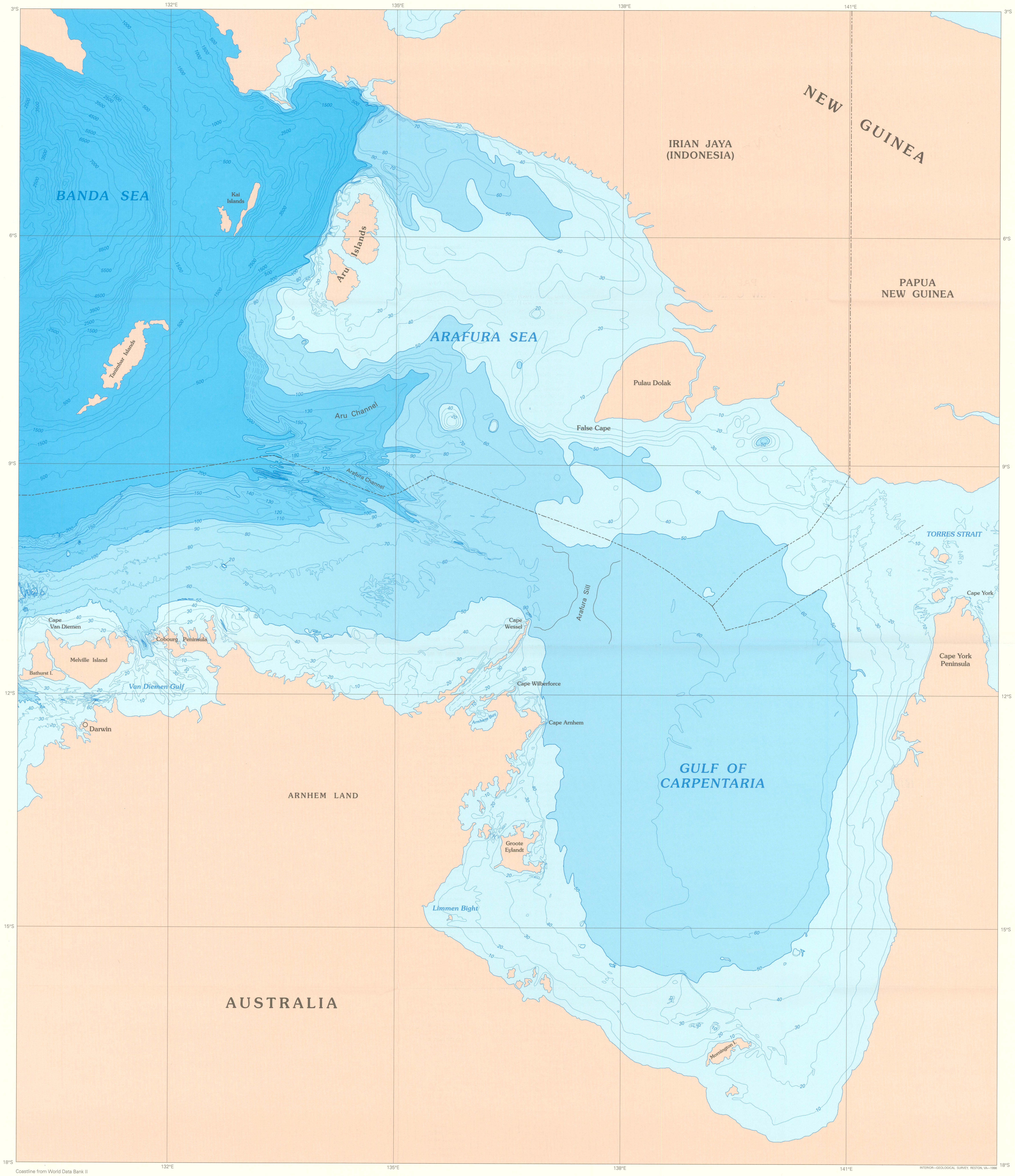
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

GEOLOGIC INVESTIGATIONS SERIES
MAP I-2550



Coastline from World Data Bank II
Political boundaries and coastlines are not necessarily authoritative
Not to be used for navigational purposes

