



# Next-generation Technology for Ocean Resources Exploration

“Zipangu-in-the-Ocean” Program

## “Zipangu-in-the-Ocean” Program –Seeking the Wealth of Mineral Resources in Our Seas

In the 13th century, the Italian explorer/merchant Marco Polo described Japan as *Zipangu*, that is, the island of gold in the “Travels of Marco Polo”. In fact, Japan once was the world-leading producer of gold, silver, and copper, but now it imports almost all the metal resources it needs from abroad. Although these resources on land have been mined out, the seabed around the Japanese archipelago is still believed to hold a wealth of mineral resources. The goal of the Next-generation Technology for Ocean Resources Exploration (“*Zipangu-in-the-Ocean*”) Project is to develop ocean resource survey technologies to launch a strategy in creating a world-leading ocean resource survey industry.



Program Director

**URABE Tetsuro**  
Ph. D.

Professor Emeritus, The University of Tokyo  
Executive Adviser,  
Japan Mining Engineering &  
Training Center (JMEC)

Profile

URABE Tetsuro graduated from the University of Tokyo in 1971 and received a Ph.D. in geology at the University of Tokyo in 1976. His professional career includes assistant professor, Geological Institute, University of Tokyo (1976–1985), chief geologist, Geological Survey of Japan (1996–2000), and professor, Department of Earth and Planetary Science, University of Tokyo (2000–2014). He was also a member of the United Nations Commission on the Limits of the Continental Shelf (CLCS) (2011–2017). Dr. URABE is currently executive adviser at the Japan Mining Engineering & Training Center (JMEC) and professor emeritus at the University of Tokyo.

\* The affiliation and title of PD shall be as of the end of the 1st period (the end of FY2018).

### Research and Development Topics

#### 1. Identification of Promising Ocean Areas for Investigation Based on Ore Genesis Research

We have developed a science-based methodology to narrow down potential areas for seafloor exploration to identify mineral resources. Such techniques will be developed through understanding of the mechanisms by which mineral resources are formed, as well as identifying distinctive indicators of mineral occurrence. We organize these techniques into a survey protocol for use by private enterprises, helping them to reduce exploration time and costs significantly.

#### 2. Development of ocean resource survey technologies

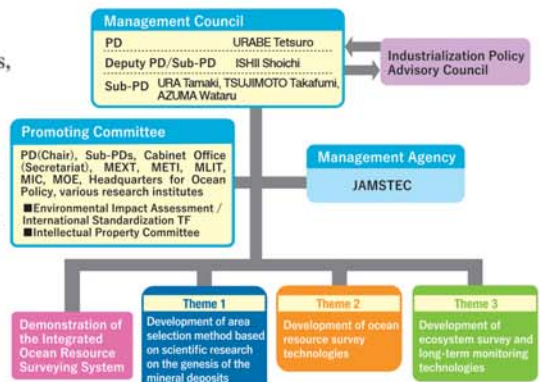
There have been no systems to date that enable us to detect seafloor massive sulfide (SMS) deposits concealed under the seabed. Accordingly, we have developed the world’s first survey system enabling us to efficiently discover resources below the seabed, by combining the operation of multiple autonomous underwater vehicles /robots (AUVs) for wide-range surveys with the remotely controlled underwater vehicles (ROVs) for detailed data acquisitions. With these advancements, we will create new markets of ocean resource survey and development business.

#### 3. Development of ecosystem survey and long-term monitoring technologies

Consideration for ecosystems and the environment is essential for ocean resources development. Assess risks to ensure a harmony between the development of ocean resources and the protection of the environment. Establish internationally granted standards for environmental impact assessment and environmental management, aiming to apply these technologies to other countries and win contracts for overseas surveys.

### Implementation Structure

The project’s Management Council consists of the Program Director (PD), Sub-PDs, and Research Topic Leaders. The Council manages progress of the project with a view to the exit strategies, guiding the project to solid results. With an aim of creating an ocean resource survey venture, the Council has gathered industry, academia and government together into an agile and strategic research framework. In a close partnership with JOGMEC, the Council promotes efforts from development of technologies to their tests under actual ocean conditions. Moreover, the Council is responsible for promoting the transfer of technology to private enterprise. The Promoting Committee consists of the PD serving as Chair, the Cabinet Office serving as Secretariat, as well as other experts and representatives from various ministries and agencies. The Committee utilizes operating expense grants provided to the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), making maximum use of the knowledge and expertise developed.



