GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES

NOTES

The Macmillan River sheet extends across nearly all of northern Cordilleran Orogen, embracing an area of about 301,000 square kilometres (116,000 square miles). The Mackenzie Mountains in the northeast are rugged and bare. St. Elias Mountains in the southwest are the highest in Canada and largely covered with glaciers. Intervening parts, including Yukon Plateau, are generally mountainous but relatively subdued and forested. The northwest trending Tintina and Shakwak Trenches are prominent regional physiographic lineaments, the loci of transcurrent faults of large dextral displacement.

Mackenzie Fold Belt forms a part of the Columbian Orogenic Belt. It includes thick miogeoclinal strata of Helikian to late Devonian age. The strata are gently to tightly folded and broken by high angle reverse and wrench faults. Most systems exhibit southwesterly facies changes from carbonate to shale and fine clastics indicating deeper environments of deposition to the southwest, within Selwyn Fold Belt. Non-marine, Cretaceous (Albian?) strata are faulted and folded with the older rocks indicating that most deformation occurred early in the late Cretaceous-Paleocene Laramide Orogeny.

The northeastern margin of Selwyn Fold Belt closely follows the limit of mid-Cretaceous late tectonic granitic plutons. The belt is underlain by a great diversity of clastic, carbonate, volcanic, ultrabasic and granitic rocks of Hadrynian to Tertiary age. Anvil Allochthon comprises at least two westerly derived thrust sheets, the lower with basic volcanics and ultramafics and the upper with granitic and gneissic rocks which were emplaced at least in part after the late Triassic(?) and prior to the mid-Cretaceous. Intense mylonitization occurs near the thrust surfaces. In the southwest, gently folded Cretaceous volcanics overlie deformed strata, metamorphic and plutonic rocks indicating that most deformation there occurred during the Jura-Cretaceous, Columbian Orogeny. Hadrynian and lower Paleozoic calcareous and argillaceous strata host lead-zinc deposits; tungsten is associated with some mid-Cretaceous plutons. As much as 450 km of dextral offset during the mid- and late Cretaceous along Tintina fault has juxtaposed rocks of markedly different facies.

