are acknowledged by the Levinson notation: a	Glossary of Geology, Fifth Edition (revised), 2011

	hyphenated suffix of the principal element. Syn: *cryptolite.*	
muscovite	(a) A mineral of the *mica* group: $KAl_2(Si_3Al)O_{10}(OH,F)_2$. It is colorless to yellowish or pale brown, and is a common mineral in gneisses and schists, in most acid igneous rocks (such as granites and pegmatites), and in many sedimentary rocks (esp. sandstones). Several monoclinic, triclinic and trigonal polytypes are recognized. Also spelled: *moscovite.* Syn: *white mica; potash mica; common mica; Muscovy glass; mirror stone.* (b) A term applied in clay mineralogy to *illite*. See also: *sericite; talcite*.	Glossary of Geology, Fifth Edition (revised), 2011
nannofossil	(a) A collective term for fossil discoasters and coccoliths, both primarily calcareous microfossils, mostly rather near the limit of resolution of the light microscope and hence best studied with electron microscopy. (b) A term sometimes used in a more general sense for other extremely small marine (usually algal) fossils, smaller than microfossils.	Glossary of Geology, Fifth Edition (revised), 2011
not available	Age material is not known	
ostracode	Any aquatic crustacean belonging to the subclass Ostracoda, characterized by a bivalve, generally calcified carapace with a hinge along the dorsal margin. Most ostracodes are of microscopic size (0.4-1.5 mm long), although freshwater forms up to 5 mm long and marine forms up to 30 mm long are known. Range, Lower Cambrian to Holocene. Also spelled: ostracod.	Glossary of Geology, Fifth Edition (revised), 2011
palynomorph - spore - pollen	A microscopic, resistant-walled organic body found in palynologic maceration residues; a palynologic study object. Palynomorphs include pollen, spores of many sorts, acritarchs, chitinozoans, dinoflagellate thecae and cysts, certain colonial algae, and other acid-insoluble microfossils. Cf: *sporomorph*.	Glossary of Geology, Fifth Edition (revised), 2011
perovskite	(a) A yellow, brown, or grayish-black cubic mineral: $CaTiO_3$. It sometimes has cerium and other rare-earth elements. Cf: *latrappite*. Also spelled: *perofskite.* (b) A group name for cubic minerals with an analogous composition, but with Ca replaced by Na, and Ti replaced by Nb.	Glossary of Geology, Fifth Edition (revised), 2011
phlogopite	A magnesium-rich mineral of the *mica* group: $KMg_3Si_3AlO_{10}(F,OH)_2$. It is yellowish brown to brownish red or copper-colored, and usually occurs in crystalline limestones as a result of dedolomitization. It crystallizes in monoclinic, trigonal and orthorhombic polytypes. Phlogopite is near biotite in composition, but contains little iron. Cf: *sodium phlogopite.* Syn: *magnesia mica; amber mica; brown mica.*	Glossary of Geology, Fifth Edition (revised), 2011
phosphate	A mineral compound containing tetrahedral PO_4^{-3} groups. An example is fluorapatite, $Ca_5(PO_4)_3F$. Cf: *arsenate; vanadate*.	Glossary of Geology, Fifth Edition (revised), 2011

radiolarian	Any actinopod belonging to the subclass Radiolaria, characterized mainly by a siliceous skeleton and a marine pelagic environment. Range, Cambrian to Holocene. In some classifications the radiolarians are grouped with the rhizopods.	Glossary of Geology, Fifth Edition (revised), 2011
rudist	Any bivalve mollusk belonging to the superfamily Hippuritacea, characterized by an inequivalve shell, usually attached to a substrate, and either solitary or gregarious in reeflike masses. "Although the first rudists were only slightly inequivalve, their descendants very early became strongly so, with the two valves of individuals usually differing greatly from each other in size, shape, and shell wall structure" (TIP, 1969, pt.N, P.751). They are frequently found in association with corals. Range, Upper Jurassic to Upper Cretaceous, possibly Paleocene.	Glossary of Geology, Fifth Edition (revised), 2011
rutile	A usually reddish-brown tetragonal mineral: TiO_2. It is trimorphous with anatase and brookite, and often contains a little iron. Rutile forms prismatic crystals in other minerals (esp. quartz); it occurs as a primary mineral in some acid igneous rocks (esp. those rich in hornblende), in metamorphic rocks, and as residual grains in sediments and beach sands. It is an ore of titanium. Syn: *red schorl.*	Glossary of Geology, Fifth Edition (revised), 2011
titanite - sphene	(a) A usually yellow or brown monoclinic mineral: $CaTiSiO_5$. It often contains other elements such as niobium, chromium, fluorine, sodium, iron, manganese, and yttrium. Titanite occurs in wedge-shaped or lozenge-shaped monoclinic crystals as an accessory mineral in granitic rocks and in calcium-rich metamorphic rocks. Syn: *sphene; grothite.* (b) A group name for monoclinic minerals with an analogous composition, but with Ti replaced by Sn or V.	Glossary of Geology, Fifth Edition (revised), 2011
trace fossil	A sedimentary structure consisting of a fossilized track, trail, burrow, tube, boring, or tunnel resulting from the life activities (other than growth) of an animal, such as a mark made by an invertebrate moving, creeping, feeding, hiding, browsing, running, or resting on or in soft sediment. It is often preserved as a raised or depressed form in sedimentary rock. Many trace fossils were formerly assumed to be bodily preserved plants or animals. Syn: *ichnofossil; trace [paleont]; vestigiofossil; lebensspur; bioglyph.*	Glossary of Geology, Fifth Edition (revised), 2011
trilobite	Any marine arthropod belonging to the class Trilobita, characterized by a three-lobed, ovoid to subelliptical exoskeleton divisible longitudinally into axial and side regions and transversely into cephalon (anterior), thorax (middle), and pygidium (posterior). Range, Lower Cambrian to Permian.	Glossary of Geology, Fifth Edition (revised), 2011
unspecified		
vertebrate -	Of an animal belonging to the subphylum Vertebrata; having a backbone or spinal	Oxford English Dictionary, Oxford Press, 2015

terrestrial	column. Also: relating to or comprising such animals	
whole rock	Used to indicate that a portion of rock rather than individual minerals was analyzed. In the rubidium-strontium age method the rock may have remained a closed system for rubidium and strontium isotopes whereas the constituent minerals did not. Thus, a calculated age for the whole rock would give the apparent age of formation whereas the individual minerals might give discordant ages. This whole-rock, closed-system feature does not hold true for all isotopic systems. Syn: *total-rock.*	Glossary of Geology, Fifth Edition (revised), 2011
wood	In *woody plants*, the tissue produced to the inside of a *vascular cambium*, i.e., the secondary xylem. Also syn. of *woody plant*.	Glossary of Geology, Fifth Edition (revised), 2011
xenotime	A group name for tetragonal minerals of the zircon structure type and with the general formula AXO_4, where *A* = Sc, Y, REE, or Bi and *X* = P, As, or V. Xenotime occurs as an accessory mineral in granites and pegmatites.	Glossary of Geology, Fifth Edition (revised), 2011
zircon	(a) A mineral: $ZrSiO_4$. It occurs in tetragonal prisms, has various colors and is a common accessory mineral in siliceous igneous rocks, crystalline limestones, schists, and gneisses, in sedimentary rocks derived therefrom, and in beach and river placer deposits. It is the chief ore of zirconium, and is used as a refractory; when cut and polished, the colorless varieties provide exceptionally brilliant gemstones. Syn: *zirconite; hyacinth*; jacinth. (b) A group name for tetragonal minerals with the general formula $ASiO_4$, where *A* = Zr, Hg, Th, or U.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.8 vocab_AgeType

Categories denoting whether the age is related to the protolith or to metamorphism.

Term	Definition	Reference
metamorphic	Pertaining to the process of *metamorphism* or to its results.	Glossary of Geology, Fifth Edition (revised), 2011
protolith	(a) The unmetamorphosed rock from which a given metamorphic rock was formed by metamorphism. Syn: *parent rock.* (b) The parent or unweathered rock from which *regolith* is formed.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.9 vocab_Colour

Categories denoting the colour of a geologic unit or lithology.

Term	Definition	Reference
beige		
black		
blue		
blue black		
blue grey		

brown		
buff		
cream		
dark blue		
dark blue grey		
dark brown		
dark green		
dark green grey		
dark grey		
dark grey brown		
dark orange		
dark pink		
dark red		
green		
green grey		
grey		
grey brown		
leucocratic	Light-colored; applied to light-colored igneous rocks that are relatively poor in mafic minerals. The percentage of mafic minerals necessary for a rock to be classified as leucocratic varies among petrologists, but is usually given as less than 30 to 37.5 percent. Cf: *melanocratic; mesocratic.* Noun: leucocrate. Syn: *light-colored.*	Glossary of Geology, Fifth Edition (revised), 2011
light blue		
light blue grey		
light brown		
light green		
light green grey		
light grey		
light grey brown		
light orange		
light pink		
light red		
maroon		
medium blue		
medium blue grey		
medium brown		
medium green		
medium green grey		
medium grey		
medium grey brown		
medium orange		
medium pink		
medium red		
melanocratic	Dark-colored; applied to dark-colored igneous rocks rich in mafic minerals. The percentage of mafic minerals required for a rock to be classified as melanocratic varies among petrologists; the lower limit ranges from 60 to 67%. n. melanocrate. Cf: *leucocratic; mesocratic*. Syn: *dark-colored.*	Glossary of Geology, Fifth Edition (revised), 2011

mesocratic	Composed of almost equal amounts of light and dark constituents; applied to igneous rocks intermediate in color between *leucocratic* and *melanocratic*. The percentage of mafic minerals required for a rock to be classified as mesocratic varies among petrologists; the lower limit ranges from 30 to 37%, the upper limit from 60 to 67%.	Glossary of Geology, Fifth Edition (revised), 2011
olive		
olive green		
orange		
orange brown		
pink		
pinkish grey		
red		
reddish pink		
rusty		
rusty brown		
salt and pepper		
tan		
white		
yellow		
yellowish brown		
yellowish grey		
yellowish orange		

4.1.10 vocab_ContactCharacter

Categories denoting the nature of the contact.

Term	Definition	Reference
sharp	Abrupt, not rounded off or blunted; involving sudden change of direction	Oxford English Dictionary, Oxford Press, 2015
gradational	A means of gradual transition	Oxford English Dictionary, Oxford Press, 2015
diffuse	Spread through or over a wide area; widespread, scattered, diffuse	Oxford English Dictionary, Oxford Press, 2015
concealed	Hidden	Oxford English Dictionary, Oxford Press, 2015
not specified		
present	contact exists	

4.1.11 vocab_DeformationExtent

Categories denoting a unit is deformed and extends beyond an indicated global domain, e.g. beyond the N. American Continent.

Term	Definition	Reference
deformed	(a) A general term for the process of folding, faulting, shearing, or fabric development of the rocks as a result of Earth stresses. (b) The change in the geometry of a body of rock that occurs as a consequence of stress, e.g. translation, rigid body rotation about an axis, and *strain* or distortion.	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	(b)	
unit also occurs outside the named deformation domain	indicates the unit spatially extends beyond the spatial extents of a specific deformation domain	

4.1.12 vocab_FoldProfile

Categories denoting the type of fold.

Term	Definition	Reference
antiform	Any convex-upward, concave downward fold. The term is usually used when the folded layers do not possess a stratigraphic order, when the stratigraphic order of the folded layers is not known, or when the fold core also contains the stratigraphically younger rock.	Glossary of Geology, Fifth Edition (revised), 2011
synform	Any fold whose limbs close at the bottom. The term is usually used when the folded layers do not possess a stratigraphic order, when the stratigraphic order of the folded layers is not known, or when the fold core also contains the stratigraphically older rock.	Glossary of Geology, Fifth Edition (revised), 2011
neutral	surface of no strain.	Glossary of Geology, Fifth Edition (revised), 2011
anticline	A fold, generally convex upward, whose core contains the stratigraphically older rocks. Ant: *syncline*. See also *antiform*; *synformal anticline*.	Glossary of Geology, Fifth Edition (revised), 2011
syncline	A fold of which the core contains the stratigraphically younger rocks; it is generally concave upward. Ant: *anticline*. See also: *synform*; *synclinal*.	Glossary of Geology, Fifth Edition (revised), 2011
monocline	A local steepening in an otherwise uniform gentle dip. Cf: *homocline*. Adj: *monoclinal*. Obsolete syn: *unicline*.	Glossary of Geology, Fifth Edition (revised), 2011
ptygmatic	Folds with rounded hinges and fold amplitudes nearly equal to fold wavelength; they develop in isolated layers, usually in metamorphic rocks. Syn: *ptygma*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.13 vocab_Generation

Categories denoting the generation of a structure.

Term	Definition	Reference
unknown	Not known; strange, unfamiliar	Oxford English Dictionary, Oxford Press, 2015
D1	First recognized deformation phase	Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics, Springer-Verlag, 366 p.
D2	Second recognized deformation phase	Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics, Springer-Verlag, 366 p.
D3	Third recognized deformation phase	Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics, Springer-Verlag, 366 p.
D4	Fourth recognized deformation phase	Passchier, C.W. and Trouw, R.A.J., 2005, Microtectonics, Springer-Verlag, 366 p.

4.1.14 vocab_GeogDirection

Categories denoting a geographic direction such as North or North-West.

Term	Definition	Reference
North		
South		
East		
West		
North-East		
North-West		
South-East		
South-West		

4.1.15 vocab_GeolPurpose

Categories denoting whether an entity in the database describes a type (e.g.' X Formation' or 'Fault') or an instance (polygon 1 of 'X Formation').

Term	Definition	Reference
definition	denotes a type	
instance	denotes an instance	

4.1.16 vocab_HangWallDirection

To be determined.

4.1.17 vocab_LithBeddingPattern

Categories denoting the type of bedding pattern.

Term	Definition	Reference
coarsening upward	A succession of beds that increase in grain-size upward through a vertical column of sediment such as a beach sequence.	Glossary of Geology, Fifth Edition (revised), 2011
cross-bedded	(a) *Cross-stratification* in which the cross-beds are more than 1 cm in thickness (McKee and Weir, 1953, p.382). (b) A cross-bedded structure; a cross-bed. See also: *current bedding*; *inclined bedding*; *discordant bedding*; *crisscross-bedding*. Syn: *false bedding*; *diagonal bedding*; *oblique bedding*; *foreset bedding*.	Glossary of Geology, Fifth Edition (revised), 2011
cross-laminated	a) *Cross-stratification* characterized by cross-beds that are <1 cm in thickness (McKee and Weir, 1953, p.382). (b) A cross-laminated structure; a *cross-lamina*. See also: *flow-and-plunge structure*. Syn: *oblique lamination*; *diagonal lamination.*	Glossary of Geology, Fifth Edition (revised), 2011
fining upward	A succession of beds that decrease in grain size upward through a vertical column of sediment such as in a river or tidal bar.	Glossary of Geology, Fifth Edition (revised), 2011
hummocky	Said of topographic land or ice forms that are abounding in small hills and depressions meters to tens of meters across (hummocks), such as a hummocky dune or *hummocked ice*.	Glossary of Geology, Fifth Edition (revised), 2011

banded	Said of a vein, sediment, or other deposit having alternating layers that differ in color or texture and that may or may not differ in mineral composition, e.g. *banded iron formation*. Cf: *ribbon [ore dep]*.	Glossary of Geology, Fifth Edition (revised), 2011
blocky	**blocky prismatic structure [paleont]** A simple *prismatic structure* in which each first-order prism has a low length/width ratio and consists of irregularly stacked, more or less equidimensional structural units (Bandel, 1977a).	Glossary of Geology, Fifth Edition (revised), 2011
cyclic	Adj. of cycle; recurrent rather than *secular*.	Glossary of Geology, Fifth Edition (revised), 2011
fissile	(a) Capable of being easily split along closely spaced planes; exhibiting *fissility*. (b) Said of bedding that consists of laminae less than 2 mm in thickness (Payne, 1942). Cf: *cleavage [struc geol]*.	Glossary of Geology, Fifth Edition (revised), 2011
flaggy	(a) Splitting or tending to split into layers of suitable thickness for use as flagstones; specif. descriptive of a sedimentary rock that splits into layers from 1 cm to 5 cm in thickness (McKee and Weir, 1953, p.383). (b) Said of bedding that consists of layers from 1 cm to 10 cm in thickness (Payne, 1942). (c) Pertaining to a flag or flagstone. (d) Said of a soil full of flagstone fragments.	Glossary of Geology, Fifth Edition (revised), 2011
flaser	The streaky layers of parallel, scaly aggregates surrounding the lenticular bodies of granular material in flaser structure. Etymol: German, "streak".	Glossary of Geology, Fifth Edition (revised), 2011
parting	A lamina or very thin sedimentary layer, following a surface of separation between thicker strata of different lithology; e.g. a *shale break* in sandstone, or a thin bed of shale or slate in a coal bed.	Glossary of Geology, Fifth Edition (revised), 2011
planar	Lying or arranged as a plane or in planes, usually implying more or less parallelism, as in bedding or cleavage. It is a two-dimensional arrangement, in contrast to the one-dimensional *linear* arrangement.	Glossary of Geology, Fifth Edition (revised), 2011
platy	(a) Said of a sedimentary particle whose length is more than three times its thickness (Krynine, 1948, p.142). Cf: *acicular [sed]*. (b) Said of a sandstone or limestone that splits into laminae having thicknesses in the range of 2 to 10 mm (McKee and Weir, 1953, p.383).	Glossary of Geology, Fifth Edition (revised), 2011
rhythmic	cyclical	Glossary of Geology, Fifth Edition (revised), 2011
ribbon	Centimetre scale layering	Glossary of Geology, Fifth Edition (revised), 2011
slabby	Having a horizontal parting that produces slabs	Glossary of Geology, Fifth Edition (revised), 2011
thickening upward	Layer thickness increases upsection	Glossary of Geology, Fifth Edition (revised), 2011
thinning upward	Layer thickness decreases upsection	Glossary of Geology, Fifth Edition (revised), 2011
wavy	Compositional layering that forms waves	Glossary of Geology, Fifth Edition (revised), 2011

4.1.18 vocab_LithBedThickness

Categories denoting the range of thickness of a bed.

Term	Definition	Reference
laminated	Bedding < 1 cm	Ingram, 1954
massive bedded	Bedding < 3 m	
bedded	Containing depositonal layers	
thinly laminated	Bedding <3 mm	Ingram, 1954
thickly laminated	Bedding 3 mm – 1 cm	Ingram, 1954
very thin bedded	Bedding 1 – 3 cm	Ingram, 1954
thin bedded	Bedding 3 -10 cm	Ingram, 1954
medium bedded	Bedding 10 – 30 cm	Ingram, 1954
thick bedded	Bedding 30cm – 1 m	Ingram, 1954
very thick bedded	Bedding >1 m	Ingram, 1954
thin to thickly laminated	–as above	
thinly laminated to very thin bedded	as above	
thinly laminated to thin bedded	as above	
thinly laminated to medium bedded	as above	
thinly laminated to thick bedded	as above	
thinly laminated to very thick bedded	as above	
thinly laminated to massive bedded	as above	
thickly laminated to very thin bedded	as above	
thickly laminated to thin bedded	as above	
thickly laminated to medium bedded	as above	
thickly laminated to thick bedded	as above	
thickly laminated to very thick bedded	as above	
thickly laminated to massive bedded	as above	
very thin to thin bedded	as above	
very thin to medium bedded	as above	
very thin to thick bedded	as above	
very thin to very	as above	

thick bedded		
very thin to massive bedded	as above	
thin to medium bedded	as above	
thin to thick bedded	as above	
thin to very thick bedded	as above	
thin to massive bedded	as above	
medium to thick bedded	as above	
medium to very thick bedded	as above	
medium to massive bedded	as above	
thick to very thick bedded	as above	
thick to massive bedded	as above	
very thick to massive bedded	as above	

4.1.19 vocab_LithFabric

Categories denoting lithologic fabric.

Term	Definition	Reference
amygdaloidal	Said of the textures of rocks containing amygdules. Sp: *amigdaloidal*.	Glossary of Geology, Fifth Edition (revised), 2011
aphanitic	Any fine-grained igneous rock whose components are not distinguishable with the unaided eye; a rock having *aphanitic* texture. The obsolescent syn. *felsite* has been sometimes restricted to the light-colored rocks with this texture and *aphanite* to the dark-colored (Johanssen, 1939, p.201). Adj: *aphanitic [ign]*. Cf: *felsite; phanerite*.	Glossary of Geology, Fifth Edition (revised), 2011
aplitic	Fine- to medium-grained *saccharoidal* or xenomorphic-granular texture characteristic of some granitic rocks (aplites) which lack dark minerals and micas.	Glossary of Geology, Fifth Edition (revised), 2011
bioclastic	(a) A rock consisting primarily of fragments that are broken from pre-existing rocks, or are pulverized or arranged, by the action of living organisms, such as plant roots or earthworms (Grabau, 1904). The rock need not consist of biogenic material. The term includes "rocks" (such as concrete) that owe their existence to human activities. (b) A sedimentary rock consisting of fragmental or broken remains of organisms, such as a limestone composed of shell fragments or bedded phosphate deposits composed largely of vertebrate skeletal fragments, coprolites, and similar remains (Boggs, 1987). Cf: *biogenic rock*.	Glossary of Geology, Fifth Edition (revised), 2011

biogenic	An *organic rock* produced directly by the physiological activities of organisms, either plant or animal (Grabau, 1924, p.280); e.g. coral reefs, shelly limestone, pelagic ooze, coal, and peat. Cf: *bioclastic rock; biolith*. See also: *phytogenic rock; zoogenic rock*. Syn: *biogenous rock; biogenetic rock.*	Glossary of Geology, Fifth Edition (revised), 2011
bird's eye	A spot, bleb, tube, or irregular patch of sparry calcite commonly found in limestones (such as dismicrites) and some dolomites as a precipitate that infills cavities resulting from localized disturbances, such as microbial or burrowing activity, escaping gas bubbles, shrinkage cracking, or plant roots. Also applied to the porosity created by the presence of bird's-eyes in a rock. Also spelled: birdseye. Syn: *calcite eye*.	Glossary of Geology, Fifth Edition (revised), 2011
cataclastic	(a) Pertaining to the structure produced in a rock by the action of severe mechanical stress during dynamic metamorphism; characteristic features include the bending, breaking, and granulation of the minerals. Also, said of the rocks exhibiting such structures. Cf: *mortar structure*. (b) Pertaining to clastic rocks, the fragments of which have been produced by the fracture of preexisting rocks by Earth stresses; e.g., crush breccia (Teall, 1887).	Glossary of Geology, Fifth Edition (revised), 2011
cavernous	Said of the texture of a volcanic rock that is coarsely *porous* or *cellular*.	Glossary of Geology, Fifth Edition (revised), 2011
clast-supported	A sedimentary texture in which the larger particles are in contact. Cf: *matrix support*.	Glossary of Geology, Fifth Edition (revised), 2011
clastic	(a) Pertaining to a rock or sediment composed principally of broken fragments that are derived from preexisting rocks or minerals and that have been transported some distance from their places of origin; also said of the texture of such a rock. The term has been used to indicate a source both within and outside the depositional basin. (b) *pyroclastic*. (c) Said of a bioclastic rock. (d) Pertaining to the fragments (clasts) composing a clastic rock. n. A clastic rock. Term is usually used in the plural; e.g. the commonest "clastics" are sandstone and shale.	Glossary of Geology, Fifth Edition (revised), 2011
cryptocrystalline	(a) Said of the texture of a rock consisting of crystals that are too small to be recognized and separately distinguished even under the ordinary microscope (although crystallinity may be shown by use of the electron microscope); indistinctly crystalline, as evidenced by a confused aggregate effect under polarized light. Also, said of a rock with such a texture. Cf: *microcrystalline; dubiocrystalline*. Syn: *felsophyric*. (b) Said of the texture of a crystalline rock in which the crystals are too small to be recognized megascopically. This usage is not recommended "since it cannot be known that an aphanitic rock is cryptocrystalline until the microscope has shown that it is actually microscopically crystalline" (Johannsen, 1939, p.206). (c) Descriptive of a crystalline texture of a carbonate sedimentary rock having discrete crystals whose diameters are	Glossary of Geology, Fifth Edition (revised), 2011

	less than 0.001 mm (Bissell and Chilingar, 1967, p.103) or less than 0.01 mm (Pettijohn, 1957, p.93). Some petrographers use an upper limit of 0.004 mm.	
deformed	Body of rock characterized by planar and/or linear fabrics that occurs penetratively and are the result of pure or simple shear.	Passchier, C.W. and Trouw, R.A.J., 2005. Microtectonics. Springer-Verlag, Berlin, 366p.
equigranular	Texture consisting of grains roughly equal in size; used primarily for igneous and metamorphic rocks. Syn: *granoblastic* (metamorphic).	Glossary of Geology, Fifth Edition (revised), 2011
fenestral	(a) A small opening in an invertebrate; e.g. an open space in a reticulate or anastomosing bryozoan colony, or an open or closed window in the wall or lorica of a tintinnid. Pl: fenestrae. Syn: *fenestrule.*	Glossary of Geology, Fifth Edition (revised), 2011
flattened	Body of rock characterized by a planar feature that occurs penetratively and is the result of pure shear (flattening).	Passchier, C.W. and Trouw, R.A.J., 2005. Microtectonics. Springer-Verlag, Berlin, 366p.
foliated	Body of rock characterized by any planar feature that occurs penetratively. It may refer to thin rhythmic bedding in a sedimentary rock to compositional layering in igneous rocks or to cleavage, schistosity, or other planar structures in metamorphic rocks.	Passchier, C.W. and Trouw, R.A.J., 2005. Microtectonics. Springer-Verlag, Berlin, 366p.
fragmental	The texture of a pyroclastic rock, such as that of a tuff or a volcanic breccia.	Glossary of Geology, Fifth Edition (revised), 2011
glassy	Said of the texture of certain extrusive igneous rocks, which is similar to that of broken glass or quartz and developed as a result of rapid cooling of the lava, without distinct crystallization. Syn: *hyaline [ign]; vitreous [ign].*	Glossary of Geology, Fifth Edition (revised), 2011
graded	A type of bedding in which each layer displays a gradual and progressive change in particle size, usually from coarse at the base of the bed to fine at the top. It may form under conditions in which the velocity of the prevailing current declined in a gradual manner, as by deposition from a single short-lived turbidity current. Cf: *normal grading; inverse grading.*	Glossary of Geology, Fifth Edition (revised), 2011
granophyric	(a) An igneous texture characterized by the microscopic intergrowth of quartz and alkali feldspar. Syn: *micrographic.* Cf: *graphic [ign].* (b) As defined by Rosenbusch, a term applied to the texture of a porphyritic igneous rock in which the phenocrysts and groundmass penetrate each other, having crystallized simultaneously; of or pertaining to a *granophyre* (Cross et al., 1906, p.703). (c) As defined by Vogelsang, a term applied to a porphyritic igneous rock having a microgranular groundmass (Johannsen, 1939, p.214).	Glossary of Geology, Fifth Edition (revised), 2011
granular	A *soil micromorphology* term used to describe *skeleton grains* that are touching with little or no fine-grained matrix in the interstices. Syn: monic; chitonic.	Glossary of Geology, Fifth Edition (revised), 2011

hyaloclastic	A deposit formed by the flow or intrusion of lava or magma into water, ice, or water-saturated sediment, and its consequent granulation or shattering into small angular fragments. Also includes vitric tuff from shallow-water explosive volcanism or explosive interaction of magma and groundwater. Syn: *aquagene tuff.* Cf: *palagonite tuff*.	Glossary of Geology, Fifth Edition (revised), 2011
imbricated	Overlapping, as tiles on a roof or scales on a bud.	Glossary of Geology, Fifth Edition (revised), 2011
layered	An intrusive body in which there are layers, centimeters to many meters thick, of varying mineralogical composition, e.g. the Bushveld Complex, Stillwater Complex, and Skaergaard Intrusion. Syn: *stratiform intrusion.*	Glossary of Geology, Fifth Edition (revised), 2011
lineated	A general, nongeneric term for a locally linear structure or fabric in a rock, e.g. flow lines, scratches, striae, slickensides or slickenfibers on a single surface; linear arrangements of components in sediments; or axes of folds. Lineation in metamorphic rocks includes aligned rod-shaped and/or elongate minerals grains, crenulation fold axes, and the lines of intersection between bedding and cleavage or any two sets of oriented surfaces (O'Leary et al., 1976; El-Etr, 1976).	Glossary of Geology, Fifth Edition (revised), 2011
massive - unstructured	(a) Said of a stratified rock that occurs in very thick, homogeneous beds, or of a stratum that is imposing by its thickness; specif. said of a bed that is more than 10 cm (4 in.) in thickness (Payne, 1942) or more than 1.8 m (6 ft) in thickness (Kelley, 1956, p.294). (b) Said of a stratum or stratified rock that is obscurely bedded, or that is or appears to be without internal structure (such as a rock free from minor joints, fissility, or lamination), regardless of thickness. The massive appearance may be deceptive, as many "massive" beds display laminae and other structures when X-rayed. See also: *unstratified*. (c) Descriptive of a sedimentary rock that is difficult to split, or that splits into layers greater than 120 cm (4 ft) in thickness (McKee and Weir, 1953, p.383).	Glossary of Geology, Fifth Edition (revised), 2011
matrix-supported	A sedimentary texture in which the larger particles are not in contact but are separated by finer particles.	Glossary of Geology, Fifth Edition (revised), 2011
megacrystic	**megacryst** (meg**'**-a-cryst) A nongenetic term introduced by Clarke (1958, p.12) for "any crystal or grain" in an igneous or metamorphic rock that is "significantly larger" than the surrounding groundmass or matrix; e.g. a large microcline crystal in porphyritic granite. It may be a phenocryst, a xenocryst, a porphyroblast, or a porphyroclast.	Glossary of Geology, Fifth Edition (revised), 2011
miarolitic	Small irregular cavities in phaneritic igneous rocks, esp. "granites", into which small crystals of the rock-forming minerals protrude.	Glossary of Geology, Fifth Edition (revised), 2011
oolitic	Pertaining to an oolite, or to a rock or mineral made up of ooliths; e.g. an "oolitic ironstone", in which iron oxide or iron carbonate has replaced the calcium carbonate of an oolitic limestone. Also	Glossary of Geology, Fifth Edition (revised), 2011

	spelled: oölitic.	
ophitic	Igneous texture characterized by plagioclase laths largely or entirely enclosed by pyroxene grains. Cf: *subophitic*. The term *diabasic* was distinguished from "ophitic" by Kemp (1900, p.158-159), who considered the latter as requiring an excess of augite over plagioclase, and the former as having a predominance of plagioclase, with augite filling the interstices. Cf: *poikilitic*; *poikilophitic*. Syn: *doleritic*.	Glossary of Geology, Fifth Edition (revised), 2011
orbicular	Igneous texture characterized by numerous orbicules. Cf: *centric*; *nodular*; *spheroidal*; *spherulitic*.	Glossary of Geology, Fifth Edition (revised), 2011
pegmatitic	Said of the texture of very coarse-grained (crystal diameter greater than 3 cm) igneous rocks.	Glossary of Geology, Fifth Edition (revised), 2011
peloidal	A limestone characterized by abundant peloids.	Glossary of Geology, Fifth Edition (revised), 2011
porphyritic	(a) Said of the texture of an igneous rock in which larger crystals (phenocrysts) are set in a finer-grained groundmass, which may be crystalline or glassy or both; a rock with such texture.	Glossary of Geology, Fifth Edition (revised), 2011
porphyroblastic	Pertaining to the texture of a recrystallized metamorphic rock having large idioblasts of minerals (e.g., garnet, andalusite) in a finer-grained crystalloblastic matrix. Cf: *pseudoporphyroblastic*.	Glossary of Geology, Fifth Edition (revised), 2011
porphyroclastic	Said of a heterogranular metamorphic texture characterized by volumetrically significant amounts of both porphyroclasts and neoblasts. Also, said of a rock with such a texture. This follows "a longstanding descriptive usage in geology, and does not imply the earlier genetic and etymological connotation of breakage or fracture. Indeed, it is believed that porphyroclastic rocks are the product of plastic deformation and dynamic recrystallization rather than brittle deformation or cataclasis" (Harte, 1977). Semantically correct, though less used, syn: *blastogranular*. *Blastolaminar* applies to the most strongly laminated facies of porphyroclastic rocks.	Glossary of Geology, Fifth Edition (revised), 2011
pyroclastic	Pertaining to clastic rock material formed by volcanic explosion or aerial expulsion from a volcanic vent; also, pertaining to rock texture of explosive origin. It is not synonymous with the adjective "volcanic".	Glossary of Geology, Fifth Edition (revised), 2011
shattered	The breaking-up into angular blocks of a hard rock that has been subjected to severe stresses; the fractures may cut across mineral grains and structures in the rock	Glossary of Geology, Fifth Edition (revised), 2011
skeletal	(a) Pertaining to material derived from organisms and consisting of the hard parts secreted by the organisms or of the hard material around or within organic tissue. (b) Synonymous with "bioclastic" (Leighton and Pendexter, 1962); but used by Nelson et al. (1962, p.234) to refer to a limestone that consists of, or owes its characteristics to, virtually in-place accumulation of skeletal matter (as distinguished from a fragmental limestone formed by mechanical	Glossary of Geology, Fifth Edition (revised), 2011

	transport); but regarded by Leighton and Pendexter (1962) as synonymous with "bioclastic", indicating faunal or floral fragments, or whole components of organisms, that are not in their place of origin.	
spherulitic	Volcanic igneous texture dominated by spherulites or spherical bodies of radiating mineral fibers. Cf: *variolitic*. Syn: *globular*.	Glossary of Geology, Fifth Edition (revised), 2011
spiculitic	Texture resulting from numerous minute calcareous or siliceous bodies, having highly varied and often characteristic forms, occurring in and serving to stiffen and support the tissues of various invertebrates, and frequently found in marine-sediment samples and in Paleozoic and Cretaceous cherts. Examples: a discrete skeletal element of a sponge, typically a needlelike rod or a fused cluster of such rods; a long sharp calcareous skeletal element of the mesogloea of an octocoral; a discrete elongate or needlelike skeletal element of many radiolarians; a scalelike calcareous object borne on the girdle of a primitive chiton; an irregular calcareous body secreted within the connective tissue of a brachiopod; and a minute cylindrical or radiate skeletal element of an asterozoan.	Glossary of Geology, Fifth Edition (revised), 2011
stretched	Said of a structure or texture produced by *dynamic metamorphism*, in which the constituents are stretched and commonly broken in the same direction; e.g., stretch-pebble conglomerate. A stretched condition should not be confused with lineation.	Glossary of Geology, Fifth Edition (revised), 2011
stromatolitic	An organosedimentary structure produced by sediment trapping, binding, and/or precipitation as a result of the growth and metabolic activity of micro-organisms, principally cyanophytes (blue-green algae) (Walter, 1976, p.1). It has a variety of gross forms, from nearly horizontal to markedly columnar, domal, or subspherical. The term was introduced by Kalkowsky in 1908 as stromatolith. Cf: *oncolite*.	Glossary of Geology, Fifth Edition (revised), 2011
uniform	Of one form, character, or kind; having, maintaining, occurring in or under, the same form.	Oxford English Dictionary, Oxford Press, 2015
vesicular	Said of the texture of a rock, esp. a lava, characterized by abundant vesicles formed as a result of the expansion of gases during the fluid stage of the lava. Cf: *cellular; scoriaceous [volc]*.	Glossary of Geology, Fifth Edition (revised), 2011
volcaniclastic	Pertaining to all clastic volcanic materials formed by any process of fragmentation, dispersed by any kind of transporting agent, deposited in any environment, or mixed in any significant portion with nonvolcanic fragments (Fisher, 1961, p.1409).	Glossary of Geology, Fifth Edition (revised), 2011
vuggy	Pertaining to a *vug* or having numerous vugs.	Glossary of Geology, Fifth Edition (revised), 2011
welded	A texture of pyroclastic rocks, especially those derived from ash flows and nuées ardentes, that is formed by the heat and pressure of still-plastic particles as they are deposited.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.20 vocab_LithName

Categories denoting the type of lithology.

Term	Definition	Reference
alkali_basalt	In the *IUGS classification*, a nepheline-normative basalt. Silica-undersaturated basalt, containing normative nepheline, diopside, and plagioclase with no normative hypersthene. The term was defined by Yoder and Tilley (1962). Cf: *alkali-olivine basalt; alkaline basalt; basalt [petrology]; olivine basalt.*	Glossary of Geology, Fifth Edition (revised), 2011
amphibolite	Metamorphic rock mainly consisting of green, brown or black amphibole and plagioclase (including albite), which combined form 75 percent or more of the rock, and both of which are present as major constituents. The amphibole constitutes 50 percent or more of the total mafic constituents and is present in an amount of 30 percent or more; other common minerals include quartz, clinopyroxene, garnet, epidote-group minerals, biotite, titanite and scapolite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/amphibolite
andesite	Fine-grained igneous rock with less than 20 percent quartz and less than 10 percent feldspathoid minerals in the QAPF fraction, in which the ratio of plagioclase to total feldspar is greater 0.65. Includes rocks defined modally in QAPF fields 9 and 10 or chemically in TAS field O2 as andesite. Basalt and andesite, which share the same QAPF fields, are distinguished chemically based on silica content, with basalt defined to contain less than 52 weight percent silica. If chemical data are not available, the color index is used to distinguish the categories, with basalt defined to contain greater than 35 percent mafic minerals by volume or greater than 40 percent mafic minerals by weight. Typically consists of plagioclase (frequently zoned from labradorite to oligoclase), pyroxene, hornblende and/or biotite. Fine grained equivalent of dioritic rock.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/andesite
anorthosite	(a) In the *IUGS classification*, a plutonic rock with Q between 0 and 5, P/(A+P) greater than 90, and M less than 10. (b) A group of essentially monomineralic plutonic igneous rocks composed almost entirely of plagioclase feldspar, which is usually labradorite but may be as calcic as bytownite or as sodic as andesine or oligoclase, and little or no dark-colored	Glossary of Geology, Fifth Edition (revised), 2011

	minerals; also, any rock in that group. Anorthosites occur as large nonstratiform plutonic bodies and as stratiform intrusions; they are the main rock type of the lunar highlands. Syn: *plagioclase rock*.	
anthracite	Coal that has vitrinite mean random reflectance greater than 2.0% (determined in conformance with ISO 7404-5). Less than 12-14 percent volatiles (dry, ash free), greater than 91 percent fixed carbon (dry, ash free basis). The highest rank coal; very hard, glossy, black, with semimetallic luster, semi conchoidal fracture.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/anthracite_coal
aphanite	Any fine-grained igneous rock whose components are not distinguishable with the unaided eye; a rock having *aphanitic* texture. The obsolescent syn. *felsite* has been sometimes restricted to the light-colored rocks with this texture and *aphanite* to the dark-colored (Johanssen, 1939, p.201). Adj: *aphanitic [ign]*. Cf: *felsite; phanerite*.	Glossary of Geology, Fifth Edition (revised), 2011
aplite	A light-colored hypabyssal igneous rock characterized by a fine-grained allotriomorphic-granular (i.e. aplitic) texture. Aplites may range in composition from granitic to gabbroic, but the term "aplite" with no modifier is generally understood to mean granitic aplite, consisting essentially of quartz, potassium feldspar, and sodic plagioclase. The term, from a Greek word meaning "simple", was in use before 1823.	Glossary of Geology, Fifth Edition (revised), 2011
arenite	(a) A general name used for consolidated sedimentary rocks composed of sand-sized fragments (irrespective of composition) with a pure or nearly pure chemical cement and little or no interstitial matrix material; e.g., sandstone, graywacke, arkose, and calcarenite. The term is equivalent to the Greek-derived term *psammite* and was introduced as *arenyte* by Grabau (1904, p.242) who used it with appropriate prefixes in classifying medium-grained rocks (e.g., "autoarenyte," "autocalcarenyte," "hydrarenite," and "hydrosilicarenyte"). See also: *lutite; rudite*. (b) A "clean" sandstone that is well sorted, contains little or no matrix material, and has a relatively simple mineralogic composition; specif. a pure or nearly pure, chemically cemented sandstone containing <10% argillaceous matrix (Williams et al., 1954, p.290). The term is used for a	Glossary of Geology, Fifth Edition (revised), 2011

	major category of sandstone, as distinguished from *wacke*. Etymol: Latin "arena" = sand. Adj: arenitic.	
argillite	(a) A compact rock, derived either from mudstone (claystone or siltstone) or shale, that has undergone a somewhat higher degree of induration than mudstone or shale but is less clearly laminated than shale and without its fissility, and that lacks the cleavage distinctive of slate. Flawn (1953, p.563-564) regards argillite as a weakly metamorphosed argillaceous rock, intermediate in character between a claystone and a *meta-argillite*, in which less than half of the constituent material (clay minerals and micaceous paste) has been reconstituted to combinations of sericite, chlorite, epidote, or green biotite, the particle size of the reconstituted material ranging from 0.01 to 0.05 mm. Cf: *clay slate*. (b) A term that has been applied to an argillaceous rock cemented by silica (Holmes, 1928, p.35) and to a claystone composed entirely of clay minerals. Also spelled: *argillyte*.	Glossary of Geology, Fifth Edition (revised), 2011
arkose	A feldspar-rich sandstone, commonly coarse-grained and pink or reddish, that is typically composed of angular to subangular grains that may be either poorly or moderately well sorted, is usually derived from the rapid disintegration of granite or granitic rocks, and often closely resembles granite; e.g. the Triassic arkoses of the eastern United States. Quartz is usually the dominant mineral, with feldspars constituting at least 25%. Cement (silica or calcite) is commonly rare, and matrix material (usually less than 15%) includes clay minerals (esp. kaolinite), mica, and iron oxide; fine-grained rock fragments are often present. Modern definitions of arkose include those by Krynine (1940); Folk (1954); Williams et al. (1954, p.294-295); Pettijohn (1957; 1975, p.214); McBride (1963, p.667); and Folk (1968, p.124). The term "arkose" was introduced by Brongniart (1823, p.497-498) in an attempt to limit use of "grés" (sandstone) and was defined by him as a rock of granular texture formed principally by mechanical aggregation and composed essentially of large grains of feldspar and glassy quartz mixed together unequally, with mica and clay as fortuitous constituents	Glossary of Geology, Fifth Edition (revised), 2011

