DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

Prepared in cooperation with the
DEFENSE MAPPING AGENCY

MISCELLANEOUS FIELD STUDIES
MAP MF-2098-A

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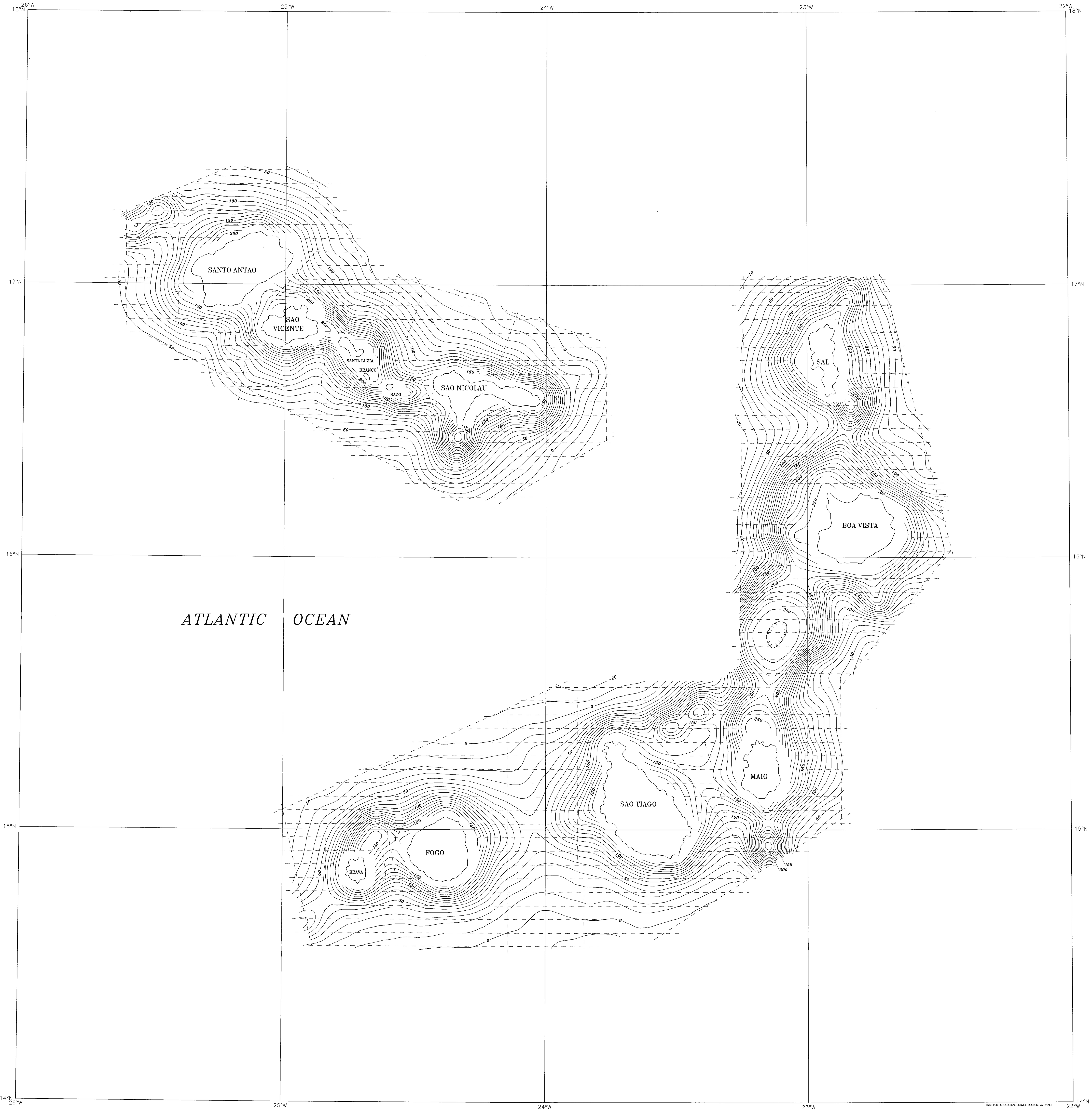
8 7009



Coastline from World Data Bank II, Tape 4, Africa,
National Technical Information Service no. CIA/DF-77/004