EXPLANATION

Land

DEPTH IN METERS

0–50
50–100
100–200
>200

—50— Bathymetric contour; dashed or absent where uncertain

– – – International boundary

——— Outline of shallowest part of Arafura Sill, at about 55 m depth

INTRODUCTION

This bathymetric map shows the morphology of the Gulf of Carpentaria and the Arafura Sea, which form a broad, shallow epicontinental sea between Australia and New Guinea. At 1:2,500,000 scale, the entire epicontinental sea can be shown and the 10-meter-interval contours, needed to depict low-relief features, also can be accommodated. This map was prepared as an initial product arising from joint Australian National University–University of Wollongong–U.S. Geological Survey research in the Gulf of Carpentaria and Arafura Sea.

DATA SOURCES

Contours were hand-drawn using digital systematic-survey soundings obtained from the Royal Australian Navy (RAN), Hydrographic Service (unpub. data, 1992), and using a variety of nautical charts from the following sources: Australia Department of the Navy, Hydrography Branch (1970); [Great Britain] Admiralty (1983, 1990); [Great Britain] Hydrographer of the Navy (1988); Indonesia Angkatan Laut, Djawatan Hidrografi (1961); and Royal Australian Navy, Hydrographic Service (1968, 1974, 1979, 1991a,b,c). Also, contours were scanned from an unpublished map (1987) by T. Chase, B. Seekins, and J. Young (all of the U.S. Geological Survey), and H. Prasetyo (Marine Geological Institute of Indonesia); they were modified and scanned from published geological studies (Jongsma, 1974; Torgersen and others, 1983); and they were modified and scanned from the Australian National Bathymetric Map series (Australia Division of National Mapping, 1981, 1983a,b, 1984, 1986, 1989, 1990a,b,c), which was compiled by the Division of National Mapping (NATMAP) from the bathymetric data that now comprise the RAN digital data set. The sources of data used in compiling various parts of the map are identified in figure 1. The hand-drawn contours were digitized so that all contours can be displayed at different scales and projections.

Data accuracy varies. Older data were collected using techniques and navigation that were less accurate than those used at the time this map was prepared. Although nautical charts are periodically updated, some contain soundings that are over 100 years old. Accuracy estimates of the location and depth of soundings cannot be made because information on collection and processing procedures was not available for much of the source data.

MAP PREPARATION

To combine data from different sources, tidal datum differences had to be considered. For example, the RAN digital data, which were used to produce about one-half of the map, were adjusted to Mean Sea Level (MSL), but the nautical charts used other datums: Lowest Astronomical Tide, Mean Spring Low Water, and Indian Springs Low Water. Within the Gulf of Carpentaria the digital data do not contain soundings from water depths of 10 m or less. The 10-m contour in the gulf was drawn using data from nautical chart Aus 410 (Royal Australian Navy, Hydrographic Service, 1991a). The 10-m and other contours derived from nautical chart data within Australian territorial waters were adjusted to approximate MSL, a difference of 1–2 m as determined both from tide tables (National Ocean Service, 1992) and from tidal information contained on some of the charts. The remaining source data, north of the international boundaries between Australia and New Guinea, were not adjusted to MSL because to do so with old and unreliable data would not have improved the accuracy of the map. Some of the nautical charts did not contain tidal datum or tidal correction information; therefore, adjustments could not have been made in areas covered by those charts.

Another source of inconsistency is inherent in the use of nautical charts. Nautical charts display only selected depth soundings, which, in shallow areas, usually represent minimum depths rather than typical depths or all depths. However, nautical charts usually provide an approximation of the sea-floor morphology, in spite of the bias introduced by the use of selected soundings.

Trackline spacing for most of the RAN digital data is 5 km or less and data sampling along the tracklines is at an interval of about 750 m (area 9, fig. 1). Contouring was done at 1:250,000 scale with a minimal amount of smoothing; most features are retained at 1:2,500,000 scale. Outside of the area covered by the RAN digital data, contouring detail varies depending on the scales of the source maps and charts. Smoothing was essential on contours drawn from data in and near the Torres Strait (areas indicated by data densities *b* and *e* in figure 1) and in the area south of Melville Island.

