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Bathymetric map of the Bowers Basin and Aleutian Basin east of the U.S. - U.S.S.R. 1867 Convention Line, Bering Sea

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INTRODUCTION

The generation of accurate bathymetric maps is essential for the exploration and mapping of offshore areas. As part of the United States Geological Survey Exclusive Economic Zone (EEZ-SCAN) program those parts of the Aleutian and Bowers Basins deeper than 200 m water depth and east of the U.S.--U.S.S.R. Convention Line of 1867 were surveyed during four cruises of the M/V Farnella in summer 1986 and 1987 (Fig. 1; Carlson et al., 1987; Cooper et al, 1986; Gardner et al, 1986; Cooper et al., 1987). Along with GLORIA (Ground Long-Range Inclined Asdic) long-range side-scan sonar, other data routinely collected were 2-channel air gun seismic reflection, gravity, magnetics, and 3.5 kHz and 10 kHz bathymetric data. More than 40,000 line km of data were collected over the Aleutian and Bowers Basins (Fig. 2). The tracklines were laid out so that overlapping sonographs were obtained by traversing the mapped area at an average speed of 8 knots. Nominal line spacings were 30km in water depths greater than 2000 m, and 15 km or less on the slope or in areas with significant relief. The 10 kHz and side-scan sonar data with previous bathymetry maps were used to construct a new bathymetric map of the surveyed area.

METHODS

Acquisition of Data

Bathymetric data were obtained during the EEZ-SCAN surveys with a 10kHz high-resolution bottom profiler. Water depths were measured at six minute intervals on an analog paper record. Water depths were entered into the shipboard navigational system, and two minute interpolated values were calculated by computer. All depth data were corrected for sound velocity in water (Carter, 1980).

Previous surveys and bathymetric maps

Prior to the first EEZ-SCAN cruises to the Bering Sea,in 1986, bathymetric maps were prepared from existing data sets for use on the ship. Bathymetry data for the Bering Sea were available in two formats; published and unpublished bathymetric charts (Fig. 3), and archived data stored on magnetic tapes of navigation and digitized bathymetry data for all U.S.G.S. cruises in the Bering Sea (Fig. 4).

Two approaches to developing a new and accurate bathymetric map were taken. The first step was to use the "navplt" program on UNIX, U.S.G.S. Menlo Park, (McHendrie and Celluzi, 1987) to computer-generate a bathymetric map of the Bering Sea using the data from the archived magnetic tapes. The second step was to digitize published and unpublished maps (Fischer et al., 1982; Gardner and Vallier, unpub.; Nichols and Perry, 1966; Scholl et al., 1974; Schumacher, 1975) and merge together to develop one map.

The distribution of data archived on magnetic tape was uneven in the Bering Sea (Fig. 4). In some areas trackline coverage was dense and the bathymetric data abundant. In other areas coverage was sparse or lacking entirely. The published and unpublished paper maps posed futher problems. A major problem was the lack of continuity in scale, projection, contour interval, and depth units (fathoms/meters) between the various maps. The published maps were digitized and combined with the archived data points to create an improved data base in an attempt to mitigate the deficiencies inherent in the separate data sets. The EEZ-SCAN track-line coverage across the survey area was uniform and dense enough to provide a consistent data set over the survey area. By combining both data sets an accruate batymetric map of the Aleutian and Bowers Basins was prepared. data

The digitized bathymetry from the published and unpublished maps were plotted on a common base and the uncorrected 10 kHz water depth values, from EEZ-SCAN surveys, were overlayed on this base. Uncorrected water depth values were used for two reasons. (1) Uncertainty as to whether water depth values were corrected for changes in sound velocity with depth, and if so what correction factors were used, or uncorrected data were used to construct the various published and unpublished maps. (2)

The uncorrected EEZ-SCAN values in general agreed very well with most of the published maps, especially the two most detailed and accurate maps in the area (Fischer et al., 1982; Perry and Nichols, 1966). The difference between corrected and uncorrected water depths for the EEZ-SCAN data is about 1 to 5 meters in the basin and up to 50 m on the slope. This difference between corrected and uncorrected water depths does not affect the trend of the isobaths. The small shift in position between some corrected and uncorrected isobaths is not significant relative to the accuracy and precision of navigation fixes, which are accurate to within a few hundred meters for the 1986 cruises, and less than 200 m for the 1989 cruise.

