The bottom line

Studying the contours of the ocean floor – Pauline Weatherall and Ray Cramer chart our knowledge from the first soundings to satellite observations.

If you could peer beneath the ocean waves and glimpse the seafloor far below, you would see deep basins, vast mountain chains and long ocean trenches. This landscape helps steer ocean currents that in turn affect climate, and influences hazards facing coastal communities (like approaching tsunamis). Yet, despite over a century of exploration, we know more about the shape of the moon's surface than about this varied terrain.

Researchers began to systematically collect bathymetry data – information about the depth from the surface to the ocean floor – in the deep oceans in the 19th century. At this time, studying the natural world, and of course the oceans, was very much in vogue. Oceanographic expeditions that studied marine biology and physics started to map the ocean floor as well. The first trans-oceanic communication cables were being laid, and companies collected bathymetric information to find the smoothest and flattest routes. But soundings had to be taken using weighted lines – a slow and difficult process.

By the end of the 19th century the first bathymetric maps had been published, and people realised they needed a common set of terms to describe features on the maps. In 1903 a commission of oceanographers and geographers, led by Prince Albert I of Monaco, started working on the problem. Prince Albert had been in the navy as a young man, and was keenly interested in oceanography. He offered to organise and fund a set of charts mapping the world's seafloors. The series was known as the General Bathymetric Chart of the Oceans or GEBCO.

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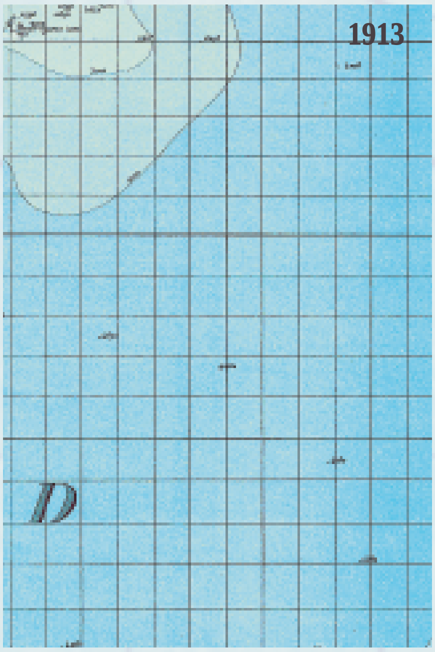
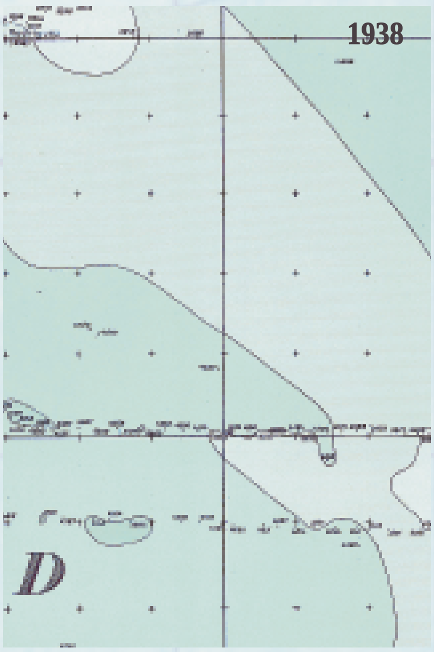
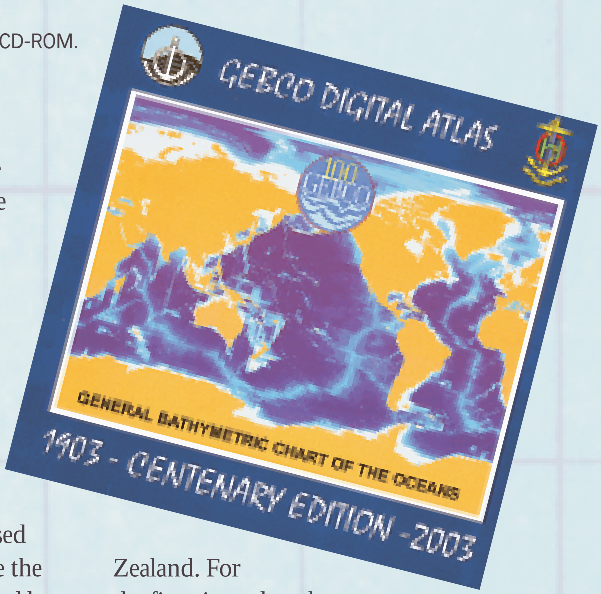
These first charts were based on just 18,400 soundings – all measured by weighted line. It wasn't until the 1930s that the single-beam echo sounder was introduced, allowing survey ships to collect greater volumes of data about the seafloor beneath the ship. Today, multi-beam swath bathymetry systems, which have a fan-like array of sonar beams directed to either side of the ship, can collect bathymetry data along a number of parallel tracks at once. This means swaths of the ocean floor can be mapped in considerable detail, at least over small areas.

