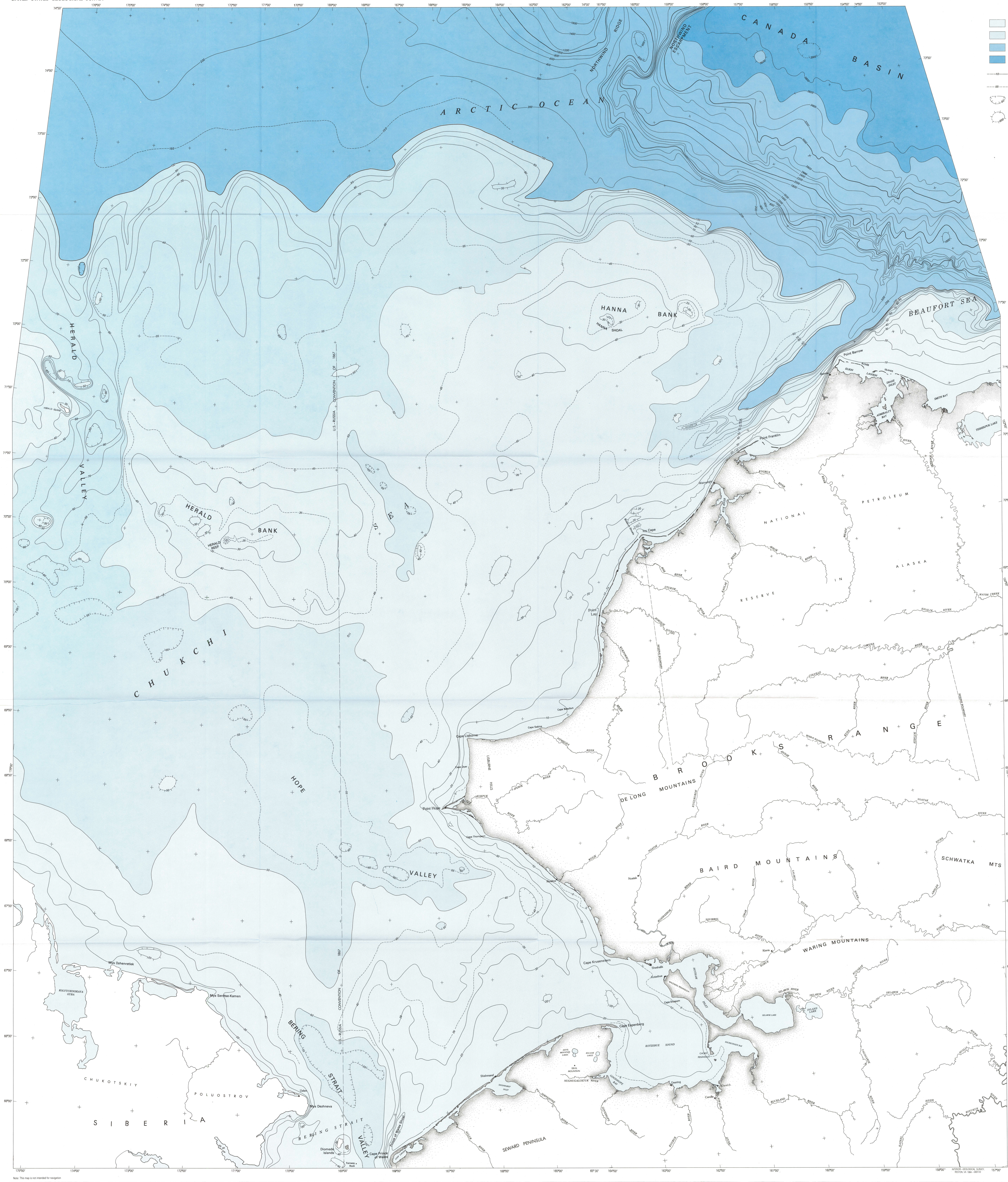
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MARINE GEOLOGY ATLAS
CHUKCHI SEA
MAP I–1182–D