The coverage and type of data used for the generation of the published and unpublished maps could not be quantitatively evaluated. Even though the data used to construct an individual map might be very good, the quality of data between maps was inconsistent and unknown. The navigation and bathymetry data acquired during the EEZ-SCAN cruises is consistent between cruises and is of high quality. Therefore, the digital data from the EEZ-SCAN cruises were weighted more when repositioning contour lines. The re-interpreted maps were hand contoured at 100 m intervals, and digitized at a scale of 1:375,000. The data were re-plotted, after being digitized, at the same projection and scale as that of the shipboard (unprocessed) GLORIA mosaic so that it could be used as an aid in editing the shape and direction of bathymetric contour lines.

The GLORIA mosaic provides an unprecedented view of the locations and shape of physiographic features on the floor of the Bering Sea. Because the EEZ-SCAN bathymetric data were derived from widely spaced linear tracks, the precise location and shape of physiographic features on the bathymetric map had to be interpreted between track lines except at those positions directly under the ship's track. Physiographic features on the bathymetric map could be more accurately positioned using the GLORIA mosaic as a guide. The isobaths were reinterpreted, using side-scan imagery as a guide, to produce a more accurate rendition of the seafloor. The final editing was done graphically using a navigational editing program developed by Clint Steele (unpub.) of the U.S.G.S.

CONCLUSION

Resulting bathymetric map

The bathymetric map constructed by the above methods is shown in Figure 5. This map has been produced in the Lambert Conic Conformal projection at a scale of 1:2,000,000 with a contour interval of 100 meters. The digital data base, however, permits the map to be reproduced at any desired scale and projection.

Availability of data.

A computer tape of the digitized water depths used to construct the bathymetric map in this report is available for purchase from the National Geophysical Data Center, Boulder, CO 80302.

ACKNOWLEDGEMENTS

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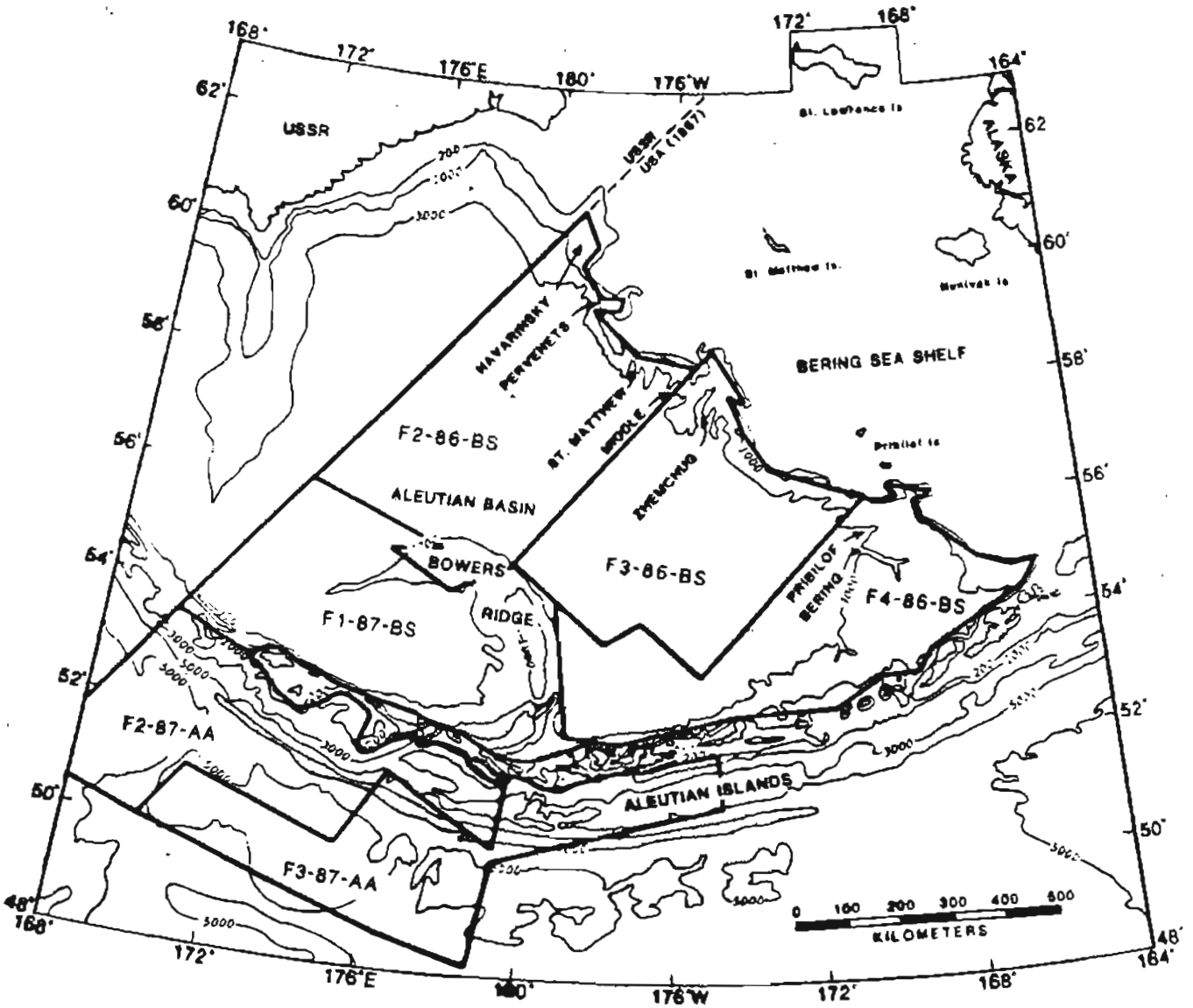
Figure 1: Map of EEZ-SCAN survey area. Cruise indentifications indicated in respective blocks.

