LEGEND

Note: Weighted legend blocks indicate map-units that appear on this map

CENOZOIC

QUATERNARY

- **Q** — Glacial till, outwash, alluvium, etc.; mapped only where deposits are thick and continuous
- **Qm** — Thick morainal deposits forming prominent topography (Amundsen and Great Bear lobe moraines)

TERTIARY and/or QUATERNARY

- **Tb** — BEAUFORT FORMATION (?): unconsolidated gravel and sand; quartzite, dolomite and black chert pebbles; wood fragments

MESOZOIC

CRETACEOUS

UPPER CRETACEOUS

- **Kps** — "Pale shale zone": pale grey shale and mudstone; grey brown ferruginous shale; minor ironstone concretionary beds
- **Kbt** — "Bituminous zone": black bituminous shale; yellow jarosite; local earthy hematite; pale grey clay; local basal ironstone-pebble and shale-chip conglomerate

LOWER CRETACEOUS

- **Kb** — "Bentonitic zone": black, soft, plastic shale; fossiliferous orange ironstone concretionary beds
- **Ks** — "Silty zone": upper division - argillaceous siltstone and mudstone; lower division - light grey friable sandstone and coal
- **Ksh** — Undifferentiated shales, equivalent to the "Silty", "Bentonitic", and "Bituminous" zones
- **Kss** — Basal sandstone, white, very fine to coarse-grained, crossbedded, partly calcareous, commonly porous, locally oil-stained; equivalent to lower division of "Silty zone"
- **K** — Cretaceous deposits (Undivided)

PALEOZOIC

DEVONIAN

UPPER DEVONIAN

- **Di2** — IMPERIAL FORMATION: shale, brown, greenish grey, generally fissile; subordinate sandstone, brown, impure, very fine grained; minor siltstone
- **Di1** — Basal unit; shale, brown, fissile, with siltstone laminae and clay ironstone concretions
- **Di** — IMPERIAL FORMATION (Undivided)
- **Dc** — CANOL FORMATION: shale, dark brown to black, mostly bituminous, partly fissile, partly siliceous and blocky

MIDDLE AND (?) UPPER DEVONIAN

- **Drk** — RAMPARTS AND KEE SCARP FORMATIONS (Undivided): limestone, generally well bedded and partly argillaceous below, massive above; commonly fossiliferous

MIDDLE DEVONIAN

- **Dhi** — HARE INDIAN FORMATION: shale, black and highly fissile at base, green above; beds of siltstone and fossiliferous limestone locally developed
- **Dh** — HUME FORMATION: limestone, well bedded and rubbly, highly fossiliferous; shales in middle and lower parts

MIDDLE AND (?) LOWER DEVONIAN

- **Db** — BEAR ROCK FORMATION: dolomite and limestone solution-breccia; bedded brown bituminous dolomite and dense limestone; gypsum

ORDOVICIAN AND SILURIAN

UPPER ORDOVICIAN AND LOWER SILURIAN

RONNING GROUP

- **OSk** — MOUNT KINDLE FORMATION: dolomite, brownish grey to medium grey, fine crystalline; locally colour mottled; silicified fauna common

LOWER AND (?) MIDDLE ORDOVICIAN

RONNING GROUP

- **Or2b** — Unit 2b: dolomite, pale yellow-brown to pale grey; mainly medium crystalline, abundant white and yellowish grey stromatolitic and locally oolitic chert, abundant drusy quartz
- **Or2a** — Unit 2a: dolomite, pale brownish grey, fine to coarse crystalline; interbedded with dolomite, greyish orange, very fine crystalline, partly laminated
- **Or2** — Unit 2 (Undivided)
- **OSr** — MOUNT KINDLE FORMATION and Unit 2 (Undivided)
- **Or1** — Unit 1: dolomite and rare limestone; cyclic repetitions of dense, laminated beds, oolite beds, conglomerate beds, stromatolitic beds and thin dolomitic shale beds

CAMBRIAN

- **€s** — SALINE RIVER FORMATION: red and green shales, gypsum, halite, siltstone; dense flaggy dolomite with salt-crystal casts
- **€cp** — MOUNT CAP FORMATION: green, grey, and minor red shales, glauconitic sandstone and siltstone; subordinate orange-weathering dolomite in some areas
- **€ck** — MOUNT CLARK FORMATION: sandstone, white, grey, locally red, quartzose, fine to very coarse-grained and conglomeratic, crossbedded, partly friable

