is correlatable with that at locality F4 and the fauna is possibly of the same age.

The middle part of the Cape Schuchert Formation in western North Greenland contains graptolites from Elles & Wood's graptolite zone 20 belonging to the late Middle Llandovery (Lower Niagaran in the North American standard) and the fauna from Frederick E. Hyde Fjord is concluded to be of the same age.

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MARINE GEOPHYSICAL SURVEY BETWEEN 68° 30′N AND 73° 30′N, WEST GREENLAND

Leslie R. Denham

An offshore geophysical programme was carried out during the summer to extend the mapping of the Cretaceous-Tertiary onshore sedimentary basin in West Greenland to the adjacent fjord areas, and to investigate the relationship of the onshore sediments and volcanics to offshore sediments to the west (Ross & Henderson, 1973).

Between 4th July and 2nd August a four-man party led by the writer and Birger Larsen (Danmarks Tekniske Højskole) on the chartered Norwegian sealer

"Brandal" completed about 3000 km of seismic and magnetic profiling, and 600 km of magnetic profiling, in coastal areas between 68°30'N and 73°30'N. In general, work was concentrated on the fjord areas and close inshore, particularly in Disko Bugt, Vaigat and Umanak Fjord, but one profile was continued 120 km west from Upernavik Isfjord. Two sonobuoy refraction profiles were recorded and a number of bottom samples were collected.

Equipment

Reflection seismic profiles were recorded by a single channel shallow-penetration seismic system assembled mainly from commercially available components. The energy source was one or two air guns; chambers for these were carried in sizes from 1 cubic inch (0.016 l) to 40 cubic inches (0.656 l). The compressor used could nominally supply enough air to run 60 cubic inches at 150 atmospheres, at a firing interval of three seconds. However, problems arose with the compressor and the most commonly used arrangement was one air gun with a 20 cubic inch chamber, firing at a nine second rate. The seismic signal was detected by an 80 m, 200 element, active streamer, and filtered and amplified before being fed to both an FM tape recorder and a graphic recorder. The signal was further filtered before being displayed on the graphic recorder.

The magnetometer used was a proton precession instrument recording on a 5 inch chart recorder. The data was also recorded on a spare channel of the seismic tape recorder.

An FM telemetry receiver was carried to allow sonobuoys to be used for recording refraction profiles. These recordings were carried out simultaneously with normal reflection recording.

Navigation

Navigation equipment was restricted to the normal instruments carried by the ship: compass, radar, echo sounder, radio direction finder and sextant. As the ship was equipped with a variable pitch propeller, a conventional log was necessary for measuring distance run: however, this could not be used when the geophysical equipment was in the water behind the ship because of the risk of entanglement. Speed was therefore estimated from engine revolutions and pitch setting. Most of the time dead reckoning was used, corrected by frequent fixes by radar distances or visual ranges and horizontal angles. Difficulties were experienced when icebergs were confused with small islands; when unpredictable currents were present; when features could not be identified on the radar (e.g. on long stretches of the coasts of Disko and Nûgssuaq); when the ship was more than 25 nautical miles from the nearest land; and when local anomalous magnetic variation made the compass unreliable. However, in general, the plotted positions of traverse lines are believed to be within 2 km of their actual position.

Operations

Operations were carried out on a 24-hour day, seven day week basis, but because of equipment breakdowns, visits to port for supplies, etc., no traversing was done on four days during the survey period, and the longest non-stop work period was only four days. On only two occasions was traversing suspended because of weather, once when rough seas increased the seismic noise to an unacceptable level, and once when very thick fog and a dense concentration of icebergs made navigation dangerous. The weather was foggy more often than not, but this did not normally affect operations.

Results

Preliminary examination of the seismic and magnetic data has shown several new features in the area surveyed. Disko Bugt appears to be generally devoid of pre-Quaternary sediments. The outlier at Grønne Ejland is of very limited extent, and other outliers of sediments west of Jakobshavn and east of Godhavn are both limited in area and quite thin: probably 300 m or less. Extensive work in Vaigat shows that the sediments continue from Disko to Nûgssuaq, and there is no evidence of faulting along Vaigat.

Throughout Disko Bugt and the eastern part of Vaigat frequent dykes and sills cut Cretaceous sediments where these are present. These igneous bodies show as sharp magnetic anomalies – almost always negative – and, usually, as ridges on the sea floor.

In two areas of undoubted Precambrian outcrop on the sea floor – among the skerries west and north of Egedesminde, and in Upernavik Isfjord – a highly variable magnetic field was found, which is superficially indistinguishable from the magnetic pattern characteristic of the Tertiary basalts of the Disko-Svartenhuk area. This immediately casts doubt on the validity of previous interpretations of the offshore extension of the basalts, as these interpretations have relied mainly on magnetic data (Park *et al.,* 1971; Ross & Henderson, 1973).