Figure 2: Trackline map of the four EEZ-SCAN cruises for the Bering Sea F2-86-BS, F3-86-BS, F4-86-BS and F1-87-BS, Lambert Conformal projection at a scale of 1:10,000,000.

Figure 3: Index map of published and unpublished bathymetric maps that were digitized.

Figure 4: Trackline map of cruises run in the Bering prior to the EEZ-SCAN surveys. Lambert Conformal projection at a scale of 1:9,000,000.

Figure 5: Bathymetry map of the Aleutian Basin and Bowers Basin, Lambert Conformal projection at a scale of 1:2,000,000.



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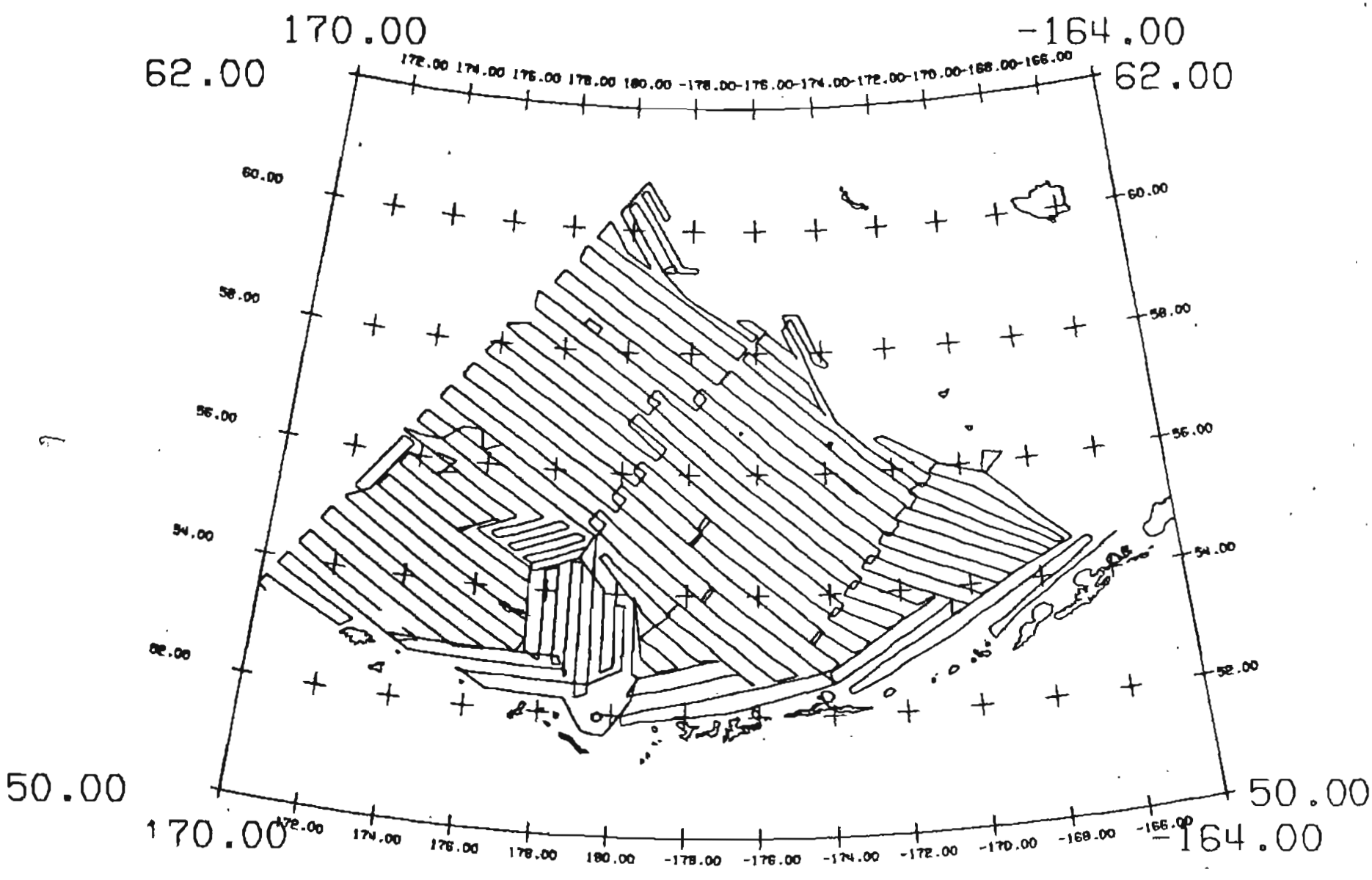

