Descriptive Notes

This map area covers the surficial geology and landslide inventory up to height of land on both sides of Douglas Channel, which includes the northern portion of Kitimat Arm. Within this map area, the topography is more subdued than further south. The highest elevation is at about 635 m. Surficial geology compilation was carried out following the Geological Survey of Canada Surficial Data Model (Deblonde et al., 2012; Cocking et al., 2016) combined with the British Columbia Terrain Classification System (Howes and Kenk, 1997). The map area is one of six surficial geology maps that cover all of Douglas Channel.

The main objective of the surficial geology compilation is to provide baseline information on surface sediments and slope processes for stakeholders and decision-makers. In addition to the surficial geology, we have compiled information about landslides that were observed in the map area (Table 1).

Most of the surficial geology consists of colluvium or a veneer of organic material cover (folisol; Agriculture Canada, 1998) partially mantling steep bedrock slopes. In lower lying areas, there are pockets of till that were deposited during the last glaciation dating back to the Pleistocene. Some of the valleys located close to the shoreline are filled with glaciomarine sediments. The highest elevation in this map area where glaciomarine deposits are found is at roughly 100–120 m, located on the east side of Kitimat Arm just south of Kitamaat Village. Superimposed on the glacial and geglacial deposits are modern Holocene stream sediments resulting from alluvial processes.

The bedrock polygons have been labeled R2 and R3 indicating dominantly igneous and metamorphic rocks, respectively, based on available bedrock geology maps (Aldrick, 2002; Nelson et al., 2014).

Interpretation of landslides was carried out using Cruden and Varnes' (1996) classification. Mappable landslide deposits and landslide tracks without mappable deposits are compiled in Table 1. The mappable landslide deposits are mainly labeled unit Cf (debris flow fans). Active talus slopes, mapped as unit Ca, are less common. A large number of map units consists of colluvium that may not have been assigned to a specific landslide process (e.g. Cb = colluvial blanket; Cv = colluvial veneer). These units are included in Table 1 because they commonly contain small areas of landslide deposits. The most common type of landslide that occurs on these fjord slopes are small, shallow-seated translational slides. Their deposits are usually too small to be mapped or they run out into the ocean. These slides are labeled on the map as sediment transport arrows and are included in Table 1. Sediment transport arrows depict debris slides and flows consisting of mineral and organic material (folic debris slides; Nagel, 2000), small rock slides and rockfalls, and/or a combination of these.

In addition, it is at Kitimat Delta that submarine landslides occurred repeatedly between 1952 and 1975 (Murty and Brown, 1979). The most recent failure (24 April 1975) produced a tsunami that was felt locally and generated tsunami wave heights up to 8.2 m (Prior et al., 1982, 1984; Bornhold et al., 2004).

Terrain stability mapping was also carried out for the map area following the method described by British Columbia Ministry of Forests (1999) for the Forest Practice Code. Although this method was developed for the forestry sector, it has been used in assessing terrain stability for environmental assessments for resource development projects, such as mining and wind farms in British Columbia and Yukon. Terrain stability mapping is intended to qualitatively highlight the potential landslide sources based on slope gradient, surficial materials, material texture, material thickness, slope morphology, moisture conditions, and ongoing geomorphic processes (British Columbia Ministry of Forests, 1999). Terrain polygons were rated as stable to unstable (Class I–V, respectively) and colour coded from green to red, respectively, for all types of landslides (Figure 1). In some cases on the surficial geology map, two adjacent polygons have the same map label, e.g. Cv. They were not joined as a single polygon because the two units were rated differently in terms of terrain stability. The reader has the option to generate a terrain stability map from the downloadable dataset associated with this map area.

Acknowledgments

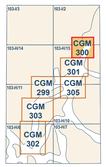
This activity was funded by the World Class Tanker Safety project at Transport Canada. It is part of the North Coast activity within the Geological Survey of Canada's Public Safety Geoscience Program. The authors would like to especially thank Gwyn Lintern and Trevor Allen (Activity leaders) for their support. Moreover, Louis Robertson is thanked for the scanning and ortho-rectification of the air-photos. William Chow and Carol Wagner are thanked for digitizing the interpreted polygons. Pouran Behnia is also thanked for compiling the database associated with the polygons.

