Inner Shelf Morphology, Beaufort Sea, Alaska

by

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U.S. Geological Survey
OPEN-FILE REPORT
78-785

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BACKGROUND - DATA SOURCES, AND METHODS

Sea bed morphology is a prime ingredient in the marine geologist's interpretaton of the geologic environment of a particular area. In the Beaufort Sea, the existing charts and bathymetric data have been, and to a large part still are, rather crude and imprecise. There are many "reported" shoals between 10 and 25 m of water that have "appeared" since the initiation of marine transport to the oil field at Prudhoe Bay (NOS Chart 16004). Several of our own sounding lines have found features not charted and conversely, we could not always locate features that were reported by earlier surveys. In the work of the earlier hydrographers "holidays" in their data due to the persistance of grounded ice in certain regions have been noted. Recently we have suggested that there is a definite relationship between ice zonation and the configuration of the coast and sea floor (Reimnitz and others, 1977). Thus when a new unified set of well controlled bathymetric data became available, we were anxious to examine and compare these data with earlier surveys, and to make further analyses of geologic processes in line with what we know of ice and water movement.

During 1973, ice conditions were ideal for an extensive survey of the Alaskan Beaufort Sea shelf and a rather complete set of bathymetric records from the shelf break to the 15-20 m isobath was obtained by the Geophysical Corporation of Alaska (GCA) in conjunction with running precisely controlled seismic operations (map inset). Lateral control for the GCA survey was accurate to $\pm$ 50 m. The fathometer trace could be read to the nearest 0.5 fathom and has a reported accuracy of 2%. The velocity of sound used in computing depth was 4750'/sec (written commun., Resource Marketing Services, 1977).

The GCA data has been supplemented with bathymetry taken from 1:80,000 metrically contoured charts originally compiled from 1950-55 U.S. Coast and Geodetic Survey hydrographic work sheets (Reimnitz and others, 1972, Melchior, 1976). In addition, 1976 and 1977 bathymetric data from the R/V KARLUK was used to delineate shoal features northeast of Oliktok Point (Reimnitz and Maurer, 1978). The wide variety of data sources, scales and quality, and multiplicity of data transfers used in compiling the data result in a bathymetric map which is not a precision product. We hasten to add, however, that its quality as a comparative and research document is more accurate than documents in use, primarily due to the continuity of the broad and precisely controlled data base.

DESCRIPTION OF SHELF FEATURES

The widely spaced sounding lines on the eastern and western portions of the 1978 GCA map grid (insert, Plate I) show a much less complex bathymetry than is seen in the central portion of the Beaufort

Shelf. Here the sounding lines of both the GCA data set and our own data are most concentrated. This suggests that the morphology of the shelf is perhaps oversimplified in poorly studied areas, simply due to a scarcity of sounding data. However, it appears more likely that the morphology is fundamentally different in the eastern, central, and western portions of the shelf. This suggestion is supported when shelf profiles are compared (Fig. 1). East of Prudhoe Bay the shelf slopes gently between 20 and 40 m and an apparent terrace exists between 40 and 50 m (Fig. 1, Profiles D and E), while to the west of Cape Halkett the sea floor slopes gently from 10 m or less out to the 30 m isobath before sloping more steeply to the shelf break (Fig. 1, Profiles A and B). The central part of the shelf is characterized by numerous submerged shoals (Fig. 1, Profiles B and C) in the 10-30 m depth zone, sloping offshore to the shelf break at 50 to 60 m.

Comparison of bathymetric features from 1950 Coast and Geodetic data as published on Chart 9403 (see Barnes and Reimnitz, 1974) and the 1978 compilation presented here (Plate I) (primarily from the 1973 Geophysical Corporation of Alaska data) shows several new and significant features and some consistent shifts in isobaths.

In the eastern third (145°-148°) the 30, 40, 50 and 60 m contours consistently plot further seaward (up to 10 km) on the newer data set, suggesting an apparent shoaling of this part of the shelf, or more likely a major error in one of the two data sets. The maximum apparent shoaling amounts to 10 m. This discrepancy in isobath location and depth decreases to the west and the maximum observed in the vicnity of 148° was 4 km and 5 m.

In the central portion of the 1978 map (Plate I) (148° - 151°) the limited offshore data from the GCA survey is insufficient for comparison. However, inshore the new data clearly delineate new shoals and topographic highs that significantly change earlier versions of the bathymetry. In particular Stamukhi Shoal (Reimnitz and Maurer, 1978) is delineated and located. Two other shoals in 18 - 24 m water depths north of the Colville River are also clarified on the 1978 data.

West of Harrison Bay toward Barrow (151° - 157°) the form of shelf bathymetry differs only slightly from the earlier data set although the GCA data is rather limited on this part of the shelf. The noselike protruberance of the shelf break northeast of Barrow is similar in shape and depth on both the 1978 and earlier charts.

