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GEOLOGICAL SURVEY OF CANADA / COMMISSION GÉOLOGIQUE DU CANADA

NATMAP CARTNAT
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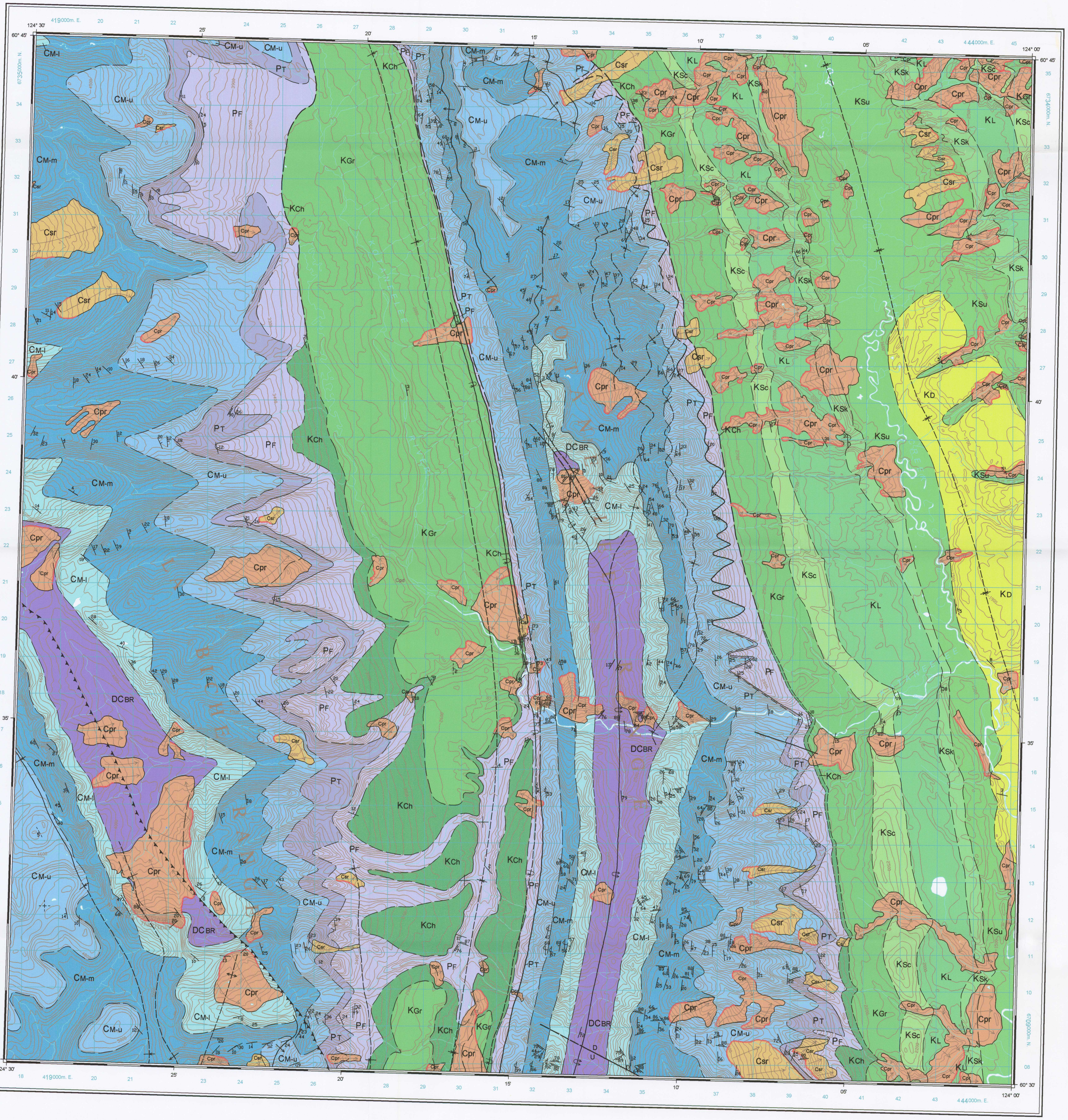
Le Programme national de cartographie géoscientifique du Canada



