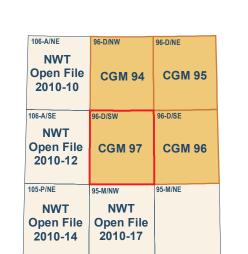
Figure 1. Schematic stratigraphic relationship diagram for southwest Carcajou Canyon map area (NTS 96-D/SW). Although normal faulting is known to affect the lower boundary of the Nainlin Formation—Saline River Formation succession, the question mark at the top end of some faults reflects uncertainty about where faulting terminates within the succession.

geological record.

The southwest quadrant of Carcajou Canyon map area (NTS 96-D) lies within the mountainous Canyon and Backbone ranges of the eastern Mackenzie Mountains, Northwest Territories. Widespread exposures in the Mackenzie Mountains include siliciclastic and carbonate strata ranging from Neoproterozoic to Devonian. These strata have been deformed by northwest- to southeasttrending folds and contractional faults associated with Cordilleran deformation. A pre-Cordilleran set of approximately north-trending extensional faults are preserved within Proterozoic and Cambrian strata, and were locally reactivated by Cordilleran deformation. Cryogenian igneous activity resulted in the emplacement of gabbroic sills and dykes into strata of the Mackenzie Mountains Supergroup. A major unconformity between Proterozoic (Cryogenian) and Cambrian strata represents a significant gap in the local

Le quadrant sud-ouest de la région cartographique de Carcajou Canyon (SNRC 96-D) se situe dans la région montagneuse des chaînons Canyon et Backbone de la partie est des monts Mackenzie (Territoires du Nord-Ouest). Les affleurements généralisées dans les monts Mackenzie renferment des strates silicoclastiques et carbonatées dont les âges s'échelonnent du Néoprotérozoïque au Dévonien. Ces strates ont été déformés par le jeu de failles de contraction et de plis de direction nord-ouest à sud-est associés à la déformation cordillérienne. Un ensemble de failles d'extension de direction approximativement nord de formation antécordillérienne ont été conservées dans les strates du Protérozoïque et du Cambrien et celles-ci ont été réactivées par endroits lors de la déformation cordillérienne. Une activité magmatique au Cryogénien s'est traduite par la mise en place de filons-couches et de dykes gabbroïques dans les strates du Supergroupe de Mackenzie Mountains. Une discordance majeure entre les strates du Protérozoïque (Cryogénien) et du

Cambrien rend compte d'une importante lacune dans la



géologie locale.

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

Cover illustration View looking north-northwest along the Conundrum Fault in the Tigonankweine Range of the Mackenzie Mountains, Northwest Territories. This steeply dipping reverse fault, placing dark grey Abrahan Plains Formation sandstone over light grey and orange carbonate of the Stone Knife Formation, is pre-Cordilleran normal fault inverted during Cordilleran deformation. Photograph by K.M. Fallas

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Canada **CANADIAN GEOSCIENCE MAP 97**