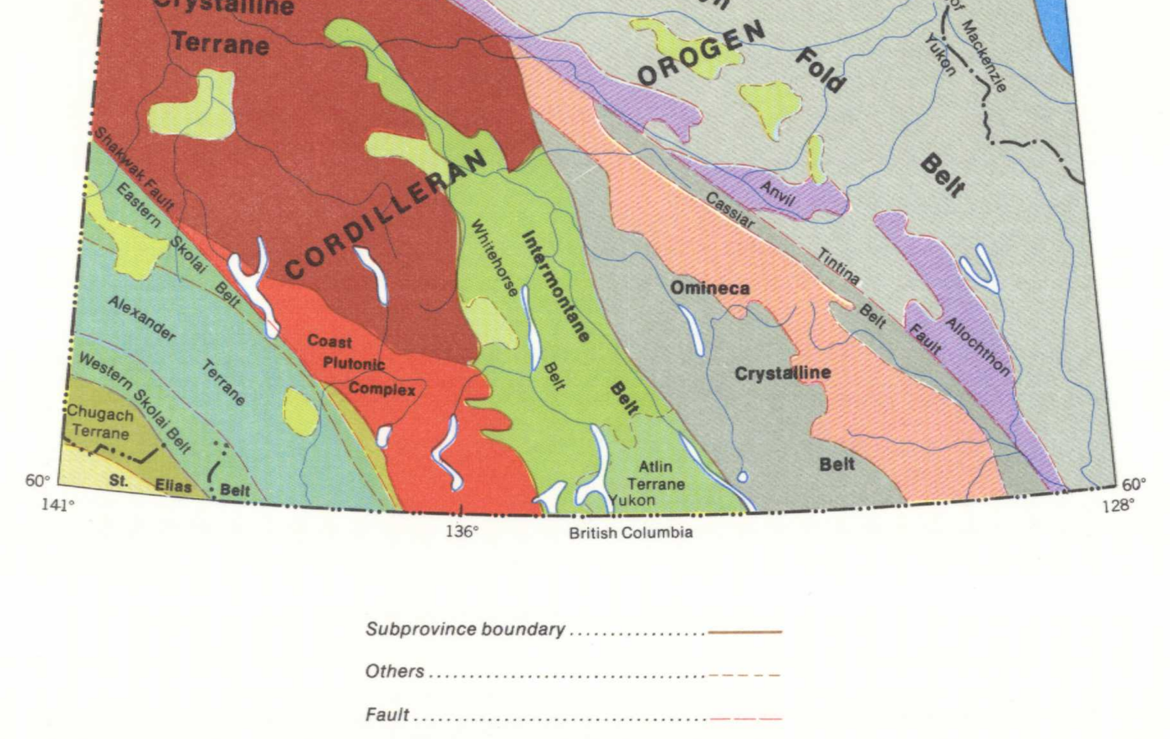
In the Cassiar Belt of eastern Omineca Crystalline Belt the thin, older Paleozoic rocks have a distinctive platformal aspect but become increasingly clastic and finer grained westward. Steeply dipping, northwest trending thrust faults of Mesozoic age are common; some may have transcurrent displacement. The upper Paleozoic, which may be partly allochthonous, comprises great thicknesses of basic volcanics, chert, shale and alpine type ultramafics. Klippen of cataclastically deformed schist and gneiss locally overlie unmetamorphosed strata. In western Omineca Crystalline Belt the metamorphism of fine-grained clastics, volcanics and carbonates reaches amphibolite grade, increasing to the west and northwest. Mid-Cretaceous quartz monzonite plutons post-date the regional metamorphism and deformation which is attributed to the early Columbian Orogeny, although part may have been produced during the Devono-Mississippian, Caribooan Orogeny. A zone of highly foliated and sheared quartz monzonite forms the southwest margin of Cassiar batholith.

In Atlin Terrane of Intermontane Belt, upper Paleozoic deep water sediments and basic volcanics are isolated from adjacent belts by faults and large ultramafic bodies. In most places the rocks are intensely folded on a small scale and penetratively cleaved along northwest trends. Locally an earlier, northerly trending set of fold axes can be seen. The Whitehorse Belt is underlain by Mesozoic volcanic and sedimentary strata, marine and non-marine, the youngest part representing a successor-basin assemblage containing commercial coal. Upper Triassic andesitic volcanics and associated sedimentary rocks include limestone reefs, some of which face northeasterly. Jurassic polymict conglomerate, volcaniclastics and turbidites were derived from the southwest and northeast. Northwest trending, early Laramide open folding predates extrusion of unconformably overlying early Tertiary medium to acid volcanics. Copper has been mined from Triassic rocks near Whitehorse.

Yukon Crystalline Terrane comprises pre-upper Triassic schist, ortho- and paragneiss, intruded by a great variety of granitic rocks of late Triassic to early Tertiary age and overlain by upper Cretaceous and Tertiary volcanics and sediments. The earlier plutons and batholiths trend northwesterly and are much permeated by younger plutons with northerly trends. Isograd surfaces are gently dipping over large areas and broad open folds reflect only the latest stages of deformation. Asbestos, copper, molybdenum, tungsten, silver, lead and placer gold occur.

