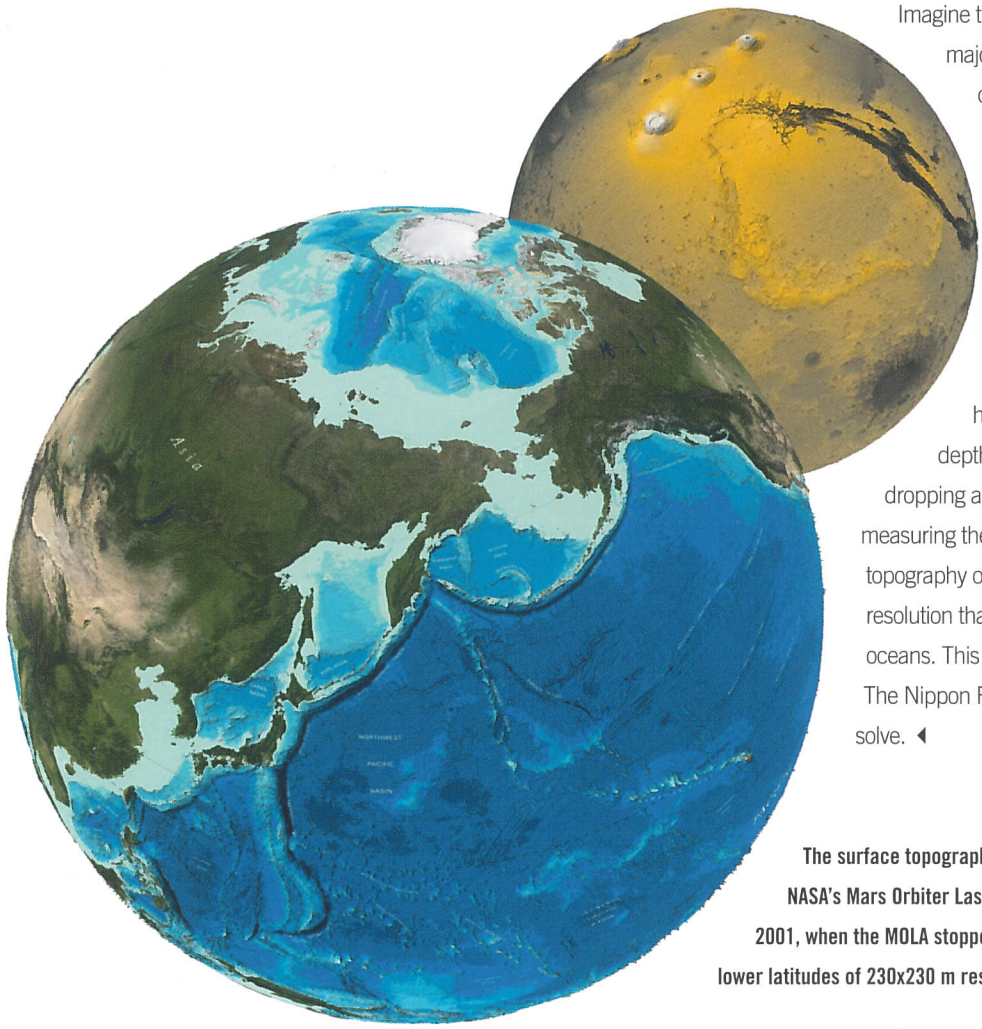
The Nippon Foundation
GEBCO Seabed 2030 Mission Statement

Vision: 100% of the World Ocean floor mapped by 2030

Mission: Produce the definitive map of the World Ocean floor by 2030 to empower the world to make policy decisions, use the ocean sustainability and undertake scientific research based on detailed bathymetric information of the Earth's seabed.



Imagine that we knew land topography only in the vicinity of major highways. We would have a blurred view at best of Earth's outstanding topographic features such as Mount Everest or the Grand Canyon. Many features would have escaped our attention altogether. This scenario may be used to describe how little we have mapped the seabed. For all of humanity's scientific achievements, more than 80% of the World Ocean floor remains unmapped with modern, high resolution technology. In some areas, our only depth data was recorded more than 100 years ago by dropping a weight tied to a line over the edge of a boat and measuring the length to the bottom. Consequently, we know the topography of several planets and their moons to a higher resolution than we do the surface our own planet beneath the oceans. This poses fundamental problems for humanity, which The Nippon Foundation-GEBCO Seabed 2030 project hopes to solve. ◂

The surface topography of Mars was mapped already in 1998 and 1999 by NASA's Mars Orbiter Laser Altimeter (MOLA) (Smith et al., 1999). By June 30, 2001, when the MOLA stopped collecting altimetry data, topographic grids at Mars lower latitudes of 230x230 m resolution had been collected.

