IGS (CSU II) 73/6

RADIOMETRIC SURVEY IN THE NORTH MORAY FIRTH 1973

SS PROFILER CRUISE 73/18
22 AUG – 2 SEP 1973

by

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PRELIMINARY ASSESMENT OF GEOLOGICAL ASPECTS

(A) Introduction

During the period 22nd August to 2nd September 1973 SS Profiler carried out a radiometric survey cruise 73/18 for the IGS Geochemical Division in the Moray Firth between latitudes 58° 25'N and 58° 55'N, and longitudes 2° 20'W and 2° 40'W. Project leaders were J Miller (RMMU) and G Symons (Harwell). Positioning was by a satellite navigation system. J Chesher (CSU II) and N Kenolty (MGU) were present to assess the potential of the eel for Continental Shelf survey work, and to operate the geophysical and sampling equipment on board.

(B) Purpose of project

The purpose of the project was threefold:

(1) To assess the radiometric eel as a viable piece of offshore research equipment.

(2) To ascertain the compatability of the radiometric eel with other routine geophysical equipment, namely sparker, pinger, magnetometer, gravimeter and transit sonar.

(3) To survey an area where good geological control already existed (from previous work by CSU II and MGU), with the view to a geological assessment of the radiometric results.

(C) Results

During the Radiometric survey Cruise 73/18 aboard SS Profiler 710 km of survey lines were completed, run on a N-S grid with line spacing 1.6 km apart, and on an E-W grid with line spacing 8 km apart (Fig 1). 26 sample stations were occupied and sampled by means of a cone dredge, the samples being frozen for later geochemical analysis. Further sampling in the area was completed by m v Steelfish during Cruise 73/SF/17 from 1st-6th October, 1973, during which time 42 stations were occupied consisting of 42 shipek grab, 42 core dredge, 38 gravity corer and 2 vibrocorer samples.

(D) Assessment of Eel

The eel, consisting of 60 ft of rubber tubing of 5 in diameter with a radiometric probe 3 ft long at the end, is easily handled by means of an electrohydraulic Lebus winch. It is lowered over the stern of the ship guided by a metal chute, and towed behind the ship at a speed of 3-4 knots by means of an armoured co-axial cable, so that approx 20 ft of the eel is always in contact with the sea floor. A ten fold increase in count rate is observed when the eel is on the bottom, and this enables the operator to easily assess when it is in contact with the sea floor. However, continuous careful observation of water depth on an echo sounder is required so the appropriate amount of cable can be payed out or brought in to keep the correct amount of the eel on the bottom. This operation is achieved by a remote control of the winch from the lab.

During an 8 day period only 8-10 hours operation were lost due to the following factors:

(D) (continued)

(1) Loose electrical connections inside probe, due to faulty assembly.

(2) Calibration time taken when new probe was attached.

(3) Complete failure of probe on rocky sea bed tentatively attributed to failure of photomultiplier tube on gamma detector.

During repair of the probe a section of rubber tubing was removed due to disintegration. The life expectancy of this tubing is at present 1000∅-2000∅ km.

Apart from the above factors few problems were encountered with equipment reliability. However, the nature of the botton proved exceptionally uniform without any major obstructions, and as a future exercise it would be of value to test the eel over a similar given period in more uneven topography.

It is important to note that at present specialist knowledge is required to undertake repairs, especially in the absence of any manual. General streamlinging of the electronic consoles and recorders is required. The duplication of chart printout for total counts on the Rikaderski and Telsec recorders seems superfluous. Data handling could be simplified if the four outputs could be logged by the IGS data logger, obviating the need for the teletype/punch.

(E) Equipment compatability

The following equipment was used in conjunction with the eel during the entire period.

(1) Sparker (10000 J) and magnetometer - towed over the stern.

(2) ORE pinger - towed on starboard side of ship.

(3) Transit sonar - attached to port side of ship.

(4) Gravimeter.

There were no problems either in operational handling proceedure, or in equipment functioning compatability without interference, for any of the above equipment and the radiometric eel.

It is emphasised that the above geophysical equipment is normally operated at a ship speed of at least 8 knots, whereas at the moment the eel is restricted to a speed of 3-4 knots to enable it to withstand bottom shocks in its present stage. This reduces the number of line miles completed, and makes the problem of keeping a ship on a straight course more difficult.

(F) Geological Account

The following geological assessment of the area is based on sparker, pinger and sampling information gathered during this survey cruise 73/18, and also on information obtained from other CSU II and MGU cruises, namely 70/3; 70/9; 70/13; 71/9; 72/10 and 73/17.