The Saint Elias Belt, with the highest and youngest mountains of the Canadian Cordillera, is divided into five distinct terranes by major northwest-trending faults. Westerly derived Jura-Cretaceous flysch and schist which occur near Shakwak fault, and in northern Coast Plutonic Complex, have been dextrally offset at least 300 km relative to equivalent strata in the Nutzotin Belt of Alaska. Eastern Skolai Belt includes upper Paleozoic and Mesozoic basaltic flows, breccias and tuff, argillite, limestone and turbidite locally resting unconformably on a mid- or early Paleozoic gabbroic and ultramafic complex. Paleozoic rocks of Alexander Terrane are bounded by the Duke River and Art Lewis faults. They include pre-Devonian andesite, greywacke, phyllite and amphibolite overlain by Devonian and Carboniferous tuff, breccia, limestone and phyllite. The rocks were probably initially deformed and metamorphosed in the late Paleozoic and are unconformably overlain by shallow-marine upper Cretaceous and non-marine Tertiary sedimentary and volcanic rocks. Jura-Cretaceous plutons are abundant in the east whereas Permian quartz monzonite, agmatitic diorite, and syenodiorite are characteristic of the west. In Western Skolai Belt, deformed and locally metamorphosed upper Paleozoic and lower Mesozoic volcaniclastics, chert, limestone and pelite are unconformably overlain by shallow-marine upper Cretaceous clastics. Chugach Terrane is bounded on the northeast by the Border Ranges fault. Locally metamorphosed upper Mesozoic, deep-water sedimentary and volcanic rocks forming eastern and northern Chugach Terrane are thrust southwesterly over Tertiary and possibly Quaternary strata which merge with those of the Pacific Continental Shelf. In this region movement of the Pacific Plate relative to the North American Plate changes from dextral transform in the east to northerly underthrusting farther west.

GEOLOGICAL PROVINCES



Subprovince boundary
Others
Fault

Geological contact (mapped, assumed)
Fault (mapped, assumed)
Transcurrent fault (mapped, assumed)
Normal fault (hachures on hanging wall)
Thrust, reverse fault (teeth on hanging wall, mapped, assumed)

Locality of isotopic age determination
by the GSC ... bK95
by other laboratories ... bK95a

Plutonic, volcanic, metamorphic and sedimentary rocks ... O,O,△,◊

Method:
Potassium-argon ... K

Material:
amphibolite, biotite, muscovite ... a, b, m
Age in millions of years ... 101