EXPLANATION

DEPTH IN METERS

- 0–50 m
- 50–100 m
- 100–3600 m
- >3600 m

---10--- DEPTH CONTOUR—Dashed where inferred

---55--- SUPPLEMENTARY DEPTH CONTOUR

LOCALIZED DEPRESSION—Hachures show direction of slope

LOCALIZED HIGH—Hachures show direction of slope

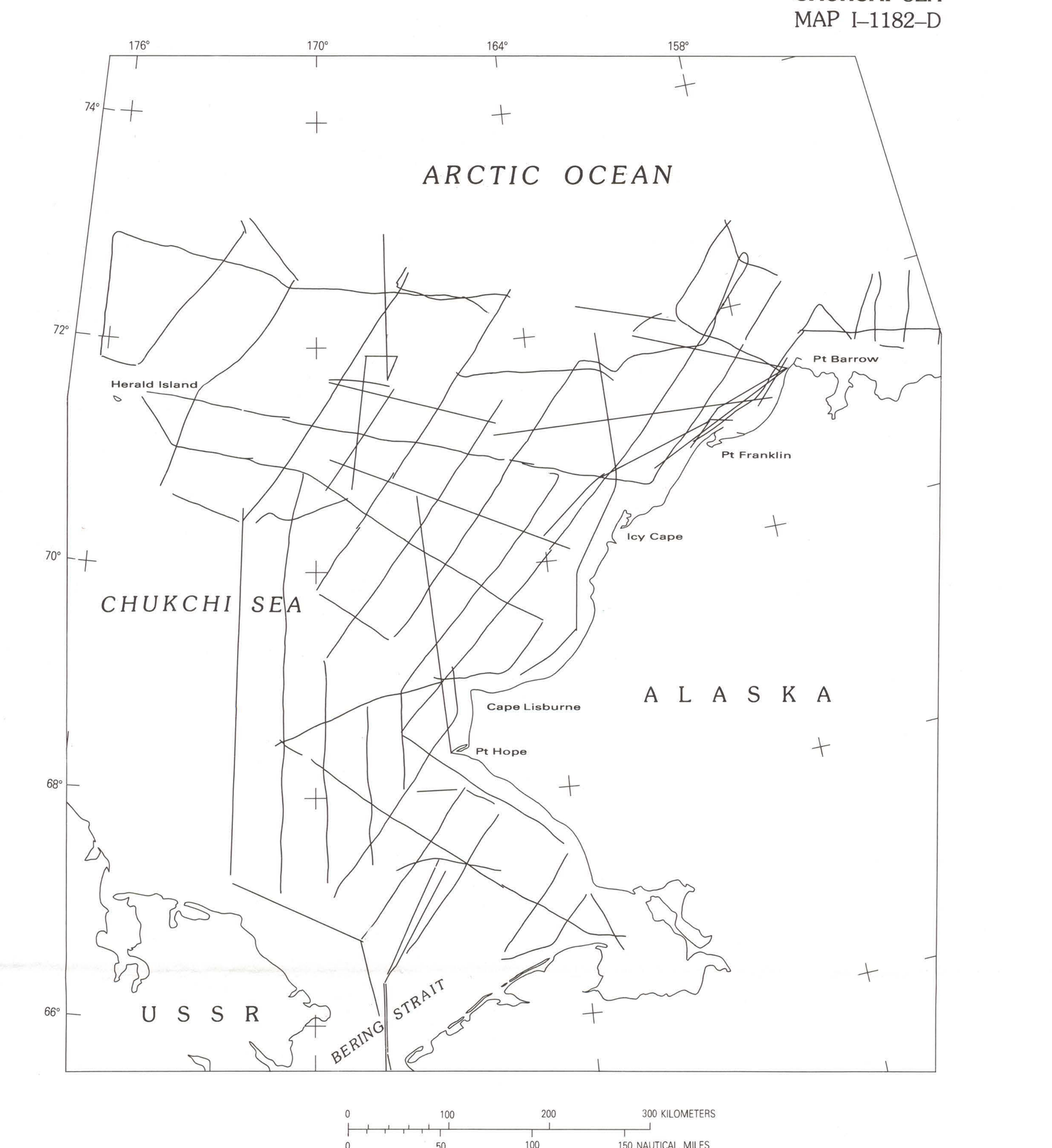