Lambert Azimuthal Equal Area projection
Central meridian 24° W
Latitude of central point 16° N

SCALE 1: 750 000

10 0 10 20 30 40 50 NAUTICAL MILES

10 0 10 20 30 40 50 KILOMETERS

Manuscript approved for publication July 20, 1989

MAP SHOWING FREE-AIR GRAVITY ANOMALIES AROUND THE CAPE VERDE ISLANDS

By
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1990

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EXPLANATION OF MAP SYMBOLS

Free-air gravity contours; interval 10 mgal

Area of decreasing gravity

Ship trackline

INTRODUCTION

This map is one of six in a series presenting marine gravity data off the west coast of Africa (fig. 1). The data, collected by the U. S. Geological Survey (USGS) in 1987 in response to a request from the Defense Mapping Agency, are intended to improve gravity coverage where it has been insufficient or inadequate. The information shown on this map represents approximately 9,900 line kilometers of marine gravity data collected around the Cape Verde Islands from February 22 to April 25, 1987.

METHODS

Data were collected aboard the Research Vessel (RV) *Starella*, a converted 73-m stern trawler owned and operated by J. Marr and Sons of Hull, England, under contract to the USGS. Nominal survey speed was 10 knots (18.5 km/hr). Two LaCoste and Romberg (L&R) Air-Sea Gravity Meters (S-26 and S-41) were operated continuously during the surveys. The dual metering provided immediate, or real-time, checks on meter performance and quality control on data collected. Both gravity meters were of standard beam-type configuration that included capacitance readouts, Loh 6200A analog-to-digital converter boxes, and USGS computer processing and recording systems. Ten-second samples of L&R raw spring tension, average beam, and cross-coupling signals were logged and used to compute the raw digital gravity values. The raw digital gravity readings were filtered by three stages of lag-20-s resistive capacitance (RC) filtering in the instrument plus three stages of lead-20-s RC digital filtering. A 5-min symmetrical digital filter was applied in the computer processing. The standard auto-reader analog gravity readings provided a graphic check on the digital computations. All land gravity stations were on the International Gravity Standardization Net (IGSN) 1971 datum. Land gravity values were calibrated to the shipboard values at dockside using a L&R Model G Geodetic Gravity Meter (G-170).

All positions were computed in the World Gravity System (WGS)-84 datum and filtered in exactly the same manner as were the gravity signals. The primary means of navigation used during the cruise was a combined Racal Hyperfix and Microfix shore-based navigation system, with Global Positioning System (GPS) as control and backup. Elements of a Magnavox S-5000 integrated navigation system were used to convey positioning information to the ship's bridge. The Racal systems provided precision to about 5 m root mean square (RMS). Shore antenna-station locations were determined by offsets from local benchmarks. The positional accuracy measured aboard ship was comparable to that obtained using GPS.

Data were recorded digitally on hard disk every 10 s and periodically were transferred to tape. Real-time 10-s digital plots of various system parameters were continuously logged. Plotted variables included time; Racal and GPS latitudes and longitudes, and their differences; Eotvos correction calculated from Racal and GPS fixes; raw and filtered gravity from both meters, and their differences; Eotvos-corrected gravity; ship's speed and direction; and gravity-platform heave and sway acceleration, which was needed to monitor sea-state effects on the gravity meters. All parameters were monitored continuously by the watchstanders and party chief. With such data, problems with components of the system were readily identified and corrected; if corrections could not be made, traverse lines were rerun immediately. This real-time editing or recapture of data virtually eliminated data loss. Subsequent editing aboard the ship on an IBM-AT XENIX computer system provided gravity and navigation plots, and backup listings of time, positions, and Eotvos-corrected gravity. Line intersection points, crossing values, and statistics were routinely recorded and analyzed. For this cruise the statistics of the line-crossing differences were 1.1 mgal RMS. Base gravity readings taken before and after the cruise established the drift rate for the marine gravimeters (+0.5 mgal in 64 days for S-26; +0.4 mgal in 64 days for S-41). This correction was applied to the data in the laboratory, where the tapes were reformatted, regional gravity field removed, and free-air gravity anomalies calculated. The resulting contour map of free-air gravity anomalies enlarges the existing data base, which was sparse for the nearshore area around the Cape Verde Islands (see, for example, Bowin and others, 1982).

