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CANADIAN GEOSCIENCE MAP 122

SURFICIAL GEOLOGY

LA JOLIE BUTTE

British Columbia



Map Information
Document

Preliminary



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Cover Illustration

Shales and sandstones exposed along the Liard River in northeast British Columbia, view south toward the confluence with Fort Nelson River. Photograph by D.H. Huntley. 2013-100

ABSTRACT

Canadian Geoscience Map 122 depicts the surficial geology over some 790 km² covered by the La Jolie Butte map sheet (NTS 94-O/12) in northeastern British Columbia. The map area lies at the western limit of the Liard Plateau and is incised by the Liard River and its tributaries. Bedrock is mantled by unconsolidated earth materials dating to the Late Pleistocene (Late Wisconsinan Glaciation, > 25 ka to ca. 10 ka) and non-glacial Holocene (ca. 10 ka to present). Deposits of till, green on the map, are generally suitable for placement of infrastructure. Glaciofluvial and eolian deposits with mineral, aggregate, and groundwater potential are coloured orange and buff. Slopes disturbed by landslides, debris flows, and rock falls appear brown and pink. Glaciolacustrine and organic deposits with sporadically discontinuous permafrost are coloured purple and grey. Alluvial deposits prone to flooding, erosion, and sedimentation appear yellow on the map.

RÉSUMÉ

La Carte géoscientifique du Canada 122 illustre la géologie des matériaux superficiels d'un territoire d'environ 790 km² couvert par le feuillet cartographique de La Jolie Butte (SNRC 94-O/12), dans le nord-est de la Colombie-Britannique. La région cartographique se situe à la bordure occidentale du plateau de Liard et est entaillée par la rivière Liard et ses affluents. Le socle rocheux est couvert de matériaux terrestres non consolidés remontant au Pléistocène supérieur (Glaciation du Wisconsinien supérieur, de > 25 ka à env. 10 ka) ainsi que de matériaux non glaciaires de l'Holocène (d'env. 10 ka jusqu'à nos jours). Les dépôts de till, de couleur verte sur la carte, sont généralement propices à l'établissement de l'infrastructure. Les dépôts fluvioglaciaires et éoliens, qui recèlent un potentiel en minéraux, en agrégats et en eau souterraine, sont figurés par les couleurs orange et chamois. Les versants dérangés par des glissements de terrain, des coulées de débris et des chutes de blocs sont représentés en brun et en rose. Les dépôts glaciolacustres et organiques, qui renferment sporadiquement du pergélisol discontinu, sont représentés en violet et en gris. Les dépôts alluviaux sujets aux inondations, à l'érosion et à la sédimentation apparaissent en jaune sur la carte.

ABOUT THE MAP

General Information

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Geology by D.H. Huntley and A.S. Hickin (2009–2010)

Geological compilation by D.H. Huntley (2009–2011)

Geomatics by D.H. Huntley, W. Chow, and M. Mirmohammadi

Cartography by W. Chow

Initiative of the Geological Survey of Canada, conducted under the auspices of the Yukon Basin Project as part of Natural Resources Canada's Geo-mapping for Energy and Minerals (GEM) program

Map projection Universal Transverse Mercator, zone 10. North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications. Elevations in feet above mean sea level

Magnetic declination 2013, 20°39'E, decreasing 22' annually.

The Geological Survey of Canada welcomes corrections or additional information from users.

This publication is available for free download through GEOSCAN (<http://geoscan.ess.nrcan.gc.ca/>).

Preliminary publications in this series have not been scientifically edited.

Map Viewing Files

The published map is distributed as a Portable Document File (PDF), and may contain a subset of the overall geological data for legibility reasons at the publication scale.

ABOUT THE GEOLOGY

Descriptive Notes

INTRODUCTION

This Surficial Geology Map of NTS 94-O/12 (Canadian Geoscience Map 122) is the product of collaboration between the Geological Survey of Canada and the British Columbia Ministry of Energy, Mines and Natural Gas as part of the Geo-mapping for Energy and Minerals Program (GEM-Energy Yukon Basins Project). The accompanying geodatabase includes field observation points and field photos, landform features as lines, and surficial geology unit polygons. The map and geodatabase are essential baseline geoscience information for a range of potential end-users including resource explorationists, geotechnical engineers, land-use managers, terrestrial ecologists, archaeologist, geoscientists and communities in northern British Columbia. By providing new insight into the distribution and origins of surficial earth materials, CGM 122 will help to reduce the economic costs and risks associated with the sustainable development of energy and mineral resources in NTS 94-O/12. Environmental impact assessments for new access roads, work camps, well pads, pipeline and power transmission line corridors, water storage and waste management systems and other infrastructure will benefit from the geoscience information presented here. By identifying areas prone to geological hazards (e.g., landslides, permafrost, flooding), CGM 122 will also help to protect natural resources, infrastructure and communities vulnerable to climate change in Canada's north.