	(see Oriel, 1949, p.825). Roberts (1839, p.11) attributes the term to Bonnard. Etymol: French, probably from Greek "archaios", "ancient, primitive" (Oriel, 1949, p.826). Adj: arkosic. Cf: *graywacke; feldspathic sandstone; subarkose*. Also spelled: *arcose*.	
arkosic_arenite	A sandstone containing abundant quartz, chert, or quartzite, less than 10% argillaceous matrix, and more than 25% feldspar (chiefly unaltered sodic and potassic varieties), and characterized by an abundance of unstable materials in which the feldspar grains exceed the rock fragments (Williams et al., 1954, p.294). It is more feldspathic and less mature than *feldspathic arenite*. See also: *arkosic sandstone*.	Glossary of Geology, Fifth Edition (revised), 2011
ash_tuff	Pyroclastic rock made up chiefly of consolidated ash.	Glossary of Geology, Fifth Edition (revised), 2011
barite_rock	A white, yellow, or colorless orthorhombic mineral: $BaSO_4$. Strontium and calcium are often present. Barite occurs in tabular crystals, in granular form, or in compact masses resembling marble, and it has a specific gravity of 4.5. It is used in paint, drilling mud, and as a filler for paper and textiles, and is the principal ore of barium. Syn: *barytes; heavy spar; cawk*.	Glossary of Geology, Fifth Edition (revised), 2011
basalt	Fine-grained or porphyritic igneous rock with less than 20 percent quartz, and less than 10 percent feldspathoid minerals, in which the ratio of plagioclase to total feldspar is greater 0.65. Typically composed of calcic plagioclase and clinopyroxene; phenocrysts typically include one or more of calcic plagioclase, clinopyroxene, orthopyroxene, and olivine. Includes rocks defined modally in QAPF fields 9 and 10 or chemically in TAS field B as basalt. Basalt and andesite are distinguished chemically based on silica content, with basalt defined to contain less than 52 weight percent silica. If chemical data are not available, the color index is used to distinguish the categories, with basalt defined to contain greater than 35 percent mafic minerals by volume or greater than 40 percent mafic minerals by weight.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/basalt
basanite	Tephritoid that has a plagioclase to total feldspar ratio greater than 0.9, and contains more than 10 percent normative (CIPW) olivine.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/basanite
bauxite	Highly aluminous material containing	See GeoSciML:

	abundant aluminium hydroxides (gibbsite, less commonly boehmite, diaspore) and aluminium-substituted iron oxides or hydroxides and generally minor or negligible kaolin minerals; may contain up to 20 percent quartz. commonly has a pisolitic or nodular texture, and may be cemented.	http://resource.geosciml.org/classifier/cgi/lithology/bauxite
bentonite	(a) Soft clay or greasy claystone composed largely of smectite formed by the chemical alteration of glassy volcanic ash in contact with water. It often contains accessory crystal grains that were originally phenocrysts in the parent rock. The rock commonly has the ability to absorb large quantities of water accompanied by a large increase in volume that can result in a thixotropic gel. The term "taylorite" was used by Knight (1898), after the owner of a quarry near Rock Springs in the Wyoming territory (see Taylor, 1897). It was later renamed "bentonite" after the Benton Formation (formerly Fort Benton Formation) in eastern Wyoming. Syn: *volcanic clay; soap clay; mineral soap; amargosite*. Cf: *fuller's earth*. (b) A commercial term applied to clay deposits (especially bentonite) containing smectite as the essential mineral. This clay presents a very large total surface area, swells in water, and is used chiefly to thicken oil-well drilling mud. (c) Any clay composed dominantly of a smectite clay mineral whose physical properties are dictated by this mineral (Grim and Güven, 1978, p.1).	Glossary of Geology, Fifth Edition (revised), 2011
bituminous_coal	Coal that has vitrinite mean random reflectance greater than 0.6% and less than 2.0% (determined in conformance with ISO 7404-5), or has a gross calorific value greater than 24 MJ/kg (determined in conformance with ISO 1928). Hard, black, organic rich sedimentary rock; contains less than 91 percent fixed carbon on a dry, mineral-matter-free basis, and greater than 13-14 percent volatiles (dry, ash free). Formed from the compaction or induration of variously altered plant remains similar to those of peaty deposits.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/bituminous_coal
bituminous_shale	A dark-gray or black shale with abundant carbon in the form of small disseminated particles or flakes; it is commonly associated with coal seams.	Glossary of Geology, Fifth Edition (revised), 2011
blueschist	A schistose metamorphic rock with a blue color owing to the presence of	Glossary of Geology, Fifth Edition (revised), 2011

	sodic amphibole, e.g. glaucophane or crossite, and commonly mottled bluish-gray lawsonite. Cf: *glaucophane schist*.	
boundstone	Sedimentary carbonate rock with preserved biogenic texture, whose original components were bound and encrusted together during deposition by the action of plants and animals during deposition, and remained substantially in the position of growth.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/boundstone
breccia	Coarse-grained material composed of angular broken rock fragments; the fragments typically have sharp edges and unworn corners. The fragments may be held together by a mineral cement or in a fine-grained matrix, and consolidated or nonconsolidated. Clasts may be of any composition or origin. In sedimentary environments, breccia is used for material that consists entirely of angular fragments, mostly derived from a single source rock body, as in a rock avalanche deposit, and matrix is interpreted to be the product of comminution of clasts during transport. Diamictite or diamicton is used when the material reflects mixing of rock from a variety of sources, some sub angular or subrounded clasts may be present, and matrix is pre-existing fine grained material that is not a direct product of the brecciation/deposition process.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/breccia
calcsilicate	A metamorphic rock consisting mainly of calcium-bearing silicates such as diopside and wollastonite, and formed by metamorphism of impure limestone or dolomite. Syn: *lime-silicate rock.*	Glossary of Geology, Fifth Edition (revised), 2011
carbonate_mudstone	Mudstone that consists of greater than 50 percent carbonate minerals of any origin in the mud size fraction.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/carbonate_mudstone
carbonate_rock	Sedimentary rock in which at least 50 percent of the primary and/or recrystallized constituents are composed of one (or more) of the carbonate minerals calcite, aragonite, magnesite or dolomite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/carbonate_sedimentary_rock
carbonatite	Igneous rock composed of more than 50 percent modal carbonate minerals.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/carbonatite
cataclasite	Fault-related rock that maintained primary cohesion during deformation, with matrix comprising greater than 10 percent of rock mass; matrix is fine-grained material formed through grain size reduction by fracture as opposed to crystal plastic process that operate in mylonitic rock. Includes	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/cataclasite_series

	cataclasite, protocataclasite and ultracataclasite.	
chalk	A generally soft, white, very fine-grained, extremely pure, porous limestone. It forms under marine conditions from the gradual accumulation of skeletal elements from minute planktonic green algae (cocoliths), associated with varying proportions of larger microscopic fragments of bivalves, foraminifera and ostracods. It is common to find flint and chert nodules embedded in chalk.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/chalk
chert	A hard, extremely dense or compact, dull to semivitreous, microcrystalline or cryptocrystalline sedimentary rock, consisting dominantly of interlocking crystals of quartz less than about 30 □m in diameter; it may contain amorphous silica (opal). It sometimes contains impurities such as calcite, iron oxide, and the remains of siliceous and other organisms. It has a tough, splintery to conchoidal fracture, and may be white or variously colored gray, green, blue, pink, red, yellow, brown, and black. Chert occurs principally as nodular or concretionary segregations (chert nodules) in limestones and dolomites, and less commonly as areally extensive layered deposits (*bedded chert*); it may be an original organic or inorganic precipitate or a replacement product. The term flint is essentially synonymous, although it has been used for the dark variety of chert (Tarr, 1938). Cf: *jasper; black chert*. Syn: *hornstone [rock]; white chert; silexite [sed]*.	Glossary of Geology, Fifth Edition (revised), 2011
chlorite_schist	Metamorphic rock characterized by 50 percent or more of combined chlorite, actinolite and epidote. Category for rocks generally named greenschist or greenstone.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/chlorite_actinolite_epidote_metamorphic_rock
clastic_mudstone	Clastic sedimentary rock consisting of less than 30 percent gravel-size (2 mm) particles and with a mud to sand ratio greater than 1.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/clastic_mudstone
clastic_rock	Sedimentary rock in which at least 50 percent of the constituent particles were derived from erosion, weathering, or mass-wasting of pre-existing earth materials, and transported to the place of deposition by mechanical agents such as water, wind, ice and gravity.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/clastic_sedimentary_rock
claystone	Mudstone that contains no detectable silt, inferred to consist virtually entirely of clay-size particles.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/cl

		aystone
coal	A consolidated organic sedimentary material having less than 75% moisture. This category includes low, medium, and high rank coals according to International Classification of In-Seam Coal (United Nations, 1998), thus including lignite. Sapropelic coal is not distinguished in this category from humic coals. Formed from the compaction or induration of variously altered plant remains similar to those of peaty deposits.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/coal
conglomerate	A coarse-grained clastic sedimentary rock, composed of rounded to subangular fragments larger than 2 mm in diameter (granules, pebbles, cobbles, boulders) typically containing fine-grained particles (sand, silt, clay) in the interstices, and commonly cemented by calcium carbonate, iron oxide, silica, or hardened clay; the consolidated equivalent of *gravel* both in size range and in the essential roundness and sorting of its constituent particles. The rock or mineral fragments may be of varied composition and range widely in size. Conglomerates may be classified according to nature or composition of fragments, proportion of matrix, degree of size sorting, type of cement, and agent or environment of formation. Etymol: Latin "conglomeratus", "heaped, rolled, or pressed together". Cf: *breccia [geol]*. Syn: *puddingstone*	Glossary of Geology, Fifth Edition (revised), 2011
dacite	Fine grained or porphyritic crystalline rock that contains less than 90 percent mafic minerals, between 20 and 60 percent quartz in the QAPF fraction, and has a plagioclase to total feldspar ratio greater than 0.65. Includes rocks defined modally in QAPF fields 4 and 5 or chemically in TAS Field O3. Typcially composed of quartz and sodic plagioclase with minor amounts of biotite and/or hornblende and/or pyroxene; fine-grained equivalent of granodiorite and tonalite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/dacite
diabase_dolerite	In the U.S., an intrusive rock whose main components are labradorite and pyroxene and which is characterized by ophitic texture. As originally applied by Brongniart in 1807, the term corresponded to what is now recognized as *diorite*. "The word has come to mean a pre-Tertiary basalt in Germany, a decomposed basalt in England, and a dike-rock with ophitic	Glossary of Geology, Fifth Edition (revised), 2011

	texture in the United States and Canada" (Johannsen, 1939, p.248). Cf: *trap [ign]*. Syn: *dolerite*.	
diamictite	Unsorted or poorly sorted, clastic sedimentary rock with a wide range of particle sizes including a muddy matrix. Biogenic materials that have such texture are excluded. Distinguished from conglomerate, sandstone, mudstone based on polymodality and lack of structures related to transport and deposition of sediment by moving air or water. If more than 10 percent of the fine grained matrix is of indeterminant clastic or diagenetic origin and the fabric is matrix supported, may also be categorized as wacke.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/diamictite
diamicton	Unsorted or poorly sorted, clastic sediment with a wide range of particle sizes, including a muddy matrix. Biogenic materials that have such texture are excluded. Distinguished from conglomerate, sandstone, mudstone based on polymodality and lack of structures related to transport and deposition of sediment by moving air or water. Assignment to an other size class can be used in conjunction to indicate the dominant grain size.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/diamicton
diorite	Phaneritic crystalline rock consisting of intermediate plagioclase, commonly with hornblende and often with biotite or augite; colour index M less than 90, sodic plagioclase (An0-An50), no feldspathoid, and between 0 and 5 percent quartz. Includes rocks defined modally in QAPF field 10 as diorite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/diorite
dolomitic limestone	(a) A limestone in which the mineral dolomite is conspicuous, but calcite is more abundant; specif. a limestone containing 10-50% dolomite and 50-90% calcite and having an approximate magnesium-carbonate equivalent of 4.4-22.7% (Pettijohn, 1957, p.418), or a limestone whose Ca/Mg ratio ranges from 4.74 to 60 (Chilingar, 1957). Cf: *calcitic dolomite; magnesian limestone*. Syn: *dolomite limestone.* (b) A limestone that has been incompletely dolomitized (Chilingar et al., 1967, p.314).	Glossary of Geology, Fifth Edition (revised), 2011
dolostone	Pure carbonate sedimentary rock with a ratio of magnesium carbonate to calcite (plus aragonite) greater than 1 to 1.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/dolostone
dunite	(a) In the *IUGS classification*, a plutonic rock with M equal to or greater than 90 and ol/(ol+opx+cpx+hbd) greater than 90. (b) *Peridotite* in which	Glossary of Geology, Fifth Edition (revised), 2011

	the mafic mineral is almost entirely olivine, with accessory chromite almost always present. Named by Hochstetter in 1864 from Dun Mountain, New Zealand.	
duricrust	Rock forming a hard crust or layer at or near the Earth's surface at the time of formation, e.g. in the upper horizons of a soil, characterized by structures indicative of pedogenic origin.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/duricrust
eclogite	Metamorphic rock composed of 75 percent or more (by volume) omphacite and garnet, both of which are present as major constituents, the amount of neither of them being higher than 75 percent (by volume); the presence of plagioclase precludes classification as an eclogite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/eclogite
evaporite	Nonclastic sedimentary rock composed of at least 50 percent non-carbonate salts, including chloride, sulfate or borate minerals; formed through precipitation of mineral salts from a saline solution (non-carbonate salt rock).	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/evaporite
fault_breccia	Angular rock fragments resulting from fracturing and frictional slip along a fault; may be cohesive or incohesive. Syn: *dislocation breccia*. Obsolete syn: *fault rubble*.	Glossary of Geology, Fifth Edition (revised), 2011
felsic_volcanic_rock	A mnemonic adjective derived from *fe*ldspar + *l*enad (feldspathoid) + *si*lica + *c,* and applied to an igneous rock having abundant light-colored minerals in its mode; also, applied to those minerals (quartz, feldspars, feldspathoids, muscovite) as a group. It is the complement of *mafic*.	Glossary of Geology, Fifth Edition (revised), 2011
felsite	A general term for any light-colored, fine-grained or aphanitic extrusive or hypabyssal rock, with or without phenocrysts and composed chiefly of quartz and feldspar; a rock characterized by *felsitic* texture. Cf: *aphanite; mafite*.	Glossary of Geology, Fifth Edition (revised), 2011
foid_gabbro	In the *IUGS classification,* a plutonic rock with F between 10 and 60, P/(A+P) greater than 90, and plagioclase more calcic than An_{50}. Syn: *theralite*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/foid_gabbro
foid_syenite	Foid syenitoid that has a plagioclase to total feldspar ratio of less than 0.1. Includes rocks defined modally in QAPF field 11.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/foid_syenite
foidite	Foiditoid that contains greater than 90 percent feldspathoid minerals in the QAPF fraction.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/foidite
framestone	Carbonate reef rock consisting of a rigid framework of colonies, shells or skeletons, with internal cavities filled	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/fr

	with fine sediment; usually created through the activities of colonial organisms.	amestone
gabbro	Gabbroic rock that contains between 0 and 5 percent quartz and no feldspathoid mineral in the QAPF fraction. Includes rocks defined modally in QAPF Field 10 as gabbro.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/gabbro
gabbroic_rock	Gabbroid that has a plagioclase to total feldspar ratio greater than 0.9 in the QAPF fraction. Includes QAPF fields 10*, 10, and 10'. This category includes the various categories defined in LeMaitre et al. (2002) based on the mafic mineralogy, but apparently not subdivided based on the quartz/feldspathoid content.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/gabbroic_rock
gneiss	Foliated metamorphic rock with bands or lenticles rich in granular minerals alternating with bands or lenticles rich in minerals with a flaky or elongate prismatic habit. Mylonitic foliation or well developed, continuous schistosity (greater than 50 percent of the rock consists of grains participate in a planar or linear fabric) precludes classification with this concept.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/gneiss
grainstone	Carbonate sedimentary rock with recognizable depositional fabric that is grain-supported, and constituent particles are of intrabasinal origin; contains little or no mud matrix. Distinction from sandstone is based on interpretation of intrabasinal origin of clasts and grain-supported fabric, but grainstone definition does not include a grain size criteria.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/grainstone
granite	Phaneritic crystalline rock consisting of quartz, alkali feldspar and plagioclase (typically sodic) in variable amounts, usually with biotite and/or hornblende. Includes rocks defined modally in QAPF Field 3.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/granite
granitoid	Phaneritic crystalline igneous rock consisting of quartz, alkali feldspar and/or plagioclase. Includes rocks defined modally in QAPF fields 2, 3, 4 and 5 as alkali feldspar granite, granite, granodiorite or tonalite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/granitoid
granodiorite	Phaneritic crystalline rock consisting essentially of quartz, sodic plagioclase and lesser amounts of alkali feldspar with minor hornblende and biotite. Includes rocks defined modally in QAPF field 4.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/granodiorite
granofels	Metamorphic rock with granoblastic fabric and very little or no foliation (less than 10 percent of the mineral grains in the rock are elements in a planar or linear fabric). Grainsize not specified.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/granofels

granulite	Metamorphic rock of high metamorphic grade in which Fe-Mg silicate minerals are dominantly hydroxl-free; feldspar must be present, and muscovite is absent; rock contains less than 90 percent mafic minerals, less than 75 percent calcite and/or dolomite, less than 75 percent quartz, less than 50 percent iron-bearing minerals (hematite, magnetite, limonite-group, siderite, iron-sulfides), and less than 50 percent calc-silicate minerals.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/granulite
gravel	Clastic sediment containing greater than 30 percent gravel-size particles (greater than 2.0 mm diameter). Gravel in which more than half of the particles are of epiclastic origin.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/gravel
greenstone	A field term applied to any compact dark-green altered or metamorphosed mafic igneous rock (e.g., spilite, basalt, gabbro, diabase) that owes its color to the presence of chlorite, actinolite, or epidote.	Glossary of Geology, Fifth Edition (revised), 2011
greywacke	An old rock name that has been variously defined but is now generally applied to a dark gray firmly indurated coarse-grained sandstone that consists of poorly sorted angular to subangular grains of quartz and feldspar, with a variety of dark rock and mineral fragments embedded in a compact clayey matrix and containing an abundance of very fine-grained illite, sericite, and chloritic minerals; e.g. the Jackfork Sandstone (Mississippian) in Oklahoma, parts of the Franciscan Formation (Mesozoic) in western California, and certain Ordovician rocks in the Taconic region of New York and Vermont. This description is similar to Naumann's (1858, p.663) definition of the type graywacke, the Tanner Graywacke (Upper Devonian and Lower Carboniferous) of the Harz Mountains, Germany. It generally reflects an environment in which erosion, transportation, deposition, and burial were so rapid that complete chemical weathering did not occur. Graywackes are typically marine and commonly turbiditic (Pettijohn, 1957, p.313). Selected modern definitions have been given by Allen (1936, p.22); Twenhofel (1939, p.289); Krynine (1948); Folk (1954); Williams et al. (1954, p.293-297); Pettijohn (1957); McBride (1962a); and Krumbein and Sloss (1963, p.171-172). The first recorded use of the term was by Lasius	Glossary of Geology, Fifth Edition (revised), 2011

	(1789, p.132-152) who referred to "Grauewacke" as a German miner's term for barren country rock of certain ore veins in the Harz Mountains, and who described the rock as a gray or dark quartz "breccia" with mica flakes and fragments of chert or sandstone in a clay cement (see Dott, 1964). The term "greywacke" was probably first used in English by Jameson (1808). Early usage was wide and vague: "geologists differ much respecting what is, and what is not, Grey Wacce" (Mawe, 1818, p.92), and "it has already been amply shown that this word should cease to be used in geological nomenclature, and...is mineralogically worthless" (Murchison, 1839). Formally defined by Geikie (1885, p.162) as "a compact aggregate of rounded or subangular grains of quartz, feldspar, slate, or other minerals or rocks cemented by a paste...gray, as its name denotes." In view of the diversity of usage, the term "graywacke" should not be used formally without either a specific definition or a reference to a readily available published definition. Folk (1968, p.125) advocates discarding the term for any precise petrographic usage, and relegating it to nonquantitative field usage for a hard, dark, clayey, impure sandstone "that you can't tell much about in the field". Etymol: German *Grauwacke,* "gray stone", probably so named because the original graywackes resembled partly weathered basaltic residues (wackes). See also: *wacke*. Cf: *arkose; subgraywacke*. Also spelled: *greywacke; grauwacke*.	
grit	(a) A coarse-grained sandstone, esp. one composed of angular particles; e.g. a fine-grained breccia composed of particles ranging in diameter from 2 mm to 4 mm (Woodford, 1925, p.183). (b) A sand or sandstone made up of angular grains that may be coarse or fine. The term has been applied to any sedimentary rock that looks or feels gritty on account of the angularity of the grains. (c) *gritstone*. (d) A sandstone composed of particles of conspicuously unequal sizes (including small pebbles or gravel). (e) A sandstone with a calcareous cement. The term has been applied incorrectly to any nonquartzose rock resembling a grit; e.g. pea grit or a calcareous grit. (f) A small particle of a stone or rock;	Glossary of Geology, Fifth Edition (revised), 2011

	esp. a hard, angular grain of sand. Also, an abrasive composed of such granules. (g) The structure or "grain" of a stone that adapts it for grinding or sharpening; the hold of a grinding substance. Also, the size of abrasive particles, usually expressed as their *mesh number*. (h) An obsolete term for sand or gravel, and for earth or soil. The term is vague and has been applied widely with many different connotations. Allen (1936, p.22) proposed to restrict the term to a coarse-grained sandstone composed of angular particles varying in diameter from 0.5 mm to 1 mm. Etymol: Old English greot, "gravel, sand".	
gypsum_anhydrite	A widely distributed mineral consisting of aquated calcium sulfate: $CaSO_4 \cdot 2H_2O$. It is the commonest sulfate mineral, and is frequently associated with halite and anhydrite in evaporites, forming thick, extensive beds interstratified with limestone, shale, and clay (esp. in rocks of Permian and Triassic age). Gypsum is soft (hardness of 2 on the Mohs scale); it is white or colorless when pure, but commonly has tints of gray, red, yellow, blue, or brown. It occurs massive (alabaster), fibrous (satin spar), or in monoclinic crystals (selenite) Gypsum is used chiefly as a soil amendment, as a retarder in portland cement, and in making Plaster of Paris. Etymol: Greek "gypsos", "chalk". Syn: *gypsite; gyp; plaster stone.* A mineral consisting of anhydrous calcium sulfate: $CaSO_4$. It represents *gypsum* without its water of crystallization, and it alters readily to gypsum, from which it differs in crystal form (anhydrite is orthorhombic) and in being harder and slightly less soluble. Anhydrite usually occurs in white or slightly colored, granular to compact masses, forming large beds or seams in sedimentary rocks or associated with gypsum and halite in evaporites. Syn: *cube spar.*	Glossary of Geology, Fifth Edition (revised), 2011
hornblendite	Ultramafic rock that consists of greater than 40 percent hornblende plus pyroxene and has a hornblende to pyroxene ratio greater than 1. Includes olivine hornblendite, olivine-pyroxene hornblendite, pyroxene hornblendite, and hornblendite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/hornblendite

hornfels	Granofels formed by contact metamorphism, composed of a mosaic of equidimensional grains in a characteristically granoblastic or decussate matrix; porphyroblasts or relict phenocrysts may be present. Typically fine grained.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/hornfels
igneous_rock	rock formed as a result of igneous processes, for example intrusion and cooling of magma in the crust, or volcanic eruption.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/igneous_rock
intermediate_volcanic_rock	Said of an igneous rock that is transitional between *basic* and *silicic* (or between *mafic* and *felsic*), generally having a silica content of 54 to 65 percent; e.g. syenite and diorite. "Intermediate" is one subdivision of a widely used system for classifying igneous rocks on the basis of their silica content; the other subdivisions are *acidic*, *basic*, and *ultrabasic*.	Glossary of Geology, Fifth Edition (revised), 2011
ironstone_iron_formation	A chemical sedimentary rock, typically thin-bedded and/or finely laminated, containing at least 15% iron of sedimentary origin, and commonly but not necessarily containing layers of chert (James, 1954, p.239). Various primary facies (usually not weathered) of iron formation are distinguished on the basis of whether the iron occurs predominantly as oxide, silicate, carbonate, or sulfide. Most iron formation is of Precambrian age. In mining usage, the term refers to a low-grade sedimentary iron ore with the iron mineral(s) segregated in bands or sheets irregularly mingled with chert or fine-grained quartz (Thrush, 1968, p.590). Cf: *ironstone; jaspilite*. See also: *Algoma-type iron formation; Lake Superior-type iron formation; oxide-facies iron formation; carbonate-facies iron formation; silicate-facies iron formation; sulfide-facies iron formation*. Essentially synonymous terms: *itabirite; banded hematite quartzite; taconite; quartz-banded ore; banded ironstone; calico rock; jasper bar; iron-bearing formation.*	Glossary of Geology, Fifth Edition (revised), 2011
kalsilitic_melilitic_rock	Igneous rock containing greater than 10 percent melilite or kalsilite. Typically undersaturated, ultrapotassic (kalsilitic rocks) or calcium-rich (melilitic rocks) mafic or ultramafic rocks.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/kalsilitic_and_melilitic_rock
kimberlite	An ultramafic igneous rock containing at least 35% olivine, with one or more of the following in the groundmass; monticellite, phlogopite, carbonate, serpentine, diopside. No leucite is	Glossary of Geology, Fifth Edition (revised), 2011

	allowed in the definition of kimberlite (Woolley et al., 1996). The name, proposed by Lewis in 1888, is for the Kimberley district, South Africa, where kimberlite is a host for diamonds. Two types of kimberlite have long been distinguished. *Basaltic kimberlite* or Type 1 kimberlite is more widespread, and constitutes the classic diatreme-filling diamond-bearing rocks of South Africa. Texturally, most Type 1 kimberlites are serpentinite microbreccias that have xenolithic fragments. Micaceous kimberlite, also called lamprophyric kimberlite, orangeite, or Type 2 kimberlite, is apparently restricted to southern Africa, and differs so strongly from Type 1 that some authorities do not consider it a variety of kimberlite. Cf: *orangeite*.	
komatiite	Ultramafic, magnesium-rich volcanic rock, typically with spinifex texture of intergrown skeletal and bladed olivine and pyroxene crystals set in abundant glass. Includes komatiite and meimechite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/komatiitic_rock
lamprophyre_minette	In the *IUGS classification,* a group of porphyritic igneous rocks in which mafic minerals form the phenocrysts; feldspars, if present, are restricted to the groundmass. Varieties of lamprophyre are camptonite, kersantite, minette, monchiquite, sannaite, spessartite, and vogesite.	Glossary of Geology, Fifth Edition (revised), 2011
lapilli_tuff	An indurated deposit that is predominantly lapilli, with a matrix of ash. Syn: *lapillite.*	Glossary of Geology, Fifth Edition (revised), 2011
laterite	(a) An older term for a highly weathered red subsoil or material rich in secondary oxides of iron, aluminum, or both, nearly devoid of bases and primary silicates, and commonly with quartz and kaolinite. It develops in a tropical or forested warm to temperate climate, and is a residual product of weathering. Laterite is capable of hardening after a treatment of wetting and drying, and can be cut and used for bricks; hence its etymology: Latin, latericius, "brick". See also: *Oxisols; plinthite*. (b) In modern usage, the iron oxide rich, silica-poor upper soil horizon of intensely weathered *regolith* found in tropical climates (Eggleton, 2001).	Glossary of Geology, Fifth Edition (revised), 2011
latite	Latitic rock that contains between 0 and 5 percent quartz and no feldspathoid in the QAPF fraction. QAPF field 8.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/latite
lignite	Coal that has a gross calorific value	See GeoSciML:

	less than 24 MJ/kg (determined in conformance with ISO 1928), and vitrinite mean random reflectance less than 0.6% (determined in conformance with ISO 7404-5). Gross calorific value is recalculated to a moist, ash free basis using bed moisture (determined according to ISO 1015 or ISO 5068). Includes all low-rank coals, including sub-bitiminous coal. A consolidated, dull, soft brown to black coal having many readily discernible plant fragments set in a finer grained organic matrix. Tends to crack and fall apart on drying. Operationally sub-bituminous and bitiminous coal are qualitatively distinguished based on brown streak for sub-bitiminous coal and black streak for bituminous coal.	http://resource.geosciml.org/classifier/cgi/lithology/lignite
limestone	Pure carbonate sedimentary rock with a calcite (plus aragonite) to dolomite ratio greater than 1 to 1. Includes limestone and dolomitic limestone.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/limestone
lithic_arenite	(a) A term used by Williams et al. (1954, p.294, 304) for a sandstone containing abundant quartz, chert, and quartzite, less than 10% argillaceous matrix, and more than 10% feldspar, and characterized by an abundance of unstable materials in which the fine-grained rock fragments exceed feldspar grains. It is better sorted and more porous and permeable, and contains better-rounded grains, than lithic wacke. The rock is roughly equivalent to "subgraywacke" as redefined by Pettijohn (1957). See also: *litharenite; subgraywacke*. (b) A term used by Pettijohn (1954, p.364) as a syn. of *lithic sandstone* and by Krynine (1945) as a syn. of *low-rank graywacke*.	Glossary of Geology, Fifth Edition (revised), 2011
loess	A widespread, homogeneous, commonly nonstratified, porous, friable, slightly coherent, usually highly calcareous, fine-grained blanket deposit (generally less than 30 m thick), consisting predominantly of silt with secondary grain sizes ranging from clay to fine sand. It covers areas extending from north-central Europe to eastern China as well as the Mississippi Valley and Pacific Northwest of the U.S. Loess is generally buff to light yellow or yellowish brown, often contains shells, bones, and teeth of mammals, and is traversed by networks of small narrow vertical tubes (frequently lined with	Glossary of Geology, Fifth Edition (revised), 2011

	calcium-carbonate concretions) left by successive generations of grass roots, which allow the loess to stand in steep or nearly vertical faces. Loess is now generally believed to be windblown dust of Pleistocene age, carried from desert surfaces, alluvial valleys, and outwash plains, or from unconsolidated glacial or glaciofluvial deposits uncovered by successive glacial recessions but prior to invasion by a vegetation mat. The mineral grains, composed mostly of silica and associated heavy minerals, are fresh and angular, and are generally held together by calcareous cement. In some regions, e.g. Moravia and China, more than 10 successive loess formations are separated by red to dark brown paleosols. A "lee-desert loess" commonly found in the Middle East on the downwind side of the northeastern Sahara is reddish in color and commonly noncalcareous. Etymol: German "Löss", from dialectal (Switzerland) "lösch", "loose", so named by peasants and brickworkers along the Rhine valley where the deposit was first recognized. Pron: luehss. Cf: *limon; adobe*. Syn: *löss; lehm*.	
mafic_volcanic_rock	Said of an igneous rock composed chiefly of one or more ferromagnesian, *dark-colored* minerals in its mode; also, said of those minerals. The term was proposed by Cross, et al. (1902, p.561) to replace the term *femag,* which they did not consider to be euphonious. Etymol: a mnemonic term derived from *ma*gnesium + *f*erric + *ic.* It is the complement of *felsic*. Cf: *femic; salic; basic*. Partial syn: *ferromagnesian*.	Glossary of Geology, Fifth Edition (revised), 2011
marble	Metamorphic rock consisting of greater than 75 percent fine- to coarse-grained recrystallized calcite and/or dolomite; usually with a granoblastic, saccharoidal texture.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/marble
marl	(a) A term loosely applied to a variety of materials, most of which occur as loose, earthy deposits consisting chiefly of an intimate mixture of clay and calcium carbonate, formed under marine or esp. freshwater conditions; specif. an earthy substance containing 35-65% clay and 65-35% carbonate (Pettijohn, 1957, p.410). Marl is usually gray; it is used esp. as a fertilizer for acid soils deficient in lime. In the Coastal Plain area of SE U.S., the term has been used for calcareous	Glossary of Geology, Fifth Edition (revised), 2011

	clays, silts, and sands, esp. those containing glauconite (greensand marls); and for newly formed deposits of shells mixed with clay. The term has also been used to designate a soft, friable clay with very little calcium carbonate, and a very fine, loose, almost pure calcium carbonate with little clay or silt. Syn: *calcareous clay*. (b) A soft, grayish to white, earthy or powdery, usually impure calcium carbonate precipitated on the bottoms of present-day freshwater lakes and ponds largely through the chemical action of aquatic plants, or forming deposits that underlie marshes, swamps, and bogs that occupy the sites of former (glacial) lakes. The calcium carbonate may range from 90% to less than 30%. Syn: *bog lime*. (c) A term occasionally used (as in Scotland) for a compact, impure, argillaceous limestone. (d) A term loosely applied to any soil that falls readily to pieces on exposure to air. (e) A literary term for clay or earthy material. Etymol: French marle.	
metamorphic_rock	Rock formed by solid-state mineralogical, chemical and/or structural changes to a pre-existing rock, in response to marked changes in temperature, pressure, shearing stress and chemical environment.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/metamorphic_rock
metasedimentary_rock	A sediment or sedimentary rock that shows evidence of having been subjected to metamorphism.	Glossary of Geology, Fifth Edition (revised), 2011
metasomatic_rock	Rock that has fabric and composition indicating open-system mineralogical and chemical changes in response to interaction with a fluid phase, typically water rich.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/metasomatic_rock
mica_schist	A schist that consists of more than 50 percent mica minerals, typically muscovite or biotite. Special type included to distinguish this common variety of schist.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/mica_schist
migmatite	Silicate metamorphic rock that is pervasively heterogeneous on a decimeter to meter scale that typically consists of darker and lighter parts; the darker parts usually exhibit features of metamorphic rocks whereas the lighter parts are of igneous-looking appearance.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/migmatite
monzodiorite	Phaneritic crystalline igneous rock consisting of sodic plagioclase (An0 to An50), alkali feldspar, hornblende and biotite, with or without pyroxene, and 0 to 5 percent quartz. Includes rocks defined modally in QAPF field 9.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/monzodiorite
monzogabbro	Monzogabbroic rock that contains	See GeoSciML:

	between 0 an 5 percent quartz and no feldspathoid mineral in the QAPF fraction. Includes rocks defined modally in QAPF field 9 .	http://resource.geosciml.org/classifier/cgi/lithology/monzogabbro
monzogranite	Granite that has a plagiolcase to total feldspar ratio between 0.35 and 0.65. QAPF field 3b.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/monzogranite
monzonite	Monzonitic rock that contains 0-5 percent quartz and no feldspathoid mineral in the QAPF fraction. Includes rocks defined modally in QAPF Field 8.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/monzonite
mud	Clastic sediment consisting of less than 30 percent gravel-size (2 mm) particles and with a mud-size to sand-size particle ratio greater than 1. More than half of the particles are of epiclastic origin.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/mud
mylonite	Metamorphic rock characterised by a foliation resulting from tectonic grain size reduction, in which more than 10 percent of the rock volume has undergone grain size reduction. Includes protomylonite, mylonite, ultramylonite, and blastomylonite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/mylonitic_rock
mélange	A body of rock mappable at a scale of 1:24000 or smaller, characterized by a lack of internal continuity of contacts or strata and by the inclusion of fragments and blocks of all sizes, both exotic and native, embedded in a fragmental matrix of finer-grained material (Raymond, 1984). Criteria of matrix composition and fabric are not employed in the definition, and no genetic significance is implied. Cf: *tectonic mélange*; *allolistostrome*. See also: *dismembered formation*; *chaos [geol]*. The term was introduced by Greenly (1919, p.980). Etymol: French, "mixture."	Glossary of Geology, Fifth Edition (revised), 2011
norite	(a) In the *IUGS classification*, a plutonic rock satisfying the definition of *gabbro*, in which pl/(pl+px+ol) is between 10 and 90 and opx/(opx+cpx) is greater than 95. (b) A coarse-grained plutonic rock containing basic plagioclase (labradorite) as the chief constituent and differing from gabbro by the presence of orthopyroxene as the dominant mafic mineral. The name was first used by Esmark in 1823.	Glossary of Geology, Fifth Edition (revised), 2011
obsidian	A black or dark-colored volcanic glass, usually of rhyolite composition, characterized by conchoidal fracture. It is sometimes banded or has microlites. Usage of the term goes back as far as Pliny, who described the rock from Ethiopia. Obsidian has been used for making arrowheads, other	Glossary of Geology, Fifth Edition (revised), 2011

	sharp implements, jewelry, and art objects. Syn: *Iceland agate*.	
orthogneiss	A gneiss with mineralogy and texture indicating derivation from a phaneritic igneous rock protolith. Typically consists of abundant feldspar, with quartz, and variable hornblende, biotite, and muscovite, with a relatively homogeneous character.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/orthogneiss
packstone	Carbonate sedimentary rock with discernible grain supported depositional texture, containing greater than 10 percent grains, and constituent particles are of intrabasinal origin; intergranular spaces are filled by matrix.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/packstone
paleosol	(a) Soils formed on a landscape or under an environment of the past. (b) A soil with distinct evidence that the direction of soil development was different from that of the present. (c) Lithified buried paleosols. Syn: fossil soil. See also: *buried soil; exhumed soils; multistory soil; polygenetic soils; relict soils.*	Glossary of Geology, Fifth Edition (revised), 2011
paragneiss	A gneiss with mineralogy and texture indicating derivation from a sedimentary rock protolith. Typically consists of abundant quartz, mica, or calcsilicate minerals; aluminosilicate minerals or garnet commonly present. composition of rock tends to be more variable on a decimetric scale that in orthogneiss.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/paragneiss
peat	Unconsolidated organic-rich sediment composed of at least 50 percent semi-carbonised plant remains; individual remains commonly seen with unaided eye; yellowish brown to brownish black; generally fibrous texture; can be plastic or friable. In its natural state it can be readily cut and has a very high moisture content, generally greater than 90 percent. Liptinite to Inertinite ratio is less than one (Economic commission for Europe, committee on Sustainable Energy-United Nations (ECE-UN), 1998, International Classification of in-Seam Coals: Energy 19, 41 pp.)	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/peat
pegmatite	Exceptionally coarse grained crystalline rock with interlocking crystals; most grains are 1cm or more diameter; composition is generally that of granite, but the term may refer to the coarse grained facies of any type of igneous rock;usually found as irregular dikes, lenses, or veins associated with plutons or batholiths.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/pegmatite
pelite	(a) A sediment or sedimentary rock composed of the finest detritus (clay-	Glossary of Geology, Fifth Edition (revised), 2011

	or mud-size particles); e.g. a *mudstone*, or a calcareous sediment composed of clay and minute particles of quartz. The term is equivalent to the Latin-derived term, *lutite*. (b) A fine-grained sedimentary rock composed of more or less hydrated aluminum silicates with which are mingled small particles of various other minerals (Twenhofel, 1937, p.90); an aluminous sediment. (c) A term regarded by Tyrrell (1921, p.501-502) as the metamorphic derivative of lutite, such as the metamorphosed product of a siltstone or mudstone. "As commonly used, a pelite means an aluminous sediment metamorphosed, but if used systematically, it means a fine-grained sediment metamorphosed" (Bayly, 1968, p.230). Etymol: Greek "pelos", "clay mud". See also: *psammite; psephite*. Also spelled: *pelyte*.	
peridotite	(a) In the *IUGS classification*, a plutonic rock with M equal to or greater than 90 and ol/(ol+opx+cpx) greater than 40. (b) A general term for a coarse-grained plutonic rock composed chiefly of olivine with or without other mafic minerals such as pyroxenes, amphiboles, or micas, and containing little or no feldspar. Peridotites encompass the more specific terms saxonite, harzburgite, lherzolite, wehrlite, dunite. Accessory minerals of the spinel group are commonly present. Peridotite is commonly altered to *serpentinite*.	Glossary of Geology, Fifth Edition (revised), 2011
phonolite	Phonolitoid in which the plagioclase to total feldspar ratio is less than 0.1. Rock consists of alkali feldspar, feldspathoid minerals, and mafic minerals.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/phonolilte
phosphorite	Sedimentary rock in which at least 50 percent of the primary or recrystallized constituents are phosphate minerals. Most commonly occurs as a bedded primary or reworked secondary marine rock, composed of microcrystalline carbonate fluorapatite in the form of lamina, pellets, oolites and nodules, and skeletal, shell and bone fragments.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/phosphorite
phyllite	Rock with a well developed, continuous schistosity, an average grain size between 0.1 and 0.5 millimeters, and a silvery sheen on cleavage surfaces. Individual phyllosilicate grains are barely visible with the unaided eye.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/phyllite
phyllonite	Mylonitic rock composed largely of	See GeoSciML:

	fine-grained mica that imparts a sheen to foliation surfaces; may have flaser lamination, isoclinal folding, and deformed veins, which indicate significant shearing. Macroscopically resembles phyllite, but formed by mechanical degradation of initially coarser rock.	http://resource.geosciml.org/classifier/cgi/lithology/phyllonite
plutonic_rock	An igneous rock formed at considerable depth; it is characteristically medium- to coarse-grained and of granitoid texture. Syn: *plutonite*.	Glossary of Geology, Fifth Edition (revised), 2011
polymictic_conglomerate	A coarse-grained clastic sedimentary rock, composed of rounded to subangular fragments larger than 2 mm in diameter (granules, pebbles, cobbles, boulders) typically containing fine-grained particles (sand, silt, clay) in the interstices, and commonly cemented by calcium carbonate, iron oxide, silica, or hardened clay; the consolidated equivalent of *gravel* both in size range and in the essential roundness and sorting of its constituent particles. The rock or mineral fragments may be of varied composition and range widely in size. Conglomerates may be classified according to nature or composition of fragments, proportion of matrix, degree of size sorting, type of cement, and agent or environment of formation. Etymol: Latin "conglomeratus", "heaped, rolled, or pressed together". Cf: *breccia [geol]*. Syn: *puddingstone*.	Glossary of Geology, Fifth Edition (revised), 2011
porphyry	Igneous rock that contains conspicuous phenocrysts in a finer grained groundmass; groundmass itself may be phaneritic or fine-grained.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/porphyry
protomylonite	(a) A mylonitic rock produced from contact-metamorphosed rock, with granulation and flowage caused by overthrusts following the contact surfaces between intrusion and country rock (Holmes, 1920). (b) A coherent crush breccia whose characteristically lenticular, megascopic particles faintly retain primary structures. It is a lower grade in the development of *mylonite* and *ultramylonite* (Waters and Campbell, 1935, p.479).	Glossary of Geology, Fifth Edition (revised), 2011
psammite	(a) A clastic sediment or sedimentary rock composed of sand-size particles; a sandstone. The term is equivalent to the Latin-derived term, *arenite*. (b) A term formerly used in Europe for a fine-grained, fissile, clayey sandstone	Glossary of Geology, Fifth Edition (revised), 2011