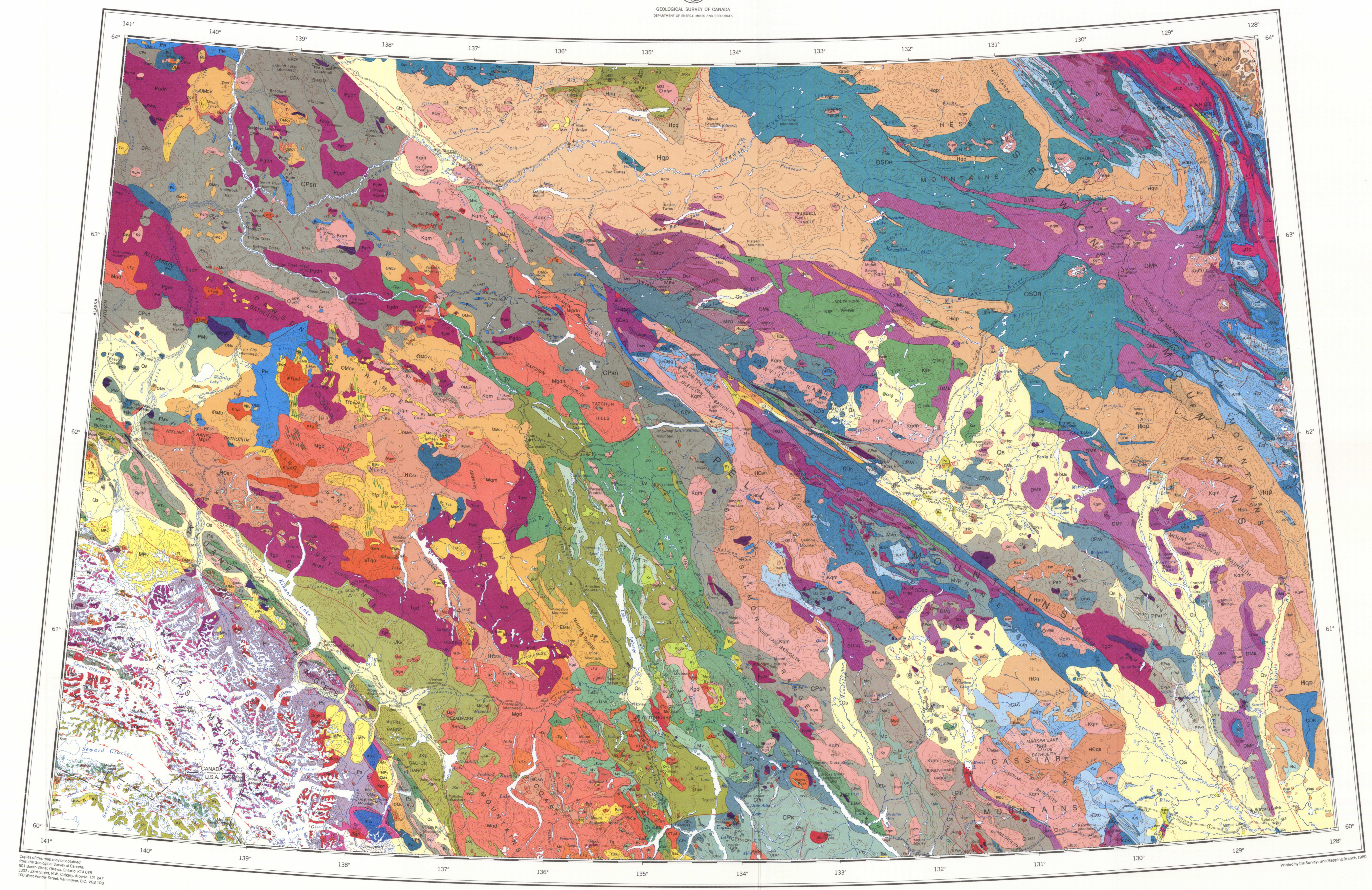
Other laboratories designation:
University of Alberta ... a
University of British Columbia ... b

Geological compilation by H. Gabrielse, D.J. Tempelman - Kluit, S.L. Blusson and R.B. Campbell, 1977

Yukon and District of Mackenzie geology was compiled from published and unpublished maps of the Geological Survey of Canada. R.B. Campbell compiled the geology of the St. Elias Belt, with contributions by J.J. McDougall; S.L. Blusson the northern Selwyn Fold Belt. The remainder of the sheet was compiled by H. Gabrielse and D.J. Tempelman - Kluit. Alaska geology was compiled by G. Plafker from unpublished maps of the United States Geological Survey

Geological cartography by J.A.Y. Pratt, Geological Survey of Canada

Base map at the same scale, published by Surveys and Mapping Branch in 1974 as IMW sheet NP-7/8/9



Copies of this map may be obtained from the Geological Survey of Canada:
601 Booth Street, Ottawa, Ontario K1A 0E8
3303 - 33rd Street, N.W., Calgary, Alberta T2L 2A7
100 West Pender Street, Vancouver, B.C. V6B 1R8