In the Arafura Sea, there is an obvious difference in smoothness of the contours north and south of the international boundary. This difference may be caused by a difference in data density, but might also reflect a morphologic change. In the Gulf of Carpentaria, near long 137° E. (source area 10 in figure 1), low data density may also account for the smoothness of (1) the 10-m through 50-m contours between lat 11° S. and 12° S., (2) the 40- and 50-m contours between lat 12° S. and 13° S., and (3) the 30-m through 50-m contours between lat 13° S. and 14° S. By contrast, the change of character of the 60-, 70-, and 80-m contours northwest of Van Diemen Gulf probably indicates a real change in roughness of the sea floor rather than a change of data density or contouring techniques. In this area, west of long 132° E., the NATMAP map series was the only source used. East of long 141° E., the change in character of the contours from rougher in the north near lat 9° S. to very smooth south of 12° S. is exaggerated by the use of different data sources, but also appears to reflect a gradual topographic change. The data density and data source in the area immediately north of lat 12° S. are the same as in the area south of lat 12° S.

Differences between the contours presented on this map and those presented on maps of the NATMAP series occur because different criteria were used in contouring. In the preparation of this map, inconsistent single-point soundings or depth changes along single tracklines, that were inconsistent with adjacent trackline depths, were ignored unless they helped depict geomorphic features that were apparent when the data were contoured at larger scales or with smaller contouring intervals. Also, contours on this map were drawn at the first occurrence of a new isobath. For example, where there were several 20-m soundings, the 20-m contour was drawn at the location of a 20-m depth adjacent to 19-m depths rather than adjacent to 21-m depths or at some intermediate point.

In some parts of the flat floor of the Gulf of Carpentaria, the depth values are inconsistent between tracklines, alternately increasing and decreasing by one or two meters from one trackline to the next. Because of the flatness of the sea floor, individual isobaths, therefore, are displaced from trackline to trackline for distances of about 20 km. To compensate for inconsistencies between tracklines the contours on this map were drawn through the approximate midpoints of the displacements. This problem was especially severe in and adjacent to the depression indicated by the 60-m contour extending from long 138°45′ E. to 139°15′ E. and from lat 11°10′ S. to 11°40′ S. It is possible that some small features were masked by generalization of the 60-m contour in this depression.

Where water depths very close to the shoreline exceed 10 m, the 10-m isobath is not shown in order to avoid having it appear to merge with the coastline. This is the case in the northwestern part of the Gulf of Carpentaria, the southern part of the Arafura Sea, and offshore from the westernmost part of New Guinea.

SEA-FLOOR TOPOGRAPHY

The main bathymetric features of the Gulf of Carpentaria described by Torgersen and others (1983) are also apparent on this map: the extensive flat floor of the gulf, the east-trending linear slope (10-m to more than 40-m depths) south of Pulau Dolak, and the east-northeast-trending ridge, extending from the shoreline at a point close to the Irian Jaya–Papua New Guinea border to approximately long 137° E. A feature they did not discuss, but which is apparent on both maps, is the northwest-trending linear slope (in water depths of 10–50 m) in the southern Gulf of Carpentaria extending from the eastern tip of Mornington Island to approximately lat 15°30′ S., long 138°50′ E. Because Torgersen and others' (1983) map does not cover as large an area as this map, it does not show that a low-gradient sea floor, between 50 and more than 80 m in depth, extends across most of the Arafura Sea.

Differences in detail between this map and that of Torgersen and others (1983) result from the use of different tidal datums, from different density of data, and, on this map, from the use of hand rather than machine contouring. For example, using the contouring criteria described above, hand-contouring of the RAN digital data did not reveal several depressions, from about 10 to 40 km in length, shown on Torgersen and others' (1983) map at depths greater than 50 m. Also, this map shows several small shoals located in the southern and western parts of the Gulf of Carpentaria that are not indicated on Torgersen and others' (1983) map.

