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Ship and Airborne Magnetometer Results from the Scotia Shelf, Grand Banks and Flemish Cap

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Ship and Airborne Magnetometer Results from the Scotia Shelf, Grand Banks and Flemish Cap.*

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Since 1958 the GEOLOGICAL SURVEY OF CANADA has been carrying out magnetic surveys over the continental shelves of Eastern Canada (Figure 1). The objective of these surveys is to aid the geological study of the continental shelves, and particularly to outline areas of thick sedimentary accumulations which could be important in petroleum exploration.

This report deals with results of some of the surveys in the area, including sea magnetometer results from the eastern Scotia Shelf and the Grand Banks of Newfoundland, and results obtained during magnetic airborne detector (MAD) surveys carried out in co-operation with the NATIONAL AERONAUTICAL ESTABLISHMENT and the RCAF. Since the end of 1963, the sea magnetometer work has been carried on by BEDFORD INSTITUTE OF OCEANOGRAPHY.

The Eastern Scotia Shelf

The Eastern Scotian Shelf, including the area around Sable Island, was surveyed in 1961 by sea magnetometer in CSS Kapuskasing (Figure 2; area A in Figure 1). The Cambro-Ordovician Meguma Group shows up as a characteristic pattern of anomalies, and the eastern margin of this area can readily be traced. Seaward of this, the thickness of the sedimentary cover over the basement increases so that basement anomalies are progressively subdued in definition. Of particular interest is a zone of relatively flat magnetics extending eastwards from Chedabucto Bay in an area where LONCAREVIC (1965) has reported a negative gravity anomaly. The formations underlying Chedabucto Bay are most probably Carboniferous sedimentary rocks and are bounded on the south by a fault contact with the Meguma Group. Pockets of Triassic sedimentary rock outcrop at the eastern end of Chedabucto Bay (STEVENSON, 1964), so that it is also possible that the bay is underlain in part by formations of Triassic age.

A line of magnetic highs and lows is present immediately to the south of the 100-fathom contour on the edge of the continental shelf (Figure 2). These are presumably part of the well-known continental slope anomaly, and are shown by a line of crosses. Their position is consistent with a suggestion of BERGER et al (1965) of a basement ridge south of Sable Island.

An example of the features found during the 1962 Scotian Shelf aeromagnetic survey is shown in Figure 3, south of Halifax (area B in Figure 1). The magnetic grain parallels the coastline, indicating the presence of the Meguma Group. There is a noticeable offset in the magnetic contours running approximately north-south, and very probably this is due to a fault transecting the shelf. The two circular magnetic lows A and B are interpreted as Devonian granites by comparison with similar patterns mapped over known granites on the mainland. The granites presumably have a very low magnetite content, while the anomalies fringing the intrusions appear to have been augmented by contact metamorphism.