Printed by the Surveys and Mapping Branch, 1980

INDEX MAP

MAP 1398A

MACMILLAN RIVER

YUKON – DISTRICT OF MACKENZIE – ALASKA

1:1,000,000 GEOLOGICAL ATLAS

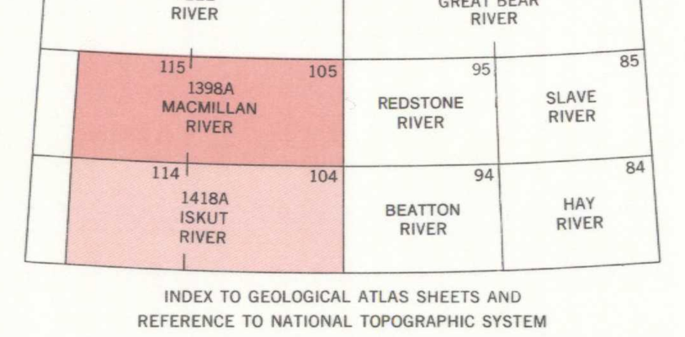
SHEET 105, 115

GENERAL CO-ORDINATOR: R.J.W. DOUGLAS

Kilometres 25 0 25 50 75 Kilometres

Miles 20 0 20 40 Miles

Lambert Comformal Projection standard parallels 60°40′ and 63°20′



INDEX TO GEOLOGICAL ATLAS SHEETS AND REFERENCE TO NATIONAL TOPOGRAPHIC SYSTEM

LEGEND

CENOZOIC

QUATERNARY
RECENT
- RMC — MILES CANYON: *basalt*
- RS — SELKIRK GROUP: *basalt, andesite flows, breccia, tuff*

PLEISTOCENE AND RECENT
- Qs — *glacial and surficial deposits*

TERTIARY AND QUATERNARY
PLIOCENE AND PLEISTOCENE
- PPv — *olivine basalt*

TERTIARY
PLIOCENE
- Ps — *conglomerate, sandstone*
- Pv — *basalt*

MIOCENE AND PLIOCENE
- MPY — YAKATAGA: *siltstone, mudstone, sandstone, conglomerate, tillite*
- MPv — WRANGELL: *basalt, andesite pyroclastics, sediments*

MIOCENE
- Mvr — *rhyolite, trachyte*

OLIGOCENE AND MIOCENE
- OMA — AMPHITHEATRE: *sandstone, conglomerate, shale, coal*
- OMCv — CARMACKS GROUP: *andesite, basalt, breccia*
- OMD — DONJEK: *tuff, breccia*

OLIGOCENE
- Ocs — CARMACKS GROUP: *conglomerate, sandstone, shale*
- OPC — POUL CREEK: *sandstone, siltstone*

EOCENE
- EK — KULTHIETH: *sandstone, siltstone, conglomerate, coal*
- EMN — MOUNT NANSEN GROUP: *acid to intermediate tuff, breccia*
- ESK — SKUKUM GROUP: *andesite, basalt, breccia*
- ESL — SLOKO GROUP: *rhyolite, trachyte*

PALEOCENE
- PHP — HAYDON PEAK: *siltstone, sandstone, conglomerate, tuff*

LOWER TERTIARY
- lTs — *conglomerate, sandstone, shale*

LOWER ? TERTIARY
- Tc — CASINO: *tuff, ignimbrite, breccia*
- Tfp — *felsdpar porphyry dykes, flows*
- Tva — *acid tuff*
- Tvb — *basalt*
- Tvd — *andesite, porphyritic basalt flows and dykes*
- Tvr — *rhyolite, quartz feldspar porphyry*

MESOZOIC

CRETACEOUS
- KY — YAKUTAT (VALDEZ) GROUP: *greywacke, shale, limestone, conglomerate; minor basic volcanics: metasediments and granitoid gneiss*
- Kvm — *pillow lava, breccia, tuff; metavolcanics*
- Ks — *non-marine sandstone, shale, conglomerate, coal*
- Kv — *basalt, andesite, quartz dacite*
- KSF — SOUTH FORK: *andesite, dacite, basalt*

UPPER CRETACEOUS
- uKs — *sandstone, conglomerate, shale, silicious tuff*

JURASSIC AND CRETACEOUS
- JKD — DEZADEASH GROUP: *argillite, greywacke, conglomerate, volcanics*
- JKKH — KENO HILL: *quartzite (may be older)*
- JKT — TANTALUS: *conglomerate, siltstone, arkose, coal*
- JKK — KLUANE: *sericitic, biotitic schist, gneiss, amphibolite*

