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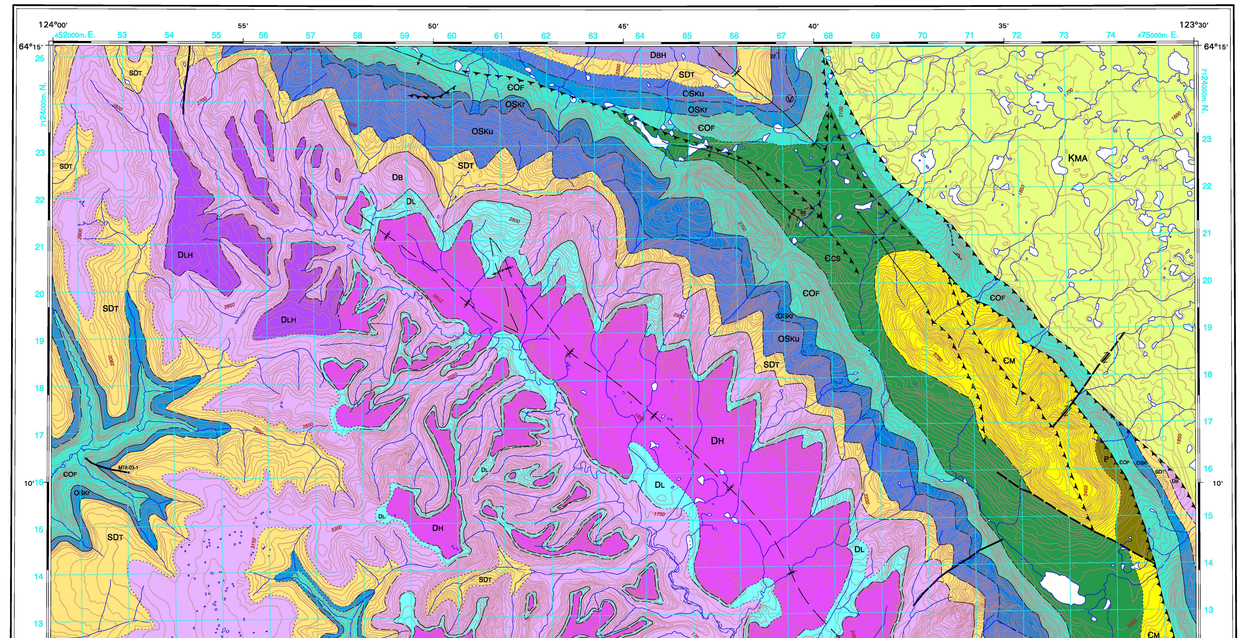

LEGEND

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.

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; 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

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

Cherty member

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

Rhythmic member (COFr)
COFr1 COFr2 — Dolomite, alternating greyish brown weathering, fine- to medium-crystalline, and greyish orange weathering, very fine-crystalline.
Rhythmic member (limestone facies) (COFr)
Limestone.

Cyclic member (COFc)
COFc1 COFc2 — Dolomite, shaly, stromatolitic, alternating argillaceous and very fine-crystalline; minor flat-pebble conglomerate.
Cyclic member (limestone facies) (COFc)
Limestone, shaly.

UPPER CAMBRIAN
Saline River Formation

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

LOWER AND MIDDLE CAMBRIAN
Mount Cap Formation

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

LOWER CAMBRIAN
Mount Clark Formation

CM — 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

COFK — Dolomite; chert.

CAMBRIAN
Mount Cap and Saline River formations

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

Geological boundary (defined, approximate, assumed)
Nomenclature change, limit of formation differentiation
Bedding (upright) 45
Bedding, from aerial photographs or estimated from aircraft (overturned)
Ground observation (mapping station)
Traverse
Measured stratigraphic section (D.W. Morrow)
Thrust fault (defined, approximate, assumed; teeth on up thrust side)
Fault, with strike slip component (defined, assumed)
Fault, sense of displacement unknown (defined, assumed)
Anticline, trace of axial plane (defined, approximate) arrow indicates plunge 35
Syncline, trace of axial plane (defined, approximate) arrow indicates plunge 35
Mappable sandstone (approximate) 35