MAPPING TECHNIQUE

Eotvos-corrected gravity data (free-air values) were reduced to 6-min samples and gridded using a standard minimum-tension gridding technique. This procedure has two stages: initial estimate, and biharmonic iteration with scattered-data feedback. The initial estimate selects data points within a grid cell by their proximity to the grid node, and averages them using an inverse-distance weighting function that depends on the angular distance between points. Once averaged, the grid nodes are re-evaluated (second stage) using a biharmonic cubic spline function, which is followed by a scattered-data feedback procedure (Dynamic Graphics, Inc., 1988). The grid-cell size for this map is approximately 1220 m on a side. Contour lines are truncated along shore and at the open-ocean margins using zone blanking.

ACKNOWLEDGMENTS

We are indebted to V. Carvalho and A. Querida of the Cape Verde Islands for participating in the cruise and to T. Cocke (U. S. Department of State) and R. Rowland (USGS) for helping to obtain diplomatic clearances. Captain J. Nichols and the crew of RV *Starella* were most cooperative. C. Ryland (USGS) provided assistance with the preparation of the final map product.

REFERENCES CITED

Bowin, C. O., Warsi, Waris, and Milligan, Julie, 1982, Free-air gravity anomaly atlas of the world: Geological Society of America Map and Chart Series, No. MC-46.

Dynamic Graphics, Inc., 1988, Interactive surface modeling: Berkeley, Calif., Release No. 6.93, 467 p.

Woods Hole Oceanographic Institution Contribution No. 7056

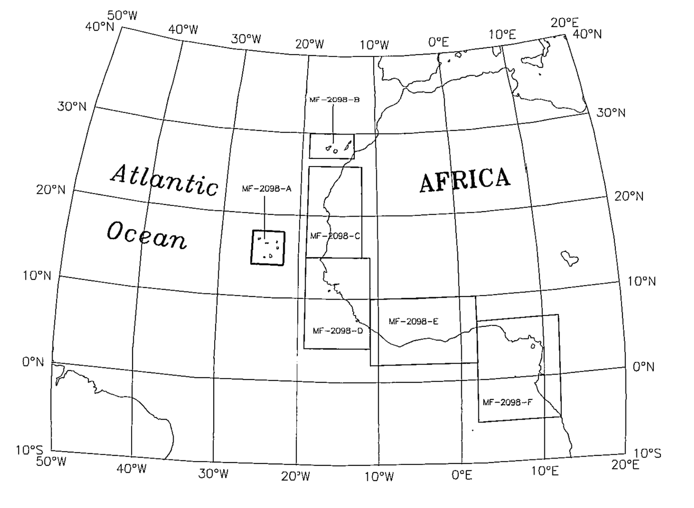

Figure 1. – Map areas and numbers of the six published marine gravity surveys in this series. These publications (except for this study) are listed at right:

MF-2098-B: Folger, D.W., McCullough, J.R., Irwin, B.J., Dodd, J.E., Strahle, W.J., Polloni, C.F., and Bouse, R.M., 1990, Map showing free-air gravity anomalies around the Canary Islands, Spain, scale 1:750,000.

MF-2098-C: Folger, D.W., Irwin, B.J., McCullough, J.R., Driscoll, G.R., and Polloni, C.F., 1990, Map showing free-air gravity anomalies off the western coast of Africa: Western Sahara to Senegal (north of 15° north latitude), scale 1:1,500,000.

MF-2098-D: Folger, D.W., McCullough, J.R., Irwin, B.J., Driscoll, G.R., and Polloni, C.F., 1990, Map showing free-air gravity anomalies off the western coast of Africa: Senegal (south of 15° north latitude) to Sierra Leone, scale 1:1,500,000.

MF-2098-E: Folger, D.W., Irwin, B.J., McCullough, J.R., Rowland, R.W., and Polloni, C.F., 1990, Map showing free-air gravity anomalies off the southern coast of west-central Africa: Liberia to Ghana, scale 1:1,500,000.

MF-2098-F: Folger, D.W., McCullough, J.R., Irwin, B.J., Driscoll, G.R., Delorey, C.M., and Polloni, C.F., 1990, Map showing free-air gravity anomalies off the western coast of Africa: Nigeria to Gabon, scale 1:1,500,000.

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