LEGEND

Coloured legend blocks indicate map units that appear on this map

QUATERNARY
SURFICIAL DEPOSITS

COLLUVIAL DEPOSITS : bedrock mass wasting debris, 1-50 m thick

Csr — ***Rock slide deposits:*** *chaotic landscape of irregular and stacked bedrock blocks; associated with steeply dipping, poorly-indurated sandstone and shale-rich beds in the Mattson and Fantasque formations*

Cpr — ***Rock slump deposit complexes:*** *stepped to chaotic landscape of bedrock debris; individual rotational blocks to a complex of slump blocks, translational slides, debris flows and other types of mass wasting; commonly traceable upslope to active scarps; where sufficient moisture is present, slumps may produce a flow at their base, forming a characteristic spatulate form; prominent in areas underlain by steeply dipping, poorly-indurated sandstone and shale-rich beds of the Mattson and Fantasque formations, and moderate to shallow dipping, shale-rich beds of the Fort St. John Group; associated with the largest mass movements in the region*

MESOZOIC

CRETACEOUS

UPPER CRETACEOUS

KD — ***DUNVEGAN FORMATION*** *: Light grey to buff sandstone, massive or crossbedded; subordinate pebble conglomerate, dark grey silty shale, and coal.*

LOWER AND UPPER CRETACEOUS

FORT ST JOHN GROUP (KCh - KSu)

KSu — ***SULLY FORMATION:*** *Dark grey shale and siltstone with sideritic concretions; silt content higher in upper part*

LOWER CRETACEOUS

KSk — ***SIKANNI FORMATION:*** *Greenish grey sandstone, siltstone, and shale; sandstone is thick-bedded, commonly calcareous or glauconitic; typically thinly laminated and cross-laminated.*

KL — ***LEPINE FORMATION:*** *Dark grey mudstone with concretions, silty shale, and black fissile shale; lower part of unit abundantly fossiliferous.*

KSc — ***SCATTER FORMATION:*** *Resistant, greenish-grey, glauconitic, laminated sandstone; medium- to thick-bedded; silty, concretionary mudstone common in middle part of unit.*

KGr — ***GARBUTT FORMATION:*** *Grey shale and siltstone with sideritic concretions; minor thin-bedded, finely laminated sandstone.*

KCh / KCh — ***CHINKEH FORMATION:*** *Chert-pebble conglomerate overlain by bioturbated quartz arenite with variable chert content, and argillaceous siltstone; woody or plant debris common.*

PALEOZOIC

PERMIAN

ISHBEL GROUP

PF — ***FANTASQUE FORMATION:*** *Dark grey to white, well bedded, spiculitic chert; rusty weathering; rhythmically interbedded with minor shale and siliceous siltstone.*

PT / PT — *Tika map unit: Buff weathering, light to medium brown, silty and sandy limestone or dolostone grading into calcareous siltstone and sandstone; subordinate lithoclast breccia and shale; medium-bedded, massive to cross-laminated; sparsely fossiliferous; characteristic rectilinear fracture pattern.*

CARBONIFEROUS

LOWER CARBONIFEROUS

MATTSON FORMATION

CM-u — ***UPPER MEMBER:*** *Light to medium grey, fine- to coarse-grained, locally calcareous or dolomitic quartz arenite and sub-chert-arenite; subordinate fossiliferous limestone, and grey to green shale; sandstone commonly shows large-scale crossbedding; fossils in the limestone are commonly silicified; may include Tika map unit.*

CM-m — ***MIDDLE MEMBER:*** *Grey to buff to brown, poorly- to well-indurated, fine-grained quartz arenite with subordinate siltstone and dark shale; minor coal and sandy dolostone; sandstone shows fine- to large-scale crossbedding; typically forms sharp-based, thick-bedded, fining-up sequences.*

