## **CANADIAN GEOSCIENCE MAP 105** DESCRIPTIVE NOTES INTRODUCTION **Peat bogs**: fibric to humic organic matter; massive to stratified accumulations; ———— Geological boundary (Confidence: approximate) This Surficial Geology Map of NTS 94-O/1 (Canadian Geoscience Map 105) is the product of collaboration between the Geological Survey of generally greater than 2 m thick; confined to topographic depressions or level Canada and the British Columbia Ministry of Energy, Mines and Natural Gas as part of the Geo-mapping for Energy and Minerals Program areas; underlain by poorly drained till, glaciolacustrine and other • • • • • • • Major moraine ridge (end, interlobate, or unspecified) (GEM-Energy Yukon Basins Project. The accompanying geodatabase includes field observation points and field photos, landform features as unconsolidated sediments; formed by decomposition of plant material in lines, and surficial geology unit polygons. The map and geodatabase are essential baseline geoscience information for a range of potential Other moraine ridge (DeGeer, minor lateral, recessional, rogen, washboard, wetland areas; bogs with sporadically discontinuous permafrost and end-users including resource explorationists, geotechnical engineers, land-use managers, terrestrial ecologists, archaeologists, geoscientists and communities in northern British Columbia. By providing new insight into the distribution and origins of surficial earth thermokarst depressions potentially unstable if organic material is disturbed or other transverse or unspecified) materials, CGM 105 will help to reduce the economic costs and risks associated with the sustainable development of energy and mineral <><><><> Esker ridge (sense: unknown or unspecified) resources in NTS 94-O/1. Environmental impact assessments for new access roads, work camps, well pads, pipeline and power transmission Fens: fibric organic matter; massive to stratified; generally greater than 2 m line corridors, water storage and waste management systems and other infrastructure will benefit from the geoscience information presented nere. By identifying areas prone to geological hazards (e.g., landslides, permafrost, flooding), CGM 105 will also help to protect natural thick; confined to topographic depressions, level areas and meltwater resources, infrastructure and communities vulnerable to climate change in Canada's north. channels; underlain by poorly drained till, glaciolacustrine and other unconsolidated sediments; formed by decomposition of plant material in ----- Landslide escarpment (Status: inactive or unspecified) wetland areas; fens are prone to flooding following drainage damming by APPROACHTO SURFICIAL GEOLOGY MAPPING Major meltwater channel scarp 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 94-0/1 map area (Huntley and Hickin, 2010; Huntley et al., 2011a-b). Undifferentiated peat bogs and fens: humic to fibric organic matter; massive Surficial earth materials and landforms were classified using a combination of stereo-pair air photos (BCB97010, 15BCB97015 15BCB97029, 15BCB97075 and 15BCB97088 series), LANDSAT 7 satellite imagery (http://glovis.usgs.gov/ [URL 2011]) and ShuttleRadar to stratified accumulations; generally greater than 2 m thick; confined to unspecified; sense: known) Topography Mission digital elevation models (http://dds.cr.usgs.gov/srtm/ [URL 2011]). The base map was generated from CANVEC shape topographic depressions, level areas or channels; underlain by poorly drained files (http://geogratis.cgdi.gc.ca/geogratis/ [URL 2011]). Surficial geology polygons and landform line symbols were digitized using Terrace scarp (environment: glaciofluvial) till, glaciolacustrine and other unconsolidated sediments; formed by commercially available computer software packages (Global Mapper, ArcMap and ArcGIS) and compared to published maps, reports and decomposition of plant material in wetland areas; may contain sporadically archived digital data from adjacent map areas (e.g., Stott and Taylor, 1968; Bednarski, 2003a-d; Clement et al., 2004; Bednarski, 2005a-b; Terrace scarp (environment: fluvial) discontinuous permafrost and thermokarst depressions; potentially unstable if Frommelen and Levson, 2008; Demchuk, 2010). The geodatabase accompanying this map conforms to the Science Language for the Data disturbed or removed during development. Management component of the GEM Geological Map Flow process (cf. Huntley and Sidwell, 2010; Huntley et al., 2011a; Deblonde et al., Terrace scarp (environment: glaciolacustrine) Alluvial deposits Fieldwork was undertaken in 2009 and 2010 to ground truth surficial