We have also become much better at







The GEBCO Digital Atlas CD-ROM.

recording the position of depth measurements. Mariners have moved from astronomical observations to radio navigation systems, and more recently, satellite systems such as the Global Positioning System. Now we can record positions to within a few metres.

As the volume of bathymetry data increased, researchers needed a better way to manage it. In 1990 the International Hydrographic Organisation (IHO) set up a database at the US National Geophysical Data Center. The database now holds over 41 million echo-soundings.

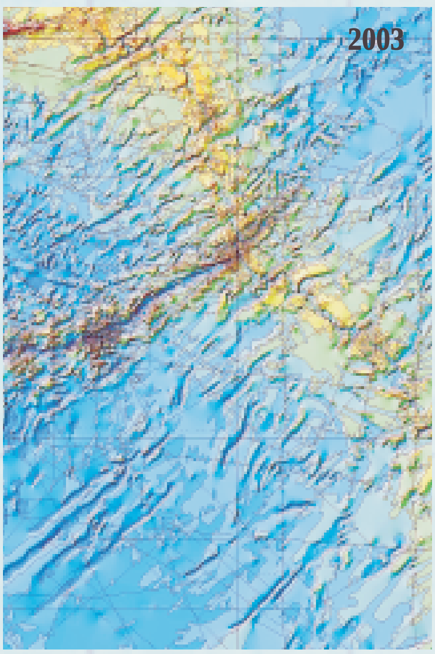
But even with this vast increase in information, there are still large areas of the ocean floor that haven't been fully surveyed. Data are often concentrated along isolated ship tracks, and there may be many miles between one track and the next. Scientists may need other information to help them interpret what lies in between. In recent years satellite altimetry data has helped. This measures the height of the sea surface. Small variations in sea height can be related to changes in the Earth's gravity field. This in turn can be related to features on the ocean floor. For example, the sea surface may be high over a seamount, or show a depression, or trough, over a trench. This can help scientists interpret the size and shape of features on the ocean floor, although there are some limitations, for example in areas covered by sediment.

In the 1980s GEBCO's governing body decided to turn the data from the charts' fifth edition into digital maps, making GEBCO easier to update and useful for more varied tasks. The bathymetric contours, coastlines and ship track data digitised from the paper charts went to create the GEBCO Digital Atlas, first published by the British Oceanographic Data Centre (BODC) in 1994 on behalf of the GEBCO community. The digital atlas includes a gazetteer naming undersea features, maintained by the International Hydrographic Bureau on behalf of the GEBCO community. It includes over 3000 features, such as Carpathia Knoll in the North Atlantic, named for the ship that picked up survivors from the Titanic disaster.

> 'Understanding the seafloor helps us understand the rest of our planet.'

In 2003, the BODC published The Centenary Edition of the GEBCO Digital Atlas. This latest version includes much-improved information for the Arctic Ocean, the Indian Ocean, the north-east and central-eastern Atlantic, the Caribbean Sea and the Gulf of Mexico, the Weddell Sea and waters around New Zealand. For the first time, the atlas gives a depth estimate for the world's oceans at one minute intervals of latitude and longitude. The digital atlas is distributed on CD-ROM and comes with software that lets you view the data sets on your computer screen and export the data for use in your own programmes.

Understanding the seafloor helps us understand the rest of our planet. Accurate bathymetry helps us model ocean currents, and may even help us predict climate change. Today the GEBCO project is run by an international organisation under the patronage of the International Hydrographic Organisation and the Intergovernmental Oceanographic Commission. GEBCO aims to provide the most authoritative and publicly available bathymetric data sets for the world's oceans. The digital atlas is used by over 1000 organisations in 96 countries.



BODC is the UK's main centre for storing and distributing data about the marine environment. It is hosted by the Proudman Oceanographic Laboratory and is part of the Intergovernmental Oceanographic Commission's network of data centres.

You can find out more about GEBCO and the GEBCO Digital Atlas CD-ROM at www.ngdc.noaa.gov/mgg/gebco and www.bodc.ac.uk/gebco.

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