CM-l — ***LOWER MEMBER:*** *Greyish orange weathering, light grey or buff, well-indurated, fine- to very fine-grained quartz arenite interbedded with siltstone and dark grey shale; minor coal, dolostone, and lithoclast breccia; cross laminae and trace fossils common, typically thin- to medium-bedded with coarsening-up sequences.*

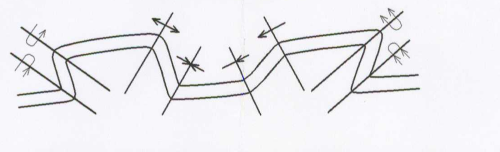
DEVONIAN AND CARBONIFEROUS

DCBR — ***BESA RIVER FORMATION:*** *Dark grey to black shale, locally weathers buff; sparsely fossiliferous; minor interbedded greyish-orange weathering sandstone, siltstone, lithoclast breccia, and scattered sideritic nodules.*

MAP SYMBOLS

- Geological boundary (defined, approximate, assumed)
- Landslide flow path
- Scarp
- Bedding (inclined, vertical, horizontal, overturned, estimated) — 60, 60, 60
- Joints — 60
- Anticline (defined, approximate, assumed)
- Syncline (defined, approximate, assumed)
- Overturned anticline (defined, approximate, assumed)
- Overturned syncline (defined, approximate, assumed)
- Anticlinal kink fold (defined, approximate, assumed) (See diagram below)
- Synclinal kink fold (defined, approximate, assumed) (See diagram below)
- Overturned anticline - limbs dip in opposite direction (defined, approximate, assumed)
- Overturned syncline - limbs dip in opposite direction (defined, approximate, assumed)
- Fault, thrust (approximate, assumed)
- Fault, unknown type (defined, approximate) (U on upthrown side, D on downthrown side) — D / U

FOLD SYMBOLOGY



Fold symbols as used on the map apply to folds having cross-sectional geometries depicted in this diagram (see Stockmal et al., 2002).

NOTE:

The bedrock geology, and associated measurements and observations, depicted on this map are derived from Lane and Fallas (2003). For clarity purposes, some measurement and observational data from Lane and Fallas (2003) have been excluded, and the user is thus referred to the original bedrock geology map for greater detail. Similarly, only the bedrock-controlled landslides (Csr and Cpr) from the accordant surficial geology map of Smith (2003) are depicted here. Users seeking information on the nature and distribution of Quaternary deposits and landslides in unconsolidated material should consult the Smith (2003) map.

Mass Wasting *is the collective term given to the range of processes and resultant landforms that relate to the gravitational downslope movement of rock and/or unconsolidated material without direct conveyance by water, air or ice. Water and ice are, however, commonly key components in initiating and perpetuating mass wasting by reducing the strength of materials and altering their plastic and fluid behaviour.*

Different types of mass wasting are distinguished by the type of materials involved (e.g., bedrock, talus, till), the mode of deformation (e.g., creep, slide, slump, flow), speed of movement, morphology of the moving mass, and water content. Many mass wasting events that are initiated in bedrock also incorporate considerable surficial materials in their motion (particularly in valleys where glacial deposits may be thick; Smith, 2003), producing a complex of mass wasting deposits.

While different earth surface materials and geological settings may be strongly associated with various types of mass wasting, predicting their occurrence, magnitude and rate of deformation is often not possible. Human activities such as road building, pipeline trenching, logging and seismic exploration can also initiate mass wasting, particularly where they undercut slopes, or act to destabilize surficial materials. Some areas that are prone to mass wasting in the Chinkeh Creek region include areas of steep to moderately dipping bedrock, poorly indurated and shale-rich bedrock, and cutbanks along stream courses and meandering river channels. Overall, the extent of mass wasting in the Chinkeh Creek 95C/9 map is much less than that seen in map areas to the north and south (Smith and Fallas, 2002; Smith et al. 2002, 2003).