geology polygons interpreted from air photos and satellite imagery, and to Station location (ground observation or stratigraphic section) Alluvial fan sediments: boulders, gravel, sand and silt; generally massive gather characteristics that could not be determined through remote predictive mapping. Earth materials were defined on thebasis of facies to planar stratified; well to rapidly drained; greater than 2 m thick; fan and landform associations, texture, sorting, colour, sedimentary structures, degree of consolidation, and stratigraphic contact relationships at morphology with slopes up to 15°: may contain interbedded debris flows and 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. buried organic material; transported and deposited by modern rivers, streams and creeks; subject to periodic flooding; potential source of aggregate. Alluvial terraced sediments: boulders, gravel, sand and silt; generally REFERENCES massive to planar stratified; well to rapidly drained; greater than 2 m thick; may Wisconsinan Laurentide Ice Sheet, Exposures in creek and river sections indicate that undifferentiated clastic bedrock (Lower Cretaceous contain interbedded debris flows and buried organic material; underlain by Fort St. John Group) underlies the map area (Stott and Taylor, 1968). Topography and drainage patterns were greatly modified during the outwash, till or bedrock; transported and deposited by modern rivers, streams Bednarski, J.M., 2003a. Betalamea Lake, Northwest Territories - Yukon Territory - British Columbia (NTS phase of maximum ice cover (>18 <sup>14</sup>C ka BP or >21.4 calendar ka BP). Unconsolidated sediment thicknesses in excess of 2 to 5 m are and creeks; subject to rare flooding; potential source of aggregate; land use 95B/4); Geological Survey of Canada, Open File 4502, scale 150000. observed in major valley exposures and it is suspected that similar drift thicknesses blanket bedrock (unit R) across the map area. Silt- and activities may adversely affect stream courses and conditions, and impact fish clay-rich Laurentide tills have low clast contents (<20%) of proximally derived Cretaceous siliciclastic sedimentary rocks and distal igneous Bednarski, J.M., 2003b. Surficial geology of Fort Liard, Northwest Territories - British Columbia. Geological and metamorphic clasts from the Canadian Shield, hundreds of kilometres to the northeast. Drumlin ridges up to several hundred metres in Survey of Canada, Open File 1760, scale 1:50 000 length suggest clay-rich tills (unit Ts) were deposited beneath active, rapidly flowing warm-based glacial ice moving southwest across the map Alluvial floodplain sediments: gravel, sand and silt; massive, trough Bednarski, J.M., 2003c. Surficial geology of Lake Bovie, Northwest Territories - British Columbia. Geological area (Huntley and Hickin, 2010; Huntley et al., 2011b). Multiple directions and generations of ice flow are preserved in streamlined landforms. crossbedded, rippled-bedded, planar stratified; well to rapidly drained; greater North of the Sahtaneh River, west- and northwest-oriented drumlin ridges, separated by a linear interlobate moraine, are interpreted to reflect than 2 m thick; underlain by till or bedrock; transported and deposited by converging ice masses in this portion of the lowland. Bednarski, J.M., 2003d. Surficial geology of Celibeta Lake, Northwest Territories - British Columbia. Geological modern rivers, streams and creeks; subject to seasonal flooding; land use Deglaciation began sometime after 18 <sup>14</sup>C ka BP (or >21.4 calendar ka BP) and ended before 10 <sup>14</sup>C ka BP (ca. 12 calendar ka BP), with the activities may adversely affect stream courses and conditions, and impact fish retreating active Laurentide Ice Sheet, stagnant ice masses in lowlands, glaciofluvial outwash and landslide debris blocking and reordering and wildlife resources. Bednarski, J.M., 2005a. Surficial Geology of Etsine Creek, British Columbia, Geological Survey of Canada, Open regional drainage. The mapped distribution of major moraine ridges (unit Tm) and drumlin ridges implies that active ice margins receded east to southeast across the Fort Nelson Lowland (Huntley and Hickin, 2010). 