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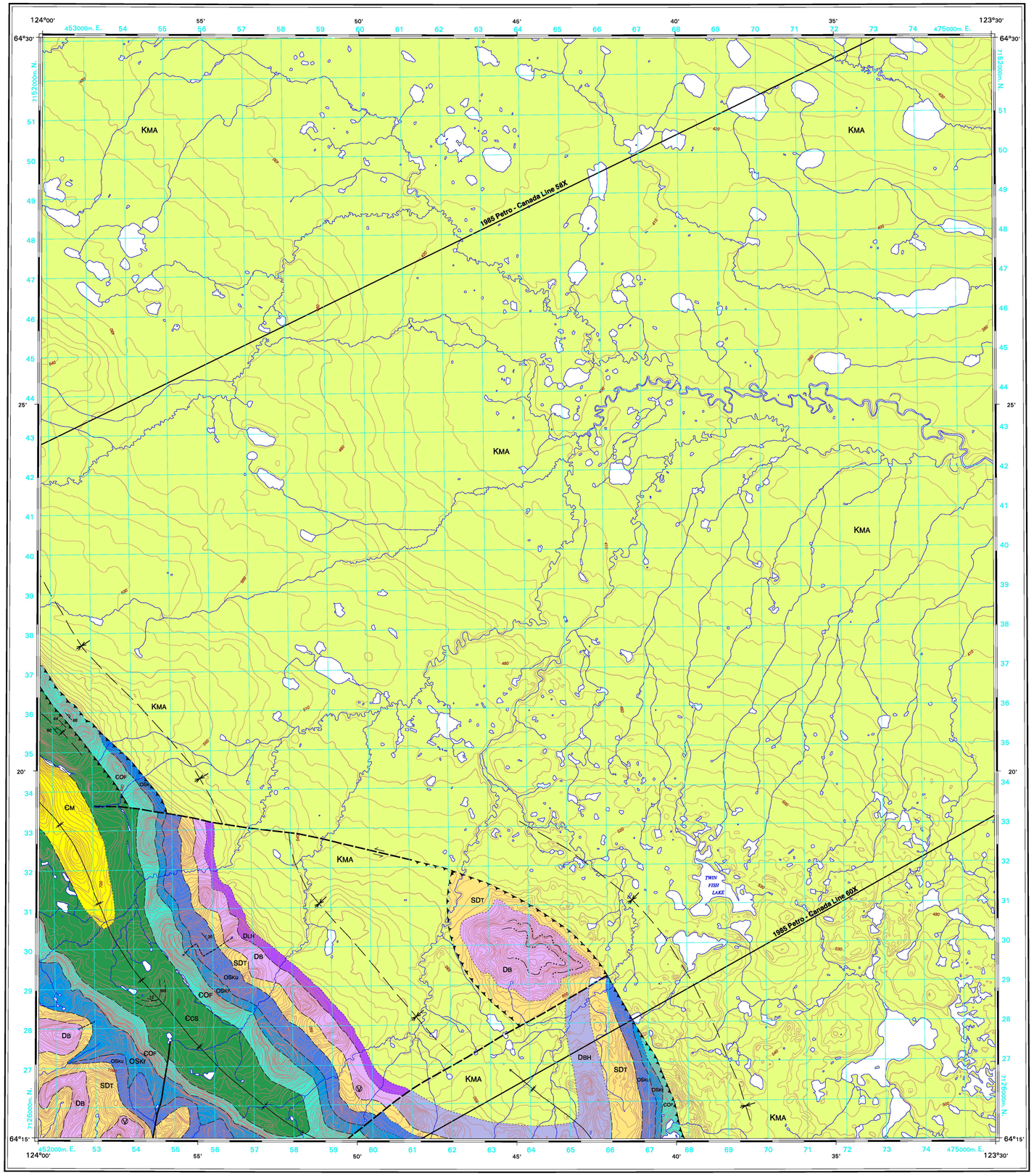

OPEN FILE 5336

GEOLOGY

TWIN FISH LAKE

NORTHWEST TERRITORIES

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilometres

Universal Transverse Mercator Projection
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Projection transverse universelle de Mercator
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LOCATION MAP

96 C/9	96 B/12	96 B/11
96 C/8 SALINE RIVER	96 B/5 TWIN FISH LAKE OF 5336	96 B/6 KODAKIN CREEK
95 C/1 BIRCH ISLAND	96 B/4 TWIN PEAKS OF 5335	96 B/3 BLACKWATER LAKE NORTH OF 5334

NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

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.

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.

SILURIAN AND DEVONIAN
Tsetso Formation

SDT — Dolomite, partly sandy or argillaceous; sandstone, dolomitic.

UPPER ORDOVICIAN AND LOWER SILURIAN
Mount Kindle Formation

OSK — Dolomite; fossilliferous, 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, recessive (Basal member).

UPPER CAMBRIAN AND LOWER ORDOVICIAN
Franklin Mountain Formation

ĆOF — Dolomite, argillaceous; chert; minor flat-pebble conglomerate.