Rock Slides *are the rapid, downslope movement of bedrock. Failure occurs along bedding and/or joint planes. Slides can be initiated at shallow or considerable depths. Rock slides cover* **13.0 km²** *(~1.7% of the total map area). They are found principally within the middle and upper Mattson Formation, but also occur in Fantasque and Sully formations and Tika map unit. As in the Babiche Mountain (95C/8) map area to the south (Smith et al., 2003), there is a conspicuous spatial pattern of rock slides along the eastern limb of Kotaneelee Anticline. In the southern third of the map, ridges of bedrock extend obliquely across strike, northeast from the axis of Kotaneelee Anticline. This creates a situation wherein beds of Mattson Formation and other strata have a down-dip component parallel to the southeast-trending surface slope of the ridge. Interaction of bedding and jointing planes facilitates failure in shale and/or poorly lithified sandstone beds, leading to large rock slides. In the northern third of the map, Kotaneelee Anticline is deflected to the northwest. Bedrock ridges extend northeastward, perpendicular to strike, resulting in active rock slides along eastward-facing ridge slopes. The less common occurrence of rock slides in Mattson Formation strata along the La Biche Anticline (the eastern margin of which is situated along the western edge of this map) may reflect generally shallower dipping strata. In the northeastern corner of the map a series of rock slides generated in Sully Formation shales are oriented down dip and therefore likely represent detachments along bedding planes that then slide perpendicular downslope.*

Rock Slumps *involve the rotational movement of bedrock along failure planes. Slumps may occur as individual blocks or amorphous masses (reflecting water content and structural integrity of the failing material). Slumps often extend progressively up-slope through time, and can be associated with active scarp or headwall retreat. Slumps can be initiated by failure along bedding or joint planes, by infiltration of surface water, through lateral incision and undercutting of slopes by streams, or excavation activities. Rock slumps cover* **58.6 km²** *(~7.6% of the total map area) and are the most extensive form of mass wasting in the map area (see Smith, 2003). Found in all of the different rock formations present in the 95C/9 map, they are particularly prominent in Lepine, Garbutt and Sully formation shale and siltstone, as well as in Besa River Formation and upper upper Mattson Formation strata. Many slumps are clearly aligned down dip, suggesting that they are generated by failure along bedding planes, possibly within shale or other poorly indurated beds. Slumps are also common in areas along the eastern Kotaneelee Anticline where there are numerous rock slides. The slumps occur on the opposing sides of ridges as the slides, reflecting an opposite geometry to that associated with rock slides along these ridges. This serves to illustrate the often simple bedrock structural control of different types of mass wasting (i.e., beds parallel to slope producing rock slides, beds perpendicular or oblique to slope producing rock slumps). Elsewhere, slumps have, and continue to be generated by the undercutting of slopes by the Kotaneelee River and Chinkeh Creek. This is particularly evident along the Kotaneelee River where many relic and active slumps are found. Diversion and/or temporary damming of the Kotaneelee River and Chinkeh Creek by large slumps generated along the valley sides represents a considerable, albeit rare, hazard in this region. By sheer number, most slumps in the map area are found along tributaries draining into Chinkeh Creek. Often small, these slumps display morphological characteristics of slumps that are frequently reactivated and/or migrate upslope by headward erosion. The majority of these small slumps appear to be triggered through undercutting of slopes by ephemeral creek drainage. This implies that there may be strong seasonal (i.e., spring snow melt) and meteorological (i.e., intense rainstorm) factors controlling their dynamics. Temporary small-scale damming of creek flow by slumps is likely a frequent occurrence, and would inevitably lead to eventual breaching of the impoundment and down-valley propagation of a debris flow. Larger-scale events of a similar nature would have to be taken into consideration by development activities situated in the valley bottom below as examples of breached-sediment dam-initiated debris flows in areas north of this map area have been observed to extend kilometres down-valley.*

In attempting to discern where exactly slumps were initiated, it is important to recognize that the location of scarps does not necessarily coincide with the geological/structural failure surface. Many of the slumps seen in this map involve considerable depths of material, indicating that the slumps are being triggered in strata underlying that exposed at the surface. This is perhaps best illustrated along the southern La Biche Anticline where several slumps, which extend upslope through the lower Mattson, were likely generated by failure within underlying Besa River shales.