The gradient of the flat floor of the Gulf of Carpentaria is about 1:16,000, which is as flat as or flatter than most abyssal plains. Unlike abyssal plains, however, the flatness cannot be attributed to deposition from turbidity currents because the gradient from the shoreline to the deepest part of the basin is too low. The distribution of sediments by tidal currents may have created and maintained the flat floor.

The shallowest part of the Arafura Sill, outlined on the map at about 55 m depth, approximates the northwestern edge of the Gulf of Carpentaria, which was defined by Torgersen and others (1983) as a line between Cape Wilberforce and False Cape. West of the Arafura Sill, there is a marked physiographic change dominated by a large submarine channel system. The channel that extends west-northwestward from the Arafura Sill, referred to here as the Arafura Channel, is a relict of the channel that drained the Gulf of Carpentaria during glacially driven lowstands of sea level (Fairbridge, 1951; Jongsma, 1974). The rate of sediment accumulation in the central part of the Arafura Sea is sufficiently low that the channel never filled in following the Holocene transgression. Using seismic-reflection records, Jongsma (1974) provided evidence for the age and erosional nature of the channel by showing that reflectors, from Tertiary sediments, were truncated at the channel. Some small channels are apparent on the slopes of the Gulf of Carpentaria, but no major river-drainage channels similar to the Arafura Channel exist on the flat floor of the gulf. The absence of relict-surface channels in the gulf may be due to extremely dry conditions in that area during the Wisconsin glaciation.

On the floor of the Arafura Sea, former subaerial erosion and deposition are indicated where contours, particularly 60 to 80 m, define channel drainage patterns and shoreline features. The 70- and 60-m contours between lat 10° and 11° S. and long 133° and 135° E. suggest an ancient shoreline and delta. The distinctively subaerial patterns are not obvious north of lat 9° S. It is probable that contouring would have revealed subaerial patterns if there were a denser distribution of data in that area.

The detailed drainage pattern offshore from the northern coast of Australia was not evident to Jongsma (1974). He described the sea floor south of lat 10° S. as "undissected and almost flat" and the area north of lat 10° S. and east of long 133° E. as having "many channels, terraces, and ridges." Thorough surveying of the area south of lat 10° S. revealed features not apparent from older, less-dense bathymetric data. This supports the suggestion that with more data, more detailed subaerial drainage features should be evident north of lat 9° S.

At the scale of this map, several small elongate depressions are just barely distinguished. They are found west and south of Groote Eylandt, in Arnhem Bay, and in several locations between the 20- and 50-m isobaths in the southern part of the Gulf of Carpentaria. The depressions occur where bottom currents would be constricted or diverted, suggesting the depressions were formed by current scouring. A small elongate depression north of Cape Wessel is more than 40 m deeper than the surrounding sea floor and also appears to be maintained by current scour.

At the western edge of the map area, one additional physiographic province is seen. North of Bathurst Island between the 50- and 100-m contours, the rugged relief of the extensively channeled Joseph Bonaparte Gulf region, which is located west of the area depicted on this map, is just barely evident.

ACKNOWLEDGMENTS

We gratefully acknowledge the contributions of Thomas Torgersen of the University of Connecticut, who made a large-scale copy of the 1983 bathymetric map available and also reviewed this map, and of Ronald Furness and Ian Halls of the Royal Australian Navy, Hydrographic Service, who supplied the RAN digital data. Thanks also are extended to Troy Holcombe and George Sharman of the National Oceanic and Atmospheric Administration, National Geophysical Data Center, and to David Twichell of the U.S. Geological Survey, for their reviews, helpful comments, and suggestions.

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Australia Division of National Mapping, 1981, Pillar Bank: Australia Division of National Mapping, sheet SC 53–5, scale 1:250,000.

———1983a, [untitled]: Australia Division of National Mapping, sheet SC 52-8, scale 1:250,000.

———1983b, Lynedoch Bank: Australia Division of National Mapping, sheet SC 52-12, scale 1:250,000.

———1984, Marie Shoal: Australia Division of National Mapping, sheet SC 52–11, scale 1:250,000.

———1986, Fog Bay: Australia Division of National Mapping, sheet SD 52–3, scale 1:250,000.