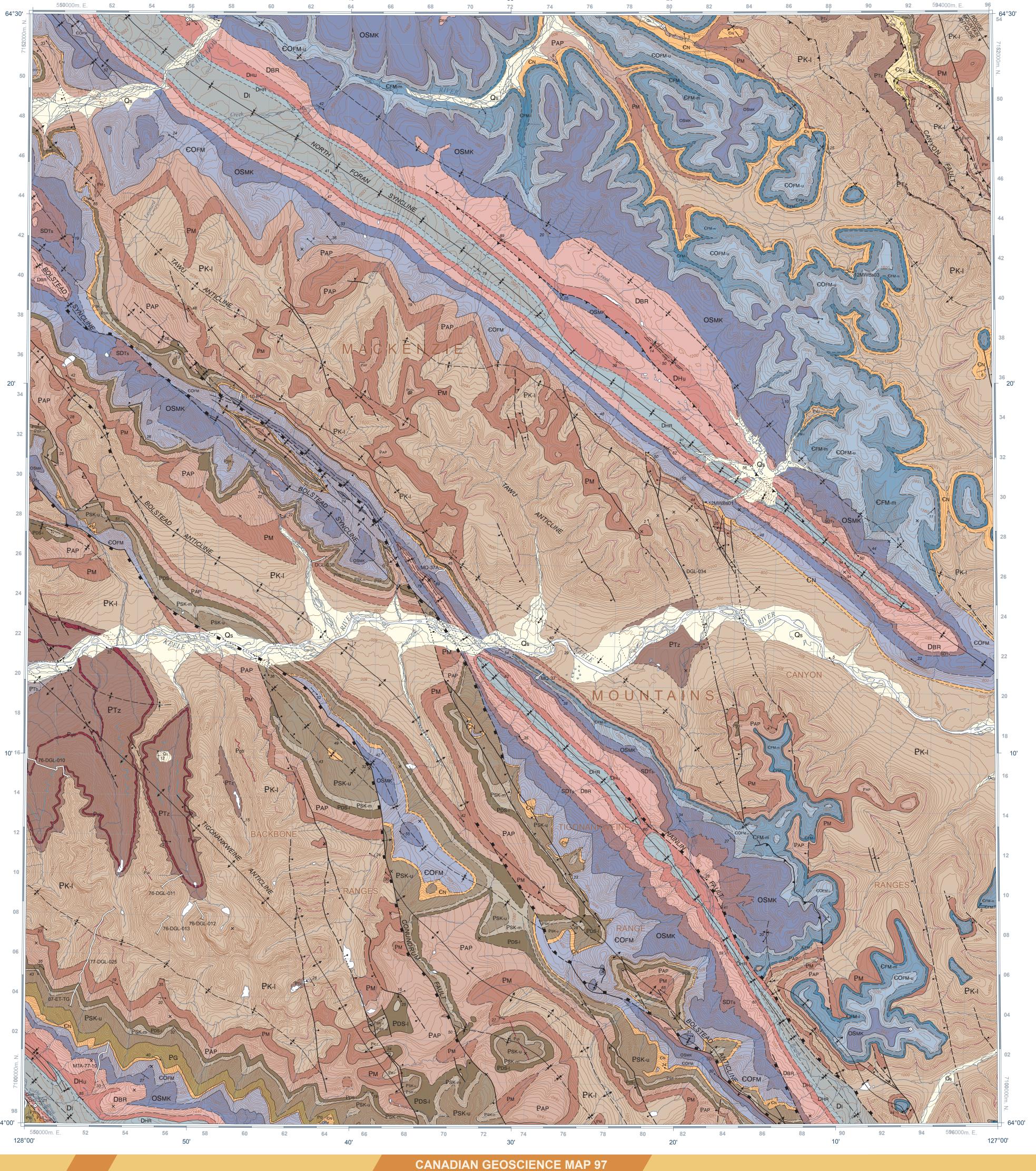
Natural Resources Ressources naturelles

CARCAJOU CANYON (SOUTHWEST)

Northwest Territories



Canadian **Geoscience Maps**



GEOLOGY

CARCAJOU CANYON

Northwest Territories

Scientific editing by E. Inglis

Initiative of the Geological Survey of Canada, conducted under the auspices of

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Canada's Geo-mapping for Energy and Minerals (GEM) Program.

mandate to promote scientific research in the Canadian North, PCSP 01310

00411, and 00912.

Map projection Universal Tranverse Mercator, zone 9.

North America Datum 1983

Base map at the scale of 1:50 000 from Natural Resources Canada,

Elevations are in metres above mean sea level

with modifications.

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Compilation by K.M. Fallas and R.B. MacNaughton, 2011–2013

Geological field observations by K.M. Fallas, R.B. MacNaughton, J. Powell

(University of Ottawa), T. Proks, 2010–2012, J.D. Aitken, H.R. Balkwill, 1969, G Cook 1979 C Roots 2006 C Leslie K Rasmussen and W Zantvoor

(Northwest Territories Geoscience Office), 2006–2007

Stratigraphic sections measured by R.B. MacNaughton, E.C. Turner (Laurentian

University), M. Pope (Texas A&M University), and S. Leslie (James Madison

University), 2010–2012, J.D. Aitken, D.G.F. Long, and D.W. Morrow,

1976–1979, and R.W. Macqueen, 1969

Geomatics by K.M. Fallas, S.D. Orzeck, and N. Raska

Cartography by S.D. Orzeck

Quaternary sediment: mud, sand, and gravel: unconsolidated.