West of Upernavik is one area where magnetic rocks previously thought to be basalt are almost certainly Precambrian. At latitude 73°15′N sediments lap onto these magnetic rocks 40 km west of the outermost skerries, and increase in thickness to about 3.5 km 100 km offshore. The western boundary of the sediments was not reached, but it seems probable that this is the southern end of the Melville Bugt "graben" (Ross & Henderson, 1973).

West of Prøven another area of sediments lapping onto the magnetic Precambrian was located. Here the maximum thickness of sediments traversed was about 1.4 km, and the sediments were increasing in thickness to the south.

West of Disko and Nûgssuaq it now appears that the Tertiary volcanics are limited by a major fault down-thrown to the east. In the south, west of Diskofjord, the volcanics are faulted against sediments which are presumed to be Cretaceous or older. A Jurassic fossil was found in a dredge sample off Disko last

century (Haughton, 1862). To the north the sediments thin until they are replaced on the sea floor by Precambrian basement against the basalt, while further west sediments lap on to the basement. This strip of basement outcrops on the sea floor from about 70°00′N to 71°20′N, where it appears to be cut off by an E-W fault which forms the southern limit of the Svartenhuk volcanics.

In Umanak Fjord and Igdlorssuit Sund the results indicate a general continuation of the geology of Nûgssuaq: a sedimentary sequence is limited in the west by a fault which brings it against volcanics, and in the east the sediments have a complex fault-controlled relationship with the Precambrian rocks. North of Ubekendt Ejland the relationships of the volcanics, sediments and basement are too complex to be unravelled with the limited data collected.

The seismic profiles recorded are potentially of great value in interpreting the Quaternary history of the area surveyed, because they show detailed sea-bed topography as well as quite precise limits and thicknesses of Quaternary sediments. Specific features which have been mapped are the divide between the former ice drainage through Vaigat and through Disko Bugt, and the limited channels through which ice drained from Disko Bugt. The difference in cross sections of glacial valleys in different rock types has also been demonstrated.

Intrusions

The magnetic profiles show numerous bodies of magnetic rocks in the form of dykes or sills. The dykes in the Vaigat and Disko Bugt all show as a sharp negative anomaly of 500–1500 gammas against a smooth background characteristic of the sedimentary areas and many basement areas. The negative anomaly indicates reversed remanent magnetism. In the Atanikerdluk area such dykes offshore can be correlated with the onshore dykes which cut the Cretaceous and Tertiary sediments.

Off the entrance to Umanak Fjord is a local magnetic body about 30 km by 5 km. The anomaly is positive (in contrast with the negative anomalies most commonly associated with the Tertiary volcanics) and is of exceptional magnitude – over 2000 gammas. This anomaly is in the area of presumed basement outcrop on the sea floor and thus may represent an intrabasement feature.

Bottom sampling

Dredges, a corer and a grab were carried to take bottom samples and were used on several occasions. However, results were disappointing because only Recent sediments were recovered on all occasions. The deep water generally present in the areas surveyed made sampling very time consuming, and after it became apparent that the recovery was poor, the time available was used mainly for geophysical measurements. The deepst sample recovered was a grab sample taken in 1100 m of water in Upernavik Isfjord.

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GEOLOGICAL AND GEOPHYSICAL WORK IN THE NÛGSSUAQ–DISKO REGION, CENTRAL WEST GREENLAND

Gilroy Henderson

During the summer the geological and geophysical work on Cretaceous-Tertiary sedimentary and volcanic rocks of central West Greenland embarked upon in 1971 (see Henderson, 1972), was continued. This programme ran concurrently with offshore geophysical work (see Denham, this report), the object of the combined investigations being to study in detail the sedimentary and volcanic rocks of the entire area. With the interest in the petroleum potential of the West Greenland continental shelf continuing unabated, the only area where the Cretaceous-Tertiary rocks are exposed is clearly of considerable economic as well as academic interest.

As in 1971 three main groups participated in the work on land: a field mapping group, a geophysical group and a drilling group. A team of eight people from outside Greenland, comprising three geologists, two geophysicists, two technicians and one assistant worked in the area, and were ably assisted by Greenlanders from Niaqornat. The expedition was supported by the GGU ship "K. J. V. Steenstrup", with Andreas Viðstein as skipper.

Field mapping group

A party led by A. K. Pedersen (Univ. of Copenhagen) extended the area already mapped in detail to include north-west Disko. The Tertiary volcanic sequence in this area comprises the top of the olivine basalts from the lower lava formation and about 1.8 km of predominantly feldspar-porphyritic basalts from the upper lava formation.

The outermost 7–8 km along the west coast of Disko is very extensively faulted. The lavas strike N-S and dip west, the amount of dip increasing westwards from less than 10° to 35–40°. The presence in the upper lava formation of a marker sequence dominated by highly sediment-contaminated lavas and tuffs enabled correlation to be made across the faults. The faults have resulted in numerous re-