———1989, Darwin: Australia Division of National Mapping, sheet SD 52–4, scale 1:250,000.

———1990a, Cape Beatrice: Australia Division of National Mapping, sheet SD 53–12, scale 1:250,000.

———1990b, Gove: Australia Division of National Mapping, sheet SD 53–4, scale 1:250,000.

———1990c, Port Langdon: Australia Division of National Mapping, sheet SD 53–8, scale 1:250,000.

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———1990, Cape Arnhem to Cape Fourcroy, Australia (revised ed.): [Great Britain] Admiralty chart 1044, scale 1:1,000,000 at lat 27°15′ S. [First published in 1955.]

[Great Britain] Hydrographer of the Navy, 1988, Sungai Aikato to Selat Muli: Hydrographer of the Navy chart 3527, scale 1:500,000.

Indonesia Angkatan Laut, Djawatan Hidrografi, 1961, Pantai Barat Dan Pantai Selatan Irian Barat, Tandjung Nasaulang sampai Perbatasan Australia: Djawatan Hidrografi Angkatan Laut Republik Indonesia chart 195, scale 1:1,000,000 at lat 6°25′ S.

Jongsma, D., 1974, Marine geology of the Arafura Sea: Australia Department of Minerals and Energy, Bureau of Mineral Resources, Geology and Geophysics Bulletin 157, 73 p.

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———1974, Approaches to Port Darwin: RAN Hydrographic Service chart AUS 27, scale 1:75,000 at lat 12°15′ S.

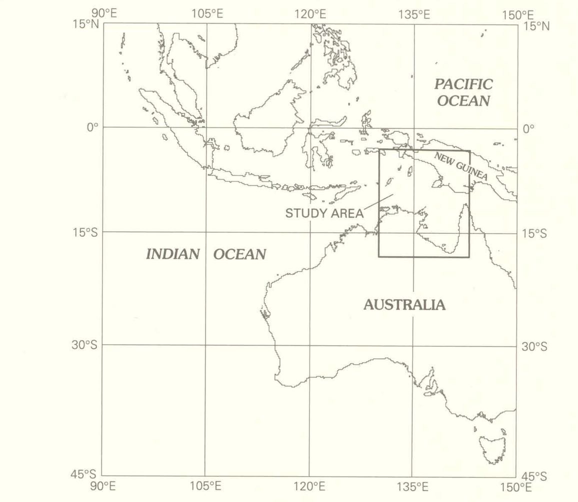
———1979, Western approaches to Torres Strait: RAN Hydrographic Service chart AUS 700, scale 1:150,000.

———1991a, Booby Island to Cape Wessel, including the Gulf of Carpentaria, Northern Territory and Queensland, north coast, Australia (revised ed.): RAN chart AUS 410, scale 1:1,000,000 at lat 27°15′ S. [First published in 1971.]

———1991b, Cairncross Islets to Arden Islet: RAN Hydrographic Service chart AUS 839, scale 1:150,000. [First published in 1978.]

———1991c, Torres Strait (revised ed.): RAN Hydrographic Service chart AUS 376, scale 1:300,000. [First published in 1984.]

Torgersen, Thomas, Hutchinson, M.F., Searle, D.E., and Nix, H.A., 1983, General bathymetry of the Gulf of Carpentaria and the Quaternary physiography of Lake Carpentaria: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 41, p. 207–225.