(1) Bathymetry

The sea floor is level throughout the area surveyed, and is very regular in character.

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(F) (1) (Continued)

It remains at a fairly consistent depth of about 70 metres. The only irregularities present are due to sand waves, and these occur only in the extreme NW of the area; they are also present to the west of the survey area towards Wick.

(2) Drift

Rock is near outcrop over most of the region especially in the central and northern parts where rockhead is less than 0.5 m below sea floor in the area indicated by shading on Fig. 2. Small patches of thicker drift are due to infill of small trough like depressions in rockhead in the SE of the area and to the presence of large sand waves in the NW and west of the area.

The drift deposits consist largely of marine sands, probably with a thin veneer of underlying boulder clay.

(3) Sediments

The marine sediments consist mainly of shell sands averaging between 50% and 99.9% shell material. These sands vary from very coarse to fine in grain size, and are generally poorly sorted. The shell débris consists largely of broken bivalve debris, but foraminifera, ostracods and echinoid spines are also prolific.

The sand waves in the west and north-west generally consist of coarser material, while over the rest of the area fine shell sand predominates with occassional layers of coarser material. In the south-east of the area shell content in the sands diminishes and the sands become more quartzose in composition.

(4) Solid

Rockhead is in the main a smooth horizontal surface representing a level of planation. Bedrock consists of Old Red Sandstone in the northern half of the area and Upper Cretaceous chalk and marl in the south. The Upper Cretaceous is downfaulted against the Old Red Sandstone by a major EW trending normal fault (Fig.4).

The Old Red sandstone is folded into a series of anticlines and synclines with bedding dips averaging about 6 degrees. These dips form a marked contrast to those in the Upper Cretaceous where the bedding is essentially horizontal and only folded into very broad open flexures.

(G) Interpretation of results

Radiometric information was recorded in the following format:

Digital (1) No. total counts: No. counts U, K, Th, printed on a teletype.

(2) No. total counts: No. counts U, K, Th, on punch tape.

Analog (3) No. total counts: No. counts U, K, Th recorded on a Rakaderski chart reader.

(4) No. total couhts recorded separately on a Telsec 700 chart recorder.

A provisional map of total counts of U, K, Th taken at 10 minute fix intervals, was constructed during the cruise. Assessment of this data was made possible by comparison with drift isopachyte maps and solid

(G) (Continued)

geology maps drawn from data simultaneously recorded by pinger and sparker. The following preliminary results emerged from the shipboard radiometric map, but it must be stressed that these will need to be reconsidered when a more detailed radiometric map is available.

(1) Areas of near surface outcrop where rockhead was less than 0.5 m below sea floor as shown by the pinger and sampling could not be easily ascertained from the radiometric results. Only in the centre of the area did a high count rate correspond with near surface outcrop, and even in this instance it is not immediately apparent which radiometric contour should be taken to delimit the area of near surface outcrop.

(2) No obvious distinction or mappable boundary between the Upper Cretaceous chalk and the Old Red Sandstone was indicated by the radiometric results, although the higher count maxima were in areas of ORS.

(3) No fault trends were immediately apparent.

(4) A faint grain in the radiometric results, possibly due to Old Red Sandstone lithological variation, might be discernible through the drift. This requires further analysis.

(H) <u>Provisional Conclusions based on shipboard radiometric results</u>

(1) Over a given period the radiometric eel proved satisfactory as far as handling and general reliability were concerned.

(2) Further trials over more irregular topography are required to assess this reliability more accurately, since the area surveyed proved to be of exceptionally even character.

(3) Regions of outcrop are not easily ascertained from the provisional radiometric map.

(4) A lack of immediately apparent lithological distinction between solid Cretaceous and ORS strata is probably a reflection of masking by overlying drift. There is an apparent problem in discriminating between radiometric effects due to drift and those due to the influence of underlying solid.

(5) Analysis of samples of sediment and solid collected will enable a more qualitative evaluation of the radiometric counts to be made.

(6) A final assessment awaits the production of a more detailed rediometric map.

(I) <u>Cruise Sheet Numbers. 1:100,000</u>

Profiler 73/18 Sheet 58 30N/03W

Profiler 73/18 Sheet 58 00N/03W

Steelfish 73/17 Sheet 58 30N/03W

Steelfish 73/17 Sheet 58 00N/03W

Cruise sheets are deposited at CSU II

J. A. Chesher.
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