Abstract

Douglas Channel is a 100 km long fjord located south of the municipality of Kitimat, in northwest British Columbia. The North Kitimat Arm map area covers the northern portion, the head of Douglas Channel where the town of Kitimat and Kitamaat Village are located. The area also covers a distance of about 10 km from Kitimat to Bish Creek. Mapping of surficial sediments, compilation of landslide deposits, and preliminary interpretation of bedrock types up to height of land were primarily carried out using British Columbia orgeoblue dated from 2001, 2003, and 2007 ranging in scales from 1:15 000 to 1:25 000. Older, field-based mapping by the authors in some isolated parts of the study area was incorporated into this mapping, complemented with additional, reconnaissance-level field observation in 2015 and 2016.

Résumé

Le chenal Douglas est un fjord de 100 km de longueur, situé au sud de la municipalité de Kitimat, dans le nord-ouest de la Colombie-Britannique. La région cartographiée de North Kitimat Arm couvre l'extrémité nord du chenal Douglas, là où la ville de Kitimat et le village de Kitamaat sont situés. La région couvre une distance d'environ 10 km du chenal Douglas, de Kitimat au ruisseau Bish. La cartographie des sédiments superficiels, la compilation des dépôts de glissements de terrain et l'interprétation préliminaire des types de substratum rocheux jusqu'à la ligne de faîte ont été effectuées à l'aide de photos aériennes de la Colombie-Britannique à des échelles de 1/15 000 à 1/25 000 datant de 2001, 2003 et 2007. Les résultats d'anciens travaux de cartographie réalisés par les auteurs dans des endroits isolés de la région d'étude ont été incorporés à la compilation cartographique, à laquelle s'ajoutent aussi des observations complémentaires provenant de travaux de reconnaissance sur le terrain effectués en 2015 et 2016.



National Topographic System reference and index to adjoining published Geological Survey of Canada maps