DEEP AMBITION: HOW TO MAP THE WORLD

THIS INFORMATION IS BASED ON THE NIPPON FOUNDATION - GEBCO - SEABED 2030 ROADMAP FOR FUTURE OCEAN FLOOR MAPPING

Yohei Sasakawa, Chairman of The Nippon Foundation, in Monaco in June 2016, where his vision for mapping the entire ocean floor by 2030 was first articulated by him at the Forum for Future Ocean Floor Mapping. The Nippon Foundation, Japan's largest private foundation, has a long history of engagement with maritime issues.

Announced by Mr Yohei Sasakawa, Chairman of The Nippon Foundation, at the UN Ocean Conference in New York on 6 June this year, the vision of the project is to have 100% of the World Ocean floor mapped by 2030. The Nippon Foundation is planning to contribute US$ 18.5 million for the first ten years of the Seabed 2030 project. The ultimate project mission is to produce the definitive map of the World Ocean floor to empower the world to make policy decisions, use the ocean sustainability and undertake scientific research based on detailed bathymetric information of the Earth's seabed. This will support the fulfillment of the UN Sustainable Development Goal 14: *Conserve and sustainably use the oceans, seas and marine resources for sustainable development.*

The Seabed 2030 project has an ambitious target that, with current multibeam mapping technology, would take a single ship approximately 1,000 years to complete. That is why Seabed 2030 has been designed not only to aggregate and compile existing depth data, but also to serve as a roadmap; or a set of guidelines and instructions, providing a model of collaboration to focus the efforts of the international mapping community towards its ultimate objective.

This roadmap to success will be implemented by building a set of critical pillars, each designed to systemize the process of mapping the world ocean floor by 2030.

- To build working relationships with bathymetric data contributors all around the world
- To aggregate and compile existing data into a widely available digital database
- To identify unmapped areas, enabling the prioritisation of coordinated survey operations in these regions
- To implement the latest technology for ocean mapping, e.g. satellite derived near shore bathymetry, and facilitate crowd sourcing to source data from fishing, merchant and recreational vessels.

The data generated from each of these activities will be brought together to make new, more detailed maps of the ocean floor. Having 100% of the World Ocean floor mapped by 2030 raises the question to what resolution? Seabed 2030 starts with the vision to map all accessible parts of the World Ocean floor to the best possible resolution a modern multibeam sonar installed in a surface vessel can provide, although, there is no ambition to go beyond mapping features smaller than 100 x 100 m. While a modern multibeam sonar is capable of providing much higher resolution than 100 x 100 m on the shallow continental shelves, even this resolution poses a great challenge in the deeper ocean. A specification of target resolutions varying with depth will therefore be developed during the first phase of the project.

Who's involved?

GEBCO and The Nippon Foundation have teamed up to achieve the Seabed 2030 objectives

The General Bathymetric Chart of the Oceans (GEBCO) is the only organisation with a mandate to map the entire ocean floor. Operating under the auspices of the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), GEBCO aims to provide the most authoritative, publicly-available bathymetric datasets for the world's oceans. The Nippon Foundation's mission focuses on social innovation, in which *"The future of our ocean"* is one of seven key fields of activity.

Through the Seabed 2030 program, GEBCO and the Nippon Foundation have committed to build the necessary technical, scientific and management framework to compile all available bathymetric information into a seamless digital bathymetric map of the World Ocean floor by the year 2030.

THE NIPPON FOUNDATION

General Bathymetric Chart of the Oceans GEBCO

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

Why map the ocean floor?

Real world applications for science and industry

Seabed 2030 is not simply science for its own sake; the real world benefits of detailed ocean floor maps are tangible. Bathymetric data from the deep ocean is critical for a wide variety of scientific applications, including marine geology and geophysics. A prime example is how bathymetric data obtained in the 1950s and '60s by Bruce Heezen and Marie Tharp led to our modern understanding of plate tectonics.