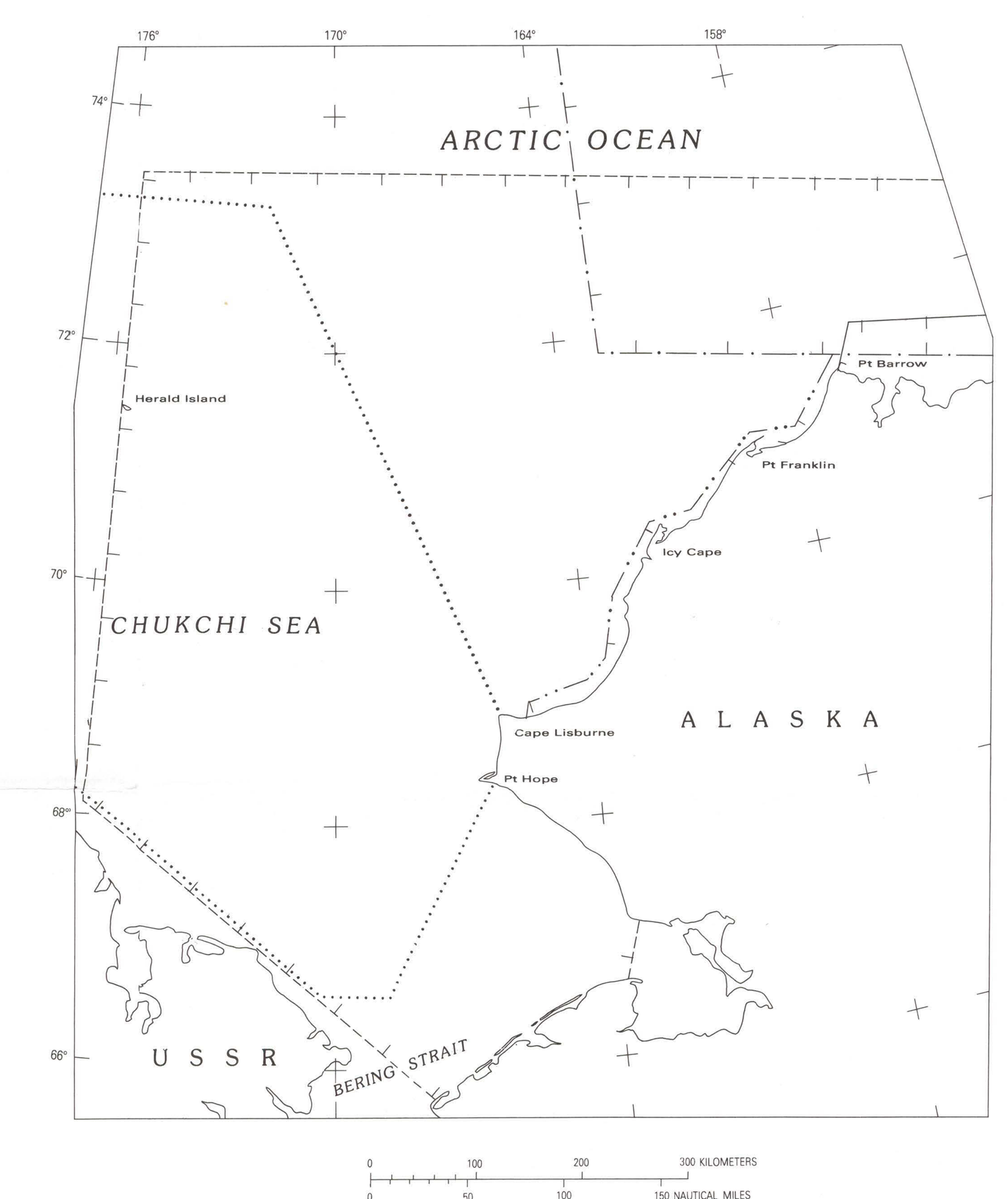


FIGURE 1. Location of continuous bathymetric profiles collected by the U.S. Geological Survey, 1976–78, 1980, and 1982. These profiles constitute the primary data set for this map. Position control was by integrated satellite (satellite plus doppler sonar) navigation.