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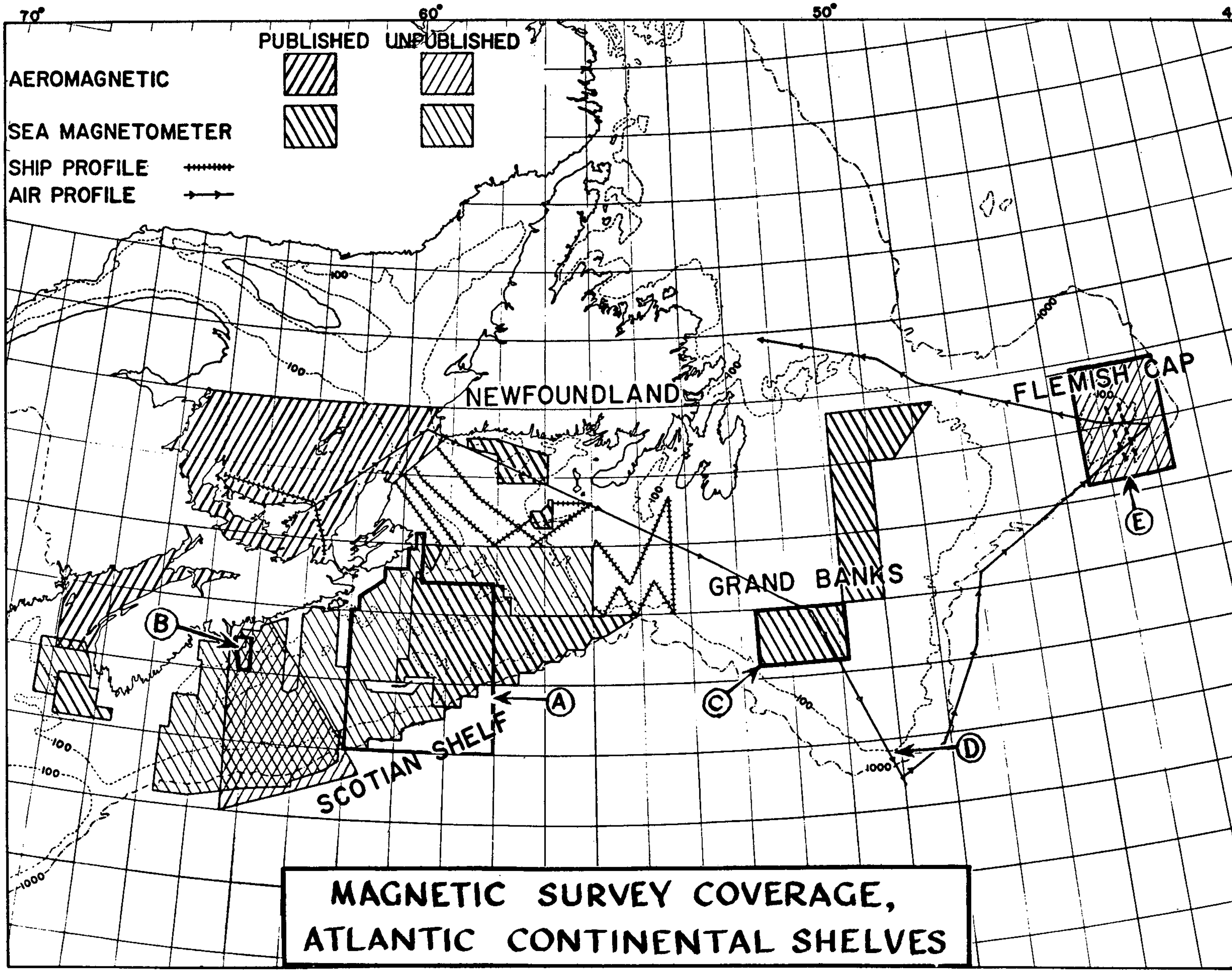
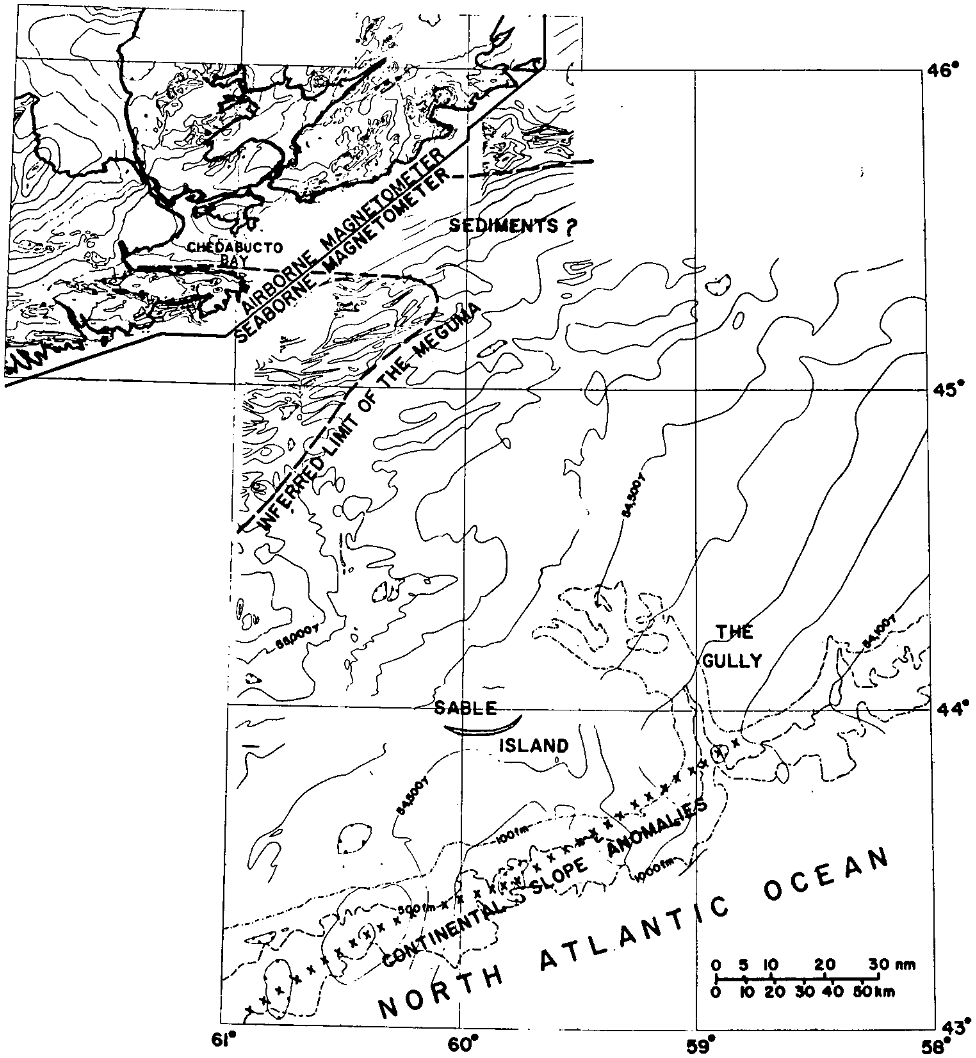


