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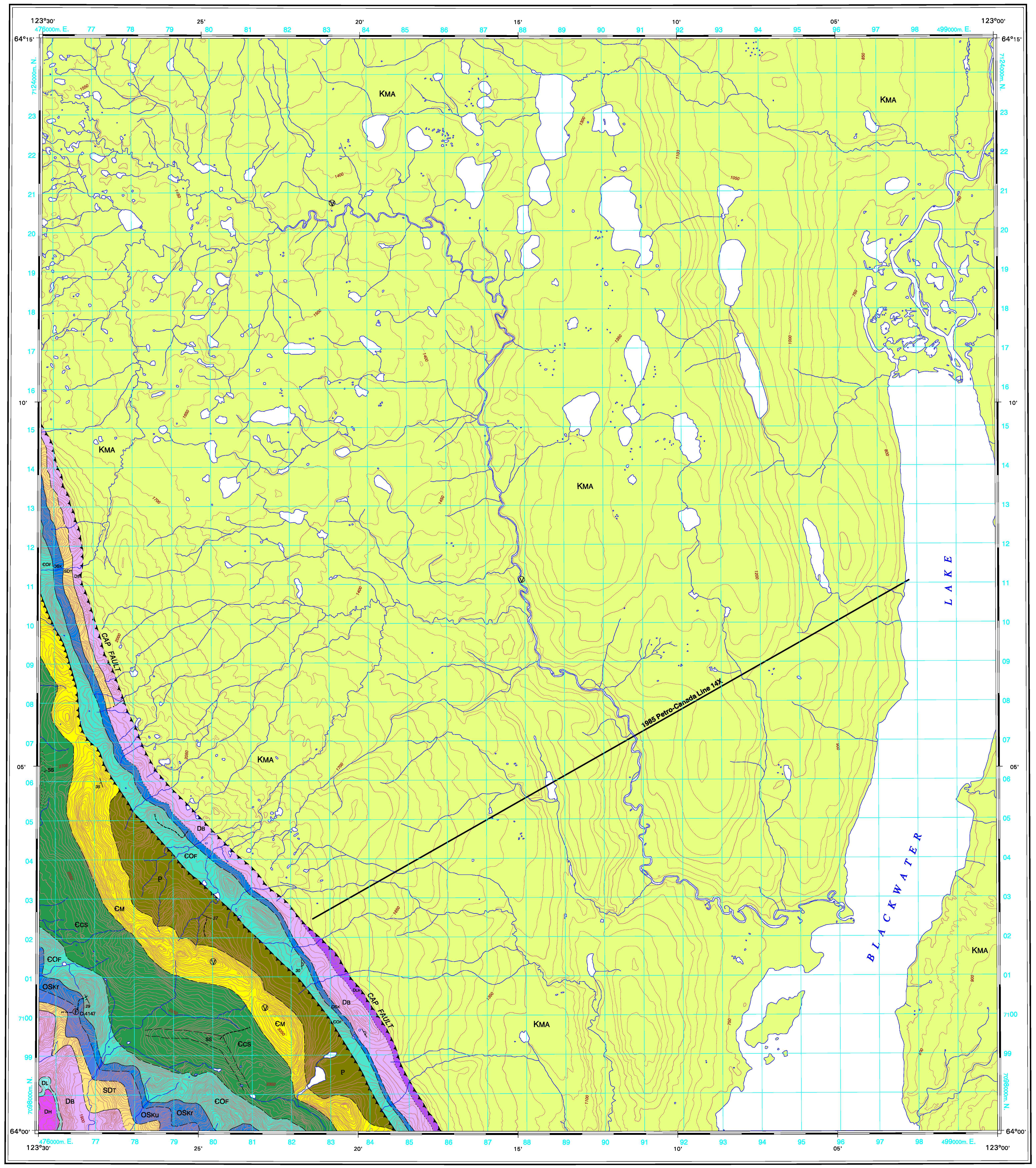

LEGEND

Note: Legend also relates to other maps in a series.

Coloured legend boxes indicate map-units that appear on this map.

UPPER CRETACEOUS AND TERTIARY
Summit Creek Formation
KTS — Sandstone; conglomerate; shale.