SYMBOL	YEAR SURVEYED	ORGANIZATION	FORMAT OF DATA USED IN COMPILATION	NAVIGATION
	1969–74, 1976	U.S. Geological Survey[1]	Continuous bathymetric profiles	Satellite
	1973	Geophysical Corporation of Alaska	Continuous bathymetric profiles	Integrated satellite
	1951, 1957	Scripps Institution of Oceanography, Naval Electronics Laboratory	Unpublished charts	Radar and celestial
	1961	Naval Electronics Laboratory[2]	Spot soundings	Electronic position indicator
	Editions released in 1974–76	National Ocean Survey	NOS charts: 16082–88, 16101–103	Visual methods (sextant) supplemented by Shoran
Entire map area	Compiled from government, military, and private sources	U.S. Naval Oceanographic Office and Defense Mapping Agency	Hydrographic Charts: NO 16002, 41002	Mostly celestial, some radar

[1]Maps showing the tracklines of the surveys conducted by the U.S Geological Survey in 1969, 1970, 1971, 1972 and 1973 are shown in the following Open-File Reports (Grantz and others, 1970, 1971, 1972a, 1972b, and 1974).

[2]A map showing the tracklines of the survey conducted by the Naval Electronics Laboratory on the USCGC *Northwind* in 1961, from which these spot soundings were obtained, has been published in Creager and Mc Manus (1965).

FIGURE 2. Index map showing area of coverage of supplementary bathymetric data sets.

Data Sources

The "Bathymetric map of the Chukchi Sea" is based mainly on new soundings collected during geophysical surveys conducted by the U.S. Geological Survey (USGS) in 1969–74, 1976–78, 1980, and 1982 (figs. 1 and 2) supplemented by data from other sources (fig. 2). The Geological Survey soundings provide regional coverage of the Chukchi Sea; position control for these soundings was by satellite or integrated satellite (satellite plus doppler sonar) navigation. In the northeast quadrant of the map area, the USGS data are supplemented by soundings on the shelf, slope, and rise furnished by R. L. Fisher of the Scripps Institution of Oceanography (in part published in Fisher and others, 1958), and by soundings on the shelf obtained by the Geophysical Corporation of Alaska in 1973. In the west half of the map area, they are supplemented by soundings collected in 1961 by the U.S. Naval Electronics Laboratory (in part published in Creager and McManus, 1965). Near the coast, the map incorporates soundings published by the U.S. National Ocean Survey, and over the entire map region supplementary soundings published by the U.S. Naval Oceanographic Office. Most of the supplementary soundings were positioned by radar and celestial navigation (fig. 2). However, the data collected by the U.S. Naval Electronics Laboratory was positioned by electronic position equipment, that of the Geophysical Corporation of Alaska by integrated satellite navigation, and the nearshore soundings of the U.S. National Ocean Survey by visual methods (sextant). The USGS surveys of 1976–78, 1980, and 1982, which were collected from the Research Vessel *S. P. Lee* using a 3.5–kHz echo-sounding system and integrated satellite position control, tied within a meter at trackline crossings. The USGS surveys of 1976 to 1982 were adopted as the primary data set to which the other surveys were adjusted where necessary. The isobaths in the region bounded by lat 70°30′ and 73°00′ N. and long. 152° and 158° W. are revised from those previously published by Greenberg and others (1981) because of the availability of new soundings and revision of some preexisting data in that area.

Uses of This Map

The bathymetric map was prepared as a base for displaying physiographic and geologic data of the USGS on the continental shelf, slope, and rise west and northwest of Alaska. It was not designed to serve as a chart for navigation.