DEVONIAN

Imperial Formation: shale: locally silty, dark grey to greenish-grey, fissile; interbedded with siltstone: locally micaceous or calcareous, greenish-grey to purplish-brown, laminated, bioturbated; and sandstone; lithic wacke to quartz arenite, micaceous, locally calcareous or glauconitic, grey to greenish-grey or brown, very thin- to medium-bedded, laminated and crosslaminated, abundant and diverse trace fossils; and minor limestone: bioclastic, grey to brown or orange, diverse fossil assemblage

Horn River Group (Hare Indian and Canol formations): shale: arbonaceous or petroliferous, calcareous to siliceous, locally silty, dark grey or black, weathers grey, black, brown, or rusty, locally fossiliferous; minor

mestone: dark grey with tentaculitids, interbedded with shale at base of unit. Hume Formation: limestone: wackestone to grainstone, floatstone, medium to dark grey or brownish-grey, typically weathers light grey, thin- to very thick-bedded, parallel to irregular or nodular bedded, fossiliferous with abundant and diverse assemblage. Unit is thicker bedded and cliff-forming in Bear Rock Formation: limestone breccia: variably dolomitic and

petroliferous, angular clasts range from granule- to boulder-sized, greyish-brown to grey, weathers light grey, vuggy, massive and rubbly with are bedded intervals of laminated carbonate, tends to form hoodoos. SILURIAN TO DEVONIAN

Delorme Group (Tsetso Formation)

Tsetso Formation: dolostone: dolomudstone to dolograinstone, locally alcareous or quartzose (sandy), cream to light grey, weathers light grey to ellow or light orange, thin- to thick-bedded, parallel-bedded, laminated, romatolitic; interbedded locally with sandstone: dolomitic, silty, light brown, thin- to medium-bedded, laminated, and crossbedded. ORDOVICIAN TO SILURIAN

Mount Kindle Formation: dolostone: dolowackestone to dolopackstone and

and weathered surfaces, thin- to very thick-bedded, vuggy, recrystallized, bioturbated, and fossiliferous (mainly silicified corals, crinoids, orthocone cephalopods, and stromatoporoids); interbedded with dolomudstone: light grey or cream, laminated, unfossiliferous. CAMBRIAN TO ORDOVICIAN Franklin Mountain Formation: dolostone: dolomudstone to dolograinstone locally calcareous or cherty, grey, cream, or light brown, weathers light grey,

dolofloatstone, siliceous and cherty, light to dark grey or brownish-grey fresh

vellowish-grey, or orange, very thin- to thick-bedded, typically recrystallized locally yuggy, stromatolitic, bioturbated, politic, crossbedded, or intraclast-bearing; minor shale: greenish-grey or red, fissile, and laminated; and sandstone: lithic wacke to quartz arenite, dolomitic, cream to orange, red, or brown, weathers light orange to red, very thin- to medium-bedded, crossbedded, ripple marks, and bioturbated. Shale and sandstone found in basal part of unit. Alternation, at 1-2 m intervals, of ooid dolograinstone with dolomudstone produces a locally prominent striped appearance in the middle part of the unit.

Franklin Mountain Formation, upper member: dolostone: crystalline dolostone, commonly cherty and siliceous, cream to beige or grey, weathers white to light grey, very thin- to thick-bedded, vuggy and nodular, locally stromatolitic, bioturbated, intraclast-bearing, or

Franklin Mountain Formation, middle member: dolostone: olomudstone to dolograinstone, rarely calcareous or cherty, light grey to cream or beige, weathers light yellowish-grey to orange-brown, thin- to thick-bedded, typically recrystallized obliterating primary textures, locally vuggy, stromatolitic or thrombolitic, bioturbated, oolitic, crossbedded, or intraclast-bearing; rare shale partings. Alternation, at 1–2 m intervals, of ooid dolograinstone with dolomudstone produces a locally prominent striped appearance.

