BAFFIN ISLAND SHELF – SHALLOW COREHOLE DRILLING, 1976

Projects 760015 and 760039

Brian MacLean and R.K.H. Falconer
Atlantic Geoscience Centre, Dartmouth

Shallow corehole drilling was undertaken at nine principal localities on the southeastern Baffin Island shelf (Fig. 25.1, Table 25.1) from **CSS Hudson** during cruise 76-029, September 22 to October 23, 1976 (Falconer, 1977) as part of the program to map the offshore geology of that region. The coring was carried out by means of the Bedford Institute of Oceanography's underwater electric rock core drill which cuts a 25 mm diameter core and penetrates to a maximum of 6 m below the seafloor. Site selection was on the basis of data obtained with continuous seismic reflection and Huntec deep tow high resolution seismic systems. The drilling procedure was similar to that used in 1975 (MacLean and Srivastava, 1976).

Cores of consolidated and semi-consolidated rock were recovered at six localities. These samples are considered to represent material in situ at these localities as opposed to the other stations (Table 25.1 and Fig. 25.1) where no samples other than from erratics in the overburden were recovered. The cores averaged 61 cm in length, but most were relatively short. This resulted from several factors, principally: 1. difficulties in coring some of the material encountered (loss of sample in the case of semi-consolidated strata, and limited bedrock penetration at some stations due to core fragments jamming in the core barrel); 2. mechanical problems; and 3. the difficulty of landing the drill on the prime target area. The strong southbound current (up to about 3 knots) along the Baffin Island Shelf caused some station keeping problems that led to the early termination of drilling at four stations. On the whole, however, the **Hudson** kept station well during drilling by means of the main propulsion system and bow thruster.

The continental shelf off southeastern Baffin Island was investigated previously by Grant (1975) who outlined six main bedrock units on the basis of data from seismic reflection and magnetic profiling. McMillan (1973), Wallace (1973) and Beh (1975) discussed the geology of parts of the Baffin Island shelf. Jansa (1976) and MacLean et al. (in press) reported on middle-late Ordovician strata and Precambrian rocks sampled by drilling in this area in 1975. The geology of adjacent southern Baffin Island was mapped on a reconnaissance basis by Blackadar (1967). Clarke and Upton (1971) reported on Tertiary sedimentary and volcanic rocks which occur in a narrow belt along the coast northwestward from Cape Dyer.

Cores composed of semi-consolidated sandstone with scattered gravel fragments were recovered at drill stations 6A, 16, and 16A (Fig. 25.1, Table 25.1). The cores from these stations consist of poorly sorted, mainly angular, silt to pebble sized particles with a matrix of