PROTEROZOIC

NEOHELIKIAN OR HADRYNIAN

SHALER GROUP

- **P6** — Diabase and gabbro dykes and sills
- **P5** — Dolomite, mainly yellow-weathering; gypsum, varicoloured shales; minor limestone, chert; non-resistant
- **P4** — Dolomite, mainly massive, resistant, weathering mainly deep brownish-orange; minor limestone; stromatolites large and abundant
- **P3** — Quartzite, mainly grey, fine and medium-grained
- **P2** — Dolomite, grey, locally pink, mainly yellow-weathering, flaggy, siliceous
- **P1** — Shale, green, locally red

COPPERMINE RIVER SERIES

- **Pcb** — Basaltic flows

HORNBY BAY GROUP

- **Phd** — Dolomite, partly silicified; many stromatolitic beds
- **Phq** — Quartzite, white, pink, purple-mottled

Rock outcrop
Rock outcrop visited by helicopter
Fossil locality
Geological boundary (defined, approximate, assumed; includes contacts extended by air photo interpretation)
Geological marker
Limit of geological mapping
Bedding, tops known (horizontal, inclined)
Bedding estimated on photos or from aircraft (horizontal; dip 5°-15°; 15°-45°)
Fault, movement unknown (defined, inferred)
Fault (defined, inferred; solid circle on downthrown side)
Fault, thrust or reverse (defined, inferred; teeth extend down-dip)
Anticline (defined, approximate; arrow indicates plunge)
Syncline (defined, approximate; arrow indicates plunge)
Monocline (arrows on steepened limb)
Stratigraphic section studied

Stratigraphic Section Reference

R.W. Macqueen MQ-18

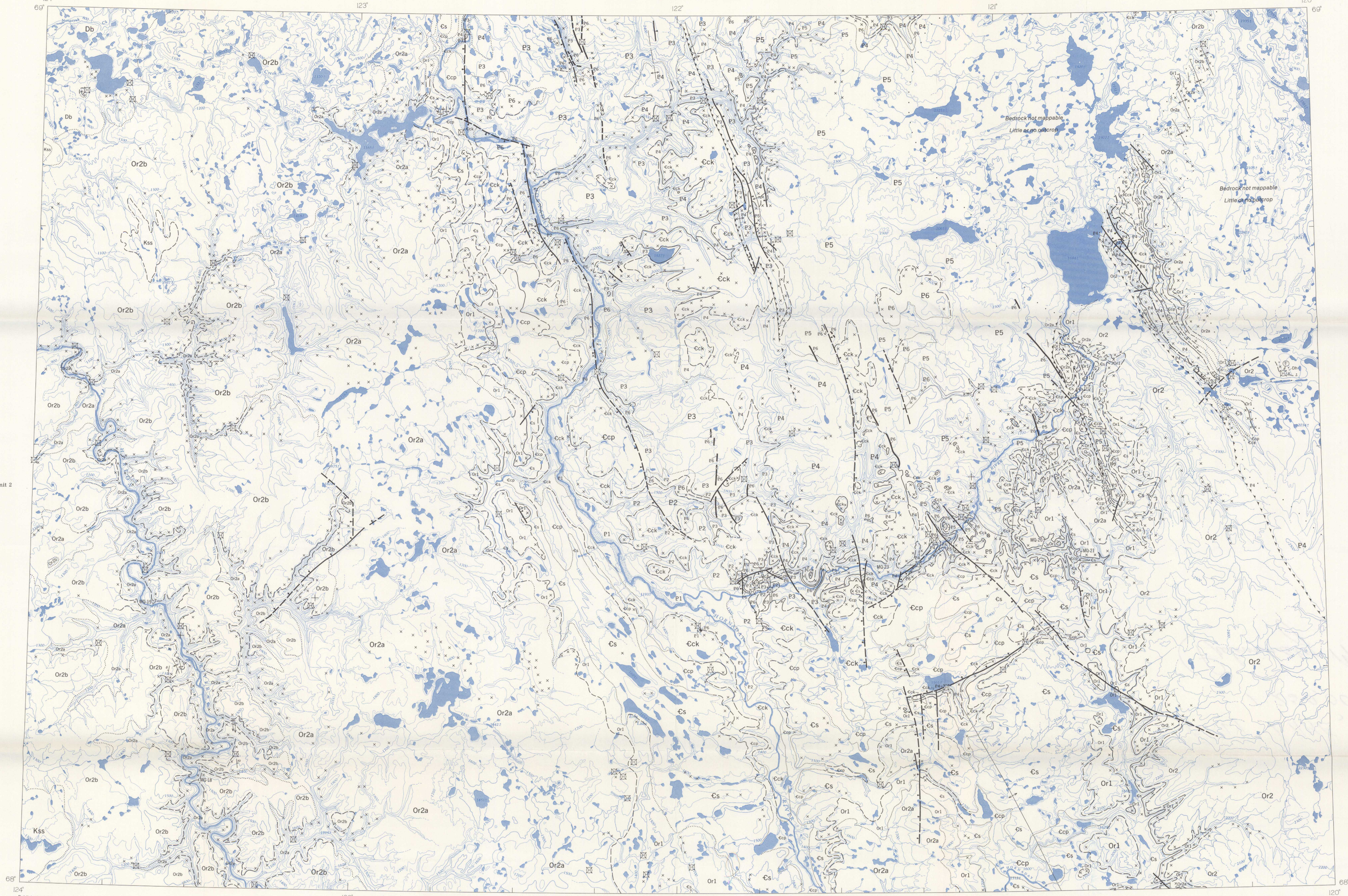
Geology by J.D. Aitken, M.E. Ayling, H.R. Balkwill, D.G. Cook, R.W. Macqueen, 1968