Franklin Mountain Formation, lower member: dolostone: locally calcareous, silty, or sandy, detrital chert or quartz grains, grey to greenish-grev or brown, weathers pale vellow to grev or prange-brown, thin- to medium-bedded, parallel-laminated, crossbedded, locally includes intraclast rudstone, locally stromatolitic or bioturbated; interbedded with sandstone: quartz arenite, dolomitic and silty, crossbedded

Nainlin Formation: shale: light green, brick red, or grey, fissile, mud cracks; interbedded with sandstone: quartz wacke to quartz arenite, locally dolomitic, arely conglomeratic, cream to pink, red, or brown, variable weathering colour, ripple marks, sporadic horizontal or vertical burrows; minor conglomerate:

found at base or within unit. Saline River Formation: evaporite: gypsum, anhydrite, or halite, white and grey to pink or red, very thin- to thin-bedded, bedding typically disturbed and chaotic, dominates middle part of unit; shale: silty, grey, red, or green, fissile, minor salt casts, desiccation cracks, and horizontal burrows: minor dolostone dolomudstone to dolograinstone, grey to yellow, green, or orange, locally intraclast-bearing, oolitic, stromatolitic; and sandstone: lithic wacke to guartz arenite, calcareous or dolomitic, can be conglomeratic, varicoloured, paralleland crosslaminated, ripple marks, rip-up clasts, and possible trace fossils.

Mount Cap Formation: shale: locally silty or dolomitic, dark grey to brown or black, fissile, may contain horizontal burrows, trilobites, and brachiopods, dominates upper part of unit; limestone or dolostone: mudstone to wackestone and bindstone, locally silty, medium to dark grey, weathers orange-brown, parallel to nodular bedded, intraclast-bearing, stromatolitic, bioturbated, few trilobites or brachiopods; and sandstone: quartz wacke to quartz arenite, calcareous and glauconitic, grey to greenish-grey, brown, or orange, very thinto thick-bedded, trace fossils abundant.

Mount Clark Formation: sandstone: quartz arenite, locally glauconitic, very fine- to coarse-grained, can be conglomeratic at base of unit. white to tan or grey, weathers white to grey or brown, very thin- to thick-bedded. parallel-bedded to crossbedded, horizontal and vertical burrows locally abundant, but of low diversity; minor shale or siltstone: grey.

NEOPROTEROZOIC (Tonian to Cryogenian)

contains desiccation cracks.

Mafic dykes and sills: gabbro and diabase: fine- to medium-grained, dark grey to dark green, weathers brown to grey or black, homogeneous texture, ocurs as both dykes and sills in Proterozoic strata.

Gabbro and diabase: fine- to medium-grained, dark grey to dark green, weathers brown to grey or black, homogeneous texture, occurs as both dykes and sills in Proterozoic strata.

Mackenzie Mountains Supergroup (Tabasco Formation, Tsezotene Formation, Katherine Group, and Little Dal Group) Little Dal Group (Dodo Creek, Stone Knife, Gayna, Ten Stone,

and Snail Spring formations) Snail Spring Formation: siltstone and shale: locally sandy, weathers brown to orange, desiccation cracks, minor ripple crosslamination; interbedded with

guartz sandstone: weathers pale grey to rusty brown, ripple crosslaminated crossbedded, rip-up clasts, and desiccation cracks; and dolostone: locally calcareous or sandy, weathers grey to orange, molar-tooth structure. intraclast-bearing, stromatolitic, and oolitic, more abundant at base and top of Ten Stone Formation: evaporite: gypsum, locally sandy or argillaceous, white, grey, pink, or red fresh and weathered surfaces, parallel- and ripple-

minor dolostone: locally calcareous, weathers grey to pale brown, very thin- to Gayna Formation: dolograinstone: quartz-silty, locally cherty, weathers beige to orange, thin- to medium-bedded, oolitic, intraclast-bearing, crossbedded, rosslaminated, locally stromatolitic or contains molar-tooth structure; interbedded with dolomudstone: silty, weathers yellow to beige, thin-bedded