LOWER AND UPPER CRETACEOUS
Martin House, Arctic Red, Slater River, Little Bear, and East Fork formations
KME — Sandstone; conglomerate; shale.

UPPER CRETACEOUS
Slater River, Little Bear, and East Fork formations
KSE — Shale and sandstone. May include Summit Creek Formation.

LOWER CRETACEOUS
Martin House and Arctic Red formations
KMA — Sandstone; siltstone; shale.

CRETACEOUS AND TERTIARY
Martin House, Arctic Red, Slater River, Little Bear, East Fork, and Summit Creek formations
KTMS — Sandstone; conglomerate; shale.

MIDDLE DEVONIAN
Hare Indian Formation
DHI — Shale, grey.

Hume Formation
DH — Limestone, fossiliferous; minor shale.

LOWER DEVONIAN
Landry Formation
DL — Limestone, dark grey, alternating thick- and thin-bedded, ribbed appearance.

Bear Rock Formation
DB — Limestone breccia. May include Tsetso Formation locally at base.

LOWER AND MIDDLE DEVONIAN
Landry and Hume formations
DLH — Limestone; minor shale.

LOWER AND MIDDLE DEVONIAN
Bear Rock, Landry, and Hume formations
DBH — Limestone; limestone breccia; minor shale.

SILURIAN AND DEVONIAN
Tsetso Formation
SDT — Dolomite, partly sandy or argillaceous; sandstone, dolomitic.

SILURIAN AND DEVONIAN
Tsetso and Bear Rock formations
SDTB — Sandstone; minor shale; dolomite; limestone breccia.

ORDOVICIAN, SILURIAN, AND DEVONIAN
Mount Kindle, Tsetso, Bear Rock, Landry, and Hume formations
ODKH — Limestone; limestone breccia; dolomite; sandstone; minor shale.

UPPER ORDOVICIAN AND LOWER SILURIAN
Mount Kindle Formation
OSK — Dolomite; fossiliferous, siliceous; minor chert.

Upper member
OSKu — Dolomite, alternating dark grey and light grey weathering.

Basal and Resistant members
OSKr — Dolomite, dark grey weathering, (Resistant member); dolomite, argillaceous, rescessive (Basal member).

UPPER CAMBRIAN AND LOWER ORDOVICIAN
Franklin Mountain Formation
ЄOF — Dolomite, argillaceous; chert; minor flat-pebble conglomerate.

Cherty member
ЄOFch — Dolomite, with silicified stromatolites, drusy quartz; chert.

ЄOFr | ЄOFrl — **Rhythmic member** (ЄOFr)
Dolomite, alternating greyish brown weathering, fine- to medium-crystalline, and greyish orange weathering, very fine-crystalline.
Rhythmic member (limestone facies) (ЄOFrl)
Limestone.

ЄOFc | ЄOFcl — **Cyclic member** (ЄOFc)
Dolomite, shaly, stromatolitic, alternating argillaceous and very fine-crystalline; minor flat-pebble conglomerate.
Cyclic member (limestone facies) (ЄOFcl)
Limestone, shaly.

CAMBRIAN, ORDOVICIAN
Franklin Mountain and Mount Kindle formations
ЄOFK — Dolomite; chert.

UPPER CAMBRIAN
Saline River Formation
ЄS — Shale, siltstone, sandstone, red; anhydrite; gypsum; dolomite.

LOWER AND MIDDLE CAMBRIAN
Mount Cap Formation
ЄC — Shale; limestone, thin-bedded; sandstone; siltstone.

CAMBRIAN
Mount Cap and Saline River formations
ЄCS — Shale; limestone, thin-bedded; siltstone; quartz sandstone; anhydrite; gypsum; dolomite.

LOWER CAMBRIAN
Mount Clark Formation
ЄM — Quartz sandstone, white.

PROTEROZOIC
Unnamed
P — Shale, siltstone, dark grey; possibly equivalent to part of Mackenzie Mountains Supergroup.