Compiled by D.G. Cook, J.D. Aitken, 1969

Geological cartography by the Institute of Sedimentary and Petroleum Geology, Geological Survey of Canada, 1969

PRELIMINARY SERIES

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES



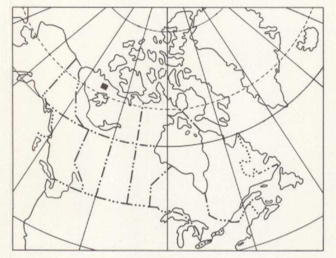
Published, 1969
Copies of this map may be obtained from the Geological Survey of Canada, Ottawa

Printed by the Surveys and Mapping Branch

MAP 5-1969
GEOLOGY
ERLY LAKE
DISTRICT OF MACKENZIE

Scale 1:250,000

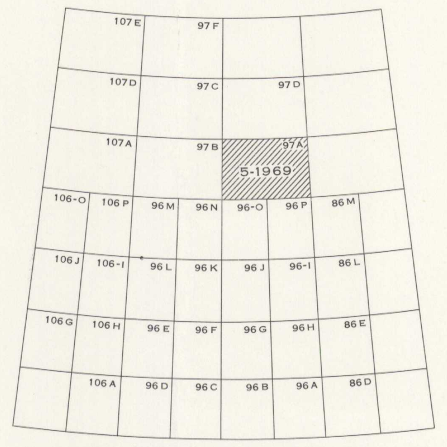
Miles 4 0 4 8 12 Miles
Kilometres 6 0 6 12 18 Kilometres



INDEX MAP

Topographic base-map at the same scale published by the Army Survey Establishment R.C.E., 1961

Magnetic declination 1969 varies from 42° 13' easterly at centre of west edge to 42° 36' easterly at centre of east edge. Mean annual change: -8.9'



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

National Topographical System designations indicate other quadrangles mapped geologically during Operation Norman

DESCRIPTIVE NOTES

Geological studies of the area were carried out in 1968 as part of Operation Norman, an airborne, regional geological reconnaissance.

The area, part of the Horton Plain of Bostock (1964), is a regular plateau sloping gently westward, into which Horton and Hornaday Rivers and their principal tributaries are incised. Bedrock exposures are good along the incised streams but poor elsewhere. A major moraine system obscures bedrock in much of the northeast corner of the map-area.

The oldest rocks exposed in the map-area (P1 to P5) are a succession of unmetamorphosed, unfossiliferous, largely or entirely marine strata intruded by dykes and sills of diabase and gabbro (P6). Both the stratified rocks and the intrusions are truncated by a regional unconformity at the base of the Cambrian Mount Clark Formation and, thus, on stratigraphic evidence are Precambrian. This succession was mapped as Coppermine River Series (Sandberg, 1913) by Craig et al. (1960). It is considered preferable to assign the Precambrian strata of the area to the Shaler Group (Thorsteinsson and Tozer, 1962), because they lie on trend with that Group at its type locality on Victoria Island, and are similar in lithology and stratigraphic position. The type Shaler Group is much more completely described at this date than is the poorly exposed and little studied Coppermine River Group (Coppermine River "Series").