Cherty member

ĆOFch — Dolomite, with silicified stromatolites, drusy quartz; chert.

Rhythmic member (ĆOFr)
Dolomite, alternating greyish brown weathering, fine- to medium-crystalline, and greyish orange weathering, very fine-crystalline.
Rhythmic member (limestone facies) (ĆOFri)
Limestone.

Cyclic member (ĆOFc)
Dolomite, shaly, stromatolitic, alternating argillaceous and very fine-crystalline; minor flat-pebble conglomerate.
Cyclic member (limestone facies) (ĆOFci)
Limestone, shaly.

UPPER CAMBRIAN
Saline River Formation

Ćs — Shale, siltstone, sandstone, red; anhydrite; gypsum; dolomite.

LOWER AND MIDDLE CAMBRIAN
Mount Cap Formation

Ćc — Shale; limestone, thin-bedded; sandstone; siltstone.

LOWER CAMBRIAN
Mount Clark Formation

ĆM — Quartz sandstone, white.

PROTEROZOIC
Unnamed

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

CRETACEOUS AND TERTIARY
Martin House, Arctic Red, Slater River, Little Bear, East Fork, and Summit Creek formations

KTMS — Sandstone; conglomerate; shale.

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 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.

CAMBRIAN, ORDOVICIAN
Franklin Mountain and Mount Kindle formations

ĆOFK — Dolomite; chert.

CAMBRIAN
Mount Cap and Saline River formations

ĆCS — Shale; limestone, thin-bedded; siltstone; quartz sandstone; anhydrite; gypsum; dolomite.

Geological boundary (defined, approximate, assumed)
Stratigraphic marker
Bedding (upright, overturned) 20 80
Ground observation (mapping station) V
Traverse
Thrust fault (approximate, assumed; teeth on up thrust side)
Fault, with strike slip component (assumed)
Fault, sense of displacement unknown (defined, assumed)
Anticline, trace of axial plane (defined, approximate) arrow indicates plunge
Syncline, trace of axial plane (defined, approximate) arrow indicates plunge
Syncline, strongly asymmetrical (short arrow on steeper limb; approximate)
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 Twin Fish Lake map area (NTS 96B/5) was previously mapped as part of Operation Norman, a regional, reconnaissance, helicopter-supported mapping program of the Geological Survey of Canada. The geology of Twin Fish Lake was published as part of the 1:250 000 scale Blackwater Lake sheet (Cook and Aitken, 1977). That part of the McConnell Range occurring in NTS 96B 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. The user should be aware that 'assumed' contacts are very subjective. Approximate stratigraphic thicknesses presented here are estimated from map expression and measured dips where available.

Structure

The McConnell Range deformation front in Twin Fish Lake, 96 B/5 is complex. An anticline–syncline pair in the southwest part of the map area seems to be bounded on the east by a thrust fault that places Paleozoic strata onto assumed Cretaceous strata. That thrust fault is considered to be a splay from a hypothesized deep detachment underlying the anticline, an interpretation based on equivocal data from a seismic line, 1985 Petro-Canada Line 60X, which crosses the syncline. The thrust plate carrying the syncline is complicated because it is apparently cut by a northeast-trending transverse fault. A westward-dipping panel of Franklin Mountain, Mount Kindle, and Tsetso formations south of the inferred fault is structurally incompatible with a plateau of flat-lying Bear Rock Formation to the north. The required fault is interpreted to be a tear fault extending across the syncline and developed within the thrust plate. Development of the tear fault would have permitted independent growth of structures north and south of the fault. Because the west flank of the plateau is overburden covered, interpreting the structure is problematical. In the map portrayal, the flat-lying beds in the plateau are interpreted to occur in a 'pop-up' structure bounded by the east-verging sole thrust and, on the west by a subsidiary, conjugate, west-verging thrust. Stratigraphy in the 'pop-up' is poorly controlled. No landing was possible on the plateau and the Bear Rock Formation was tentatively identified from the air. Tsetso Formation, interpreted to underlie the Bear Rock Formation, was not observed. Clearly, interpretations other than the 'pop-up'are possible. Regardless of the stratigraphic and structural details a transverse fault is required by the contrasting west-dipping versus flat-lying beds on opposite sides the fault. The broad syncline with its inherent complexities comprises the eastern component of an anticline–syncline pair. The western limb of the syncline, coinciding with the eastern limb of the frontal anticline, displays an unfaulted Paleozoic section that terminates abruptly northwestward at an eastsoutheast-trending transverse fault. We interpret the transverse fault as extending across the syncline and connecting with the thrust fault underlying the syncline. Thus the synclinally folded thrust plate is bounded on the north by the transverse fault. As the fault curves to the south, strikeslip movement becomes dipslip movement. At the mountain front proper, the structure changes abruptly across the transverse fault. The simple, east-dipping, unfaulted, west limb of the syncline lies south of the fault, whereas on the north side the structure is that of a thrust fault carrying Mount Cap Formation in its hanging wall and having an overturned panel of Franklin Mountain and Mount Kindle formations in its footwall. We interpret the overturned panel to be underlain by a subsidiary fault, a footwall splay from the main fault. That interpretation is supported by seismic data on 1985 Petro-Canada line 58X where it crosses the range-front in the adjacent map area, Saline River 96C/8. Northward, the pair of faults comprise the McConnell Range frontal structure, similar in structural geometry to the range-front in Twin Peaks, 96 B/4 and Blackwater Lake North, 96 B/3 (Cook et al., 2007 a, b). Thus, the fault-bounded syncline comprises a displacement transfer structure providing an en échelon shift to the west of the frontal thrust-faulted anticline.