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 (1958), 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 most of Twin Peaks map area, NTS 96B/4, 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 Peaks was published as part of the 1:250,000 scale Blackwater Lake sheet, NTS 96B, (Cook and Aitken, 1977). That part of the McConnell Range lying within 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. Two stratigraphic sections measured in this map area established the thickness of certain formations; otherwise approximate thicknesses presented here are estimated from map expression and measured dips where available. Strata are well exposed in the central part of the map area but are poorly exposed or unexposed in the southwestern and northeastern parts. The structure is simple enough that limited ground observations can be extrapolated long distances. However, the user should be aware that 'assumed' contacts are very subjective.

Structure

McConnell Range in Twin Peaks, 96B/4, comprises a broad upland of gently flexed strata bounded on the northeast by a large, unnamed, steeply dipping, east-verging thrust fault that brings Lower Cambrian and possibly Precambrian strata to the surface. Anticlinal and homoclinal culminations occur regionally along the hanging wall of the large thrust. One such anticlinal culmination, cored by Lower Cambrian Mount Clark Formation is prominent in the map area. The footwall of the thrust is occupied by steeply eastward-dipping, locally overturned Paleozoic formations that we interpret as being underlain by a subsidiary thrust, a footwall splay from the main thrust. The inferred fault extends into Twin Peaks map area from the adjoining Blackwater Lake North (Cook et al., 2007a) and is considered to be the northwestward extension of Cap Fault, interpreted by Douglas and Norris (1974) in the Wrigley map area (NTS 95O) to the south. The subsidiary Cap Fault is nowhere exposed. 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 and Twin Peaks map areas. Support for carrying Cap Fault northward is provided by Petro-Canada Seismic Line 14X (see Cook et al., 2007a). The major fault and the subsidiary Cap Fault comprise a genetically linked pair of faults that are replaced, at surface, along strike to the northwest, by a prominent syncline whose eastern limb is interpreted as being underlain by a thrust fault that places Paleozoic strata on Cretaceous (see adjacent Twin Fish Lake map-area, Cook et al., 2007b). Details of the transition are obscured by lack of bedrock exposure, but the linked thrust faults are interpreted to plunge beneath the syncline and its underlying thrust. The syncline is the eastern component of an anticline–syncline pair. The anticline, traced northwestward (see Cook et al., 2007b) becomes the McConnell Range frontal structure. Thus, although not well understood, the anticline–syncline pair comprises a displacement transfer zone that accommodates an en échelon shift to the west of the frontal thrust-faulted anticline.

Stratigraphy

Proterozoic strata do not outcrop, but are interpreted to underlie the Lower Cambrian Mount Clark Formation in a small area in the hanging wall of the frontal thrust. Proterozoic strata in this part of the McConnell Range probably correlate in general with Neoproterozoic 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 789 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 Neoproterozoic 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 Neoproterozoic age inferred from detrital zircon data from underlying units but do not help in further constraining the 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 (Shuster Longgroup, 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 ~ 5) document a fundamentally more intense burial/tectonic history than the Neoproterozoic strata at G-52 (medium orange fossils with a TAI ~2)".

The Mount Clark Formation, composed of white, medium-grained, silica-cemented quartz sandstone, occurs in an anticlinal culmination in the hanging wall of the frontal thrust. The unit appears to be structurally thickened by poorly defined thrust faults (interpreted on air photos), consequently stratigraphic thickness there is uncertain. Aitken et al. (1973) reported a thickness greater than 218 m at Cap Mountain, about 90 km to the south. It is considered to be about 350 m thick based on an estimate made about 15 km to the southeast, in Blackwater Lake North 96B/3 (Cook et al., 2007a). 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 Mount Cap (Aitken et al. 1973).