The Shaler Group of the map-area is exposed in a regional northeast-dipping homocline, the faulting and folding of which are at least as young as Devonian. Five lithostratigraphic units are recognized but were not measured nor studied in detail. The oldest unit (P1) consists of rarely exposed shales, generally green in colour but locally red: it is at least 3,000 ft. thick on the Arctic coast near Cape Lyon (Yorath et al., 1969). The shales are overlain by a unit (P2) consisting of very fine-crystalline, grey, yellow-grey, and pink dolomites, that are generally flaggy and platy. Partial silicification is widespread; ripple-marks and stromatolites occur locally. The unit is about 400 feet thick on Little Hornaday River. Next in the sequence is a unit (P3) of poorly bedded sandstone and quartzite that is mainly fine-grained and pale brownish grey in colour, but locally brown to dark red where cemented with iron oxides. Most specimens contain abundant grains altered to white clay, and clay cement is widespread. The unit is about 400 feet thick on Little Hornaday River, but thickens northward to more than 700 feet near the north boundary of the map-area.

The sandstones are overlain by a unit (P4) composed mainly of massive and resistant dolomites, characterized by the predominance of orange weathering colours and an abundance of stromatolites. The dolomite is generally pale grey, and microcrystalline to fine-crystalline. Stromatolitic sequences are interrupted by intervals of dolomitized calcarenite, crossbedded in places. Grey, dense limestone with columnar stromatolites occurs locally. Small, irregular chert masses occur in some outcrops. The unit is 400 to 500 feet thick along Little Hornaday River and immediately west of the major fault in the north-central part of the map-area. Immediately east of the fault, it is about 200 feet thick. These relationships suggest the possibility of Precambrian movement on the fault, followed by erosion prior to deposition of unit P5.

Unit P4 is overlain by a heterogeneous unit (P5) that contains several intervals of gypsum and is generally poorly exposed. Most common of the several lithologies is microcrystalline, grey to red, and generally laminated dolomite. Coarse-grained, grey, thin- to medium-bedded, particulate limestones are common, as are red and green, mud-cracked shales with intercalated beds of greenish grey siltstone and sandstone. Nodules and large, irregular masses of grey, black and white chert are common in the carbonate intervals. Rare salt-crystal casts occur in thin, platy beds of silty dolomite and dolomitic siltstone. Thick intervals of white and pale green gypsum occur near the base; in the upper half of the unit, a single exposure reveals 25 feet of grey gypsum with argillaceous partings; white and red gypsum also occurs. The whole unit weathers pale yellow, but intervals of orange-weathering dolomite resembling the underlying unit also occur. The unit is bounded above by the sub-Paleozoic unconformity and its maximum thickness is unknown. It is missing, presumably because of pre-Paleozoic erosion, in the easternmost panel of Precambrian rocks.

All the Proterozoic units (P1 to P 5) are intruded by dykes and sills of dark igneous rock (P 6) ranging in texture from very fine- to medium-grained diabasic and in composition from olivine gabbro to quartz gabbro. Two specimens of gabbros intrusive into the Shaler Group of the immediate area have yielded apparent radiometric ages (based on whole-rock, K/Ar determinations) of 705 and 770 m.y. (Fahrig, in Wanless et al., 1965, p. 48). A sill intrusive into the Shaler Group on Victoria Island has, by the same method, yielded apparent ages of 635 and 640 m.y. (Christie, 1964, p. 10). Baragar, however, suggests (in Wanless, et al., 1968, p. 66) that apparent K/Ar ages based on whole-rock determinations on gabbros from the region are probably up-dated by a tectonic event substantially younger than the rocks analysed. Thus, it remains undetermined whether the Shaler Group is Hadrynian or Neohelikian in age.

The three lowest units of the Paleozoic succession of the map-area, a quartzose sandstone, a unit of green shales with glauconitic sandstone and siltstone, and a unit of variegated shales with dolomite and gypsum, are virtually identical with the sequence, Mt. Clark Formation - Mt. Cap Formation - Saline River Formation (Williams, 1923), known from the Franklin Mountains. The degree of lithological correspondence as well as the stratigraphic position and sequence are considered to justify the extension of these formation names to the present area, although support of the correlation by fossil evidence is lacking.