	(as distinguished from a more siliceous and gritty one) in which "the component grains are scarcely distinguishable by the unassisted eye" (Oldham, 1879, p.44). (c) A term regarded by Tyrrell (1921, p.501-502) as the metamorphic derivative of arenite. Etymol: Greek "psammos", "sand". See also: *psephite; pelite*. Also spelled: *psammyte.*	
pseudotachylite	A dense rock produced in the compression and shear associated with intense fault movements, involving extreme mylonitization or partial melting. Similar rocks, such as the Sudbury breccias, contain shock-metamorphic effects and may be injection breccias emplaced in fractures formed during meteoritic impact. Cf: *ultramylonite*..	Glossary of Geology, Fifth Edition (revised), 2011
pyribolite	A mnemonic term coined by Johannsen in 1911 in his classification of igneous rocks to indicate the presence of either or both a pyroxene and/or an amphibole. Also spelled: pyrabole; pyrabol; pyrobol. Obsolete. Etymol: *pyr*oxene + amph*ibole.*	Glossary of Geology, Fifth Edition (revised), 2011
pyroclastic_rock	Fragmental igneous rock that consists of greater than 75 percent fragments produced as a direct result of eruption or extrusion of magma from within the earth onto its surface. Includes autobreccia associated with lava flows and excludes deposits reworked by epiclastic processes.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/pyroclastic_rock
pyroxenite	Ultramafic phaneritic igneous rock composed almost entirely of one or more pyroxenes and occasionally biotite, hornblende and olivine. Includes rocks defined modally in the ultramafic rock classification as olivine pyroxenite, olivine-hornblende pyroxenite, pyroxenite, orthopyroxenite, clinopyroxenite and websterite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/pyroxenite
quartz_arenite	A sandstone that is composed primarily of quartz; specif. a sandstone containing more than 95% quartz framework grains (excluding detrital chert grains) and having little clay matrix and any sorting, rounding, texture, or hardness (Folk, 1968). McBride (1963, p.667), who included chert and quartzite in the 95% quartz content, coined the term as a contracted form of "quartz arenite", a term used by Williams et al. (1954, p.294, 316) for a mature sandstone containing more than 80% quartz, chert, and quartzite and less than 10% each of argillaceous matrix, feldspars,	Glossary of Geology, Fifth Edition (revised), 2011

	and unstable fine-grained rock fragments. The term is essentially equivalent to *orthoquartzite*.	
quartz_diorite	Dioritic rock that contains between 5 to 20 percent quartz in the QAPF fraction. QAPF field 10*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_diorite
quartz_latite	Latitic rock that contains between 5 and 20 percent quartz in the QAPF fraction. QAPF field 8*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_latite
quartz_monzodiorite	Monzodioritic rock that contains between 5 and 20 percent quartz.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_monzodiorite
quartz_monzogabbro	Monzogabbroic rock that contains between 5 and 20 percent quartz in the QAPF fraction. QAPF field 9*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_monzogabbro
quartz_monzonite	Monzonitic rock that contains 5-20 percent quartz iin the QAPF fraction. Includes rocks defined modally in QAPF Field 8*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_monzonite
quartz_syenite	Syenitic rock that contains between 5 and 20 percent quartz in the QAPF fraction. Defined modally in QAPF Field 7*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_syenite
quartz_trachyte	Trachytic rock that contains between 5 and 20 percent quartz in the QAPF fraction. QAPF field 7*.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartz_trachyte
quartzite	Metamorphic rock consisting of greater than or equal to 75 percent quartz; typically granoblastic texture.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/quartzite
rhyodacite	A volcanic rock intermediate between rhyolite and dacite. Winchell proposed the name in 1913, apparently not knowing that Brögger had earlier proposed *dellenite* for the same composition. The *IUGS classification* does not include a category between rhyolite and dacite. Obsolete.	Glossary of Geology, Fifth Edition (revised), 2011
rhyolite	rhyolitoid in which the ratio of plagioclase to total feldspar is between 0.1 and 0.65.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/rhyolite
rock	Consolidated aggregate of one or more EarthMaterials, or a body of undifferentiated mineral matter, or of solid organic material. Includes mineral aggregates such as granite, shale, marble; glassy matter such as obsidian; and organic material such a coal. Excludes unconsolidated materials.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/rock
rock_salt	Evaporite composed of at least 50 percent halite.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/rock_salt

sand	Clastic sediment in which less than 30 percent of particles are gravel (greater than 2 mm in diameter) and the sand to mud ratio is at least 1. More than half of the particles are of epiclastic origin.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/sand
sandstone	Originally defined by Lyell (1833, p.79) as "any stone which is composed of an agglutinization of grains of sand." (a) A medium-grained clastic sedimentary rock composed of abundant rounded or angular fragments of sand size with or without a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate); the consolidated equivalent of sand, intermediate in texture between conglomerate and shale. The sand particles are predominantly quartz, and the term "sandstone", when used without qualification, indicates a rock containing about 85-90% quartz (Krynine, 1940). The rock varies in color, may be deposited by water or wind, and may contain numerous primary features (sedimentary structures and fossils). Sandstone may be classified according to composition of particles, mineralogic or textural maturity, primary structures, and type of cement (Klein, 1963). (b) A field term for any clastic rock containing individual particles that are visible to the unaided eye or slightly larger. Syn: *sand [sed]; sandrock*.	Glossary of Geology, Fifth Edition (revised), 2011
schist	Foliated phaneritic metamorphic rock with well developed, continuous schistosity, meaning that greater than 50 percent of the rock by volume is mineral grains with a thin tabular, lamellar, or acicular prismatic crystallographic habit that are oriented in a continuous planar or linear fabric.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/schist
sediment	Unconsolidated material consisting of an aggregation of particles transported or deposited by air, water or ice, or that accumulated by other natural agents, such as chemical precipitation, and that forms in layers on the Earth's surface. Includes epiclastic deposits.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/sediment
sedimentary_rock	Rock formed by accumulation and cementation of solid fragmental material deposited by air, water or ice, or as a result of other natural agents, such as precipitation from solution, the accumulation of organic material, or from biogenic processes, including	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/sedimentary_rock

	secretion by organisms. Includes epiclastic deposits.	
semipelite	Metamorphosed product of a siltstone.	Glossary of Geology, Fifth Edition (revised), 2011
serpentinite	Rock consisting of more than 75 percent serpentine-group minerals, eg. antigorite, chrysotile or lizardite; accessory chlorite, talc and magnetite may be present; derived from hydration of ferromagnesian silicate minerals such as olivine and pyroxene.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/serpentinite
shale	Laminated mudstone that will part or break along thin, closely spaced layers parallel to stratification.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/shale
silt	Mud that consists of greater than 50 percent silt-size grains.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/silt
siltstone	Mudstone that contains detectable silt.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/siltstone
skarn	Metasomatic rock consisting mainly of Ca-, Mg-, Fe-, or Mn-silicate minerals, which are free from or poor in water. Typically formed at the contact between a silicate rock or magma and a carbonate rock.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/skarn
slate	compact, fine grained rock with an average grain size less than 0.032 millimeter and a well developed schistosity (slaty cleavage), and hence can be split into slabs or thin plates.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/slate
spilite	Altered basic to intermediate composition fine-grained igneous rock in which the feldspar is partially or completely composed of of albite, typically accompanied by chlorite, calcite, quartz, epidote, prehnite, and low-tempaerature hydrous crystallization products. Preservation of eruptive volcanic features is typical.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/spilite
syenite	Syenitic rock that contains between 0 and 5 percent quartz and no feldspathoid mineral in the QAPF fraction. Defined modally in QAPF Field 7.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/syenite
syenitic_rock	Syenitoid with a plagioclase to total feldspar ratio between 0.1 and 0.35. Includes rocks in QAPF fields 7, 7*, and 7'.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/syenitic_rock
syenogranite	Granite that has a plagiolcase to total feldspar ratio between 0.10 and 0.35. QAPF field 3a.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/syenogranite
tectonite	(a) Any rock whose fabric reflects the history of its deformation; a rock whose fabric clearly displays coordinated geometric features that	Glossary of Geology, Fifth Edition (revised), 2011

	indicate continuous solid flow during formation (Turner and Weiss, 1963, p.39). (b) A rock whose fabric has been modified substantially by deformation processes. Also spelled: *tektonite.*	
tephrite	Tephritoid that has a plagioclase to total feldspar ratio greater than 0.9, and contains less than 10 percent normative (CIPW) olivine.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/tephrite
tholeiitic_basalt	Tholeiitic basalt is defined here to contain 2 pyroxene phases and interstitial quartz or tridymite or cristobalite in the groundmass. Pyroxene (augite and orthopyroxene or pigeonite) and calcium-rich plagioclase are common phenocryst minerals. Olivine may also be a phenocryst, and when present, may have rims of pigeonite. Only in tholeiitic basalt is olivine in reaction relationship with melt. Interstitial siliceous residue may be present, and is often glassy. Tholeiitic basalt is relatively poor in sodium. This category includes most basalts of the ocean floor, most large oceanic islands, and continental flood basalts such as the Columbia River Plateau.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/tholeiitic_basalt
tonalite	Granitoid consisting of quartz and intermediate plagioclase, usually with biotite and amphibole. Includes rocks defined modally in QAPF field 5; ratio of plagioclase to total feldspar is greater than 0.9.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/tonalite
trachyte	(a) In the *IUGS classification*, a volcanic rock defined in the QAPF diagram by Q/(Q+A+P) between 0 and 5 and P/(P+A) between 10 and 35, and in the TAS diagram by a field partly bounded by points with SiO_2 and total alkali coordinates: 57.6, 11.7; 61, 13.5; 63, 7; and 69, 8. The field is bounded at high silica contents by a vertical line with its lowest end at 69, 8. In addition, normative quartz is <20%. Cf: *trachydacite*. (b) A group of fine-grained, generally porphyritic, extrusive rocks having alkali feldspar and minor mafic minerals (biotite, amphibole, or pyroxene) as the main components, and possibly a small amount of sodic plagioclase; also, any member of that group; the extrusive equivalent of *syenite*. Trachyte grades into *latite* as the alkali feldspar content decreases, and into *rhyolite* with an increase in quartz. Etymol: Greek "trachys", "rough", in reference to the fact that rocks of this group are commonly rough to the touch.	Glossary of Geology, Fifth Edition (revised), 2011

trachytic_volcanic_rock	Trachytoid that has a plagioclase to total feldspar ratio between 0.1 and 0.35, between 0 and 5 percent quartz in the QAPF fraction, and no feldspathoid minerals. QAPF field 7.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/trachyte
travertine	Biotically or abiotically precipitated calcium carbonate, from spring-fed, heated, or ambient-temperature water. May be white and spongy, various shades of orange, tan or gray, and ranges to dense, banded or laminated rock. Macrophytes, bryophytes, algae, cyanobacteria and other organisms often colonize the surface of travertine and may be preserved, to produce the porous varieties.	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/travertine
tuff	Consolidated or cemented volcanic ash and lapilli. Not to be confused with *tufa*. Adj: *tuffaceous*.	Glossary of Geology, Fifth Edition (revised), 2011
tuff_breccia_agglomerate	Pyroclastic rock in which greater than 25 percent of particles are greater than 64 mm in largest dimension. Includes agglomerate, pyroclastic breccia of Gillespie and Styles (1999)	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/tuff_breccia_agglomerate_or_pyroclastic_breccia
ultramafic_ultrabasic_rock	Said of an igneous rock having a silica content lower than that of a basic rock. Percentage limitations are arbitrary and vary with different petrologists, although the upper limit was originally set at 44%. The term is frequently used interchangeably with *ultramafic*. Although most ultrabasic rocks are also ultramafic, there are some exceptions; e.g. monomineralic rocks composed of pyroxenes are ultramafic but are not ultrabasic because of their high SiO_2 content. A monomineralic rock composed of anorthite would be considered ultrabasic (SiO_2 = 43.2 percent) but not ultramafic. "Ultrabasic" is one subdivision of a widely used system for classifying igneous rocks on the basis of silica content; the other subdivisions are *acidic*, *basic*, and *intermediate*. Cf: *silicic*.	Glossary of Geology, Fifth Edition (revised), 2011
ultramafic_volcanic_rock	Said of an igneous rock composed chiefly of mafic minerals, e.g. monomineralic rocks composed of hypersthene, augite, or olivine. Cf: *ultrabasic*.	Adapted from: Glossary of Geology, Fifth Edition (revised), 2011
ultramylonite	An ultra-crushed variety of *mylonite*, in which primary structures and porphyroclasts have been obliterated so that the rock becomes homogeneous and dense, with little if any parallel structure (Quensel, 1916). Cf: *protomylonite*; *pseudotachylyte*. Syn: *flinty crush rock*.	Glossary of Geology, Fifth Edition (revised), 2011
ultrapotassic_rock	An igneous rock in which the wt% of	Glossary of Geology, Fifth

	K_2O and MgO each exceed 3, and the wt% of K_2O is at least twice that of Na_2O (Foley et al., 1987). Cf: *perpotassic rock; potassic rock*.	Edition (revised), 2011
volcanic_rock	(a) A generally finely crystalline or glassy igneous rock resulting from volcanic action at or near the Earth's surface, either ejected explosively or extruded as lava; e.g. basalt. The term includes near-surface intrusions that form a part of the volcanic structure. See also: *volcanics*. Cf: *plutonic rock*. (b) A general term proposed by Read (1944) to include the effusive rocks and associated high-level intrusive rocks; they are dominantly basic. Cf: *neptunic rock; plutonic rock*.	Glossary of Geology, Fifth Edition (revised), 2011
volcaniclastic_rock	**Volcaniclastic** Pertaining to all clastic volcanic materials formed by any process of fragmentation, dispersed by any kind of transporting agent, deposited in any environment, or mixed in any significant portion with nonvolcanic fragments (Fisher, 1961, p.1409).	Glossary of Geology, Fifth Edition (revised), 2011
wacke	Clastic sandstone with more than 10 percent matrix of indeterminate detrital or diagenetic nature. Matrix is mud size silicate minerals (clay, feldspar, quartz, rock fragments, and alteration products).	See GeoSciML: http://resource.geosciml.org/classifier/cgi/lithology/wacke
wackestone	A term for a mud-supported carbonate sedimentary rock containing more than 10% grains (particles with diameters greater than 20 micrometers); e.g. a calcarenite (Dunham, 1962). Cf: *mudstone; packstone*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.21 vocab_LithParticleSize

Categories denoting the size of particles within a lithology.

Term	Definition	Reference
very fine grained	A term for a sand particle having a diameter in the range of 0.062-0.125 mm (62-125 micrometers, or 4 to 3 phi units). Also, a loose aggregate of sand consisting of very fine sand particles. Syn: *flour sand*. (b) A soil term used in the United States for a sand particle having a diameter in the range of 0.05-0.10 mm. (c) Soil material containing 85% or more of sand-size particles (percentage of silt plus 1.5 times the percentage of clay not exceeding 15) and 50% or more of very fine sand (SSSA, 1965, p.347).	Glossary of Geology, Fifth Edition (revised), 2011
very fine to medium grained	–derived	
fine to very grained	–derived	

fine grained	(a) Said of a crystalline or glassy rock, and of its texture, in which the individual minerals are relatively small; specif. said of an igneous rock whose particles have an average diameter less than 1 mm (0.04 in.). Syn: *aphanitic*. (b) Said of a sediment or sedimentary rock, and of its texture, in which the individual constituents are too small to distinguish with the unaided eye; specif. said of a sediment or rock whose particles have an average diameter less than 1/16 mm (62 micrometers, or silt size and smaller). The term is used in a relative sense, and various size limits have been suggested and used. Cf: *coarse-grained; medium-grained*. (c) Said of a soil in which silt and/or clay predominate. In the U.S., the maximum average diameter of the constituent particles is 0.05 mm (0.002 in.), or as used by engineers, 0.074 mm (passing U.S. standard sieve No. 200); the International Society of Soil Science recognizes a diameter limit of 0.02 mm. Cf: *coarse-grained*.	Glossary of Geology, Fifth Edition (revised), 2011
fine to medium grained	derived	
medium grained	(a) Said of an igneous rock, and of its texture, in which the individual crystals have an average diameter in the range of 1-5 mm (0.04-0.2 in.). Johannsen (1931, p.31) earlier used the range of 1-10 mm. (b) Said of a sediment or sedimentary rock, and of its texture, in which the individual particles have an average diameter in the range of 1/16 to 2 mm (62-2,000 μm or sand size). Cf: *medium-crystalline*. The term is used in a relative sense to describe rocks that are neither *coarse-grained* nor *fine-grained*.	Glossary of Geology, Fifth Edition (revised), 2011
medium to coarse grained	derived	
coarse grained	(a) Said of a crystalline rock, and of its texture, in which the individual minerals are relatively large; specif. said of an igneous rock whose particles have an average diameter greater than 5 mm (0.2 in.). Johannsen (1931, p.31) earlier used a minimum diameter of 1 cm, and referred to igneous rocks having walnut-size to coconut-size grains as "very coarse-grained". Syn: *phaneritic*. (b) Said of a sediment or sedimentary rock, and of its texture, in which the individual constituents are easily seen with the unaided eye; specif. said of a sediment or rock whose particles have an average diameter greater than 2 mm (0.08 in., or granule size and larger). The term is used in a relative sense, and various size limits have been suggested and used. Cf: *fine-grained; medium-grained*. (c) Said of a soil in which gravel and/or sand predominates. In the U.S., the minimum average diameter of the constituent particles is 0.05 mm (0.002 in.), or, as used by engineers, 0.074 mm (retained on U.S. standard sieve no.200); the International Society of Soil Science recognizes a diameter limit of 0.02 mm. Cf: *fine-grained*.	Glossary of Geology, Fifth Edition (revised), 2011

granule grade	A term proposed by Wentworth (1922, p.380-381) for a rock fragment larger than a very coarse sand grain and smaller than a pebble, having a diameter in the range of 2-4 mm (1/12 to 1/6 in., or -1 to -2 phi units, or a size between that of the head of a small wooden match and that of a small pea) being somewhat rounded or otherwise modified by abrasion in the course of transport. The term *very fine pebble* has been used as a synonym.	Glossary of Geology, Fifth Edition (revised), 2011
pebble grade	A term used in sedimentology for a particle size greater than that of a sphere with a diameter of 4 mm (1/6 in.) and less than that of a sphere with a diameter of 64 mm (2.5 in.).	Glossary of Geology, Fifth Edition (revised), 2011
cobble grade	A rock fragment larger than a pebble and smaller than a boulder, having a diameter in the range of 64-256 mm (2.5-10 in., or -6 to -8 phi units) being somewhat rounded or otherwise modified by abrasion in the course of transport; in Great Britain, the range of 60-200 mm has been used. Also, a similar rock fragment rounded in place by weathering at or somewhat below the surface of the ground; e.g. a "cobble of exfoliation" or a "cobble of spheroidal weathering". See also: *large cobble; small cobble*.	Glossary of Geology, Fifth Edition (revised), 2011
boulder grade	A detached rock mass larger than a cobble, having a diameter greater than 256 mm (10 in., or -8 phi units, or about the size of a volleyball), being somewhat rounded or otherwise distinctively shaped by abrasion in the course of transport; the largest rock-fragment size recognized by sedimentologists. In Great Britain, the limiting size of 200 mm (8 in.) has been used. Cf: *block [part size]*. See also: *small boulder; medium boulder; large boulder; very large boulder*. (b) *glacial boulder*. (c) *boulder of weathering*. (d) *boulder stone*. (e) A general term for any rock that is too heavy to be lifted readily by hand.	Glossary of Geology, Fifth Edition (revised), 2011
granule to pebble	derived	
granule to cobble	derived	
granule to boulder	derived	
pebble to cobble	derived	
pebble to boulder	derived	
cobble to boulder	derived	

4.1.22 vocab_LithParticleType

Categories denoting the type of particle within a lithology.

Term	Definition	Reference
amygdule	A gas cavity or vesicle in an igneous rock, which is filled with secondary minerals. The term *amygdale* is preferred in British usage. Adj: *amygdaloidal*.	Glossary of Geology, Fifth Edition (revised), 2011
archaeocyathid	Any marine organism belonging to the phylum Archaeocyatha and characterized chiefly by a cone-, goblet-, or vase-shaped skeleton	Glossary of Geology, Fifth Edition (revised), 2011

	composed of calcium carbonate. The archaeocyathids have been variously classified as corals, sponges, protozoans, and calcareous algae. Range, Lower to Middle Cambrian; worldwide in distribution.	
ash	Fine pyroclastic material (under 2.0 mm diameter; under 0.063 mm diameter for fine ash). The term usually refers to the unconsolidated material but is sometimes also used for its consolidated counterpart, *tuff*. Syn: *dust [volc]; pumicite; volcanic ash;* volcanic dust.	Glossary of Geology, Fifth Edition (revised), 2011
augen	In foliate metamorphic rocks such as schists and gneisses, large lenticular mineral grains or mineral aggregates having the shape of an eye in cross section, in contrast to the shapes of other minerals in the rock. Cf: *augen structure*. Etymol: German, "eyes".	Glossary of Geology, Fifth Edition (revised), 2011
bivalve	adj. Having a shell composed of two distinct and usually movable valves, equal or subequal, that open and shut. Cf: *univalve*. Syn: bivalved. n. A bivalve animal, such as a rostroconch, a brachiopod, or an ostracode; specif. a mollusk of the class Bivalvia (Pelecypoda), including the clams, oysters, scallops, and mussels, generally sessile or burrowing into soft sediment, having no distinct head, and possessing a hatchet-shaped foot and a sheetlike or lamelliform gill on each side of a bilaterally symmetrical body. The class was formerly named class Pelecypoda or class Lamellibranchia. Range, Cambrian (limited), Ordovician to Holocene. See also: *pelecypod*.	Glossary of Geology, Fifth Edition (revised), 2011
boulder	(a) A detached rock mass larger than a cobble, having a diameter greater than 256 mm (10 in., or -8 phi units, or about the size of a volleyball), being somewhat rounded or otherwise distinctively shaped by abrasion in the course of transport; the largest rock-fragment size recognized by sedimentologists. In Great Britain, the limiting size of 200 mm (8 in.) has been used. Cf: *block [part size]*. See also: *small boulder; medium boulder; large boulder; very large boulder*. (b) *glacial boulder*. (c) *boulder of weathering*. (d) *boulder stone*. (e) A general term for any rock that is too heavy to be lifted readily by hand. Also spelled: *bowlder.*	Glossary of Geology, Fifth Edition (revised), 2011
brachiopod	Any solitary marine invertebrate belonging to the phylum Brachiopoda, characterized by a lophophore and by two bilaterally symmetrical valves that may be calcareous or composed of chitinophosphate and that are commonly attached to a substratum but may also be free. Range, Lower Cambrian to Holocene. Syn: *brach; lamp shell*.	Glossary of Geology, Fifth Edition (revised), 2011
bryozoa	Any invertebrate characterized chiefly by colonial growth, a calcareous skeleton, or, less commonly, a chitinous membrane, and a U-shaped alimentary canal, with mouth and anus. Range, Ordovician to Holocene, with a possible downward extension into the Upper Cambrian. Syn: *sea mat; moss animal; moss coral; moss polyp; polyzoan.* See also: *ectoproct; entoproct*.	Glossary of Geology, Fifth Edition (revised), 2011

clast	(a) An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical or chemical disintegration of a larger rock mass; e.g. a *phenoclast*. (b) *pyroclast*. (c) *bioclast*.	Glossary of Geology, Fifth Edition (revised), 2011
cobble	(a) A rock fragment larger than a pebble and smaller than a boulder, having a diameter in the range of 64-256 mm (2.5-10 in., or -6 to -8 phi units) being somewhat rounded or otherwise modified by abrasion in the course of transport; in Great Britain, the range of 60-200 mm has been used. Also, a similar rock fragment rounded in place by weathering at or somewhat below the surface of the ground; e.g. a "cobble of exfoliation" or a "cobble of spheroidal weathering". See also: *large cobble*; *small cobble*.	Glossary of Geology, Fifth Edition (revised), 2011
concretion	(a) A hard, compact mass or aggregate of mineral matter, normally subspherical but commonly oblate, disk-shaped, or irregular with odd or fantastic outlines; formed by precipitation from aqueous solution about a nucleus or center, such as a leaf, shell, bone, or fossil, in the pores of a sedimentary or fragmental volcanic rock, and usually of a composition widely different from that of the rock in which it is found and from which it is rather sharply separated. It represents a concentration of some minor constituent of the enclosing rock or of cementing material, such as silica (chert), calcite, dolomite, iron oxide, pyrite, or gypsum, and it ranges in size from a small pellet-like object to a great spheroidal body as much as 3 m in diameter. Most concretions were formed during diagenesis, and many (especially in limestone and shale) shortly after sediment deposition. Cf: *nodule [sed]*; *secretion [sed struc]*. See also: *accretion [sed struc]*; *incretion*; *intercretion*; *excretion*. (b) A collective term applied loosely to various primary and secondary mineral segregations of diverse origin, including irregular nodules, spherulites, crystalline aggregates, geodes, septaria, and related bodies.	Glossary of Geology, Fifth Edition (revised), 2011
coral	(a) A general name for any of a large group of bottom-dwelling, sessile, marine invertebrate organisms (polyps) that belong to the class Anthozoa (phylum Cnidaria (formerly Coelenterata)), are common in warm intertropical modern seas and abundant in the fossil record in all periods later than the Cambrian, produce external skeletons of calcium carbonate, and exist as solitary individuals or grow in colonies. (b) A hard calcareous substance consisting of the continuous skeleton secreted by coral polyps for their support and habitation, and found in single specimens growing plantlike on the sea bottom or in extensive solidified accumulations (coral reefs). Also, any marine deposit like coral resulting from vital activities of various organisms (such as certain algae, or bryozoans and worms). (c) A piece of coral; e.g. "precious coral", a semitranslucent to opaque mass usually red to	Glossary of Geology, Fifth Edition (revised), 2011

	orange red, but sometimes white, cream, brown, blue, or black.	
crinoid	Any pelmatozoan echinoderm belonging to the class Crinoidea, characterized by quinqueradiate symmetry, by a disk-shaped or globular body enclosed by calcareous plates from which appendages, commonly branched, extend radially, and usually by the presence of a stem, or column, more common in fossil than in living forms. Syn: *encrinite [paleont]*. Range, Ordovician to Holocene.	Glossary of Geology, Fifth Edition (revised), 2011
crystal - metamorphic	A homogeneous, solid body of a chemical element, compound, or isomorphous mixture, having a regularly repeating atomic arrangement that may be outwardly expressed by plane faces.	Glossary of Geology, Fifth Edition (revised), 2011
crystal - sedimentary	A homogeneous, solid body of a chemical element, compound, or isomorphous mixture, having a regularly repeating atomic arrangement that may be outwardly expressed by plane faces.	Glossary of Geology, Fifth Edition (revised), 2011
echinoid	Any echinozoan belonging to the class Echinoidea, characterized by a subspherical to modified spherical shape, interlocking calcareous plates, and movable appendages; e.g. a *sea urchin*.	Glossary of Geology, Fifth Edition (revised), 2011
enclave	A body of rock that has become detached or isolated from its source by tectonic forces. Cf: *tectonic inclusion*.	Glossary of Geology, Fifth Edition (revised), 2011
fossiliferous	Containing fossils.	Glossary of Geology, Fifth Edition (revised), 2011
fragment	(a) A rock or mineral *particle* larger than a grain. (b) A piece of rock that has been detached or broken from a preexisting mass; e.g. a clast produced by volcanic, dynamic, or weathering processes.	Glossary of Geology, Fifth Edition (revised), 2011
fusulinid	Any foraminifer belonging to the suborder Fusulinina, family Fusulinidae, characterized by a multichambered elongate calcareous microgranular test, commonly resembling the shape of a grain of wheat. Range, Middle Pennsylvanian to Upper Permian. Syn: *fusuline.* See also: *alveolinid*.	Glossary of Geology, Fifth Edition (revised), 2011
glass	An amorphous product of the rapid cooling of a magma. It may constitute the whole rock (e.g. obsidian) or only part of a groundmass. Cf: *volcanic glass*.	Glossary of Geology, Fifth Edition (revised), 2011
glendonite	A pseudomorph of a carbonate (calcite or esp. siderite) after glauberite.	Glossary of Geology, Fifth Edition (revised), 2011
grain	(a) A mineral or rock *particle*, smaller than a *fragment*, having a diameter of less than a few millimeters and generally lacking well-developed crystal faces; esp. a small, hard, more or less rounded mineral particle, such as a sand grain. Also, a general term for sedimentary particles of all sizes (from clay to boulders), as used in the expressions "grain size", "fine-grained", and "coarse-grained".	Glossary of Geology, Fifth Edition (revised), 2011
granule	A natural soil aggregate or *ped* of relatively low porosity. See also: *soil structure; soil structure shape*.	Glossary of Geology, Fifth Edition (revised), 2011
graptolite	Any colonial marine organism belonging to the	Glossary of Geology, Fifth

	class Graptolithina, variously assigned to the phylum Coelenterata or to the Hemichordata, characterized by a cup- or tube-shaped, highly resistant exoskeleton of organic composition, arranged with other individuals along one or more branches (stipes) to form a colony (*rhabdosome*). Graptolites commonly occur in black shales. Range, Middle Cambrian to Carboniferous. Adj: graptolithine; graptolitic.	Edition (revised), 2011
inclusion	(a) A fragment of older rock within an igneous rock to which it may or may not be genetically related. Syn: *xenolith*. See also: *autolith*. (b) A small foreign body (solid, liquid, or gas) in a gem material, usually seen with magnification. Inclusions often provide important information to help identify gemstones.	Glossary of Geology, Fifth Edition (revised), 2011
intraclast	A broad, general term introduced by Folk (1959, p.4) for a component of a limestone, representing a torn-up and reworked fragment of a penecontemporaneous sediment (usually weakly consolidated) that has been eroded within the basin of deposition (such as the nearby sea floor or an exposed carbonate mud flat) and redeposited there to form a new sediment; an *allochem* derived from the same formation. The fragment may range in size from silt to gravel, and is generally rounded but may be equant to discoidal. Cf: *protointraclast; extraclast*.	Glossary of Geology, Fifth Edition (revised), 2011
lapilli	Pyroclastic materials that may be either essential, accessory, or accidental in origin, of a size range that has been variously defined within the limits of 2 and 64 mm. The fragments may be either solidified or still viscous when they land (though some classifications restrict the term to the former); thus there is no characteristic shape. An individual fragment is called a *lapillus*. Cf: *volcanic gravel; block [volc]; cinder*.	Glossary of Geology, Fifth Edition (revised), 2011
marine bivalve	Having a shell composed of two distinct and usually movable valves, equal or subequal, that open and shut. Cf: *univalve*. Syn: bivalved. n. A bivalve animal, such as a rostroconch, a brachiopod, or an ostracode; specif. a mollusk of the class Bivalvia (Pelecypoda), including the clams, oysters, scallops, and mussels, generally sessile or burrowing into soft sediment, having no distinct head, and possessing a hatchet-shaped foot and a sheetlike or lamelliform gill on each side of a bilaterally symmetrical body. The class was formerly named class Pelecypoda or class Lamellibranchia. Range, Cambrian (limited), Ordovician to Holocene. See also: *pelecypod*.	Glossary of Geology, Fifth Edition (revised), 2011
megacryst	A nongenetic term introduced by Clarke (1958, p.12) for "any crystal or grain" in an igneous or metamorphic rock that is "significantly larger" than the surrounding groundmass or matrix; e.g. a large microcline crystal in porphyritic granite. It may be a phenocryst, a xenocryst, a porphyroblast, or a porphyroclast.	Glossary of Geology, Fifth Edition (revised), 2011
olistolith	A large *exotic block* or other rock mass (usually >10m) transported by submarine gravity sliding	Glossary of Geology, Fifth Edition (revised), 2011

	or slumping and included within the binder of an olistostrome. Term introduced by G. Flores in Beneo (1955, p.122). See also: Abbate et al., (1970) and Reedins (1986) p.402.	
ooid	(a) An individual spherite of an oolitic rock; an *oolith*. The term has been used in preference to "oolith" to avoid confusion with "oolite". (b) A general, nongeneric term for a particle that resembles an oolith in outer appearance and size (Henbest, 1968, p.2). Cf: *pseudo-oolith*. Adj: ooidal.	Glossary of Geology, Fifth Edition (revised), 2011
organic	Pertaining or relating to a compound containing carbon, especially as an essential component. Organic compounds usually have hydrogen bonded to the carbon atom. Cf: *inorganic*. n. A substance containing carbon, as in such expressions as "organic-rich shale".	Glossary of Geology, Fifth Edition (revised), 2011
pebble	(a) A general term for a small, roundish, esp. waterworn stone; specif. a rock fragment larger than a granule and smaller than a cobble, having a diameter in the range of 4-64 mm (1/6 to 2.5 in., or -2 to -6 phi units, or a size between that of a small pea and that of a tennis ball), being somewhat rounded or otherwise modified by abrasion in the course of transport. In Great Britain, the range of 10-50 mm has been used. The term has been used to include fragments of cobble size; it is frequently used in the plural as a syn. of *gravel*. See also: *very coarse pebble*; *coarse pebble*; *medium pebble*; *fine pebble*. Syn: *pebblestone*.	Glossary of Geology, Fifth Edition (revised), 2011
peloid	(a) An *allochem* composed of micrite, irrespective of size or origin, for which exact origin is unknown; e.g., completely micritized fossils or ooids. Other types of peloid include pseudo-ooids and aggregates produced by gas bubbling, by microbial precipitation, or by other intraformational reworking of lithified or semilithified carbonate mud. Some peloids in reefs are the products of microbially induced precipitation around clumps of bacteria. (b) A small, rounded aggregate (0.1-0.3 mm in diameter) of clay minerals and fine quartz found in some shales and clays, separated from a matrix of the same materials by a shell of organic material, and ascribed to the action of water currents (Allen and Nichols, 1945). Also spelled: pelloid. See also: *pellet*.	Glossary of Geology, Fifth Edition (revised), 2011
pendant	*roof pendant*.	Glossary of Geology, Fifth Edition (revised), 2011
phenocryst	A term suggested by J.P. Iddings, and widely used, for a relatively large, conspicuous crystal in a porphyritic rock. The term *inset [petrology]* has been suggested as an alternative.	Glossary of Geology, Fifth Edition (revised), 2011
pisolite	A sedimentary rock, usually a limestone, made up chiefly of pisoids cemented together.	Glossary of Geology, Fifth Edition (revised), 2011
plant fossil	The fossilized remains of a living organism other than an animal, able to subsist wholly on inorganic substances, typically fixed to a substrate and moving chiefly by means of growth, and lacking specialized sensory and digestive	Oxford English Dictionary, Oxford Press, 2015

	organs; *spec.* (more fully green plant) such an organism belonging to a group (the kingdom Plantae) which comprises multicellular forms having cellulose cell walls and capable of photosynthesis by means of chlorophyll, including trees, shrubs, herbs, grasses, and ferns (the vascular or higher plants), and also mosses and liverworts (the bryophytes).	
porphyroblast	A large crystal (relative to average matrix minerals) in a rock produced by metamorphic recrystallization. Adj: *porphyroblastic*. Syn: *metacryst*. Rarely used syn: *pseudophenocryst*.	Glossary of Geology, Fifth Edition (revised), 2011
porphyroclast	A relict, partly crushed protolith grain within a finer-grained (often recrystallized) matrix in a metamorphic rock. See also: *porphyroclastic*.	Glossary of Geology, Fifth Edition (revised), 2011
shelly fossil	(a) Pertaining to the shell of an animal; chitinous, siliceous, or testaceous. (b) Having a shell. Sp: *conchífero*.	Glossary of Geology, Fifth Edition (revised), 2011
sponge megafauna	A many-celled aquatic invertebrate belonging to the phylum *Porifera* and characterized by an internal skeleton composed most frequently of opaline silica and less commonly of calcium carbonate. Range, Precambrian to Holocene. Syn: *poriferan.*	Glossary of Geology, Fifth Edition (revised), 2011
tectonic block	A mass of rock that has been transported with respect to adjacent rock masses through the operation of tectonic processes (Berkland et al., 1972, p.2296).	Glossary of Geology, Fifth Edition (revised), 2011
trilobite	Any marine arthropod belonging to the class Trilobita, characterized by a three-lobed, ovoid to subelliptical exoskeleton divisible longitudinally into axial and side regions and transversely into cephalon (anterior), thorax (middle), and pygidium (posterior). Range, Lower Cambrian to Permian.	Glossary of Geology, Fifth Edition (revised), 2011
vesicle	A cavity of variable shape in a lava, formed by the entrapment of a gas bubble during solidification of the lava.	Glossary of Geology, Fifth Edition (revised), 2011
volcanic bomb/block	*bomb [pyroclast]*.	Glossary of Geology, Fifth Edition (revised), 2011
vug	A small cavity in a vein or in rock, usually lined with crystals of a different mineral composition from the enclosing rock. Etymol: Cornish "vooga", "underground chamber, cavern, cavity". Adj: *vuggy*. Cf: *druse*; *geode*. Syn: *bug hole*.	Glossary of Geology, Fifth Edition (revised), 2011
wood	In *woody plants*, the tissue produced to the inside of a *vascular cambium*, i.e., the secondary xylem. Also syn. of *woody plant*.	Glossary of Geology, Fifth Edition (revised), 2011
xenocryst	A crystal that resembles a phenocryst in igneous rock but is foreign to the body of rock in which it occurs. Cf: *disomatic*.	Glossary of Geology, Fifth Edition (revised), 2011
xenolith	A fragment of country rock within a plutonic or volcanic rock. Cf: *autolith*. Syn: *inclusion*; *accidental inclusion*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.23 vocab_LithPrimaryStruct

Categories denoting the type of primary structure within a lithology.

Term	Definition	Reference
aa flow	A Hawaiian term for lava flows typified by a rough, jagged, spinose, clinkery surface. Cf: *pahoehoe; block lava*. Etymol: Hawaiian. An expletive of pain when walking barefoot on such lava. Obs. syn: *aphrolith*.	Glossary of Geology, Fifth Edition (revised), 2011
algal mat	A layer of eubacteria, cyanobacteria, and fungi growing over the surface of the sediment. The microbially induced precipitation of $CaCO_3$ plus the trapping and binding of sediment by these mats gives rise to microbial laminites and stromatolites.	Glossary of Geology, Fifth Edition (revised), 2011
algal mound	A local thickening of limestone attributed chiefly to the presence of a distinctive suite of rock types (such as massive calcilutite) containing algae.	Glossary of Geology, Fifth Edition (revised), 2011
bioherm	A moundlike, domelike, lenslike, or reeflike mass of rock built up by sedentary organisms (such as corals, algae, foraminifers, mollusks, gastropods, and stromatoporoids), composed almost exclusively of their calcareous remains, and enclosed or surrounded by rock of different lithology; e.g. an *organic reef* or a nonreef limestone mound. Term proposed by Cumings and Shrock (1928, p.599), and defined by Cumings (1930, p.207), as a structural term, although as applied it often stresses calcareous composition. Cf: *biostrome*. Syn: *organic mound*.	Glossary of Geology, Fifth Edition (revised), 2011
biothermal algal mound	A local thickening of limestone attributed chiefly to the presence of a distinctive suite of rock types (such as massive calcilutite) containing algae.	Glossary of Geology, Fifth Edition (revised), 2011
bioturbation	The reworking of a sediment by organisms.	Glossary of Geology, Fifth Edition (revised), 2011
burrow	A tubular or cylindrical hole or opening, made in originally soft or loose sediment, by a mud-eating worm, a mollusk, or other invertebrate, extending along a bedding plane or penetrating a rock, and often later filled with clay or sand and preserved as a filling; it may be straight or sinuous, and vertical, horizontal, or inclined. Cf: *boring*.	Glossary of Geology, Fifth Edition (revised), 2011
channel	(a) A linear current mark, larger than a groove, produced on a sedimentary surface, parallel to the current, and often preserved as a *channel cast*. It is 0.5-2 m wide, 20-50 cm deep, and up to 30 m long and is best developed in a *turbidite* sequence. (b) An erosional feature "that may be meandering and branching and is part of an integrated transport system" (Pettijohn and Potter, 1964, p.288).	Glossary of Geology, Fifth Edition (revised), 2011
clastic dyke	A *sedimentary dike* consisting of a variety of clastic materials derived from underlying or overlying beds; esp. a *sandstone dike* or a *pebble dike*. Sp	Glossary of Geology, Fifth Edition (revised), 2011
columnar joint	Parallel, prismatic columns, polygonal in cross section, in basaltic flows and sometimes in other extrusive and intrusive rocks. They form as the result of contraction during cooling. Syn: *columnar structure; prismatic joints; prismatic structure; cooling crack*.	Glossary of Geology, Fifth Edition (revised), 2011

cryptalgal	Said of rocks or rock structures formed "through the sediment - binding and / or carbonate -precipitating activities of nonskeletal algae" (Aitken, 1967, p.1163). The influence of these organisms is more commonly inferred than observed, hence the etymol: Greek "kryptos", "hidden, secret", + *algal*.	Glossary of Geology, Fifth Edition (revised), 2011
cryptalgal lamination	Said of carbonate rocks "displaying a distinctive form of discontinuous, more or less planar lamination believed to have resulted from the activities upon and within the sediments of successive mats or films of blue-green and green algae" (Aitken, 1967, p.1164). See also: *cryptalgal; stromatolite*.	Glossary of Geology, Fifth Edition (revised), 2011
crystal cast	The filling of a crystal mold; e.g. *ice-crystal cast, salt-crystal cast*.	Glossary of Geology, Fifth Edition (revised), 2011
current crescent	(a) A small, semicircular or U-shaped rounded ridge, convex upcurrent, commonly with a pit in the center, and developed on a muddy surface by current action (Peabody, 1947, p.73). (b) A flute cast of a horseshoe-shaped moat eroded on the upcurrent side of a pebble, shell, or other obstacle. Syn: *horseshoe flute cast; crescent cast; crescent scour; crescentic mark [sed]*.	Glossary of Geology, Fifth Edition (revised), 2011
flow	The smallest formal lithostratigraphic unit of volcanic flow rocks. A flow is a discrete, extrusive, volcanic body distinguishable by texture, composition, order of superposition, paleomagnetism, or other objective criteria. It is part of a *member* and thus is equivalent in rank to a bed or beds of sedimentary-rock classification. Many flows are informal units. Designation of flows as formal units should be limited to those that are distinctive and widespread (NACSN, 1983, Art. 27).	Glossary of Geology, Fifth Edition (revised), 2011
flute cast	A term suggested by Crowell (1955, p.1359) for a spatulate or lingulate *sole mark* consisting of a raised, oblong, and subconical bulge on the underside of a siltstone or sandstone bed, characterized by a steep or blunt bulbous or beaked upcurrent end from which the structure flattens or flares out in the downcurrent direction and merges with the bedding plane. It is formed by the filling of a flute. See also: *lobate rill mark*. Syn: *fluting [sed]; flute [sed]; flow cast; flow mark; scour cast; vortex cast; linguoid sole mark; lobate plunge structure.*	Glossary of Geology, Fifth Edition (revised), 2011
groove cast	A term used by Shrock (1948, p.162-163) for a rounded or sharp-crested rectilinear ridge, a few millimeters high and many centimeters in length and width, produced on the underside of a sandstone bed by the filling of a groove on the surface of an underlying mudstone. This structure was called a *drag mark* by Kuenen (1957, p.244) who considered "groove cast" as a general term including drag marks and slide marks. Cf: *striation cast*.	Glossary of Geology, Fifth Edition (revised), 2011
lava shelf	step marks on the walls of lava tubes that mark the various depths at which the lava flowed	http://en.wikipedia.org/wiki/Lava_tube

load cast	A *sole mark*, usually measuring less than a meter in any direction, consisting of a swelling in the shape of a slight bulge, a deep or shallow rounded sack, a highly irregular protuberance, or a bulbous, mammillary, or papilliform protrusion of sand or other coarse clastics, extending downward into finer-grained, softer, and originally hydroplastic underlying material, such as wet clay, mud, or peat, that contained an initial depression. It is produced by the exaggeration of the depression as a result of unequal settling and compaction of the overlying material and by the partial sinking of such material into the depression, as during the onset of deposition of a turbidite on unconsolidated mud. A load cast is more irregular than a flute cast (it is usually not systematically elongated in the current direction), and is characterized by an absence of a distinction between the upcurrent and downcurrent ends. The term was proposed by Kuenen (1953, p.1058) to replace *flow cast* used by Shrock (1948, p.156), although Kuenen excluded the phenomenon of warping of underlying laminae and applied the term to a feature resulting from vertical adjustment only. See also: *load-flow structure*. Syn: *load casting*.	Glossary of Geology, Fifth Edition (revised), 2011
molar tooth	synsedimentary, combined deformation and early diagenetic feature occurring in calcareous strata of mainly Precambrian age. It consists of arrays of closely spaced, sharply defined, upright veins, and subordinate horizontal sheets and spheroids composed of calcite microspar. Veins are vertically to obliquely oriented, discontinuous, typically strongly squashed or crumpled, and often brecciated.	Encyclopedia of Geobiology, 2011, Springer Netherlands
mud crack	(a) An irregular fracture in a crudely polygonal pattern, formed by the shrinkage of clay, silt, or mud, generally in the course of drying under the influence of atmospheric surface conditions. Also referred to as a *sun crack*, a *shrinkage crack*, and a *desiccation crack*. (b) *mud-crack cast*. Also spelled: mudcrack.	Glossary of Geology, Fifth Edition (revised), 2011
nodular	(a) Composed of nodules; e.g. "nodular bedding" consisting of scattered to loosely packed nodules in matrix of like or unlike character. (b) Having the shape of a nodule, or occurring in the form of nodules; e.g. "nodular ore" such as a colloform mineral aggregate with a bulbed surface. Syn: *nodulated*. (c) *orbicular*.	Glossary of Geology, Fifth Edition (revised), 2011
pahoehoe flow	A Hawaiian term for a type of basaltic lava flow typified by a smooth, billowy, or ropy surface. Varieties include corded, elephant-hide, entrail, festooned, filamented, sharkskin, shelly, and slab pahoehoe. Cf: *aa*. Obsolete syn. *dermolith*. Syn: *ropy lava*.	Glossary of Geology, Fifth Edition (revised), 2011
pillowed flow	A general term for those lavas displaying pillow structure and considered to have formed in a subaqueous environment; such lava is usually basaltic or andesitic. Syn: *ellipsoidal lava*.	Glossary of Geology, Fifth Edition (revised), 2011
rain print	A small, shallow craterlike pit surrounded by a slightly raised rim, formed in soft fine sand, silt, or	Glossary of Geology, Fifth Edition (revised), 2011

	clay, or in the mud of a tidal flat, by the impact of a falling raindrop, and sometimes preserved on the bedding planes of sedimentary rocks or as casts on the underside of overlying sandstone beds. See also: *hail imprint; spray print*. Syn: *raindrop imprint; raindrop impression.*	
reef	(a) A ridgelike or moundlike structure, layered or massive, built by sedentary calcareous organisms, esp. corals, and consisting mostly of their remains; it is wave-resistant and stands above the surrounding contemporaneously deposited sediment. Also, such a structure built in the geologic past and now enclosed in rock, commonly of differing lithology. See also: *bank [oceanog]; bioherm; biostrome*. Syn: *organic reef*. (b) A mass or ridge of rocks, esp. coral or shells and sometimes sand, gravel, boulder conglomerate, hogback ridges, dikes, or sills, rising above the surrounding sea or lake bottom to or nearly to the surface, and forming an obstruction to navigation; specif. such a feature at 10 fathoms (formerly 6) or less. See also: *shoal*. (c) A provincial term for a metalliferous mineral deposit, esp. gold-bearing quartz (e.g. *saddle reef*).	Glossary of Geology, Fifth Edition (revised), 2011
reefoid	Resembling a reef; e.g. "reefoid rocks".	Glossary of Geology, Fifth Edition (revised), 2011
ripple mark	A *ripple*. The addition of the word "mark" was common in the past and remains a relatively common practice among geologists-particularly, but not exclusively, nonspecialists in the area of sedimentology. The use of the word "mark" provides no additional information about the bed form itself and is therefore not recommended.	Glossary of Geology, Fifth Edition (revised), 2011
scour mark	A *current mark* produced by the cutting or scouring action of a current of water flowing over the bottom; e.g. a flute. See also: *transverse scour mark*.	Glossary of Geology, Fifth Edition (revised), 2011
slump structure	A generic term for any sedimentary structure produced by subaqueous slumping.	Glossary of Geology, Fifth Edition (revised), 2011
stromatolite	An organosedimentary structure produced by sediment trapping, binding, and/or precipitation as a result of the growth and metabolic activity of micro-organisms, principally cyanophytes (blue-green algae) (Walter, 1976, p.1). It has a variety of gross forms, from nearly horizontal to markedly columnar, domal, or subspherical. The term was introduced by Kalkowsky in 1908 as stromatolith. Cf: *oncolite*.	Glossary of Geology, Fifth Edition (revised), 2011
tepee	A conical hill or knoll resembling an American Indian tepee; esp. an isolated, residual hill formed by a capping of resistant rock that protects the underlying softer material from erosion, e.g. one of the partly exhumed bioherms in the Pierre Shale of Colorado, or one of the sandstone-capped hills in the Painted Desert, Ariz. Cf: *tent hill; klint [reef]*. Also spelled: *teepee butte.*	Glossary of Geology, Fifth Edition (revised), 2011
tool mark	A *current mark* produced by the impact against a muddy bottom of a solid object swept along by the current, and generally preserved as a cast on	Glossary of Geology, Fifth Edition (revised), 2011

	the underside of the overlying bed. The mark may be produced by an object in continuous contact with the bottom (e.g. a *groove* or a *striation*), in intermittent contact with the bottom (e.g. a *skip mark* or a *prod mark*), or rolling along the bottom (e.g. a *roll mark*). The engraving "tools" include shell fragments, sand grains, pebbles, fish bones, seaweed, and wood chips. Originally defined by Dzulynski and Sanders (1962, p.72).	
trace fossil	A sedimentary structure consisting of a fossilized track, trail, burrow, tube, boring, or tunnel resulting from the life activities (other than growth) of an animal, such as a mark made by an invertebrate moving, creeping, feeding, hiding, browsing, running, or resting on or in soft sediment. It is often preserved as a raised or depressed form in sedimentary rock. Many trace fossils were formerly assumed to be bodily preserved plants or animals. Syn: *ichnofossil; trace [paleont]; vestigiofossil; lebensspur; bioglyph*.	Glossary of Geology, Fifth Edition (revised), 2011
varve	(a) A sedimentary bed or lamina or sequence of laminae deposited in a body of still water within one year's time; specif. a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier. A glacial varve normally includes a lower "summer" layer consisting of relatively coarse-grained, light-colored sediment (usually sand or silt) produced by rapid melting of ice in the warmer months, which grades upward into a thinner "winter" layer, consisting of very fine-grained (clayey), often organic, dark sediment slowly deposited from suspension in quiet water while the streams were ice-bound. Counting and correlation of varves have been used to measure the ages of Pleistocene glacial deposits. (b) Any cyclic sedimentary *couplet*, as in certain shales and evaporites. Cf: *rhythmite*. Etymol: Swedish "varv", "layer" or "periodical iteration of layers" (De Geer, 1912, p.242).	Glossary of Geology, Fifth Edition (revised), 2011

4.1.24 vocab_LithRole

Not used.