JURASSIC
- JL — LABERGE GROUP: *greywacke, arkose, conglomerate*
- Jp — *graphitic phyllite, quartzite, greenstone*

TERTIARY
- Tqm — *quartz monzonite, granodiorite*
- Tgd — *quartz diorite, granodiorite*
- Tdi — *diorite*

LATE TERTIARY
- LTf — *felsite, granite porphyry*
- LTy — *soda syenite*
- LTg — *rhyolite porphyry, granite, granodiorite*
- LTqm — *quartz monzonite*
- LTgp — *granite porphyry*

EARLY TERTIARY
- ETf — *granite and syenite porphyry, rhyolite*
- ETg — *grandiorite, granite*
- ETgal — *alaskite, granite, quartz monzonite*
- ETqm — *granite, quartz monzonite*

feldspar porphyry dykes includes KTg in the St. Elias Mtns

MESOZOIC AND TERTIARY
- MTqd — *quartz diorite, granodiorite*

CRETACEOUS AND TERTIARY
- KTg — *granite, quartz monzonite*
- KTgd — *granodiorite, quartz diorite*
- KTqd — *tonalite*
- KTvdp — *andesite and dacite porphyry*

CRETACEOUS
- Ky — *syenite, monzonite*
- Kg — *granite*
- Kgp — *porphyritic granite*
- Kqm — *quartz monzonite, granodiorite; CASSIAR quartz monzonite, alaskite*
- Kgd — *granodiorite*
- Kgdn — *granodiorite, quartz diorite diorite, agmatite complex*
- Kgdp — *granodioritic and monzonitic porphyry*
- Kqd — *quartz diorite*
- Kdi — *diorite*
- Kub — *pyroxenite, diorite*

JURASSIC AND CRETACEOUS
- JKgd — *granodiorite, quartz diorite, quartz monzonite, diorite*
- JKqd — *quartz diorite, diorite, granodiorite*
- JKdi — *diorite, hornblende diorite*
- JKb — *gabbro, diorite, some ultramafic rocks*

TRIASSIC AND JURASSIC
- TJs — *argillite, sandstone, siltstone*
- TJsv — *volcanic and sedimentary rocks*
- TJc — *limestone*
- TJvp — *augite, hornblende feldspar porphyry*

TRIASSIC
- Tcg — *polymictic conglomerate*
- Ts — *sandstone, siltstone*
- Tv — *basaltic greenstone*

UPPER TRIASSIC
- uTLW — LEWES RIVER GROUP: *greywacke, argillite, conglomerate*
- uTs — CHITISONE, McCARTHY: *limestone, dolomite, shale*
- uTc — LEWES RIVER GROUP: *limestone*
- uTLV — LEWES RIVER GROUP: *andesite, basalt*
- uTN — NIKOLAI: *greenstone, basalt, andesite, limestone (may include MIDDLE TRIASSIC shale)*

MESOZOIC
- Mcg — *conglomerate, chert, tuff*
- Mv — *andesite, basalt, tuff*
- Mvd — *andesite, trachyte*
- Mvs — *greenstone, greenschist, argillite, greywacke*

PERMIAN AND TRIASSIC
- PTc — *limestone*
- PTs — *conglomerate, greywacke, limestone, grit*
- PTsv — *greenstone, greywacke, shale, limestone*
- PTv — *greenstone, diorite*

PALEOZOIC AND MESOZOIC
- PMv — *basic to intermediate volcanic rocks*

TRIASSIC
- Tqm — *leucocratic, porphyritic quartz monzonite*
- Tgd — RUBY RANGE: *granodiorite*
- Tgdn — *foliated hornblende granodiorite, quartz*

MESOZOIC
- Mqm — *porphyritic quartz monzonite*
- Mgd — *granodiorite, quartz monzonite*
- Mgdn — *foliated hornblende granodiorite, quartz monzonite*
- Mdi — *diorite*