Stratigraphy

The oldest strata in the map area are composed of the white, medium-grained, silica-cemented quartz sandstone of the Mount Clark Formation, occurring in a culmination in the frontal anticline. The base of the formation is not exposed. Aitken et al. (1973) reported a thickness greater than 218 m at Cap Mountain, about 110 km to the south. The thickness based on exposures to the southeast in Blackwater Lake North, 96B/3, (Cook et al., 2007b) may be about 350 m. There, 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 contact with underlying Proterozoic strata is known from regional relationships to be an unconformity. It is an angular unconformity at Cap Mountain (Aitken et al., 1973).

The Mount Clark is conformably overlain by the undivided Mount Cap and Saline River formations, which occur as a recessive, mostly covered interval. Brown shale with thin sandstone beds are in thrust contact with overturned Franklin Mountain Formation near the west boundary of the map area. Down-plunge southward from the Mount Clark Formation anticlinal culmination an exposure of rusty quartz sandstone is shown as a 'mappable sandstone'. Similar resistant 'mappable sandstones' occur sporadically along the recessive Mount Cap/Saline River interval. They may represent a single sandstone unit near the top of the Mount Cap. Alternatively 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 is composed of cliff-forming, well-bedded platformal dolomite. It is estimated to be about 400 m thick along the east limb of the frontal anticline. 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, the Franklin Mountain Formation was subdivided into the Cyclic unit, Rhythmic unit, and Cherty unit (Macqueen, 1970). 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 unconformably overlies the Franklin Mountain Formation. In Twin Fish Lake, 96B/5, it is estimated to be a maximum of 250 m thick, thinning to about 100 m northwestward as a result of erosional truncation. At the type section on Mount Kindle, about 110 km to the south, the formation was subdivided by Norford and Macqueen (1975) into Basal, Resistant, and Upper members. In Twin Fish Lake map area the recessive Basal member was not noted. Along both limbs of the frontal anticline the Mount Kindle can be subdivided into the Resistant and Upper members. The Resistant member is a cliff-forming unit about 100 m thick comprising dark brownish grey weathering fine- to medium-crystalline dolomite characterized by silicified halysitid, favositid and solitary corals and orthoconic cephalapods. The Upper member is a distinctive banded unit, zero to about 150 m thick, of alternating dark grey and light grey weathering dolomite. 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. In the west limb of the frontal anticline the Upper member thins northwestward, apparently by erosional truncation at the overlying sub-Tsetso unconformity, and was not noted in the northwestern part of the west limb.

The Tsetso Formation (Meijer-Drees, 1993) is light yellow weathering, laminated, and platy dolomite, locally silty and/or sandy. The Tsetso and the upper beds of the Mount Kindle are recessive-weathering, rendering the contact difficult to pick, and it is everywhere mapped as 'approximate'. Correspondingly, the thickness of the Tsetso is difficult to estimate. The formation is 113 m thick in section MTA 03-3 about 20 km to the south in the west-central part of the Twin Peaks, 96B/4, map area.

The Bear Rock Formation (Morrow, 1991), conformably overlying the Tsetso, comprises an oligomictic limestone dissolution particulate rubble breccia. 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 about 220 m thick. The formation is tentatively mapped in a small plateau in the south-central part of the map area. No landing on the plateau was possible and the Bear Rock was identified from the helicopter. The 'Bear Rock' there, atypically has two, distinctive, resistant beds mapped as stratigraphic markers. These beds clearly define the subhorizontal bedding attitude. Problems inherent in interpreting structure relative to this plateau are discussed above under the heading 'Structure'.

The Bear Rock is capped by the Landry Formation, composed of alternating thin- and thick-bedded limestone, dominantly unfossiliferous pelletal packstone (Morrow, 1991). The Landry was not visited in this map area but was observed as a small, prominent cliff stratigraphically above the Bear Rock in a few places along the east limb of the frontal anticline. The Hume Formation, comprising argillaceous and fossilliferous limestone (containing crinoids, corals and brachiopods) normally overlies the Landry but was not identified in this map area. Along the east flank of the frontal anticline we assume that the Hume is present but not exposed and accordingly we carry a Landry/Hume undivided map unit.

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 underlying Paleozoic strata is nowhere exposed. We assume that Paleozoic formations as young as Landry and Hume are present everywhere along strike, but the possibility that some units are missing as a result of pre-Cretaceous erosion cannot be precluded.

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