The Mount Clark Formation (€ck) in exposures on the flanks of the Coppermine Arch consists of quartzose sandstone, grit, and minor amounts of pebble-conglomerate. It is pale yellowish grey to near-white, and locally brick-red. Grain-size varies, rapidly and widely, from very fine-grained sandstone to quartz-pebble conglomerate. Crossbedding of planar and trough type is prominent. In the Hornaday River region the sandstone is mostly friable and very porous; near Great Bear Lake, however, it is a silica-cemented quartzite. No evidence was seen in the former region of appreciable topographic relief at the Shaler Group - Mt. Clark contact but, in the latter, the quartzite was deposited on hilly topography developed on the Hornby Bay dolomites and Coppermine River basalts. The formation is consistently about 200 feet thick in the Hornaday River area, but may thin somewhat northeastward. No fossils other than the cylindrical burrow Skolithos were recovered from the Mt. Clark Formation, however, this trace-fossil alone almost certainly establishes that the formation is in part at least of marine origin. In the Hornaday River region the Mt. Clark sandstones outcrop prominently in white scarps, and provide an outstanding photogeological marker. Near Great Bear Lake, the Mt. Clark quartzites support extensive scoured surfaces with a distinctive scaly appearance in air photographs.

The Mt. Cap Formation (€cp) is recessive and rarely exposed. It consists of grey, green, and locally red shales, with interbedded glauconitic sandstone and siltstone that is extremely burrowed. Among the trace-fossils of several types, an Arthrophycus - like form is notable. At the top of the unit are one or two thick beds of orange-weathering dolomite, derived from particulate and stromatolitic limestone. The upper contact is drawn at the top of these resistant dolomites, except in the eastern half of the map-area where a tongue of sandstone similar to the Mt. Clark Formation and as much as 40 feet thick appears above them; here, the contact is drawn above the sandstone. The Mt. Cap Formation is 230 feet thick at MQ-20, in the southeastern quadrant of the map-area, and appears to vary little in thickness throughout the map-area.

The Saline River Formation (€s) is a recessive unit bounded above by the resistant basal unit of the Ronning Group and below by the thin, resistant dolomite or sandstone at the top of the Mt. Cap Formation. It consists of green and red shales with thin flaggy interbeds of siltstone and silty dolomite and, rarely exposed, white and pink gypsum. Mudcracks, ripple-marks, and salt-crystal casts are common. The formation appears to vary little in thickness; it is 195 feet thick at section MQ-20.

The Ronning Group (Hume, 1954) of the region comprises the thick sequence of marine strata, mainly dolomites, that lies between the Saline River Formation and Devonian rocks. It is incomplete within the Erly Lake map-area, owing to pre-Devonian, pre-Cretaceous, Tertiary and Quaternary erosion. Three rock-units are distinguished. The basal unit of the Ronning Group (Orl) is in gradational contact with the underlying Saline River Formation. It is a resistant unit, weathering pale yellow, and characterized by cyclic repetitions of dense, laminated, oolitic, conglomeratic and stromatolitic dolomite beds; the presence of cyclically recurring thin beds and partings of green dolomitic shale readily distinguishes this unit from the overlying unit (Or2a). The unit is 145 feet thick at section MQ-21.

Unit (Or2a) of the Ronning Group continues the cyclic nature of the basal unit, but lacks shale beds and partings, and displays a more limited range of dolomite types. It is a moderately resistant unit, weathering grey, and consisting mainly of thick beds of pale brownish grey, coarse-crystalline dolomites, commonly with vuggy porosity, alternating with greyish orange, very fine-crystalline dolomites, in part laminated. Purple mottling occurs at many localities. No complete section of the unit was measured; it is at least 400 feet thick. Unit (Or2a) is overlain by a slightly more resistant unit (Or2b) of similar-appearing dolomites, pale yellow-brown to pale grey in colour and mainly medium-crystalline. This unit is characterized by an abundance of white and yellowish grey bedded chert, stromatolites replaced by chert, and vugs lined with drusy quartz. No complete section was measured; it is at least 350 feet thick.

Fossils collected from the cherty unit (Or2b) by H.G. Bassett and identified by B.S. Norford indicate an Early Ordovician age. The two underlying units of the Ronning Group are not independently dated, and may be Cambrian in part.

The Middle Devonian Bear Rock Formation (Hume 1954) occurs only in the northwestern corner of the map-area where it rests unconformably upon the chert unit (Or2b) of the Ronning Group. No complete section of the formation is present: the outcrops observed consist of grey to brown laminated dolomite, dolomite breccia, and dolomitic pellet limestone. Almost all rock types observed are bituminous.