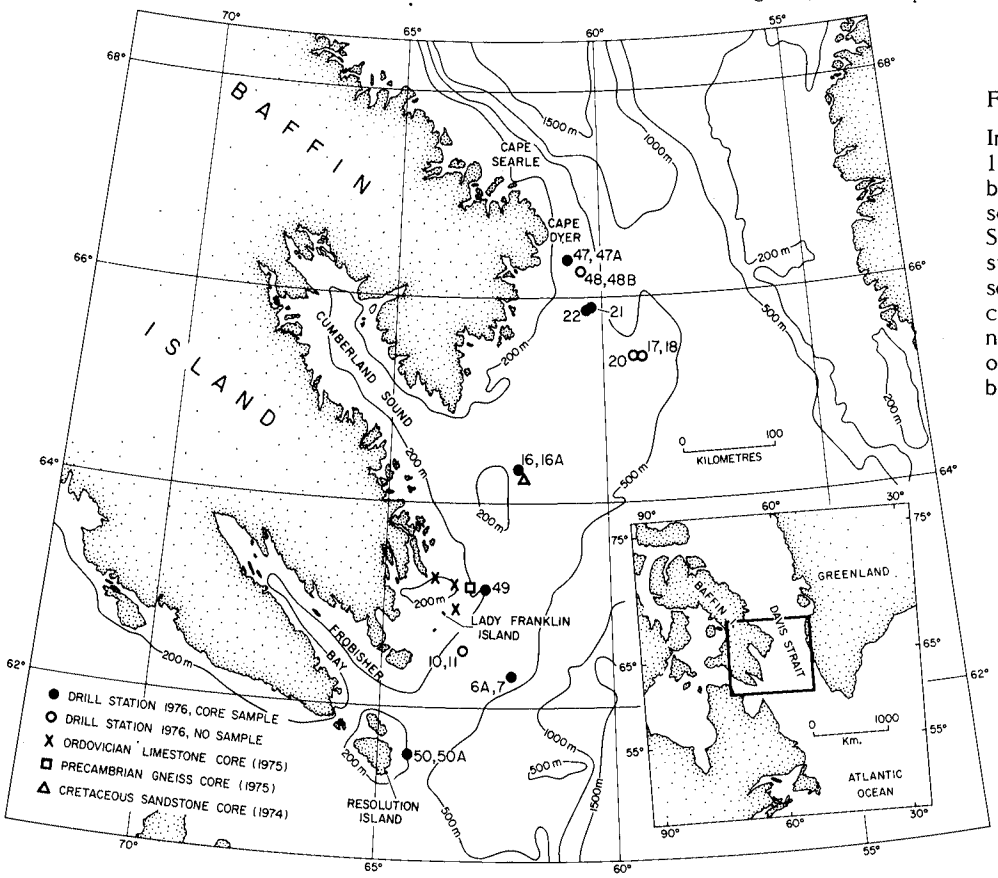

Figure 25.1

Index map showing locations of 1976 drill stations and previous bedrock sample localities on the southeastern Baffin Island Shelf. Solid circles designate 1976 stations where consolidated or semi-consolidated rocks were cored in situ. Open circles designate stations where no samples other than erratics from the overburden were recovered.

From: Report of Activities, Part B; Geol. Surv. Can., Paper 77-1B (1977)

Table 25.1

Drill Station Data

Station	Location		Water Depth(m)	Sea Floor Penetration (cm)	Results
6A	62°18.5'N	62°11.7'W	385	364	5 cm gravel, 53 cm sandstone core (semi-consolidated)
7	62°17.5'N	62°14.9'W	398	124	no core recovery.
10	62°33.1'N	63°14.0'W	223	545	18 cm gravel
11	62°32.7'N	63°16.3'W	224	545	no core recovery.
16	64°19.8'N	62°02.3'W	283	519	44 cm sandstone core (semi-consolidated)
16A	64°19.9'N	62°00.6'W	285	523	16 cm gravel, 33 cm sandstone core (semi-consolidated)
17	65°25.1'N	59°05.4'W	448	545(approx)	30 cm gravel
18	65°24.9'N	59°05.6'W	453	530	73 cm gravel
20	65°25.7'N	59°16.4'W	439	345	14 cm gravel
21	65°55.3'N	60°18.7'W	408	120	13 cm basalt core
22	65°54.2'N	60°20.2'W	404	118	37 cm basalt core
47	66°22.5'N	60°50.3'W	391	295	29 cm gravel, 37 cm basalt core
47A	66°21.6'N	60°48.6'W	391	545	30 cm gravel
48	66°16.6'N	60°30.9'W	422	545	19 cm gravel
48B	66°16.6'N	60°30.5'W	427	101	16 cm gravel
49	63°10.5'N	62°46.2'W	199	318	8 cm gravel, 104 cm gneiss core
50	61°33.3'N	64°23.1'W	199	250	no core recovery
50A	61°33.7'N	64°23.0'W	194	253	172 cm gneiss core

calcareous mud. Foraminifera are present in the cores, and the core from station 6A also contains fragments of plant material (R.H. Fillon, pers. comm.). Station 6A is 100 km east of the coast of Baffin Island and is underlain by strata that regionally have, for the most part, a regular gentle seaward dip, but in the vicinity of the drill station the strata in the upper part of the sequence prograde. Huntec data across the site reveal a continuous near surface reflector that is overlain by a hummocky layer of unconsolidated sediment ranging from near zero to 8 m or more in thickness. A grab sample of this material consisted of silty and clayey sand with some gravel. The near surface reflector appears to mark the top of the sequence cored, but whether this forms part of the progradational sequence or a thin overlying younger sequence unresolved on the seismic profiles is not clear from the present data.

