GEBCO Sheet G.08
(Greater Indian Ocean)

BATHYMETRY OF THE GREATER INDIAN OCEAN (compiled September 2002)

(Note: a subset of this sheet was released as GEBCO sheet 97.1 in the 1997 release of the GEBCO Digital Atlas covering the area of the Indian Ocean south of 31°S and extending from 10°W in the South Atlantic to 140°E south of Australia. This area has been further updated and the sheet now extends to cover the whole of the Indian Ocean from Asia down to Antarctica, extending eastwards to 170°E in the south-west Pacific and westwards to 12°W in the south-east Atlantic. The area covered is about a quarter of the world's oceans)

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Digitised by:	Pauline Weatherall, British Oceanographic Data Centre
Sheet Limits:	31°N to 72°S; 12°W to 170°E (see below for detailed coverage)
Scale:	Contours compiled and digitised on Mercator sheets at a scale of 4 inches per degree longitude (i.e. approximately 1:1 million)
Horizontal Datum:	WGS-84
Contour Units:	Bathymetric depth in corrected metres
Contours present:	standard GEBCO depths i.e. 200m, 500m and at 500m intervals thereafter down to 7000m. Locally the 100m contour is also present.
Coastline Source:	SCAR Coastline of Antarctica south of 60°S (Version 3.0; Full resolution version at a scale of 1:1 million or better). NIMA World Vector Shoreline north of 60°S. (Scale of 1:1 million.)

Geographic Coverage:

a) SE Atlantic from 24°S to 72°S; 12°W to 20°E with an extension to 20°W between 56°S to 60°S. South of 65°S and west of 2°E, the bathymetry is provided by GEBCO sheet G.07 and the two sheets are merged at this boundary.

b) Indian Ocean from 20°E to 147°E, from Asia down to Antarctica (including the Gulf of Aden). The north east boundary with the South China and Eastern Archipelagic Seas is along a line taken between 9°N,99°E; 0°N,105°E; 0°N,115°E; 4°N,115°E; 4°N,136°E; and then southwards to the coast of Australia.

c) SW Pacific from 24°S to 72°S; 147°E to 170°E but restricted in the northeast where it abuts, and is merged with, GEBCO sheet G.09 – in this region the eastern limit is as follows: 24°-31°S,158.6°E; 31°-47°S,157°E; 47°-54°S,165°E; 54°-57.5°S,163.5°E.

PREPARATION OF GEBCO SHEET G.08

The compilation and hand contouring of all echo-sounding data used in the construction of Sheet G.08 was carried out by Dr. Robert L. Fisher of the Scripps Institution of Oceanography (SIO) as part of the International Indian Ocean Data Compilation Project (IODCP), a collaborative venture between scientists at SIO and L'Ecole et Observatoire de Physique du Globe, Strasbourg, France. The project's aim is to produce a detailed tectonic chart for the entire Indian Ocean and the contiguous Southern Ocean between 5°W to 166°E. It will include the compilation and interpretation of all available bathymetric, magnetic and satellite-derived gravity data from Africa-Asia-Australia south to Antarctica.

The basic "source document" used for the bathymetric contouring was the 1950-1995 compilation of echo-sounding data maintained by Dr. Fisher at SIO on a set of 240 or so hard copy oceanic scale (4 inches to 1 degree of longitude, Mercator projection) plotting sheets. These were augmented in very large degree by further soundings contributed by academic and government agency sources (as listed below). These sources contributed data either as hard copy plotting sheets (typically 1:1 million scale Mercator plots) or as digital files of cruise navigation and soundings accompanied by standard velocity correction notations. The digital files were plotted out for Dr. Fisher by Virginia Wells and Uta Albright at SIO's Geological Data Center. During the compilation, the soundings were compared and checked for recording errors and, for pre-satellite-navigated tracks, slight track adjustments were made as necessary to minimize crossover discrepancies. A compilation of tracklines, corrected for digitising errors and omitting segments without soundings, was compiled concurrently on a parallel set of hard copy plotting sheets at the same scale.

