CANADIAN GEOSCIENCE MAP 107 DESCRIPTIVE NOTES Fhis Surficial Geology Map of NTS 94-O/3 (Canadian Geoscience Map 107) 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 lines, and surficial geology unit polygons. The map and geodatabase are essential baseline geoscience information for a range of 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 materials, CGM 107 will help to reduce the economic costs and risks associated with the sustainable development of energy and mineral resources in NTS 94-O/3. 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 107 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/3 map area (Huntley and Hickin, 2010; Huntley et al., 2011a-b) 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 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]). Surficial geology polygons and landform line 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; Trommelen and Levson, 2008; Demchuk, 2010). 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 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 The distinctive landscape of NTS 94-O/3 is largely a product of underlying bedrock and geological structures, with ornamentation by the Late Wisconsinan Laurentide Ice Sheet, The Tsoo Tablelands are underlain by shale, siltstone and sandstone (Upper Cretaceous Kotaneelee Formation). Conglomerate, sandstone and carbonaceous shale (Upper Cretaceous Dunvegan Formation) forms prominent bedrock escarpments along the Fort Nelson River and valleys draining the uplands. Fine-grained sandstone and shale (Lower Cretaceous Sikanni ormation) underlies the southwest. Exposures in creek and river sections indicate that undifferentiated clastic bedrock (Lower Cretaceous Fort St. John Group) underlies much of the map area (Stott and Taylor 1968). Topography and drainage patterns were greatly modified during the phase of maximum ice cover (>18 ¹⁴C ka BP or >21.4 calendar ka BP). Unconsolidated sediment thicknesses in excess of 2-5 m are observed in valley exposures 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 retaceous 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 day-rich tills (unit Ts) were deposited beneath active, rapidly flowing warm-based glacial ice flowing southwest across the map area (Huntley and Hickin, 2010; Huntley et al., 2011b). At least two generations o iceflow are preserved in streamlined landforms: in the east and south, the dominant flow is west to west-southwest toward the Tsoo Uplands; in the north and centre of the map area, this orientation is overridden by later west-northwest iceflow toward the Fort Nelson valley. Deglaciation began sometime after 18 ¹⁴C ka BP (or >21.4 calendar ka BP) and ended before 10 ¹⁴C 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 major moraine ridges (unit Tm) implies that ice margins receded northeast from the Tsoo Tablelands and 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 (Huntley et al., 2011b). Hummocky till (unit Th) occurring with short segments of subareal-subglacial meltwater channels and eskers indicate iat bodies of stagnant glacier ice remained in tributary valleys and on the plateau (Huntley et al., 2011a; Huntley et al., 2011b). As ice retreated from the map area, a proglacial lake system formed in the Fort Nelson Lowland. Proglacial lakes were linked by spillways that drained meltwater northward into the Liard 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. Most fine-grained glacial earth materials were re-worked by eolian activity and parabolic dunes (unit Er) and discontinuous loess (unit El) cover glacial lake and till deposits in the Fort Nelson Lowland. Post-glaciation (10 %C ka BP, or ca. 12 calendar ka BP to present), changes in regional base-level led to episodes of changel 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 fans (unit Af) and 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 undifferentiated wetlands (unit O). Discontinuous permafrost is sporadically encountered in glaciolacustrine and some peat deposits. harcoal, 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 escaroments, and where shale or fine-grained glacial deposits are exposed along steep cutbanks. Stream networks and wetlands draining plateau watersheds are rupted 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). Canadian Geoscience Map 107 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 107 was provided by Dan Kerr (GSC-Ottawa). Canadian Geoscience Map 107 depicts the surficial La Carte géoscientifique du Canada 107 illustre la geology over some 790 km² covered by the Stanolind géologie des matériaux superficiels d'un territoire Creek map sheet (NTS 94-O/03) in northeastern British d'environ 790 km² couvert par le feuillet cartographique Columbia. The map area encompasses the western de Stanolind Creek (SNRC 94-O/03), dans le nord-est limit of the Tsoo Tablelands (Alberta Plateau) and is de la Colombie-Britannique. La région cartographique incised by Tsoo and Stanolind creeks draining north into comprend la bordure occidentale des hauts plateaux de the west-flowing Fort Nelson River. Bedrock is mantled Tsoo (plateau de l'Alberta) et est entaillée par les by unconsolidated sediments dating to the Late ruisseaux Tsoo et Stanolind qui coulent vers le nord Pleistocene (Late Wisconsinan Glaciation, >25 to 10 ka) pour se jeter dans la rivière Fort Nelson à écoulement and non-glacial Holocene (10 ka to present). Deposits ouest. Le socle rocheux est couvert de matériaux of till, green on the map, are generally suitable for terrestres non consolidés remontant au Pléistocène placement of infrastructure. Glaciofluvial and eolian supérieur (Glaciation du Wisconsinien supérieur, de > deposits with mineral, aggregate, and groundwater 25 ka à env. 10 ka) ainsi que de matériaux non potential are coloured orange and buff. Slopes glaciaires de l'Holocène (d'env. 10 ka jusqu'à nos disturbed by landslides, debris flows and rock falls jours). Les dépôts de till, de couleur verte sur la carte, appear brown and pink. Glaciolacustrine and organic sont généralement propices à l'établissement de deposits with sporadically discontinuous permafrost are l'infrastructure. Les dépôts fluvioglaciaires et éoliens, qui recèlent un potentiel en minéraux, en agrégats et en coloured purple and grey. Alluvial deposits prone to flooding, erosion, and sedimentation appear yellow on eau souterraine, sont figurés par les couleurs orange et chamois. Les versants dérangés par des glissements de terrain, des coulés 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. CGM 109 | CGM 128 | CGM 127 CGM 108 | CGM 107 | National Topographic System reference and index to adjoining published Geological Survey of Canada maps Catalogue No. M183-1/107-2012E-PDF ISBN 978-1-100-21443-6 Loess covered glacial lake sediments and morain ridges incised by Tsoo Creek, with a view west to the Tsoo Tablelands, northeast British Columbia © Her Majesty the Queen in Right of Canada 2013 Photograph by D.H. Huntley. 2013-080 Natural Resources Ressources naturelles du Canada **CANADIAN GEOSCIENCE MAP 107 SURFICIAL GEOLOGY** STANOLIND CREEK British Columbia 1:50 000