A single outcrop of Devonian strata was found lying unconformably upon Ronning Group strata near the eastern boundary of the map-area. The exposure consists of only 12 feet of limestone, mainly coral-fragment conglomerate and rubble, with stromatoporoids and minor shaly beds. Preliminary identification of the fauna by A.E.H. Pedder indicates a Middle Devonian age; the unit is tentatively mapped as Hume Formation (Bassett 1961).

Cretaceous rocks occur only in scattered exposures in the western part of the map-area, partly in sub-Cretaceous erosional "lows". The only unit represented is the lower, sandstone and coal division of the "Silty zone" of late Lower Cretaceous age (Yorath et al., 1969). The only exposure examined is near the northwest corner of the map-area, and this contains, near the base, 4 soft coal seams interbedded with very fine-grained sand containing nodular marcasitic concretions. This interval is overlain by a bed about 2 feet thick of dense limestone with burrows or root casts. The uppermost unit is a spectacularly crossbedded friable sandstone, about 30 feet thick, consisting of alternating cross-laminations of fine-grained and very coarse-grained quartzose sand. Other patches of Cretaceous rocks mapped are based on photo interpretation and projection from exposures in the adjoining map-area.

The area contains evidence of a long and incompletely understood structural history. Two faults trending north-northwest in the northeast quadrant of the map-area and a fault system along Hornaday River contain Proterozoic units in one of the juxtaposed blocks that are much thinner than normal or are missing. This suggests movement predating and, possibly, postdating deposition of Proterozoic unit (P5). Subsequently, the entire Proterozoic succession and the gabbroic rocks intrusive into it were tilted toward the northeast and deeply bevelled prior to the beginning of Paleozoic sedimentation. The sequence from basal Cambrian through early Silurian, as determined in this and adjoining areas, is apparently continuous except for a disconformity at the base of the Mt. Kindle Formation, and displays no change of facies suggestive of a topographic "high" along the Coppermine Arch; faulting and folding of the lower Paleozoic succession (in part along faults which were apparently active in the Proterozoic) is, therefore, post-Early Silurian. Absence of the Late Ordovician and Early Silurian Mt. Kindle Formation beneath Middle Devonian strata in the northwest corner and the eastern margin of the map-area confirms the existence here of the sub-Middle Devonian unconformity that is well documented in map-areas to the southwest, and suggests the possibility of pre-Middle Devonian (Caledonian?) tectonism along the Coppermine Arch. Basal Cretaceous deposits are unconformable on all pre-Cretaceous formations and, within the map-area, appear to be restricted to sub-Cretaceous topographic "lows". The sub-Cretaceous unconformity, as documented mainly in the region to the west, records gentle northwestward regional tilting followed by deep erosional bevelling that results in the subsequently deposited Cretaceous strata lying upon successively older formations to the southeast. The youngest identifiable tectonic movements in the region are documented by basal Cretaceous strata that are involved in compressional structures in the Colville Hills, 100 miles south-west of the map-area. Regional uplift of the Coppermine Arch to form the present day structural "high" is not dated. It is clearly post-Middle Devonian, and probably postdates deposition of the Cretaceous strata of the area.

From the foregoing, it is evident that each of the present-day structures within the map-area may be the result of movements during one or more of at least four tectonic episodes. A dominant northwesterly trend parallel to the axis of the Coppermine Arch is seen in most folds and in faults whether interpreted as of normal or reverse type, but structures also occur trending at high angles to this dominant trend. Interpretation of faults is difficult because the dip of the fault plane is rarely seen. The faults of greatest displacement are interpreted as reverse faults because of their close association with folds that are almost certainly compressional, and because of the existence of a well-documented reverse fault near the head of Little Hornaday River. The remainder are generally considered as normal faults because of their almost vertical dips along the surface trace. With one exception, all major northwesterly trending faults display downthrow to the southwest, regardless of the interpretation as to normal or reverse type. Asymmetry of the folds associated with major faults is directed westward; the one documented reverse fault dips in a direction opposite to the assumed dip of the other faults interpreted as reverse faults. Although gypsum occurs at two levels in the known stratigraphic column, no evidence suggestive of intrusive action of evaporites, whether under gravitational or tectonic forces, was observed.

The region was completely covered by ice during the last glaciation.

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MAP 5-1969
ERLY LAKE
DISTRICT OF MACKENZIE