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 Eolian deposits Bednarski, J.M., 2005b. Surficial Geology of Gote Creek, British Columbia, Geological Survey of Canada, Open Loess: silt and sand; generally massive, well-sorted, crossbedded or Huntley et al., 2011b). Hummocky till (unit Th) occurring in association with short segments of subareal-subglacial meltwater channels and File 4846, scale 1:50 000. eskers suggest that local bodies of staggant glacier ice remained in some lowland areas (Huntley et al., 2011a; Huntley et al., 2011b). As ice rippled-bedded; moderately to well drained; discontinuous veneers less than 1 retreated from the map area, a proglacial lake system formed in the Fort Nelson Lowland. Proglacial lakes were linked by spillways that Clement, C., Kowall, R. Huntley, D. and Dalziel, R., 2004. Ecosystem units of the Sahtaneh area; Slocan Forest m thick, blankets greater than 2 m thick; underlain by glacial lake sediments, drained meltwater northward into the Liard River basin. In the map area, glaciolacustrine deposits (unit GLb), glaciofluvial terraces (unit GFt). Products (Fort Nelson) Report, 39 pages and appendices. outwash, till and alluvial deposits; derived from deflation, transportation and and meltwater channels incised into till and bedrock indicate that glacial lake levels fell stepwise through deglaciation, with stable elevations at deposition of fine-grained sediment by wind action; contains little or no ground Deblonde, C., Plouffe, A., Boisvert, E., Buller, G., Davenport, P., Everett, D., Huntley, D., Inglis, E., Kerr, D., Moore, A., Paradis, S.J., Parent, M., Smith, R., St-Onge, D., and Weatherston, A., 2012. Science Language approximately 420 m, 380 m and <300 m. Most fine-grained glacial earth materials were re-worked by eolian activity and discontinuousloess (unit EI) covers glacial lake and till deposits in some places. for an Integrated Geological Survey of Canada Data Model for Surficial Maps Version 1.1 Results of Colluvial deposits Geological Survey of Canada Surficial Legend Review Committee; Geological Survey of Canada, Open File Post-glaciation (10 <sup>14</sup>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 Colluvial veneer: clast-supported diamictons and rubble; massive to stratified, terrace building followed initial valley incision by the Liard and other major rivers. Most streams and rivers have active floodplains (unit Ap) poorly-sorted; well to rapidly drained; deposits less than 2 m thick; landslide Demchuk, T., 2010. Surficial geology of the Komie Creek area (NTS 094P/05). British Columbia Ministry of 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), fens (unit Owf) and undifferentiated wetlands (unit O). Discontinuous permafrost is headscarps range from 300 m to 10.5 km; formed by the weathering and Energy, Mines and Petroleum Resources, Open File 2010-08; Geological Survey of Canada Open File 6568, sporadically encountered in glaciolacustrine and some peat deposits. Charcoal, observed in dug pits on alluvial terraces, suggest forest fires down-slope movement of earth materials by gravitational processes; bedrock scale 1:50 000. may have contributed to periods of landslide activity on slopes and local fluvial aggradation. Landslides and colluviated deposits (unit Cb) are and unconsolidated debris on slopes above 10-15° with greater than 5 m relief Huntley, D.H. and Hickin, A.S., 2010. Surficial deposits, landforms, glacial history and potential for granular common where bedrock outcrops form escarpments, and where shale or fine-grained glacial deposits are exposed along steep cutbanks. prone to mass-wasting; rock falls, topples, rock slides and debris flows occur aggregate and frac sand: Maxhamish Lake Map Area (NTS 94-O), British Columbia. Geological Survey of Stream networks and wetlands draining plateau watersheds are disrupted by beaver activity and, to a lesser extent, by roads and where shale, sandstone and carbonate strata is exposed close to the surface; Canada, Open File 6430, 17 pages. infrastructure where they cross streams, rivers and organic deposits (Huntley and Hickin, 2010; Huntley and Hickin, 2011a-b). retrogressive rotational debris slides, debris flows and slumps occur in Huntley, D., Hickin, A. and Chow, W., 2011a. Surficial geology, geomorphology, granular resource evaluation and glaciolacustrine sediments and outwash containing sporadically discontinuous geohazard assessment for the Maxhamish Lake map area (NTS 94-O), northeastern British Columbia; Geological Survey of Canada, Open File 6883, 20 pages. permafrost; where ground ice is found slope failure can occur on surfaces less ACKNOWLEDGMENTS than 5°; slope instability could present major problems for construction in Canadian Geoscience Map 105 is an output of the Geo-Mapping for Energy and Minerals Yukon Basins Project managed by Carl Ozyer and Huntley, D.H., Hickin, A.S. and Ferri, F., 2011b. Provisional surficial geology, glacial history and paleogeographic 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 