Holocene earth materials and landforms

98 499000m. E. **500**

Peat bogs: fibric to humic organic matter: massive to stratified accumulations generally greater than 2 m thick; confined to topographic depressions or level areas; underlain by poorly drained till, glaciolacustrine and other unconsolidated sediments; formed by decomposition of plant material in wetland areas; bogs with sporadically discontinuous permafrost and thermokarst depressions potentially unstable if organic material is disturbed or

Fens: fibric organic matter; massive to stratified; generally greater than 2 m thick; confined to topographic depressions, level areas and meltwater channels; underlain by poorly drained till, glaciolacustrine and other unconsolidated sediments; formed by decomposition of plant material in wetland areas; fens are prone to flooding following drainage damming by

Undifferentiated peat bogs and fens: humic to fibric organic matter; massive to stratified accumulations; generally greater than 2 m thick; confined to topographic depressions, level areas or channels; underlain by poorly drained till, glaciolacustrine and other unconsolidated sediments: formed by decomposition of plant material in wetland areas: may contain sporadically

discontinuous permafrost and thermokarst depressions; potentially unstable if disturbed or removed during development.

Alluvial fan sediments: boulders, gravel, sand and silt; generally massive to planar stratified; well to rapidly drained; greater than 2 m thick; fan morphology with slopes up to 15°; may contain interbedded debris flows and 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

massive to planar stratified; well to rapidly drained; greater than 2 m thick; may contain interbedded debris flows and buried organic material; underlain by outwash, till or bedrock; transported and deposited by modern rivers, streams and creeks; subject to rare flooding; potential source of aggregate; land use activities may adversely affect stream courses and conditions, and impact fish and wildlife resources. Alluvial floodplain sediments: gravel, sand and silt; massive, trough

Survey of Canada, Open File 1760, scale 1:50 000. cross-bedded, rippled-bedded, planar stratified; well to rapidly drained; greater than 2 m thick; underlain by till or bedrock; transported and deposited by modern rivers, streams and creeks; subject to seasonal flooding; land use activities may adversely affect stream courses and conditions, and impact fish

Late Pleistocene to Holocene earth materials and landforms

Loess: silt and sand; generally massive, well-sorted, cross-bedded or rippled-bedded; moderately to well drained; discontinuous veneers less than 1 m thick, blankets greater than 2 m thick; underlain by glacial lake sediments, outwash, till and alluvial deposits: derived from deflation, transportation and deposition of fine-grained sediment by wind action; contains little or no ground

Dunes: silt and sand; generally massive, cross-bedded or rippled-bedded; well to rapidly drained; parabolic ridges greater than 2 m thick; underlain by glacial lake sediments, outwash, till and alluvial deposits; derived from deflation, transportation and deposition of fine-grained sediment by wind action; contains