Catalogue No. M183-1/300-2016E-PDF
ISBN 978-0-660-06891-6
doi:10.4095/300850

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2017

Government of Canada / Gouvernement du Canada

CANADIAN GEOSCIENCE MAP 300

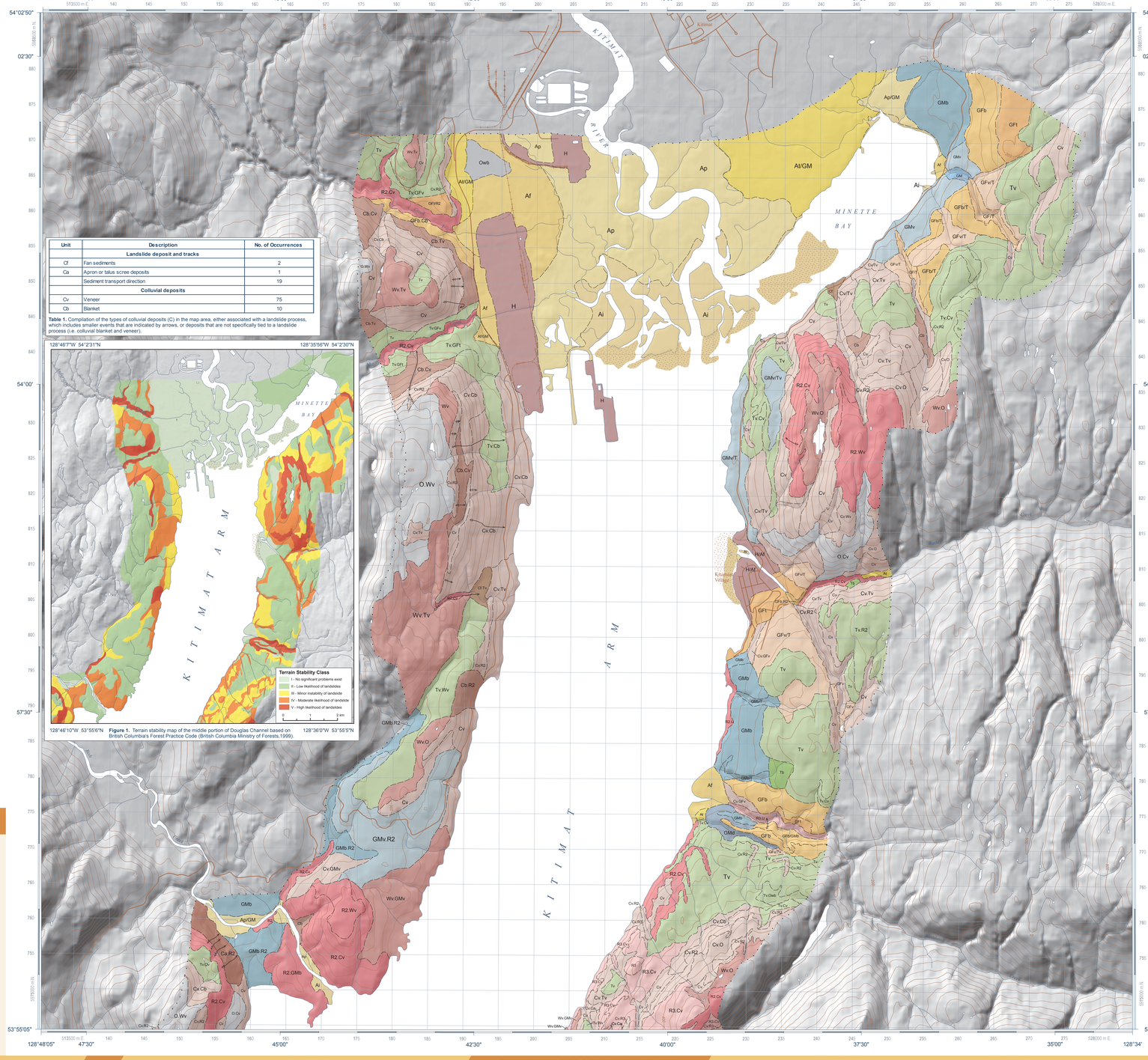
SURFICIAL GEOLOGY

NORTH KITIMAT ARM, DOUGLAS CHANNEL AREA

British Columbia

parts of NTS 103-H/15 and 103-I/2

1:25 000



Unit	Description	No. of Occurrences
	Landslide deposit and tracks	
Cf	Fan sediments	2
Ca	Apron or talus scree deposits	1
	Sediment transport direction	19
	Colluvial deposits	
Cv	Veneer	75
Cb	Blanket	10

Table 1. Compilation of the types of colluvial deposits (C) in the map area, either associated with a landslide process, which includes smaller events that are indicated by arrows, or deposits that are not specifically tied to a landslide process (i.e. colluvial blanket and veneer).

Figure 1. Terrain stability map of the middle portion of Douglas Channel based on British Columbia's Forest Practice Code (British Columbia Ministry of Forests,1999).

QUATERNARY

POST-FRASER GLACIATION

NONGLACIAL ENVIRONMENT

ANTHROPOGENIC DEPOSITS: rubble, diamicton, gravel and other foundation materials; usually less than 5 m thick; emplaced by human activity for residential and industrial infrastructure.

Undifferentiated anthropogenic deposits: Kitimat port area and Kitamaat Village.

ORGANIC DEPOSITS: accumulations of plant material in various stages of decomposition; typically 1 to 3 m thick forming fens and bogs in wetlands; folic material greater than 10 cm thick over bedrock in upland locations; organic deposits too small to be shown at this scale occur within other units.

Organic deposits, Owb; peat, decomposing plant material, and muck; saturated with the groundwater table at or near the surface; generally greater than 2 m thick; forming level to gently sloping freshwater wetlands.

Organic veneer: peat, decomposing plant material, and muck in a freshwater wetland; less than 2 m thick; may have somewhat discontinuous coverage. Occurs in secondary anti only.

Undifferentiated folic material: upland organic material of forest origin (leaf litter, twigs, branches, mosses and muck) accumulated directly over bedrock; greater than 10 cm thick; more than 40 cm thick overlying till; occurring on upland and sloping locations in cool, moist and humid forest ecosystems; rarely saturated with water; prone to debris slides and debris avalanches when disturbed or when saturated during intense rainfall events.

COLLUVIAL AND MASS-WASTING DEPOSITS: diamicton and rubble; non-sorted to poorly sorted; massive to moderately stratified; accumulated from gradually-induced movement of various mass-wasting processes, ranging from slope wash to large landslides; composition dependent on source materials and type of depositional process.