105 was some areas. reconstructions of the Toad River (NTS 94-N) and Maxhamish Lake map areas (NTS 94-O), British Columbia. Geoscience Reports 2011, BC Ministry of Energy, pages 37-55. Colluvial blanket: clast-supported diamictons and rubble; massive provided by Alain Plouffe (GSC-Ottawa). to stratified, poorly-sorted; well to rapidly drained; deposits greater than 2 m Huntley, D.H. and Sidwell, C.F., 2010. Application of the GEM surficial geology data model to resource thick; landslide headscarps range from 300 m to 10.5 km; formed by the evaluation and geohazard assessment for the Maxhamish Lake map area (NTS 94-O), British Columbia. weathering and down-slope movement of earth materials by gravitational Geological Survey of Canada, Open File 6553, 22 pages. processes; bedrock and unconsolidated debris on slopes above 10-15° with Stott, D.F. and Taylor, G.C., 1968. Geology of Maxhamish Lake. Geological Survey of Canada, Map 2-1968, greater than 5 m relief prone to mass-wasting; rock falls, topples, rock slides Canadian Geoscience Map 105 depicts the surficial La Carte géoscientifique du Canada 105 illustre la and debris flows occur where shale, sandstone and carbonate strata is geology over some 790 km<sup>2</sup> covered by the Sahtaneh géologie des matériaux superficiels d'un territoire exposed close to the surface; retrogressive rotational debris slides, debris rommelen, M. and Levson, V.M., 2008. Quaternary stratigraphy of the Prophet River, northeastern British River map sheet (NTS 94-O/01) in northeastern British d'environ 790 km<sup>2</sup> couvert par le feuillet cartographique flows and slumps occur in glaciolacustrine sediments and outwash containing Columbia; Canadian Journal of Earth Sciences, Vol. 45, pages 565-575. Columbia. The map area lies within the Fort Nelson de Sahtaneh River (SNRC 94-O/01), dans le nord-est sporadically discontinuous permafrost; where ground ice is found slope failure de la Colombie-Britannique. La région cartographique Lowland and is incised by southwest-draining Sahtaneh can occur on surfaces less than 5°; slope instability could present major River and a number of smaller tributaries to the se situe dans les basses terres de Fort Nelson et est problems for construction in some areas. northwest-flowing Fort Nelson River. Bedrock is mantled entaillée par la rivière Sahteneh à écoulement sudby unconsolidated earth materials dating to the Late ouest, ainsi que par de nombreux petits affluents de la Glaciolacustrine deposits Pleistocene (Late Wisconsinan Glaciation, > 25 ka to rivière Fort Nelson qui coule vers le nord-ouest. Le Glaciolacustrine blanket: silt and clay with subordinate sand, gravel and ca. 10 ka ) and non-glacial Holocene (ca. 10 ka to socle rocheux est couvert de matériaux terrestres non diamicton; massive or rhythmically interbedded; slump structures and present). Deposits of till, green on the map, are consolidés remontant au Pléistocène supérieur dropstones locally present; poor to moderately drained; generally greater than generally suitable for placement of infrastructure. (Glaciation du Wisconsinien supérieur, de > 25 ka à 2 m thick; kettle lakes and irregular topography underlain by bedrock, tills and Glaciofluvial and eolian deposits with mineral, env. 10 ka) ainsi que de matériaux non glaciaires de outwash; transported by and deposited from sediment-laden meltwater, aggregate, and groundwater potential are coloured l'Holocène (d'env. 10 ka jusqu'à nos jours). Les dépôts subaqueous gravity flows and thermal melting of ice in proglacial lakes; where orange and buff. Slopes disturbed by landslides and de till, de couleur verte sur la carte, sont généralement sporadically discontinuous permafrost is, or was present, glaciolacustrine debris flows appear brown. Glaciolacustrine and organic propices à l'établissement de l'infrastructure. Les sediments may be subject to thermokarst processes; slopes less than 5° are deposits with sporadically discontinuous permafrost are dépôts fluvioglaciaires et éoliens, qui recèlent un potentially unstable and prone to landslides and debris flows. coloured purple and grey. Alluvial deposits prone to potentiel en minéraux, en agrégats et en eau flooding, erosion, and sedimentation appear yellow on souterraine, sont figurés par les couleurs orange et Glaciofluvial deposits chamois. Les versants dérangés par des glissements Kames and hummocky outwash: boulders, cobbles, pebble-gravel, sand, silt de terrain et des coulés de débris sont représentés en and diamicton; generally massive to stratified, some slump structures; brun. Les dépôts glaciolacustres et organiques, qui