GEOLOGICAL SURVEY OF CANADA

LOWER PALEOZOIC GEOLOGY IN PARTS OF GREELY FIORD EAST, GREELY FIORD WEST AND CAÑON FIORD MAP-AREAS, DISTRICT OF FRANKLIN (NTS 340 A, B, 49H)--- PRELIMINARY GEOLOGICAL MAP AND NOTES

by H.P. Trettin

INTRODUCTION

This report describes a belt of lower Paleozoic sedimentary rocks extending from the vicinity of Caledonian Bay, Cañon Fiord in the southwest to the northeastern extremity of the Greely Fiord map-area in the northeast. It is bordered by the Agassiz Ice Cap on the southeast and by upper Paleozoic terranes on the northwest.

Parts of the belt were previously mapped in reconnaissance fashion by Troelsen (1940) and Christie (1964) who assigned the lower Paleozoic rocks to the Cape Rawson Group, a now abandoned unit. In 1961 and 1962 J.Wm. Kerr carried out mapping and stratigraphic work in the area east of Cañon Fiord and south of d'Ibberville Fiord, while R. Thorsteinsson studied and mapped the upper Paleozoic succession. The resulting maps and reports (Thorsteinsson, 1971, 1972, 1974; Thorsteinsson and Kerr, 1972; Kerr, 1967, 1968) formed the basis for more detailed stratigraphic and sedimentological studies by Trettin in the Cañon Fiord area in 1970 and 1972 (1979).

A program to complete the geological reconnaissance of parts of nine map-areas in northeren Ellesmere Island was begun by the Geological Survey in 1975 and is scheduled to terminate with the 1982 field season. In the course of this program the writer carried out four days of field work on foot from a fly camp at d'Ibberville Glacier in 1975 and made a helicopter traverse from d'Ibberville Glacier to Caledonian Bay in 1980.

I am indebted to the Director and officers of the Polar Continental Shelf Project for management of the helicopter, fixed-wing aircraft support and numerous courtesies. Conodont identifications are by G.S. Nowlan and C.R. Barnes.

NOTES ON STRATIGRAPHY

Two major depositional realms are recognized in this region between late Early Cambrian and Middle Ordovician time: a southeastern shelf (miogeosyncline or miogeocline) and a northwestern deep-water basin named Hazen Trough. The shelf received mainly carbonate sediments with evaporites in the Early and Middle

