Program Director Interview

PD Interview

12 Leading Experts Who Accelerate SIP

Unprecedented in the World, Innovative Deep Sea Resource Development

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Globally supply rare-earth elements from deep sea areas in Japan

"Japanese future relies on the deep sea." – Rare-earth elements, regarded to be indispensable when 5G in mobile communication technologies spreads around the world, are known to exist over a wide range of the Pacific Ocean. With R&D implemented by SIP, natural resources also exist in deep sea areas of the Japanese Exclusive Economic Zone (EEZ). We interviewed Program Director (PD) ISHII Shoichi about the status of innovative deep sea resource development and the outlook for the future.

Driving rare-earth element collection and development of deep-sea exploration robots

Q: Could you tell us about the context of the "Japanese future relies on deep sea areas," and the significance of your project?

PD: The advent of 5G is expected to revolutionize our daily life on land. Our goal is to expand such 5G experience to the sea. For that purpose, collection of rare-earth elements utilizing advanced technology is extremely significant. As both electric vehicles (EVs) and the robot industry require high-performance magnets and motors, rare-earth elements are essential materials for manufacturing such components. In terms of 5G technology, rare-earth elements are necessary, as we intend to manipulate a self-driven unmanned exploration robot in the sea just like drones on land and implement marine geological surveys or environmental monitoring.

In short, we believe that the "Japanese future relies on deep seas," from two perspectives: to supply rare-earth elements which will be most needed for the world with 5G from Japanese deep sea areas on an industrial scale, and to expand the world with 5G to the sea. If it is a feasible scenario, Japan has immense potential to be a world leader in marine-related fields, as Japan's sea is the sixth largest in area, including the EEZ, and the fourth largest in water volume (considering the depth as well) in the world.

The first-in-the-world attempt to target the seafloor at a depth of 6,000 m

Q: In 2019, you succeeded in collecting stratum samples and proceeded with evaluations on the amount of marine mineral resources. How is the research progressing?

PD: We published the mid-term report on the approximate amounts of reserves for Minamitorishima Island in November 2020, proving that a considerable amount of rare-earth deposits existed. Also, upon receiving the final report in March 2021, we are currently verifying the contents of the report.

In the first period of SIP, we conducted R&D focusing mainly on deep-sea hydrothermal deposits in the sea at a depth of 2,000 m or more. In parallel with SIP, Japan Oil, Gas and Metals National Corporation (JOGMEC) succeeded for the first time in the world in collecting rare-earth elements from deep-sea hydrothermal deposits at a depth of 1,600 m in the Okinawa Trough. Based on such outcomes, we initiated R&Ds to a depth of 6,000 m for the second period, assuming there to be deep sea areas offshore in Minamitorishima Island.

Again, it was the first attempt at such a depth and at the beginning of the program, there were many skeptical questions asked such as "Do rare-earth elements actually exist?" or "If so, can you collect them from seafloors 6,000 m deep?" However, thanks to our solid and steady efforts in R&D over the last three years, we compiled the evaluations for approximate amounts of rare-earth elements which are expected to be enough for industrial use.

Q: Could you update us with the status of development of survey technologies such as autonomous underwater vehicles (AUVs) in deep sea areas, the progress with deep-sea exploration, and exit strategies?

PD: To conduct research over a wide range of the EEZ efficiently, specific operations are required where multiple AUVs are controlled in formation. Also, undersea recharging technology is required for long-term deep-sea research activities. In the conventional research method, AUVs in the ocean should be lifted from the seafloor to the mother ship for recharging each time, limiting the duration of research to a few hours per day. However, once the deep-sea terminal system we have been developing in SIP is installed and recharging AUVs and collection of research data becomes possible on the seafloor, very efficient research will be realized, research activities can be conducted for longer and the risk of losing the obtained data will be eliminated.