APPROACH TO SURFICIAL GEOLOGY MAPPING

Terrain mapping and field-based benchmarking studies have led to a better understanding of the regional distribution of surficial deposits, permafrost, landslides and other geomorphic processes in the NTS 94-O/12 map area (Huntley and Hickin, 2010; Huntley et al., 2011a-b). Surficial earth materials and landforms were interpreted using a combination of stereo-pair air photos (e.g., BCB97010, 15BCB97015, 15BCB97029, 15BCB97075 and 15BCB97088 series), LANDSAT 7 satellite imagery (<http://glovis.usgs.gov/> [URL 2011]) and Shuttle Radar Topography Mission digital elevation models (<http://dds.cr.usgs.gov/srtm/> [URL 2011]). The base map was generated from CANVEC shape files (<http://geogratis.cgdi.gc.ca/geogratis/> [URL 2011]). Terrain polygons and on-site symbols were digitized using commercially available computer software packages (Global Mapper, ArcMap and ArcGIS) and compared to published maps, reports and archived digital data (e.g., Stott and Taylor, 1968; Bednarski, 2003a-d; Clement et al., 2004; Bednarski, 2005a-b). The geodatabase accompanying this map conforms to the Science Language for the Data Management

component of the GEM Geological Map Flow process (cf. Huntley and Sidwell, 2010; Huntley et al., 2011a; Deblonde et al., 2012).

Fieldwork was undertaken in 2009 and 2010 to ground truth surficial geology polygons interpreted from air photos and satellite imagery, and to gather characteristics that could not be determined through remote predictive mapping. Earth materials were defined on the basis of facies and landform associations, texture, sorting, colour, sedimentary structures, degree of consolidation, and stratigraphic contact relationships at field stations and remote observations from helicopters. The distribution of glacial and non-glacial landforms is depicted on the surficial geology map. Map units in the Legend are presented chronostratigraphically and include organic deposits, alluvial, colluvial, eolian, glaciolacustrine and glaciofluvial sediments, tills and areas of bedrock.

INFERRED GEOLOGICAL HISTORY

The distinctive landscape of NTS 94-O/12 is largely a product of underlying bedrock and geological structures, with ornamentation by the Late Wisconsinan Laurentide Ice Sheet. La Jolie Butte is underlain by conglomerate, sandstone, carbonaceous shale and coal (Upper Cretaceous Wapiti Formation). Over much map area, shale, siltstone and sandstone (Upper Cretaceous Kotaneelee Formation) lie beneath surficial units (Stott and Taylor, 1968). Topography and drainage patterns were greatly modified during the phase of maximum ice cover ($>18^{14}\text{C}$ ka BP or >21.4 calendar ka BP). Unconsolidated sediment thicknesses in excess of 2-5 m are observed in valleys and it is suspected that similar drift thicknesses blanket bedrock (unit R) across the map area. Silt- and clay-rich Laurentide tills have low clast contents ($<20\%$) of proximally derived Cretaceous siliciclastic sedimentary rocks and distal igneous and metamorphic clasts from the Canadian Shield, hundreds of kilometres to the northeast. Drumlin ridges up to several hundred metres in length suggest clay-rich tills (unit Ts) were deposited beneath active, rapidly flowing warm-based glacial ice (Huntley and Hickin, 2010; Huntley et al., 2011b). Drumlinized till (unit Ts) is most pronounced west of La Jolie Butte where west- and southwest moving ice flowed up-hill, and thick accumulations of till were deposited over soft bedrock and unconsolidated advance-phase sediments. Small lake basins were excavated by erosion and ice-thrusting as Laurentide ice and subglacial meltwater scoured and deformed older glacial deposits and weak bedrock.

Deglaciation began sometime after 18^{14}C ka BP (or >21.4 calendar ka BP) and ended before 10^{14}C ka BP (ca. 12 calendar ka BP), with the retreating active Laurentide Ice Sheet, stagnant ice masses in lowlands, glaciofluvial outwash and landslide debris blocking and reordering regional drainage. The mapped distribution of moraine ridges (unit Tm) implies that ice margins receded to the northeast across the map sheet (Huntley and Hickin, 2010). Some large end moraines are deformed and streamlined suggesting that receding lobes remained active during retreat and occasionally rapidly advanced. Minor moraine ridges drape drumlins in cross-cutting patterns and are interpreted as crevasse fillings and squeeze moraines deposited shortly after drumlinization ended, or as ice retreated from the map area (Huntley et al., 2011b). Hummocky till (unit Th) together with short segments of subareal-subglacial meltwater channels and eskers indicate that bodies of stagnant glacier ice remained in lowland

areas west of the Maxhamish Escarpment (Huntley et al., 2011a-b). As ice retreated from the map area, a proglacial lake system formed on the Liard Plateau. Proglacial lakes were linked by spillways that drained meltwater northward into the Mackenzie River basin. In the map area, glaciolacustrine deposits (unit GLb), glaciofluvial terraces (unit GFt), and meltwater channels incised into till and bedrock indicate that glacial lake levels fell stepwise through deglaciation, with stable elevations at approximately 420 m, 380 m and <300 m. Fine-grained glacial earth materials have been re-worked by eolian activity and discontinuous loess covers glacial lake and till deposits in some areas.

