

S'pore team delves into secrets of the Pacific

Findings from seabed exploration will help in assessing impact of deep-sea mining



Audrey Tan

The Pacific Ocean is the world's oldest, largest and deepest body of water, and could fit all Earth's continents in its basin with room to spare. Although it contains more than half the world's free water, much of it remains a mystery.

But some of its secrets could soon be revealed.

A new agreement earlier last week between a Singapore firm and the International Seabed Authority – a body formed by the United Nations that regulates deep-sea mining and governs the seabeds and ocean floors beyond national jurisdictions – will allow the Republic to stake a claim in a section of the ocean's uncharted waters.

Ocean Mineral Singapore (OMS), a unit of rig builder Keppel Corporation, is the first Singapore company to secure a 15-year contract to explore how metal-rich rocks can be harvested from the bottom of the Pacific.

With land deposits being depleted rapidly, the firm is hoping to mine the sea's depths to help satisfy the world's growing hunger for metals and minerals.

But first, it must assure the international authority that mining works will cause minimal damage to marine life, and that a suitable environmental management plan is in place.

The area in question – the Pacific's Clarion-Clipperton fracture zone – is almost 1,600 nautical miles due south off San Diego in the United States, and about half that distance from the Mexican coast. It has an area of 58,000 sq km – about 80 times the size of Singapore – and is 4,000m deep, almost half the height of Mount Everest.

OMS has engaged researchers from the Keppel-National University of Singapore (NUS) Corporate Laboratory to conduct environmental studies and surveys for polymetallic nodule deposits. These black, potato-size rocks are usually half-buried on the sea floor. They contain a variety of metals such as copper, nickel, cobalt and manganese and can be used in construction and aerospace, among other industries.

However, environmental advocacy groups such as Greenpeace have argued that deep-sea mining should be banned in most oceans because of the potential for damage to deep-sea ecosystems.

They say that mineral extraction operations will kill organisms that cannot get away fast enough, and that seabed organisms will be smothered by sediment and waste discharge.

OMS director Ong Ye Kung said that the company would work closely with the International Seabed Authority and other stakeholders to develop an environmentally responsible and commercially viable solution.

As part of this effort, five scientists from the Keppel-NUS lab went on a research expedition to Singapore's claim area to collect data in February this year, living on a US oceanographic vessel for almost two months.

The lab was established in November 2013, and leverages on the expertise of NUS research centres such as the Tropical Marine Science Institute (TMSI).

Explained TMSI senior research fellow Tan Koh Siang: "A prerequisite for getting a licence is to provide the International Seabed Authority with a baseline assessment



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(From left) Dr Tan Koh Siang, research assistants Helen Wong and Gan Bin Qi, lab manager Lim Swee Cheng and research associate Chim Chee Kong are part of the team studying the specimens taken from the Pacific Ocean seafloor.



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Among the marine creatures collected by researchers were (from left) a small sea star, a soft foraminifera and a hard foraminifera. All the specimens were smaller than 2cm in length.

of the marine life there, and details on what the environment is like.

"With the data, the authority can make an informed decision on whether or not to allow mining."

Preliminary findings have shown that despite the cold and dark conditions 4,000m underwater, the seabed in question has hundreds of different types of marine animals, many of which are "small in size and few in number".

In contrast, the waters around Singapore go only as far as 200m, but are home to exponentially more different types of organisms that show "a great range of sizes and abundance".

For the researchers, who were also involved in Singapore's first Comprehensive Marine Biodiversity Survey, the contrast was stark, and the Pacific's marine environment presented a huge learning opportunity.

"Biodiversity is high, although abundance is low," said Dr Tan.

"We have no real explanation for why there can be so many different types of animals in such a low energy input environment, and it's

one of the bigger ecological questions not yet answered."

At 4,000m underwater, temperatures are a low 1 deg C or 2 deg C, and the pressure is almost 400 times that felt on land at sea level.

The average temperature on board the vessel was a more comfortable 28 deg C, and researchers say the differences in temperatures at depth and on the surface could be one reason organisms pulled up from the seafloor were all dead. The animals in the catch were nearly all colourless and small – usually not exceeding 2cm in length.

As laboratory manager Lim Swee Cheng put it: "I heard some scientists going 'wow' when some samples were brought on board – but when I went over to take a look, the bivalve (a mollusc with a body enclosed by two shells) was only about the size of a 20-cent coin."

There were three main groups of macrofauna – small organisms measuring between a quarter of a millimetre and 2cm that live on or in sediment on the seafloor in the Clarion-Clipperton zone: foraminifera (unicellular organisms encased in a shell), crustaceans (ani-

mals with an exoskeleton), and polychaetes (worms).

For research associate Chim Chee Kong, the foraminifera were the most intriguing as they came in a variety of shapes and sizes, with some taking the shape of a mushroom or a wand.

"They are so diverse that there was a joke that anything that you cannot identify is a foraminifera," he said. "We have them in Singapore too, but not in the kind of diversity that we saw in the seabed in the deep sea."

The next step for the researchers was to process the specimens and samples.

Two of them, Mr Chim and Ms Helen Wong, are now in Hawaii to sort and identify some. The team hopes to submit its findings to the International Seabed Authority in the next year.

Said Dr Tan: "Biologists have not really explored the seabed of the tropical eastern Pacific Ocean compared to other habitats in the deep sea, so we are really charting terrain for the first time."

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PACIFIC OCEAN ADVENTURE

Laboratory manager Lim Swee Cheng, 38, got married in February last year, but spent his first wedding anniversary far away from his wife.

The Keppel-National University of Singapore (NUS) Corporate Laboratory researcher also missed his birthday and the Chinese New Year celebrations while he was on a six-week research expedition in the middle of the Pacific Ocean, with four of his colleagues.

"I have no children, but I was married only last year, and six weeks is a long time to be separated from my wife," said Mr Lim.

Still, the experience was an adventure, he said, and he "did not know what to expect or what would happen".

Although the waves reached 3m in height on some days, causing slight sea sickness for those on board, the scientists did not have to weather any storms.

Said research associate Chim Chee Kong, 38: "It was a good learning experience, especially as we got to learn how to use equipment that we didn't get to use during Singapore's Comprehensive Marine Biodiversity Survey."

During the survey – Singapore's first assessment of marine life – researchers used a 12m-long boat.

But on the Pacific Ocean voyage, the oceanographic vessel they were on measured almost 100m. The sheer size of the vessel, and the extreme depths of 4,000m where the samples were located, meant the scientists had to learn to use bigger and heavier equipment, Mr Chim said.

The researchers worked in 12-hour shifts and, when off duty, they slept, did the laundry and other chores, and also got to soak in a tub of seawater drawn up by the crew for them to relax in, while enjoying views of the horizon.

They even saw a minke whale, at least 5m long, and its calf, and witnessed pods of dolphins while out at sea.

Although the shore was four days away, they were happy they did not have to sacrifice Wi-Fi.

Said Mr Lim: "Most ships do not have Wi-Fi so it was a pleasant surprise to find out that the research vessel did. I was overjoyed to be able to stay in contact with my wife over Whatsapp."

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