moderately to well-drained; greater than 2 m thick; irregular hummocks and renferment sporadiquement du pergélisol discontinu, kettled topography; in contact with, and overlying till units, outwash and sont représentés en violet et en gris. Les dépôts glaciolacustrine sediments; deposited by rivers and streams flowing from, or in alluviaux sujets aux inondations, à l'érosion et à la contact with glacial ice; potential source of groundwater and granular sédimentation apparaissent en jaune sur la carte. aggregate when material is gravel rich. Esker ridges: boulders, cobbles, pebble-gravel, sand, silt and matrix-supported diamicton; generally massive to stratified, some slump structures; moderately to well-drained; greater than 2 m thick; range from 100 m to 8.8 km in length; in contact with, and overlying till units, outwash and glaciolacustrine sediments; deposited by subglacial meltwater in contact with glacial ice; potential source of groundwater and granular aggregate when material is gravel rich. Outwash terraces: boulders, cobbles, pebble-gravel, sand, silt and matrix-supported diamicton; generally massive to stratified, some slump structures; moderately to well-drained; greater than 2 m thick; terrace scarps CGM 106. CGM 10 range from 100 m to 8 km in length; in contact with, and overlying other till units, outwash and glaciolacustrine sediments; deposited by meltwater confined to proglacial channels and spillways; potential source of groundwater and granular aggregate when material is gravel rich. Till blanket: sand, silt and clay-rich diamictons; massive, matrix-supported and compact; clast contents less than 20% and contain sub-rounded granitic erratic boulders with sources on the Canadian Shield; moderately to well-drained; greater than 2 m thick mantling bedrock and older glacia National Topographic System reference and index to adjoining deposits; transported and deposited by the Laurentide Ice Sheet directly published Geological Survey of Canada maps through lodgement, basal meltout, glacigenic deformation of sediment beneath active, warm-based ice and in situ melting from stagnant cold-based ice; stable terrain, generally suitable for infrastructure placement. **Cover illustration** Moraine ridges: sand, silt and clay-rich diamictons; massive, Catalogue No. M183-1/105-2012E-PDF Loess covered glacial lake sediments, moraines and matrix-supported; clast contents less than 20% and contain sub-rounded ISBN 978-1-100-21441-2 drumlins incised by Fort Nelson River in northeast granitic erratic boulders with sources on the Canadian Shield; moderately to doi:10.4095/291997 British Columbia, view northwest, well-drained; greater than 2 m thick; minor moraines less than 1 km long and 5 Photograph by D.H. Huntley. 2013-079 m high; major moraines up to 12.5 km in length and 10 m high; ridges drape © Her Majesty the Queen in Right of Canada 2013 bedrock and older glacial deposits; minor moraines include crevasse-fill ridges and small recessional push moraines; major ridges features are large recessional end moraines and ice-thrust ridges; generally suitable for infrastructure placement. Natural Resources Ressources naturelles du Canada Streamlined till: silt and clay-rich diamictons; massive, matrix-supported and compact; clast contents less than 20% and contain sub-rounded granitic erratic boulders with sources on the Canadian Shield; moderately well-drained; greater than 2 m thick mantling bedrock and older glacia deposits; drumlins and fluted till ridges typically under 1 km long but can **CANADIAN GEOSCIENCE MAP 105** exceed 9 km in length; generally less than 50 m wide and 20 m high; formed beneath the Laurentide Ice Sheet directly through lodgement, basal meltout, glacigenic deformation of sediment beneath rapidly-flowing warm-based ice; **SURFICIAL GEOLOGY** generally suitable for infrastructure placement. **SAHTANEH RIVER** British Columbia 1:50 000 Recommended citation scale 1:50 000. doi:10.4095/291997

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**Preliminary** 

Canadian **Geoscience Maps** 

Authors: D.H. Huntley, A.S. Hickin, W. Chow, and M. Mirmohammadi

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

**Preliminary** 

**SURFICIAL GEOLOGY SAHTANEH RIVER British Columbia** 1:50 000

**CANADIAN GEOSCIENCE MAP 105** 

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°08'E,

decreasing 21' 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** 

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eliminary publications if this series have not been scientifically edited.

**Preliminary** 

**CANADIAN GEOSCIENCE MAP 105**