ISOPACH MAP OF QUATERNARY AND UPPER TERTIARY STRATA

This isopach map of Quaternary and upper Tertiary strata reflects the near-surface stratigraphy and structure of the Outer Continental Shelf (OCS) Oil and Gas Lease Sale 57 area. The seismic systems used in this interpretation had either a minisleeve exploder or a 15-cubic-inch watergun as the energy source. The incoming signal was sampled at a 0.5-ms rate for 1 s. The data were processed using a twelve-fold, common-depth-point (CDP) stack, and were displayed in both automatic gain control and relative true amplitude formats.

Stratigraphy

Norton Basin is filled with about 4 km of sediment as old as early Tertiary (Nelson, Hopkins and Scholl, 1974) or Late Cretaceous (Fisher and others, 1979). These sediments are continuous with the main layered sequence (Scholl and Hopkins, 1969) and overlie the acoustic basement of Paleozoic rocks. On the basis of velocity contrasts identified from sonobuoy refraction surveys, Fisher and others (1979) have divided this sequence into four velocity units. These velocity units probably correspond to various lithologic units that were deposited as the basin evolved. The youngest velocity unit, A, is characterized by compressional velocities of 1.7 to 2.1 km/s, and the underlying unit, B, by velocities of 2.3 to 2.8 km/s. They do not specifically explain the A and B velocity contrast, nor describe the lithology of unit A. However, they imply that the older unit, B, was deposited during a marine transgression of the basin. The unconformity at the base of unit B marks the time when the basin changed from a nonmarine or deltaic environment to a marine environment. This unconformity is dated as Oligocene-Miocene by Fisher and others (1979), and as late Miocene by Scholl and Hopkins (1969) and Holmes and others (1978). Therefore, the base of unit A is probably younger than the Oligocene-Miocene boundary, and may be younger than late Miocene.

This isopach map represents what we have identified as corresponding to unit A in the survey area. We have tentatively assigned an age of Quaternary and late Tertiary to the strata. We located the base of unit A by using the A and B velocity contrast, and a corresponding change in reflective characteristics. On the seismic sections, the base of unit A is displayed as a narrow zone of continuous, high-amplitude reflectors which occurs at depths ranging from 180 to 440 m. This zone of reflectors was not seen over much of the survey area because of the masking effect of extensive, shallow, acoustic anomalies (Steffy and Hoose, 1981). However, we infer that unit A underlies the entire survey area. Reflectors within the probable Quaternary and upper Tertiary strata, unit A, are characteristically continuous, parallel, high-amplitude features, whereas reflectors below these strata are discontinuous, low-amplitude features. A subtle divergence between the internal reflectors of units A and B towards the basin axis has been observed. This has also been recognized by Scholl (oral communication, 1981), using seismic data collected by the Geologic Division, U.S. Geological Survey.

An acoustic velocity of 1,700 m/s for the strata of unit A was used to convert from travel time to isopach thickness. This velocity was obtained from the multichannel velocity analysis and matches the sonobuoy refraction results of Holmes and others (1978), and Fisher and others (1979). Holmes and others propose that this velocity indicates loosely cemented sands, silts, and clays deposited in a marine environment. This assumption is corroborated by two boreholes drilled by the U.S. Bureau of Mines in 1967 (Scholl and Hopkins, 1969). These holes, drilled to depths of 61.0 and 73.2 m (200 and 240 feet), are located about 56 km north of the survey area near Nome. The boreholes penetrated 12.2 and 22.9 m (40 and 75 feet) of Quaternary sediments underlain by marine silts and clays dated by pollen, foraminifera, and ostracods as Pliocene.

Acoustic anomalies, believed to represent gas-charged sediment, commonly occur along the base of unit A which ranges in depth between 100 and 260 ms (Steffy and Hoose, 1981). Acoustic anomalies also occur within the upper 100 ms two-way travel time (140 m) of the seismic section. Holmes and Thor (1981), and Steffy and Hoose (1981) have explained that many of these shallow anomalies result from gas-charged sediments or a strong reflecting horizon. The gas-charged sediments and the horizon correspond to a buried, Quaternary peat layer which has been sampled in cores.