Colluvial fan sediments: diamicton and rubble; variable thickness; may contain organics; may be moderately stratified; accumulated as a fan or cone at the mouth of a steep–gradient stream or gully from debris slides and flows, debris floods and/or snow avalanches.

Colluvial apron or talus scree: rubble and block accumulations; 1 to 10 m thick; massive; forming aprons and cones at the base of steep (greater than 40°) slopes; often accumulated due to rock fall and/or small rock slides.

Colluvial veneer: diamicton and rubble; less than 2 m thick; mainly derived from disintegration of upslope bedrock on moderate to steep slopes; strongly conforms to the surface expression of the underlying landform.

Colluvial blanket: diamicton and rubble; 2 to 5 m thick; mainly derived from disintegration of upslope bedrock on moderate to steep slopes; typically conforms to the surface expression of the underlying landform and may include smaller deposits of unconsolidated debris at the toe of minor landslide and snow avalanche tracks.

ALLUVIAL (FLUVIAL) SEDIMENTS: gravel and sand with minor silt; commonly stratified; generally well sorted except in alluvial fans; deposited by modern streams.

Floodplain sediments: usually sandy, gravelly deposits; 1 to 5 m thick; forming flat to gently sloping surfaces adjacent to stream and river level; prone to flooding; larger, low-gradient channels are often bordered by low surfaces mantled by overbank sand, silt, and organic material.

Alluvial fan sediments: sand and gravel, with diamicton; poorly sorted; usually 2 to 10 m thick, located at the toe of slopes where a stream issues from a confined channel and at the mouths of narrow valleys.

Intertidal alluvial sediments: silt, sand, and minor small gravel; variable thickness; deposited in the intertidal zone of the ocean.

Alluvial terrace sediments: sand, gravel, and minor silt; mostly well sorted and stratified; 2 to 10 m thick; forming terraces well above modern flood levels.

POSTGLACIAL ENVIRONMENT ASSOCIATED WITH DEGLACIATION

GLACIOMARINE SEDIMENTS: clay, silt, sand, and gravel, massive or laminated; ice-rafted stones, rhythmic bedding (mm to cm thick) and marine shells may be present; bedding may be distorted due to submarine gravity flows; deposited in a marine environment in relatively close proximity to glacier ice, ice shelves or floating ice, or sediment-laden glacial meltwater streams.

Proglacial deltaic sediments: sand and gravel with minor silt and clay; on average typically greater than 3 m thick, but can be more than 10 m thick; commonly overlie glaciomarine silt and clay; may form inclined surfaces. There is an inferred transition between the terrestrial and marine proglacial sediments.

Glaciomarine veneer: mainly clay, silt, and sand; less than 2 m thick; sediment cover may be discontinuous in places and follows the underlying morphology.

Glaciomarine blanket: mainly clay, silt, and minor sand; greater than 2 m thick; extensive deposits may exceed 10 m thickness.

Undifferentiated glaciomarine sediments: of unknown texture, extent, and thickness; usually overlain by later post-glacial or Holocene sediments or exposed on an erosional slope (scarp).

FRASER GLACIATION (WISCONSINAN)

PROGLACIAL AND GLACIAL ENVIRONMENT

GLACIOFLUVIAL SEDIMENTS: sand and gravel with minor diamicton, well sorted to poorly sorted, and well to poorly stratified; variable thickness; deposited by glacial meltwater at or in close proximity to stagnating or retreating glaciers; bedding may have been disrupted locally following the melting of supporting ice.

Glaciofluvial terrace sediments: sand and gravel, stratified to massive; 1 to 10 m thick; forming terraced deposits along valley walls or associated with meltwater channels and perched well above modern alluvial deposits.

Glaciofluvial veneer: sand and gravel; generally less than 2 m thick; sediment cover may be discontinuous in places and follows the underlying morphology.

Glaciofluvial blanket: sand and gravel, stratified to massive; usually more than 2 m thick; sediment cover is continuous, but the underlying morphology is often visible; commonly located adjacent to meltwater channels.

Undifferentiated glaciofluvial sediments: sand and gravel of unknown extent and thickness, usually occurring on an erosional slope (scarp) or underlying Holocene sediment.