70°
60°
50°
40°
PUBLISHED
UNPUBLISHED
AEROMAGNETIC
SEA MAGNETOMETER
SHIP PROFILE
AIR PROFILE
50°
45°
40°
NEWFOUNDLAND
FLEMISH CAP
GRAND BANKS
SCOTIAN SHELF
A
B
C
D
E
100
1000
MAGNETIC SURVEY COVERAGE,
ATLANTIC CONTINENTAL SHELVES

Figure 1



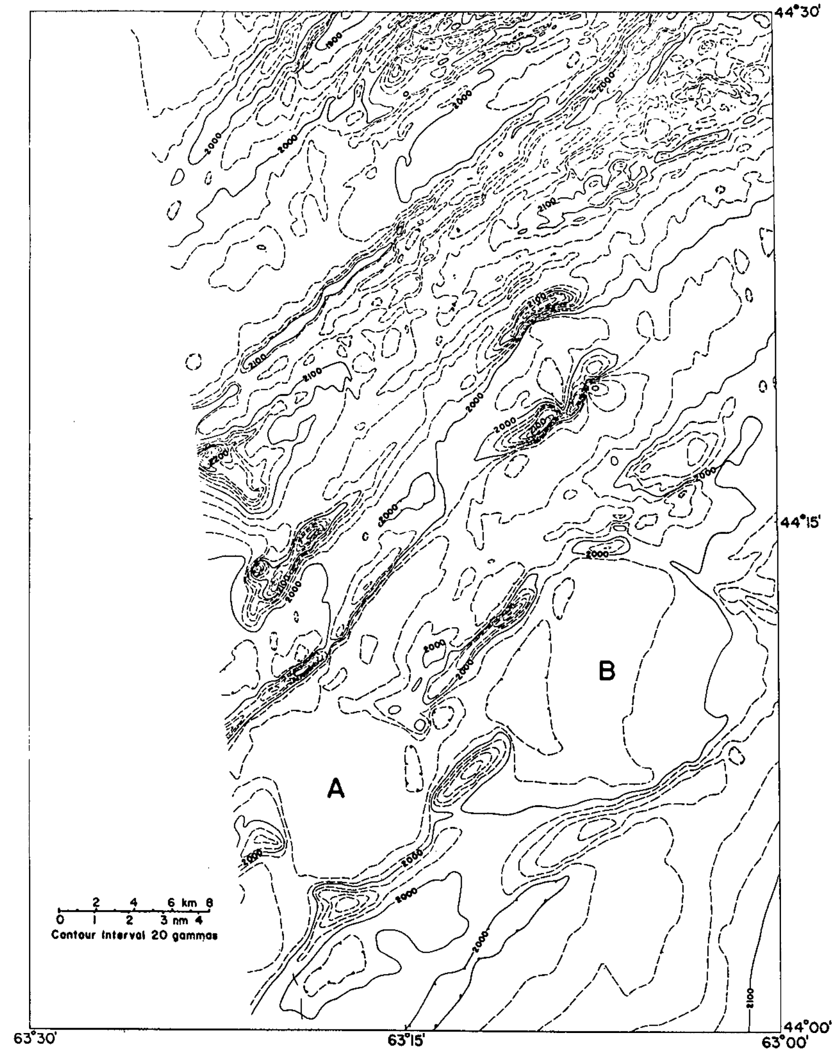


Figure 2. Sea magnetometer results from the CSS Kapuskasing 1961 survey of the eastern Scotia Shelf, together with aeromagnetic results from the adjacent mainland. Contour interval 100 gammas.