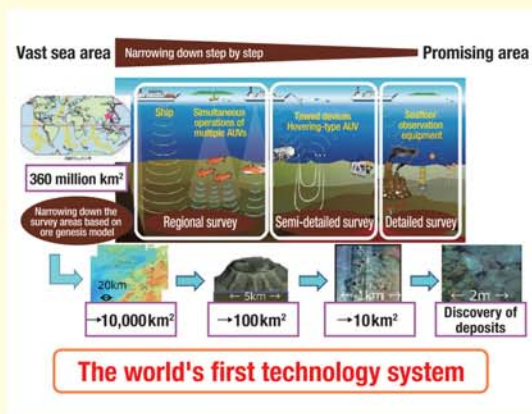
\* It shows the structure and organization at the end of the 1st period (the end of FY2018).

## Verification of Integrated Ocean Resource Surveying System

We published a result booklet titled “The mechanism of formation of seafloor massive sulfide deposits—toward establishing survey method” summarizing the research results obtained from the investigation of the seafloor massive sulfide deposits (SMS) in fiscal year (FY) 2016, and summarized a series of effective flows for investigating SMS deposits (know-how on investigation) into “Survey Protocol for Seafloor Massive Sulfide Deposits” toward technology transfer to private companies in FY 2017.

The “Integrated Ocean Resource Surveying System” developed based on said results, which narrows down the promising area for investigation through step by step exploration, from regional-, through semi-detailed-, to detailed-survey levels, was verified by two private groups in the unexplored sea area of Okinawa in FY 2018. The verification proved successful because the existence of sulfide minerals in the deposits 40 meters below sea level was detected. This unique system, which has not been achieved anywhere else in the world, is expected to contribute to Japan’s future resource security and stable resource supply.

This technology and know-how will be commercialized by private organizations that are scheduled to receive its technical transfer (such as the Japan Marine Surveys Association and Research and Development Partnership for Next Generation Technology of Marine Resources Survey) and will be applied to ocean resource exploration research, platforms for development of oil and natural gas, ocean civil engineering projects, and subsurface exploration.



## Establishment of technology for simultaneous operations of multiple AUVs

Multiple small-sized AUVs suitable for actual operations and a system for simultaneous operations of multiple AUVs in collaboration with an autonomous surface vehicle (ASV) had been developed and established prior to FY 2018. The established operations method was implemented mainly by private organizations west of Amami Oshima Island as part of the verification of the Integrated Ocean Resource Surveying System. We acquired high-quality data such as high-resolution seafloor bathymetry images and traces of hot water plumes. The technology transfer to private companies has been accomplished, and the system for receiving orders for marine research has been established. These cutting-edge technologies will dramatically improve research efficiency and increase business profitability through quicker and more efficient ocean resource exploration by private companies. They are expected to be applied to various markets including fishery resource research, lake bottom research, and route surveying for the laying submarine cables.



## Prospects for the establishment and international deployment of environmental impact assessment technologies

A long-term observation system of seabed organisms to be used for seabed resources development had been established by FY 2018. The Edokko Mark 1 monitoring system (See the image on the right), onboard bioassay (rapid evaluation of biological toxicity), environmental metagenome analyses, and automatic organism identification methods are among the technologies mentioned above. An international standards proposal had been already registered with the International Standardization Organization (ISO) by FY 2018 and a working draft is being prepared with an aim to familiarize the technologies in the global market. Furthermore, there are other prospects for the issuance of ISO standards. In addition, the International Seabed Authority (ISA), which manages deep-sea mineral resources, is also in the process of establishing a rule for seabed resource development based on the pending ISO standards. The environmental impact assessment technologies developed by the SIP program are expected to expand overseas.

These technological results have been presented at international workshops and conferences and summarized into the “SIP Protocol Series” composed of six technical manuals. Furthermore, we have published the “Social Science Reference” to lower barriers that restrict the participation of Japan’s private companies in ocean resource exploration and development overseas.



\* PDF files of the booklets, etc. published in connection with this program are available at <http://www.jamstec.go.jp/sip/resultList.html>