PERMIAN AND TRIASSIC
- PTub — *pyroxenite, serpentinite*

PALEOZOIC AND MESOZOIC
- PMb — *hornblende gabbro*
- PMub — *ultramafic rocks*

PALEOZOIC

PALEOZOIC
- PN — NASINA: *graphitic quartzite, schist*
- Pc — *limestone*
- Pm — *amphibolite, schist, gneiss*
- Ptp — *chert argillite, quartzite*
- Ptv — *chert volcanic rocks, slate*
- Pv — *greenstone, amphibolite*
- Pvs — *basalt, andesite, limestone, greywacke*
- Ps — *greywacke, argillite, limestone; local basalt, andesite and volcaniclastic sediments; includes greenschist and low amphibolite facies, regional metamorphic equivalents*

LOWER PALEOZOIC
CAMBRIAN ? TO DEVONIAN
- lPvs — *andesite, basalt, greywacke, phyllite, tuff, limestone, conglomerate*

PERMIAN
- PT — TESLIN: *limestone*
- Ps — SKOLAI GROUP: *andesite, basalt, ultramafics, pyroclastics, phyllite, chert, limestone, conglomerate (may include PENNSYLVANIAN)*

PENNSYLVANIAN AND PERMIAN
ANVIL RANGE GROUP *(PPac, PPas, PPat)*
- PPAC — *limestone*
- PPAS — *limestone, conglomerate, sandy limestone*
- PPAt — *chert*

PENNSYLVANIAN
- Pc — *limestone*

CARBONIFEROUS AND PERMIAN
- CPH — HORSEFEED: *limestone*
- CPKC — KEDAHDA: *limestone*
- CPc — *limestone*
- CPcs — *cherty dolomite, quartzite, shale*
- CPK — KEDAHDA: *chert, argillite*
- CPAv — ANVIL RANGE GROUP: *andesite, basalt, slate, chert, limestone*
- CPv — *andesite, basalt, chert, tuff*
- CPs — *quartz-muscovite schist*
- CPsn — *schist, gneiss, includes BIG SALMON METAMORPHIC COMPLEX*

CARBONIFEROUS
- Cc — *limestone*
- CE — ENGLISHMANS GROUP: *quartzite, phyllite, schist, chert, conglomerate, limestone*
- Ctp — *chert, argillite, phyllite, quartzite*

MISSISSIPPIAN
- MEu — EARN GROUP (upper): *chert, argillite, quartzite, limestone*
- MK — KALZAS: *limestone, argillite, chert*
- Mc — *limestone*
- Mvt — *greenstone, chert, phyllite*
- Mvp — *black slate, chert, acidic volcanics*

EARLY PALEOZOIC
- EPub — *gabbro complex*

PALEOZOIC
- Pqmn — *foliated muscovite quartz monzonite*
- Pgdn — PELLY GNEISS: *foliated to gneissic granodiorite*

PENNSYLVANIAN AND PERMIAN
- PPyd — *syenodiorite complex*
- PPqm — *quartz monzonite*
- PPgd — *granodiorite, granodiorite-diorite agmatite complex*
- PPqd — *quartz diorite, granodiorite, diorite*
- PPdi — *diorite, quartz diorite, agmatite complex*

CARBONIFEROUS AND PERMIAN
- CPub — *serpentinite, diorite pyroxenite, peridotite*

MISSISSIPPIAN
- My — *hornblende, syenite*

DEVONIAN AND MISSISSIPPIAN
- DMs — SYLVESTER GROUP: *shale, chert arenite, conglomerate, basic volcanic rocks*
- DME — EARN GROUP: *(MEu, MK, DMCP, DEI) undivided: shale, chert arenite, conglomerate*
- DMCP — CRYSTAL PEAKS: *chert pebble conglomerate*
- DMss — *sandstone, conglomerate, shale*