Geological boundary (defined, approximate, assumed)
Nomenclature change, limit of formation differentiation
Bedding (upright, overturned) 20 20
Bedding, from aerial photographs or estimated from aircraft (overturned)
Ground observation (mapping station)
Fossil locality (GSC catalogue number) C-4147
Traverse
Thrust fault (defined, approximate, assumed; teeth on up thrust side)
Mappable sandstone (approximate) SS
Migrated seismic line

Authors: D.G. Cook, D.W. Morrow and J.D. Aitken

Geological compilation by D.G. Cook (2005) based on studies of vertical aerial photographs and air and ground observations by J.D. Aitken (1969), D.G. Cook (1969, 2003, 2004) D.W. Morrow (2003, 2004) subsurface seismic and well studies by B.C. MacLean (2005)

Geological cartography by D. Nunez and S.D. Orzeck

Elevations in feet above mean sea level

Contour interval 50 feet

NOTES

Introduction

The McConnell Range, which occupies the southwest corner of Blackwater Lake North (NTS 96B/3), was previously mapped as part of Operation Norman, a regional, reconnaissance, helicopter-supported mapping program of the Geological Survey of Canada. The geology of this map area was published as part of the 1:250,000 scale Blackwater Lake sheet (Cook and Aitken, 1977). The McConnell Range in NTS 96 B and C was revisited by D.G. Cook and D.W. Morrow in 2003 and 2004 in order to improve our geological understanding of the range and its relationships to the plains area to the east and Mackenzie River valley to the west. The current re-mapping was carried out by helicopter traverses, scattered ground observations, and interpretation of aerial photographs. Approximate stratigraphic thicknesses presented here are estimated from map expression and measured dips where available.

Structure

Along the east flank of McConnell Range in Blackwater Lake North a large, unnamed, steeply dipping, east-verging thrust fault brings strata as old as Proterozoic to the surface. This fault is considered to correspond to an unnamed thrust fault mapped by Douglas and Norris (1974) in the core of the frontal anticline in the Wrigley map area (NTS 95O) immediately to the south. Anticlinal and homoclinal culminations occur regionally along the hanging wall of the large thrust. One such culmination, dominating the structure in this map area, is cored by Proterozoic strata. The footwall of the thrust is occupied by steeply eastward-dipping, locally overturned Paleozoic formations that we interpret to be underlain by a subsidiary thrust, a footwall splay from the main thrust. The inferred fault is considered to be the northwestward extension of Cap Fault, interpreted by Douglas and Norris (1974) in the adjoining Wrigley map area (NTS 95O) to the south. The subsidiary thrust is nowhere exposed. Support for the thrust interpretation is provided by Petro-Canada Seismic Line 14X. Subhorizontal strata imaged at the western end of the line are structurally discordant to the closely proximate, outcropping, steeply dipping to overturned Paleozoic carbonate rocks. That discordance is resolved if the steeply dipping panel is underlain by a thrust fault. Cretaceous strata occur in the subsurface of the plains to the east and are assumed to be in fault contact with Paleozoic rocks along the full length of Cap Fault in Blackwater Lake North map area.

Stratigraphy

The oldest rocks exposed in Blackwater Lake North are unnamed shale and siltstone with minor sandstone, estimated to be greater than 600 m thick. They underlie Lower Cambrian sandstone of the Mount Clark Formation, and comprise the farthest north occurrence of observed Proterozoic outcrop in the McConnell Range. These strata probably correlate in general with Proterozoic rocks exposed in Cap Mountain, about 65 km to the south. Their age within the Neoproterozoic is problematical. The section at Cap Mountain was considered (Villeneuve et al., 1998) to belong to Sequence B of Young et al. (1979) based primarily on the presence of 'Grenville-age' detrital zircons (ca. 1 Ga). If so, they correlate approximately with the Mackenzie Mountains Supergroup exposed in the Mackenzie Mountains to the west. The Sequence B assignment, however, may have been premature considering that Grenville-age detrital zircons have subsequently been reported (Ross et al., 2005) from the much younger Hyland Group (Sequence C) in Yukon and Alaska. Furthermore, a sandstone sample from NTS 96 B/3 yielded detrital zircons (V. McNicoll, pers. comm., 2006), including a number with 'Grenville' ages and interestingly, a single grain that was analyzed to be 769 Ma. The single grain has great significance because if its younger age is verified, the Proterozoic strata in NTS 96 B/3, and presumably those in Cap Mountain, would correlate with some part of the Windermere Supergroup or younger strata. Windermere equivalents have not previously been identified east of the Mackenzie Mountains.