The sounding data were hand contoured by geological interpretation by Dr. Fisher sheet by sheet, employing multiple cruise sounding overlays as required for legibility and clarity. In contouring, the standard GEBCO contour levels were followed i.e. 500m intervals, plus the 200m contour and, occasionally, on wide shelves, the 100m contour. The contoured depths are in "corrected metres" using Carter's Tables (NP 139, "Echo-Sounding Correction Tables", 3rd Edition, D.J.T. Carter, Hydrographic Department, Taunton, 1980). None of the contouring was taken from existing nautical or scientific publications or manuscripts; rather, all was done by hand from 1987 to 2002 by Dr. Fisher from his collection of soundings sheets.

In constructing the contours, the echo-sounding based interpretation was compared with large-scale portrayals of satellite altimetry "topography". Such gravity-based portrayals were constructed from a data file available at SIO (Sandwell, D.T. and W.H.F. Smith, "Marine Gravity Anomalies from GEOSAT and ERS-1 Altimetry", (version 7.2, Aug. 1996), Journal of Geophysical Research, vol.102, p.10,039-10,054). These comparisons at large scale helped eliminate spurious structural trends or major misconnections in regions contoured from sparse shipboard coverage. However, depth contour levels are based entirely on sounding data; gravity indications affected only the general shape of features detectable from existing soundings.

The hand contoured sheets at a scale of 4 inches per degree longitude and their corresponding trackline plots were duplicated at SIO and sent to the British

Oceanographic Data Centre (BODC) at the Proudman Oceanographic Laboratory, Birkenhead, UK - a total of some 250 pairs of sheets! The contours and tracklines were digitised by Pauline Weatherall at BODC employing raster scanning techniques and subsequent vectorisation and labelling using Laser-Scan's VTRAK system. Careful control was exercised in the geographic registration of the material which was checked at one degree intervals of both latitude and longitude across the full area of each sheet. Both contours and tracklines were digitised with a registration accuracy within the line thickness of the source material. For the area between 10°W and 20°E, the contours were hand digitised by Karen Walters and Jon Anderson at SIO and the files transmitted to BODC for quality control. Miss Weatherall was responsible for edgematching the digitised contours across sheet boundaries so as to provide a seamless data set. She was also responsible for incorporating a digital coastline into the data set using the Defense Mapping Agency's World Vector Shoreline (north of 60°S) and the Scientific Committee on Antarctic Research's coastline of Antarctica (south of 60°S). Careful checks were made to ensure that the bathymetric contours were consistent with the coastlines, particularly around islands.

The contouring and digitizing work was undertaken over a period of more than 10 years – as new sounding data continued to be acquired over this period, the bathymetry was updated as and when appropriate. As a result of this, over 600 sections of update charts were delivered to BODC for digitising during the project, in addition to the 250 ‘first version’ sheets. The work was completed in September 2002.

DATA SOURCES USED FOR GEBCO SHEET G.08

During the compilation of data for GEBCO Sheet G.08, the "oceanic scale" (4 inches per degree longitude, Mercator projection) sounding compilation sheets maintained at SIO were augmented by shipboard data from the following sources (individuals responsible for contributing the data are named in parenthesis):

1. Principal sources: collector sheets

1.1 GEBCO Collected Soundings Sheets (1:1 million scale, Mercator) maintained by Volunteering Hydrographic Offices with geographic responsibilities within the region:

a) U.K. Hydrographic Department, Taunton: complete collection, including Southern Ocean, updated to 1988-1989: (Nigel Gooding, Brian Harper)

b) South Africa Hydrographic Office, Tokai, Cape: complete collection variously updated to 1981-1983: (C.G.H. Wagenfeld, D.B. MacPherson)

c) Hydrographic Office, Royal Australian Navy, Garden Island and Wollongong, NSW: 57 sheets, variously updated to 1971-1989: (Mark A. Bolger)

1.2 USNOO Bay St. Louis, Mississippi: USNS Wilkes, 1977-1979, 1981-82 operations: (Francis Marchant, Luther Little)

2. Principal sources: digital files

2.1 Government agencies:

a) Australian Antarctic Division, Kingston, Tasmania: R/V Aurora australis 1990's sub-Antarctic cruises: (Henk Brolsma, Lee Belbin, Ursula Ryan)

b) Australian Geological Survey Organisation (formerly Bureau of Mineral Resources), Canberra:

   1) 979-1995 tracks and soundings of geophysical survey ships in the Australian EEZ, on Kerguelen Plateau and the Antarctic margin: (Chris Johnston, Millard Coffin)