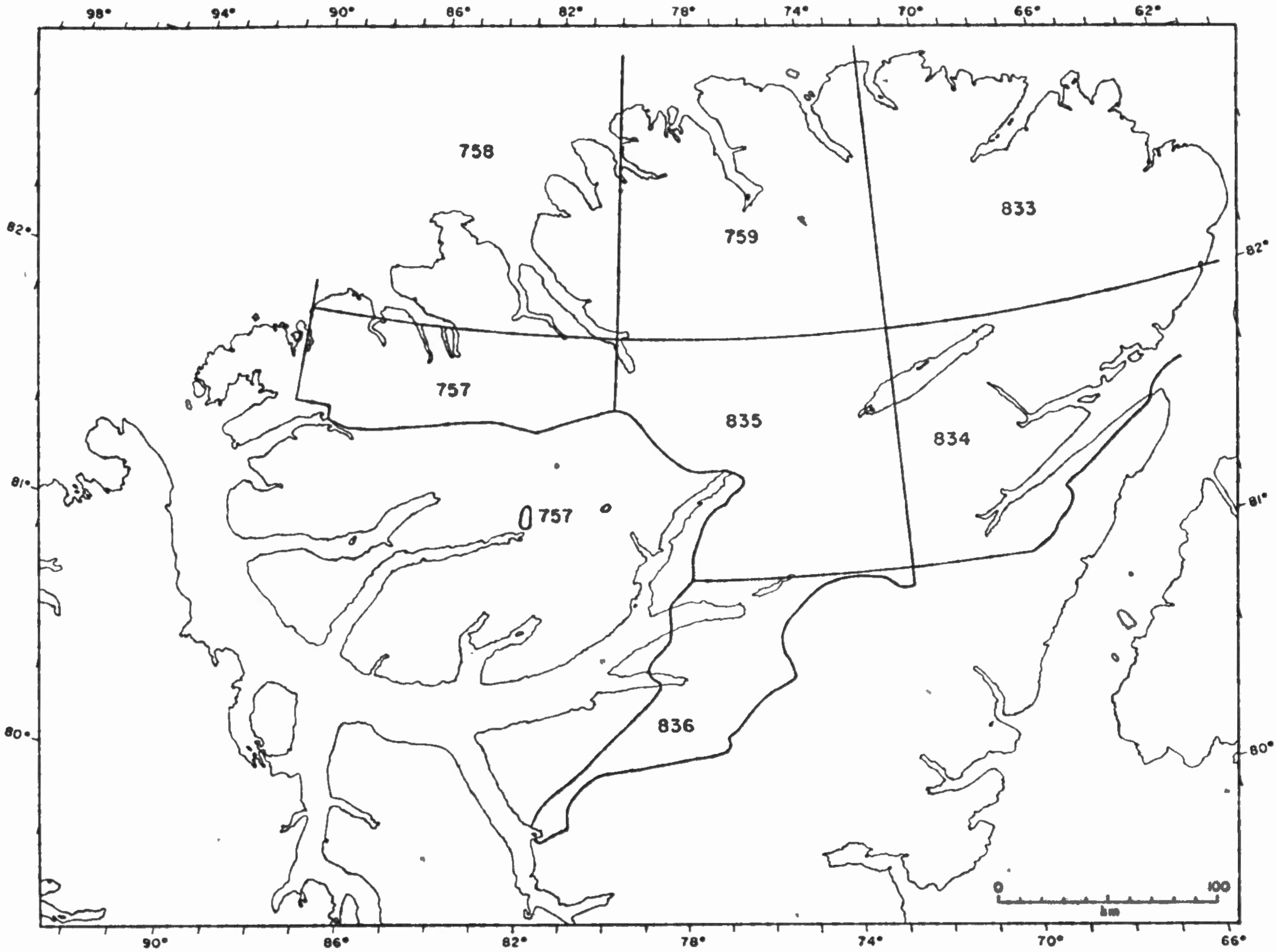

Figure 1: Index of Open Files, Project 730051

Open File 757	Preliminary geological map and notes, parts of Otto Fiord and Cape Stallworthy areas, District of Franklin (NTS 340C, 560D), by H.P.Trettin and U.Mayr, 1981
758	Preliminary geological map and notes,Yelverton Inlet map-area, District of Franklin (NTS 340F, 540C),by H.P.Trettin and T.O.Frisch, 1981
759	Geology of Precambrian to Devonian rocks,M'Clintock Inlet area, District of Franklin (NTS 340E,H) --preliminary geological map and notes, by H.P.Trettin, 1981*
833	Preliminary geological map and notes,Clements Markham Inlet and Robeson Channel map-areas, District of Franklin (NTS 120E,F.G), by U.Mayr, H.P.Trettin, A.F.Embry and R.L.Christie,1982
834	Preliminary geological map and notes, part of Lady Franklin Bay map-area, District of Franklin (NTS 120C), by H.P.Trettin, U.Mayr and A.F.Embry, 1982
835	Preliminary geological map and notes, part of Tanquary Fiord map-area (NTS 340D), by U.Mayr, H.P.Trettin and A.F.Embry, 1982
836	Lower Paleozoic geology in parts of Greely Fiord East, Greely Fiord West and Cañon Fiord map-areas, District of Franklin (NTS 340A,B, 49H) ,by H.P.Trettin, 1982

* a revised version of map and notes, based on brief field work in 1981, age determinations ,etc. has been placed with the Librey, Institute of Sedimentary and Petroleum Geology, Calgary

Ordovician and some clastic sediments derived from the craton. Stratigraphic evidence from the Lady Franklin Bay map-area indicates that the trough subsided to a depth of no less than 1 km while receiving a condensed succession of resedimented carbonate deposits, mudrock and radiolarian chert with minor calcareous sandstone (Hazen Formation). From latest Ordovician or Early Silurian to Early Devonian time the trough became filled with flysch-like sediment gravity flows of northerly and northeasterly provenance (Imina Formation). Pronounced subsidence of the outer shelf from Late Ordovician time onward resulted in encroachment of deep-water facies in some areas and accelerated growth of carbonate buildups in others. The buildups, which developed near the original shelf edge, became separated from the retreating margin of the inner shelf by a relatively deep back-reef basin that received resedimented carbonates, chert and mudrocks of graptolitic facies (Cape Phillips Formation). This facies is highly diachronous, its base ranging in age anywhere from Late Ordovician to Late Silurian.

Ordovician-Silurian shelf succession

The Ordovician-Silurian shelf succession east of Cañon Fiord has been described by Kerr (1968). There it comprises the Cornwallis Group and overlying equivalents of the undivided Allen Bay and Read Bay Formations. The latter range in age from Late Ordovician (Ashgillian) to early Late Silurian (Ludlovian) and have resedimented limestone conglomerate at the top (Trettin, 1979). This carbonate succession is overlain by the Cape Phillips Formation, which is restricted to the latest Silurian (Pridolian) at Caledonian Bay but ranges in age from early Middle Silurian to Late Silurian east of upper Cañon Fiord and south of the fiord.