slamination common, nodules and enterolithic folds also present; very

Stone Knife Formation, upper part: lime mudstone or dolomudstone: locally argillaceous, light to dark grey, weathers orange, yellowish-grey, and beige, ery thin- to thick-bedded, typically parallel-bedded and laminated, some osslamination, locally stromatolitic, may include molar-tooth structure; minor shale: dark grey, weathers grey or brown, fissile, occurs as partings or very thin interbeds with limestone. Stone Knife Formation, middle part: shale: variably calcareous, brick red or

ght green fresh and weathered surfaces, fissile, abundant concretions; lime udstone: grey or greenish-grey, weathers light greenish-grey, very in-bedded, nodular, interbedded with shale. Oodo Creek and lower Stone Knife formations: Dodo Creek Formation: shale and siltstone: dark grey, lesser red or green, synaeresis cracks common: nterbedded with sandstone: quartz arenite, slightly micaceous, cream, grey, brown, or red, thin- to medium-bedded, parallel-bedded and crosslaminated and dolomudstone; locally calcareous, dark grey, weathers grey or orange. thin- to medium-bedded, locally intraclast-bearing. Overlain by lower part of Stone Knife Formation: limestone: lime mudstone to dolomudstone, medium to

dark grey, weathers lighter shades of grey, beige, or orange,

parallel-laminated, intraclast-bearing, molar-tooth structure, and locally

stromatolite bioherm at top of unit. Combined unit is semirecessive.

stromatolitic; interbedded with minor shale: dark grey to black. Unit includes a

noticeable orange oncolite at base of unit and a locally prominent light grey

Some geographic names on this map are not official.

Mean magnetic declination 2014, 22°34'E, decreasing 29' annually. Readings vary from 22°42'E in the NW corner of the map to 22°25'E in the SE corner of the map.

information from users.

Data may include additional features not portrayed on this map. See documentation accompanying the data. Additional references are included in the map information documen This publication is available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/).

Katherine Group (Eduni, Tawu, Grafe River, Etagochile, **Shattered Range, McClure, and Abraham Plains formations)**

Abraham Plains Formation: sandstone: quartz arenite, hematitic, cream to brown, light grey, orange, pink, or maroon, thin- to very thick-bedded, well cemented, parallel-bedded and crossbedded, crosslaminated, ripple marks, rip-up clasts; interbedded with minor conglomerate: granule to pebble, white to orange-brown, pink, red, or purple, massive to crossbedded; and siltstone: locally shaly or micaceous, maroon or green, very thin-bedded, and

crosslaminated. McClure Formation: shale: locally dolomitic or silty, grey, rusty-brown, green, and maroon, fissile, desiccation cracks; interbedded with dolostone: commonly cherty, silty, or sandy, medium grey, weathers to orange or orange-brown, very thin- to thick-bedded, typically stromatolitic, pisolitic, oolitic, intraclast-bearing, and parallel- or crosslaminated; and sandstone: lithic wacke to quartz arenite, can be micaceous, hematitic, or dolomitic, cream to brown, grey, red, or purple, very thin- to medium-bedded, crosslaminated, ripple marks, rip-up

clasts, sole marks, and desiccation cracks. Katherine Group, lower part: Eduni, Tawu, Grafe River, Etagochile, and Shattered Range formations: sandstone: quartz arenite, locally hematitic or micaceous, locally conglomeratic, white to light grey, pink, brown, or orange very thin- to very thick-bedded, well cemented, parallel- and crossbedded ripple marks, rip-up clasts, and desiccation cracks; interbedded with minor shale: silty, greenish-grey to pink or red, fissile, desiccation cracks; and dolomudstone: may be calcareous, grey to orange or red, medium-bedded, parallel-laminated, and intraclast-bearing. Shale and carbonate dominate in the Tawu and Etagochile formations.