   2) SOJOURN 7 and TASMANTE cruises: (Neville Exon, Peter Hill)

c) Australian CSIRO Division of Oceanography, Hobart, Tasmania: R/V Franklin 1987-1998 tracks and soundings on continental margins, EEZ and near Christmas Island: (Bernadette Heaney, Data Librarian and Terry Byrne)

d) Geological Survey of Japan, Marine Geophysics Section, Marine Geology Department: bathymetric data collected during JNOC (Japan National Oil Corporation) survey cruises off Antarctica, R/V Hakurei Maru 1980-1995: (Takemi Ishihara, JGS)

e) Japanese (JARE, ANTAC) and Soviet (R/V Ob, 1957-58) research vessel soundings off Antarctica (received via US National Geophysical Data Center, Boulder, Colorado)

f) South Africa Hydrographic Office, Tokai, Cape: throughout S.A. GEBCO Area of Responsibility, 1990-1998: (Sidney Osborne, B.D. Law, Tony Pharaoh)

2.2 Laboratories and academic institutions:

a) Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven: R/V Polarstern pre-1998 soundings in the sub-Antarctic between 10°W and 40°E: (Hans Werner Schenke)

b) L'Ecole et Observatoire de Physique du Globe de Strasbourg: track and soundings of R/V Marion Dufresne and R/V l'Atalante in central and eastern Indian Ocean, 1980-1998: (Marc Munschy, Marc Schaming, Roland Schlich, Marie-Odile Boulanger)

c) Institut Universitaire European de la Mer, Universite de Bretagne Occidentale, Plouzane: 1998 MAGOFOND 2 cruise of R/V Marion Dufresne: (Jerome Dyment); R/V Marion Dufresne 110 and R/V Atalante TASMANTE 1994 cruises: (J.-Y. Royer)

d) Laboratoire de Geophysique Marine, Institut de Physique du Globe de Paris, Paris VI: R/V Marion Dufresne and R/V L'Atalante 1982-1995 sounding data in the western and east-central Indian Ocean: (Philippe Patriat, Jacques Segoufin)

e) R/V Melville (SIO) soundings in the southeast Indian Ocean, 1994-1995: contributions from Lamont-Doherty Earth Observatory, New York: (Christopher

Small, James Cochran, Carl Brenner); Oregon State University: (David Christie); University of Washington: (Jean-Christophe Sempere)

f) Geological Data Center, Scripps Institution of Oceanography, La Jolla, California: "Alliance exotique" (IODCP) files, 1987-2001: (Virginia Wells)

3. Secondary sources: digital files

a) Bullard Laboratories, University of Cambridge, UK: 1986-1987 cruises of RRS Charles Darwin, RRS Shackleton: (Carol Williams)

b) Bundesamt fur Seeschiffahrt und Hydrographie, Hamburg: 1997 tracks and soundings being compiled for IOC's International Bathymetric Chart of the Western Indian Ocean: (Hartmut Kluger)

c) Hydrographic Office, Taunton, UK: (Gordon Taylor)

d) National Institute of Water and Atmospheric Research Ltd, Wellington New Zealand: 1997: partial tracks of 15 NIWA cruises between 166°E and 170°E: (Ian Wright)

e) Netherlands Institute for Sea Research, Texel: R/V Tyro 1992-1993 cruise, Arabian Sea: (C.N. van Bergen Henegouw)

f) Ocean Research Institute, Tokyo: 1999 tracks and soundings from ORI's FUJI and INDOYO cruises: (Kensaku Tamaki, Hiromi Fujimoto, Tomohiro Yamaashi) also (Catherine Mevel, Laboratoire de Petrologie, Mineralogie, Metallogenie, Paris VI)

g) Southampton Oceanography Centre, Southampton, UK: RRS Discovery cruises 199, 200, 207, 208 southwest Indian Ocean: (Martin Saunders, Peter Hunter)

h) University of Texas Institute of Geophysics, Austin: tracks and soundings of Australia's R/V Rig Seismic (1994) and of R/V Maurice Ewing (1996), Macquarie Ridge Complex: (Millard Coffin, Christina Massell)

i) Woods Hole Oceanographic Institution, Massachusetts: 1987 RRS Charles Darwin Durban-Fremantle cruise: (John Toole)

j) National Geophysical Data Centre, Boulder, Colorado: Acquisition updates 1995-1998