Stations 16 and 16A are on the shelf seaward from the entrance to Cumberland Sound approximately 8 km north-northwest of the site where Srivastava, (1974) recovered 18 cm of sandstone core of late Albian-Cenomanian age (G.L. Williams, pers. comm.). The 1976 drilling locality is underlain by strata which flank a possible diapiric? or fault structure and have an apparent southeasterly dip of some 15°. Huntec and grab sample data from this locality reveal a near surface reflector and overlying unconsolidated sediments that closely resemble those at station 6A in texture and hummocky surface. Seismic reflection (air gun) data in the general area indicate that a thin sequence of younger strata in places unconformably overlies the more steeply dipping beds associated with the underlying structure. Core samples obtained at stations 16 and 16A may be from this younger sequence.

Foraminifera and other shelly microfossils in the cores from stations 6A, 16, and 16A were examined by F.M. Gradstein and spores and dinoflagellates by G.L. Williams and they consider the sediment to be of probable Pliocene-Recent age (F.M. Gradstein, G.L. Williams, pers. comm.). Palynomorphs in the core from station 6A were of Paleozoic, Cretaceous and Plio-Pleistocene ages whereas those in the cores from stations 16 and 16A were predominantly of Aptian-Cenomanian age together with some Senonian-Early Paleocene, Eocene and Plio-Pleistocene forms (G.L. Williams, pers. comm.). In view of the broad spread of ages represented by the palynomorphs and the post Miocene age assigned to the shelly microfossils by Gradstein, the older palynomorphs are considered to have been derived through reworking of material from older strata. The microfossil assemblage at station 6A is indicative of deposition in a brackish-shallow marine environment whereas the assemblage at stations 16 and 16A is characteristic of a shallow open shelf environment (Gradstein, pers. comm.). The presence of plant remains is compatible with a nearshore environment for the material cored at station 6A. The texture of the sediments suggests that floating ice was an important transporting agent at both localities. The interpretation that the sediments in the cores are products of earlier and different environments than those presently prevailing there is supported by contrasts between the microfossil assemblages in the cores and those of grab samples of material from the present sea floor at these localities. R.H. Fillon (pers. comm.) found the latter to be generally consistent with the deeper open shelf marine environment that currently exists in those areas.

Short cores of basalt were recovered at two main localities on the shelf southeast of Cape Dyer (Table 25.1). These are 33 km (station 47) and 89 km (stations 21 and 22) south-southeast of Cape Dyer, respectively (Fig. 25.1), in an area where Grant (1975) inferred the presence of volcanic rocks on the basis of seismic and magnetic data. The core samples from stations 21 and 22 are reddish brown and dark grey in colour respectively, and both consist of fine grained basalt and contain numerous zeolite filled vesicles. The core from station 47 consists of dark grey fine grained basalt in which some vesicles, mainly unfilled, are present.

Basaltic rocks occur on eastern Baffin Island as discontinuous outcrops within a narrow zone some 10 km wide that extends along the coast from just north of Cape Dyer to near Cape Searle 45 km to the northwest. Clarke and Upton (1971) reported a K-Ar age of 58 ± 2 m.y. for the basalt which in places lies on sediments containing fossil flora dated by W.A. Bell as Paleocene. Offshore the seismic reflection data reveal an acoustically relatively uniform sequence of rocks that except for a few local structures seems to dip southeasterly at an apparent angle of approximately 10° from the vicinity of Cape Dyer to station 22 and beyond. The attitude of these rocks on the seismic reflection profiles resembles that of the subaqueous breccias of eastern Baffin Island illustrated by Clarke and Upton (1971). Radiometric ages of the core samples are not yet available, but on the basis of relationships inferred from the seismic profiles, the sequence cored offshore appears to postdate the breccias examined on land by Clarke and Upton.