4.1.25 vocab_MeasureConvtn

Categories denoting the convention used to take a planar measurement.

Term	Definition	Reference
dip-direction	The maximum angle that a structural surface, e.g. bedding or a fault plane, makes with the horizontal; measured perpendicular to the strike of the structure and in the vertical plane. Syn: *true dip; angle of dip*. Cf: *regional dip; primary dip*. v. To be tilted or inclined at an angle.	Adapted from Glossary of Geology, Fifth Edition (revised), 2011
strike dip RHR	The direction trend taken by a structural surface, e.g. a bedding or fault plane, as it intersects the horizontal. See also: *attitude [struc geol]*. Cf:	Adapted from Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	trend [struc geol]; *trace [struc geol]*. Syn: *line of strike.* v. To be aligned or to trend in a direction at right angles to the *line of dip*.	

4.1.26 vocab_MetamorphicFacies

Categories denoting the type of metamorphic facies.

Term	Definition	Reference
not metamorphosed		
amphibolite	The facies (set of metamorphic mineral assemblages) in which mafic rocks are represented by hornblende + plagioclase, the plagioclase being oligoclase-andesine or some more calcic variety (Eskola, 1939). Epidote and almandine are common in amphibolites. Pelitic assemblages contain micas associated with almandine, staurolite, kyanite, or sillimanite, but not andalusite or cordierite (Turner, 1968). The facies is typical of regional dynamothermal metamorphism under moderate to high pressures (in excess of 300 MPa) with temperatures in the range 450°-700°C. Cf: *hornblende-hornfels facies*.	Glossary of Geology, Fifth Edition (revised), 2011
blueschist	The facies (set of metamorphic mineral assemblages) in which mafic rocks are represented by combinations of sodic amphibole (e.g., glaucophane, crossite), lawsonite, sodic pyroxene, aragonite, epidote, and garnet. The mineral pair jadeite + quartz is also diagnostic. Exact definitions of the facies and its subdivisions vary (Turner, 1968). It represents lower temperatures and higher pressures than the *greenschist facies*. It is characteristic of metamorphism in subduction zones, with their unusually low geothermal gradients. Syn: *glaucophane-schist facies.*	Glossary of Geology, Fifth Edition (revised), 2011
eclogite	The set of metamorphic mineral assemblages (facies) in which basic rocks are represented by omphacitic pyroxene and almandine-pyrope garnet. Also common, although not essential, is the association pyrope+olivine+diopside+enstatite. Phase-equilibrium work has shown that these high-density mineral associations indicate high pressure of crystallization, although the range of geologic environments in which the facies has been encountered, and the variation in mineral composition (Coleman et al., 1965), point to a broad range of possible pressure-temperature conditions. Many workers have suggested that low H_2O pressures are required, and that pressures and temperatures overlap those of several other metamorphic facies.	Glossary of Geology, Fifth Edition (revised), 2011
granulite	The facies (set of metamorphic mineral assemblages) in which mafic rocks are represented by diopside+hypersthene+plagioclase, with amphibole generally minor in amount. Almandine	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	is characteristic of mafic and pelitic rocks. Pelitic assemblages show the association of sillimanite or kyanite with perthitic feldspar and almandine, often also with cordierite; muscovite is absent and biotite small in amount. The facies is typical of deep-seated regional dynamothermal metamorphism, at temperatures in excess of 650°C. Cf: *pyroxene-hornfels facies*.	
greenschist	The facies (set of metamorphic mineral assemblages) in which mafic rocks are represented by albite+epidote+chlorite+actinolite (Eskola, 1939). Chlorite, white mica, biotite, and chloritoid are typical minerals in pelitic rocks. It is believed to correspond to temperatures in the range 300°-500°C.	Glossary of Geology, Fifth Edition (revised), 2011
hornfels	A loosely defined term used to denote the physical conditions involved, or the set of mineral assemblages produced, by thermal (contact) metamorphism at relatively shallow depths in the Earth's crust. It encompasses the *albite-epidote-hornfels facies*, the *hornblende-hornfels facies*, the *pyroxene-hornfels facies*, and the *sanidinite facies*.	Glossary of Geology, Fifth Edition (revised), 2011
zeolite	The facies (set of metamorphic mineral assemblages) that includes the zeolites analcime, heulandite, stilbite, laumontite, and wairakite (Coombs, 1960). Developed best in metagraywackes and metabasalts, it is the lowest grade of metamorphism, transitional between diagenesis (or unmetamorphosed rock) and the prehnite-pumpellyite facies or the *greenschist facies*. Various zeolite assemblages can be correlated with depth of burial (Miyashiro and Shido, 1970).	Glossary of Geology, Fifth Edition (revised), 2011

4.1.27 vocab_MetamorphicPressure

Categories denoting the type of metamorphic pressure.

Term	Definition	Reference
not consolidated	A sediment that is loosely arranged or unstratified, or whose particles are not cemented together, occurring either at the surface or at depth	Glossary of Geology, Fifth Edition (revised), 2011
very low pressure	Lowest part of the broad range of pressure conditions encountered during crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
low pressure	Second lowest part of the broad range of pressure conditions encountered during crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
medium pressure	Middle part of the broad range of pressure conditions encountered during crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
high pressure	Second highest part of the broad range of pressure conditions encountered during crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
very high pressure	Highest part of the broad range of pressure	http://www.bgs.ac.uk/scmr

Term	Definition	Reference
	conditions encountered during crustal metamorphism	/docs/papers/paper_2.pdf

4.1.28 vocab_MetamorphicTemp

Categories denoting the range of metamorphic temperature.

Term	Definition	Reference
medium temperature	Middle part of the whole spectrum of temperature conditions encountered in crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
high temperature	Second highest part of the whole spectrum of temperature conditions encountered in crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
very high temperature	Highest part of the whole spectrum of temperature conditions encountered in crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
very low temperature	Lowest part of the whole spectrum of temperature conditions encountered in crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf
low temperature	Second lowest part of the whole spectrum of temperature conditions encountered in crustal metamorphism	http://www.bgs.ac.uk/scmr/docs/papers/paper_2.pdf

4.1.29 vocab_MinName

Categories denoting types of minerals.

Term	Definition	Reference
acmite	A brown or green monoclinic mineral of the clinopyroxene group: $NaFe^{3+}[Si_2O_6]$. It occurs in certain alkali-rich igneous rocks. Syn: *aegirine*.	Glossary of Geology, Fifth Edition (revised), 2011
actinolite	A bright-green or grayish-green monoclinic mineral of the *amphibole* group: $Ca_2(Mg,Fe)_5(OH)_2[Si_8O_{22}]$. It may contain manganese. It sometimes occurs in the form of *asbestos*, and also in fibrous, radiated, or columnar forms in metamorphic rocks (such as schists) and in altered igneous rocks. Cf: *tremolite*. Syn: *kidney stone [mineral]*.	Glossary of Geology, Fifth Edition (revised), 2011
adularia	A moderate to low-temperature mineral of the alkali feldspar group: $K[AlSi_3O_8]$. It is weakly triclinic (formerly regarded as apparently monoclinic) and typically occurs in well-developed, usually transparent, and colorless to milky-white (and often opalescent) pseudo-orthorhombic crystals in fissures in crystalline schists, esp. in the region of the Swiss Alps. Adularia displays pearly internal reflections and a fascinating variety of optical behavior between crossed nicols. It typically has a relatively high content of barium.	Glossary of Geology, Fifth Edition (revised), 2011
aegirine-augite	A mineral intermediate between augite and aegirine. Syn: *acmite-augite*.	Glossary of Geology, Fifth Edition (revised), 2011

aenigmatite	A vitreous black triclinic mineral: $Na_2Fe^{2+}{}_5TiSi_6O_{20}$. Also spelled: *enigmatite.*	Glossary of Geology, Fifth Edition (revised), 2011
akermanite	A tetragonal greenish-brown mineral of the *melilite* group: $Ca_2MgSi_2O_7$. It is isomorphous with gehlenite.	Glossary of Geology, Fifth Edition (revised), 2011
albite	(a) A colorless or milky-white triclinic mineral of the feldspar group: $Na_{1.0-0.9}Ca_{0.0-0.1}Al_{1.0-1.1}Si_{3.0-2.9}O_8$. It is a variety of plagioclase with composition ranging from $Ab_{100}An_0$ to $Ab_{90}An_{10}$; it is also an alkali feldspar, representing the triclinic modification of sodium feldspar. Albite occurs in all groups of rocks, forming a common constituent of granite and of various acid-to-intermediate igneous rocks; it is widely distributed in low-temperature metamorphic rocks (greenschist facies), and is regularly deposited from hydrothermal solutions in cavities and veins. Albite crystals frequently exhibit polysynthetic twinning, predominantly after the *albite twin law*. Cf: *analbite*. Syn: *sodium feldspar; sodaclase; white feldspar; white schorl.* (b) The pure sodium-feldspar end member in the *plagioclase* series.	Glossary of Geology, Fifth Edition (revised), 2011
alkali-feldspar	(a) A group of feldspars composed of mixtures, or mixed crystals, of potassium feldspar ($KAlSi_3O_8$) and sodium feldspar ($NaAlSi_3O_8$) in any ratio; a group of feldspars containing alkali metals but little calcium. (b) A mineral of the alkali feldspar group, such as microcline, orthoclase, sanidine, adularia, albite, anorthoclase, and plagioclase in which the proportion of the An molecule is less than 20%. Cf: *plagioclase*. Syn: alkalic feldspar.	Glossary of Geology, Fifth Edition (revised), 2011
allanite	A sub-metallic pitchy brownish-black monoclinic mineral of the *epidote* group: $CeCa(Al,Fe)_3O(O,OH)(SiO_4)[Si_2O_7]$. It is typically an accessory mineral in igneous rocks (granite, syenite, diorite, pegmatite) and in their metamorphic equivalents. Syn: *orthite; cerine; bucklandite; treanorite.*	Glossary of Geology, Fifth Edition (revised), 2011
almandine	(a) The iron-aluminum end member of the *garnet* group, characterized by a deep-red to purplish color: $Fe_3^{2+}Al_2(SiO_4)_3$. It occurs in mica schists and other regionally metamorphosed rocks, and is used as a gemstone. Syn: *almandite; alamandine; almond stone.* (b) A violet or mauve variety of ruby spinel; a reddish-purple to purplish-red spinel. (c) A reddish-purple sapphire.	Glossary of Geology, Fifth Edition (revised), 2011
aluminosilicate	A silicate in which aluminum substitutes for some of the silicon in the SiO_4	Glossary of Geology, Fifth Edition (revised), 2011

	tetrahedra.	
amethyst	(a) A transparent to translucent, purple to pale violet variety of crystalline quartz, much used as a semiprecious gemstone. The color is due to iron compounds. Syn: *bishop's stone.* (b) A term applied to a deep-purple variety of corundum and to a pale reddish-violet beryl.	Glossary of Geology, Fifth Edition (revised), 2011
amphibole	(a) A group of dark rock-forming ferromagnesian silicate minerals, closely related in crystal form and composition and having the general formula: $A_{2\text{-}3}B_5(Si,Al)_8O_{22}(OH)_2$, where *A* = Mg, Fe^{2+}, Ca, or Na, and *B* = Mg, Fe^{2+}, Fe^{3+}, Li, Mn, or Al. It is characterized by a cross-linked double chain of tetrahedra with a silicon:oxygen ratio of 4:11, by columnar or fibrous prismatic crystals, and by good prismatic cleavage in two directions parallel to the crystal faces and intersecting at angles of about 56° and 124°; colors range from white to black. Most amphiboles crystallize in the monoclinic system, some in the orthorhombic. They constitute an abundant and widely distributed constituent in igneous and metamorphic rocks (some are wholly metamorphic), and they are analogous in chemical composition to the *pyroxenes*. (b) A mineral of the amphibole group, such as hornblende, anthophyllite, cummingtonite, tremolite, actinolite, riebeckite, glaucophane, arfvedsonite, etc. (c) A term sometimes used as a syn. of *hornblende*. Etymol: Greek "amphibolos", "ambiguous, doubtful", in reference to its many varieties.	Glossary of Geology, Fifth Edition (revised), 2011
analcite	*analcime*.	Glossary of Geology, Fifth Edition (revised), 2011
anatase	An adamantine brown, dark-blue, or black tetragonal mineral: TiO_2. It is trimorphous with rutile (which has different facial angles) and brookite, and occurs as an alteration product of other titanium minerals. Syn: *octahedrite*.	Glossary of Geology, Fifth Edition (revised), 2011
andalusite	A brown, yellow, green, red, or gray orthorhombic mineral: Al_2SiO_5. It is trimorphous with kyanite and sillimanite. Andalusite occurs in thick, nearly square prisms in schists, gneisses, and hornfelses; it forms at medium temperatures and pressures of a regionally metamorphosed sequence and is characteristic of contact-metamorphosed argillaceous rocks. In transparent gem quality, andalusite has a very strong pleochroism: brownish green in one direction and brownish red at 90°. See	Glossary of Geology, Fifth Edition (revised), 2011

	also: *chiastolite*.	
andesine	A mineral of the plagioclase *feldspar* group with composition ranging from $Ab_{70}An_{30}$ to $Ab_{50}An_{50}$. It occurs as a primary constituent of intermediate igneous rocks, such as andesites and diorites.	Glossary of Geology, Fifth Edition (revised), 2011
andradite	The calcium-iron end member of the *garnet* group: $Ca_3Fe_2^{3+}(SiO_4)_3$. It has a variety of colors, ranging from yellow, red, and green to brown and black; it often occurs in contact-metamorphosed limestones. Varieties include topazolite, demantoid, melanite, aplome, and bredbergite.	Glossary of Geology, Fifth Edition (revised), 2011
anhydrite	A mineral consisting of anhydrous calcium sulfate: $CaSO_4$. It represents *gypsum* without its water of crystallization, and it alters readily to gypsum, from which it differs in crystal form (anhydrite is orthorhombic) and in being harder and slightly less soluble. Anhydrite usually occurs in white or slightly colored, granular to compact masses, forming large beds or seams in sedimentary rocks or associated with gypsum and halite in evaporites. Syn: *cube spar.*	Glossary of Geology, Fifth Edition (revised), 2011
ankerite	A white, red, or grayish iron-rich rhombohedral mineral: $Ca(Fe^{2+},Mg,Mn^{2+})(CO_3)_2$. It is associated with iron ores and commonly forms thin veins of secondary matter in some coal seams. Syn: *ferroan dolomite; cleat spar*. A member of the *dolomite* group.	Glossary of Geology, Fifth Edition (revised), 2011
annite	A vitreous black monoclinic trioctahedral mica of ideal composition $KFe_3^{2+}(OH,F)_2[AlSi_3O_{10}]$. Cf: *ferri-annite.*	Glossary of Geology, Fifth Edition (revised), 2011
anorthite	(a) A white or grayish triclinic mineral of the plagioclase *feldspar* group: $Na_{0.1\text{-}0.0}Ca_{0.9\text{-}1.0}Al_{1.9\text{-}2.0}Si_{2.1\text{-}2.0}O_8$. It is the most basic member of the plagioclases, its composition ranging from $Ab_{10}An_{90}$ to Ab_0An_{100}. Anorthite occurs in basic and ultrabasic igneous rocks (gabbro, norite, anorthosite), rarely as a well-developed druse mineral, sometimes in tuffs, and very rarely in metamorphic rocks (skarns). Syn: *calcium feldspar; calciclase.* (b) The pure calcium-feldspar end-member in the *plagioclase* series.	Glossary of Geology, Fifth Edition (revised), 2011
anthophyllite	A clove-brown to colorless orthorhombic mineral of the *amphibole* group: $(Mg,Fe^{2+})_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$. It is dimorphous with cummingtonite; with increase in aluminum it grades into gedrite. Anthophyllite occurs in metamorphosed ultrabasic rocks, typically with olivine or talc or in monomineralic aggregates of parallel or radiating asbestiform fibers. It has been	Glossary of Geology, Fifth Edition (revised), 2011

	mined for asbestos. Syn: *bidalotite*.	
antigorite	A macroscopically lamellar brown to green monoclinic serpentine mineral, which consists structurally of alternating wave forms in which the 1:1 T-O layer reverses sides and direction of curvature at each wave null point. In most specimens the repeat distance of the wave pattern measures between 25.5 and 51.0 Å: $(Mg,Fe^{2+})_3Si_2O_5(OH)_4$.	Glossary of Geology, Fifth Edition (revised), 2011
apatite	(a) A group of variously colored hexagonal minerals consisting of calcium phosphate together with fluorine, chlorine, hydroxyl, or carbonate in varying amounts and having the general formula: $Ca_5(F,OH,Cl)(PO_4,CO_3)_3$. Also, any mineral of the *apatite* group, such as fluorapatite, chlorapatite, hydroxylapatite, carbonate-apatite, and francolite; when not specified, the term usually refers to *fluorapatite*. The apatite minerals occur as accessory minerals in almost all igneous rocks, in metamorphic rocks, and in veins and other ore deposits; and most commonly as fine-grained and often impure masses as the chief constituent of phosphate rock and of most or all bones and teeth. Syn: *calcium phosphate*. (b) A group of hexagonal minerals having the general formula: $A_5(F,OH,Cl)(RO_4)_3$, where A = Ca, Sr, or Pb, and R = P, As, V, or less commonly Si. Examples include svabite, hedyphane, mimetite, pyromorphite, and vanadinite.	Glossary of Geology, Fifth Edition (revised), 2011
apophyllite	A mineral group including *fluorapophyllite*, *hydroxyapophyllite*, and *natroapophyllite*. These platy, colorless, tetragonal secondary minerals are related to and occur with zeolites in geodes in decomposed basalts and other igneous rocks. Syn: *fish-eye stone*, ichthyophthalmite.	Glossary of Geology, Fifth Edition (revised), 2011
aragonite	(a) A white, yellowish, or gray orthorhombic mineral: $CaCO_3$. It is trimorphous with calcite and vaterite. Aragonite has a greater density and hardness, and a less distinct cleavage, than calcite, and is also less stable and less common. It occurs in fibrous aggregates in beds of gypsum and iron ore; as a deposit from hot springs; and as a major constituent of shallow marine muds and the upper parts of coral reefs. Aragonite is also an important constituent of the pearl, and of some shells. Syn: *Aragon spar.* (b) A group of orthorhombic carbonate minerals, including *aragonite*, *alstonite*, *witherite*, *strontianite*, and *cerussite*.	Glossary of Geology, Fifth Edition (revised), 2011

arfvedsonite	(a) A greenish black to black monoclinic mineral of the *amphibole* group, approximately: $Na_{2-3}(Fe,Mg,Al)_5Si_8O_{22}$. It may contain some calcium, and it occurs in strongly pleochroic prisms in certain sodium-rich igneous rocks. Syn: *soda hornblende.* (b) An end-member of the amphibole group: $Na_3(Fe_4^{2+}Fe^{3+})Si_8O_{22}(OH)_2$.	Glossary of Geology, Fifth Edition (revised), 2011
arsenopyrite	(a) A tin-white or silver-white to steel-gray orthorhombic mineral: FeAsS. It occurs chiefly in crystalline rocks and esp. in lead and silver veins, and it constitutes the principal ore of arsenic. Syn: *arsenical pyrites; mispickel; white pyrites; white mundic.* (b) a group of minerals with the general formula *RX*(As,Sb)S, where *R* = Fe, Co or platinum-broup metals.	Glossary of Geology, Fifth Edition (revised), 2011
augite	(a) A common mineral of the *clinopyroxene* group: $(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$. It may contain titanium and ferric iron. Augite is usually black, greenish black, or dark green, and occurs as an essential constituent in many basic igneous rocks and in certain metamorphic rocks. Dana (1892) confined the name "augite" to clinopyroxenes containing appreciable $(Al,Fe)_2O_3$, but petrologists have applied it to members of the system $(Mg,Fe,Ca)SiO_3$. Cf: *pigeonite*. (b) A term often used as a syn. of *pyroxene*. Syn: *basaltine; violaite.*	Glossary of Geology, Fifth Edition (revised), 2011
axinite	A group name for brown, violet, blue, green, or gray triclinic borosilicate minerals: $(Ca,Mn,Fe,Mg)_3Al_2(OH)[BSi_4O_{15}]$. See: *ferro-axinite; magnesioaxinite; manganaxinite; tinzenite*. Syn: *glass schorl.*	Glossary of Geology, Fifth Edition (revised), 2011
azurite	(a) A deep-blue to violet-blue monoclinic mineral: $Cu_3(CO_3)_2(OH)_2$. It is an ore of copper and is a common secondary mineral associated with malachite in the upper (oxidized) zones of copper veins. Syn: *chessylite; blue copper ore; blue malachite*. (b) A semiprecious stone derived from compact azurite and used chiefly for ornamental objects. (c) A trade name for a sky-blue gem variety of *smithsonite*.	Glossary of Geology, Fifth Edition (revised), 2011
barite	(a) A white, yellow, or colorless orthorhombic mineral: $BaSO_4$. Strontium and calcium are often present. Barite occurs in tabular crystals, in granular form, or in compact masses resembling marble, and it has a specific gravity of 4.5. It is used in paint,	Glossary of Geology, Fifth Edition (revised), 2011

	drilling mud, and as a filler for paper and textiles, and is the principal ore of barium. Syn: *barytes; heavy spar; cawk.* (b) A group of sulfates with the general formula *R*(S,Se)O4, where *R* = Ba, Pb or Sr.	
beryl	(a) A mineral: $Be_3Al_2Si_6O_{18}$. It usually occurs in green or bluish-green, sometimes yellow or pink, or rarely white, hexagonal prisms in metamorphic rocks and granitic pegmatites and as an accessory mineral in acid igneous rocks. Transparent and colored gem varieties include emerald, aquamarine, heliodor, golden beryl, and vorobievite. Beryl is the principal ore of beryllium. (b) A group name for analogous silicates, including *stoppaniite, bazzite* and *indialite*.	Glossary of Geology, Fifth Edition (revised), 2011
biotite	(a) A widely distributed and important rock-forming mineral of the mica group: $K(Mg,Fe^{2+})_3(Al,Fe^{3+})Si_3O_{10}(OH,F)_2$. It is generally black, dark brown, or dark green, and occurs in various monoclinic polytypes. It forms a constituent of crystalline rocks (either as an original crystal in igneous rocks of all kinds or a product of metamorphic origin in gneisses and schists) or a detrital constituent of sandstones and other sedimentary rocks. Biotite is useful in the potassium-argon method of age determination. (b) A general term to designate all ferromagnesian micas. Syn: *black mica; iron mica; magnesia mica*.	Glossary of Geology, Fifth Edition (revised), 2011
bituminous_mineral	Said of a mineral having an odor like that of bitumen.	Glossary of Geology, Fifth Edition (revised), 2011
boehmite	A grayish, brownish, or reddish orthorhombic mineral: AlO(OH). It is a major constituent of some bauxites and it represents the gamma phase dimorphous with diaspore. Also spelled: *boehmite.*	Glossary of Geology, Fifth Edition (revised), 2011
bornite	A brittle, metallic-looking orthorhombic mineral: Cu_5FeS_4. It has a reddish-brown or coppery-red color on fresh fracture, but tarnishes rapidly to iridescent purple or blue. Bornite is a valuable ore of copper. Syn: *erubescite; variegated copper ore; peacock ore; horseflesh ore; purple copper ore.*	Glossary of Geology, Fifth Edition (revised), 2011
brookite	A brown, reddish, or sometimes black orthorhombic mineral: TiO_2. It is trimorphous with rutile and anatase, and occurs in druses and cavities. Syn: *pyromelane.*	Glossary of Geology, Fifth Edition (revised), 2011
brucite	(a) A variously colored platy trigonal mineral: $Mg(OH)_2$. It commonly occurs in thin pearly folia and in fibrous form, as in serpentine and impure limestone.	Glossary of Geology, Fifth Edition (revised), 2011

	(b) A group name for trigonal minerals of composition $A(OH)_2$, where *A* = Mg, Mn^{2+}, Fe^{2+}, Ni or Ca.	
bustamite	A pink or brownish red triclinic pyroxenoid mineral: $CaMnSi_2O_6$.	Glossary of Geology, Fifth Edition (revised), 2011
bytownite	A bluish to dark-gray triclinic mineral of the plagioclase *feldspar* group with composition ranging from $Ab_{30}An_{70}$ to $Ab_{10}An_{90}$. It occurs in basic and ultrabasic igneous rocks.	Glossary of Geology, Fifth Edition (revised), 2011
calcareous_mineral	**calcareous** (cal-car'-e-ous) Said of a substance that contains calcium carbonate. When applied to a rock name it implies that as much as 50% of the rock is calcium carbonate (Stokes and Varnes, 1955).	Glossary of Geology, Fifth Edition (revised), 2011
calcite	(a) A common rock-forming mineral: $CaCO_3$. It is trimorphous with aragonite and vaterite. Calcite is usually white, colorless, or pale shades of gray, yellow, and blue; it has perfect rhombohedral cleavage, a vitreous luster, and a hardness of 3 on the Mohs scale, and it readily effervesces in cold dilute hydrochloric acid. It is the principal constituent of limestone; calcite also occurs crystalline in marble, loose and earthy in chalk, spongy in tufa, and stalactitic in cave deposits. It is commonly found as a gangue mineral in many ore deposits and as a cementing medium in clastic sedimentary rocks; it is also a minor constituent of many igneous rocks and the chief constituent of some carbonatites. Calcite crystallizes in a variety of forms, such as nailhead spar, dogtooth spar, and Iceland spar. Symbol: Cc. Cf: *dolomite [mineral]*. Syn: *calcspar*. (b) A group name for minerals with the general formula ACO_3, where *A* = Ca, Mg, Fe, Mn, Co, Ni, Zn or Cd.	Glossary of Geology, Fifth Edition (revised), 2011
cancrinite	(a) A variuosly colored hexagonal feldspathoid mineral: $Na_6Ca_2Al_6Si_6O_{24}(CO_3)_2 \cdot 2H_2O$. (b) A group name for hexagonal or trigonal minerals with the above general formula, but with Na replaced by Ca or K; CO_3 replaced by SO_4, OH, Cl or S; and containing variable amounts of H_2O.	Glossary of Geology, Fifth Edition (revised), 2011
carbonaceous_mineral		
carbonate	A sediment formed by the biotic or abiotic precipitation from aqueous solution of carbonates of calcium, magnesium, or iron; e.g. limestone and dolomite. See also: *carbonate rock*.	Glossary of Geology, Fifth Edition (revised), 2011
carnegieite	A synthetic compound: $Na[AlSiO_4]$. It is the high-temperature equivalent of nepheline. It is triclinic at low temperatures, cubic at high temperatures.	Glossary of Geology, Fifth Edition (revised), 2011

carnotite	A strongly radioactive, canary-yellow to greenish-yellow monoclinic secondary mineral: $K_2(UO_2)_2(V_2O_8)\cdot 3H_2O$. An ore of uranium and vanadium, and a source of radium, it occurs as a powdery incrustation or in loosely coherent masses, chiefly in sandstone (as in the western U.S.).	Glossary of Geology, Fifth Edition (revised), 2011
cassiterite	A variously colored tetragonal mineral: SnO_2. It is the principal ore of tin. Cassiterite occurs in prismatic crystals of adamantine luster, and also in massive forms, either compact with concentric fibrous structure (*wood tin*) or in rolled or pebbly fragments (*stream tin*). Syn: *tinstone; tin ore; black tin.*	Glossary of Geology, Fifth Edition (revised), 2011
celestite	A variously colored orthorhombic mineral of the *barite* group: $SrSO_4$. It often occurs in residual clays and in deposits of salt, gypsum, and associated dolomite and shale. Celestine is the principal ore of strontium. Syn: *celestite; coelestine*	Glossary of Geology, Fifth Edition (revised), 2011
chabazite	A group name for zeolites of composition $A_{1-2}(Si,Al)_6O_{12}\cdot H_2O$, where *A* = Ca, Na, K or Sr. Also spelled: chabasite.	Glossary of Geology, Fifth Edition (revised), 2011
chalcedony	(a) A cryptocrystalline variety of quartz. It is commonly microscopically fibrous, may be translucent or semitransparent, and has a nearly waxlike luster, a uniform tint, and a white, pale-blue, gray, brown, or black color; it has a lower density and lower indices of refraction than ordinary quartz. Chalcedony is the material of much chert, and often occurs as an aqueous deposit filling or lining cavities in rocks. In the gem trade, the name refers specif. to the light blue-gray or "common" variety of chalcedony. Varieties include carnelian, sard, chrysoprase, prase, plasma, bloodstone, onyx, and sardonyx. See also: *agate*. Var:*calcedony.* Syn: *chalcedonite.* (b) A general name for crystalline silica that forms concretionary masses with radial-fibrous and concentric structure and that is optically negative (unlike true quartz). (c) A trade name for a natural blue onyx.	Glossary of Geology, Fifth Edition (revised), 2011
chalcocite	A black or dark lead-gray mineral: Cu_2S. It has a metallic luster, occurs in tetragonal or monoclinic crystals or as anhedral masses, and is an important ore of copper. Syn: *copper glance; chalcosine; redruthite; beta chalcocite; vitreous copper.*	Glossary of Geology, Fifth Edition (revised), 2011
chalcopyrite	(a) A bright brass-yellow tetragonal mineral: $CuFeS_2$. It is generally found	Glossary of Geology, Fifth Edition (revised), 2011

	massive and constitutes the most important ore of copper. Syn: *copper pyrites; yellow copper ore; yellow pyrites; fool's gold.* (b) A group name for minerals with the formula *ABX2,* where *A* = Cu or Ag, *B* = Fe, Ga or In, and *X* = S or Se.	
chalcocite	A black or dark lead-gray mineral: Cu_2S. It has a metallic luster, occurs in tetragonal or monoclinic crystals or as anhedral masses, and is an important ore of copper. Syn: *copper glance; chalcosine; redruthite; beta chalcocite; vitreous copper.*	Glossary of Geology, Fifth Edition (revised), 2011
chiastolite	An opaque variety of andalusite containing black carbonaceous impurities arranged in a regular manner so that a section normal to the longer axis of the crystal shows a black Maltese cross formed as a result of the pushing aside of the impurities into definite areas as the crystal grew in metamorphosed shales. It has long been used for amulets, charms, and other inexpensive novelty jewelry. Syn: *cross-stone; crucite; macle [mineral].*	Glossary of Geology, Fifth Edition (revised), 2011
chlorite	A group of platy, monoclinic, usually greenish minerals with the general formula $(R_{2+},R_{3+})_{4-6}(Si,Al)_4O_{10}(OH,O)_8$. There are four subgroups of this 2:1 layer clay mineral (the interlayer hydroxyl sheet is to be treated like other interlayer material), (1) trioctahedral chlorite (the most common chlorites) i.e., both the octahedral sheet sandwiched between tetrahedral sheets and the interlayer one are trioctahedral; (2) dioctahedral chlorite with both octahedral sheets dioctahedral, e.g. donbassite; (3) di,trioctahedral chlorite with the octahedral sheet in the 2:1 layer dioctahedral, but with the hydroxyl sheet trioctahedral, e.g. cookeite or sudoite; and (4) tri,dioctahedral with the 2:1 layer trioctahedral, but with the hydroxyl sheet dioctahedral. No examples of this mineral have yet been found. The most common chlorites, the trioctahedral ones, are named according to the dominant cation: Fe-rich is chamosite, Mg-rich is clinochlore, Ni-rich is nimite, and Mn-rich is pennantite (Bailey et al., 1979). Cf: *structural terms*.	Glossary of Geology, Fifth Edition (revised), 2011
chloritoid	Micaceous brittle monoclinic or triclinic minerals: $(Fe^{2+},Mg,Mn)Al_2SiO_5(OH)_2$. They occur in dull-green or dark-green to gray or grayish-black masses of brittle folia in metamorphosed argillaceous sedimentary rocks, and are	Glossary of Geology, Fifth Edition (revised), 2011

	related to the brittle micas. Their structures are based on local closest-packing.	
chondrodite	A dark-red, orange-red, or yellow monoclinic mineral of the humite group: $(Mg,Fe^{2+})_5(SiO_4)_2(F,OH)_2$. It commonly occurs in contact-metamorphosed dolomites. Also spelled: *condrodite.*	Glossary of Geology, Fifth Edition (revised), 2011
chromite	A brownish-black to iron-black cubic mineral of the spinel group: $Fe^{2+}Cr_2O_4$. It occurs in octahedral crystals as a primary accessory mineral in basic and ultrabasic igneous rocks; it also occurs massive, and it forms detrital deposits. Chromite is isomorphous with magnesiochromite, and is the most important ore of chromium. Syn: *chrome iron ore*.	Glossary of Geology, Fifth Edition (revised), 2011
chrysocolla	(a) A blue, blue-green, or emerald-green amorphous mineral: $Cu_2(OH)_4[Si_2O_3(OH)_2]$. It occurs as incrustations and thin seams in the zone of weathering of copper ores. Its chemical composition was formerly given as: $CuSiO_3 \cdot 2H_2O$. (b) An old name given to a mineral or minerals (such as chrysocolla, borax, and malachite) used for soldering gold (Hey, 1962, p.384).	Glossary of Geology, Fifth Edition (revised), 2011
chrysotile	A white, gray, or greenish orthorhombic or monoclinic mineral of the *serpentine* group: $Mg_3(OH)_4Si_2O_5$. It is a highly fibrous, silky variety of serpentine, and constitutes the most important type of *asbestos*. Not to be confused with *chrysolite*. Syn: *serpentine asbestos; clinochrysotile*.	Glossary of Geology, Fifth Edition (revised), 2011
clinoamphibole	(a) A group name for amphiboles crystallizing in the monoclinic system. (b) Any monoclinic mineral of the amphibole group, such as hornblende, cummingtonite, grunerite, tremolite, actinolite, riebeckite, glaucophane, and arfvedsonite. Cf: *orthoamphibole*.	Glossary of Geology, Fifth Edition (revised), 2011
clinoenstatite	A colorless, yellow, brown, or green monoclinic mineral of the *pyroxene* group: $Mg_2Si_2O_6$.	Glossary of Geology, Fifth Edition (revised), 2011
clinoferrosilite	A colorless or amber monoclinic mineral of the pyroxene group: $(Fe^{2+},Mg)_2Si_2O_6$. See also: *ferrosilite*. Cf: *orthoferrosilite*.	Glossary of Geology, Fifth Edition (revised), 2011
clinohumite	A white, orange, or brown monoclinic mineral of the *humite* group: $(Mg,Fe^{2+})_9(SiO_4)_4(F,OH)_2$. A dimorph of humite.	Glossary of Geology, Fifth Edition (revised), 2011
clinopyroxene	(a) A group name for pyroxenes crystallizing in the monoclinic system and sometimes containing considerable calcium with or without aluminum and the alkalies. (b) Any monoclinic mineral of the *pyroxene* group, such as diopside, hedenbergite, clinoenstatite, clinohypersthene, clinoferrosilite,	Glossary of Geology, Fifth Edition (revised), 2011

	augite, acmite, pigeonite, spodumene, jadeite, and omphacite. Cf: *orthopyroxene*. Syn: *monopyroxene; clinoaugite.*	
clinozoisite	A grayish-white, pink, or green mineral of the *epidote* group: $Ca_2Al_3(SiO_4)(Si_2O_7)O(OH)$. It is the monoclinic dimorph of *zoisite* and grades into, but is lighter in color than, epidote.	Glossary of Geology, Fifth Edition (revised), 2011
coesite	A monoclinic mineral, a dense (2.93 g/cm^3) polymorph of SiO_2, which is stable at room temperature only at pressures above 20 kilobars. The silicon is coordinated to 4 oxygens. Coesite is found in impact craters, or in rocks (such as suevite) associated with such structures. It also occurs in xenoliths in kimberlite, and as inclusions in garnet and pyroxene in unusual eclogite-facies rocks. Cf: *stishovite*.	Glossary of Geology, Fifth Edition (revised), 2011
copper	A reddish or salmon-pink cubic mineral, the native metallic element Cu. It is ductile and malleable, a good conductor of heat and electricity, usually dull and tarnished, and formerly an important ore. Copper is the only metal that occurs native abundantly in large masses; it frequently occurs in dendritic clusters or mossy aggregates, in sheets, or in plates filling narrow cracks or fissures. It has many uses, notably as an electric conductor and as the base metal in brass, bronze, and other alloys.	Glossary of Geology, Fifth Edition (revised), 2011
cordierite	A variously colored orthorhombic mineral: $(Mg,Fe^{2+})_2Al_4Si_5O_{18}$. It exhibits strong pleochroism, is easily altered by exposure, and is an accessory mineral in granites and a common constituent in metamorphic rocks formed under low pressure. Syn: *iolite; dichroite.*	Glossary of Geology, Fifth Edition (revised), 2011
corundum	A mineral: Al_2O_3. It occurs as shapeless grains and masses, or as variously colored rhombohedral crystals (such as prisms or tapering hexagonal pyramids), including the gem varieties such as ruby and sapphire. Corundum is extremely tough, has a hardness of 9 on the Mohs scale, and is used industrially as an abrasive. See also: *emery*. Syn: *adamantine spar; diamond spar; corindon.*	Glossary of Geology, Fifth Edition (revised), 2011
covellite	An indigo-blue hexagonal mineral: CuS. It is a common secondary mineral and represents an ore of copper. Syn: *covelline; indigo copper.*	Glossary of Geology, Fifth Edition (revised), 2011
cristobalite	A mineral: SiO_2. It is a high-temperature polymorph of quartz and tridymite, and occurs as white octahedrons in the cavities and fine-grained groundmasses	Glossary of Geology, Fifth Edition (revised), 2011

	of acidic volcanic rocks. Cristobalite is stable only above 1470°C; it has a tetragonal structure (alpha-cristobalite) at low temperatures and a cubic structure (beta-cristobalite) at higher temperatures. Cf: *tridymite*	
cummingtonite	A dark green, brown, gray, or beige monoclinic mineral of the *amphibole* group: $(Mg,Fe^{2+})_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$. It is dimorphous with anthophyllite, and typically contains calcium and manganese. Cummingtonite occurs in metamorphosed ironstone, mafic and ultrabasic rocks, some dacites and rhyolites, and as a component of uralite. Its iron-rich variety is *grunerite*.	Glossary of Geology, Fifth Edition (revised), 2011
diaspore	(a) A variously colored orthorhombic mineral: AlO(OH). It represents the alpha base dimorphous with boehmite. Diaspore is found in bauxite and is associated with corundum and dolomite; it occurs in lamellar masses with pearly luster or in prismatic crystals. Syn: diasporite. (b) A group name for minerals of composition *A*O(OH), where *A* = Al, Fe^{3+}, Mn^{3+}, Cr, V.	Glossary of Geology, Fifth Edition (revised), 2011
digenite	A blue to black rhombohedral mineral: Cu_9S_5. It often occurs with chalcocite, and is stable below 73°C; it converts to a cubic phase above this temperature. Syn: *blue chalcocite; alpha chalcocite.*	Glossary of Geology, Fifth Edition (revised), 2011
diopside	A monoclinic mineral of the *pyroxene* group: $CaMgSi_2O_6$. It contains little or no aluminum and may contain some iron. It ranges in color from white to green; transparent varieties are used in jewelry. Diopside occurs in some metamorphic rocks, and is found esp. as a contact-metamorphic mineral in crystalline limestones. Symbol: Di. Syn: *malacolite*.	Glossary of Geology, Fifth Edition (revised), 2011
dolomite	A common rock-forming rhombohedral mineral: $CaMg(CO_3)_2$. Part of the magnesium may be replaced by ferrous iron and less frequently by manganese. Dolomite is white, colorless, or tinged yellow, brown, pink, or gray; it has perfect rhombohedral cleavage and a pearly to vitreous luster, effervesces feebly in cold dilute hydrochloric acid, and forms curved, saddlelike crystals. Dolomite is found in extensive beds as dolomite rock; it is a common vein mineral, and is found in *serpentinite* and other magnesian rocks. Cf: *calcite*. Syn: *bitter spar; pearl spar; magnesian spar; rhomb spar*.	Glossary of Geology, Fifth Edition (revised), 2011
dravite	A brown, magnesium-rich rhombohedral mineral of the *tourmaline* group: $NaMg_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$.	Glossary of Geology, Fifth Edition (revised), 2011
eckermannite	A dark bluish-green to black monoclinic	Glossary of Geology, Fifth

	mineral of the *amphibole* group: $NaNa_2(Mg_4Al)Si_8O_{22}(OH)_2$.	Edition (revised), 2011
edenite	(a) A light-colored, iron-free variety of hornblende. (b) An end member in the *amphibole* mineral group: $NaCa_2(Mg,Fe^{2+})_5(Si_7Al)O_{22}(OH)_2$. Cf: *pargasite*.	Glossary of Geology, Fifth Edition (revised), 2011
elbaite	A variously colored rhombohedral mineral of the *tourmaline* group: $Na(Al,Li)_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$. It is the principal gem tourmaline.	Glossary of Geology, Fifth Edition (revised), 2011
emerald	(a) A brilliant green variety of beryl, highly prized as a gemstone. The color, which is caused by the presence of chromium or possibly vanadium, ranges from medium-light or medium-dark tones of slightly bluish-green to those of slightly yellowish-green. Syn: *smaragd.* (b) Any of various gemstones having a green color, such as "oriental emerald" (sapphire), "copper emerald" (dioptase), "Brazilian emerald" (tourmaline), and "Uralian emerald" (demantoid). (c) Said of a gemmy and richly green-colored mineral, such as "emerald jade" (jadeite), "emerald spodumene" (hiddenite), and "emerald malachite" (dioptase).	Glossary of Geology, Fifth Edition (revised), 2011
enstatite - ortho	A common rock-forming mineral of the *orthopyroxene* group: $MgSiO_3$. It is isomorphous with hypersthene, and may contain a little iron replacing the magnesium. Enstatite ranges from grayish white to yellowish, olive green, and brown. It is an important primary constituent of intermediate and basic igneous rocks. Symbol: En. Cf: *bronzite*. Syn: *chladnite [mineral]*.	Glossary of Geology, Fifth Edition (revised), 2011
epidote	(a) A yellowish-green, pistachio-green, or blackish-green mineral: $Ca_2Al_2(Fe^{3+},Al)(SiO_4)(Si_2O_7)O(OH)$. It commonly occurs associated with albite and chlorite as formless grains or masses or as monoclinic crystals in low-grade metamorphic rocks (derived from limestones), or as a rare accessory constituent in igneous rocks, where it represents alteration products of ferromagnesian minerals. Syn: *pistacite; arendalite; delphinite; thallite*. (b) A name for a mineral group with an analogous formula, but with Ca partially replaced by rare-earth elements, and Fe^{3+} replaced by Al, Mn^{3+}, V^{3+}, Fe^{2+} or Mg.	Glossary of Geology, Fifth Edition (revised), 2011
eudialyte	A pale-pink, garnet red, to brownish-red rhombohedral zeolitic mineral: $Na_{15}Ca_6Fe_3Zr_3Si(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_{22}$. It occasionally occurs in great quantity in certain nepheline syenites. Cf: *eucolite*. Syn: *barsanovite.* (b) A	Glossary of Geology, Fifth Edition (revised), 2011

