Program Director Interview

# PD Interview

12 Leading Experts Who Accelerate SIP

# Innovative Deep Sea Resource Development Supporting Society 5.0

## Unprecedented Attempt to Collect Rare-Earth Elements from Deep Sea Areas

Rare earth elements are indispensable in realizing innovative next-generation technologies including those for Society 5.0. It was found that rare-earth deposits exist not only on land but also in the mud on seafloors in deep sea areas. The program aims to establish deep sea resource development as an industrial process through research. We interviewed Program Director (PD) ISHII Shoichi.

ISHII Shoichi

Corporate Advisor of Japan CSS Co., Ltd.

### Efficiently narrow down useful deep-sea mineral resources.

**Q:** We heard you succeeded in collecting core samples around Minamitorishima Island. Are your plans going well?

**PD:** During the research program in 2019, we succeeded in collecting 61 stratum samples and more precisely identified places where quality rare-earth elements exist. The maximum concentration of rare-earth elements at such places was more than 6,000 ppm. This year, while gathering additional data by implementing high-precision acoustic research, we are proceeding with evaluations for approximate amounts of rare-earth elements with geostatistical spatial estimation methods as the final phase to narrow down rare-earth concentration areas around Minamitorishima Island.

**Q:** As the deep sea terminal has been completed, are you going to start the docking test in the sea this year?

**PD:** To research the seafloor efficiently, underwater robots (such as AUVs) are essential. These include sea surface or underwater unmanned probes. To help you understand, just imagine drones moving underwater.

This program operates multiple AUVs at the same time to dramatically improve the research capabilities at sea. And we are developing the system to collect deep sea information efficiently. One of the challenges that we must overcome is how to recharge AUVs. Once the deep sea terminal is completed, recharging of AUVs or data collection will become available on the seafloor. Because the AUVs don't have to be lifted to the mother ship for recharging or data collection each time, long-term deep sea research becomes possible.

Also, in addition to ocean research, the terminal is expected to be applied in other ways in marine industries such as maintenance of submarine communication cables, soil research to install facilities for offshore wind power generation, and monitoring for fish farming.

### Coexistence of environmental friendliness and resource development

**Q:** It seems collecting rare-earth deposits from the seafloor at a depth of 6,000m is very difficult from a technical perspective. Do you think you can realize this goal?

**PD:** So far, no one in the world has tried mass collection of rare-earth deposits from seafloors 6,000m deep. I recognize that the goal of this program is very challenging.

Therefore, the first thing we did in the first year was to collect a considerable amount of deposits around Minamitorishima Island. Based on the analysis results of the deposits, we repeated various simulations. In 2019, we completed the conceptual design of a special device to collect rare-earth deposits from seafloors 6,000m deep.

From this year, we started the phase to design and fabricate production versions of the machines. By 2022, the last year of the project, we will demonstrate cracking, sampling and lifting rare-earth deposits from seafloors at depths of 6,000m as a comprehensive system to establish the technology to collect rare-earth elements. The next challenge will be to establish this as an industrial process.

**Q:** Consideration for the environment is essential in developing deep sea resources. What efforts are you making in this regard in the development of rare earth deposits?

**PD:** I recognize consideration for the environment is a critical challenge.

For deep sea resource development, it is necessary to consider

the impact on the eco-system of seafloors. For this, I believe we need to understand the current environment around the development target area.
According to the environment guideline for mineral resource development stipulated by the International Seabed Authority (ISA), operators are obliged to monitor various factors such as sea currents, water temperatures and turbidity for a certain period.
In our program, a new long-term seafloor-installed observation device called "Edokko Mark 1" was installed in the target area and environment data for one year was successfully obtained. This is the world's first successful acquisition of one-year-duration data and videos of seafloor areas of a depth of 6,000m. The data is also academically very useful. Currently, we are proceeding with detailed analysis of the videos and data with researchers.
Also, to make the sea monitoring methods developed in SIP a global standard, we aim to standardize them for the International Organization for Standardization (ISO). I hope Japan will be the global leader for these deep sea environment preservation efforts.

## Rare-earth elements are critical for supporting Society 5.0.

**Q:** You refined rare-earth deposits and succeeded in extracting about 500g of rare earth elements. What characteristics did you find in the compositions of such elements?
**PD:** The rare-earth deposits collected around Minamitorishima Island were rich with important elements such as neodymium and dysprosium. These components are very important elements to support Society 5.0 promoted by the Japanese government. For example, EVs and auto driving technologies are attracting attention as next-generation automobile industry products. These elements are indispensable for high-power motors installed on such vehicles.
Also, notably, unlike rare-earth elements currently imported from other countries, the rare earth collected from the seafloor of Minamitorishima Island areas offers two benefits. One is that the rare-earth elements collected from the seafloor contain very little radioactive substances, which are posing serious problems in the development of rare-earth elements on land. In terms of environmental preservation and safety, this is a significant advantage. Another benefit is that stable collection is feasible regardless of the international situation, because the deposits exist in our Exclusive Economic Zone.
Although currently, rare-earth resources are collected in certain regions such as China, stable supplies for future emergencies need to be secured, which will contribute to realize Society 5.0 to some extent.

**Q:** You are also engaging in international activities such as training in environmental technologies and seminars in foreign countries.
**PD:** I believe Japan will be a global leader in the technology to evaluate the marine environment. We not only communicate our efforts for resource development and technological outcomes of our environmental research to foreign countries, but also foster international talent working at sea. Especially, we invited 17 trainees from 7 Pacific Island states to Japan and provided environmental technology training. This activity was well received. In February this year, we held a seminar introducing SIP efforts at the University of the South Pacific in Fiji, and listened to local needs regarding sea monitoring directly from the local people. Through these efforts, I think it is also very important to help neighboring countries more deepen their understanding of marine resource development.

## We aim to establish an industrialized model of deep sea resources while cooperating with the ministries.

**Q:** What do you think of the cooperation with the ministries, which is a feature of SIP?
**PD:** Cooperation with the ministries is essential because bridging for social implementation is vital for this challenge. We cooperate with the Ministry of Economy, Trade and Industry for abundance research on rare-earth deposits, and with the Ministry of Land, Infrastructure and Transport for AUV development, respectively, and hold regular meetings to exchange opinions. Last year, we also started cooperating with the Ministry of Foreign Affairs to disseminate the technologies overseas. Thus, we have leveraged the cooperation framework with the ministries very well, which is a feature of SIP.
Among the 12 issues in SIP, this program, which is moving ahead with the cooperation of nine ministries, will bring various spin-off benefits.

**Q:** Please tell us about issues you will have to handle from now on and your perspective for the future.
**PD:** Although we have focused on development and analysis of element technologies for each theme, from now on, we aim to integrate these systems and pave the way to establish an industrialized model regarding deep sea resource development as a harvest strategy. To this end, we will implement large-scale site tests including a test to verify performance of the pipe to collect deposits at a depth of 3,000m with the riser drilling vessel "Chikyu0," and navigation tests for AUVs at a depth of 6,000m. Therefore, we want to work steadily on the plans step by step, avoiding the influence of COVID-19 as much as possible.