SUMMARY

The new version of the Beaufort shelf bathymetry provides two main contributions. First, the overall morphology of the shelf takes another step towards its precise definition. Secondly, the presence of a string of major shoals stretching northwestward from Stefansson Sound to at least Cape Halkett is confirmed.

ACKNOWLEDGMENT

We would like to express our appreciation to Mel Rappaport who digitized the GCA data and aided us in retrieving this data from the computer.

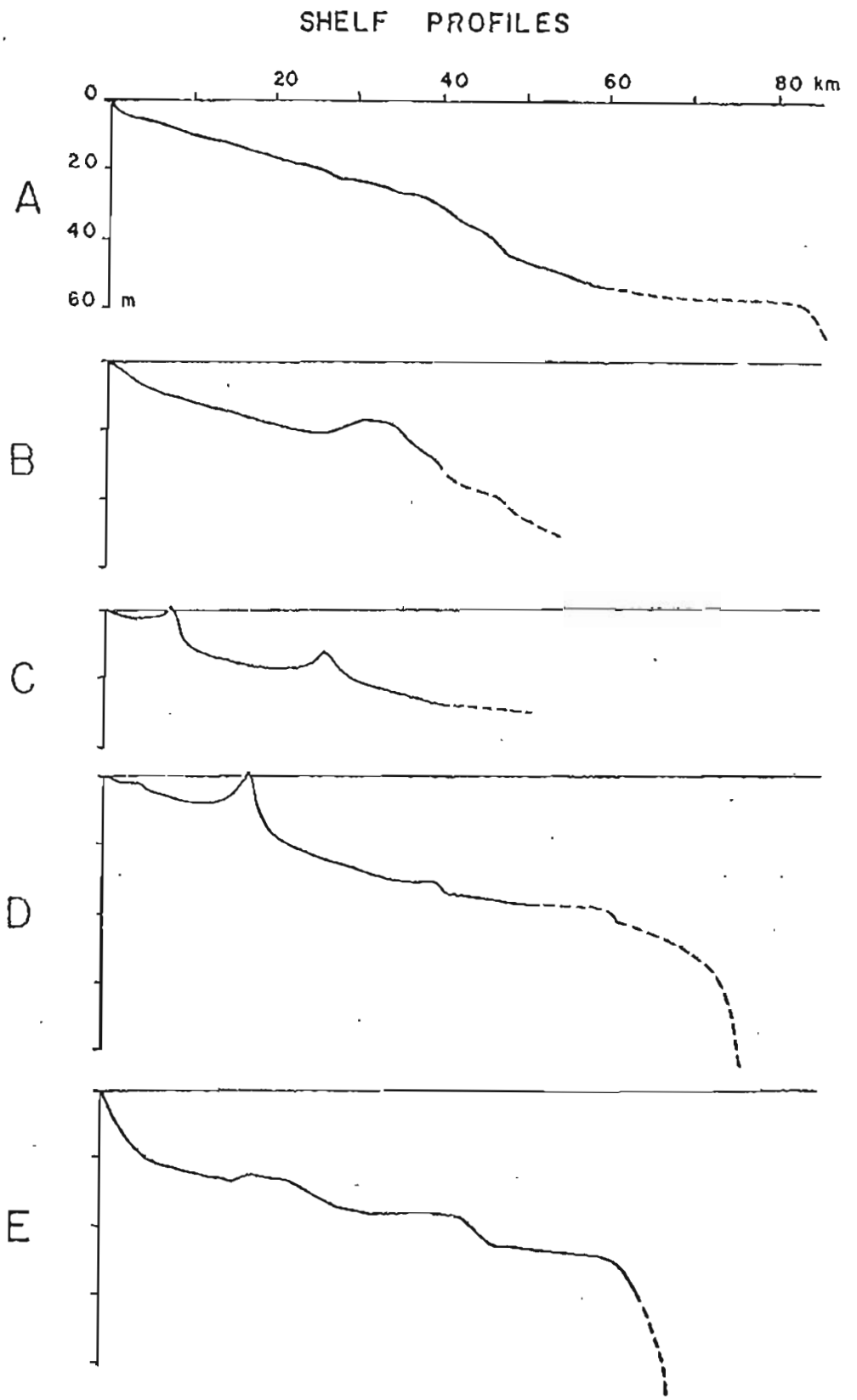

Figure 1. Bathymetric profiles across the Alaskan Beaufort Sea shelf. Profiles are dashed where the data are poor or widely spaced. Profiles are keyed to locations shown in Plate I. Note the change in character from the western portion of the shelf (A), to the central shelf (B and C), to the eastern shelf (D and E).

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