Crucial parameter

The shape of the seabed is also a crucial parameter for understanding ocean circulation patterns relating to regional and global ocean-atmosphere processes, including temperature regulation between the tropics and the poles – as well as being an important variable for accurately forecasting tsunami wave propagation. Bathymetric data illuminates the study of tides, wave action, sediment transport, underwater geo-hazards, cable routing, fisheries management, resource exploration and exploitation, the extension of continental shelf (UN Law of the Sea treaty issues), military and defence applications, and represents a fundamental dataset for confronting the growing challenges associated with climate change. In coastal regions, bathymetry underpins marine and maritime spatial planning and decision-making, navigation safety, and provides a scientific basis for models of storm surges, while also informing our understanding of marine ecosystems and habitats.

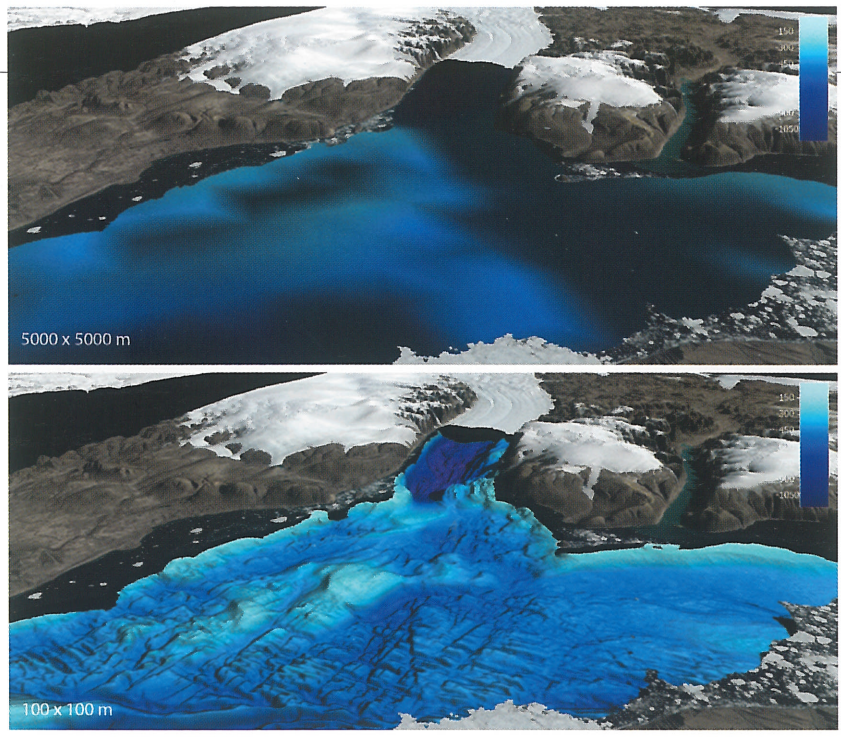
The more data we acquire about the details of seabed shape, the more we recognize that the ocean and its floor are more dynamic than previously realised. Detailed knowledge of bathymetry is a fundamental prerequisite for attaining an improved understanding of these subsea processes.

How to go about it?

This can only be achieved through international collaboration with respect to data acquisition, assimilation and compilation

Modern bathymetric mapping that acquire high-resolution data for production of detailed digital models of the seafloor relies on acoustic technologies deployed from surface or submerged vessels. Given the sheer size of the World Ocean, it takes many actors to map all of the

Bruce Heezen and Marie Tharp. Their work to portray the seabed played an important part in the formulation of one of the most prominent paradigm shifts in geosciences – the seafloor spreading and the plate tectonic revolution. (Text from The Nippon Foundation – GEBCO Seabed 2030 Roadmap for Future Ocean Floor Mapping. Photo credit: Lamont-Doherty Earth Observatory)