GLACIAL ENVIRONMENT

TILL: diamicton consisting of poorly sorted pebbles, cobbles, and boulders in a sandy to clayey matrix; directly deposited by glaciers; may contain small inclusions of glaciofluvial sediments, especially in valley bottoms and near the mouths and banks of meltwater channels; includes till that has been reworked due to gravity on steep slopes.

Till veneer: diamicton; less than 2 m thick on average; underlying bedrock morphology is discernible and where till cover is discontinuous, bedrock outcrops are abundant.

Till blanket: diamicton; more than 2 m thick on average; continuous till cover with few bedrock outcrops; conforming to and locally obscuring topography of underlying units.

Undifferentiated till: till deposits of unknown extent and thickness; usually overlain by post-glacial non-glacial sediments; till exposed on an erosional slope (scarp). Occurs in secondary unit only.

WEATHERED BEDROCK: rock fragments of rubble to block size, with variable amounts of residual silt, sand or clay, depending on the original bedrock type; derived from bedrock that is decomposed or disintegrated in-situ by mechanical or chemical weathering.

Weathered bedrock veneer: less than 2 m thick; discontinuous cover with abundant bedrock outcrops.

UNDIFFERENTIATED DEPOSITS: a layered sequence of more than two types of unknown surficial material.

Undifferentiated sediments: a thick stratigraphic sequence of unknown surficial material occurring along steep erosional (scarp) slopes. Occurs in secondary unit only.

PRE-QUATERNARY

BEDROCK: Paleozoic, Mesozoic and Cenozoic igneous and metamorphic bedrock outcrops; includes bedrock covered by unconsolidated or organic material that is less than 10 to 20 cm thick.

R2 — Dominantly igneous bedrock.

R3 — Dominantly metamorphic bedrock.

Complex units: two map-unit designators are used in cases where the surficial cover forms a complex area and the map units are too small to be mapped individually, yet constitute a significant areal extent of the total polygon (e.g. Owb.Tb designates an area of organic bog deposits with numerous outcrops of till blanket). In such instances a dot (.') is used to separate the map-unit designator.

Stratigraphic relationship: a stratigraphic relationship is shown with two map-unit designators separated by a slash (/') (e.g. GFv/Tb indicates glaciofluvial veneer overlying till blanket).

Geological boundary (confidence approximate)

Limit of mapping

Landslide track, sediment transport direction

References

Agriculture Canada, 1998. The Canadian System of Soil Classification, 3rd ed.; Agriculture and Agri-Food Canada, Publication 1646, 187 p.

Aldrick, D.J., 2002. Geology of the Ecstall Greenstone Belt, British Columbia; British Columbia Ministry of Energy and Mines, Open File 2002-3, scale 1:50 000.

Bornhold, B.D., Rabinovich, A.B., Fine, I.V., Kulikov, E.A., and Thomson, R.E., 2004. Landslide-generated tsunamis and their risk in coastal areas; GeoQuebec 2004, 57th Canadian Geotechnical Conference, 5th joint CGS/IAH-CNC Conference, Session 7G, p. 28–33.

British Columbia Ministry of Forests, 1999. Mapping and assessing terrain stability guidebook, 2nd ed.; Forest Practices Code of British Columbia, Victoria, British Columbia.

Cocking, R.B., Deblonde, C., Kerr, D.E., Campbell, J.E., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Lavoiette, A., Parent, M., Plouffe, A., Robertson, L., Smith, I.R., and Weatherston, A., 2016. Surficial Data Model, version 2.2.0: Revisions to the science language of the integrated Geological Survey of Canada data model for surficialgeology maps; Geological Survey of Canada, Open File 8041, 45 p. doi:10.4095/298767

Cruden, D.M. and Varnes, D.J., 1996. Landslide types and processes; *in* Landslides: Investigation and Mitigation, (ed.) A.K. Turner and L.R. Schuster; Transportation Research Board, National Academy of Sciences, Special Report 247, p. 36–75.