Post-glaciation (10^{14} C ka BP, or ca. 12 calendar ka BP to present), changes in regional base-level led to episodes of channel incision and aggradation, resulting in the formation of erosional alluvial terraces along most stream and river valleys. In the early Holocene, pulses of fluvial terrace building followed initial valley incision by the Liard and other major rivers. Most streams and rivers have alluvial terraces (unit At) <5 m above active floodplains (unit Ap) consisting of gravel overlain by silt and sand. Poorly drained clay-rich till on the plateaux and glaciolacustrine sediments in lowland areas are covered by extensive postglacial peat deposits (unit Owb). Discontinuous permafrost is sporadically encountered in glaciolacustrine and some peat deposits. Charcoal, observed in dug pits on alluvial terraces, suggest forest fires may have contributed to periods of landslide activity on slopes and local fluvial aggradation. Landslides and colluviated deposits (units Cv, Cb) are common where bedrock outcrops form escarpments, and where shale or fine-grained glacial deposits are exposed along steep cutbanks. Stream networks and wetlands draining plateau watersheds are disrupted by beaver activity and, to a lesser extent, by roads and infrastructure where they cross streams, rivers and organic deposits (Huntley and Hickin, 2010; Huntley and Hickin, 2011a-b).

Acknowledgments

Canadian Geoscience Map 122 is an output of the Geo-Mapping for Energy and Minerals Yukon Basins Project managed by Carl Ozyer and Larry Lane (GSC-Calgary). The assistance of Robert Cocking, Sean Eagles, Vic Dohar, Mike Sigouin, Scott Tweedy and Martin Legault (NRCAN Scientific Publishing Services) was greatly appreciated throughout the map-making process. A critical review of CGM 122 was provided by Ron DiLabio (GSC-Ottawa).

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Coordinate System

Projection: Universal Transverse Mercator
Units: metres
Zone: 10N
Horizontal Datum: NAD83
Vertical Datum: mean sea level

Bounding Coordinates

Western longitude: 124°00'00" W
Eastern longitude: 123°30'00" W
Northern latitude: 59°45'00" N
Southern latitude: 59°30'00" N

Data Model Information

The Geological Survey of Canada (GSC) through the Geomapping for Energy and Minerals Program (GEM) has undertaken the Geological Map Flow to develop protocols for the collection, management (compilation, interpretation), and dissemination of surficial and bedrock geology data and map information. To this end, a data model has been created.

The Surficial Data Model (SDM) was designed using ESRI geodatabase architecture. The XML workspace document provided can be imported into a geodatabase, and the geodatabase will then be populated with the feature datasets, feature classes, tables, relationship classes, subtypes and domains.

Shapefile and table (.dbf) versions of the data are included within the data. Column names have been simplified and the text values have been maintained within the shapefile attributes. The direction columns are numerical, to display rotation for points, and the symbol fields will hold the correct values to be matched to the appropriate style file.

For a more in depth description of the data model please refer to the official publication:

Science language for an integrated Geological Survey of Canada data model for surficial geology maps, version 1.2; Deblonde, C; Plouffe, A; Boisvert, É; Buller, G; Davenport, P; Everett, D; Huntley, E; Inglis, E; Kerr, D; Moore, A; Paradis, S J; Parent, M; Smith, I R; St. Onge, D; Weatherston, A. Geological Survey of Canada, Open File 7003, (ed. 1.2), 2012, ; 238 pages (1 sheet), doi:10.4095/290144

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 - ii. par un préavis écrit de résiliation émis par le Détenteur de licence, en tout temps, et cette résiliation prendra effet trente (30) jours suivant la réception d'un tel préavis par le Canada; ou
 - iii. par consentement mutuel des parties.

2. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, les obligations qui incombent au Détenteur de licence en vertu de la section 4.0 continueront de s'appliquer et les droits du Détenteur de licence en vertu de la section 2.0 cesseront immédiatement.
3. Lors de la résiliation de cet Accord, pour quelque raison que ce soit, le Détenteur de licence devra immédiatement effacer ou détruire toutes les Données obtenues en vertu de cet Accord, ou à l'intérieur d'un délai raisonnable lorsque les Données sont nécessaires pour terminer la livraison de Produits dérivés commandés avant la résiliation de cet Accord.

7.0 GÉNÉRAL

1. Lois d'application

Le présent Accord est régi et interprété en vertu des lois en vigueur dans la province de l'Ontario. Les parties acceptent de tomber sous la juridiction de la Cour supérieure de la Province de l'Ontario.

2. Totalité de l'Accord

Le présent Accord constitue l'intégralité de l'entente conclue entre les parties relativement à l'objet du présent Accord. Toute modification à cet Accord ne peut être que par écrit, doit porter la signature de chaque partie et exprimer clairement l'intention de modifier cet Accord.

3. Solution des litiges

Si un litige survient à propos de cet Accord, les parties tenteront de le résoudre par des négociations de bonne foi.