Samuelsson and Butterfield (2001) reported Neoproterozic fossils from the Lone Land Formation at Mount Cap and from the Shell Blackwater Lake G-52 well (located about 6 km east of Blackwater Lake). The Lone Land fauna concur with the detrital zircon data from underlying units but do not help in further constraining its age (Sequence B versus C). The fossil assemblage from the G-52 well is distinct from that of the Lone Land Formation, and has a marked similarity to assemblages from the Wynniat Formation on Victoria Island (Shaler Supergroup, i.e. Sequence B). Regarding a potential correlation of the Lone Land Formation at Cap Mountain with Neoproterozoic rocks in G-52, Samuelsson and Butterfield (2001, p. 244) note, "A consideration of the thermal alteration of the two assemblages of organic-walled fossils argues strongly against any direct correlation the brown colour of the Lone Land fossils (Thermal Alteration Index ~ 3) document a fundamentally more intense burial/tectonic history than the Neoproterozoic strata at G-52 (medium orange fossils with a TAI ~2)".

The Proterozoic strata are overlain by perhaps 350 m of white, medium-grained, silica-cemented quartz sandstone of the Lower Cambrian Mount Clark Formation. Aitken et al. (1973) reported a thickness of greater than 218 m at Cap Mountain about 70 km to the south. A Phanerozoic age was confirmed during 2004 fieldwork by the discovery of the trace fossil *Skolithos* (common in Lower Cambrian sandstones). *Skolithos* occurs in the Mount Clark Formation at Cap Mountain (Aitken et al., 1973). The paraconformable contact with underlying Proterozoic units is poorly exposed but is known from regional relationships to be an unconformity. The contact is an angular unconformity at Cap Mountain (Aitken et al., 1973).

The Mount Clark is conformably overlain by about 850 m of undivided Mount Cap and Saline River formations, which occur as a poorly exposed recessive interval. The best exposure of Mount Cap occurs in a prominent ridge in the southern part of the map area where it is composed of shale, silty dolomite, and platy limestone. A prominent rib of white, locally rusty, quartz sandstone forms the top of the ridge. Similar resistant sandstone outcrops, shown as 'mappable sandstone', occur sporadically along the recessive Mount CapSaline River interval in map areas to the west and northwest (Cook et al., 2007a,b). It is not known whether or not they represent a single sandstone unit near the top of the Mount Cap, but the discontinuous topographic expression suggests that the unit itself may be discontinuous. The Saline River Formation may not occur in this map area because characteristic pink-weathering beds were nowhere observed at or near the base of the overlying Franklin Mountain Formation.

The Franklin Mountain Formation, estimated to be about 570 m thick, is composed of cliff-forming, well-bedded, platformal dolomite. Exposures mostly represent the Rhythmic member (Rhythmic unit of Norford and Macqueen, 1975). The basal Cyclic member (Cyclic unit of Norford and Macqueen, ibid.) is probably present but was not identified at cliff base. The uppermost, distinctive Cherty member (Cherty unit of Norford and Macqueen, ibid.) was not identified in this map area and is probably missing as a result of erosional truncation at the base of the overlying Mount Kindle Formation.

Historically, Macqueen (1970) subdivided the Franklin Mountain Formation into the Cyclic unit, Rhythmic unit, and Cherty unit. The cyclic, rhythmic, and cherty terminology has since been variously and inconsistently applied. Aitken and Cook (1974 and elsewhere), called the units "Cyclic" member, "Rhythmic" member, and "Cherty" member. Norford and Macqueen (1975) applied Macqueen's original Cyclic, Rhythmic, and Cherty units. In the Lexicon of Canadian Stratigraphy, Volume 2 (Hills et al.,1981) they are "Cyclic" unit, "Rhythmic" unit, and "Cherty" unit. In subsurface studies Pugh (1993), and Morrow (1999), for example, used Cyclic member, Rhythmic member, and Cherty member. In choosing Franklin Mountain Formation terminology for this and related maps we observe a) that these are informal mappable members, b) The North American Stratigraphic Code, Article 30 (A.A.P.G. 1983) precludes capitalizing all words in an informal name, and c) historically the descriptive terms Cyclic, Rhythmic, and Cherty have been consistently capitalized. Accordingly, we follow Pugh (1993) and Morrow (1999) and use Cyclic member, Rhythmic member, and Cherty member.