The shelf succession also is exposed at d'Ibberville Glacier, where it has been reconnoitered only briefly. Eleanor River, Bay Fiord, Thumb Mountain and Irene Bay Formations seem to be present but this requires confirmation. Overlying carbonate strata, mapped as equivalents of the Allen Bay Formation, yielded conodonts, identified as follows by G.S. Nowlan:

GSC loc. C-75464, station 80TM21OE

Panderodus gracilis (Branson and Mehl)	15
Paroistodus? mutatus (Branson and Mehl)	2
Plegagnathus dartoni (Stone and Furnish)	2
Pseudobelodina vulgaris Sweet	2

Richmondian (CAI 5)

This locality is close to the contact with the Imina Formation. It appears therefore that in this region the shelf carbonate succession terminates in the latest Ordovician or earliest Silurian as is the case on southwestern Judge Daly Promontory (unpub. conodont identification by G.S. Nowlan).

Deep-water succession of Hazen Trough

Hazen Formation

The Hazen Formation (Trettin, 1971) comprises a condensed succession of redeposited carbonate sediments, fine grained clastic sediments and chert that in the central parts of the Hazen Trough lies stratigraphically between Grant Land and Imina formations. On the southern margin, in the Lady Franklin Bay map-area, it lies on the Lower Cambrian Ellesmere Group and is overlain at some localities by Ordovician shelf carbonate units (equivalents of Copes Bay and Eleanor River formations) and at others by the Imina formation. It is diachronous with a total age span from middle or late Early Cambrian to Early Silurian. Two highly diachronous members, a lower carbonate and an upper chert member are recognized throughout the region of the Hazen Trough. At Caledonian Bay, the chert member is succeeded by a carbonate conglomerate member that is of local extent only.

Carbonate member. At Ella Bay, in the Lady Franklin Bay map-area, this unit is 540 m thick, but in the present area its base is not exposed. An incomplete section at Caledonian Bay, 259 m thick, consists of: interlaminated lime mudstone and claystone; laminated and graded lime wackestone and packstone; primary and replacement chert; and two major units of limestone conglomerate and breccia. It yielded conodonts of late Middle Ordovician age (Trettin, 1979).

A 276 m thick, incomplete section at d'Ibberville Glacier consists mainly of resedimented lime mudstone with minor packstone, grainstone, limestone conglomerate, mudrock and replacement chert, and produced conodonts of unspecified Late Cambrian to Late Ordovician age. The limestone conglomerate represents redeposited slope sediments.

Chert member. At Caledonian Bay this unit is about 120 m thick and consists mainly of radiolarian chert with interlaminated mudrock (original claystone) and minor amounts of lime wackestone and packstone. It contains graptolites of middle to late Llandoverian age (*op. cit.*).

At localities 8 and 182 south of d'Ibberville Fiord, investigated by Kerr, it is about 30 m thick, composed of chert and interlaminated mudrock and contains graptolites of latest Ordovician (Ashgillian) age (identification by J. Riva in Trettin et al., 1979, loc. 6). Similar graptolites were found near the top of the formation at St. Patrick and Ella bays (Trettin et al., locs. 4 and 5).

South of d'Ibberville Glacier the member is 37.5 m thick and consists of about 2-10 cm thick chert bed with argillaceous partings and some carbonate replacement. The unit is recognizable on air photographs by its dark grey colour and resistance to erosion.

Imina Formation

This widely exposed formation comprises a great thickness of flysch-like sediments. In most of the present area it lies conformably on the Hazen Formation but at d'Ibberville Glacier it overlies equivalents of the Allen Bay Formation. The top is only preserved at Caledonian Bay, where it is conformably overlain by the Eids Formation. The best stratigraphic sections are at Caledonian Bay where the formation is highly diachronous (*op. cit.*). Three subdivisions are recognized on the northwestern limb of the Caledonian Bay Syncline, referred to as lower Imina Formation, Caledonian Bay Conglomerate Member, and upper Imina Formation. Lower and upper Imina Formation both consist of very fine grained calcareous and dolomitic sandstone and similar mudrock with minor amounts of carbonate conglomerate and breccia. The sediments show flysch-like primary structures including Bouma sequences, massive sandstone beds and sole marks. The Caledonian Bay Conglomerate Member is composed of siliceous pebble and cobble conglomerate that probably represents a submarine channel fill. The lower Imina Formation is about 1057 m thick and ranges in age from late Early Silurian (late Landoverian) to early Late Silurian (Ludlovian). The Caledonian Bay Conglomerate Member is 42-101 m thick and Ludlovian in age. The upper Imina Formation, about 1637 m thick, ranges in age from Ludlovian to earliest Devonian. On the southeastern limb of the Caledonian Bay Syncline and south of there the Imina Formation is restricted to the Early Devonian and underlain by the Cape Phillips Formation, in turn underlain by Silurian and Ordovician shelf carbonates.