	group name for minerals with the analogous formula, with Na replaced by rare-earth elements or H_2O; Ca replaced by Mn, Sr or Fe; Fe replaced by Mn; and Zr replaced by Ti or Nb.	
fassaite	A pale-green to dark-green variety of monoclinic pyroxene containing considerable aluminum substituting for silicon: $(Ca,Mg,Fe^{3+},Al,Ti)_2(Si,Al)_2O_6$.	Glossary of Geology, Fifth Edition (revised), 2011
fayalite	A greenish yellow, brown to black orthorhombic mineral of the *olivine* group: Fe_2SiO_4. It is isomorphous with forsterite, and occurs chiefly in igneous rocks and in marbles which host magnetite ores. Symbol: Fa. Syn: *iron olivine.*	Glossary of Geology, Fifth Edition (revised), 2011
feldspar	(a) A group of abundant rock-forming minerals of general formula: $MAl(Si,Al)_3O_8$, where *M* = K, Na, Ca, Ba, Rb, Sr, or rarely Fe. Feldspars are the most widespread of any mineral group and constitute 60% of the Earth's crust; they occur as components of all kinds of rocks (crystalline schists, migmatites, gneisses, granites, most magmatic rocks) and as fissure minerals in clefts and druse minerals in cavities. Feldspars are usually white or nearly white and clear and translucent (they have no color of their own but are frequently colored by impurities), have a hardness of 6 on the Mohs scale, frequently display twinning, exhibit monoclinic or triclinic symmetry, and possess good cleavage in two directions (intersecting at 90° as in orthoclase and at about 86° as in plagioclase). On decomposition, feldspars yield a large part of the clay of soil and also the mineral kaolinite. (b) A mineral of the *feldspar* group, such as alkali feldspar (orthoclase, microcline), plagioclase (albite, anorthite), and celsian. Syn: *felspar; feldspath.*	Glossary of Geology, Fifth Edition (revised), 2011
ferroactinolite	The Fe-rich variety of actinolite, a bright-green or grayish-green monoclinic mineral of the *amphibole* group: $Ca_2(Mg,Fe)_5(OH)_2[Si_8O_{22}]$.	Glossary of Geology, Fifth Edition (revised), 2011
ferroedenite	The Fe-rich variety of edenite, an end member in the *amphibole* mineral group: $NaCa_2(Mg,Fe^{2+})_5(Si_7Al)O_{22}(OH)_2$.	Glossary of Geology, Fifth Edition (revised), 2011
ferrosilite - ortho	A dark green, dark brown, or black orthorhombic mineral of the *pyroxene* group: $(Fe^{2+},Mg)_2Si_2O_6$. It is the iron analogue of enstatite.	
ferrotschermakite	A green monoclinic mineral of the *amphibole* group, representing tschermakite with essential Fe^{2+}: $Ca_2(Fe^{2+}{}_3AlFe^{3+})(Si_6Al_2)O_{22}(OH)_2$.	Glossary of Geology, Fifth Edition (revised), 2011

ferruginous_mineral	Pertaining to or containing iron, e.g. a sandstone that is cemented with iron oxide. Cf: *ferriferous; siderose.*	Glossary of Geology, Fifth Edition (revised), 2011
fluorite	A transparent to translucent mineral: CaF_2. It is found in many different colors (often blue or purple) and has a hardness of 4 on the Mohs scale. Fluorite occurs in veins, usually as a gangue mineral associated with lead, tin, and zinc ores, and is commonly found in crystalline cubes with perfect octahedral cleavage. It is the principal ore of fluorine, and is used as a flux, in the preparation of glass and enamel, in the manufacture of hydrofluoric acid, and for carved ornamental objects. Syn: *fluorspar; fluor; Derbyshire spar.*	Glossary of Geology, Fifth Edition (revised), 2011
forsterite	A whitish, yellowish, or green orthorhombic mineral of the olivine group: Mg_2SiO_4. It is isomorphous with fayalite, and occurs chiefly in metamorphosed dolomites and crystalline limestones. Symbol: Fo. Syn: *white olivine.*	Glossary of Geology, Fifth Edition (revised), 2011
fuchsite	A bright-green, chromium-rich variety of muscovite. Syn: *chrome mica.*	Glossary of Geology, Fifth Edition (revised), 2011
galena	(a) A bluish-gray to lead-gray mineral: PbS. It frequently contains included silver minerals. Galena occurs in cubic or octahedral crystals, in masses, or in coarse or fine grains; it is often associated with sphalerite as disseminations in veins in limestone, dolomite, and sandstone. It has a shiny metallic luster, exhibits highly perfect cubic cleavage, and is relatively soft and very heavy. Galena is the most important ore of lead and one of the most important sources of silver. Syn: *galenite; lead glance; blue lead [mineral].* (b) A group name for cubic minerals with the formula *AX*, where *A* = Mg, Ca,Mn, (AgSb) or (AgBi), and *X* = S, Se or Te.	Glossary of Geology, Fifth Edition (revised), 2011
garnet	(a) A group of minerals of formula: $A_3B_2(SiO_4)_3$, where *A* = Ca, Mg, Fe^{2+}, or Mn^{2+}, and *B* = Al, Fe^{3+}, Mn^{3+}, V^{3+}, or Cr^{3+}. (b) Any of the minerals of the *garnet* group, such as the end members almandine (Fe-Al), andradite (Ca-Fe), grossular (Ca-Al), pyrope (Mg-Al), spessartine (Mn-Al), uvarovite (Ca-Cr), and goldmanite (Ca-V). Garnet is a brittle and transparent to subtransparent mineral, having a vitreous luster, no cleavage, and a variety of colors, dark red being the most common. It occurs as an accessory mineral in a wide range of igneous rocks, but is most commonly found as distinctive euhedral cubic crystals in	Glossary of Geology, Fifth Edition (revised), 2011

	metamorphic rocks (gneiss, mica schist, marble); it may also be massive or granular. Garnet is used as a semiprecious stone and as an abrasive.	
gedrite	A white, gray, green, or brown prismatic monoclinic mineral: $(Mg,Fe^{2+})_2(Mg,Fe^{2+},Al)_5(Si_6Al_2)O_{22}(OH)_2$. A member of the *amphibole* group	Glossary of Geology, Fifth Edition (revised), 2011
gehlenite	A grayish-green to brown tetragonal mineral of the *melilite* group: $Ca_2Al(AlSi)O_7$. It is isomorphous with akermanite. Syn: *velardeñite.*	Glossary of Geology, Fifth Edition (revised), 2011
geothite	A yellowish, reddish, or brownish-black orthorhombic mineral of the *diaspore* group: $\alpha Fe^{3+}O(OH)$. It is trimorphous with lepidocrocite and akaganéite. Goethite is the commonest constituent of many forms of natural rust or of limonite, and it occurs esp. as a weathering product in the gossans of sulfide-bearing ore deposits. Also spelled: *göthite.* Syn: *allcharite; xanthosiderite.*	Glossary of Geology, Fifth Edition (revised), 2011
gibbsite	A white or tinted monoclinic mineral: $Al(OH)_3$. It is polymorphous with bayerite and nordstrandite. Gibbsite is formed by weathering of igneous rocks and is the principal constituent of bauxite; it occurs in micalike crystals or in stalactitic and spheroidal forms. Syn: *hydrargillite*	Glossary of Geology, Fifth Edition (revised), 2011
glauconite	A group name for a series that comprises dioctahedral interlayer-deficient micas. Often interstratified with smectite as the mixed-layered mineral glauconite/smectite. When mixed with other minerals or when referring to morphological features, the term glauconitic is appropriate. Often assumed to be associated with specific conditions of deposition, but the Nomenclature Committtee of the Clay Minerals Society stated, "Mode of origin is not a criterion..." (Bailey et al., 1979).	Glossary of Geology, Fifth Edition (revised), 2011
glaucophane	A blue, bluish-black, or grayish-blue monoclinic mineral of the *amphibole* group: $Na_2(Mg_3Al_2)Si_8O_{22}(OH)_2$. It is a fibrous or prismatic mineral that occurs only in certain crystalline schists resulting from regional metamorphism of sodium-rich igneous rocks (such as spilites).	Glossary of Geology, Fifth Edition (revised), 2011
goethite	A yellowish, reddish, or brownish-black orthorhombic mineral of the *diaspore* group: $\alpha Fe^{3+}O(OH)$. It is trimorphous with lepidocrocite and akaganéite. Goethite is the commonest constituent of many forms of natural rust or of limonite, and it occurs esp. as a weathering product in the gossans of	Glossary of Geology, Fifth Edition (revised), 2011

	sulfide-bearing ore deposits. Also spelled: *göthite.* Syn: *allcharite; xanthosiderite*	
gold	A soft, heavy, yellow, cubic mineral, the native metallic element Au. It is often naturally alloyed with silver or copper and occasionally with bismuth, mercury, or other metals, and is widely found in alluvial deposits (as nuggets and grains) or in veins associated with quartz and various sulfides. Gold is malleable and ductile, and is used chiefly for jewelry and as the international standard for world finance.	Glossary of Geology, Fifth Edition (revised), 2011
graphite	A hexagonal mineral, a naturally occurring crystalline form of carbon dimorphous with diamond. It is opaque, lustrous, greasy to the touch, and iron black to steel gray in color; it occurs as crystals or as flakes, scales, laminae, or grains in veins or bedded masses or as disseminations in metamorphic rocks. Graphite conducts electricity well, and is soft and unctuous, immune to most acids, and extremely refractory. It is used in "lead" pencils, paints, and crucibles, as a lubricant and an electrode, and as a moderator in nuclear reactors. Syn: *plumbago; black lead.*	Glossary of Geology, Fifth Edition (revised), 2011
grossularite	The calcium-aluminum end member of the *garnet* group, usually characterized by a green color: $Ca_3Al_2(SiO_4)_3$. It may be colorless, yellow, orange, brown, rose, or red, and it often occurs in contact-metamorphosed impure limestones. The principal variety is essonite. Syn: *grossularite; gooseberry stone.*	Glossary of Geology, Fifth Edition (revised), 2011
grunerite	A green, brown, or gray monoclinic mineral of the *amphibole* group: $Fe^{2+}_2(Fe^{2+},Mg)_5Si_8O_{22}(OH)_2$. Cf: *cummingtonite.* Also spelled: grünerite.	Glossary of Geology, Fifth Edition (revised), 2011
gummite	A general term for yellow, orange, red, or brown secondary minerals consisting of a mixture of hydrous oxides of uranium, thorium, and lead, and occurring as alteration products of uraninite and not otherwise identified. It includes silicates, phosphates, and oxides; much of the material is probably mixtures or amorphous gels, but some consists perhaps largely of curite. Syn: *uranium ocher.*	Glossary of Geology, Fifth Edition (revised), 2011
gypsum	A widely distributed mineral consisting of aquated calcium sulfate: $CaSO_4 \cdot 2H_2O$. It is the commonest sulfate mineral, and is frequently associated with halite and anhydrite in evaporites, forming thick, extensive beds interstratified with limestone, shale, and clay (esp. in rocks of Permian and Triassic age). Gypsum is	Glossary of Geology, Fifth Edition (revised), 2011

	soft (hardness of 2 on the Mohs scale); it is white or colorless when pure, but commonly has tints of gray, red, yellow, blue, or brown. It occurs massive (alabaster), fibrous (satin spar), or in monoclinic crystals (selenite) Gypsum is used chiefly as a soil amendment, as a retarder in portland cement, and in making Plaster of Paris. Etymol: Greek "gypsos", "chalk". Syn: *gypsite; gyp; plaster stone.*	
halite	A cubic mineral: NaCl. It is native salt, occurring in massive, granular, compact, or cubic-crystalline forms, and having a distinctive salty taste. Halite is typically colorless, but certain occurrences provide red, yellow, blue, etc. colors owing to impurities and/or "color centers" in the structure. Symbol: Hl. Syn: *common salt; rock salt.*	Glossary of Geology, Fifth Edition (revised), 2011
hastingsite	A dark green monoclinic mineral of the *amphibole* group: $NaCa_2(Fe^{2+}{}_4Fe^{3+})(Si_6Al_2)O_{22}(OH)_2$. It generally contains a little potassium	Glossary of Geology, Fifth Edition (revised), 2011
hauyne	A variously colored cubic feldspathoid mineral of the *sodalite* group: $(Na,Ca)_{4\text{-}8}Al_6Si_6(O,S)_{24}(SO_4,Cl)_{1\text{-}2}$. It is related to nosean and occurs in rounded and subangular grains embedded in various volcanic rocks.	Glossary of Geology, Fifth Edition (revised), 2011
hedenbergite	A green to brown or black monoclinic mineral of the pyroxene group: or $CaFe^{2+}Si_2O_6$. It occurs as a *skarn* mineral at the contact of limestones with granitic masses.	Glossary of Geology, Fifth Edition (revised), 2011
hematite	A common iron mineral: αFe_2O_3. It is dimorphous with maghemite. Hematite occurs in splendent, metallic-looking, steel-gray or iron-black rhombohedral crystals, in reniform masses or fibrous aggregates, or in deep-red or red-brown earthy forms: it has a distinctive cherry-red to reddish-brown streak and a characteristic brick-red color when powdered. It is found in igneous, sedimentary, and metamorphic rocks, both as a primary constituent and as an alteration product. Hematite is the principal ore of iron. Symbol: Hm. See also: *specularite.* Originally spelled: *haematite.* Syn: *red hematite; red iron ore; red ocher; rhombohedral iron ore; oligist iron; bloodstone*	Glossary of Geology, Fifth Edition (revised), 2011
hercynite	A black cubic mineral of the *spinel* group: $Fe^{2+}Al_2O_4$. It often contains some magnesium. Syn: *iron spinel; ferrospinel.*	Glossary of Geology, Fifth Edition (revised), 2011
heulandite	**heulandite-Ca** A zeolite mineral: $(Ca,Na)_5(Si,Al)_{36}O_{72}{\cdot}nH_2O$. It often occurs as white to pink foliated masses or as coffin-shaped monoclinic crystals	

	in cavities in decomposed basic igneous rocks. See also: *clinoptilolite*; *stilbite-Ca*. **heulandite-K** A monoclinic zeolite mineral: $(K,Na,Ca)_5(Si,Al)_{36}O_{72}\cdot nH_2O$. **heulandite-Na** A monoclinic zeolite mineral: $(Na,Ca,K)_5(Si,Al)_{36}O_{72}\cdot nH_2O$. **heulandite-Sr** A monoclinic zeolite mineral: $(Sr,Ca,Na)_5(Si,Al)_{36}O_{72}\cdot nH_2O$.	
hornblende	(a) The commonest mineral of the *amphibole* group: $(Ca,Na)_{2-3}(Mg,Fe^{+2},Fe^{+3},Al)_5(OH)_2[(Si,Al)_8O_{22}]$. It has a variable composition, and may contain potassium and appreciable fluorine. Hornblende is commonly black, dark green, or brown, and occurs in distinct monoclinic crystals or in columnar, fibrous, or granular forms. It is a primary constituent of many acid and intermediate igneous rocks (granite, syenite, diorite, andesite) and less commonly of basic igneous rocks, and it is a common metamorphic mineral in gneiss and schist. (b) A term sometimes used (esp. by the Germans) to designate the *amphibole* group of minerals. The term "Hornblende" is an old German name for any dark, prismatic crystal found with metallic ores but containing no valuable metal (the word "Blende" indicates "a deceiver"). Obsolete syn: *hornstone*	Glossary of Geology, Fifth Edition (revised), 2011
humite	A white, yellow, brown, or red orthorhombic mineral: $Mg_7(F,OH)_2[SiO_4]_3$. It sometimes contains appreciable iron, and it is found in the masses ejected from volcanoes. (b) A group of homologous magnesium-silicate minerals frequently containing fluorine and closely resembling one another in chemical composition, physical properties, and crystallization. It consists of olivine, humite, clinohumite, chondrodite, and norbergite, and occurs as skarns in high grade marbles.	Glossary of Geology, Fifth Edition (revised), 2011
illite	The term illite is used in two ways: In the general sense that Grim et al. (1937) introduced it, it is the 2:1 muscovite-like monoclinic or rhombohedral mineral in the clay-size fraction, but which has less K and more water than muscovite and gives a 10 Å d(001) from X-ray diffraction: $(K,H_3O)Al_2(Si_3Al)O_{10}(H_2O,OH)_2$. As a specific mineral, illite is an end-member of a series just as albite is the end-member of the *plagioclase* series. Because less than 5% of interstratified material in illite is difficult to detect by	Glossary of Geology, Fifth Edition (revised), 2011

	conventional X-ray methods, illite in the sense of a specific mineral, may contain up to 5% of an interstratified component. This component will be the other end of a compositional series. It is most commonly smectite, but can be vermiculite or perhaps chlorite. Srodon et al. (1992) concluded that illite has a layer charge of -0.89. However, others find values as low as -0.70. In the treatment here, the term illitic material covers the original, general intention of Grim et al. (1937), and the term illite should be used when referring to a specific mineral (Moore and Reynolds, 1996). In soil taxonomy, the presence of a 1nm X-ray diffraction peak and >&eq;4% K_2O is used to denote the presence of illite. Syn: *hydromuscovite*	
ilmenite	An iron-black, opaque, rhombohedral mineral of the corundum group: $Fe^{2+}TiO_3$. It is the principal ore of titanium. Ilmenite occurs as a common accessory mineral in basic igneous rocks (esp. gabbros and norites), and is also concentrated in mineral sands. See also: *menaccanite*. Syn: *titanic iron ore; mohsite.*	Glossary of Geology, Fifth Edition (revised), 2011
jadeite	A high-pressure monoclinic mineral of the *clinopyroxene* group, essentially: $Na(Al,Fe^{3+})Si_2O_6$. It occurs in various colors (esp. green) and is found chiefly in Burma; when cut, it furnishes the most valuable and desirable variety of jade and is used for ornamental purposes	Glossary of Geology, Fifth Edition (revised), 2011
jasper	A variety of *chert* associated with iron ores and containing iron-oxide impurities that give it various colors, characteristically red, although yellow, green, grayish-blue, brown, and black cherts have also been called jasper. The term has also been applied to any red chert or chalcedony irrespective of associated iron ore. Syn: *jasperite; jaspis; jasperoid.*	Glossary of Geology, Fifth Edition (revised), 2011
johannsenite	A colorless, clove-brown, grayish, blue, or greenish monoclinic mineral of the *pyroxene* group: $CaMn^{2+}Si_2O_6$.	Glossary of Geology, Fifth Edition (revised), 2011
K-feldspar	An alkali feldspar containing the Or molecule, $KAlSi_3O_8$; e.g. orthoclase, microcline, sanidine, and adularia. See also: *potash spar*. Syn: *K-feldspar; K-spar.*	Glossary of Geology, Fifth Edition (revised), 2011
kaersutite	A dark-brown to black monoclinic member of the *amphibole* group: $NaCa_2(Mg_4Ti)(Si_6Al_2)O_{23}(OH)$.	Glossary of Geology, Fifth Edition (revised), 2011
kalsilite	A colorless mineral of the *nepheline* group: $KAlSiO_4$. It exists in hexagonal and trigonal polytypes, and is dimorphous with kaliophilite	Glossary of Geology, Fifth Edition (revised), 2011

kaolinite	(a) A common earthy white, grayish, yellowish, etc. triclinic clay mineral of the *kaolin* group: $Al_2Si_2O_5(OH)_4$. It is the characteristic mineral of most kaolins, and is polymorphous with dickite and nacrite. Kaolinite consists of sheets of tetrahedrally coordinated silicon joined by an oxygen shared with octahedrally coordinated aluminum; it also occurs as a disordered monoclinic variant. Kaolinite is a high-alumina clay mineral that does not appreciably expand under varying water content and does not exchange iron or magnesium. The mineral was formerly known as kaolin. (b) A name sometimes applied to the kaolin group of clay minerals, and formerly applied to individual minerals of that group (such as to dickite and nacrite).	Glossary of Geology, Fifth Edition (revised), 2011
kataphorite	A black, greenish black or bluish black monoclinic member of the *amphibole* group: $Na_2Ca[Fe^{2+}{}_4(Al,Fe^{3+})](Si_7Al)O_{22}(OH)_2$.	Glossary of Geology, Fifth Edition (revised), 2011
kornerupine	A colorless, yellow, brown, or sea-green hard orthorhombic mineral: $(Mg,Fe^{2+})_4Al_6(Si,Al,B)_5O_{21}(OH)$. It resembles sillimanite in appearance and typically occurs in granulite facies rocks.	Glossary of Geology, Fifth Edition (revised), 2011
kyanite	A mainly blue but variously colored triclinic mineral: Al_2SiO_5. It is trimorphous with andalusite and sillimanite. Kyanite occurs in long, thin, bladed crystals and crystalline aggregates in schists, gneisses, and granite pegmatites, and has a hardness of 4-5 along the length of the crystal and 6-7 across it. It forms at medium temperatures and high pressures in regionally metamorphosed sequences. Also spelled: *cyanite.* Syn: *sappare; disthene.*	Glossary of Geology, Fifth Edition (revised), 2011
labradorite	A colorless to dark mineral of the plagioclase feldspar group with composition ranging from $Ab_{50}An_{50}$ to $Ab_{30}An_{70}$. It commonly shows a rich, beautiful play of colors (commonly blue or green), and is therefore much used for ornamental purposes. Labradorite is common in igneous rocks of intermediate to low silica content. Syn: *Labrador spar*.	Glossary of Geology, Fifth Edition (revised), 2011
lapis lazuli	(a) A blue, semitranslucent to opaque, granular crystalline rock used as a semiprecious stone for ornamental purposes and composed essentially of lazurite and calcite but also containing hauyne, sodalite, pyrite inclusions, and other minerals. It usually has a rich azure-blue color, but may be other	Glossary of Geology, Fifth Edition (revised), 2011

	shades of blue, depending on the amount of inclusions. It is probably the original sapphire of the ancients. Syn: *lazuli*. (b) An old name for lazurite, still used esp. for the gem variety. (c) An ultramarine-colored serpentine from India	
laumontite	A white or variously colored monoclinic zeolite mineral: $CaAl_2Si_4O_{12}{\cdot}4H_2O$. It sometimes contains appreciable sodium, and on exposure to air it loses water, becomes opaque, and crumbles. It occurs as prismatic crystals in veins in schist and slate, and in cavities in igneous rocks. Also spelled: *lomonite; lomontite.*	Glossary of Geology, Fifth Edition (revised), 2011
lawsonite	(a) A colorless to grayish-blue orthorhombic mineral: $CaAl_2Si_2O_7(OH)_2{\cdot}H_2O$. (b) A group name for minerals with an analogous formula, but with Ca replaced by Ba or Sr, and Al replaced by Mn^{3+}.	Glossary of Geology, Fifth Edition (revised), 2011
lepidolite	Group name for trioctahedral Li-rich micas, including the species polylithionite, trilithionite, taeniolite, and zinnwaldite. It commonly occurs in rose or lilac-colored masses made up of small scales, as in pegmatites. Syn: *lithium mica; lithia mica; lithionite.*	Glossary of Geology, Fifth Edition (revised), 2011
leucite	A white or gray tetragonal mineral of the *feldspathoid* group: $KAlSi_2O_6$. It is an important rock-forming mineral in alkalic rocks (esp. lavas), and usually occurs in trapezohedral crystals with a glassy fracture. Syn: *amphigene; grenatite; white garnet; Vesuvian garnet; vesuvian.*	Glossary of Geology, Fifth Edition (revised), 2011
limonite	(a) A general field term for a group of brown, amorphous, to cryptocrystalline naturally occurring hydrous ferric oxides whose real identities are unknown in absense of determinitive study. Limonite was formerly thought to be a distinct mineral ($2Fe_2O_3{\cdot}3H_2O$), but is now considered to have a variable composition (and variable chemical and physical properties) and to consist of any of several iron oxyhydroxides (commonly goethite) or of a mixture of several minerals (such as hematite, goethite, and lepidocrocite) with or without presumably adsorbed additional water. It is a common secondary substance formed by oxidation (weathering) of iron or iron-bearing minerals, and it may also be formed as an inorganic or biogenic precipitate in bogs, lakes, springs, or marine deposits; it occurs as coatings (such as ordinary rust), as loose or dense earthy masses, as pseudomorphs after other	Glossary of Geology, Fifth Edition (revised), 2011

	iron minerals, and in a variety of stalactitic, fibrous, reniform, botryoidal, or mammillary forms, and it represents the coloring material of yellow clays and soils. Limonite is commonly dark brown or yellowish brown, but may be yellow, red, or nearly black; it is a minor ore of iron. See also: *bog iron ore*. Syn: *brown iron ore; brown hematite; brown ocher*. (b) Informal term for the iron oxide-rich upper portion of *saprolite* soil profiles	
lizardite	The most abundant form of the trioctahedral serpentine minerals. It crystallizes as flat platelets. Variable amounts of Al substitute for both Mg and Si in the ideal serpentine formula of $Mg_3Si_2O_5(OH)_4$ to create a better lateral fit between the component octahedral and tetrahedral sheets than found in antigorite and chrysotile. Several polytypes exist: rhombohedral, trigonal, hexagonal, or monoclinic.	Glossary of Geology, Fifth Edition (revised), 2011
loellingite	(a) A metallic bright gray orthorhombic mineral: $FeAs_2$. Also spelled: *loellingite.* Syn: *leucopyrite.* (b) A group name for minerals with the formula AX_2, where *A* = Fe, Co, Ni or platinum-group elements, *X* = As, or Sb	Glossary of Geology, Fifth Edition (revised), 2011
maghemite	A strongly magnetic brown to bluish-black mineral possessing cation vacancies in the magnetite series of the *spinel* group: $Fe_{2.67}O_4$. It is dimorphous with hematite. Syn: *oxymagnite.*	Glossary of Geology, Fifth Edition (revised), 2011
magnesiokatophorite	A black, greenish black or reddish brown monoclinic mineral of the *amphibole* group, representing katophorite with essential Mg: $Na_2Ca(Mg_4Al)(Si_7Al)O_{22}(OH)_2$.	Glossary of Geology, Fifth Edition (revised), 2011
magnesioriebeckite	A blue or black monoclinic mineral of the *amphibole* group: $Na_2Mg^{2+}{}_3Fe^{3+}{}_2Si_8O_{22}(OH)_2$.	Glossary of Geology, Fifth Edition (revised), 2011
magnesite	A white to grayish, yellow, or brown rhombohedral mineral: $MgCO_3$. It is isomorphous with siderite. Magnesite is generally found as earthy masses or irregular veins resulting from the alteration of dolomite rocks, or of rocks rich in magnesium silicates, by magmatic solutions. It is used chiefly in making refractories and magnesia. Syn: *giobertite.*	Glossary of Geology, Fifth Edition (revised), 2011
magnetite	(a) A black, cubic, strongly magnetic, opaque mineral of the spinel group: $(Fe^{2+}Fe^{3+})Fe^{3+}O_4$. More properly it is an inverse spinel, with ferric iron in the bracketed tetrahedral site. It often contains variable amounts of titanium oxide, and it constitutes an important ore of iron. Magnetite commonly occurs in octahedrons and also granular or massive; it is a very common and widely	Glossary of Geology, Fifth Edition (revised), 2011

	distributed accessory mineral in rocks of all kinds (in orebodies as a magmatic segregation, in lenses enclosed in schists and gneisses, in igneous rocks as a primary mineral or as an alteration product, in placer deposits, and as a heavy mineral in sands). Syn: *magnetic iron ore; octahedral iron ore.* (b) A name applied to a series of isomorphous or near-isomorphous minerals in the spinel group, consisting of magnetite, magnesioferrite, franklinite, jacobsite, trevorite, and maghemite. Symbol: Mt.	
malachite	A bright-green monoclinic mineral: $Cu_2(CO_3)(OH)_2$. It is an ore of copper and is a common secondary mineral associated with azurite in the upper (oxidized) zones of copper veins. Malachite occurs in masses having smooth mammillated or botryoidal surfaces, and it is often concentrically banded in different shades of colors. It is used to make ornamental objects	Glossary of Geology, Fifth Edition (revised), 2011
manganite	A brilliant steel-gray or iron-black monoclinic mineral: $Mn^{3+}O(OH)$. It is trimorphous with groutite and feitknechtite, and is a minor ore mineral of manganese. Syn: *gray manganese ore*.	Glossary of Geology, Fifth Edition (revised), 2011
marcasite	. A common metallic light yellow or grayish orthorhombic mineral: FeS_2. It is dimorphous with pyrite and resembles it in appearance, but marcasite has a lower specific gravity, less chemical stability, and usually a paler color. Marcasite often occurs in sedimentary rocks (such as chalk) in the form of nodules or concretions with a radiating fibrous structure. Syn: *white iron pyrites; iron pyrites; white pyrite; white pyrites; cockscomb pyrites; spear pyrites; lamellar pyrites.*	Glossary of Geology, Fifth Edition (revised), 2011
margarite	. A dioctahedral monoclinic brittle mica of ideal composition $CaAl_2(Si_2Al_2)O_{10}(OH,F)_2$. It has a pale pink, green, or yellowish color, and is marked by a pearly luster. Syn: *lime mica; calcium mica; pearl mica.*	Glossary of Geology, Fifth Edition (revised), 2011
melilite	(a) A group of pale-colored tetragonal minerals of general formula: $(Na,Ca)_2(Mg,Al)(Si,Al)_2O_7$. It consists of an isomorphous solid-solution series, and may contain some iron. (b) A tetragonal, often honey-yellow mineral of the melilite group, such as the end members gehlenite and åkermanite. It occurs as a component of certain recent basic volcanic rocks. The melilites of volcanic rocks are usually classed as	Glossary of Geology, Fifth Edition (revised), 2011

	feldspathoids (even though they do not possess framework structures), but have also been considered as "undersaturated pyroxenes". Also spelled: *mellilite*	
mica	(a) A group of minerals of general formula: $(K,Na,Ca)(Mg,Fe,Li,Al)_{2-3}(OH,F)_2[(Si,Al)_4O_{10}]$. It consists of complex phyllosilicates that crystallize in forms apparently orthorhombic or hexagonal (such as tabular six-sided prisms) but really monoclinic; that are characterized by low hardness and by perfect basal cleavage, readily splitting into thin, tough, somewhat elastic laminae or plates with a splendent pearly luster; and that range in color from colorless, silvery white, pale brown, or yellow to green or black. Micas are prominent rock-forming constituents of igneous and metamorphic rocks, and commonly occur as flakes, scales, or shreds. Sheet muscovite is used in electric insulators; ground mica in paint and as a dusting agent. Cf: *brittle mica*. Syn: *isinglass; glimmer*. (b) Any mineral of the mica group, including muscovite, biotite, lepidolite, phlogopite, zinnwaldite, roscoelite, paragonite, and sericite.	Glossary of Geology, Fifth Edition (revised), 2011
microcline	A clear, white to gray, brick-red, or green mineral of the alkali *feldspar* group: $KAlSi_3O_8$. It is the fully ordered, triclinic modification of potassium feldspar and is dimorphous with orthoclase, being stable at lower temperatures; it usually contains some sodium in minor amounts. Microcline is a common rock-forming mineral of granitic rocks and pegmatites, and is often secondary after orthoclase. It is generally characterized by cross-hatch twinning.	Glossary of Geology, Fifth Edition (revised), 2011
molybdenite	A soft platy lead-gray mineral crystallizing in hexagonal aand rhombohedral polytypes: MoS_2. It is the principal ore of molybdenum. Molybdenite generally occurs in foliated masses or scales, and is found in pegmatite dikes and quartz veins or disseminated in porphyry; it resembles graphite in appearance and to the touch, but has a bluer color. Cf: *jordisite*.	Glossary of Geology, Fifth Edition (revised), 2011
monazite	A yellow, brown, or reddish-brown monoclinic mineral: $(Ce,La,Nd,Th)(PO_4,SiO_4)$. It is a rare-earth phosphate with appreciable substitution of thorium for rare earths and silicon for phosphorus; thorium-free monazite is rare. It is widely disseminated as an accessory mineral in	Glossary of Geology, Fifth Edition (revised), 2011

	granites, gneisses, and pegmatites, and it is often naturally concentrated in detrital sand, gravel, and alluvial tin deposits. Monazite is a principal ore of the rare earths and the main source of thorium. Several end-members of the lanthanide elements are known, and they are acknowledged by the Levinson notation: a hyphenated suffix of the principal element. Syn: *cryptolite*	
monticellite	A colorless, greenish-gray, or yellowish-gray orthorhombic mineral related to olivine: $CaMgSiO_4$. It is isomorphous with kirschsteinite and glaucochroite, and usually occurs in contact-metamorphosed limestones	Glossary of Geology, Fifth Edition (revised), 2011
montmorillonite	(a) A white, yellow, or green monoclinic mineral that has the origin of the layer charge primarily in the octahedral sheet. An ideal formula is: $(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot nH_2O$. Cf: *smectite*. (b) A name for a group of monoclinic dioctahedral micaceous minerals of analogous composition, but with (Na,Ca) replaced by Ca, and (Al,Mg) replaced by Fe^{3+} or Cr. Syn: *smectite*.	Glossary of Geology, Fifth Edition (revised), 2011
mullite	A white or variously colored orthorhombic mineral: $Al_{4+2x}Si_{2-2x}O_{10-x}$ ($x \sim 0.4$). Synthetic mullite is a valuable refractory material. Syn: *porcelainite*.	Glossary of Geology, Fifth Edition (revised), 2011
muscovite	(a) A mineral of the *mica* group: $KAl_2(Si_3Al)O_{10}(OH,F)_2$. It is colorless to yellowish or pale brown, and is a common mineral in gneisses and schists, in most acid igneous rocks (such as granites and pegmatites), and in many sedimentary rocks (esp. sandstones). Several monoclinic, triclinic and trigonal polytypes are recognized. Also spelled: *moscovite.* Syn: *white mica; potash mica; common mica; Muscovy glass; mirror stone.* (b) A term applied in clay mineralogy to *illite*. See also: *sericite; talcite*.	Glossary of Geology, Fifth Edition (revised), 2011
natrolite	A variously colored monoclinic zeolite mineral: $Na_2Al_2Si_3O_{10} \cdot 2H_2O$. It sometimes contains appreciable calcium, and usually occurs in slender, acicular or prismatic crystals. Partial syn: *mesotype; needle zeolite*.	Glossary of Geology, Fifth Edition (revised), 2011
nepheline	A hexagonal feldspathoid mineral: $(Na,K)AlSiO_4$. It occurs as glassy crystals or colorless grains, or as coarse crystals or green to brown masses of greasy luster without cleavage, in alkalic igneous rocks; it is an essential constituent of some sodium-rich rocks. Syn: *nephelite; eleolite*.	Glossary of Geology, Fifth Edition (revised), 2011
norbergite	A tan, yellow yellow-orange, orange-brown, or purplish pink	Glossary of Geology, Fifth Edition (revised), 2011

	orthorhombic mineral related to humite: $Mg_3(SiO_4)(F,OH)_2$.	
nosean	A cubic feldspathoid mineral of the *sodalite* group: $Na_8Al_6Si_6O_{24}(SO_4)\cdot H_2O$. It is gray, blue, or brown, and is related to hauyne.	Glossary of Geology, Fifth Edition (revised), 2011
oligoclase	A triclinic mineral of the plagioclase *feldspar* group with composition ranging from $Ab_{90}An_{10}$ to $Ab_{70}An_{30}$. It is common in igneous rocks of intermediate to high silica content.	Glossary of Geology, Fifth Edition (revised), 2011
olivine	(a) An olive-green, grayish-green, or brown orthorhombic mineral: $(Mg,Fe)_2SiO_4$. It consists of the isomorphous solid-solution series forsterite-fayalite. Olivine is a common rock-forming mineral of basic, ultrabasic, and low-silica igneous rocks (gabbro, basalt, peridotite, dunite); it crystallizes early from a magma, weathers readily at the Earth's surface, and metamorphoses to serpentine. (b) A name applied to a group of minerals with the general formula *A*2SiO4, where *A* = Mg, Fe^{2+}, Mn^{2+} or Ni. See also: *peridot; chrysolite [mineral].* Syn: *olivinoid*	Glossary of Geology, Fifth Edition (revised), 2011
omphacite	A grass-green to pale-green granular monoclinic of the pyroxene group, found as a common constituent in the rock *eclogite;* $(Ca,Na)(Fe^{2+},Al)Si_2O_6$. In thin section it is colorless, superficially resembling olivine. Syn: *tuxtlite.*	Glossary of Geology, Fifth Edition (revised), 2011
orthoamphibole	(a) A group name for amphiboles crystallizing in the orthorhombic system. (b) Any orthorhombic mineral of the *amphibole* group, such as anthophyllite, gedrite, and holmquistite. Cf: *clinoamphibole*	Glossary of Geology, Fifth Edition (revised), 2011
orthoclase	(a) A colorless, white, cream-yellow, flesh-pink, or gray mineral of the alkali *feldspar* group: $KAlSi_3O_8$. It is the partly ordered, monoclinic modification of potassium feldspar and is dimorphous with microcline, being stable at higher temperatures; it usually contains some sodium in minor amounts. Ordinary or common orthoclase is a common rock-forming mineral; it occurs esp. in granites, acid igneous rocks, and crystalline schists, and is usually perthitic. Syn: *common feldspar; orthose; pegmatolite.* (b) A general term applied to any potassium feldspar that is or appears to be monoclinic; e.g. sanidine, submicroscopically twinned microcline, adularia, and submicroscopically twinned analbite. Cf: *plagioclase; anorthoclase.*	Glossary of Geology, Fifth Edition (revised), 2011
orthopyroxene	(a) A group name for pyroxenes crystallizing in the orthorhombic system	Glossary of Geology, Fifth Edition (revised), 2011

	and usually containing no calcium and little or no aluminum. (b) Any orthorhombic mineral of the *pyroxene* group, such as enstatite, bronzite, hypersthene, and orthoferrosilite. Cf: *clinopyroxene*.	
paragonite	A yellowish or greenish mineral of the *mica* group: $NaAl_2(Si_3Al)O_{10}(OH)_2$. It crystallizes in several monoclinic and trigonal polytypes, and is the Na-analogue of muscovite, with Na in place of K in the interlayer position. It usually occurs in metamorphic rocks. Syn: *soda mica.*	Glossary of Geology, Fifth Edition (revised), 2011
pargasite	(a) A monoclinic mineral of the *amphibole* group: $NaCa_2(Mg_4Al)(Si_6Al_2)O_{22}(OH)_2$. Cf: *edenite.* (b) A green or blue-green variety of hornblende containing sodium and found in contact-metamorphosed rocks.	Glossary of Geology, Fifth Edition (revised), 2011
pectolite	A whitish or grayish triclinic mineral: $NaCa_2Si_3O_8(OH)$. It occurs in compact masses of divergent or parallel fibers, commonly in cavities in basalts and scoriaceous lavas. Cf: *sérandite.*	Glossary of Geology, Fifth Edition (revised), 2011
pentlandite	(a) A pale bronze to light-brown cubic mineral: $(Fe,Ni)_9S_8$. It is commonly intergrown with pyrrhotite, from which it is distinguished by its octahedral cleavage and lack of magnetism. Pentlandite is the principal ore of nickel. Syn: *folgerite; nicopyrite.* (b) A group name for cubic minerals with the general composition A_9S_8, where *A* = Fe, Ni, Co, Ag, Pb, Mn or Cu.	Glossary of Geology, Fifth Edition (revised), 2011
periclase	(a) A colorless cubic mineral with the rocksalt structure: MgO. It alters easily to brucite. Syn: periclasite. (b) A group name for cubic minerals with the rocksalt structure and the general formula *A*O, where *A* = Mg, Fe^{2+}, Ni, Mn^{2+}, Cd or Ca.	Glossary of Geology, Fifth Edition (revised), 2011
perovskite	(a) A yellow, brown, or grayish-black cubic mineral: $CaTiO_3$. It sometimes has cerium and other rare-earth elements. Cf: *latrappite*. Also spelled: *perofskite.* (b) A group name for cubic minerals with an analogous composition, but with Ca replaced by Na, and Ti replaced by Nb	Glossary of Geology, Fifth Edition (revised), 2011
petroliferous_phase	Bearing crude oil or natural gas. The term may be applied to a province, a geologic structure, or a geologic formation or unit.	Glossary of Geology, Fifth Edition (revised), 2011
phlogopite	A magnesium-rich mineral of the *mica* group: $KMg_3Si_3AlO_{10}(F,OH)_2$. It is yellowish brown to brownish red or copper-colored, and usually occurs in crystalline limestones as a result of dedolomitization. It crystallizes in	Glossary of Geology, Fifth Edition (revised), 2011

	monoclinic, trigonal and orthorhombic polytypes. Phlogopite is near biotite in composition, but contains little iron. Cf: *sodium phlogopite.* Syn: *magnesia mica; amber mica; brown mica.*	
phosphate_mineral	A mineral compound containing tetrahedral PO_4^{-3} groups. An example is fluorapatite, $Ca_5(PO_4)_3F$	Glossary of Geology, Fifth Edition (revised), 2011
pigeonite	A brown, greenish-brown, or black monoclinic mineral of the *pyroxene* group: $(Mg,Fe^{2+},Ca)SiO_3$. It is intermediate in composition between clinoenstatite and diopside, and has little calcium, little or no aluminum or ferric iron, and less ferrous iron than magnesium. Pigeonite is characterized optically by a small and variable axial angle (2V = 0-30°). It is found in basic igneous rocks at Pigeon Point in Minnesota. Cf: *augite*	Glossary of Geology, Fifth Edition (revised), 2011
pitchblende	A massive brown to black variety of uraninite, found in hydrothermal sulfide-bearing veins. It is fine-grained (colloform), amorphous, or microcrystalline, and has a distinctive pitchy to dull luster. Pitchblende contains a slight amount of radium; thorium and the rare earths are generally absent. Syn: *pitch ore; nasturan.*	Glossary of Geology, Fifth Edition (revised), 2011
plagioclase	(a) A group of triclinic feldspars of general formula: $(Na,Ca)[Al(Si,Al)Si_2O_8]$. At high temperatures it forms a complete solid-solution series from Ab $Na[AlSi_3O_8]$ to An $Ca[Al_2Si_2O_8]$. The plagioclase series is arbitrarily subdivided and named according to increasing mole fraction of the An component: albite (An 0-10), oligoclase (An 10-30), andesine (An 30-50), labradorite (An 50-70), bytownite (An 70-90), and anorthite (An 90-100). The Al/Si ratio ranges with increasing An content from 1:3 to 1:1. Plagioclase minerals are among the commonest rock-forming minerals, have characteristic twinning, and commonly display zoning. (b) A mineral of the plagioclase group; e.g. albite, anorthite, peristerite, and aventurine feldspar. The term was introduced by Breithaupt (1847, p.490) who applied it to all feldspars having an oblique angle between the two main cleavages. Cf: *alkali feldspar; orthoclase*. Syn: *sodium-calcium feldspar*	Glossary of Geology, Fifth Edition (revised), 2011
prehnite	A pale-green, yellow-brown, or white orthorhombic mineral: $Ca_2Al_2Si_3O_{10}(OH)_2$. It usually occurs in crystalline aggregates having a botryoidal or mammillary and radiating	Glossary of Geology, Fifth Edition (revised), 2011

	structure, and is commonly associated with zeolites in geodes, druses, fissures, or joints in altered igneous rocks.	
protoenstatite	An artificial, unstable modification of $MgSiO_3$, produced by decomposition of talc by heating, and convertible to enstatite by grinding or by heating to a high temperature.	Glossary of Geology, Fifth Edition (revised), 2011
pumpellyite	A group name for monoclinic minerals with the general formula $Ca_2AB^{3+}{}_2(SiO_4)(Si_2O_7)(OH,O)_2 \cdot H_2O$, where *A* = Mg, Mn^{2+}, Fe^{2+}, Fe^{3+}, or Al and *B* = Al, Fe^{3+}, Mn^{3+}, or Cr. See also: *chlorastrolite*. Syn: *zonochlorite; lotrite*	Glossary of Geology, Fifth Edition (revised), 2011
pyrite	(a) A common, pale-bronze or brass-yellow, cubic mineral: FeS_2. It is dimorphous with marcasite, and often contains small amounts of other metals. Pyrite has a brilliant metallic luster and an absence of cleavage, and has been mistaken for gold (which is softer and heavier). It commonly crystallizes in cubes (whose faces are usually striated), octahedrons, or pyritohedrons, and it also occurs in shapeless grains and masses. Pyrite is the most widespread and abundant of the sulfide minerals and occurs in all kinds of rocks, such as in nodules in sedimentary rocks and coal seams or as a common vein material associated with many different minerals. Pyrite is an important ore of sulfur, less so of iron, and is burned in making sulfur dioxide and sulfuric acid; it is sometimes mined for the associated gold and copper. Cf: *pyrites*. Syn: *iron pyrites; fool's gold; mundic; common pyrites.* (b) A group name for minerals isomorphous with pyrite, with the general formula AX_2, where *A* = Fe, Co, Ni, Mn, Cu, Au, Ru, Os, Ir or Pt, and *X* = S and, more rarely, Se, Te, Sb or As.	Glossary of Geology, Fifth Edition (revised), 2011
pyrope	(a) The magnesium-aluminum end-member of the garnet group, characterized by a deep fiery-red color: $Mg_3Al_2(SiO_4)_3$. It rarely occurs in crystals, but is found in detrital deposits as rounded and angular fragments, or associated with olivine and serpentine in basic igneous rocks such as kimberlite. See also: *Cape ruby; Bohemian garnet*. Syn: *rock ruby*. (b) An obsolete name for a bright red gem, such as a ruby.	Glossary of Geology, Fifth Edition (revised), 2011
pyrophyllite	A white, gray, blue, green, or brown mineral occurring in monoclinic and triclinic polytypes: $Al_2Si_4O_{10}(OH)_2$. It resembles talc and occurs in a foliated form or in compact masses in quartz veins, granites, and esp. metamorphic rocks. Syn: *pencil stone*	Glossary of Geology, Fifth Edition (revised), 2011