Colluvial veneer: clast-supported diamictons and rubble; massive to stratified, poorly-sorted; well to rapidly drained; deposits less than 2 m thick; landslide headscarps range from 300 m to 10.5 km; formed by the weathering and down-slope movement of earth materials by gravitational processes; bedrock and unconsolidated debris on slopes above 10-15° with greater than 5 m relief prone to mass-wasting; rock falls, topples, rock slides and debris flows occur where shale, sandstone and carbonate strata is exposed close to the surface; retrogressive rotational debris slides, debris flows and slumps occur in glaciolacustrine sediments and outwash containing sporadically discontinuous permafrost; where ground ice is found slope failure can occur on surfaces less than 5°; slope instability could present major problems for construction in

Colluvial blanket: clast-supported diamictons and rubble; massive to stratified, poorly-sorted; well to rapidly drained; deposits greater than 2 m thick; landslide headscarps range from 300 m to 10.5 km; formed by the weathering and down-slope movement of earth materials by gravitational processes; bedrock and unconsolidated debris on slopes above 10-15° with greater than 5 m relief prone to mass-wasting; rock falls, topples, rock slides and debris flows occur where shale, sandstone and carbonate strata is exposed close to the surface; retrogressive rotational debris slides, debris flows and slumps occur in glaciolacustrine sediments and outwash containing sporadically discontinuous permafrost; where ground ice is found slope failure can occur on surfaces less than 5°; slope instability could present major problems for construction in some areas.

Late Pleistocene earth materials and landforms Glaciolacustrine deposits

> Glaciolacustrine blanket: silt and clay with subordinate sand, gravel and ropstones locally present; poor to moderately drained; generally greater than 2 m thick; kettle lakes and irregular topography underlain by bedrock, tills and outwash; transported by and deposited from sediment-laden meltwater, subaqueous gravity flows and thermal melting of ice in proglacial lakes; where sporadically discontinuous permafrost is, or was present, glaciolacustrine sediments may be subject to thermokarst processes; slopes less than 5° are

Glaciofluvial deposits 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 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.

well-drained; greater than 2 m thick mantling bedrock and older glacial deposits; transported and deposited by the Laurentide Ice Sheet directly 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. Moraine ridges: sand, silt and clay-rich diamictons; massive, matrix-supported; 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; minor moraines less than 1 km long and 5 m high; major moraines up to 12.5 km in length and 10 m high; ridges drape 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. 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 glacial deposits; drumlins and fluted till ridges typically under 1 km long but can 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; generally suitable for infrastructure placement. Till veneer: sand, silt and clay-rich diamictons; massive, matrix-supported and

erratic boulders with sources on the Canadian Shield; moderately to well-drained; less than 2 m thick draping bedrock and older glacial deposits transported and deposited by the Laurentide Ice Sheet directly through lodgement, basal meltout, glacigenic deformation beneath active, warm-based ice and in situ melting from stagnant cold-based ice; generally suitable for infrastructure placement.

Pre-Quaternary earth materials and landforms

Undifferentiated bedrock: conglomerate, sandstone, siltstone, shale and limestone; exposed in escarpments between 300 m and 80 km in length; slopes above 10-15° with greater than 5 m relief prone to rock falls, topples rock slides and debris flows; Paleozoic unconformably overlain by Mesozoic sedimentary rocks; limestone and clastic sedimentary rocks are a potential source of crushed granular aggregate.

Preliminary

---- Geological boundary (Confidence: approximate)

••••• Major moraine ridge (end, interlobate, or unspecified)

other transverse or unspecified)

unspecified; sense: known)

Terrace scarp (environment: glaciolacustrine)

Terrace scarp (environment: glaciofluvial)

Terrace scarp (environment: fluvial)

Other moraine ridge (DeGeer, minor lateral, recessional, rogen, washboard,

Station location (ground observation or stratigraphic section)

Bedrock scarp

Drumlin ridge

Major meltwater channel scarp

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potentially unstable and prone to landslides and debris flows.

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

compact; clast contents less than 20% and contain sub-rounded granitic

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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)

Preliminary Geomatics by D.H. Huntley, W. Chow, and Cartography by W. Chow Initiative of the Geological Survey of Canada, Project as part of Natural Resources Canada's Geo-

mapping for Energy and Minerals (GEM) program

SURFICIAL GEOLOGY STANOLIND CREEK **British Columbia**

CANADIAN GEOSCIENCE MAP 107

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°21'E,

decreasing 21' annually.

Preliminary

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/).

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Preliminary publications in this series have not been scientifically edited.

CANADIAN GEOSCIENCE MAP 107 SURFICIAL GEOLOGY STANOLIND CREEK British Columbia

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