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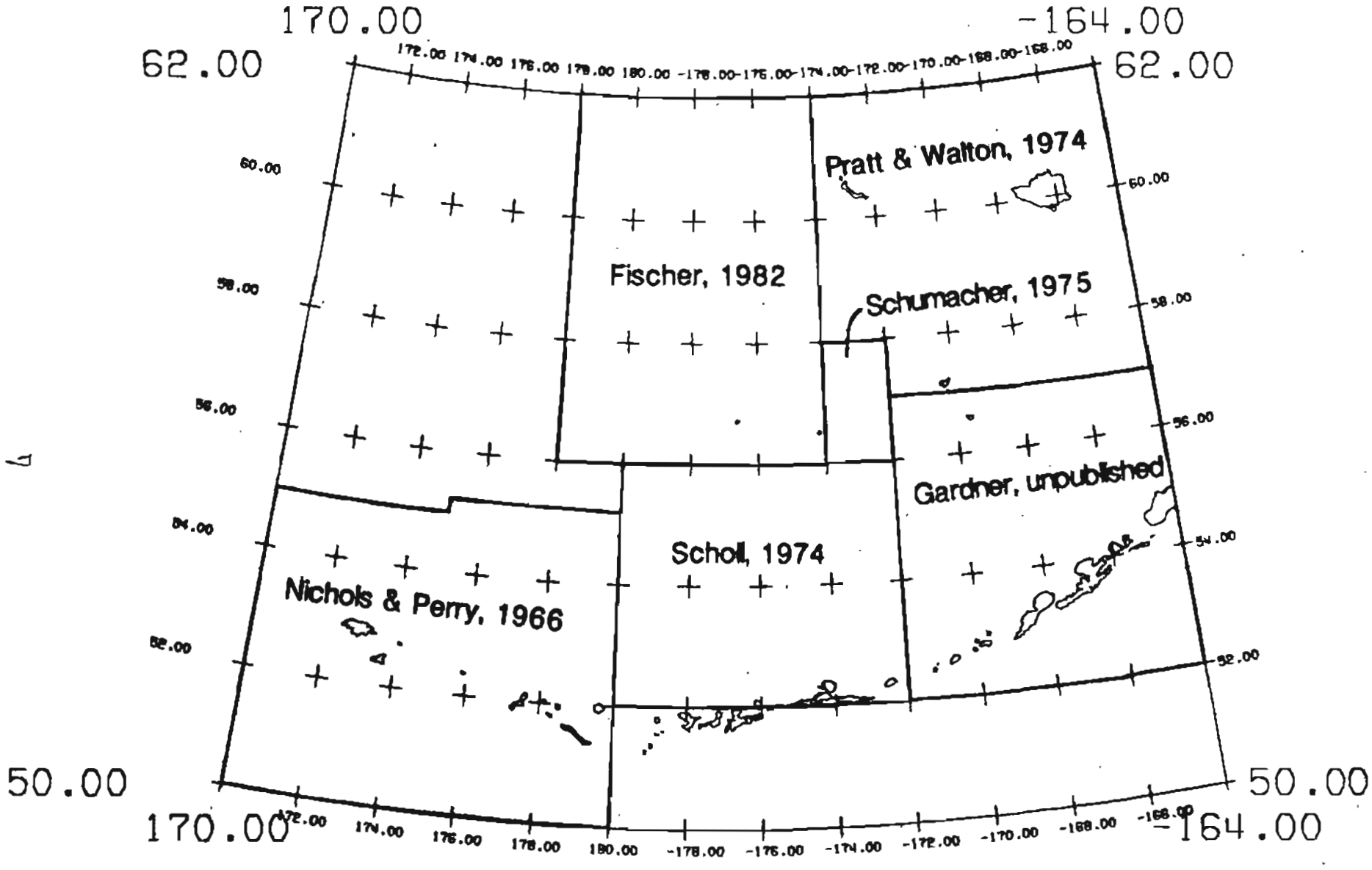