Northeast of Caledonian Bay the Caledonian Bay Conglomerate Member has not been recognized suggesting that only the lower Imina Formation is preserved. Graptolites of late Early or Middle Silurian (late Landoverian or Wenlockian) age were collected by J.Wm. Kerr at locality 183.

Eids Formation

In the present map-area, the Eids Formation is preserved only at Caledonian Bay where it conformably overlies the Imina Formation (*op. cit.*). It has a minimum thickness of 854 m, consists mainly of greenish grey calcareous and dolomitic siltstone with minor sandy sequences, comparable to those in the Imina Formation, and is earliest Devonian in age.

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PRELIMINARY GEOLOGICAL MAP, PART OF GREELY FIORD EAST, GREELY FIORD WEST AND CAÑON FIORD MAP-AREAS

Combined Legend

QUATERNARY

Q — unconsolidated sediments

Vicinity of Caledonian Bay, Cañon Fiord

CARBONIFEROUS AND PERMIAN

Upper Carboniferous and Lower Permian

Belcher Channel Formation

CPbc — limestone; minor siltstone, sandstone

Cañon Fiord Formation

CPc — sandstone, siltstone, limestone, conglomerate

Other areas

CARBONIFEROUS

Upper Carbonifereous

Cañon Fiord Formation

Cc — sandstone, siltstone, limestone, conglomerate

Lower Paleozoic shelf and back-reef basin

SILURIAN

Upper Silurian

Cape Phillips Formation

Scp — mudrock , limestone; minor dolostone

Equivalent of undivided Allen Bay and Read Bay Formations

Sar — mainly limestone; minor limestone conglomerate (at top)

ORDOVICIAN AND (?) SILURIAN

Upper Ordovician and (?) Lower Silurian

Equivalent of Allen Bay Formation

Sa — carbonate rocks, probably mainly limestone

ORDOVICIAN

(Based on airphoto interpretation; age and lithology not established)

Irene Bay Formation

Oci

Oct — Thumb Mountain Formation

Ocb — Bay Fiord Formation

Oe — Eleanor River Formation

Lower Paleozoic Hazen Trough

DEVONIAN

Lower Devonian

Eids Formation

De — siltstone, minor sandstone

SILURIAN AND DEVONIAN

Lower Silurian to Lower Devonian

Imina Formation

SDi3 — upper Imina Formation: sandstone, mudrock; minor limestone conglomerate

(SDi3 -- Upper Silurian to Lower Devonian;
Di -- Lower Devonian)

Si2 — Caledonian Bay Conglomerate Member: conglomerate, sandstone, mudrock (Upper Silurian)

Si1 — Lower Imina Formation: sandstone, mudrock minor limestone conglomerate (Lower to Upper Silurian)

SILURIAN

Lower Silurian and younger

Imina Formation

Si — sandstone, mudrock; minor conglomerate

CAMBRIAN (?), ORDOVICIAN, AND SILURIAN

upper Lower Cambrian (or younger) to Lower Silurian

Hazen Formation

€-Sh

resedimented lime mudstone, grainstone, packstone and conglomerate; radiolarian and replacement chert; mudrock

CAMBRIAN (?), ORDOVICIAN, AND (?) SILURIAN

upper Lower Cambrian (or younger) to Upper Ordovician or Lower Silurian

Hazen Formation

€Oh

resedimented lime mudstone, grainstone ,packstone and conglomerate; radiolarian and replacement chert;mudrock

Oh2: chert member-- radiolarian chert, minor mudrock (Upper Ordovician and (?) Lower Silurian)

€Oh1: carbonate member -- resedimented carbonates, mudrock, chert (Cambrian (?) abd Ordovician)

 geological boundary (defined,approximate,assumed; projected through ice or overburden)

 fault (defined,approximate,assumed or projected through ice or overburden; solid circle indicates downthrow side)

 thrust fault,assumed or projected through ice or overburden; teeth on hanging wall)

 lineament visible on air photographs

 anticline (arrow indicates plunge)

 syncline

 strike and dipp of bedding, tops known

 strike and dip of bedding , tops unknown; dip estimate from air photographs

- g: gentle (about 3°-10°)
- m: medium (about 10°- 25°)
- s: steep (about 25°- 45°)
- vs: very steep (about 45°- 89°)
- vertical

 trend of bedding

× helicopter landing, outcrop observation or sample locality

× (F) fossil locality

 stratigraphic section (longer, short)

(locality numbers at Caledonian Bay from Trettin, 1979; localities 182, 183 in Greely Fiord East area from Thorsteinsson and Kerr, 1972)

Partly adapted from Thorsteinsson,1971, 1972; Thorsteinsson and Kerr, 1972; Trettin, 1979, Fig.2 .
Additional field work by H.P.Trettin, 1975, 1980.
Compiled by H.P.Trettin, 1982.