We attribute the stratigraphic relationship and the velocity contrast between units A and B to a change in the upper Tertiary sedimentary environment of the Norton Basin. This interpretation is based on (1) the divergence of and the reflective difference between the internal reflectors of the two units; (2) the nearly parallel relationship between the zone of reflectors that define the A and B boundary and the internal reflectors of unit B; and (3) the inferred presence of marine sediments in both units. This change in the sedimentary environment could have been caused by a change in the rate of subsidence according to Greene and Perry (Holmes and others, 1978, p. 74) or a change in the sediment source (Nelson and others, 1974, p. 133).

Structure

The Quaternary and upper Tertiary strata show little structural deformation. These strata dip gently southward towards the east-west trending basin axis in the eastern portion of the map, and dip southwestward towards the northwest-southeast trending basin axis in the western portion of the map. Superimposed on these general dips are small, elongated depocenters that parallel the basin axis. These small depocenters are usually associated with growth faults that were mapped by Steffy and Hoose (1981) and are shown on this map. These faults have vertical offsets of usually less than 50 m and are downthrown towards the basin axis in the eastern portion of the map and are downthrown away from the basin axis in the western portion of the map. Over most of the area, these growth faults are parallel to deeper faults that do not cut the unit A strata. The deeper faults occur as sets forming grabens or as single faults downthrown towards the basin axis.

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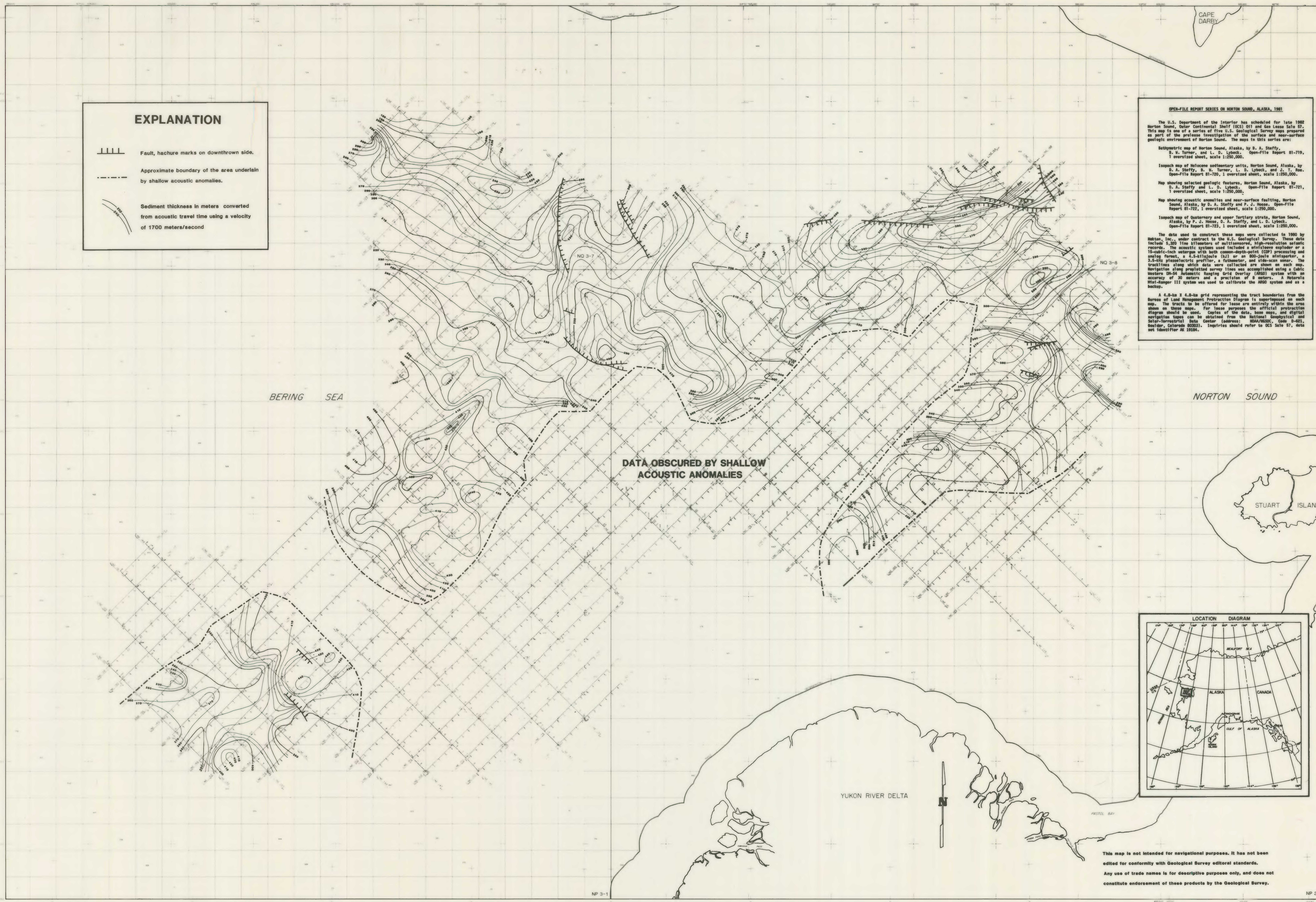

