Deep-sea Dilemma

Sea-bed mining promises many riches, but at great risk. Should we pause for thought? asks marine biologist Diva Amon.

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I'm on a ship 1,600 kilometres away from the nearest landmass. It has taken us five days to get from California to the middle of the equatorial Pacific Ocean. Our team sends a remotely operated vehicle 4.5 kilometres down to a flat abyssal plain that has never been explored by humans before. As deep-sea biologists, we are privileged to see incredible sights and discover new species and habitats on every research cruise. And this time is no exception: an anemone-like animal with three-metre tentacles that billow across the seafloor, purple, pink and yellow sea cucumbers, incredibly delicate white corals, and flower-like glass sponges.

As incredible as seeing these creatures is, I can't help but feel a tinge of sadness. It's difficult for a marine biologist working in an area that may be forever changed within the next few decades. As the demand for metals increases, humans are seeking resources in ever more remote places and the next frontier of mining may take place in the deep ocean.

There are three types of resources being sought from distinct deep-sea habitats: polymetallic nodules on abyssal plains (4,000-6,000 metres depth), polymetallic sulphides at hydrothermal vents (150-5,000 metres), and cobalt-rich ferromanganese-encrusted seamounts and ridges (800-2,500 metres) throughout the global ocean. In areas beyond national jurisdiction, already there have been 29 leases – occupying 1.5 million square kilometres of our seafloor – granted for exploration by the International Seabed Authority (ISA). And mining could be imminent, with the ISA aiming to have exploitation regulations ready by 2020.

Once our research cruise collecting baseline data is over, we return to our labs to continue working on the samples. And instead of celebrating each exciting scientific revelation, my heart grows heavier. For instance, we now know that there are at least 1,000 species of macrofauna and megafauna, over 90 per cent of which are new to science, in an area the size of Hong Kong in the eastern Clarion-Clipperton Zone. Hydrothermal vents provide habitat to species not seen elsewhere on the planet and that have altered our views of the primary energy sources and origins of life on Earth. The total area occupied by these teeming hydrothermal habitats is only 50 square kilometres globally.

More widespread, ferromanganese-encrusted seamounts support hotspots of biodiversity and are home to the rainforests of the deep ocean – corals, sponges and other invertebrates – that are thousands of years old.

Future threat

It is clear that deep-sea mining will cause damage. The removal of the resources will result in local extinctions of many creatures that call these three habitats home, leaving little possibility for their re-establishment within human timescales. For vents, this could be decades or more; for nodules, millions of years. Mining will also disturb large swathes of seafloor, kicking up plumes which will travel for kilometres before depositing and causing havoc elsewhere. Further entombment of the seafloor will occur when discharges from shipboard dewatering are returned to the ocean. Not to mention other possible impacts that include light and noise pollution from machinery, and major changes to the geochemistry of the sediment, food webs and carbon sequestration pathways.

And there are bigger questions: we understand little of the potential effects on deep-ocean ecosystem services that keep our planet healthy, such as climate regulation, nutrient cycling and detoxification. Our oceans are experiencing stress from all angles: pollution, fishing, nutrient loading and climate change. How these impacts will interact with those of mining is not yet understood but will likely be long-standing and ocean-wide.

Despite this future threat, the vulnerable habitats are critically under-explored. We know little of what species live at each, much less about their ecology and how they might cope with mining impacts. This is where the role of deep-sea scientists comes in. Many of us assist in collecting mandatory and crucial baseline data and performing environmental impact assessments for contractors. The work described at the start of this article was done under the ABYSSLINE Project, which undertook baseline surveys in the easternmost contract area leased to UK Seabed Resources, a wholly owned subsidiary of Lockheed Martin. Over three years, a consortium of scientists spent close to three months sampling the seafloor of the Pacific Ocean with a menagerie of oceanographic equipment so that there would be a solid starting point against which all future change could be measured.

Although the ABYSSLINE Project has ended, many of us scientists continue to conduct independent research, advancing science and our knowledge of the planet. And there are many others working to have these new scientific findings incorporated into regulations, including those currently being drafted at the ISA.

Is it realistic to hope the deep sea remains near pristine? Would deep-sea mining provide the minerals to power a low-carbon, less exploitative energy future?

Is remedying one human-caused crisis a reason to potentially create another? Should there be a pause enforced on deep-sea mining? Despite having more scientific information about the deep than we have ever had, should mining proceed if we don’t have all the answers? Ultimately, is my work accelerating this nascent industry? Frustratingly, as a deep-sea biologist, I don’t have the answers to those questions, but I endeavour to help find them.

We must continue to explore these unique areas of the ocean to understand them better, as well as implement and enforce strong regulations to prevent the loss of biodiversity and ecosystem functions, and ultimately, seek to balance the needs of both society and nature. It is critical that regulators and society appreciate the best scientific predictions of mining impacts and move forward with the utmost precaution. If we don’t, there is a real chance that we could change our oceans irreparably before we fully understand and appreciate them, and that would be a catastrophic loss for science, but most importantly, for humanity.

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Featured image: The mineral-rich eastern Clarion-Clipperton zone is home to diverse marine species, 90 per cent of which are new to science. Credit: Max Pixel

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