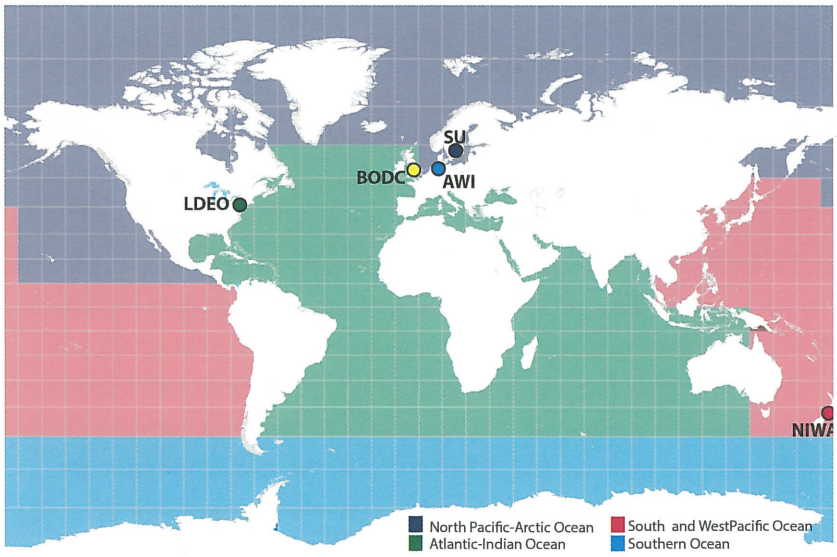


The influence a fjord's bathymetry on outlet glaciers' sensitivity to inflow of warmer sub-surface ocean water is one scientific example of when the depth and shape of the seafloor is critical knowledge. The existence of a bathymetric shoal in front of an outlet glacier, a fjord sill, acts as a protecting barrier. An outlet glacier draining into a fjord without a prominent sill is sensitive and may begin loosing mass rapidly if current changes imply influx of warmer sub-surface water. The bathymetry is therefore key to model potential mass loss of glaciers in a warming climate, in turn causing sea-level rise that impacts living conditions far beyond the Polar Regions. The upper image show Petermann Fjord and nearby area of Nares Strait, Northwest Greenland. The bathymetry is gridded at 5x5 km, which illustrates our knowledge in many regions of the World Ocean. The lower image shows the seafloor at a resolution of 100x100 m, after a complete mapping was done by Swedish icebreaker Oden during the Petermann 2015 Expedition. While the full resolution multibeam bathymetry is 15x15 m, the 100x100 m resolution resolves the critical sill at the fjord entrance.

seafloor with existing technologies. This implies that the Seabed 2030 goals can only be achieved through international coordination and collaboration with respect to data acquisition, assimilation and compilation. There is no use to duplicate efforts.

Central to the Seabed 2030 strategy is the creation of Regional Data Assembly and Coordination Centres (RDACCs), with each having a defined ocean region of responsibility (see map). A board will be established for each region consisting of local experts and representatives of mapping activities. This board will have two main tasks: to identify existing bathymetric data, and to help coordinate new bathymetric surveys. Collaborating with ongoing mapping efforts such as EMODnet covering European waters (www.emodnet-bathymetry.eu), the Baltic Sea Bathymetry Database (http://data.bshc.pro), and the Atlantic Galway Statement implementation initiatives will be key to get the World Ocean mapped by 2030.

The first Regional Mapping Project working along these lines was the International Bathymetric Chart of the Arctic Ocean (IBCAO), initially established 1997 in St Petersburg, Russia, as an international project aiming to map the Arctic Ocean. The first bathymetric compilation from IBCAO was released in 2000 and later included in the GEBCO World Ocean bathymetric grid to represent the Arctic Ocean. Following the concept of IBCAO was the International Bathymetric Chart of the Southern Ocean (IBCSO). >>>



This diagram shows the location of each of the RDACCs and the area for which they are responsible, feeding into a Global Data Assembly Centre (GDACC), based at the British Oceanographic Data Centre (BODC) in Liverpool/

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>>> For Seabed 2030, The four RDACCs will be based at The Alfred Wegener Institute, Germany, covering the Southern Ocean; The National Institute of Water and Atmospheric Research, Wellington, New Zealand, covering the South and West Pacific Ocean; The Lamont Doherty Earth Observatory, Columbia University, USA, covering the Atlantic and Indian Oceans; and Stockholm University, Sweden, for the North Pacific and Arctic Ocean.