The Mount Kindle Formation is estimated to be at least 300 m thick along the west limb of the frontal anticline. The lowermost beds are a recessive interval of pink to buff weathering, argillaceous and silty, thin-bedded, platy dolomite, considered to represent the recessive Basal member of Norford and Macqueen (1975). The Basal member occurs in wells in the adjacent subsurface (Pugh, 1993) and presumably occurs everywhere in this map area. However, it was observed only in one ground traverse and is not carried as a mappable unit. The Basal member is overlain by dark brownish grey weathering fine- to medium-crystalline dolomite characterized by silicified halysitid, favositid and solitary corals and orthoconic cephalapods. This dark brown cliff-forming unit, assigned to the Resistant member of Norford and Macqueen (1975) is readily differentiated from the underlying light grey weathering Franklin Mountain Formation. The Basal and Resistant members combined are estimated to be about 100 m thick. The Resistant member is overlain by a distinctive banded unit, about 200 m thick, of alternating dark grey and light grey weathering dolomite assigned to the Upper member of Norford and Macqueen (1975). The member is fossiliferous, particularly the darker beds, and particularly in the lower part. The light grey intervals tend to be shaly and thin bedded and consequently the member in total is more recessive than the underlying Resistant member. To the east in the steeply dipping to overturned panel underlain by Cap Fault, the Upper member was not identified and the Mount Kindle is carried there as an undivided unit. As mapped, the Mount Kindle, in this footwall panel, appears to be too thin, particularly in the southern part of the trend. Better ground control in the future may see revisions to the map in that area.

The Tsetso Formation (Meijer-Drees, 1993), about 150 m thick, is buff weathering, silty, sandy and shaly dolomite occupying a recessive, mostly covered interval. The recessive nature renders picking the contact with the underlying Mount Kindle Formation difficult. The contact is known to be an unconformity regionally. On air photo interpretation the contact is placed at the top of the dark- and light-banded interval representing the 'Upper member' of the Mount Kindle.

The Bear Rock Formation (Morrow, 1991), conformably overlying the Tsetso, comprises an oligomictic limestone dissolution particulate rubble breccia about 500 m thick. The breccia is massive bedded to nonbedded and forms a structurally homogeneous unit readily identified from the air or on air photos.

The Bear Rock is capped by the Landry Formation, composed of alternating thin- and thick-bedded limestone (dominantly unfossiliferous pelletal packstone) about 20 m thick, which is overlain in turn by argillaceous and fossiliferous limestone (containing crinoids, corals and brachiopods) of the Hume Formation (Morrow, 1991).

In this map area the plains to the east of McConnell Range are underlain by Cretaceous strata, an undivided succession of sandstone and shale of the lower Cretaceous Martin House and Arctic Red formations (Dixon, 1999). The contact with Paleozoic strata is nowhere exposed and is interpreted as a fault contact.

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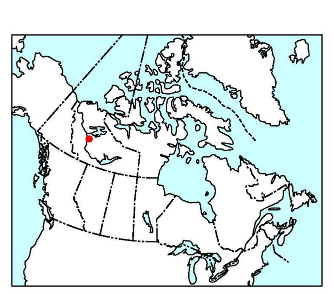

LOCATION MAP

OPEN FILE 5334

GEOLOGY

BLACKWATER LAKE NORTH

NORTHWEST TERRITORIES

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilomètres

Universal Transverse Mercator Projection

Projection transverse universelle de Mercator

96 B/5 TWIN FISH LAKE OF 5336	96 B/6 KODAKIN CREEK	96 B/7 WATER LILY LAKE
96 B/4 TWIN PEAKS OF 5335	96 B/3 BLACKWATER LAKE NORTH OF 5334	96 B/2 MODESTE CREEK
95-O/13 BLACKWATER RIVER	95-O/14 BLACKWATER LAKE	95-O/15 NOTSEGLEE LAKE

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2007

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Recommended citation:
Cook, D.G., Morrow, D.W., and Aitken, J.D.
2007: Geology, Blackwater Lake North, Northwest Territories; Geological Survey of Canada, Open File 5334, scale 1:50 000.

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