DEVONIAN
- Dc — *limestone, marble*
- DEI — EARN GROUP (lower): *slate, quartzite, limestone*
- Dp — *shale, siltstone*
- Dv — *greenstone (may be older)*

MIDDLE DEVONIAN
- mDM — McDAME GROUP: *limestone, dolomite*
- mDc — *limestone, dolomite, shale (ARNICA, LANDRY, NATLA, HEADLESS, NAHANNI)*
- mDpc — *shale, limestone (may include older)*

SILURIAN AND DEVONIAN
- SDAc — ASKIN GROUP: *dolomite, limestone*
- SDc — DELORME, CAMSELL, SOMBRE: *dolomite, limestone, shale*
- SDAq — ASKIN GROUP: *quartzite, shale*
- SDcq — *dolomite, quartzite, argillite*
- SDs — *siltstone, quartzite, argillite*
- SDp — *black shale*

ORDOVICIAN, SILURIAN AND LOWER DEVONIAN
- OSDR — ROAD RIVER: *black graptolitic shale, chert (may include older; may not include DEVONIAN)*

ORDOVICIAN AND SILURIAN
- OSK — KECHIKA GROUP (upper): *limestone, slate*
- OSc — *limestone, shale (includes SUNBLOOD, WHITTAKER)*

CAMBRIAN AND ORDOVICIAN
- €OR — RABBITKETTLE: *limestone, siltstone*
- €Oc — *dolomite, limestone, siltstone (includes ROCKSLIDE, BROKENSKULL, SUNBLOOD)*
- €OH — HARVEY GROUP: *shale, phyllite*
- €OK — KECHIKA GROUP: *phyllite, limestone*
- €Op — *shale, limestone*

MIDDLE CAMBRIAN
- m€c — *limestone, shale*
- m€s — *quartzite, dolomite, limestone (may include UPPER CAMBRIAN)*

LOWER CAMBRIAN
- l€AC — ATAN GROUP: *limestone*
- l€HC — HARVEY GROUP: *limestone*
- l€s — SEKWI: *dolomite, limestone, quartzite*
- l€c — *limestone, marble*
- l€cq — *dolomite, salty dolomite, quartzite (may include MIDDLE CAMBRIAN)*
- l€Aq — ATAN GROUP: *quartzite, shale, phyllite*
- l€BR — BACKBONE RANGES: *quartzite, slate*
- l€Hq — HARVEY GROUP: *quartzite, schist*
- l€p — *siltstone, shale*
- l€q — *quartzite, shale*
- l€sn — *schist, gneiss*

PROTEROZOIC

HADRYNIAN AND CAMBRIAN
- H€p — *siltstone, shale*
- H€q — *quartzite, shale*
- H€qs — *quartzite, schist*
- H€sn — *schist, gneiss, quartzite*

HADRYNIAN
- HS — SHEEPBED: *shale, siltstone*
- HK — KEELE: *dolomite, quartzite*
- Hc — *crystalline limestone*

RAPITAN GROUP: (RHT, RHS, RHSA)
- RHT — TWITYA: *shale, siltstone*
- RHS — SHEZAL: *conglomerate, shale*
- RHSA — SAYUNEI: *hematitic mudstone, conglomerate*
- Hqp — *gritty quartzite, argillite, shale, phyllite (may include LOWER CAMBRIAN)*
- Hp — *shale, phyllite*
- Hpq — *graphitic phyllite, quartzite*
- Hv — *greenstone*
- Hsn — *schist, gneiss, quartzite*

HADRYNIAN OR OLDER
- HRC — REDSTONE RIVER: *pink siltstone, gypsum*; COPPER CAP: *silty limestone*

HELIKIAN OR YOUNGER
- HLD — LITTLE DAL: *stromatolitic limestone, dolomite*

SHEET 105, 115
MACMILLAN RIVER
MAP 1398 A