Figure 3. Aeromagnetic map of a portion of the Scotia Shelf south of Halifax. Areas A and B are presumed to be underlain by granites.

The Grand Banks of Newfoundland

The sea magnetometer map from the CSS Baffin survey of the Grand Banks of Newfoundland (area C in Figure 1) is in striking contrast with those of the Scotian Shelf. Four prominent anomalies, with amplitudes greater than 1,000gammas and fairly circular in outline, appear to strike roughly parallel to the nearby edge of the bank, and one anomaly in particular appears to have been produced by a rock formation having a remanent magnetization vector aligned in a direction quite different from the earth's present magnetic field. The presence of these anomalies is interesting in view of DRAKE and WOODWARD's (1963) suggestion that a right lateral wrench fault runs along the south-west edge of the Grand Banks, through the Cabot Strait and into the Gulf of St. Lawrence. The anomalies may occur along a line of crustal weakness, and appear to be due to basic intrusive bodies. Depth determinations indicate the tops of the anomalies to lie between 14,000 feet and 20,000 feet below sea level.

In January, 1963, an RCAF Argus aircraft flew a traverse across the Grand Banks (track shown in Figure 1), reported in HOOD and GODBY (1965). Over the Tail of the Bank (at D in Figure 1), a distinct 400-gamma anomaly was found associated with the edge of the continental shelf; this may relate to the slope anomalies recorded south of Sable Island.

Over Flemish Cap a series of shallow-source anomalies were recorded on both legs of the traverse, including a reversely-magnetized core zone, outlined by dashed lines in Figure 1. The Cap is presumably underlain by basic intrusive rocks, and the evidence is that west of the Cap these rocks are found at progressively greater depths; there is a distinct possibility that this is part of the oceanic crust, and may thus be basaltic material Cretaceous or younger in age.

Two further survey flights were undertaken in November 1965 in a North Star aircraft, operating out of the U.S. base at Argentia, Newfoundland. They were carried out in co-operation with the National Aeronautical Establishment, using a digital rubidium-vapour magnetometer. Ten east-west lines spaced about 10 miles apart and about 70 miles long were flown in the area E in Figure 1. Survey altitude was 300 feet.

The expected sharp short-wavelength anomalies were recorded on all lines except the most northerly, and are presumably due to basic igneous intrusions whose tops are buried at no great distance below the ocean bottom. More detailed interpretation must await the compilation of the resultant aeromagnetic profiles.

Acknowledgements

Acknowledgement is made to E.A. GODBY, R.C. BAKER, and H.C. LYSTER of the National Aeronautical Establishment and MARGARET E. BOWER of the Geological Survey of Canada for their co-operation in the execution and subsequent compilation of the aeromagnetic surveys described in this article.

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Relating Directional Current Structures of Modern Sediments to the Direction and Velocity of Tidal Current Systems, Five Islands Tidal-Flat Complex, Nova Scotia*

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During July and August, 1965, the first phase of a larger study relating directional properties of modern sediments to depositional current systems was undertaken in the Five Islands intertidal zone complex of Nova Scotia under the sponsorship of Hudson Laboratories. The purpose of the study at Five Islands was to (1) determine morphology, sediment composition, and texture of modern tidal-flat sediments, (2) map the surficial geology of the tidal-flat complex to form a geological basis for comparison with acoustical data obtained concurrently with a side-looking sonar by DR. JOHN E. SANDERS (see report in this issue), (3) map the orientation of directional current structures, (4) map the direction of flow of bottom-scouring current systems and relate these to directional properties in the sediments, and (5) determine the velocity and depth of bottom-scouring currents and relate these data to the size of sedimentary bedforms.

The Five Islands intertidal zone complex was selected because of easy access to sedimentary features at low tide, and easy occupation of buoyed stations at high tide. The project area was mapped by combined use of aerial photographs taken from a helicopter made available to the writer by the BEDFORD INSTITUTE OF OCEANOGRAPHY and plane-table and transit surveys in critical areas selected from analysis of aerial photographs.

Navigation was accomplished by mooring buoys at low tide and locating their position with a transit. These buoyed stations were

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