Challenges

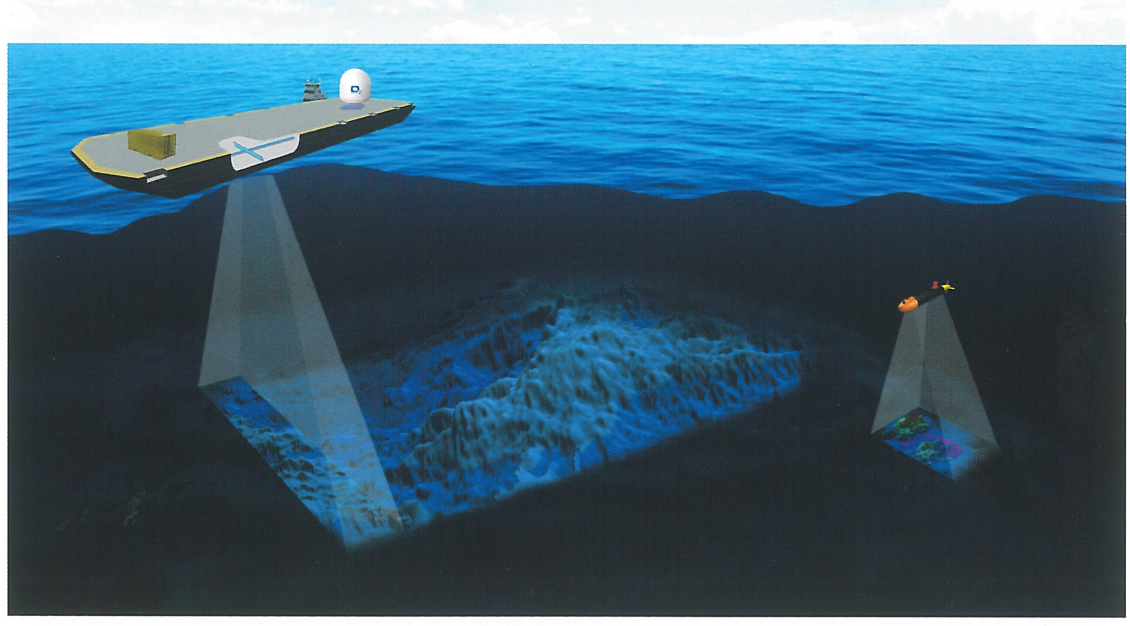
Even using the RDACC/GDACC model, the goal of mapping the entire world ocean is a significant challenge, and can only be accomplished if new field mapping projects are initiated.

Crowdsourcing bathymetric data from fishing vessels and recreational small boats etc. represents one approach for gathering information in shallower water regions, but is less efficient in deeper waters due to depth limitations of standard echo sounders.

Deep water mapping remains a major challenge due to the cost involved and the limited number of available research vessels that are equipped with modern deep-water multibeam sonars. To meet this challenge, Seabed 2030 will create a series of programmatic guidelines to be submitted to national and international funding agencies, with the goal to promote funding opportunities that will support and share the Seabed 2030 vision.

Keeping up with technology is also critical to the project's success. Seabed 2030 will evolve over time to make sure that processes, products and services are forward-looking and well-positioned to make use of new technologies as they become available.

With technological innovation, international collaboration and deep ambition, The Nippon foundation-GEBCO Seabed 2030 project will produce the ultimate bathymetric map of the seafloor for the benefit of everyone on Earth.



Implementing the latest technology for ocean mapping is one of the pillars of the Seabed 2030 project. The concept of an unmanned mapping barge, monitored by satellite communication and equipped with an ultra-narrow beam deep-water multibeam (left), is just one of many ways technology could be used to generate new data. Such a barge would be able to systematically map the deepest sections of the open ocean from the surface at a resolution in excess of 100x100 m. The sub-meter level of detail sometimes needed to investigate small scale processes at the seabed is today only possible to achieve in the deep ocean using AUVs equipped with high-resolution high frequency multibeam systems. These AUVs would serve as excellent complements to the mapping barge
For further information: https://seabed2030.gebco.net/documents/seabed_2030_roadmap_v10_low.pdf

SEA-KIT – Advancing the goal of Seabed 2030

The Shell Ocean Discovery XPRIZE is one example of an initiative with the potential to significantly advance the Seabed 2030 objective. Teams must build an autonomous craft, capable of launching from shore or air with restricted human intervention, to produce: a high resolution bathymetric map, images of a specified object, and to identify archaeological, biological or geological features – all at depths of 2000 and 4000 metres. The GEBCO-NF Alumni Team, funded by The Nippon Foundation, will be utilising SEA-KIT, designed and built by Hushcraft Ltd in Essex, UK; an Unmanned Surface Vessel (USV) designed to transport AUV and auxiliary systems for positioning and communications. It is capable of autonomously deploying and recovering an AUV, which will be used to map the ocean floor. SEA-KIT will be mounted with Kongsberg's HiPAP System, and other new Kongsberg systems, to be used for the positioning of the AUV as well as command and data link to the AUV and to a shore facility. SEA-KIT is designed to exceed the competition goals, being capable of unmanned, long-range trans-ocean missions; significantly reducing the cost of producing new bathymetric data.