Scarps/headwalls bounding the lateral and upper margins of slumps within Mattson Formation often display a marked orthogonal and/or rectilinear pattern. These patterns are strongly correlative with measured bedding and joint orientations. Since jointing is particularly well developed in sandstone beds of Mattson Formation, these structural associations likely contribute to regional mass wasting trends and the block-failure of bedrock. Retrogressive landslides which propagate upslope after initial bedrock failure, or when slumps are reactivated, are also likely to be strongly correlated with these structural associations.

Many bedrock slumps in the map area are classified as rotational-slumps. These slumps have a longitudinal profile which shows a steep slope in the upper third to two-thirds, an inflection, and then a more gentle slope through the lower reaches. This morphology reflects the failure of bedrock at depth, the backward and down-slope rotation of bedrock above the failure surface, and the run-out of slumped material downslope. In these cases, the inflection can be used to estimate where the bedrock failure surface was located. On a regional scale, in areas where bed strike and dip remain relatively constant, it may be possible to infer areas of potential future failure (and apply this to possible development considerations). Clearly, such a scheme is dependent on several assumptions including those of lateral bed continuity and compositional homogeneity. Drilling activities may ultimately be able to resolve these, by specifically identifying which bed is responsible for triggering the failures. This knowledge could then be applied to larger regional studies, tracing the same bed, and assessing the potential for failure for a given stratigraphic and topographic locale.

REFERENCES

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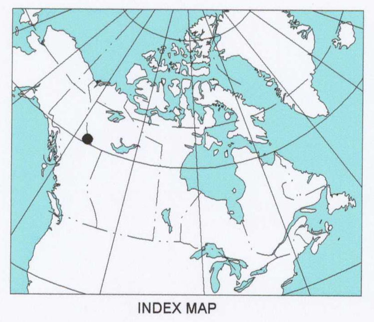

INDEX MAP

CONTOUR INTERVAL 100 FEET
Elevations in Feet above Mean Sea Level

OPEN FILE 4925

LANDSLIDES AND BEDROCK GEOLOGY ASSOCIATIONS
CHINKEH CREEK
NORTHWEST TERRITORIES - YUKON TERRITORY

Scale 1:50 000/Échelle 1/50 000

Kilometres 1 0 1 2 3 Kilomètres

Universal Transverse Mercator Projection
North American Datum 1983

Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983

Compilation by I.R. Smith, L.S. Lane, and K.M. Fallas
THIS MAP IS A PRODUCT OF THE CENTRAL FORELAND NATMAP PROJECT

Surficial geology by: I.R. Smith, 2000-2002;
Bedrock Geology by: L.S. Lane, K.M. Fallas, A.K. Khudoley, and L.C. Pigage, 2000-2002;
L.D. Currie, T.E. Kubli, and M.R. McDonough, 1995-1997;
based on fieldwork and studies of vertical air photographs.

Digital cartography by I.R. Smith and S.J. Hinds.

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada.

Base map at the same scale published by Surveys and Mapping Branch in 1971.

95C/15 Dendale Lake	95C/16 Etanda Lakes	95B/13 Sawmill Mountain
95C/10 Tika Creek	95C/9 Chinkeh Creek GSC OF 4925	95B/12 Mount Flett
95C/7 Brown Lake	95C/8 Babiche Mountain GSC OF 1752	95B/5 Fisherman Lake

NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND INDEX TO ADJOINING GEOLOGICAL SURVEY OF CANADA MAPS

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4925
GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA
2005

Recommended citation:
Smith, I.R., Lane, L.S., and Fallas, K.M.
2005: Landslides and Bedrock Geology Associations, Chinkeh Creek (95C/9), Northwest Territories - Yukon Territory; Geological Survey of Canada, Open File 4925, 1 map, scale 1:50 000.