LOCATION MAP

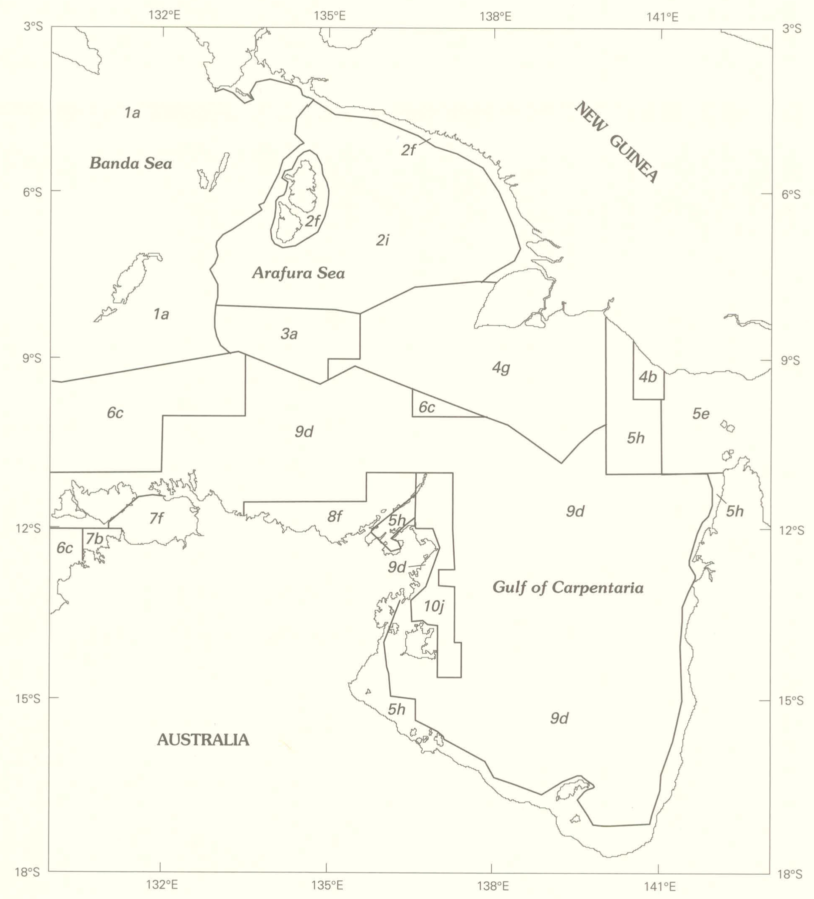


Figure 1.—Data sources and data density. Data and maps used in the preparation of this report are shown by number and listed below. Within delineated areas, density of sounding and (or) trackline data, where known, is indicated by letter and explained below.

Data sources

1. Unpublished map compiled by T.E. Chase (U.S. Geological Survey) and others, 1987, Marine topography of the Indonesia region, scale 1:3,640,000
2. [Great Britain] Admiralty (1983); [Great Britain] Hydrographer of the Navy (1988); Indonesia Angkatan Laut, Djawatan Hidrografi (1961)
3. Jongsma, D. (1974)
4. Torgersen and others (1983)
5. Royal Australian Navy, Hydrographic Service (1979, 1991a,b,c)
6. Australia Division of National Mapping (1981, 1983a,b, 1984, 1986, 1989)
7. Royal Australian Navy, Hydrographic Service (1968, 1974)
8. Australia Department of the Navy, Hydrography Branch (1970); [Great Britain] Admiralty (1990)
9. Unpublished data from Royal Australian Navy, Hydrographic Service, 1992
10. Australia Division of National Mapping (1990a,b,c) and unpublished data from Royal Australian Navy, Hydrographic Service, 1992

Density of sounding and (or) trackline data

a. Multiple sources; data density not available
b. Spacing of soundings less than 2 km
c. Continuous soundings; trackline spacing 1–5 km
d. Trackline spacing 1–5 km; data sampled about 750 m
e. Spacing of soundings about 2 km
f. Spacing of soundings about 5 km
g. Gridded data; 0.05° by 0.05° grid
h. Spacing of soundings 10–15 km
i. Spacing of soundings greater than 10 km
j. Sparse data; trackline spacing as much as 30 km; data sampled about 750 m

MERCATOR PROJECTION
SCALE 1:2,500,000 AT 0° LATITUDE

25 0 25 50 75 100 NAUTICAL MILES
25 0 25 50 75 100 125 150 175 200 KILOMETERS
25 0 25 50 75 100 STATUTE MILES

CONTOUR INTERVALS: 10 METERS TO 200-METER DEPTH, 500 METERS FROM 200-METER DEPTH TO MAXIMUM DEPTH
TIDAL DATUM: SEE "MAP PREPARATION" SECTION OF TEXT

BATHYMETRIC MAP OF THE GULF OF CARPENTARIA AND THE ARAFURA SEA

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INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1998