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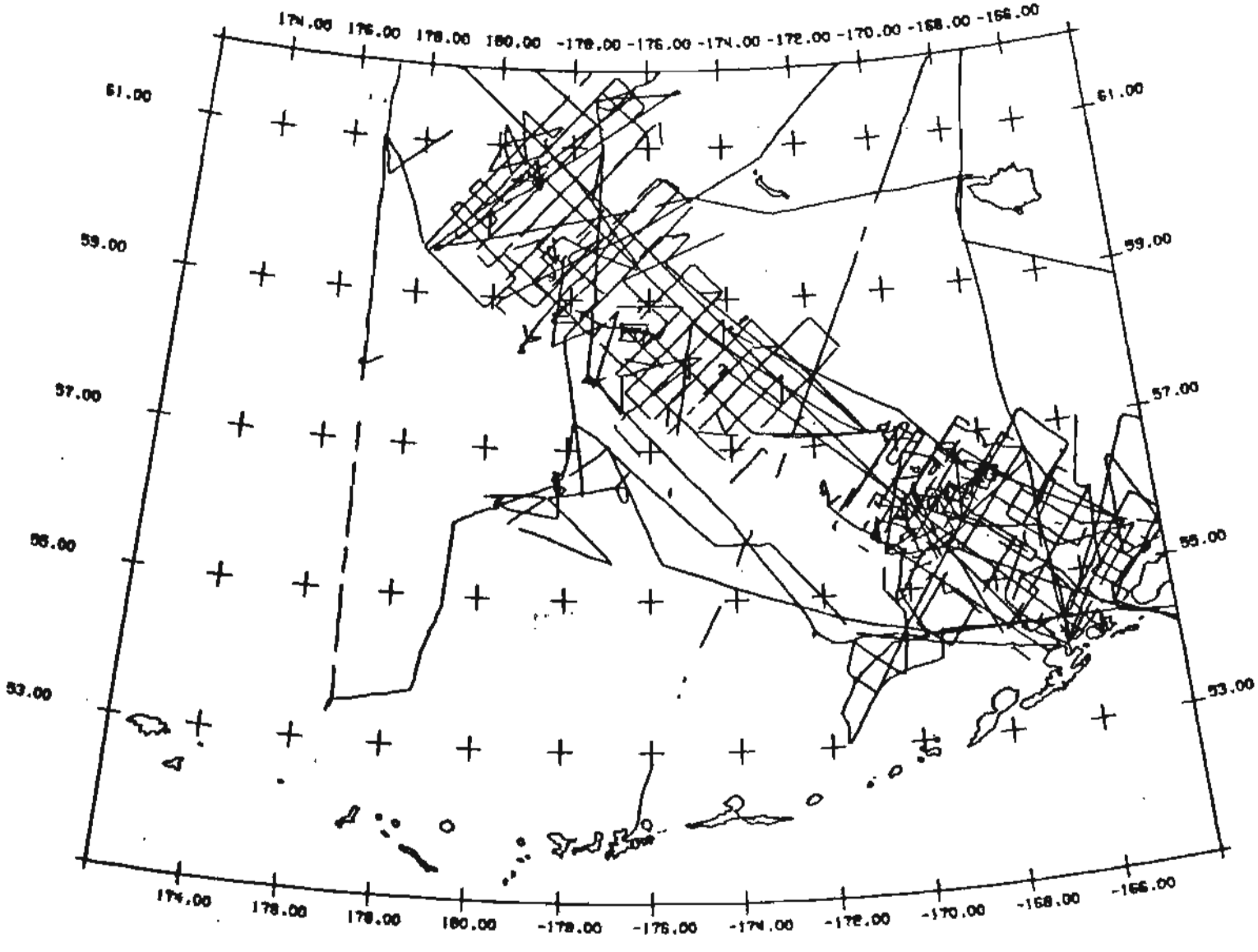

Figure 4: Trackline map of cruises run in the Bering prior to the EEZ-SCAN surveys, Lambert Conformal projection at a scale of 1:9,000,000.