The Mount Clark is conformably overlain by the undivided Mount Cap and Saline River formations, which occur as a recessive covered interval. From exposures to the southeast in Blackwater Lake North, 96B/3, the Mount Cap is known to comprise shale, silty dolomite, and platy limestone. However, in this map area virtually the only Mount Cap Formation outcrop is a small exposure of quartz sandstone shown as a 'mappable sandstone'. Other resistant 'mappable sandstones' occur sporadically along the recessive Mount Cap/Saline River interval. 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 sandstone 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 comprises cliff-forming, well-bedded, platformal dolomite. It is estimated to be 300 to 500 m thick along the frontal anticline and is greater than 100 m in measured section MTA-03-1 (base not exposed) in the northwestern part of the map area. 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. At the type section on Mount Kindle, about 100 km to the south, the Mount Kindle was subdivided by Norford and Macqueen (1975) into Basal, Resistant, and Upper members. In Twin Peaks map area the Basal member was not noted, with the possible exception of about 90 m of light grey, cream weathering, dolomite-cemented quartz arenite and sandy dolomite capping the Franklin Mountain Formation in Section MTA 03-1. These sandy beds are atypical of the Franklin Mountain and are considered to be a local sandstone accumulation on the sub-Mount Kindle unconformity. Similar sandstone probably occurs elsewhere, unrecognized, in strata mapped as Franklin Mountain. In Section MTA-03-1 the thickness of the Mount Kindle, including the sandy beds, is about 114 m. A similar sandy interval was not noted in Section MTA-03-3.

Along the west limb of the frontal anticline the Mount Kindle is estimated to be at least 300 m thick. Along most of the west limb it can be subdivided into the Resistant and Upper members of Norford and Macqueen (1975). 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 cephalopods. The Upper member is a distinctive banded unit, about 200 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. To the east in the sheeply dipping to overturned panel in the footwall of the major thrust the Resistant and Upper members are probably both present, but because of poor exposure the Mount Kindle is carried there as an undivided unit. Better ground control in the future may see revisions to the map in that area.

The Mount Kindle is truncated by erosion at the overlying sub-Tsetso unconformity, such that the Upper member is missing to the north along the frontal anticline in Twin Fish Lake, 96 B/5, (Cook et al., 2007b) and to the west in section MTA-03-1 and MTA-03-3. The thickness decreases westward from the estimated 300 m along the frontal anticline to 27 m and 114 m measured in Sections MTA 03-3 and MTA-03-1, respectively, in the western part of the map area.

The Tsetso Formation (Meijer-Drees, 1993) is light yellow weathering, laminated, and platy dolomite, locally silty and/or sandy. The formation is 113 m thick in section MTA-03-3 in the west-central part of the map area. 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'.

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 was measured to be 158 m in section MTA-03-3 in the west-central part of the map area.

The Bear Rock is capped by the Landry Formation, composed of alternating thin- and thick-bedded limestone (dominantly unfossiliferous pelletal packstone) 20 m thick in section MTA-03-3. The Landry typically forms a small, prominent cliff above the Bear Rock and the contact is readily located on air photos. The Landry is overlain in turn by 60 to 80 m of argillaceous and fossiliferous limestone (containing crinoids, corals and brachiopods) of the Hume Formation (Morrow, 1991). Because the upper part of the Hume Formation is also cliff forming, picking the contact between the Landry and the Hume is more subjective. In areas of poor exposure the Landry and Hume were mapped as an 'undivided' unit.

Hare Indian Formation shale, although masked by glacial drift, is interpreted to conformably overlie Hume Formation in the southwestern part of the map area, based on topographic expression and compatibility with the geology of Wrigley, 95O, (Douglas and Norris, 1974)

In Twin Peaks 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 surface contact with Paleozoic strata is nowhere exposed and is interpreted as a fault contact.

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GEOLOGY

TWIN PEAKS

NORTHWEST TERRITORIES

Scale 1:50 000/Échelle 1/50 000

kilometres 1 0 1 2 3 4 kilomètres

Universal Transverse Mercator Projection
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Projection transverse universelle de Mercator
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96 C/9 SALINE RIVER	96 B/5 TWIN FISH LAKE OF 5336	96 B/6 KODAKIN CREEK
96 C/1 BIRCH ISLAND	96 B/4 TWIN PEAKS OF 5335	96 B/3 BLACKWATER LAKE NORTH OF 5334
95 N/16	95 O/13 BLACKWATER RIVER	95 O/14 BLACKWATER LAKE

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