Tsezotene Formation: shale: micaceous, silty in places, grey, maroon, or green, fissile, minor desiccation cracks; interbedded with sandstone: lithic wacke to quartz arenite, micaceous, locally conglomeratic, varicoloured, typically weathers brown or orange-brown, thin- to thick-bedded, parallel-bedded, crossbedded, and crosslaminated, rip-up clasts, ripple marks; minor dolostone: dolomudstone to dolograinstone, calcareous, grey to greenish-grey, weathers beige to orange-brown, thin- to thick-bedded, laminated, minor salt casts and ooids

Tabasco Formation: dolostone: cherty, light grey, weathers light grey to orange, very thick-bedded, stromatolitic, intraclast-bearing, minor quartz sand

Geological contact / Approximate

/ Inferred Concealed Nomenclature or mapping precision change

Marker bed, Etagochile Formation Marker bed, Tawu Formation Marker bed, Tsezotene Formation limestone

Drift contact Defined / Approximate

Fault, motion undefined — Defined ———· Approximate Normal fault, symbol on hanging-wall side

— — — · Approximate ----- Inferred ····· Concealed Reverse fault, symbol on hanging-wall side

_____ Defined

____ Defined

Concealed Thrust fault, symbol on hanging-wall side ■ Defined

— → — · Approximate --▼--- Inferred ···· T Concealed Anticline, upright ______ Defined

> — ↑ — — · Approximate ··---- Concealed Syncline, uprigh ______ Defined — ▼ — — · Approximate Concealed

Inclined syncline, upright, shorter arrow on steeper limb ______ Defined

> Defined Monocline, anticlinal bend, shorter arrow on steeper limb _______ Defined

Anticline, overturned

— ↓ — — · Approximate ····‡····· Concealed Monocline, synclinal bend, shorter arrow on steeper limb ______ Defined — † — — · Approximate

X Visited outcrop, no measurements Outcrop observed remotely from ground or air Bedding strike and dip, inclined, upright Evidence for younging direction known

> Evidence for younging direction known, estimated measurement No evidence for younging direction Bedding strike and dip, inclined, overturned

Evidence for younging direction known MQ-37 Measured stratigraphic section with name of section

The authors have updated and revised map unit terminology from the Operation Norman map (Aitken et al., 1974). In general, terminology for Cambrian units is that of Dixon and Stasiuk (1998) with modifications by Fallas and MacNaughton (2012), and Silurian to Devonian usage follows that of Morrow (1991). Neoproterozoic to Ordovician units have recently undergone revision to their terminology, as outlined below.

Recent stratigraphic work in the Mackenzie Mountains has formalized the Mackenzie Mountains Supergroup and revised its formation-level nomenclature. The oldest exposed unit, previously the H1 unit of Aitken and Cook (1974), has since been defined as the Tabasco Formation (Turner and Long, 2012). No revisions have been applied to the overlying Tsezotene Formation. Within the Katherine Group, the Eduni, Tawu, Grafe River, Etagochile, and Shattered Range formations of Long and Turner (2012) correspond to the lower part of the Katherine Group as shown on the GSC maps for Carcaiou Canvon (Aitken et al., 1974), and to the K1 to K5 divisions of Aitken et al. (1978) and Long et al. (2008). Delineation of these new formations depends on the ability to recognize the recessive Tawu and Etagochile formations. These formations are poorly exposed in the mapping area and so the five lower formations of the Katherine Group were grouped during mapping. The McClure and Abraham Plains formations correspond to the upper Katherine Group on the Carcajou Canyon map (Aitken et al., 1974), and to the K6 and K7 divisions of Aitken et al. (1978) and Long et al. (2008).