As such AUV technology is versatile, it can be applied to other activities besides marine resource research. Specifically, long-length submarine power transmission cables and communication cables installed on deep seas have risks of being damaged by abyssal circulation and high-hydrostatic pressure, as they are lightly equipped. If we conduct research over a wide range of deep sea areas using AUVs, we can select an optimal, low-risk installation area and conduct inspections of the cables after installation. Moreover, the terminal is expected to be utilized for subsurface investigation of floating offshore wind power generation plants and efficient maintenance of floating wind farms.

Import Japanese technology to Asia-Pacific states and support efforts against global warming

Q: You have entered the phase to design and produce special devices to collect REY-rich muds.

PD: Eight foreign countries have been working on development and production of devices to collect deep-sea deposits based on the technology used for development of submarine oil fields and natural gas fields. However, technology developed and commercialized for the oil/natural gas industry applies to the seafloors at a depth of 3,000 m. It is an unprecedented challenge, as no one in the world has tried collecting REY-rich muds from the seafloor at a depth of 6,000 m. Currently, we are developing the equipment and preparing for the field experiment next year using the scientific drilling vessel, "Chikyu" in the sea area at a depth of 3,000 m. Although overseas plants locking down due to COVID-19 has caused major delays, we now have a good chance of conducting a test voyage to verify the performance of "Chikyu" this September.

Q: You are aiming at international standardization of the sea monitoring method developed in SIP.

PD: The International Seabed Authority (ISA) under the United Nations defines long-term environmental monitoring for deep sea mineral resource development as the guideline. Through SIP, we installed the observation device called "Edokko Mark 1" on the seafloor at a depth of 6,000 m and conducted deep-sea environment research offshore in Minamitorishima Island over one year. The data and videos obtained are internationally valuable. This deep-sea environmental monitoring method using "Edokko Mark 1" will soon be certified by the International Organization for Standardization (ISO) as the international standard proposed by Japan.

In the future, we will try to downsize, reduce weight and sophisticate the special features of the devices and technical assets such as AUVs and "Edokko Mark 1," and to expand the usage as sea environmental monitoring technology for islands and states in the Pacific Ocean. We believe it is crucial for the survival of humans to make such marine monitoring devices available globally and monitor the marine environment properly.

Demonstrate to the world the industrialization model for deep-sea resources in Japan

Q: How do you cooperate with the relevant government ministries?

PD: Among the 12 subjects in the second period of SIP, we cooperate with 9 ministries and 4 research institutions, the greatest number of cooperative groups, through this program. For example, in collaboration with the ministries, we consider utilizing the collected sediments from Minamitorishima Island for local construction materials, etc. After collecting sediments from deep sea areas and extracting crude rare-earth elements, most of the residue is disused mud. As transporting it to the main island is not cost-effective due to the considerable transportation expense, we are investigating practical onshore use of mud in Minamitorishima Island. We are also proceeding with research and study toward industrialization of rare-earth resources in cooperation with the relevant ministries in the area such as sharing data they have obtained and lessons they have learned.

Q: Regardless of skepticism about the existence of rare-earth elements, what was the driving force in seeking the approximate amounts of reserves? Also, what are the future prospects?

PD: JOGMEC's report in 2016 indicated 770,000 tons of rare-earth deposits existed. Most people regarded it as an insignificant amount of resources; however, the descriptions about a massive amount of heavy rare-earth elements attracted our attention. Therefore, we found it worth trying and decided to initiate the program.

The issue of dependence on specific countries regarding increased demand of supply for rare-earth elements which are used for mainstream technology such as EVs, etc., is internationally recognized. As Japan, the U.S., Australia, and India agreed to cooperate in supplying rare-earth elements in March 2021, we should continue paying attention to the global trend of rare-earth resources.

This SIP program has proved approximate amounts of resources which are available for industrial use in offshore Minamitorishima Island. Our goal is to industrialize rare-earth elements from deep sea areas in Japan, contribute to the global rare-earth supply chain, even if this is a limited amount, and highlight the presence of Japan in the world of 5G in mobile communication technologies.

To achieve such goal, we will start with executing an extensive oceanographic survey to designate a mining area, establish a process of collecting/refining/purifying REY-rich muds from deep sea areas, and move toward industrialization.