pyroxene	(a) A group of dark rock-forming silicate minerals, closely related in crystal form and composition and having the general formula: $A_2M_2Si_4O_{12}$, where *A* = Ca, Na, Mg, or Fe^{2+}, and *B* = Mg, Fe^{2+}, Fe^{3+}, Cr, Mn, or Al, with silicon sometimes replaced in part by aluminum. It is characterized by a single chain of tetrahedra with a silicon:oxygen ratio of 1:3; by short, stout prismatic crystals; and by good prismatic cleavage in two directions parallel to the crystal faces and intersecting at angles of about 87° and 93°. Colors range from white to dark green or black. Pyroxenes may crystallize in the orthorhombic or monoclinic systems; they constitute a common constituent of igneous rocks, and are similar in chemical composition to the amphiboles (except that the pyroxenes lack hydroxyls). (b) A mineral of the pyroxene group, such as enstatite, hypersthene, diopside, hedenbergite, acmite, jadeite, pigeonite, and esp. augite. Etymol: Greek "pyros", "fire", + "xenos", "stranger", apparently so named from the mistaken belief that the pyroxenes "were only accidentally caught up in the lavas that contain them" (Challinor, 1978, p.250). Pron: pie-rok-seen or peer-ok-seen.	Glossary of Geology, Fifth Edition (revised), 2011
pyrrhotite	A common red-brown to bronze hexagonal to pseudohexagonal mineral: $Fe_{1-x}S$(x=0 to 0.17). Many ordered superstructures are known for discrete values of *x*. It has a defect structure with a lattice of hexagonal close-packed S ions in which some of the Fe ions are lacking. Some pyrrhotite is magnetic. The mineral is darker and softer than pyrite; it is usually found massive and commonly associated with pentlandite, sometimes containing as much as 5% nickel, in which case it is mined as an ore of nickel. Syn: *pyrrhotine; magnetic pyrites; dipyrite*	Glossary of Geology, Fifth Edition (revised), 2011
quartz	(a) Crystalline silica, an important rock-forming mineral: SiO_2. It is, next to feldspar, the commonest mineral, occurring either in transparent hexagonal crystals (colorless, or colored by impurities) or in crystalline or cryptocrystalline masses. Quartz is the commonest gangue mineral of ore deposits, forms the major proportion of most sands, and has a widespread distribution in igneous (esp. granitic), metamorphic, and sedimentary rocks. It has a vitreous to greasy luster, a conchoidal fracture, an absence of	Glossary of Geology, Fifth Edition (revised), 2011

	cleavage, and a hardness of 7 on the Mohs scale (scratches glass easily, but cannot be scratched by a knife); it is composed exclusively of silicon-oxygen tetrahedra with all oxygens joined together in a three-dimensional network. It is polymorphous with cristobalite, tridymite, stishovite, coesite and keatite. Symbol: Q. Abbrev: qtz; qz. Etymol: German provincial "Quarz". Cf: *tridymite*; *cristobalite*; *coesite*; *stishovite*. (b) A general term for a variety of noncrystalline or cryptocrystalline minerals having the same chemical composition as that of quartz, such as chalcedony, agate, and opal.	
rhodochrosite	A rose-red or pink to gray rhombohedral mineral of the calcite group: $Mn^{2+}CO_3$. It is isomorphous with calcite and siderite, and commonly contains some calcium and iron; it is a minor ore of manganese. Syn: *dialogite*; *manganese spar*; *raspberry spar*	Glossary of Geology, Fifth Edition (revised), 2011
rhodonite	A pale-red, rose-red, or flesh-pink to brownish-red or red-brown triclinic pyroxenoid mineral: $(Mn^{2+},Fe^{2+},Mg,Ca)SiO_3$. It sometimes contains zinc, and is often marked by black streaks and veins of manganese oxide. Rhodonite is used as an ornamental stone, esp. in Russia. Syn: *manganese spar*; *manganolite [mineral]*; *rhodarsenide*	Glossary of Geology, Fifth Edition (revised), 2011
riebeckite	A dark blue or black monoclinic mineral of the *amphibole* group: $Na_2Fe^{2+}{}_3Fe^{3+}{}_2Si_8O_{22}(OH)_2$. It occurs as a primary constituent in some acid or sodium-rich igneous rocks. See also: *crocidolite*	Glossary of Geology, Fifth Edition (revised), 2011
rubellite	A pale rose-red to deep ruby-red transparent lithian variety of tourmaline, used as a gemstone. Syn: *red schorl*.	Glossary of Geology, Fifth Edition (revised), 2011
ruby	The red variety of corundum, containing small amounts of chromium, used as a gemstone, and found esp. in the Orient (Myanmar, Sri Lanka, Thailand). Cf: *sapphire*	Glossary of Geology, Fifth Edition (revised), 2011
rutile	A usually reddish-brown tetragonal mineral: TiO_2. It is trimorphous with anatase and brookite, and often contains a little iron. Rutile forms prismatic crystals in other minerals (esp. quartz); it occurs as a primary mineral in some acid igneous rocks (esp. those rich in hornblende), in metamorphic rocks, and as residual grains in sediments and beach sands. It is an ore of titanium. Syn: *red schorl*.	Glossary of Geology, Fifth Edition (revised), 2011
sanidine	A high-temperature mineral of the alkali	Glossary of Geology, Fifth

	feldspar group: $(K,Na)(Al,Si)_4O_8$. It is a highly disordered monoclinic form, occurring in clear, glassy, often tabular crystals embedded in unaltered acid volcanic rocks such as trachyte; it appears to be stable under equilibrium conditions above approximately 500°C. Sanidine forms a complete solid-solution series with high albite, and some sodium is always present. Syn: *glassy feldspar; ice spar; rhyacolite.*	Edition (revised), 2011
sapphire	(a) Any pure, gem-quality corundum other than *ruby;* esp. the fine blue transparent variety of crystalline corundum of great value, containing small amounts of oxides of cobalt, chromium, and titanium, used as a gemstone, and found esp. in the Orient (Kashmir, Myanmar, Thailand, Sri Lanka). Other colors, such as pink, purple, yellow, green, and orange, are included under *fancy sapphire*. Syn: *sappare*. (b) Any gem from a corundum crystal.	Glossary of Geology, Fifth Edition (revised), 2011
sapphirine	(a) A green or pale-blue dense, hard mineral crystallizing in monoclinic and triclinic forms: $Mg_7Al_{18}Si_3O_{40}$. It is a principal constituent of certain high-grade silica-deficient metamorphic rocks and occurs usually in granular form. (b) A name applied to certain blue minerals such as hauyne and blue chalcedony.	Glossary of Geology, Fifth Edition (revised), 2011
scapolite	(a) A group of minerals of general formula: $(Na,Ca,K)_4Al_3(Al,Si)_3Si_6O_{24}(Cl,F,OH,CO_3,SO_4)$. It consists of generally white or gray-white minerals crystallizing in the dipyramidal class of the tetragonal system, and commonly forms an isomorphous series between marialite and meionite. Scapolite minerals characteristically occur in calcium-rich metamorphic rocks or in igneous rocks as the products of alteration of basic plagioclase feldspars. (b) A specific mineral of the scapolite group, intermediate in composition between marialite and meionite (Ma:Me from 2:1 to 1:3), containing 46-54% silica, and resembling feldspar when massive but having a fibrous appearance and a higher specific gravity. Syn: *wernerite*. (c) A member of the scapolite group, including scapolite, marialite, meionite, and mizzonite.	Glossary of Geology, Fifth Edition (revised), 2011
schorl	(a) A vitreous black rhombohedral mineral of the *tourmaline* group: $NaFe^{2+}{}_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$. (b) An obsolete term for any of several dark	Glossary of Geology, Fifth Edition (revised), 2011

	minerals other than tourmaline; e.g. hornblende. Also spelled: *shorl;* schorl. Syn: *schorlite*	
sericite	A white, fine-grained potassium mica occurring in small scales and flakes as an alteration product of various aluminosilicate minerals, having a silky luster, and found in various metamorphic rocks (esp. in schists and phyllites) or in the wall rocks, fault gouge, and vein fillings of many ore deposits. It is usually muscovite or very close to muscovite in composition, and may also include much illite.	Glossary of Geology, Fifth Edition (revised), 2011
serpentine	(a) A group of common rock-forming minerals having the general formula: $(Mg,Al,Fe,Mn,Ni,Zn)_{2-3}(Si,Al,Fe)_2O_5(OH)_4$. Serpentines have a greasy or silky luster, a slightly soapy feel, and a tough, conchoidal fracture; they are usually compact but may be granular or fibrous, and are commonly green, greenish-yellow, or greenish-gray and often veined or spotted with green, and white. Serpentines are always secondary minerals, derived by alteration of magnesium-rich silicate minerals (esp. olivines), and are found in both igneous and metamorphic rocks; they generally crystallize in the monoclinic system. Translucent varieties are used for ornamental and decorative purposes, often as a substitute for jade. (b) A mineral of the serpentine group, such as chrysotile, antigorite, lizardite, parachrysotile, and orthochrysotile. Etymol: Latin "serpentinus", "resembling a serpent", from the mottled shades of green	Glossary of Geology, Fifth Edition (revised), 2011
sillimanite	(a) A brown, gray, pale-green, or white orthorhombic mineral: Al_2SiO_5. It is trimorphous with kyanite and andalusite. Sillimanite occurs in long, slender, needlelike crystals often found in wisplike or fibrous aggregates in schists and gneisses; it forms at the highest temperatures and pressures of a regionally metamorphosed sequence and is characteristic of the innermost zone of contact-metamorphosed sediments. Syn: *fibrolite.* (b) A group of aluminum-silicate minerals including sillimanite, kyanite, andalusite, dumortierite, topaz, and mullite.	Glossary of Geology, Fifth Edition (revised), 2011
silver	A soft white cubic or hexagonal mineral, the native metallic element Ag. It occurs in stringers and veins in volcanic and sedimentary rocks and in the upper parts of silver-sulfide lodes, and is often associated with small amounts of gold, mercury, copper, lead, tin, platinum,	Glossary of Geology, Fifth Edition (revised), 2011

	and other metals. Silver is ductile, malleable, and resistant to oxidation or corrosion, though it tarnishes brown; it has the highest thermal and electric conductivity of any substance. It is used for coinage, jewelry, and tableware, in photography, dentistry, and electroplating, and as a catalyst.	
sodalite	(a) A cubic mineral of the *feldspathoid* group: $Na_4Al_3Si_3O_{12}Cl$. It is usually blue or blue-violet, but may be white, greenish, gray, pink, or yellow, and it occurs in various sodium-rich igneous rocks. (b) A group of bluish feldspathoid minerals containing sodium silicate, including sodalite, hauyne, nosean, and lazurite	Glossary of Geology, Fifth Edition (revised), 2011
spessartine	The manganese-aluminum end-member of the *garnet* group: $Mn^{2+}{}_3Al_2(SiO_4)_3$. It has a brown-red to yellow-brown color, and usually contains some iron, magnesium, and other elements in minor amounts. Spessartine is rather rare; it occurs in pegmatites and granites. Syn: *spessartite [mineral].*	Glossary of Geology, Fifth Edition (revised), 2011
sphalerite	(a) A yellow, brown, or black cubic mineral: (Zn,Fe)S. It is dimorphous with wurtzite, and often contains manganese, arsenic, cadmium, and other elements. Sphalerite has a highly perfect dodecahedral cleavage and a resinous to adamantine luster. It is a widely distributed ore of zinc, commonly associated with galena in veins and other deposits. Syn: *blende; zinc blende; jack [mineral]; blackjack [mineral]; steel jack; false galena; pseudogalena; mock ore; mock lead.* (b) A group name for cubic minerals with the formula *AX*, where *A* = Zn, Cd or Hg, and *X* = S, Se or Te	Glossary of Geology, Fifth Edition (revised), 2011
spinel	(a) A mineral: $MgAl_2O_4$. The magnesium may be replaced in part by ferrous iron, and the aluminum by ferric iron. Spinel has great hardness, usually forms octahedral crystals (cubic system), varies widely in color (from colorless to purple-red, green, and yellow to black), and is used as a gemstone. It occurs typically as a product of contact metamorphism of impure dolomitic limestone, and less commonly as an accessory mineral of basic igneous rocks; it also occurs in alluvial deposits. (b) A group of minerals of general formula: AB_2O_4 where *A* = Mg, Fe^{2+}, Zn, Mn^{2+}, Ni, Co, Cu and is in tetrahedral coordination by oxygen, and *B* = Al, Fe^{3+}, Cr, V^{3+}, Ti^{4+}, Ge, or Sb and is in octahedral coordination by oxygen. In	Glossary of Geology, Fifth Edition (revised), 2011

	"inverse" spinels, half of the B^{3+} atoms are in tetrahedral sites, and the remaining B^{3+} atoms and the B^{2+} atoms are in octahedral sites. (c) A member of the spinel group or spinel series. (d) A substance (such as a sulfide) that has a similar formula and the same crystal structure as a spinel. (e) An artificial substance, similar to the mineral spinel, that is used as a gemstone, a refractory, or instrument bearings; e.g. ferrospinel. Also spelled: spinelle; spinell	
spodumene	A monoclinic mineral of the *pyroxene* group: $LiAlSi_2O_6$. It occurs mainly in white to green prismatic lath-like crystals, often of great size, esp. in granitic pegmatites. Spodumene is an ore of lithium. See also: *kunzite; hiddenite*. Syn: *triphane*	Glossary of Geology, Fifth Edition (revised), 2011
staurolite	A dark reddish brown, blackish brown, yellowish brown, or blue monoclinic (pseudo-orthorhombic) mineral: $(Fe,Mg)_4Al_{17}(Si,Al)_8O_{45}(OH)_3$. Twinned crystals often resemble a cross (six-sided prisms intersecting at 90° and 60°). It is a common constituent in rocks such as mica schists and gneisses that have undergone medium-grade metamorphism. Syn: *staurotide; cross-stone; grenatite; fairy stone*.	Glossary of Geology, Fifth Edition (revised), 2011
stibnite	A metallic lead-gray mineral: Sb_2S_3. It has a brilliant metallic luster, differs from galena by ease of fusion, and often contains gold and silver. Stibnite occurs in massive forms and in prismatic orthorhombic crystals that show highly perfect cleavage and are striated vertically. It is the principal ore of antimony. Syn: *antimonite; antimony glance; gray antimony; stibium*.	Glossary of Geology, Fifth Edition (revised), 2011
stilbite	A white, yellowish, gray, pink, reddish or brown, colorless to tan monoclinic zeolite mineral: $(Ca_{0.5},Na,K)_5(Si,Al)_{36}O_{72}\cdot 30H_2O$. It represents the Ca-dominant form of stilbite, and occurs in sheaflike aggregates of crystals and also in radiated masses. Syn: *desmine; epidesmine.*	Glossary of Geology, Fifth Edition (revised), 2011
stilpnomelane	A black, greenish-black, or bronze triclinic mineral, a trioctahedral Fe-rich phyllosilicate based on a modulation of a 2:1 T-O-T layer: $K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{36}\cdot nH_2O$. It occurs in micalike plates, fibrous forms, and velvety bronze-colored incrustations. Syn: *chalcodite.*	Glossary of Geology, Fifth Edition (revised), 2011
stishovite	A colorless tetragonal mineral: SiO_2. It is a high-pressure, extremely dense (4.35 g/cm^3) polymorph of quartz, produced under static conditions at pressures	Glossary of Geology, Fifth Edition (revised), 2011

	above about 100 kb and found naturally associated with coesite and only in shock-metamorphosed quartz-bearing rocks such as those from Barringer Crater (Meteor Crater), Ariz., and the Ries basin, Germany. Its occurrence provides a criterion for meteorite impact. Stishovite has a closely packed rutile type of structure in which the silicon has a coordination number of 6 (instead of 4 as in quartz and coesite); it forms at higher pressures than coesite and is apparently less stable at lower pressures after formation. Syn: *stipoverite.*	
strontianite	A pale green, white, gray, or yellowish orthorhombic mineral of the *aragonite* group: $SrCO_3$.	Glossary of Geology, Fifth Edition (revised), 2011
talc	(a) An extremely soft, light green or gray monoclinic mineral: $Mg_3Si_4O_{10}(OH)_2$. It has a characteristic soapy or greasy feel and a hardness of 1 on the Mohs scale, and it is easily cut with a knife. Talc is a common secondary mineral derived by alteration (hydration) of nonaluminous magnesium silicates (such as olivine, enstatite, and tremolite) in basic igneous rocks, or by metamorphism of dolomite rocks, and it usually occurs in foliated, granular, or fibrous masses. Talc is used as a filler, coating, and dusting agent, in ceramics, rubber, plastics, lubricants, and talcum powder. Originally spelled: talck. See also: *steatite.* (b) In commercial usage, a talcose rock; a rock consisting of talc, tremolite, chlorite, anthophyllite, and related minerals. (c) A thin sheet of muscovite mica.	Glossary of Geology, Fifth Edition (revised), 2011
tetrahedrite	A steel-gray to iron-black cubic mineral of the *tennantite* group: $(Cu,Fe,Ag,Zn)_{12}Sb_4S_{13}$. It often contains zinc, lead, mercury, cobalt, nickel, or silver replacing part of the copper. Tetrahedrite commonly occurs in characteristic tetrahedral crystals associated with copper ores. It is an important ore of copper and sometimes a valuable ore of silver. Syn: *fahlore; gray copper ore; panabase; stylotypite*	Glossary of Geology, Fifth Edition (revised), 2011
thompsonite	A colorless to pink, yellowish, brown, or greenish orthorhombic zeolite mineral: $NaCa_2Al_5Si_5O_{20}\cdot 6H_2O$. It has considerable replacement of CaAl by NaSi, and sometimes contains no sodium. It usually occurs in masses of radiating crystals. Syn: *ozarkite.*	Glossary of Geology, Fifth Edition (revised), 2011
titanite - sphene	(a) A usually yellow or brown monoclinic mineral: $CaTiSiO_5$. It often contains other elements such as niobium,	Glossary of Geology, Fifth Edition (revised), 2011

	chromium, fluorine, sodium, iron, manganese, and yttrium. Titanite occurs in wedge-shaped or lozenge-shaped monoclinic crystals as an accessory mineral in granitic rocks and in calcium-rich metamorphic rocks. Syn: *sphene; grothite.* (b) A group name for monoclinic minerals with an analogous composition, but with Ti replaced by Sn or V.	
topaz	(a) A white or lightly colored orthorhombic mineral: $Al_2SiO_4(F,OH)_2$. It occurs as a minor constituent in highly siliceous igneous rocks and tin-bearing veins as translucent or transparent prismatic crystals and masses, and as rounded waterworn pebbles. Topaz has a hardness of 8 on the Mohs scale. (b) A transparent topaz used as a gemstone. (c) A yellow quartz that resembles topaz in appearance, such as smoky quartz turned yellow by heating; specif. *false topaz* and *Scotch topaz*. See also: *Spanish topaz*. (d) A term used for a green-yellow to orange-yellow mineral resembling topaz in appearance, such as "oriental topaz" (a yellow corundum).	Glossary of Geology, Fifth Edition (revised), 2011
tourmaline	(a) A group of minerals of general formula: $(Na,Ca)(Mg,Fe^{2+},Fe^{3+},Al,Li)_3Al_6(OH)_4(BO_3)_3[Si_6O_{18}]$. It sometimes contains fluorine in small amounts. (b) Any of the minerals of the *tourmaline* group, such as buergerite, elbaite, and dravite. Tourmaline occurs in 3-, 6-, or 9-sided prisms, usually vertically striated, or in compact or columnar masses; it is commonly found as an accessory mineral in granitic pegmatites, and is widely distributed in acid igneous rocks and in metamorphic rocks. Its color varies greatly and gives a basis for naming the varieties; when transparent and flawless, it may be cut into gems. See also: *schörl; elbaite*. Also spelled: *turmaline*.	Glossary of Geology, Fifth Edition (revised), 2011
tremolite	A white to dark-gray monoclinic mineral of the amphibole group: $Ca_2Mg_5Si_8O_{22}(OH)_2$. It has varying amounts of iron, and may contain manganese and chromium. Tremolite occurs in long blade-shaped or short stout prismatic crystals and also in columnar, fibrous, or granular masses or compact aggregates, generally in metamorphic rocks such as crystalline dolomitic limestones and talc schists. It is a constituent of much commercial talc. Cf: *actinolite*.	Glossary of Geology, Fifth Edition (revised), 2011
tridymite	A vitreous colorless mineral: SiO_2. It is a	Glossary of Geology, Fifth

	high-temperature polymorph of quartz, and usually occurs as minute tabular white or colorless crystals or scales, in cavities in acidic volcanic rocks such as trachyte and rhyolite. Tridymite is stable between 870° and 1,470°C; it has an orthorhombic structure (alpha-tridymite) at low temperatures and a hexagonal structure (beta-tridymite) at higher temperatures. Cf: *cristobalite*. Syn: *christensenite.*	Edition (revised), 2011
troilite	A metallic bronze hexagonal mineral of the *pyrrhotite* group: FeS. It is present in small amounts in almost all meteorites.	Glossary of Geology, Fifth Edition (revised), 2011
tschermakite	(a) A monoclinic mineral of the *amphibole* group with end-member composition $Ca_2(Mg_3AlFe^{3+})(Si_6Al_2)O_{22}(OH)_2$. Not to be confused with *Ca-Tschermak molecule*. (b) A gray-white feldspar (albite?) containing some magnesium but no calcium, from Bamble, Norway. (c) A plagioclase feldspar (oligoclase or albite) with composition ranging from $Ab_{95}An_5$ to $Ab_{80}An_{20}$.	Glossary of Geology, Fifth Edition (revised), 2011
ulvospinel	A metallic cubic mineral of the *spinel* group: $TiFe^{2+}{}_2O_4$. It usually occurs as fine exsolution lamellae, intergrown with magnetite. Syn: *ulvite.*	Glossary of Geology, Fifth Edition (revised), 2011
uraninite	(a) A black, brown, or steel-gray cubic mineral, essentially UO_2, but usually partly oxidized. It is strongly radioactive, and is the chief ore of uranium. Uraninite often contains impurities such as thorium, radium, the cerium and yttrium metals, and lead; when heated, it yields a gas consisting chiefly of helium. It occurs in veins of lead, tin, and copper minerals and in sandstone deposits, and is a primary constituent of granites and pegmatites. See also: *pitchblende*. Syn: *ulrichite; coracite.* (b) A group name for cubic minerals with the general formula AO_2, where *A* = U, Th, Ce, or Zr.	Glossary of Geology, Fifth Edition (revised), 2011
vermiculite	(a) A 2:1 layer monoclinic clay mineral distinguished from smectite on the basis of a higher layer charge, generally set at greater than 0.6 per formula unit: $Mg_{0.7}(Mg,Fe,Al)_6(Si,Al)_8O_{20}(OH)_4 \cdot 8H_2O$. (b) A group name for sheet silicates with exchangeable cations.	Glossary of Geology, Fifth Edition (revised), 2011
vesuvianite	A dense, brittle tetragonal mineral: $(Ca,Na)_{19}(Al,Mg,Fe)_{13}(SiO_4)_{10}(Si_2O_7)_4(OH,F,O)_{10}$. It is usually brown, yellow, or green, sometimes contains iron and fluorine, and is commonly found in contact-metamorphosed limestones. Syn: *idocrase; vesuvian*.	Glossary of Geology, Fifth Edition (revised), 2011

witherite	A variously colored orthorhombic mineral of the *aragonite* group: $BaCO_3$.	Glossary of Geology, Fifth Edition (revised), 2011
wollastonite	A triclinic or monoclinic chain silicate mineral of the pyroxenoid type: $CaSiO_3$. It dimorphous with parawollastonite. Wollastonite is found in contact-metamorphosed limestones, and occurs usually in cleavable masses or sometimes in tabular twinned crystals; it may be white, gray, brown, red, or yellow. It is not a pyroxene. Several polytypes have been characterized. Symbol: Wo. Syn: *tabular spar.*	Glossary of Geology, Fifth Edition (revised), 2011
wustite	A metallic gray cubic mineral of the *periclase* group: $Fe^{2+}O$. Artificially prepared specimens are characteristically deficient in iron. Also spelled: wustite. Syn: *iozite.*	Glossary of Geology, Fifth Edition (revised), 2011
altered uraninite	Uraninite: A black, brown, or steel-gray cubic mineral, essentially UO_2, but usually partly oxidized. It is strongly radioactive, and is the chief ore of uranium. Uraninite often contains impurities such as thorium, radium, the cerium and yttrium metals, and lead; when heated, it yields a gas consisting chiefly of helium. It occurs in veins of lead, tin, and copper minerals and in sandstone deposits, and is a primary constituent of granites and pegmatites. See also: *pitchblende*. Syn: *ulrichite; coracite.*	Glossary of Geology, Fifth Edition (revised), 2011
zircon	(a) A mineral: $ZrSiO_4$. It occurs in tetragonal prisms, has various colors and is a common accessory mineral in siliceous igneous rocks, crystalline limestones, schists, and gneisses, in sedimentary rocks derived therefrom, and in beach and river placer deposits. It is the chief ore of zirconium, and is used as a refractory; when cut and polished, the colorless varieties provide exceptionally brilliant gemstones. Syn: *zirconite; hyacinth*; jacinth. (b) A group name for tetragonal minerals with the general formula $ASiO_4$, where A = Zr, Hg, Th, or U.	Glossary of Geology, Fifth Edition (revised), 2011
zoisite	A variously colored orthorhombic mineral related to epidote: $Ca_2Al_3(SiO_4)(Si_2O_7)O(OH)$. It often contains appreciable ferric iron, and is white, gray, brown, green, or rose red in color. Zoisite occurs in metamorphic rocks (esp. schists formed from calcium-rich igneous rocks), and in altered igneous rocks, and is an essential constituent of saussurite. Cf: *clinozoisite*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.30 vocab_MinPurpose

Categories denoting the reason for noting a mineral.

Term	Definition	Reference
composition	A substance or preparation formed by combination or mixture of various ingredients.	Oxford English Dictionary
economic	commodity which is sufficiently scarce in relation to demand to command a price.	Oxford English Dictionary
metamorphic	**metamorphic** (met-a-mor'-phic) Pertaining to the process of *metamorphism* or to its results.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.31 vocab_MovementSense

Categories denoting the sense of movement of a geologic structure.

Term	Definition	Reference
dextral	A strike-slip fault on which the side opposite the observer has been displaced to the right. Syn: *dextral fault*.	Glossary of Geology, Fifth Edition (revised), 2011
sinistral	A fault on which the displacement is *left-lateral separation*. Syn: *sinistral fault*.	Glossary of Geology, Fifth Edition (revised), 2011
normal	Said of an anticlinorium in which the axial surfaces of the subsidiary folds converge downwards; said of a synclinorium in which the axial surfaces of the subsidiary folds converge upwards. Cf: *abnormal*.	Glossary of Geology, Fifth Edition (revised), 2011
detachment	*décollement*.	Glossary of Geology, Fifth Edition (revised), 2011
reverse	(a) Pertaining to the basal side of an incrusting or freely growing bryozoan colony. (b) Aspect of graptoloid rhabdosome (especially early growth stages or biserial forms) in which *sicula* is more or less concealed by *crossing canals*. Cf: *obverse*.	Glossary of Geology, Fifth Edition (revised), 2011
thrust	(a) An overriding movement of one crustal unit over another, as in thrust faulting. (b) *thrust fault*.	Glossary of Geology, Fifth Edition (revised), 2011
thrust decollement	as above	
normal dextral	as above	
normal sinistral	as above	
reverse dextral	as above	
reverse sinistral	as above	

4.1.32 vocab_MovementType

Categories denoting type of movement of a geologic structure.

Term	Definition	Reference
dip separation sense	The distance or *separation* of formerly adjacent beds on either side of a fault surface, measured in the dip direction of the fault. Cf: *dip slip*; *strike separation*. See also: *dip-separation fault*.	Glossary of Geology, Fifth Edition (revised), 2011
dip slip	In a fault, the component of the movement or slip that is parallel to the dip of the fault. Cf: *dip*	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	separation; strike slip; oblique slip.	
oblique slip	In a fault, movement or net slip that has *dip slip* and *strike slip* components.	Glossary of Geology, Fifth Edition (revised), 2011
transpressional	A system of stresses that tends to cause oblique shortening, i.e., combined shortening and strike slip. (b) In crustal deformation, an inetrmediate stage between compression and strike-slip motion; it occurs in zones with oblique compression and combines strike-slip or wrench movement with a superposed compression perpendicular to the wrench or stike-slip zone. The tectonic style in Caledonian Spitzbergen provides evidence for a transpression regime (Harland, 1971). Cf: *Transtension.*	Glossary of Geology, Fifth Edition (revised), 2011
transtensional	A system of stresses that tends to cause oblique extension, i.e., combined extension and strike slip. (b) In crustal deformation, an inetrmediate stage between extension and strike-slip motion; it occurs in zones with oblique extension and combines strike-slip or wrench movement with a superposed extension perpendicular to the wrench or stike-slip zone.	Adapted from Glossary of Geology, Fifth Edition (revised), 2011
strike-slip	In a fault, the component of the movement or slip that is parallel to the strike of the fault. Cf: *dip slip; strike separation; oblique slip.* Syn: *horizontal displacement; horizontal separation.* Partial syn: *strike shift.*	Glossary of Geology, Fifth Edition (revised), 2011
transcurrent	A term used for a continental strike-slip fault that does not terminate at plate boundaries. Cf: *transform fault*.	Glossary of Geology, Fifth Edition (revised), 2011
transform	(a) A strike-slip fault that links two other faults or two other plate boundaries (e.g. two segments of a mid-ocean ridge). Transform faults often exhibit characteristics that distinguish them from transcurrent faults: (1) For transform faults formed at the same time as the faults they link, slip on the transform fault has equal magnitude at all points along the transform; slip magnitude on the transform fault can exceed the length of the transform fault, and slip does not decrease to zero at the fault termini. (2) For transform faults linking two similar features, e.g. if two mid-ocean ridge segments linked by a transform have equal spreading rates, then the length of the transform does not change as slip accrues on it. (b) A type of plate boundary at which lithosphere is neither created or destroyed, and plates slide past each other on a strike-slip fault. Cf: *transcurrent fault*.	Glossary of Geology, Fifth Edition (revised), 2011
wrench	A regional-scale strike-slip fault. Typically, use of the term carries with it the implication that the strike-slip movement resulted in formation of a complex band of subsidiary faults and *en echelon* folds. Obsolete and little-used syn: *basculating fault; torsion fault.*	Glossary of Geology, Fifth Edition (revised), 2011
horizontal	adj. In geodesy, said of a direction that is tangent to the *geop* at a given point. Cf: *vertical.*	Glossary of Geology, Fifth Edition (revised), 2011
scissor	A fault on which there is increasing offset or separation along the strike from an initial point of no offset, with reverse offset in the opposite	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	direction. The separation may be due to a scissorlike or pivotal movement on the fault, or it may be the result of uniform strike-slip movement along a fault across a synclinal or anticlinal fold. The terminology is not rigorous, is often used in error, and should be avoided; *pivotal fault*, *hinge fault*, and *rotational fault* are similarly used. Obsolete syn: *differential fault.*	

4.1.33 vocab_PlanePolarity

Categories denoting the polarity of planar structure.

Term	Definition	Reference
upright	A fold having an essentially vertical axial surface; a *vertical fold*.	Glossary of Geology, Fifth Edition (revised), 2011
overturned	Said of a fold, or the limb of a fold, that has tilted beyond the perpendicular. Sequence of strata thus appears reversed. Syn: *inverted; reversed.*	Glossary of Geology, Fifth Edition (revised), 2011
vertical	Said of a direction that is perpendicular to a *horizontal* plane and parallel to which the force of gravity acts.	Glossary of Geology, Fifth Edition (revised), 2011
not applicable	Polarity is not applicable to a particular structure	
unknown	Polarity is not recorded	

4.1.34 vocab_PositionReason

Categories denoting the reason for the geographic position of a linear entity on a map.
Not used.

4.1.35 vocab_PubMediaType

Categories denoting the type of media used to publish an item.

Term	Definition	Reference
paper		
digital	Said of the representation of measured quantities in discrete or quantized units. A digital computer is one in which information is stored and manipulated as a series of discrete numbers, as opposed to an *analog* computer.	Glossary of Geology, Fifth Edition (revised), 2011
CD-ROM		
DVD		
on-line		
scanned map		
vector	(a) A matrix (or array of numbers) consisting of only one row or one column. (b) A format for processing and displaying graphic data. Vector data are represented by strings of coordinate pairs defining the true position of features represented by points, lines, and areas. (c) In digital terminology, the line connecting two nodes. (d) A quantity having both a magnitude and a direction.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.36 vocab_PubSeries

Categories denoting the type of series of a publication.

Term	Definition	Reference
GSC "A" Series Map		
GSC Open File		
GSC Preliminary Map		
NWT Open File		
NWT - NU Open File		
YGS Open File		
YGS Geoscience Map		
GSC Canadian Geoscience Map		

4.1.37 vocab_PubStatus

Categories denoting the status of a publication.

Term	Definition	Reference
published		
in prep.		
in press		
unpublished		

4.1.38 vocab_SetCrustalPosition

Categories denoting the position relative to the Earth's crust.

Term	Definition	Reference
on crust		
within crust		
within mantle		
on crust		

4.1.39 vocab_SetEnvironmentSuper

Categories denoting the general geologic process associated with a setting.

Term	Definition	Reference
extrusive setting		
impact structure	A generally circular or craterlike structure produced by impact (usually extraterrestrial) on a planetary surface. The stage of erosion of the structure and the nature of the impacting body need not be specified.	Glossary of Geology, Fifth Edition (revised), 2011
intrusive setting	Pertaining to intrusion, both the process and the body so formed. n. An *intrusive* rock or body.	Glossary of Geology, Fifth Edition (revised), 2011
magmatic - intrusive and extrusive	Said of a rock or mineral that solidified from molten or partly molten material, i.e. from a magma; also, applied to processes leading to, related to, or resulting from the formation of such rocks. Igneous rocks constitute one of the three main classes into which rocks are divided, the	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	others being metamorphic and sedimentary.	
marine	Of, relating to, or characteristic of the sea; existing, originating, or found in the sea; produced by the sea; inhabiting or growing in the sea	Oxford English Dictionary
metamorphic setting	Pertaining to the process of *metamorphism* or to its results.	Glossary of Geology, Fifth Edition (revised), 2011
nonmarine	Pertaining to deposition on land	
sedimentary - carbonate setting	Setting enabling accumulation of sediment formed by the biotic or abiotic precipitation from aqueous solution of carbonates of calcium, magnesium, or iron; e.g. limestone and dolomite.	Glossary of Geology, Fifth Edition (revised), 2011
sedimentary - terrigenous setting	Setting enabling the accumulation of rock or sediment composed principally of broken fragments that are derived from preexisting rocks or minerals and that have been transported some distance from their places of origin	Glossary of Geology, Fifth Edition (revised), 2011
supracrustal - sedimentary and extrusive	Said of rocks that overlie the *basement*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.40 vocab_SetEnvironSubA

Categories denoting a regional process, event, or feature involved in a setting.

Term	Definition	Reference
algal flat	flat: Having or marked by a continuous surface or stretch of land that is smooth, even, or horizontal, or nearly so, and that lacks any significant curvature, slope, elevations, or depressions. n. A general term for a level or nearly level surface or small area of land marked by little or no relief, as a plain; specif: *mud flat*; *valley flat*.	Adapted from Glossary of Geology, Fifth Edition (revised), 2011
alluvial fan	A low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan or a segment of a cone, deposited by a stream (esp. in a semiarid region) at the place where it issues from a narrow mountain valley upon a plain or broad valley, or where a tributary stream is near or at its junction with the main stream, or wherever a constriction in a valley abruptly ceases or the gradient of the stream suddenly decreases; it is steepest near the mouth of the valley where its apex points upstream, and it slopes gently and convexly outward with gradually decreasing gradient. Cf: *alluvial cone*; *bajada*. Syn: *detrital fan; talus fan*; *dry delta*. [**image**]	Glossary of Geology, Fifth Edition (revised), 2011
alluvial plain	A level or gently sloping tract or a slightly undulating land surface produced by extensive deposition of alluvium, usually adjacent to a river that periodically overflows its banks; it may be situated on a floodplain, a delta, or an alluvial fan. Cf: *alluvial flat*. Syn: *wash plain*; *waste plain*; *river plain*; *aggraded valley plain*;	Glossary of Geology, Fifth Edition (revised), 2011

	bajada. [**image**]	
ash fall setting	Airborne ash that falls from an eruption cloud, and the resulting deposit. Cf: *pumice fall*. Syn: *ash shower*.	Glossary of Geology, Fifth Edition (revised), 2011
back shore	The upper or inner, usually dry, zone of the shore or beach, lying between the high-water line of mean spring tides and the upper limit of shore-zone processes; it is acted upon by waves or covered by water only during exceptionally severe storms or unusually high tides. It is essentially horizontal or slopes gently landward, and is divided from the *foreshore* by the crest of the most seaward berm.	Glossary of Geology, Fifth Edition (revised), 2011
barrier island	(a) A long, narrow, sandy coastal island, representing a broadened barrier beach that is above high tide and parallel to the shore, and that commonly has dunes and marshy terranes extending landward from the beach. Examples include Long Beach, N.J., and the Lido in Venice. This feature was termed an *offshore bar* by Johnson (1919). (b) A detached portion of a *barrier beach* between two inlets (Wiegel, 1953, p.5).	Glossary of Geology, Fifth Edition (revised), 2011
beach ridge - dune ridge	A series of parallel dunes, whose movements are arrested by the growth of vegetation, along the shore of a retreating sea. See also: *foredune*.	Glossary of Geology, Fifth Edition (revised), 2011
braided channel complex	A stream channel that frequently branches and rejoins after separation by visible bars or islands with lenticular shapes.	Glossary of Geology, Fifth Edition (revised), 2011
braidplain	A stream that divides into or follows an interlacing or tangled network of several small branching and reuniting shallow channels separated from each other by ephemeral branch islands or channel bars, resembling in plan the strands of a complex braid. Such a stream is generally believed to indicate an inability to carry all of its load, such as an overloaded and aggrading stream flowing in a wide channel on a floodplain. Cf: *anastomosing stream*; *split stream*.	Glossary of Geology, Fifth Edition (revised), 2011
caldera complex - caldera	A large, basin-shaped volcanic depression, more or less circular or cirquelike in form, the diameter of which is many times greater than that of the included vent or vents, no matter what the steepness of the walls or form of the floor (Williams, 1941). It is formed by collapse during an eruption. Etymol: Spanish, "kettle." See also: *collapse caldera*; *erosion caldera*; *explosion caldera*; *cauldron [volc]*.	Glossary of Geology, Fifth Edition (revised), 2011
cone - cone row	Volcanic cone	Glossary of Geology, Fifth Edition (revised), 2011
crater setting	A basinlike, rimmed structure that is usually at the summit of a volcanic cone. It commonly forms over a vent during an eruption. During hydrovolcanic eruptions, a crater may form by gradual accumulation of pyroclastic material into a surrounding rim. Cf: *caldera*.	Glossary of Geology, Fifth Edition (revised), 2011

crustal melt setting	Pertaining to the outermost layer or shell of the Earth, defined according to various criteria, including seismic velocity, density and composition; that part of the Earth above the Mohorovicic discontinuity, made up of the *sial* and the *sima*. It represents less than 0.1% of the Earth's total volume.	Glossary of Geology, Fifth Edition (revised), 2011
debris avalanche	The very rapid and usually sudden sliding and flowage of incoherent, unsorted mixtures of soil and weathered bedrock.	Glossary of Geology, Fifth Edition (revised), 2011
delta distributary	(a) A divergent stream flowing away from the main stream and not returning to it, as in a delta or on an alluvial plain. It may be produced by stream deposition choking the original channel. Ant: *tributary*. (b) One of the channels of a braided stream; a channel carrying the water of a stream distributary.	Glossary of Geology, Fifth Edition (revised), 2011
delta front	A narrow zone where deposition in deltas is most active, consisting of a continuous sheet of sand, and occurring within the effective depth of wave erosion (10 m or less). It is the zone separating the *prodelta* from the *delta plain*, and it may or may not be steep.	Glossary of Geology, Fifth Edition (revised), 2011
delta plain	The level or nearly level surface composing the landward part of a large or compound delta; strictly, an alluvial plain characterized by repeated channel bifurcation and divergence, multiple distributary channels, and interdistributary flood basins. Syn: *intradelta.* Cf: *marine delta plain*.	Glossary of Geology, Fifth Edition (revised), 2011
diatreme - breccia pipe	Funnel-shaped breccia pipe that reaches as much as 2,500 m depth. Diatremes are thought to form by hydrovolcanic fragmentation and wall-rock collapse. Diatremes may underlie maars and grade at depth into dikes (Vespermann and Schmincke, 2000). Sp: *diatrema*.	Glossary of Geology, Fifth Edition (revised), 2011
dune field	Extensive deposits on sand in an area where the supply is abundant. As a characteristic, individual dunes somewhat resemble barchans but are highly irregular in shape and crowded; *erg* areas of the Sahara are an example.	Glossary of Geology, Fifth Edition (revised), 2011
estuarine	Pertaining to or formed or living in an estuary; esp. said of deposits and of the sedimentary or biological environment of an estuary.	Glossary of Geology, Fifth Edition (revised), 2011
fan delta	(a) A gently sloping alluvial deposit produced where a mountain stream flows out onto a lowland. (b) *alluvial-fan shoreline; delta fan*. Cf: *arcuate delta*.	Glossary of Geology, Fifth Edition (revised), 2011
floodplain	(a) The surface or strip of relatively smooth land adjacent to a river channel, constructed by the present river in its existing regimen and covered with water when the river overflows its banks. It is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current. A river has one floodplain and may have one or more terraces representing abandoned floodplains. Cf: *valley flat; erosional floodplain*.	Glossary of Geology, Fifth Edition (revised), 2011