The Little Dal Group previously was mapped in this region as two units: H5, and Little Dal Formation (Aitken et al. 1974). Regionally, those two units were reorganized into seven informal units of formation scale by Aitken (1981). In the present mapping area, Aitken's terminology can be applied as follows: the lower part of H5 corresponds to the 'Mudcracked formation'; the upper part of H5 and the Little Dal Formation correspond to the 'Basinal assemblage'. Most recently, Turner and Long (2012) have formalized the internal stratigraphy of the Little Dal Group. Their nomenclature applies as follows to the present study area: the Mudcracked formation is now the Dodo Creek Formation: the Basinal Assemblage is now the Stone Knife Formation, consisting of four informal members (1, 2, 3, and 4). In the present series of maps the Dodo Creek Formation and the lower Stone Knife Formation (equivalent to its member 1) have been combined due to similarity of weathering profile and colour. Our middle Stone Knife Formation corresponds to the lower part of member 2 (typically a bright red shale in this area), and the upper Stone Knife Formation encompasses the upper part of member 2 (carbonate-dominated). Turner and Long (2012) have also formalized the 'Grainstone formation', 'Gypsum formation', and 'Rusty Shale ormation' as the Gayna Formation, Ten Stone Formation, and Snail Spring Formation,

Previous work by the Geological Survey of Canada in southwest Carcajou Canyon map area (Aitken and Cook, 1974) subdivided the Cambro-Ordovician Franklin Mountain Formation into four informal units. In ascending order they are: Basal red beds, Cyclic member, Rhythmic member, and Cherty member (Norford and Macqueen, 1975). The present work separates the basal red beds from the Franklin Mountain Formation and applies the term Nainlin Formation to this shale- and sandstone-dominated unit (MacNaughton and Fallas, in press). Field relationships suggest the Nainlin Formation is laterally equivalent to the evaporitic Saline River Formation For the remaining carbonate-dominated members of the Franklin Mountain Formation, the older unit names correspond, in ascending order, to informal lower, middle, and upper members. These also correspond to the units 1, 2, and 3 of the Franklin Mountain Formation described by Turner (2011).

respectively. Each of these units is exposed in the extreme southwest corner of this map area.

Although the Devonian Hare Indian and Canol formations (Aitken and Cook, 1974) can be distinguished in some well exposed sections, at the map scale these recessive, shaledominated units are combined and the name Horn River Group is applied.

Comparison with recent mapping in the Wrigley Lake map area (NTS 95-M) by Fallas et al. (2011) shows some discrepancies in the location of map unit contacts, as well as changes in terminology along the boundary between the Carcajou Canyon and Wrigley Lake maps. In the absence of direct observations along the northern edge of Wrigley Lake map area, Fallas et al. (2011) relied upon the original interpretations of Gabrielse et al. (1973), which accounts for most differences in contact positions and some stratigraphic differences. The changes to the terminology of the Katherine and Little Dal groups across the map boundary are outlined above. with older informal terms being used on the Wrigley Lake map area (Fallas et al., 2011). Strata equivalent to the Nainlin Formation were not recognized in the Wrigley Lake area by Fallas et al. (2011) or by Gabrielse et al. (1973). Southward from Carcajou Canyon map area, Franklin Mountain Formation passes laterally into Broken Skull Formation, Bear Rock Formation correlates with Arnica and/or Landry formations, and Hume correlates with Headless and Nahanni formations. Tsetso Formation is locally recognized in both map areas. It is equivalent to the Delorme Formation of Gabrielse et al. (1973), which was raised to Group status by Morrow

For detailed information on surficial deposits, here shown as "Quaternary sediment", see Duk-Rodkin and Hughes (2002).

The name Bolstead anticline has been introduced to facilitate future discussion of this structural feature. The names Canvon Fault. Nainlin Fault. Conundrum Fault. Foran syncline. Tawu anticline. Bolstead syncline, and Tigonankweine anticline have been incorporated from the older Carcajou Canyon map (Aitken et al., 1974). The geology of this map area is dominated by Cordilleran folds and associated contractional faults. Tigonankweine, Bolstead, and Tawu anticlines are cored by Neoproterozoic Katherine Group strata, with Little Dal Group locally preserved on the flanks and Paleozoic strata preserved in the intervening synclines. Oblique to the northwest-trending Cordilleran structures are north-northwest-trending extensional faults crosscutting Neoproterozoic and Cambrian strata. Some of these faults were reactivated during Cordilleran deformation, resulting in changes in the amount and sense of offset along strike. The Conundrum Fault is a good example of this phenomenon with west-side-down offset at the south end and west-side-up offset to the north where it links with a Cordilleran thrust fault.

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