Deblonde, C., Plouffe, A., Boisvert, É., Buller, G., Davenport, P., Everett, D., Huntley, D., Inglis, E., Kerr, D., Moore, A., Paradis, S., Parent, M., Smith, I.R., St-Onge, D., and Weatherston, A., 2012: Science language for an integrated Geological Survey of Canada data model for surficial maps version 1.2; Geological Survey of Canada, Open File 7003, 237 p. doi:10.4095/290144

Howes, D.E. and Kenk, E., 1997. Terrain Classification System for British Columbia (Version 2); British Columbia Ministry of Environment, Recreational Fisheries Branch, and British Columbia Ministry of Crown Lands, Surveys and Resource Mapping Branch, Victoria, British Columbia.

Murty, T.S. and Brown, R.E., 1979. The submarine slide of 27 April, 1975 in Kitimat Inlet and the water waves that accompanied the slide; Pacific Marine Science Report 79-11, Institute of Ocean Sciences, Sidney, British Columbia.

Nagel, H.K., 2000. Folic debris slides near Prince Rupert, British Columbia; M.Sc. thesis, University of Alberta, Edmonton, Alberta.

Nelson, J.L., Diakow, L.J., Mahoney, J.B., Gehrels, G.E., van Staal, C.R., Karl, S., Pecha, M., and Angen, J.J., 2014. Geology of the north and mid-coast regions, British Columbia (parts of NTS 103-A, -G, -H, -I and -J); Geological Survey of Canada, Open File 7604; British Columbia Geological Survey Geoscience Map 2014-03, scale 1:150 000. doi:10.4095/295460

Prior, D.B., Bornhold, B.D., Coleman, J.M., and Bryant, W.R., 1982. Morphology of a submarine slide, Kitimat Arm, British Columbia; Geology, v. 10, p. 588–592.

Prior, D.B., Bornhold, B.D., and Johns, M.W., 1984. Depositional characteristics of a submarine debris flow; Journal of Geology, v. 92, p. 707–727.

Recommended citation
Maynard, D.E., Weiland, I.C., Blais-Stevens, A., and Geertsema, M., 2017. Surficial geology, north Kitimat Arm, Douglas Channel area, British Columbia, parts of NTS 103-H/15 and 103-I/2; Geological Survey of Canada, Canadian Geoscience Map 300 (preliminary), scale 1:25 000. doi:10.4095/300850

Celebrating 175 yrs

Geological Survey of Canada
Canadian Geoscience Maps

Authors: D.E. Maynard, I.C. Weiland, A. Blais-Stevens, and M. Geertsema

This map was produced by Natural Resources Canada in co-operation with Transport Canada.

Geology by D.E Maynard, I.C. Weiland, and A. Blais-Stevens, 2015

Geology conforms to Surficial Data Model v. 2.2

Geomatics and cartography by W. Chow, C.L. Wagner, and S. van Stavel

Joint initiative of the Geological Survey of Canada and the World Class Tanker Safety Project at Transport Canada, conducted under the auspices of North Coast activity as part of Natural Resources Public Safety Geoscience Program.

Map projection Universal Transverse Mercator, zone 9. North American Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada, with modifications. Contour lines generated from Canadian Digital Elevation Model (CDEM) supplied by Natural Resources Canada. Elevations in metres above mean sea level

CANADIAN GEOSCIENCE MAP 300

SURFICIAL GEOLOGY

NORTH KITIMAT ARM, DOUGLAS CHANNEL AREA

British Columbia

parts of NTS 103-H/15 and 103-I/2

1:25 000

500 0 500 1000 1500 2000m

Shaded relief image derived from the Canadian Digital Elevation Model supplied by Natural Resources Canada. Illumination: azimuth 315°, altitude 45°, vertical factor 1x

Magnetic declination 2017, 18°16'E, decreasing 13.3' annually.

This map is not to be used for navigational purposes.

Title photograph: Kitamaat Village; Douglas Channel, northwest British Columbia. Photograph by A. Blais-Stevens. 2016–077

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

Data may include additional observations not portrayed on this map. *See* map info document accompanying the downloaded data for more information about this publication.

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

Preliminary publications in this series have not been scientifically edited.

CANADIAN GEOSCIENCE MAP 300

SURFICIAL GEOLOGY

NORTH KITIMAT ARM, DOUGLAS CHANNEL AREA

British Columbia

parts of NTS 103-H/15 and 103-I/2