Datum and Sources of Error

The bathymetry is plotted on a polar stereographic projection at a scale of 1:1,000,000. The grid base was computer generated in six sections at a scale of 1:500,000 (at lat 72°00′ N.), photographically reduced to 1:1,000,000, and the sections were hand spliced to form the present base. Inherent inaccuracies in the computer-controlled plotter that generated the 1:500,000 projections, combined with errors introduced during photographic reduction and splicing, produced errors estimated to be no larger than 1 km in the position of the grid points and bathymetry.

Datum for the U.S. National Ocean Survey charts, our primary data source nearshore, is mean lower low water. None of the other data sets were adjusted for tides because tidal data are sparse north of Bering Strait and because the diurnal tidal range along the coast is inferred from existing data to be generally much less than half a meter. Thus, the diurnal tidal range is only 12 cm at Point Barrow (U.S. National Ocean Survey, 1981); 35 cm at Kivalina, on the coast of the southeastern Chukchi Sea between Point Hope and Kotzebue (Creager and McManus, 1966); and 82 cm at Kiwalik, at the head of Kotzebue Sound (U.S. National Ocean Survey, 1981). The southward increase in periodic tidal range from the open ocean on the north to the head of landlocked Kotzebue Sound to the southeast is consistent with the observation that the tidal wave in the Chukchi Sea moves southward across the shelf from the Arctic Ocean (Hunkins and Kaplan, 1966) and the fact that tidal waves are amplified upon entering shallow coastal seas.

Variations in sea level related to changes in water temperature and salinity (steric variations), wind, and excursions of barometric pressure can be larger than the diurnal tide range in the Chukchi Sea. Thus Beal (1968) reports that steric and barometric variations cause an annual seasonal (winter-to-summer) fluctuation of sea level at Barrow of 30 to 40 cm. He also reports that identical seasonal sea level fluctuations were simultaneously measured at Cape Schmidt on the Siberian Coast, suggesting the possibility of concurrent seasonal sea level variations over the entire Chukchi Sea. Exceptional storm surges have been reported to raise sea level 3 to 4 m at Barrow (Hume and Schalk, 1967) and 2.7 m at Point Lay (Aagaard, 1978), although the effect is presumably much reduced offshore. No corrections for such effects were attempted. Other sources of bathymetric error are electronic noise and water-column inhomogeneities, commonly estimated to produce random errors of about 1 or 2 percent, and nonvertical echoes. However, due to the shallow water depths and the low relief of bottom features over most of the map area, the error induced by these sources was considered insignificant.

Conversion of Reflection Time to Water Depth

A constant velocity was used to convert the transit time of echo-sounder signals to depth. The USGS soundings were converted using a constant velocity of 1,464 m/s (meters per second), and the Geophysical Corporation of Alaska soundings a constant velocity of 1,448 m/s, a good approximation for the shallow shelf area where most of their profiles are located. The different assumed velocities on the shelf yield depth differences ranging from 0.1 m at depths of 10 m to 2.0 m at depths of 180 m. All other data sets were computed using an assumed velocity of 1,463 m/s. A discussion of the fluctuation of sound velocity with varying water depth, temperature, and salinity in the Beaufort and northern Chukchi Sea can be found in Greenberg and others (1981). Water depth in the northern, deeper parts of the present map area can be converted to a closer approximation of the true value by means of graphs given in Greenberg and others (1981). Decreased salinity and, in summer, increased water temperature in the southeastern part of the map area would probably require larger corrections, but these corrections are overshadowed by tidal and other effects in these shallow waters, and their magnitude was not assessed.

Acknowledgements

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SCALE 1:1000 000 AT LATITUDE 72°00′ N.

20 0 20 40 60 80 NAUTICAL MILES

20 0 20 40 60 80 STATUTE MILES

20 0 20 40 60 100 120 KILOMETERS

POLAR STEREOGRAPHIC PROJECTION
ISOBATHS IN METERS
SUPPLEMENTARY ISOBATHS AT 5-, 50-, AND 100-M INTERVALS

BATHYMETRIC MAP OF THE CHUKCHI SEA

By
Edwin R. Hill, Arthur Grantz, Steven D. May, and Marilyn Smith
1984

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