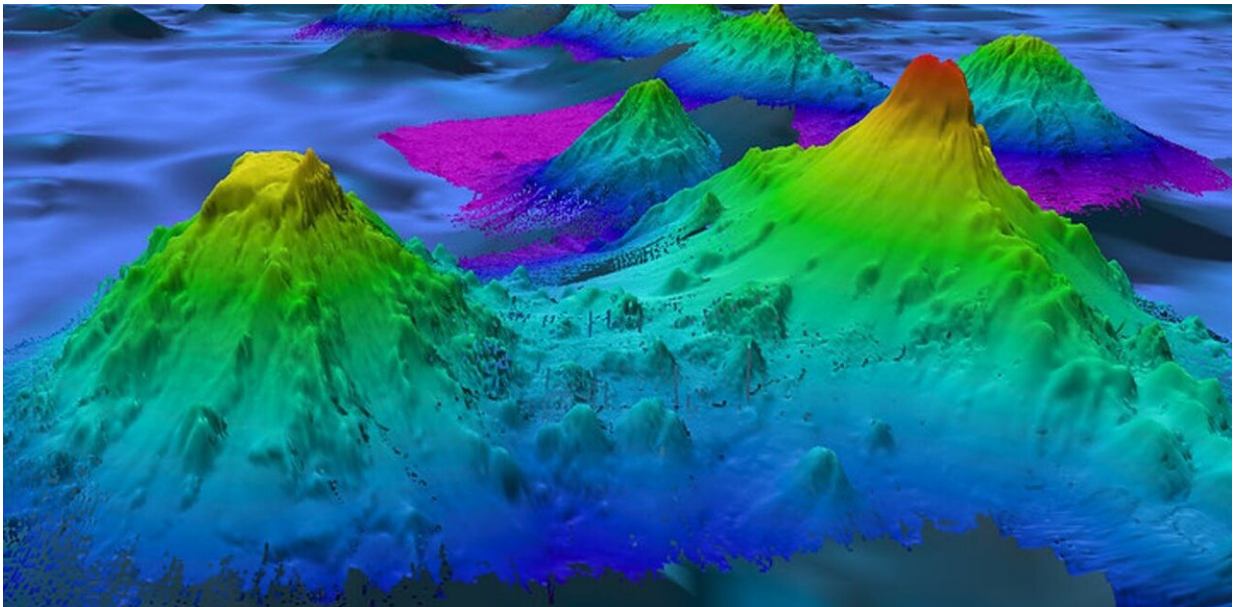


Building a detailed seafloor map to reveal the ocean's unknowns

July 15 2021, by Sean Mullan



The NOAA ship Okeanos Explorer used multibeam sonar to map the sharp Pao Pao seamount (right) and a flat-topped guyot (left) in New Zealand's waters. .

[Credit: NOAA](#), [CC BY-SA](#)

Marine scientists often feel like they're [fumbling in the dark](#). The global ocean covers about 71 percent of our planet and is central to life as it exists on Earth. But [only about 20 percent](#) of the seafloor has been directly mapped so far.

[Survey ships](#) equipped with sonars called [multibeam echo sounders](#) are

being used to measure the depth of the seafloor to better understand it. But the size of the job is enormous. A single [survey ship would take about 350 years](#) to adequately map most of the seabed deeper than 200 meters, and it would take another 620 years to map the shallower areas.

We must [map the ocean faster](#). Today, marine surveying, or [hydrography](#), is central to major international initiatives, including one that aims to see all of the [ocean floor mapped in unprecedented detail by 2030](#).

A more detailed and accurate global model of water depth would reveal the seafloor's shape, and the data can be used to [understand seabed composition](#). This will increase the [safety of marine navigation](#), inform [security and defense](#) operations, [improve oceanographic and climate studies](#), support various sectors of the [sustainable ocean economy](#) and guide decisions on [habitat conservation](#). But it could also come with [risks and costs](#).

Unknown sea

In 2007, as an undergraduate co-op student working at the [Geological Survey of Canada's](#) Pacific Geoscience Center near Victoria, B.C., I helped map seabed habitats and hazards off the West Coast.

Looking at these digitally mapped areas of Canada's undersea terrain between northern Vancouver Island and the Alaskan border was like peering out the window of an airplane. I could see prominent canyons and imposing mountains hidden deep beneath the waves. On the relatively shallow [continental shelf](#) lay the submerged remnants of coastal landforms like river banks, beaches and deltas. [Indigenous peoples](#) may have walked there when the [sea level was much lower during the last ice age](#).