EXPLANATION

Fault, hachure marks on downthrown side.

Approximate boundary of the area underlain by shallow acoustic anomalies.

Sediment thickness in meters converted from acoustic travel time using a velocity of 1700 meters/second

OPEN-FILE REPORT SERIES ON NORTON SOUND, ALASKA, 1981

The U.S. Department of the Interior has scheduled for late 1982 Norton Sound, Outer Continental Shelf (OCS) Oil and Gas Lease Sale 57. This map is one of a series of five U.S. Geological Survey maps prepared as part of the prelease investigation of the surface and near-surface geologic environment of Norton Sound. The maps in this series are:

Bathymetric map of Norton Sound, Alaska, by D. A. Steffy, B. W. Turner, and L. D. Lybeck. Open-File Report 81-719, 1 oversized sheet, scale 1:250,000.

Isopach map of Holocene sedimentary units, Norton Sound, Alaska, by D. A. Steffy, B. W. Turner, L. D. Lybeck, and J. T. Roe. Open-File Report 81-720, 1 oversized sheet, scale 1:250,000.

Map showing selected geologic features, Norton Sound, Alaska, by D. A. Steffy and L. D. Lybeck. Open-File Report 81-721, 1 oversized sheet, scale 1:250,000.

Map showing acoustic anomalies and near-surface faulting, Norton Sound, Alaska, by D. A. Steffy and P. J. Hoose. Open-File Report 81-722, 1 oversized sheet, scale 1:250,000.

Isopach map of Quaternary and upper Tertiary strata, Norton Sound, Alaska, by P. J. Hoose, D. A. Steffy, and L. D. Lybeck. Open-File Report 81-723, 1 oversized sheet, scale 1:250,000.

The data used to construct these maps were collected in 1980 by Nekton, Inc., under contract to the U.S. Geological Survey. These data include 5,320 line kilometers of multisensored, high-resolution seismic records. The acoustic systems used included a minisleeve exploder or a 15-cubic-inch watergun with both common-depth-point (CDP) processing and analog format, a 4.5-kilojoule (kJ) or an 800-joule minisparker, a 3.5-kHz piezoelectric profiler, a fathometer, and side-scan sonar. The tracklines along which data were collected are shown on each map. Navigation along preplotted survey lines was accomplished using a Cubic Western DM-54 Automatic Ranging Grid Overlay (ARGO) system with an accuracy of 30 meters and a precision of 8 meters. A Motorola Mini-Ranger III system was used to calibrate the ARGO system and as a backup.

A 4.8-km X 4.8-km grid representing the tract boundaries from the Bureau of Land Management Protraction Diagram is superimposed on each map. The tracts to be offered for lease are entirely within the area shown on these maps. For lease purposes the official protraction diagram should be used. Copies of the data, base maps, and digital navigation tapes can be obtained from the National Geophysical and Solar-Terrestrial Data Center (address: NOAA/NGSDC, Code D-621, Boulder, Colorado 80303). Inquiries should refer to OCS Sale 57, data set identifier AK 19184.

SOURCE OF SHORELINE FROM BLM PROTRACTION DIAGRAMS NQ3-7, NQ3-8, NP3-1 AND NP3-2. PUBLISHED IN 1976.

SCALE 1:250,000

5 0 5 10 15 20 25 STATUTE MILES

5 0 5 10 15 20 25 KILOMETERS

5 0 5 10 15 NAUTICAL MILES

Contour interval 10 Meters (Index C.I. 50 Meters)

MAP PROJECTION UTM CLARKE 1866 SPHEROID, ZONE3.

ISOPACH MAP OF QUATERNARY AND UPPER TERTIARY STRATA, NORTON SOUND, ALASKA

PETER J. HOOSE, DAVID A. STEFFY, AND LYNN D. LYBECK

1981