	(b) Any flat or nearly flat lowland that borders a stream and that may be covered by its waters at flood stages; the land described by the perimeter of the maximum probable flood. Syn: *floodland*. (c) The part of a lake-basin plain between the shoreline and the shore cliff, subject to submergence during a high stage of the lake.	
gibber plain	A desert plain strewn with wind-abraded pebbles, or *gibbers*; a gravelly desert in Australia.	Glossary of Geology, Fifth Edition (revised), 2011
glaciofluvial	Pertaining to the meltwater streams flowing from wasting glacier ice and esp. to the deposits and landforms produced by such streams, as kame terraces and outwash plains; relating to the combined action of glaciers and streams. Syn: *fluvioglacial*; *glacioaqueous*.	Glossary of Geology, Fifth Edition (revised), 2011
glaciolacustrine	Pertaining to, derived from, or deposited in glacial lakes; esp. said of the deposits and landforms composed of suspended material brought by meltwater streams flowing into lakes bordering the glacier, such as deltas, kame deltas, and varved sediments.	Glossary of Geology, Fifth Edition (revised), 2011
glaciomarine	The accumulation of glacially eroded, terrestrially derived sediment in the marine environment. Sediment may be introduced by fluvial transport, by ice rafting, as an ice-contact deposit, or by eolian transport. Deposits can be divided into a variety of glacial-marine (or "glacio-marine") facies (Molnia, 1983).	Glossary of Geology, Fifth Edition (revised), 2011
hemipelagic	Deep-sea sediment in which more than 25% of the fraction coarser than 5 μm is of terrigenous, volcanogenic, and/or neritic origin. Such deposits usually accumulate near the continental margin and adjacent abyssal plains, so that continentally derived sediment is more abundant than in eupelagic sediments, and the sediment has undergone lateral transport. Cf: *terrigenous deposit*; *pelagic deposit*.	Glossary of Geology, Fifth Edition (revised), 2011
hydrothermal	Of or pertaining to hot water, to the action of hot water, or to the products of this action, such as a mineral deposit precipitated from a hot aqueous solution, with or without demonstrable association with igneous processes; also, said of the solution itself.	Glossary of Geology, Fifth Edition (revised), 2011
hydrovolcanic setting	Term encompassing all volcanic activity that results from the interaction between lava, magmatic heat, or gases and meteoric or connate water at or near the surface of the Earth (Wohletz and Heiken, 1992, p.378). Syn: *phreatomagmatic*.	Glossary of Geology, Fifth Edition (revised), 2011
ignimbrite	The deposit of a pyroclastic flow. The term originally implied dense welding but there is no longer such a restriction, so that the term includes rock types such as *welded tuff* and nonwelded *sillar*. See also: *tufflava*; *ash-flow tuff*. Syn: *flood tuff*.	Glossary of Geology, Fifth Edition (revised), 2011
interdistributary bay	A pronounced indentation of the delta front between advancing stream distributaries, occupied by shallow water, and either open to the sea or partly enclosed by minor	Glossary of Geology, Fifth Edition (revised), 2011

	distributaries.	
intertidal	*littoral [oceanog]*.	Glossary of Geology, Fifth Edition (revised), 2011
laccolith	A concordant igneous intrusion with a convex-up roof and known or assumed flat floor. Syn: *laccolite*.	Glossary of Geology, Fifth Edition (revised), 2011
lagoon	Typically, a narrow water body that is parallel to the shore and is between the mainland and a barrier and parallel to the shore. Little or no fresh water in flux and limited tidal flux cause elevated salinities (Davis, 1983).	Glossary of Geology, Fifth Edition (revised), 2011
lahar	A *mudflow [mass move]* composed chiefly of volcaniclastic materials on the flank of a volcano. The debris carried in the flow includes pyroclasts, blocks from primary lava flows, and epiclastic material. Etymol: Indonesian. Syn: *mudflow [volc].*	Glossary of Geology, Fifth Edition (revised), 2011
landslide - avalanche	A general term covering a wide variety of mass-movement landforms and processes involving the downslope transport, under gravitational influence, of soil and rock material en masse. Usually the displaced material moves over a relatively confined zone or surface of shear. The wide range of sites and structures, and of material properties affecting resistance to shear, result in a great range of landslide morphology, rates, patterns of movement, and scale. Landsliding is usually preceded, accompanied, and followed by perceptible creep along the surface of sliding and/or within the slide mass. Terminology designating landslide types generally refers to the landform as well as the process responsible for it, e.g. *rockfall*, *translational slide*, *block glide*, *avalanche*, *mudflow*, *liquefaction slide*, and *slump*. Syn: *landsliding*; *slide [mass move]*; *landslip*.	Glossary of Geology, Fifth Edition (revised), 2011
lava dome	A steep-sided, rounded accumulation of lava extruded from a volcano to form a dome-shaped or bulbous mass of congealed lava above and around the vent (Peterson and Tilling, 2000). Commonly parasitic on the flanks of, or within the crater of, larger edifices, e.g., Unzen, Showa Sin-Zan. Syn: *volcanic dome.* Cf: *coulee [volc]*; *endogenous dome*; *exogenous dome*; *low dome*; *peleean dome*; *upheaved plug*; *torta*.	Glossary of Geology, Fifth Edition (revised), 2011
lava field	A more or less well-defined area that is covered by lava flows. Cf: *ash field*; *volcanic field*.	Glossary of Geology, Fifth Edition (revised), 2011
littoral	Pertaining to the benthic ocean environment or depth zone between high water and low water; also, pertaining to the organisms of that environment. Syn: *intertidal.* See also: *sublittoral.* Cf: *supralittoral*.	Glossary of Geology, Fifth Edition (revised), 2011
maar - tuff ring setting	A low-relief, broad volcanic crater formed by multiple shallow explosive eruptions. It is surrounded by a *crater ring*, and may be filled by water. Type occurrence is in the Eifel area of Germany.	Glossary of Geology, Fifth Edition (revised), 2011
meandering channel complex	(a) One of a series of regular freely developing sinuous curves, bends, loops, turns, or windings	Glossary of Geology, Fifth Edition (revised), 2011

	in the course of a stream. It is produced by a mature stream swinging from side to side as it flows across its floodplain or shifts its course laterally toward the convex side of an original curve. Etymol: Greek maiandros, from Maiandros River in western Asia Minor (now known as Menderes River in SW Turkey), proverbial for its windings. (b) *valley meander*. v. To wind or turn in a sinuous or intricate course; to form a meander.	
mud flat	A relatively level area of fine silt along a shore (as in a sheltered estuary) or around an island, alternately covered and uncovered by the tide, or covered by shallow water; a muddy *tidal flat* barren of vegetation. Cf: *sand flat; slikke.* Syn: *flat [geomorph].*	Glossary of Geology, Fifth Edition (revised), 2011
nearshore	Extending seaward or lakeward an indefinite but generally short distance from the shoreline; specif. said of the indefinite zone extending from the low-water shoreline well beyond the breaker zone, defining the area of nearshore currents, and including the *inshore* zone and part of the *offshore* zone. Nearshore is sometimes defined as extending across the area of longshore bars. Depths are generally less than 5 fathoms (10 m).	Glossary of Geology, Fifth Edition (revised), 2011
offshore	(a) Situated off or at a distance from the shore; specif. said of the comparatively flat, always submerged zone of variable width extending from the breaker zone to the seaward edge of the continental shelf. Ten meters is a suggested minimal depth. The offshore zone is seaward of the *inshore* or *nearshore* zone or the *shoreface* (CERC, 1966, p. A43; and Johnson, 1919, p.161), although it is often regarded (e.g. Shepard, 1967, p.43) as the zone extending seaward from the low-water shoreline. (b) Pertaining to a direction seaward or lakeward from the shore; e.g. an *offshore* wind or one that blows away from the land, or an *offshore* current or one moving away from the shore. Ant: *onshore*. See also: *nearshore*. Syn: *off-lying.*	Glossary of Geology, Fifth Edition (revised), 2011
pelagic	Said of marine organisms whose environment is the open ocean, rather than the bottom or shore areas. Pelagic organisms may be either *nektonic* or *planktonic*.	Glossary of Geology, Fifth Edition (revised), 2011
periglacial	(a) Said of the processes, conditions, areas, climates, and topographic features at the immediate margins of former and existing glaciers and ice sheets, and influenced by the cold temperature of the ice. (b) By extension, said of an environment in which frost action is an important factor, or of phenomena induced by a periglacial climate beyond the periphery of the ice. Syn: *cryergic; cryonival; paraglacial; subnival.* Term introduced by Lozinski (1909).	Glossary of Geology, Fifth Edition (revised), 2011
phreatomagmatic setting	Explosive volcanic eruption caused by interaction of magma with groundwater or shallow surface water. Syn: *hydrovolcanic*. Sp: *eruptción freatomagmática*.	Glossary of Geology, Fifth Edition (revised), 2011

pipe -– diatreme	Funnel-shaped breccia pipe that reaches as much as 2,500 m depth. Diatremes are thought to form by hydrovolcanic fragmentation and wall-rock collapse. Diatremes may underlie maars and grade at depth into dikes (Vespermann and Schmincke, 2000). Sp: *diatrema*.	Glossary of Geology, Fifth Edition (revised), 2011
plateau - oceanic	A broad, more or less flat-topped elevation of the sea floor, generally over 200 m in height. Syn: *submarine plateau*. Sp: *meseta submarina*.	Glossary of Geology, Fifth Edition (revised), 2011
platform	That part of a continent that is covered by flat-lying or gently tilted strata, mainly sedimentary, which are underlain at varying depths by a *basement* of rocks that were consolidated during earlier deformations. A platform is a part of the *craton*.	Glossary of Geology, Fifth Edition (revised), 2011
playa	A term used in SW U.S. for a dry, vegetation-free, flat area at the lowest part of an undrained desert basin, underlain by stratified clay, silt, or sand, and commonly by soluble salts. The term is also applied to the basin containing an expanse of playa, which may be marked by ephemeral lakes. See also: *salina; alkali flat; salt flat; salt pan; salar; salada; saline mudflat; saline pan; dry mudflat*. Syn: *dry lake; vloer; sabkha; kavir; takir*. (	Glossary of Geology, Fifth Edition (revised), 2011
prodelta	The part of a delta that is below the effective depth of wave erosion, lying beyond the *delta front*, and sloping gently down to the floor of the basin into which the delta is advancing and where clastic river sediment ceases to be a significant part of the basin-floor deposits; it is entirely below the water level. Cf: *delta plain*.	Glossary of Geology, Fifth Edition (revised), 2011
proglacial	Immediately in front of or just beyond the outer limits of a glacier or ice sheet, generally at or near its lower end; said of lakes, streams, deposits, and other features produced by or derived from the glacier ice.	Glossary of Geology, Fifth Edition (revised), 2011
pumice flow setting	A type of *pyroclastic flow* in which a large proportion of the fragments are of pumice. Cf: *ash flow*.	Glossary of Geology, Fifth Edition (revised), 2011
pyroclastic flow setting	A density current of pyroclastic material, usually very hot and composed of a mixture of gases and particles. A syn. of ash flow used in a more general sense in that an ash flow is composed of ash-sized *pyroclasts*. Cf: *pyroclastic surge*.	Glossary of Geology, Fifth Edition (revised), 2011
pyroclastic surge setting	Low-density, dilute, turbulent *pyroclastic flow*. Types of pyroclastic surges include base surges, ash-cloud surges, and ground-surges.	Glossary of Geology, Fifth Edition (revised), 2011
reef complex	A solid reef and the heterogeneous and contiguous fragmentary material derived from it by abrasion; the aggregate of reef, fore-reef, back-reef, and interreef deposits, bounded on the seaward side by basin sediments and on the landward side by lagoonal sediments (Nelson et al., 1962, p.249). Term introduced by Henson (1950, p.215-216) to include the reef and "all genetically(?) associated sediments". Cf: *reef tract*.	Glossary of Geology, Fifth Edition (revised), 2011

sabkha	(a) A supratidal environment of sedimentation, formed under arid to semiarid conditions on restricted coastal plains just above normal high-tide level (a saline marine marsh). It is the gradational zone between the land surface and the intertidal environment. Sabkhas are characterized by evaporite-saline minerals, tidal-flood, and eolian deposits, and are found on many modern coastlines, e.g. Persian Gulf, Gulf of California. (b) Any flat area, coastal or interior, where, through deflation and evaporation, saline minerals crystallize near or at the surface. (c) In the rock record, a sabkha facies may be indicated by evaporites, absence of fossils, thin flat-pebble conglomerates, stromatolitic laminae, desiccation features such as mud cracks, and diagenetic modifications, for example disrupted bedding, dissolution and replacement phenomena, and dolomitization. The sabkha environment may have been significant in the formation of certain petroleum and sulfide-mineral deposits (Kinsman, 1969; Renfro, 1974). Etymol: Arabic. Also spelled: sabkhah; sebkha.	Glossary of Geology, Fifth Edition (revised), 2011
sand plain	A sand-covered plain.	Glossary of Geology, Fifth Edition (revised), 2011
shoal	adj. Having little depth; shallow. n. (a) A relatively shallow place in a stream, lake, sea, or other body of water; a *shallows*. (b) A submerged ridge, bank, or bar consisting of or covered by sand or other unconsolidated material, rising from the bed of a body of water to near the surface so as to constitute a danger to navigation; specif. an elevation, or an area of such elevations, at a depth of 10 fathoms (formerly 6) or less, composed of material other than rock or coral. It may be exposed at low water. Cf: *reef*. (c) A rocky area on the sea floor within soundings. (d) A growth of vegetation on the bottom of a deep lake, occurring at any depth. v. To become shallow gradually; to cause to become shallow; to fill up or block off with a shoal; to proceed from a greater to a lesser depth of water.	Glossary of Geology, Fifth Edition (revised), 2011
shoreface	(a) The zone between the seaward limit of the shore and the more nearly horizontal surface of the *offshore* zone; typically extends seaward to storm wave depth or about 10 m. The term "shore face" was originally used by Barrell (1912, p.385-386), in his study of deltas, for the relatively narrow slope developed by breaking waves and separating the subaerial plain from the subaqueous one below. Not to be confused with *beach face*. See also: *inshore*. (b) A relatively steep but short concave inner portion of the continental shelf (Price, 1954, p.81).	Glossary of Geology, Fifth Edition (revised), 2011
slope failure	Gradual or rapid downslope movement of soil or rock under gravitational stress.	Glossary of Geology, Fifth Edition (revised), 2011
strandplain	A syn. of shore and *beach*; the land bordering any large body of water, esp. the beach of a sea or an arm of the ocean, or the bank of a large	Glossary of Geology, Fifth Edition (revised), 2011

	river.	
subglacial	(a) Formed or accumulated in or by the bottom parts of a glacier or ice sheet; said of meltwater streams, till, moraine, etc. Syn: *infraglacial.* (b) Pertaining to the area immediately beneath a glacier, as *subglacial* eruption or *subglacial* drainage.	Glossary of Geology, Fifth Edition (revised), 2011
submarine fan	A terrigenous, cone- or fan-shaped deposit located seaward of large rivers and submarine canyons. Syn: *submarine cone; abyssal cone; abyssal fan; subsea apron; deep-sea fan; submarine delta; sea fan; fan [marine geol]; cone [marine geol].*	Glossary of Geology, Fifth Edition (revised), 2011
supraglacial	*superglacial*. Carried upon, deposited from, or pertaining to the top surface of a glacier or ice sheet; said of meltwater streams, till, drift, etc.	Glossary of Geology, Fifth Edition (revised), 2011
tidal channel	(a) A major channel followed by the tidal currents, extending from offshore into a tidal marsh or a tidal flat. (b) *tidal inlet.*	Glossary of Geology, Fifth Edition (revised), 2011
tidal flat	An extensive, nearly horizontal, barren tract of land that is alternately covered and uncovered by the tide, and consisting of unconsolidated sediment (mostly mud and sand). It may form the top surface of a deltaic deposit. Cf: *tidal marsh; mud flat.* Syn: *tide flat.*	Glossary of Geology, Fifth Edition (revised), 2011
tidal marsh - salt marsh	Flat, poorly drained land that is subject to periodic or occasional overflow by salt water, containing water that is brackish to strongly saline, and usually covered with a thick mat of grassy halophytic plants; e.g. a coastal marsh periodically flooded by the sea, or an inland marsh (or *salina*) in an arid region and subject to intermittent overflow by water containing a high salt content. Cf: *tidal marsh; marine marsh.* Cf: *salting; open-coast marsh; tidal-delta marsh.*	Glossary of Geology, Fifth Edition (revised), 2011
transgressive	Said of a minor igneous intrusion, typically tabular, that cuts across the bedding or foliation of the country rock rather than confining itself to a single horizon.	Glossary of Geology, Fifth Edition (revised), 2011
weathering zone	The superficial layer of the Earth's crust above the water table that is subjected to the destructive agents of the atmosphere, and in which soils develop.	Glossary of Geology, Fifth Edition (revised), 2011
wetland - alluvial	An area marginal to a river course that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year (NOAA, 2004). The term has supplanted more colloquial terms such as swamp and marsh.	Glossary of Geology, Fifth Edition (revised), 2011
wetland - coastal	Wetland: A coastal area that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year (NOAA, 2004). The term has supplanted more	Glossary of Geology, Fifth Edition (revised), 2011

4.1.41 vocab_SetEnvironSubB

Categories denoting a local feature involved in the geologic setting.

Term	Definition	Reference
atoll	A coral reef appearing in plan view as a ring or horseshoe-shaped reef, rising from deep water of (1) the open sea (such as central Pacific), (2) a submarine bank or plateau of intermediate depth (e.g. Queensland Plateau), or (3) a continental shelf (e.g. Great Barrier Reef or Sahul Shelf). The three categories are identified respectively as "classic" or "open-sea" type, *bank atolls*, and *shelf atolls*. Atolls vary in size from about 1 km to more than 100 km. Smaller atolls built on the rim of a larger one are *faros*. Miniature growths of biological reef builders in the range of 1 to 10 m are called *microatolls*. Atoll reefs are commonly crowned by a discontinuous ring of islets built of coral sands, breccia or a pre-exisiting (emerged) reef. Cf: *motu*. Etymol: native name in the Maldive Islands (Indian Ocean) which are typical examples of this structure. Syn: *lagoon island; ring reef; reef ring.*	Glossary of Geology, Fifth Edition (revised), 2011
avalanche	A large mass of snow, ice, soil, or rock, or mixtures of these materials, falling, sliding, or flowing very rapidly under the force of gravity. Velocities may sometimes exceed 500 km/hr. [**image**]	Glossary of Geology, Fifth Edition (revised), 2011
backreef	The landward side of a reef. The term is often used adjectivally to refer to deposits within the restricted lagoon behind a barrier reef, such as the "back-reef facies" of lagoonal deposits. In some places, as on a platform-edge reef tract, "back reef" refers to the side of the reef away from the open sea, even though no land may be nearby. Cf: *fore reef*. Also spelled: backreef.	Glossary of Geology, Fifth Edition (revised), 2011
bar	A ridgelike accumulation of sand, gravel, or other alluvial material formed in the channel, along the banks, or at the mouth, of a stream where a decrease in velocity induces deposition; e.g. a *channel bar* or a *meander bar*. See also: *river bar*.	Glossary of Geology, Fifth Edition (revised), 2011
bog	(a) Waterlogged, spongy ground, consisting primarily of mosses, containing acidic, decaying vegetation that may develop into peat. (b) The vegetation characteristic of this environment, esp. sphagnum, sedges, and heaths. Cf: *fen; marsh; swamp*.	Glossary of Geology, Fifth Edition (revised), 2011
caliche	The term caliche has been applied broadly in SW U.S. (esp. Arizona) to a reddish-brown to buff or white calcareous material of secondary accumulation, commonly found in layers on or near the surface of stony soils of arid and semiarid regions, but also occurring as a subsoil deposit in subhumid climates. It is composed largely of crusts of soluble calcium salts in addition to such materials as gravel, sand, silt, and clay. It may occur as a thin porous friable horizon within the soil, but more commonly it is several centimeters to a meter or more in	Glossary of Geology, Fifth Edition (revised), 2011

	thickness, impermeable, and strongly indurated; the cementing material is essentially calcium carbonate, but it may include magnesium carbonate, silica, or gypsum. The term has also been used for the calcium-carbonate cement itself. Caliche appears to form by a variety of processes, e.g. capillary action, in which soil solutions rise to the surface and on evaporation deposit their salt content on or in the surface materials. It is called *hardpan*, calcareous *duricrust*, or *calcrete* in some localities, and *kankar* in parts of India. Syn: *soil caliche; calcareous crust; nari; sabach; tepetate*. Etymol: American Spanish, from a Spanish word for almost any porous material (such as gravel) cemented by calcium carbonate. "The Spanish word originally was used for a small stone or pebble accidentally burned with the clay mass when brick or tile was made, and it also was used for a crust of lime or similar material flaking from a wall" (Cottingham, 1951, p.162).	
canyon	A long, deep, relatively narrow steep-sided valley confined between lofty and precipitous walls in a plateau or mountainous area, often with a stream at the bottom; similar to, but larger than, a *gorge*. It is characteristic of an arid or semiarid area (such as western U.S.) where stream downcutting greatly exceeds weathering; e.g. Grand Canyon. long, fairly straight cave; a karst valley.	Glossary of Geology, Fifth Edition (revised), 2011
canyon mouth		
cavern	A *cave [speleo]*, generally understood to be of large size; a system or series of caves or cave chambers. Commonly used to denote a *show cave*.	Glossary of Geology, Fifth Edition (revised), 2011
channel levee	An embankment of sediment, bordering one or both sides of a submarine canyon, fan valley, or deep-sea channel. It is similar to a river-channel levee in the subaerial environment.	Glossary of Geology, Fifth Edition (revised), 2011
collapse breccia setting	A coarse-grained clastic rock, composed of angular broken rock fragments held together by a mineral cement or in a fine-grained matrix; it differs from *conglomerate* in that the fragments have sharp edges and unworn corners. Breccia may originate as a result of sedimentary processes such as talus accumulation (*sedimentary breccia*); igneous processes, esp. explosive (*igneous breccia, volcanic breccia*); disturbance during sedimentation (intraclastic breccia); collapse of rock material (*solution breccia, collapse breccia*); or tectonic processes (*fault breccia*). Etymol: Italian, "broken stones, rubble". Syn: *rubblerock*. Cf: *conglomerate*.	Glossary of Geology, Fifth Edition (revised), 2011
debris flow	A moving mass of rock fragments, soil, and mud, more than half of the particles being larger than sand size. Slow debris flows may move less that 1 m per year; rapid ones reach 160 km per hour, as in the 1977 Huascaran flow in the Peruvian Andes. Cf: *mudflow [mass move]; sturzstrom; bentonite debris flow; rockfall*	Glossary of Geology, Fifth Edition (revised), 2011

	avalanche; lahar.	
delta plain - lower	The level or nearly level surface composing the landward part of a large or compound delta; strictly, an alluvial plain characterized by repeated channel bifurcation and divergence, multiple distributary channels, and interdistributary flood basins.	Glossary of Geology, Fifth Edition (revised), 2011
delta plain - upper	The upper part of the level or nearly level surface composing the landward part of a large or compound delta; strictly, an alluvial plain characterized by repeated channel bifurcation and divergence, multiple distributary channels, and interdistributary flood basins.	Glossary of Geology, Fifth Edition (revised), 2011
dune	A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation, capable of movement from place to place but retaining its characteristic shape. Etymol: French. Cf: *sand dune.*	Glossary of Geology, Fifth Edition (revised), 2011
fan - distal	A terrigenous, cone- or fan-shaped deposit located seaward of large rivers and submarine canyons. Syn: *submarine cone; abyssal cone; abyssal fan; subsea apron; deep-sea fan; submarine delta; sea fan; fan [marine geol]; cone [marine geol].*	Glossary of Geology, Fifth Edition (revised), 2011
fan - middle		
fan - proximal		
fan channel		
fan lobe		
forereef	The seaward side of a reef; the slope covered with deposits of coarse reef talus. Cf: *back reef; off-reef.* Also spelled: forereef.	Glossary of Geology, Fifth Edition (revised), 2011
glacial outwash	(a) Stratified detritus (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier. The coarser material usually is deposited nearer to the ice. Syn: *outwash drift.* (b) The meltwater from a glacier.	Glossary of Geology, Fifth Edition (revised), 2011
marsh	A water-saturated, poorly drained area, intermittently or permanently water-covered, having aquatic and grasslike vegetation, essentially without the formation of peat. Cf: *bog; fen; swamp.*	Glossary of Geology, Fifth Edition (revised), 2011
morainal	Of, relating to, forming, or formed by a *moraine.* Also called: *morainic.*	Glossary of Geology, Fifth Edition (revised), 2011
mud diapir complex	A dome or anticlinal fold in which the overlying rocks have been ruptured by the squeezing-out of plastic core material. Diapirs in sedimentary strata usually contain cores of salt or shale; igneous intrusions may also show diapiric structure.	Glossary of Geology, Fifth Edition (revised), 2011
olistostrome	A debris-flow deposit consisting of a chaotic mass of intimately mixed heterogeneous materials (such as blocks and muds) that accumulated by submarine gravity sliding or slumping of unconsolidated sediments. It is a mappable, lens-like stratigraphic unit lacking	Glossary of Geology, Fifth Edition (revised), 2011

	true bedding but intercalated among normally bedded sequences, as in the Tertiary basin of central Sicily. Raymond (1978) gives "olistostrome" as a general term for either a *broken formation* or a *mélange* of sedimentary origin. Cf: *allolistostrome; endolistostrome*. Term introduced by G. Flores in Beneo (1955, p.122). Etymol: Greek "olistomai", "to slide", + "stroma", "bed".	
outwash	Stratified detritus (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier. The coarser material usually is deposited nearer to the ice. Syn: *outwash drift*.	Glossary of Geology, Fifth Edition (revised), 2011
patch reef	A moundlike or flat-topped *organic reef*, generally less than a kilometer across, isolated from other *bioherms*, less extensive than a *platform reef*, and frequently forming a part of a larger reef complex. Cf: *reef patch; table reef, chapeiro*.	Glossary of Geology, Fifth Edition (revised), 2011
pinnacle	A small, isolated spire or column of rock or coral, either slightly submerged or awash; specif. a small reef patch, consisting of coral growing sharply upward (with slopes ranging from 45° to nearly vertical), usually within an atoll lagoon, often rising close to the water surface. Syn: *pinnacle reef; reef pinnacle; coral pinnacle; patch reef; bommy*.	Glossary of Geology, Fifth Edition (revised), 2011
reef - barrier	A long, narrow coral reef roughly parallel to the shore and separated from it by a lagoon of considerable depth and width. It may enclose a volcanic island (either wholly or in part), or it may lie a great distance from a continental coast (such as the Great Barrier Reef off the coast of Queensland, Australia). Generally, barrier reefs follow the coasts for long distances, often with short interruptions, termed passes or channels. Cf: *fringing reef*.	Glossary of Geology, Fifth Edition (revised), 2011
reef flat - reef interior (back reef)	The landward side of a reef. The term is often used adjectivally to refer to deposits within the restricted lagoon behind a barrier reef, such as the "back-reef facies" of lagoonal deposits. In some places, as on a platform-edge reef tract, "back reef" refers to the side of the reef away from the open sea, even though no land may be nearby.	Glossary of Geology, Fifth Edition (revised), 2011
reef mound (patch reef)	A growth of coral formed independently on a shelf of less than 70 m depth, often in the lagoon of a barrier reef or atoll, ranging from an expanse several kilometers across down to that of a single large colony. See also: *reef knoll*.	Glossary of Geology, Fifth Edition (revised), 2011
reef slope - reef face		
ridge	An elongate, steep-sided elevation of the ocean floor, having rough topography. Syn: *submarine ridge.*	Glossary of Geology, Fifth Edition (revised), 2011
seamount	An elevation of the sea floor, 1000 m or higher, either flat-topped (called a *guyot*) or peaked (called a *seapeak*). Seamounts may be either	Glossary of Geology, Fifth Edition (revised), 2011

	discrete, arranged in a linear or random grouping, or connected at their bases and aligned along a ridge or rise.	
shoreface - lower	(a) The zone between the seaward limit of the shore and the more nearly horizontal surface of the *offshore* zone; typically extends seaward to storm wave depth or about 10 m. The term "shore face" was originally used by Barrell (1912, p.385-386), in his study of deltas, for the relatively narrow slope developed by breaking waves and separating the subaerial plain from the subaqueous one below. Not to be confused with *beach face*. See also: *inshore*. (b) A relatively steep but short concave inner portion of the continental shelf (Price, 1954, p.81).	Glossary of Geology, Fifth Edition (revised), 2011
sinkhole	A *closed depression* in a karst or pseudokarst area, commonly with a circular or ellipsoidal pattern. Its drainage is subterranean; its size is measured in meters or tens of meters; and it is commonly funnel shaped. Syn: *doline; sink [karst]; shakehole.* Cf: *collapse sinkhole; solution sinkhole*.	Glossary of Geology, Fifth Edition (revised), 2011
slide	A mass movement or descent resulting from failure of earth, snow, or rock under shear stress along one or several surfaces that are either visible or may reasonably be inferred; e.g. *landslide; snowslide; rockslide*. The moving mass may or may not be greatly deformed, and movement may be rotational or planar. A slide can result from lateral erosion, lateral pressure, weight of overlying material, accumulation of moisture, earthquakes, expansion owing to freeze-thaw of water in cracks, regional tilting, undermining, and human agencies.	Glossary of Geology, Fifth Edition (revised), 2011
slump	(a) A landslide characterized by a shearing and rotary movement of a generally independent mass of rock or earth along a curved slip surface (concave upward) and about an axis parallel to the slope from which it descends, and by backward tilting of the mass with respect to that slope so that the slump surface often exhibits a reversed slope facing uphill. Syn: *slumping*. (b) The sliding-down of a mass of sediment shortly after its deposition on an underwater slope; esp. the downslope flowage of soft, unconsolidated marine sediments, as at the head or along the side of a submarine canyon. This is the "commonest usage in geology in Britain", although "subaqueous slump would be more precise" (Challinor, 1978, p.283). Syn: *subaqueous gliding.* (c) The mass of material slipped down during, or produced by, a slump. See also: *slump block*.	Glossary of Geology, Fifth Edition (revised), 2011
swamp	An area of low, waterlogged ground having shrubs and trees, with or without the formation of peat. Cf: *bog; marsh; peat swamp*.	Glossary of Geology, Fifth Edition (revised), 2011
tufa-related	A variety of *travertine* that is commonly spongy or porous due to precipitation around a variety of floral strictures, such as reeds, plant roots, leaves, etc. Tufa mounds or travertine mounds (as at Mono Lake) are associated with lake	Glossary of Geology, Fifth Edition (revised), 2011

	springs (Tucker and Wright, 1990, p.169). Analogous mounds in marine or freshwater settings may be organic, thus *bioherms*. The term is rarely applied to a similar deposit consisting of silica. It is not to be confused with *tuff*. Etymol: Italian, "tufo." Syn: *calcareous tufa; calc-tufa, tuft; petrified moss*.	
turbidite setting	A sediment or rock deposited from, or inferred to have been deposited from, a *turbidity current*. It is characterized by graded bedding, moderate sorting, and well-developed primary structures in the sequence noted in the *Bouma cycle*. For the relation of turbidites to tempestites and inundites, see Einsele and Seilacher (1982, p.334).	Glossary of Geology, Fifth Edition (revised), 2011

4.1.42 vocab_SetFluidChemistry

Categories denoting the water quality / composition in a geologic setting.

Term	Definition	Reference
acidic	(a) A descriptive term applied to those igneous rocks that contain more than 60% SiO_2, as contrasted with *intermediate* and *basic*. Sometimes loosely and incorrectly used as equivalent to *felsic* and to *oversaturated*, but these terms include rock types (e.g., nepheline syenite, quartz basalt) that are not generally considered acidic. This is not the chemist's usage; the term is deprecated by some because of its confusing nature. (b) Applied loosely to any igneous rock composed predominantly of light-colored minerals having a relatively low specific gravity. Cf: *felsic*. Syn: *acid; silicic*.	Glossary of Geology, Fifth Edition (revised), 2011
alkaline	As defined by Shand in 1922, any igneous rock in which the molecular ratio [(Na_2O + K_2O):Al_2O_3:SiO_2] differs from 1:1:6 by deficiency in either Al_2O or SiO_2. The term therefore covers peralkaline silica-oversaturated rocks as well as all silica-undersaturated rocks.	Glossary of Geology, Fifth Edition (revised), 2011
brackish	An indefinite term for water with a salinity intermediate between that of average seawater (35) and that of fresh water (0).	Glossary of Geology, Fifth Edition (revised), 2011
fresh water	(a) Water containing less than 1,000 milligrams per liter of dissolved solids; generally, water with more than 500 mg/L is undesirable for drinking and for many industrial uses (Solley et al., 1983). (b) In general usage, the water of streams and lakes unaffected by salt water or salt-bearing rocks. Cf: *potable water; saline water*. Syn: *sweet water*. Also spelled: freshwater; fresh-water.	Glossary of Geology, Fifth Edition (revised), 2011
hypersaline	Excessively saline; with a salinity substantially greater than that of average seawater (35).	Glossary of Geology, Fifth Edition (revised), 2011
restricted	A depression in the ocean floor characterized by topographically restricted water circulation, often resulting in oxygen depletion.	Glossary of Geology, Fifth Edition (revised), 2011
saline	(a) A natural deposit of halite or of any other soluble salt; e.g. an evaporite. Cf: *salines*. (b) An anglicized form of *salina*. In this usage, a "saline"	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	may refer to various features such as a playa, a salt flat, a salt pan, a salt marsh, a salt lake, a salt pond, a salt well, or a saltworks. (c) *salt spring*. (d) A term used along the coast of Louisiana for a body of water behind a barrier island. adj. (a) Salty; containing dissolved sodium chloride, e.g., seawater. (b) Having a salinity appreciably greater than that of seawater, e.g. a brine. (c) Containing dissolved salts at concentrations great enough to allow the precipitation of sodium chloride; *hypersaline*. (d) Said of a taste resembling that of common salt, esp. in describing the properties of a mineral. (e) Used to describe a lake with an appreciable total of dissolved solids: 3,000 ppm (Geddes et al., 1981), 5,000 ppm (Beadle, 1974), or a concentration great enough to affect lake ecology. [**image**]	
unrestricted		
restricted - unrestricted		

4.1.43 vocab_SetMetamRegine

Categories denoting the general metamorphic environment.

Term	Definition	Reference
strike-slip	In a fault, the component of the movement or slip that is parallel to the strike of the fault. Cf: *dip slip*; *strike separation*; *oblique slip*. Syn: *horizontal displacement*; *horizontal separation*. Partial syn: *strike shift*. [**image**]	Glossary of Geology, Fifth Edition (revised), 2011
extensional	(a) A strain term signifying increase in length. Cf: *tension*, which is a stress term. (b) A measure of the change in length of a line, specif. the ratio of the change in length to the original length. Cf: *stretch [exp struc geol]*. Syn: *elongation*.	Glossary of Geology, Fifth Edition (revised), 2011
compressional	A system of forces or stresses that tends to decrease the volume of, or shorten, a substance.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.44 vocab_SetMetamType

Categories denoting the type of metamorphism.

Term	Definition	Reference
burial metamorphism	A type of low-grade regional metamorphism affecting sediments and interlayered volcanic rocks in a geosyncline without any influence of orogenesis or magmatic intrusion. Original rock fabrics are largely preserved but mineralogical compositions are generally changed (Coombs, 1961). Cf: *dynamothermal metamorphism*.	Glossary of Geology, Fifth Edition (revised), 2011
contact metamorphism	A type of low-grade regional metamorphism affecting sediments and interlayered volcanic rocks in a geosyncline without any influence of orogenesis or magmatic intrusion. Original rock	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	fabrics are largely preserved but mineralogical compositions are generally changed (Coombs, 1961). Cf: *dynamothermal metamorphism*.	
diagenesis	All the chemical, physical, and biologic changes undergone by a sediment after its initial deposition, and during and after its lithification, exclusive of surficial alteration (weathering) and metamorphism. This is the definition as applied by most geologists in the U.S. (Twenhofel, 1939, p.254-255) and Germany (Correns, 1950). It embraces those processes (such as compaction, cementation, reworking, authigenesis, replacement, crystallization, leaching, hydration, bacterial action, and formation of concretions) that occur under conditions of pressure (up to 1 kb) and temperature (maximum range of 100°C to 300°C) that are normal to the surficial or outer part of the Earth's crust; and it may include changes occurring after lithification under the same conditions of temperature and pressure. The father of this concept was Walther (1893-1894, p.693-711), although the term "Diagenese" was first used by Gümbel (1868, p.838) for a postsedimentary transformation of sediments into individual crystalline minerals, leading to the creation of metamorphic rocks such as gneiss and schist. Russian (and some U.S.) geologists restrict the term to the initial phase of postsedimentary changes, occurring in the zone where the sediment is still unconsolidated, the process being complete when the sediment has been converted to a more or less compact sedimentary rock (Fersman, 1922); in this usage, the term is equivalent to *early diagenesis* as used in the U.S. There is no universally accepted definition of the term, and no delimitation (such as the boundary with metamorphism). For a historical discussion and review, see Larsen and Chilingar (1967) and Dunoyer de Segonzac (1968). Cf: *epigenesis [sed]*.	Glossary of Geology, Fifth Edition (revised), 2011
dynamic metamorphism	The total of the processes and effects of orogenic movements and differential stresses in producing new rocks from old, with marked structural and mineralogical changes due to crushing and shearing at low temperatures and extensive recrystallization at higher temperatures. It may involve large areas of the Earth's crust, i.e., be regional in character. Cf: *dislocation metamorphism; dynamothermal metamorphism; regional metamorphism*. Syn: *dynamometamorphism*.	Glossary of Geology, Fifth Edition (revised), 2011
hydrothermal metamorphism	A local type of metamorphism caused by the percolation of hot solutions or gases through fractures, causing mineralogic changes in the neighboring rock. Syn: *hydrothermal metasomatism*.	Glossary of Geology, Fifth Edition (revised), 2011
regional metamorphism	A general term for metamorphism affecting an extensive region, as opposed to *local metamorphism* that is effective only in a	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	relatively restricted area. As introduced in the nineteenth century, the term covered only those changes due to deep burial metamorphism; today it is used almost synonymously with *dynamothermal metamorphism* (Holmes, 1920). Cf: *dynamic metamorphism*.	
regional-scale contact metamorphism	One of the principal local processes of thermal metamorphism, genetically related to the intrusion and extrusion of magmas and taking place in rocks at or near their contact with a body of igneous rock. Metamorphic changes are effected by the heat and fluids emanating from the magma and by some deformation connected with the emplacement of the igneous mass (Holmes, 1920). Adj: *contact-metamorphic*. Cf: *endomorphism; exomorphism; thermal metamorphism*.	Glossary of Geology, Fifth Edition (revised), 2011
shock metamorphism	The totality of observed permanent physical, chemical, mineralogic, and morphologic changes produced in rocks and minerals by the passage of high-pressure shock waves acting over time intervals ranging from a few microseconds to a fraction of a minute (French, 1998). The only known natural mechanism for producing shock-metamorphic effects is *hypervelocity impact*. The term also includes identical effects produced by shock waves generated in small-scale laboratory experiments and in nuclear and chemical explosions. Cf: *impact metamorphism*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.45 vocab_SetTectonicSuper

Categories denoting the most general tectonic setting.

Term	Definition	Reference
strike-slip	In a fault, the component of the movement or slip that is parallel to the strike of the fault. Cf: *dip slip; strike separation; oblique slip*. Syn: *horizontal displacement; horizontal separation*. Partial syn: *strike shift*.	Glossary of Geology, Fifth Edition (revised), 2011
convergent	Pertaining to a continental edge that is also a plate edge and is being deformed by collision with another plate.	Glossary of Geology, Fifth Edition (revised), 2011
divergent	Pertaining to the trailing edge of a continent; *passive margin*.	Glossary of Geology, Fifth Edition (revised), 2011
intraplate - continental	Within a continental landmass, far from any plate boundary and therefore considered unrelated to subduction or sea-floor spreading processes.	Glossary of Geology, Fifth Edition (revised), 2011
intraplate - oceanic	Within aan oceanic plate, far from any plate boundary and therefore considered unrelated to subduction or sea-floor spreading processes.	Glossary of Geology, Fifth Edition (revised), 2011
uncertain		
extra-terrestrial (impact event)	The collision of a large (R>~1 km) extra-terrestrial object, sometimes termed a bolide, with the Earth. The identification of the	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	element iridium in a thin clay layer at the Cretaceous/Tertiary boundary led to suggestions that at least some mass extinctions were caused by large extra-terrestrial impacts.	

4.1.46 vocab_SettingClimate

Categories denoting the overall climatic environment.

Term	Definition	Reference
arid - semi-arid	Said of a climate characterized by dryness, variously defined as rainfall insufficient for plant life or for crops without irrigation; less than 25 cm of annual rainfall; or a higher evaporation rate than precipitation rate. Syn: *dry*.	Glossary of Geology, Fifth Edition (revised), 2011
boreal	Said of a climate characterized by dryness, variously defined as rainfall insufficient for plant life or for crops without irrigation; less than 25 cm of annual rainfall; or a higher evaporation rate than precipitation rate. Syn: *dry*.	Glossary of Geology, Fifth Edition (revised), 2011
continental - dry - temperate	Said of a temperature in a continental area that is moderate or mild. The term is also used to describe temperatures of the middle latitudes, whether moderate or not	Glossary of Geology, Fifth Edition (revised), 2011
maritime - humid - temperate	Said of a temperature in a maritime area that is moderate or mild. The term is also used to describe temperatures of the middle latitudes, whether moderate or not	Glossary of Geology, Fifth Edition (revised), 2011
polar	Relating or pertaining to the region of either or both of the two poles of the Earth. Region poleward of the Arctic and Antarctic circles..	Glossary of Geology, Fifth Edition (revised), 2011
subtropical	Said of the climate of the subtropics, which borders that of the tropics and is intermediate in character between tropical and temperate, though more like the former than the latter. Syn: *semitropical.*	Glossary of Geology, Fifth Edition (revised), 2011
temperate	Said of a temperature that is moderate or mild. The term is also used to describe temperatures of the middle latitudes, whether moderate or not.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.47 vocab_SettingEnvironment

Categories denoting broad-scale features or processes involved in a geologic setting,

Term	Definition	Reference
aeolian	(a) Pertaining to the wind; esp. said of such deposits as loess and dune sand, of sedimentary structures such as wind-formed ripple marks, or of erosion and deposition accomplished by the wind. (b) Said of the active phase of a dune cycle, marked by diminished vegetal control and increased dune growth. Cf: *eluvial [sed]*. Etymol: Aeolus, god of the winds. Syn: *aeolian; eolic.*	Glossary of Geology, Fifth Edition (revised), 2011
alluvial	A name, now obsolete, applied by Jameson (1808) from the teachings of A.G. Werner in the 1790's to the group or series of rocks consisting	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	of unconsolidated or poorly consolidated gravels, sands, clays, and peat that were believed to have been formed after the withdrawal of the ocean from the continents. It constituted the fourth (following the *Floetz*) of the divisions in which Werner placed the rocks of the geologic column. Syn: *Tertiary*.	
batholith	A large, generally discordant plutonic body having an aerial extent of 40 mi^2 (100 km^2) or more and no known floor. Obsolete syn: *abyssolith*.	Glossary of Geology, Fifth Edition (revised), 2011
beach complex	(a) The unconsolidated material at the shoreline that covers a gently sloping zone, typically with a concave profile, extending landward from the low-water line to the place where there is a definite change in material or physiographic form (such as a cliff), or to the line of permanent vegetation (usually the effective limit of the highest storm waves); at the shore of a body of water, formed and washed by waves or tides, usually covered by sand or gravel, and lacking a bare rocky surface. See also: *strand [coast]*. (b) The relatively thick and temporary accumulation of loose water-borne material (usually well-sorted sand and pebbles, accompanied by mud, cobbles, boulders, and smoothed rock and shell fragments) that is in active transit along, or deposited on, the shore zone between the limits of low water and high water. The term was originally used to designate the loose wave-worn shingle or pebbles found on English shores, and is so used in this sense in some parts of England (Johnson, 1919, p.163). (c) A term used locally for a low sand island along a coast. (d) A term commonly used for a seashore or lake-shore area, esp. that part of the shore used for recreation.	Glossary of Geology, Fifth Edition (revised), 2011
coastal	Pertaining to a coast; bordering a coast, or located on or near a coast, as *coastal* waters, *coastal* zone management, or *coastal* shipping routes.	Glossary of Geology, Fifth Edition (revised), 2011
deltaic	Pertaining to or characterized by a delta; e.g. "deltaic sedimentation". Also, constituting a delta; e.g. a "deltaic coast".	Glossary of Geology, Fifth Edition (revised), 2011
dyke complex - dyke	tabular igneous intrusion that cuts across the bedding or foliation of the country rock. Also spelled: *dyke*. Cf: *sill [intrus rocks]*; *sheet [intrus rocks]*. See also: *dikelet*.	Glossary of Geology, Fifth Edition (revised), 2011
effusive setting - extrusive flows	adj. Said of igneous rock that has been erupted onto the surface of the Earth. Extrusive rocks include lava flows and pyroclastic material such as volcanic ash. n. An extrusive rock. Cf: *intrusive*. Syn: *effusive*; *volcanic*; *eruptive*.	Glossary of Geology, Fifth Edition (revised), 2011
evaporitic	Pertaining to a sedimentary rock composed primarily of minerals produced from a saline solution as a result of extensive or total evaporation of the solvent. Examples include gypsum, anhydrite, other diverse sulfates, halite (rock salt), primary dolomite, and various	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	nitrates and borates. The term commonly includes rocks with saline minerals formed by other mechanisms, e.g., mixing of waters or temperature change. Mineral grains formed by these mechanisms may be reworked by wind or saline waters as clastic particles but are also considered evaporitic deposits. Syn: evaporate; *saline deposit.*	
fluvial	a) Of or pertaining to a river or rivers. (b) Existing, growing, or living in or about a stream or river and its floodplain. (c) Produced by the action of a stream or river. Cf: *fluviatile.* Etymol: Latin "fluvius", "river".	Glossary of Geology, Fifth Edition (revised), 2011
glacial	(a) Of or relating to the presence and activities of ice or glaciers, as *glacial* erosion. (b) Pertaining to distinctive features and materials produced by or derived from glaciers and ice sheets, as *glacial* lakes. (c) Pertaining to an ice age or region of glaciation. (d) Suggestive of the extremely slow movement of glaciers. (e) Used loosely as descriptive or suggestive of ice, or of below-freezing temperature. n. A *glacial age,* or *glacial stage,* of a glacial epoch, esp. of the Pleistocene Epoch; e.g. the Wisconsin *glacial.*	Glossary of Geology, Fifth Edition (revised), 2011
karst-related	A type of topography that is formed on limestone, gypsum, and other soluble rocks, primarily by *dissolution.* It is characterized by *sinkholes, caves,* and underground drainage. First published in 1774 on a topographic map, *Ducatus Carnioliae.* Type locality: a limestone plateau in the Dinaric Alps. Adj: *karstic.* Syn: *karst topography.* Cf: *causse; pseudokarst; thermokarst.* Etymol: German, from the Slovenian region of Krs; Slavic "kras" or "krš" "a bleak, waterless place".	Glossary of Geology, Fifth Edition (revised), 2011
lacustrine	(a) Pertaining to, produced by, or formed in a lake or lakes; e.g., "lacustrine sands" deposited on the bottom of a lake, or a "lacustrine terrace" formed along its margin. (b) Growing in or inhabiting lakes; e.g., a "lacustrine fauna". (c) Said of a region characterized by lakes; e.g., a "lacustrine desert" containing the remnants of numerous lakes that are now dry. Cf: *limnic [lake].*	Glossary of Geology, Fifth Edition (revised), 2011
layered intrusion	An intrusive body in which there are layers, centimeters to many meters thick, of varying mineralogical composition, e.g. the Bushveld Complex, Stillwater Complex, and Skaergaard Intrusion. Syn: *stratiform intrusion.*	Glossary of Geology, Fifth Edition (revised), 2011
oceanic island	Island either composed of basalt or of biogenic origin (coral reef, etc.), as distinguished from islands having rocks characteristic of continents. The Hawaiian and most islands in the Pacific Ocean are oceanic, whereas Japan, the Philippines, New Zealand, and most of the larger islands toward the western side of the basin are continental. Beaches of true oceanic islands consist of rock fragments or of coral and shell debris, and have a dark, white, or reddish appearance. They lack white quartz sand, the	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
	most characteristic component of continental beaches.	
(offshore) bank	A mound-like or ridge-like submerged elevated area on the sea floor of modest to substantial extent, usually close to sea level (e.g., Bahama banks). See also: *mudbank; shell bank; lithoherm.*	Glossary of Geology, Fifth Edition (revised), 2011
pluton - plutonic complex	A deep-seated igneous *intrusion*. Cf: *plutonism [ign].*	Glossary of Geology, Fifth Edition (revised), 2011
pyroclastic setting	Pertaining to clastic rock material formed by volcanic explosion or aerial expulsion from a volcanic vent; also, pertaining to rock texture of explosive origin. It is not synonymous with the adjective "volcanic".	Glossary of Geology, Fifth Edition (revised), 2011
sediment starved	A sedimentary basin in which the rate of subsidence is more rapid than the rate of sedimentation. Sediment thickness is greater at the margins than at the center (Adams et al., 1951).	Glossary of Geology, Fifth Edition (revised), 2011
(continental) shelf	That part of the *continental margin* that is between the shoreline and the continental slope (or, when there is no noticeable continental slope, a depth of 200 m). It is characterized by its very gentle slope of 0.1°. Cf: *insular shelf; marginal plateau; continental borderland.* Syn: *continental platform; shelf [marine geol].*	Glossary of Geology, Fifth Edition (revised), 2011
shelf edge - shelf rim	The demarcation between the continental shelf and the continental slope. Cf: *shelf break.*	Glossary of Geology, Fifth Edition (revised), 2011
sill and dyke complex		
sill complex - sill	A tabular igneous intrusion that parallels the bedding or foliation of the sedimentary or metamorphic country rock, respectively. Cf: *dike [intrus rocks]; sheet [intrus rocks]; sole injection.*	Glossary of Geology, Fifth Edition (revised), 2011
submarine rise	A broad, elongate, smooth elevation of the ocean floor.	Glossary of Geology, Fifth Edition (revised), 2011
submarine slope	That part of the *continental margin* that is between the continental shelf and the continental rise if there is one. It is characterized by its relatively steep slope of 1.5° to 6°.	Glossary of Geology, Fifth Edition (revised), 2011
tidal	Pertaining to the periodic rise and fall of the surface of the ocean and bodies of water connected to the ocean that result from the gravitational attraction of sun and moon	Glossary of Geology, Fifth Edition (revised), 2011
volcaniclastic setting	Pertaining to all clastic volcanic materials formed by any process of fragmentation, dispersed by any kind of transporting agent, deposited in any environment, or mixed in any significant portion with nonvolcanic fragments (Fisher, 1961, p.1409).	Glossary of Geology, Fifth Edition (revised), 2011
wetland	An area that is regularly wet or flooded and has a water table that stands at or above the land surface for at least part of the year (NOAA, 2004). The term has supplanted more colloquial terms such as swamp and marsh.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.48 vocab_SettingTectonic

Categories denoting a regional tectonic setting.