Cores of rocks of presumed Precambrian age were recovered at two localities, stations 49 and 50A, that were sampled to investigate variations observed on magnetic profiles in those areas. The core from station 49 consists of quartz-biotite-feldspar gneiss. This station lies 17 km east of a 1975 drilling locality where cores composed of biotite gneiss were obtained. These stations are located on a basement high that extends east-northeasterly through Lady Franklin Island (MacLean et al., in press). Station 50A lies 13 km east of Resolution Island. The core recovered at this locality comprises 172 cm of light grey garnetiferous gneiss.

Preliminary compressional wave velocity measurements were performed onboard the **Hudson** on sections cut from the cores of basalt and gneiss. Eight basalt bedrock samples from stations 22 and 47 were found to have velocities ranging between 5.2 and 6.0 km/sec, the average velocity for those rocks being 5.6 km/sec. A small cobble-sized fragment composed of dense, fine grained basalt encountered in the unconsolidated sediment at station 48A had a velocity of 6.8 km/sec. Four gneiss bedrock samples from stations 49 and 50A yielded velocities ranging from 5.0 to 6.1 km/sec, the average velocity being 5.5 km/sec. Measurements on gneiss fragments from the overburden at stations 18, 47 and 48 yielded velocities ranging from 4.8 to 5.8 km/sec, the average velocity being 5.4 km/sec. Velocity data on the semi-consolidated sandstone cores from stations 6A, 16, and 16A are not yet available. These cores could not be cut with the equipment onboard ship without risk of disintegration of the samples due to their poorly lithified nature.

References

Beh, R.L.
1975: Evolution and geology of western Baffin Bay and Davis Strait; in Canada's Continental Margins and Offshore Petroleum Exploration, C.J. Yorath, E.R. Parker and D.J. Glass, Eds.; Can. Soc. Petrol. Geol., Mem. 4, p. 453-476.

Blackadar, R.G.
1967: Geological reconnaissance, southern Baffin Island, District of Franklin; Geol. Surv. Can., Paper 66-47, 32 p.

Clarke, D.B. and Upton, B.G.J.
1971: Tertiary basalts of Baffin Island: field relations and tectonic setting; Can. J. Earth Sci., v. 8, no. 2, p. 248-258.

Falconer, R.K.H.
1977: Marine geophysical and geological research in Baffin Bay and the Labrador Sea, **CSS Hudson**, 1976; in Report of Activities, Part B, Geol. Surv. Can., Paper 77-1B, rep. 46.

Grant, A.C.
1975: Geophysical results from the continental margin off southern Baffin Island; in Canada's Continental Margins and Offshore Petroleum Exploration, C.J. Yorath, E.R. Parker and D.J. Glass, Eds.; Can. Soc. Petrol. Geol., Mem. 4, p. 411-431.

Jansa, L.F.
1976: Lower Paleozoic Radiolaria-bearing limestones from the Baffin Island Shelf; in Report of Activities, Part B, Geol. Surv. Can., Paper 76-1B, p. 99-105.

MacLean, B. and Srivastava, S.P.
1976: Shallow corehole drilling on the Baffin Island Shelf; in Report of Activities, Part A, Geol. Surv. Can., Paper 76-1A, p. 141-143.

MacLean, B., Jansa, L.F., Falconer, R.K.H., and Srivastava, S.P.
Ordovician strata on the southeastern Baffin Island Shelf revealed by shallow drilling; Can. J. Earth Sci. (in press)

McMillan, N.J.
1973: Shelves of Labrador Sea and Baffin Bay, Canada; in The Future Petroleum Provinces of Canada (R.G. McCrossan, Ed.), Can. Soc. Petrol. Geol., Mem. 1, p. 473-517.

Srivastava, S.P.
1974: Cruise report **Hudson** 74-026, Phase IV, September 26 to November 1, Bedford Institute of Oceanography.

Wallace, F.K.
1973: Geology of the Davis Strait bathymetric sill and associated sediments, offshore Baffin Island, Canada; in Proceedings of the Symposium on the Geology of the Canadian Arctic, Saskatoon, May 1973 (J.D. Aitken and D.J. Glass, Eds.); Geol. Assoc. Can./Can. Soc. Petrol. Geol., p. 81-97.