We examined the depth of the seafloor, known as bathymetry, that had

been collected by the [Canadian Hydrographic Service](#) with a [high-resolution multibeam echosounder](#) mounted on the underbelly of a research ship. These sonar systems emit pings in a fan-shaped pattern and listen for returning seabed echoes. The depth of the sea is calculated by measuring the time between a ping and the return of its echo. But as sound beams spread through deeper water and "paint" more seabed terrain, the resolution of the map decreases.

The detailed bathymetry from multibeam sonar surveys off the [West Coast](#) reminded me of [Star Trek's planetary scans](#). But what intrigued me most were the gaps. There were vast areas, under both shallow and [deep water](#), that lacked any high-resolution bathymetry. *Mare incognitum*—unknown sea.

There remain immense landscapes spread across most of our planet's solid surface that no human has ever seen or explored.

Mapping the gaps

Ocean mapping is now central to two major international initiatives, the [United Nations Decade of Ocean Science for Sustainable Development \(2021-30\)](#) and the [Nippon Foundation-GEBCO Seabed 2030 project](#). The latter aims to see all of the [ocean](#) floor mapped by 2030 through voluntary data contributions by governments, industry, researchers and others. Although [some governments argue it may take longer](#) to finish detailed nearshore surveys.



Credit: AI-generated image ([disclaimer](#))

Multibeam bathymetry is much more detailed than the satellite [altimetry maps](#) of [seabed terrain](#) that provide much of the background imagery for services like [Google Maps](#). Satellite bathymetry has an average resolution of about [eight kilometers](#)—where one pixel represents an area eight kilometers by eight kilometers in size. This means that entire submarine mountains may not be captured.

Most of the elevation surface of Mars, which lacks an envelope of water, has been mapped with [space probe cameras](#) to a [resolution between 0.25 meters and six meters](#). That means we have a clearer picture of the terrain on that alien world than our own ocean floor. However, multibeam sonar can be made into a grid with a few meters resolution or better when collected from ship surveys in [shallow water](#) or from [deep seabed dives](#) with robotic vehicles.

The Seabed 2030 bathymetry product will consist of grids that [vary in resolution by depth zones](#). Across the deepest regions of the ocean (six kilometers to 11 kilometers), survey efforts could be distilled to a single depth value for each 800 meter by 800 meter area. For seas shallower than 1.5 kilometers, the project would determine the depth of 100 meter by 100 meter units (100 meter grid resolution).

Before the 2017 launch of Seabed 2030, only [about six percent](#) of the ocean floor had been adequately mapped. In just five years, the compilation of detailed area has more than tripled to [20.6 percent](#). Much of this rapid progress has been due to the public release of existing data.

Seabed 2030's objectives could be met sooner if [navies](#), petroleum companies, [wealthy yacht owners](#) and others are willing to share any of their previously unreleased bathymetric data.



Credit: AI-generated image ([disclaimer](#))

The ocean frontier

Ocean and space exploration [concepts are converging](#). [Companies and governments](#) are now using [autonomous \(uncrewed\) vehicles](#) on extended missions. These robotic surveyors can be monitored and directed from mission control centers on land, or launched from crewed research vessels. [Putting fewer people at sea](#) reduces costs, safety concerns and carbon emissions.

Data from [remote vehicles](#) can be uploaded via [satellite internet](#) to the cloud. Then [automated data processing and classification tools](#) that leverage artificial intelligence could free up ocean mappers onshore to spend more time solving scientific and applied problems.

Society can benefit greatly from an increase in the quantity and quality of seabed data. With an upgraded map of seabed shape and texture, we'll improve simulations of how water is steered by an irregular seabed, and how it slows due to bottom friction. This can help us make more accurate predictions about [tides](#), [tsunamis](#), waves and [storm surges](#). It will also help us understand how [heat transfer by ocean currents](#) affects weather and climate.

As more detailed bathymetry is [interpreted together with complimentary datasets](#), we'll learn which [seabed](#) regions should be protected to [conserve marine biodiversity](#). We'll also discover deposits of the [minerals](#) for electric car batteries and mobile devices.

A flood of mapping data is revealing "planet ocean." [Can humanity govern](#) it with greater wisdom than we have in the past?

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Provided by The Conversation

Citation: Building a detailed seafloor map to reveal the ocean's unknowns (2021, July 15)
retrieved 22 June 2024 from <https://phys.org/news/2021-07-seafloor-reveal-ocean-unknowns.html>

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