Term	Definition	Reference
accretionary prism	A generally wedge-shaped mass of tectonically deformed sediment at a *convergent plate boundary* formed when pelagic sediment, oceanic-floor basalt, and trench-fill turbidite are scraped off the downgoing plate during the process of subduction.	Glossary of Geology, Fifth Edition (revised), 2011
anatectic	Pertaining to the partial melting of preexisting rock. Anatexis implies in situ partial melting. This term is commonly modified by terms such as intergranular, partial, differential, selective, crustal, or complete (Dietrich and Mehnert, 1961). Cf: *metatexis*; *diatexis*; *palingenesis [petrology]*; *syntexis*; *anamigmatization*.	Glossary of Geology, Fifth Edition (revised), 2011
anorogenic	Not orogenic, lacking in or unrelated to orogenic disturbance; e.g. an anorogenic area, time, or granite.	Glossary of Geology, Fifth Edition (revised), 2011
aseismic ridge	A submarine ridge that is a fragment of continental crust or an anomalously shallow oceanic crust, usually associated with a hot spot; it is so named to distinguish it from a seismically active mid-ocean ridge. Cf: *microcontinent*.	Glossary of Geology, Fifth Edition (revised), 2011
back arc	The region adjacent to a subduction-related volcanic arc, on the side of the arc opposite the trench and subducting plate. If back-arc tectonic stress is tensional, a back-arc basin opens. If it is compressional, a back-arc fold-thrust belt develops. Partial syn: *remnant arc*.	Glossary of Geology, Fifth Edition (revised), 2011
basin	As a geologic term, it is used in four major contexts: In *topography*, basins (e.g., the Great Basin of the western U.S.) are low areas where surface drainage is confined to the basin and streams do not leave the basin. Relating to *structure*, basins (e.g., the Michigan Basin or the Williston Basin) are areas where the dip of strata is toward the center of the basin. *Drainage* basins (e.g., the Mississippi River drainage basin or the Clear Creek drainage basin) are areas that are drained by a single stream of any size. Relating to *sedimentation*, basins (e.g., the Appalachian Basin or the Anadarko Basin) are areas where thick sequences of sediments have accumulated.	Glossary of Geology, Fifth Edition (revised), 2011
basin plain	A general term for ponds of sediment found at the outer margin of cross-contentintal-margin sediment transport systems. Abyssal plain is the specific term used when such oceanic plains are found on the true ocean-basin floor.	Pilkey, O.H. and Hokanson, C., 2012. A proposed classification of basin plains. SEPM Special Publication No.46
continental (volcanic) arc	A generally curved linear belt of volcanoes above a *subduction zone*. Cf: *island arc*; *magmatic arc*.	
continental forearc	A generally curved linear belt of volcanoes built on a continental crust above a *subduction zone*. Cf: *island arc*; *magmatic arc*.	Glossary of Geology, Fifth Edition (revised), 2011
continental rift	(a) A long, narrow continental trough that is bounded by normal faults; a *graben* of regional extent. It marks a zone that has undergone extension. Cf: *paar*. (b) A belt of strike-slip faulting of regional extent.	

Term	Definition	Reference
epicontinental	Situated on the continental shelf or on the continental interior, as an *epicontinental sea*.	Glossary of Geology, Fifth Edition (revised), 2011
forearc	The region between a subduction-related trench and a volcanic arc. Syn: *frontal arc.*	Glossary of Geology, Fifth Edition (revised), 2011
foredeep basin	(a) An elongate depression bordering an island arc or other orogenic belt. Cf: *trench [marine geol].* (b) A syn. of *foreland basin*.	Glossary of Geology, Fifth Edition (revised), 2011
foreland - peripheral basin	A linear sedimentary basin in a *foreland [tect]*. These basins subside in response to flexural loading of the lithosphere by *thrust sheets*. Syn: *foredeep*.	Glossary of Geology, Fifth Edition (revised), 2011
hinterland - retroarc basin	An area bordering, or within, an orogenic belt on the internal side, away from the foreland; it is related to the *internides* and to the discredited *borderland* of Schuchert. In the hinterland, rocks are plastically deformed, significant metamorphism accompanies deformation, and the crystalline rocks that compose basement are extensively deformed. Syn: *backland [tect]*.	Glossary of Geology, Fifth Edition (revised), 2011
hot spot	A volcanic center, 100 to 200 km across and persistent for at least a few tens of millions of years, that is thought to be the surface expression of a persistent rising *plume* of hot mantle material. Hot spots may occur in the interior of a plate. They are not linked with volcanic arcs, and may or may not lie along oceanic ridges. Some 200 late Cenozoic hot spots have been identified (Cloud, 1974, p.879). The largest of these is the Hawaiian hot spot. See also: *melting spot*.	Glossary of Geology, Fifth Edition (revised), 2011
hot spot track	A ridge of volcanic rock formed when a lithospheric plate moves over a *hot spot;* the Hawaiian Ridge is the type example. The active hot-spot volcano lies at the end of the track. Extinct volcanoes lie along the track, with the oldest extinct volcano farthest from the active hot spot.	Glossary of Geology, Fifth Edition (revised), 2011
impact-related	Pertaining to the collision of two planetary bodies at or near cosmic velocity, which causes the propagation of a shock wave into both the impactor and the target body.	Glossary of Geology, Fifth Edition (revised), 2011
intermontane basin	Basin situated between or surrounded by mountains, mountain ranges, or mountainous regions; e.g. the Great Basin of western U.S., between the Sierra Nevada and the Wasatch Mountains. Syn: *intermont*.	Glossary of Geology, Fifth Edition (revised), 2011
intracratonic basin	A basin formed within the interior region of a continent, away from plate boundaries. It develops where there is subsidence of a portion of a craton, probably due to thermal subsidence of an unsuccessful rift.	Glossary of Geology, Fifth Edition (revised), 2011
island arc	An offshore *volcanic arc*.	Glossary of Geology, Fifth Edition (revised), 2011
island forearc	The region between a subduction-related trench and a volcanic island arc.	Glossary of Geology, Fifth Edition (revised), 2011
magmatic arc	An arcuate line of plutons, volcanic rocks, or active volcanoes formed at a convergent plate boundary; most of the magma forms by melting in the asthenosphere above the downgoing plate.	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
mantle plume - LIP	(a) A rising pipe-shaped volume of mantle that is either abnormally hot or wet or both, such that during decompression is partially melts more than "normal" mantle (in the oceans, often taken to be MORB-type mantle). The geochemically distinct (from MORB) basalt that segregates from the plume is called an *oceanic island basalt* (OIB) and forms oceanic island chains like the Hawaiian islands (Morgan, 1971; Hart, 1988). (b) A vertical cylindrical part of the Earth's mantle, hotter than its surroundings, within which larger-than-normal amounts of heat are conducted upward to form a "hot spot" at the Earth's surface (Friedman et al., 1992, p.24).	Glossary of Geology, Fifth Edition (revised), 2011
oceanic rift	See “rift”	
pull-apart basin	A topographic depression created by an extensional bend or extensional overstep along a strike-slip fault (Aydin and Nur, 1982). Syn: *sag pond; rhombochasm.*	Glossary of Geology, Fifth Edition (revised), 2011
salt tectonic	(a) The deformation of *halite* by flowage. Mechanisms cited for this process include gravity flow, tectonic thrusting, and diapirism (Kyle and Posey, 1991). Syn: *salt tectonics.* (b) Form of salt tectonics in which salt flow is powered entirely by gravity that is, by release of gravity potential energy alone, in the absence of significant lateral tectonic forces (Jackson and Talbot, 1991). Sp: *haloquinesis*.	Glossary of Geology, Fifth Edition (revised), 2011
spreading ridge	A continuous, seismically active, median mountain range extending through the North and South Atlantic Oceans, the Indian Ocean, and the South Pacific Ocean. It is a broad, fractured swell with a central rift valley and usually extremely rugged topography; it is 1-3 km in height, about 1,500 km in width, and over 84,000 km in length. The mid-ocean ridge is the source of new crustal material. See also: *rift valley [oceanog]; sea-floor spreading*. Syn: *mid-ocean rise; oceanic ridge; spreading center*.	Glossary of Geology, Fifth Edition (revised), 2011
subduction zone	long, narrow belt in which *subduction* takes place, e.g. along the Peru-Chile Trench or in the *volcanic arc* belts of the western Pacific Ocean.	Glossary of Geology, Fifth Edition (revised), 2011
successor basin	basin or sequence that overlaps a terrane boundarie and helps to constrain the time of accretion	http://maps.unomaha.edu/maher/plate/week6/terranes.html
suture	A fault or complex *shear zone* that marks the boundary between two crustal blocks that were once widely separated, often on different plates. The presence of a suture implies that oceanic lithosphere once existed between the two blocks.	Glossary of Geology, Fifth Edition (revised), 2011
trailing continental margin	The ocean floor that is between the shoreline and the abyssal ocean floor, including various provinces: the *continental shelf*, *continental borderland*, *continental slope*, and the *continental rise*.	Glossary of Geology, Fifth Edition (revised), 2011
trench	Any long, narrow cut or excavation produced naturally in the Earth's surface by erosion or tectonic movements.	Glossary of Geology, Fifth Edition (revised), 2011
uncertain		

4.1.49 vocab_SettingWaterDepth

Categories denoting the water dynamics.

Term	Definition	Reference
abyssal - hadal	Pertaining to the ocean environment or depth zone of between 3,500 and 6,000 m; also, pertaining to the organisms of that environment.	Glossary of Geology, Fifth Edition (revised), 2011
bathyal - deep water	Pertaining to the ocean environment or depth zone between 200 and 3500 meters; also, pertaining to the organisms of that environment.	Glossary of Geology, Fifth Edition (revised), 2011
intertidal	*littoral*	
neritic - shallow	Pertaining to the ocean environment or depth zone between low-tide level and 200 meters, or between low-tide level and approximately the edge of the continental shelf; also, pertaining to the organisms living in that environment. Syn: *sublittoral*.	Glossary of Geology, Fifth Edition (revised), 2011
peritidal	Referring to depositional environments in a zone from somewhat above highest storm or spring tides to somewhat below lowest tides; a broader term than "intertidal" (Folk, 1973).	Glossary of Geology, Fifth Edition (revised), 2011

4.1.50 vocab_StratAgeCertainty

Categories denoting the degree of confidence in a stratigraphic age.

Term	Definition	Reference
uncertain		
certain		

4.1.51 vocab_StructureType

Categories denoting a type of geologic structure.

Term	Definition	Reference
contact	(a) A plane or irregular surface between two types or ages of rock; examples are faults, intrusive borders, bedding planes separating distinct strata, and unconformities. (b) The surface between two fluids in a reservoir, i.e. oil and gas, oil and water, or gas and water. Syn: *interface*. adj. Said of a mineral deposit that occurs at the contact of two unlike rock types.	Glossary of Geology, Fifth Edition (revised), 2011
ductile shear	Said of a rock that is able to sustain, under a given set of conditions, 5-10% strain without losing strength. Cf: *brittle*.	Glossary of Geology, Fifth Edition (revised), 2011
fault	A discrete surface or zone of discrete surfaces separating two rock masses across which one mass has slid past the other. Cf: *shear zone*; *fault zone*.	Glossary of Geology, Fifth Edition (revised), 2011
fault system	A set or multiple sets of faults with regular orientations and interrelated kinematic character.	Glossary of Geology, Fifth Edition (revised), 2011
fold	A curve or bend of a planar structure such as rock strata, bedding planes, foliation, or cleavage. A fold is usually a product of deformation, although its definition is descriptive and not genetic and may include primary structures.	Glossary of Geology, Fifth Edition (revised), 2011

Term	Definition	Reference
foliation	A general term for a planar arrangement of textural or structural features in any type of rock, esp. the locally planar fabric in a rock defined by a fissility, a preferred orientation of crystal planes in mineral grains, a preferred orientation of inequant grain shapes, or from compositional banding. In igneous rocks, planar parallelism of flaky or tabular minerals and mineral aggregates, slabby xenoliths, or flattened vesicles as well as compositional layering. In metamorphic rocks, planar parallelism of flaky minerals and compositional layering. Adj: *foliate*. See also: *cleavage [struc geol]*.	Glossary of Geology, Fifth Edition (revised), 2011
fracture	Brittle deformation due to a momentary loss of cohesion or loss of resistance to differential stress and a release of stored elastic energy. (Both joints and faults are fractures.) Cf: *flow [exp struc geol]*. Syn: *rupture*.	Glossary of Geology, Fifth Edition (revised), 2011
joint	Non-penetrative brittle planar fracture.	Passchier, C.W. and Trouw, R.A.J., 2005. Microtectonics. Springer-Verlag, Berlin, 366p.
layering	A succession of tabular units exhibiting distinct variation in mineralogic, textural or structural characteristics within igneous, sedimentary, or metamorphic rocks; or the formation of tabular bodies at different rock type, one upon the other, in a particular rock; e.g. the phenomenon in plutonic rocks resulting from *crystal settling* in magma. Describes high-temperature sedimentation features of igneous rocks and tabular mineral segregation in metamorphic rocks. Bedding and stratification refer to layering in sedimentary rocks. Cf: *rhythmic layering; phase layering*.	Glossary of Geology, Fifth Edition (revised), 2011
lineation	A general, nongeneric term for a locally linear structure or fabric in a rock, e.g. flow lines, scratches, striae, slickensides or slickenfibers on a single surface; linear arrangements of components in sediments; or axes of folds. Lineation in metamorphic rocks includes aligned rod-shaped and/or elongate minerals grains, crenulation fold axes, and the lines of intersection between bedding and cleavage or any two sets of oriented surfaces (O'Leary et al., 1976; El-Etr, 1976).	Glossary of Geology, Fifth Edition (revised), 2011

4.1.52 vocab_UnitGlobalDomain

Categories denoting the geographic domain containing a geologic unit.

Term	Definition	Reference
Arctic ocean		
Atlantic ocean		

Term	Definition	Reference
Pacific ocean		
North American continent		

4.1.53 vocab_UnitMorphology

Categories denoting the morphology of a geologic unit.

Term	Definition	Reference
dome sheet	A general term for any smoothly rounded rock mass, such as a rock-capped mountain summit, that roughly resembles the dome of a building; e.g., the rounded granite peaks of Yosemite, Calif. The term is also applied to broadly up-arched regions, e.g., the English Lake District or the Black Hills of South Dakota.	Glossary of Geology, Fifth Edition (revised), 2011
irregular	Not of regular or symmetrical form; unevenly shaped or placed; disorderly in form or arrangement.	Oxford English Dictionary, Oxford Press, 2015
lenticular	(a) Resembling in shape the cross section of a lens, esp. of a double-convex lens. The term may be applied, for example, to a body of rock, a sedimentary structure, or a mineral habit. (b) Pertaining to a stratigraphic lens or lentil. Syn: *lentiform.*	Glossary of Geology, Fifth Edition (revised), 2011
planar sheet	Planar: of or relating to a plane; (having parts) situated in or forming a plane or (esp. parallel) planes; flat, two-dimensional.	Oxford English Dictionary, Oxford Press, 2015
shoe - string	One of several long narrow uniform channels, closely spaced and roughly parallel with one another, that merely score the homogeneous surface of a relatively steep slope of bare soil or weak clay-rich bedrock, and that develop wherever overland flow is intense.	Glossary of Geology, Fifth Edition (revised), 2011
tear drop	Anything resembling or suggesting a tear; denoting something resembling a tear-drop in shape	Oxford English Dictionary, Oxford Press, 2015
tongue	A projecting part of a lithostratigraphic unit extending beyond its main body (Stephenson, 1917). Cf: *lentil.* v. To thin laterally to disappearance.	Glossary of Geology, Fifth Edition (revised), 2011
wedge	The shape of a stratum, vein, or intrusive body that thins out; specif. a wedge-shaped sedimentary body, or *prism [sed]*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.54 vocab_UnitRank

Categories denoting the rank of a geologic unit.

Term	Definition	Reference
arc	An arcuate line of plutons, volcanic rocks, or active volcanoes formed at a convergent plate boundary; most of the magma forms by melting in the asthenosphere above the downgoing	Glossary of Geology, Fifth Edition (revised), 2011

	plate. Sp: *arco magmático*.	
arch	A broad, open anticlinal fold on a regional scale; it is usually a basement doming, e.g. the Cincinnati Arch. Cf: *dome [struc geol]*. Less-preferred syn: *swell [struc geol]*.	Glossary of Geology, Fifth Edition (revised), 2011
assemblage	subjective groupings of stratigraphic or metamorphic rock units that allow correlation and portrayal of lithological continuity on a regional scale	Gordey, S.P. and Makepeace, A.J., 2001. Bedrock geology, Yukon Territory. Geological Survey of Canada, Open File 3754, doi: 10.4095/211893
astrobleme	An ancient erosional scar on the Earth's surface, produced by the impact of a cosmic body, and usually characterized by a circular outline and highly disturbed rocks showing evidence of intense shock (Dietz, 1961, p.53); an eroded remnant of an impact crater. Term introduced by Dietz (1960); now obsolete. Etymol: Greek astron, "star", + blema, "wound from a thrown object such as a javelin or stone". Cf: *geobleme*. Syn: *fossil meteorite crater; impact structure*.	Glossary of Geology, Fifth Edition (revised), 2011
barrier	A narrow, elongate sand or gravel ridge rising slightly above the high-tide level and extending generally parallel with the shore, but separated from it by a lagoon (Shepard, 1952, p.1904), estuary, or marsh; it is extended by longshore transport and is rarely more than several kilometers long. Cf: *barrier island*. This feature was termed an *offshore bar* by Johnson (1919, p.259, 350). Syn: *offshore barrier; offshore beach; spit*.	Glossary of Geology, Fifth Edition (revised), 2011
basin	As a geologic term, it is used in four major contexts: In *topography*, basins (e.g., the Great Basin of the western U.S.) are low areas where surface drainage is confined to the basin and streams do not leave the basin. Relating to *structure*, basins (e.g., the Michigan Basin or the Williston Basin) are areas where the dip of strata is toward the center of the basin. *Drainage* basins (e.g., the Mississippi River drainage basin or the Clear Creek drainage basin) are areas that are drained by a single stream of any size. Relating to *sedimentation*, basins (e.g., the Appalachian Basin or the Anadarko Basin) are areas where thick sequences of sediments have accumulated.	Glossary of Geology, Fifth Edition (revised), 2011
batholith	A large, generally discordant plutonic body having an aerial extent of 40 mi^2 (100 km^2) or more and no known floor. Obsolete syn: *abyssolith*.	Glossary of Geology, Fifth Edition (revised), 2011
bed	a) A bedding surface feature that is an individual element of the morphology of a mobile granular or cohesive bed that develops due to local deposition and/or erosion in response to the interaction of a flowing current of air or water. Bed forms range from flat, almost featureless surfaces (e.g., *upper plane bed*) to complex forms spanning a wide range of	Glossary of Geology, Fifth Edition (revised), 2011

	sizes that are characterized by topographic highs and lows of varying morphology. The nature of the currents that produce bed forms range from simple, *unidirectional currents* (e.g., in a flowing stream) to complex, multidirectional currents. Examples of bed forms include *current ripple*, *oscillation ripple*, *dune*, *current crescent*, *draa*, and *flute*. See also: *bed configuration*. (b) Any deviation from a flat bed, generated by the flow on the bed of an alluvial channel (Middleton, 1965, p.247).	
block	A large, angular rock fragment, showing little or no modification by transporting agents, its surfaces resulting from breaking of the parent mass, and having a diameter greater than 256 mm (10 in.); it may be nearly in place or transported by gravity, ice, or other agents. Cf: *boulder*.	Glossary of Geology, Fifth Edition (revised), 2011
cartographic	The representation of only those content-worthy features that can be symbolized, taking into account the space and legibility constraints of the map (USGS, 2002b, p.1A-2). Cf: *geographic content*.	Glossary of Geology, Fifth Edition (revised), 2011
continent	(a) One of the Earth's major land masses, including both dry land and continental shelves. (b) An obsolete syn. of *terra*.	Glossary of Geology, Fifth Edition (revised), 2011
cover	sediments or sedimentary rocks on top of the basement	http://en.wikipedia.org/wiki/Basement_(geology)
craton	A part of the Earth's crust that has attained stability and has been little deformed for a prolonged period. The term is now restricted to continental areas that have not been pervasively metamorphosed and deformed for at least about one billion years. Cratons include shield areas, where Precambrian rocks are exposed, and platform areas, where Precambrian rocks are overlain by a thin layer of Phanerozoic strata. Also spelled: *kraton.* See also: *thalassocraton*. Obsolete syn: *kratogen.*	Glossary of Geology, Fifth Edition (revised), 2011
deformation	(a) A general term for the process of folding, faulting, shearing, or fabric development of the rocks as a result of Earth stresses. (b) The change in the geometry of a body of rock that occurs as a consequence of stress, e.g. translation, rigid body rotation about an axis, and *strain* or distortion.	Glossary of Geology, Fifth Edition (revised), 2011
dyke	A tabular igneous intrusion that cuts across the bedding or foliation of the country rock. Also spelled: *dyke*. Cf: *sill [intrus rocks]*; *sheet [intrus rocks]*. See also: *dikelet*.	Glossary of Geology, Fifth Edition (revised), 2011
embayment	A downwarped area containing stratified rocks, either sedimentary or volcanic or both, that extends into a terrain of other rocks, e.g. the Mississippi Embayment of the U.S. Gulf Coast.	Glossary of Geology, Fifth Edition (revised), 2011
facies	(a) The aspect, appearance, and characteristics of a rock unit, usually reflecting the conditions of its origin; esp. as differentiating the unit from adjacent or associated units. Cf: *stratigraphic facies*; *lithofacies*; *igneous facies*. (b) A mappable, areally restricted part of a lithostratigraphic body, differing in lithology or	Glossary of Geology, Fifth Edition (revised), 2011

	fossil content from other beds deposited at the same time and in lithologic continuity. Cf: *sedimentary facies*. (c) A distinctive rock type, broadly corresponding to a certain environment or mode of origin, e.g. "red-bed facies", "black-shale facies". Cf: *petrographic facies*. (d) A body of rock distinguished on the basis of its fossil content. Cf: *biofacies (a), (b).* (e) A local assemblage or association of living or fossil organisms, esp. one characteristic of some type of marine conditions. Cf: *biofacies (c).* (f) The environment or area in which a rock was formed, e.g. "sandy-bottom facies", "eolian facies", "volcanic facies". Cf: *environmental facies*. (g) Rocks broadly defined on a paleogeographic or paleotectonic basis. Cf: *geosynclinal facies; shelf facies*. (h) Rocks of any origin formed within certain pressure-temperature conditions. Cf: *mineral facies; metamorphic facies*. The concept of stratigraphic facies was first defined by Gressly (1836; 1838, p.10-12, 20-25) as the different lithologic and biologic aspects of rocks of essentially the same age. The different lithologic aspects may be termed lithofacies, the biologic aspects, biofacies (Steinker and Steinker, 1972, p.46). Usages and definitions have been reviewed by Moore (1949), Weller (1958), Teichert (1958), and Steinker and Steinker (1972). "The general term 'facies' has been greatly overworked. . . . If the term is used, it is desirable to make clear the specific kind of facies to which reference is made" (ISG, 1976, p.15). The term facies should not be used for bodies of rock (lithostratigraphic units) of any rank (Teichert, 1958; Weller, 1958). Etymol: Latin. Pron: faysheez or fayseez; or with short *a* as in "cat". Pl: *facies*.	
facies belt	A mappable, areally restricted part of a lithostratigraphic body, differing in lithology or fossil content from other beds deposited at the same time and in lithologic continuity. Cf: *sedimentary facies*.	Glossary of Geology, Fifth Edition (revised), 2011
flow	The action or fact of flowing; movement in a current or stream; an instance or mode of this. Originally said of liquids, but extended in modern use to all fluids, as air, electricity, etc.	Oxford English Dictionary, Oxford Press, 2015
formation	(a) A body of rock identified by lithic characteristics and stratigraphic position; it is prevailingly but not necessarily tabular, and is mappable at the Earth's surface or traceable in the subsurface (NACSN, 1983, Art. 24). The formation is the fundamental unit in *lithostratigraphic classification*. It may represent a long or short time interval, may be composed of materials from several sources, and may include breaks in deposition. A formation should possess some degree of internal lithic homogeneity or distinctive lithic	Glossary of Geology, Fifth Edition (revised), 2011

	features such as chemical or mineralogic composition, texture, fossils (viewed as rock-forming particles), or other organic content such as coal or oil shale. A formation must be amenable to being mapped at the scale of geologic mapping practiced in the region when the formation is proposed. Thickness is not a determining factor. Formations may be combined into groups or subdivided into members. A formation name normally consists of a geographic name followed by a descriptive geologic term (usually the dominant rock type) or by the word "formation" if the lithology is so variable that no single term is appropriate, e.g. Dakota Sandstone, Morrison Formation. Abbrev: fm. (b) A lithologically distinctive, mappable body of igneous or metamorphic rock. Syn: *geologic formation.*	
graben	An elongate trough or basin, bounded on both sides by high-angle normal faults that dip toward one another. It is a structural form that may or may not be geomorphologically expressed as a *rift valley*. Etymol: German, "ditch". Cf: *horst*; *half graben*.	Glossary of Geology, Fifth Edition (revised), 2011
group	(a) A formal lithostratigraphic unit next in rank above a formation. The term is applied most commonly to a sequence of two or more contiguous or associated formations with significant and diagnostic lithologic features in common (ISSC, 1994, p.35). A group name combines a geographic name with the term "group," and no lithic designation is included; for example, San Rafael Group. See also: *subgroup*; *supergroup*; *synthetic group*. (b) A stratigraphic sequence that will probably be divided in whole or in part into formations in the future. See also: *analytic group*. (c) A general term for an assemblage or consecutive sequence of related layers of rock, such as of igneous rocks or of sedimentary beds. (d) A term proposed at the 2nd International Geological Congress in Bologna in 1881 as the chronostratigraphic equivalent of an era, and subsequently used quite widely for the rocks now known as an *erathem*. (e) An obsolete term for a chronostratigraphic unit representing a local or provincial subdivision of a system (usually less than a standard series, or the equivalent of "stage" as that term is presently used) and containing two or more formations.	Glossary of Geology, Fifth Edition (revised), 2011
ice	a) Water in the solid state; specif. the solid substance formed in nature by the freezing of liquid water, by the condensation of water vapor directly into ice crystals, or by the recrystallization or compaction of fallen snow. It is colorless to pale blue or greenish blue when pure; white when it includes numerous gas bubbles. At standard atmospheric pressure, it is formed at, and has a melting point of, 0°C; in freezing, it expands about 1/11 in volume and thus floats in water. Ice is technically a mineral	Glossary of Geology, Fifth Edition (revised), 2011

	and has a hexagonal crystal structure (Cf: *a-axis [ice]*; *c-axis [ice]*). In large masses, it is a monomineralic rock. (b) A term often substituted for *glacier*, as in "continental ice".	
intrusion	The process of emplacement of magma in pre-existing rock; magmatic activity; also, the igneous rock mass so formed within the surrounding rock. See also: *pluton*. Syn: *injection [ign]; emplacement [intrus rocks]; invasion [ign]; irruption [intrus rocks]*. A sedimentary injection on a relatively large scale; e.g. the forcing upward of clay, chalk, salt, gypsum, or other plastic sediment, and its emplacement under abnormal pressure in the form of a diapiric plug. See also: *autointrusion [sed]*. (b) A sedimentary structure or rock formed by intrusion. (c) *stone intrusion*. Syn: *sedimentary intrusion.*	Glossary of Geology, Fifth Edition (revised), 2011
member	A formal lithostratigraphic unit next in rank below a formation, comprising some specially developed part of a *formation*. A named member may extend laterally from one formation into another. A member name combines a geographic name followed by the word "member"; where a lithologic designation is useful, it should be included (e.g. the Wedington Sandstone Member of the Fayetteville Shale). It is higher in rank than a bed. Abbrev: mbr. Cf: *lens*; *lentil*; *tongue [stratig]*.	Glossary of Geology, Fifth Edition (revised), 2011
ocean	The continuous salt-water body that surrounds the continents and fills the Earth's great depressions; also, one of its major geographic divisions. See also: *sea [oceanog]*.	Glossary of Geology, Fifth Edition (revised), 2011
orogen	Orogenic belt A linear or arcuate region that has been subjected to folding and other deformation during an *orogenic cycle*. Orogenic belts are mobile belts during their formative stages, and most of them later became mountain belts by postorogenic processes. Syn: *fold belt*; *orogen*.	Glossary of Geology, Fifth Edition (revised), 2011
part	A portion of a geological unit	
platform	That part of a continent that is covered by flat-lying or gently tilted strata, mainly sedimentary, which are underlain at varying depths by a *basement* of rocks that were consolidated during earlier deformations. A platform is a part of the *craton*. See also *shelf facies*.	Glossary of Geology, Fifth Edition (revised), 2011
pluton	A deep-seated igneous *intrusion*. Cf: *plutonism [ign]*.	Glossary of Geology, Fifth Edition (revised), 2011
plutonic assemblage	Pertaining to a group of igneous rocks or intrusive bodies formed at great depth. See also: *plutonic rock*. Cf: *hypabyssal*. Syn: *abyssal [intrus rocks]*; *deep-seated*; *hypogene*.	Glossary of Geology, Fifth Edition (revised), 2011
plutonic igneous complex	An assemblage of intimately associated and roughly contemporaneous igneous rocks differing in form or in petrographic type; it may consist of plutonic rocks, volcanic rocks, or both.	Glossary of Geology, Fifth Edition (revised), 2011

rift	The direction of easiest splitting in granite or other crystalline rocks often enhanced by a microcrack fabric that forms as a result of either cooling or decompression (Dale, 1923).	Glossary of Geology, Fifth Edition (revised), 2011
sequence	(a) A succession of geologic events, processes, or rocks, arranged in chronologic order to show their relative position and age with respect to geologic history as a whole. (b) The unit immediately above a system in the chronostratigraphic hierarchy, now called *erathem* (Moore, 1933, p.54; Weller, 1960, p.418, 449). (c) A major informal lithostratigraphic unit of greater than group or supergroup rank, traceable over large areas of a continent, and bounded by unconformities of interregional scope, such as in the cratonic interior of North America (Sloss, 1963). (d) A geographically discrete succession of major rock units that were deposited under related environmental conditions (Silberling and Roberts, 1962). Cf: *sub-sequence*. Syn: *stratigraphic sequence; tectono-stratigraphic unit*. (e) In sequence stratigraphy, a relatively conformable succession of genetically related strata bounded by unconformities or their correlative conformities (Mitchum, 1977). Parasequences and parasequence sets are the stratal building blocks of the sequence (Van Wagoner et al., 1990). Cf: *parasequence; parasequence set*. (f) A faunal succession.	Glossary of Geology, Fifth Edition (revised), 2011
shelf	A sedimentary facies that contains sediments produced in the neritic environment of the shelf seas marginal to a low-lying, stable land surface. It is also known as *shelly facies* in recognition of the importance of its characteristic carbonate rocks and fossil shells. Cf: *geosynclinal facies*. Syn: *platform facies; foreland facies.*	Glossary of Geology, Fifth Edition (revised), 2011
sill	A tabular igneous intrusion that parallels the bedding or foliation of the sedimentary or metamorphic country rock, respectively. Cf: *dike [intrus rocks]; sheet [intrus rocks]; sole injection*. Sp: *filón-capa*. [**image**]	Glossary of Geology, Fifth Edition (revised), 2011
stitching assemblage	A postaccretion unit of sedimentary or igneous rocks deposited on, or intruded into, two or more adjacent terranes. The sedimentary and volcanic parts either depositionally overlie, or are interpreted to have originally depositionally overlain, two or more adjacent terranes, or terranes and the craton margin. Overlapping plutonic rocks, which may be coeval and genetically related to overlap volcanic rocks, link or stitch together adjacent terranes, or a terrane and a craton margin.	http://pubs.usgs.gov/of/2004/1252/geodynamics_map/1_intro.pdf
stock	A relatively small, concordant and/or discordant plutonic body having an aerial extent less than 40 sq mi (100 sq km) and no known floor. Cf: *boss [ign]*.	Glossary of Geology, Fifth Edition (revised), 2011

subgroup	A formally differentiated assemblage of formations within a *group* (ACSN, 1961, art.9d); a formally established subdivision of a group (ISSC, 1994, p.35). This term is not recognized by the North American Commission on Stratigraphic Nomenclature (1983).	Glossary of Geology, Fifth Edition (revised), 2011
subterrane	The bedrock beneath a surficial deposit or below a given geologic formation. adj. *subterranean*.	Glossary of Geology, Fifth Edition (revised), 2011
succession	(a) A number of rock units or a mass of strata that succeed one another in chronologic order; e.g. an inclusive stratigraphic sequence involving any number of stages, series, systems, or parts thereof, as shown graphically in a geologic column or seen in an exposed section. (b) The chronologic order of rock units.	Glossary of Geology, Fifth Edition (revised), 2011
suite	A set of apparently comagmatic igneous rocks. (b) A collection of rock specimens from a single area, generally representing related igneous rocks.	Glossary of Geology, Fifth Edition (revised), 2011
supergroup	(a) A formal assemblage of related or superposed groups, or of groups and formations. The term should not be misused for series (NACSN, 1983, Art. 29). Cf: *megagroup*. (b) A lithostratigraphic unit composed of several associated groups or of associated formations and groups with significant lithologic features in common (ISSC, 1994, p.35).	Glossary of Geology, Fifth Edition (revised), 2011
swarm	A concentration of dikes of similar orientation (parallel, subparallel, or radiating) (Halls and Fahrig, 1987).	Glossary of Geology, Fifth Edition (revised), 2011
terrane	A fault-bounded body of rock of regional extent, characterized by a geologic history different from that of contiguous terranes or bounding continents. A terrane is generally considered to be a discrete allochthonous fragment of oceanic or continental material added to a craton at an active margin by *accretion [struc geol]*. See: D.L. Jones et al., 1983; Schermer et al., 1984. The term was first used in this sense by W.P. Irwin (1972). See also: *composite terrane*; *disrupted terrane*; *exotic terrane*; *metamorphic terrane*; *stratigraphic terrane*; *suspect terrane*. Syn: *accretionary terrane*. (b) Informally, a region where a particular rock or group of rocks predominates.	Glossary of Geology, Fifth Edition (revised), 2011
tongue	projecting part of a lithostratigraphic unit extending beyond its main body (Stephenson, 1917). Cf: *lentil*. v. To thin laterally to disappearance.	Glossary of Geology, Fifth Edition (revised), 2011
topographic	(a) Pertaining to *topography*. (b) Surveying or representing the topography of a region; e.g. a "topographic survey" or a "topographic map".	Glossary of Geology, Fifth Edition (revised), 2011
trough	A linear depression or basin that subsides as it receives clastic material, located not far from the source supplying the sediment	Glossary of Geology, Fifth Edition (revised), 2011
uplift	A structurally high area in the crust, produced by positive movements that raise or upthrust the rocks, as in a dome or arch. Cf: *depression [tect]*.	Glossary of Geology, Fifth Edition (revised), 2011

uplift stitching assemblage	A structurally high area in the crust, produced by positive movements that raise or upthrust the rocks, as in a dome or arch. Cf: *depression [tect]*.	Glossary of Geology, Fifth Edition (revised), 2011
volcanic centre	A site at which volcanic activity localized at one or several vents is occurring or has occurred in the past.	Glossary of Geology, Fifth Edition (revised), 2011
volcanic chain	Linear arrangement of a number of volcanoes, apparently associated with a controlling geologic feature such as a fault or a hot spot.	Glossary of Geology, Fifth Edition (revised), 2011
zone	A belt, band, or strip of earth materials, however disposed, characterized as distinct from surrounding parts by some particular property or content; e.g., the *zone of saturation,* the zone of fracture or a *fault zone*.	Glossary of Geology, Fifth Edition (revised), 2011

4.1.55 vocab_UnitType

Categories denoting the type of geologic unit.

Term	Definition	Reference
Allostratigraphic Unit	A mappable stratiform body of sedimentary rock that is defined and identified on the basis of its bounding discontinuities. Allostratigraphic units, in order of decreasing rank, are *allogroup*, *alloformation*, and *allomember*. The fundamental unit is the alloformation (NACSN, 1983, Art. 58).	Glossary of Geology, Fifth Edition (revised), 2011
Alteration Unit	(a) Any change in the mineralogic composition of a rock brought about by physical or chemical means, esp. by the action of hydrothermal solutions; also, a secondary, i.e. supergene, change in a rock or mineral. (b) Changes in the chemical or mineralogical composition of a rock produced by weathering.	Glossary of Geology, Fifth Edition (revised), 2011
Biostratigraphic Unit	A body of rock defined or characterized by its fossil content. Its boundaries may or may not coincide with those of a lithostratigraphic unit, but they bear no inherent relation to them. The basic unit is the *biozone* (NACSN, 1983, Art. 48).	Glossary of Geology, Fifth Edition (revised), 2011
Chronostratigraphic Unit	A body of rocks established to serve as the material reference for all rocks formed during the same span of time. Each of its boundaries is synchronous. The body also serves as the basis for defining the specific interval of time, or *geochronologic unit*, represented by the referent (NACSN, 1983, Art. 66). Chronostratigraphic units in order of decreasing rank: *eonothem*, *erathem*, *system*, *series*, *stage*. Syn: *chronostratic unit; chronolithologic unit; time-stratigraphic unit; time-rock unit; chronolith.* See also: *chronozone*.	Glossary of Geology, Fifth Edition (revised), 2011
Deformation Unit	A unit characterized by folding, faulting, shearing, or fabric development of the	Adapted from Glossary of Geology, Fifth Edition

	rocks as a result of Earth stresses.	(revised), 2011
Geologic Unit		
Geomorphologic Unit		
Lithodemic Unit	A body of predominantly intrusive, highly deformed, and/or highly metamorphosed rock, distinguished and delimited on the basis of rock characteristics. Unlike lithostratigraphic units, a lithodemic unit does not conform to the Law of Superposition. Its contacts with other rock units may be sedimentary, extrusive, intrusive, tectonic, or metamorphic (NACSN, 1983, Art. 31). The fundamental unit in lithodemic classification is the *lithodeme*. Lithodemic units are the practical units of geological work in terranes in which rocks generally lack primary stratification. See also: *complex (b).*	Glossary of Geology, Fifth Edition (revised), 2011
Lithogenetic Unit	A term used by Schenck and Muller (1941) for a local mappable assemblage of rock strata (such as a formation, member, or bed), considered without regard to time; a cartographic unit. Cf: *lithostratigraphic unit*.	Glossary of Geology, Fifth Edition (revised), 2011
Lithologic Unit	*See lithostratigraphic unit*.	Glossary of Geology, Fifth Edition (revised), 2011
Lithostratigraphic Unit	a) A defined body of sedimentary, extrusive igneous, metasedimentary, or metavolcanic strata that is distinguished and delimited on the basis of lithic characteristics and stratigraphic position. It generally conforms to the Law of Superposition and commonly is stratified and tabular in form (NACSN, 1983, Art. 22). (b) A body of rocks, sedimentary, igneous or metamorphic, that is defined and recognized on the basis of its observable and distinctive lithologic properties or combination of lithologic properties and its stratigraphic relations (ISSC, 1994, p.31-43). Boundaries of lithostratigraphic units are placed at positions of lithic change, either at distinct contacts or arbitrarily within zones of gradation. The fundamental unit is the *formation*. A lithostratigraphic unit has a binomial designation, consisting of a geographic name, derived from the *type locality*, combined with a descriptive lithologic term; both are capitalized. See also: *lithogenetic unit*. Syn: *rock-stratigraphic unit; lithostratic unit; lithologic unit; rock unit; geolith.*	Glossary of Geology, Fifth Edition (revised), 2011
Lithotectonic Unit	An assemblage of rocks that is unified on the basis of structural or deformational features, mutual relations, origin, or historical evolution.	Glossary of Geology, Fifth Edition (revised), 2011

	It may be igneous, sedimentary, or metamorphic.	
Magnetostratigraphic Unit	A body of rocks unified by specified remanent-magnetic properties and distinct from underlying and overlying magnetostratigraphic units having different magnetic properties (NACSN, 1983, Art. 43). Syn: *magnetozone*.	Glossary of Geology, Fifth Edition (revised), 2011
Mass Movement Unit	A unit movement of a portion of the land surface; specif. *mass wasting* or the gravitative transfer of material down a slope. Cf: *mass transport [sed]*.	Glossary of Geology, Fifth Edition (revised), 2011
Pedoderm	A mappable unit mantle of soil, entirely or partially truncated, at the Earth's surface or partially or wholly buried, which has physical characteristics and stratigraphic relationships that permit its consistent recognition and mapping.	Glossary of Geology, Fifth Edition (revised), 2011
Pedostratigraphic Unit	A buried, traceable, three-dimensional body of rock (or sediment) that consists of one or more differentiated pedologic horizons developed in and overlain by one or more formally defined lithostratigraphic or allostratigraphic units (NACSN, 1983, Art. 55). See also: *geosol; pedostratigraphy.*	Glossary of Geology, Fifth Edition (revised), 2011
Polarity Chronostratigraphic Unit	A body of rock that contains the primary magnetic-polarity record imposed when the rock was deposited, or crystallized, during a specific interval of geologic time. The *polarity chronozone* is the fundamental unit (NACSN, 1983, Art. 83).	Glossary of Geology, Fifth Edition (revised), 2011

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