National Platform for Innovative Ocean Developments

SiP
Cross-ministerial
Strategic Innovation
Promotion Program

SIP visualizes New Ocean Evolution

Cross-ministerial Strategic Innovation Promotion Program (SIP)Phase 3
National Platform for Innovative Ocean Developments
Program Director
Shoichi Ishii
Corporate Advisor, Japan CCS Co., Ltd

From the perspective of the national security, it is crucial for Japan, a country with few natural resources, to develop efficient and effective survey techniques for the marine mineral resources in its exclusive economic zone (EEZ) and production technologies with extremely low environmental impact. And that will allow Japan to supply those resources to the own market at any time, independent of the international situations.

In Phase 2 of the Cross-ministerial Strategic Innovation Promotion Program (SIP) led by the Cabinet Office up to March 2023, "Development of Innovative Technologies for Exploration of Deep Sea Resources," we identified the presence and the distribution of the sediments that highly contained heavy rare earth elements at the deep sea area off coast of Minamitorishima, Japan (in Japan's EEZ). In the past, it has been mined/produced in the southern part of China only.

We also developed the production technologies and equipment for rare earth sediments from the water depth of approx. 6,000 meters. And we also created and tested the world's first survey techniques in the field of exploration of the marine mineral resources.

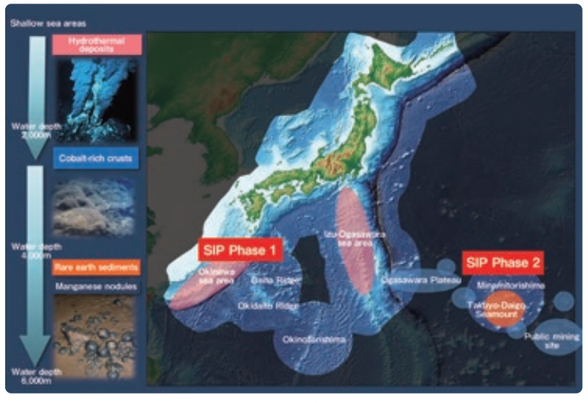
In addition, the marine observation equipment developed through the Phase 2 program are expected to be the marine environment monitoring systems covering from the deep water to shallow, and in a wide range of marine industrial applications.

Following those backgrounds, Phase 3 of SIP, "National Platform for Innovative Ocean Developments," with the aim of promoting both conservation and utilization of the ocean, which is base of the national security, has started a five-year program from April 2023.

In line with the future vision of Society 5.0, the program intends to develop technologies for wide-area environment monitoring systems by marine robotics, to accelerate the use of marine mineral resources existing in Japan' s EEZ, and to conduct basic research on large-scale carbon dioxide capture and storage (CCS) , those will establish a new mineral resources supply network independent of other countries situations and contribute to the achievement of the carbon neutrality by 2050.

We are confident that translating the research results of the program into practical applications will further invigorate the marine industry and pave the way for a prosperous future of Japan, a maritime nation surrounded by sea.

We appreciate your continued understanding and support for the program.



Distribution of marine resources around Japan

Organizational structure of the " National Platform for Innovative Ocean Developments"

Program Director
Shoichi Ishii
Corporate Advisor,
Japan CCS Co., Ltd.

Sub-Program Director
Wataru Azuma
Executive Technology Officer
JAMSTEC

Sub-Program Director
Yoshio Matsukawa
Executive Officer
Itochu Corporation

Project Manager
Hiroyuki Nakayama
Supervising Project Manager
JAMSTEC

Promotion Committee

Cabinet Office (Council for Science, Technology and Innovation)
National Ocean Policy Secretariat, Cabinet Office / National Space Policy Secretariat, Cabinet Office
Ministry of Internal Affairs and Communications / Ministry of Foreign Affairs /
Ministry of Education, Culture, Sports, Science and Technology
Ministry of Agriculture, Forestry and Fisheries / Ministry of Economy, Trade and Industry /
Ministry of Land, Infrastructure, Transport and Tourism / Ministry of the Environment / Ministry of Defense
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Japan Organization for Metals and Energy Security (JOGMEC)
National Institute of Advanced Industrial Science and Technology (AIST)
National Institute of Maritime, Port and Aviation Technology (MPAT)

Advisory Board

[Chairperson] Asahiko Taira/ Executive Director, Institute of Oceanic Research and Development, Tokai University
[Acting chairpersons] Yasuhiro Kato /Dean, Graduate School of Engineering, University of Tokyo
Yoshiaki Igarashi /Executive Vice President, JOGMEC
Kosaku Arai /General Director, Research Institute of Geology and Geoinformation, AIST
Kaoru Kubokawa / Visiting Professor, Teikyo University
Yukiko Araki / Outside Director, Fuji Pharma Co., Ltd.

Ministerial Liaison Committees

Cabinet Office Liaison Committee /METI & JOGMEC Liaison Committee /
Ports and Harbours Bureau Liaison Committee, MLIT / MOE Liaison Committee /
National Ocean Policy Secretariat, Acquisition, Technology & Logistics Agency Liaison Committee

Related governmental research institute
JAMSTEC

Participating organization
New Horizon Ocean Research & Technology

Theme 1 Development of Production Technology for Rea Earth Element (REE)

To conduct demonstration experiments for survey, mining, dressing, smelting and refining of REE using off Minamitorishima rea earth sediments. To consider a new rare earth supply chain, coexistent with the marine environment, and contribute to ensuring a stable supply of Rare Earth Element, essential for the future industry development.

Theme Leader Yoshihisa Kawamura (JAMSTEC)

Participating organizations
JAMSTEC
AIST
Kyoto University
Kochi University

Theme 2 System Development of Marine Environment Impact Assessment

To improve the precision of data from the marine observation network, being better assess the factors involved in global ocean warming, and "visualize the Ocean."

Theme Leader Hiroyuki Yamamoto (JAMSTEC)

Participating organizations
JAMSTEC
National Institute for Environmental Studies

Theme 3 Ocean Robotics Survey Technology

To construct a wide-area marine environment monitoring system using new marine robotics technologies.

Theme Leader Toshifumi Fujiwara National Institute of Maritime, Port and Aviation Technology (MPAT)

Participating organizations
MPAT
JAMSTEC

Theme 4 Basic research on large-scale carbon dioxide storage and fixation technologies using oceanic basalts

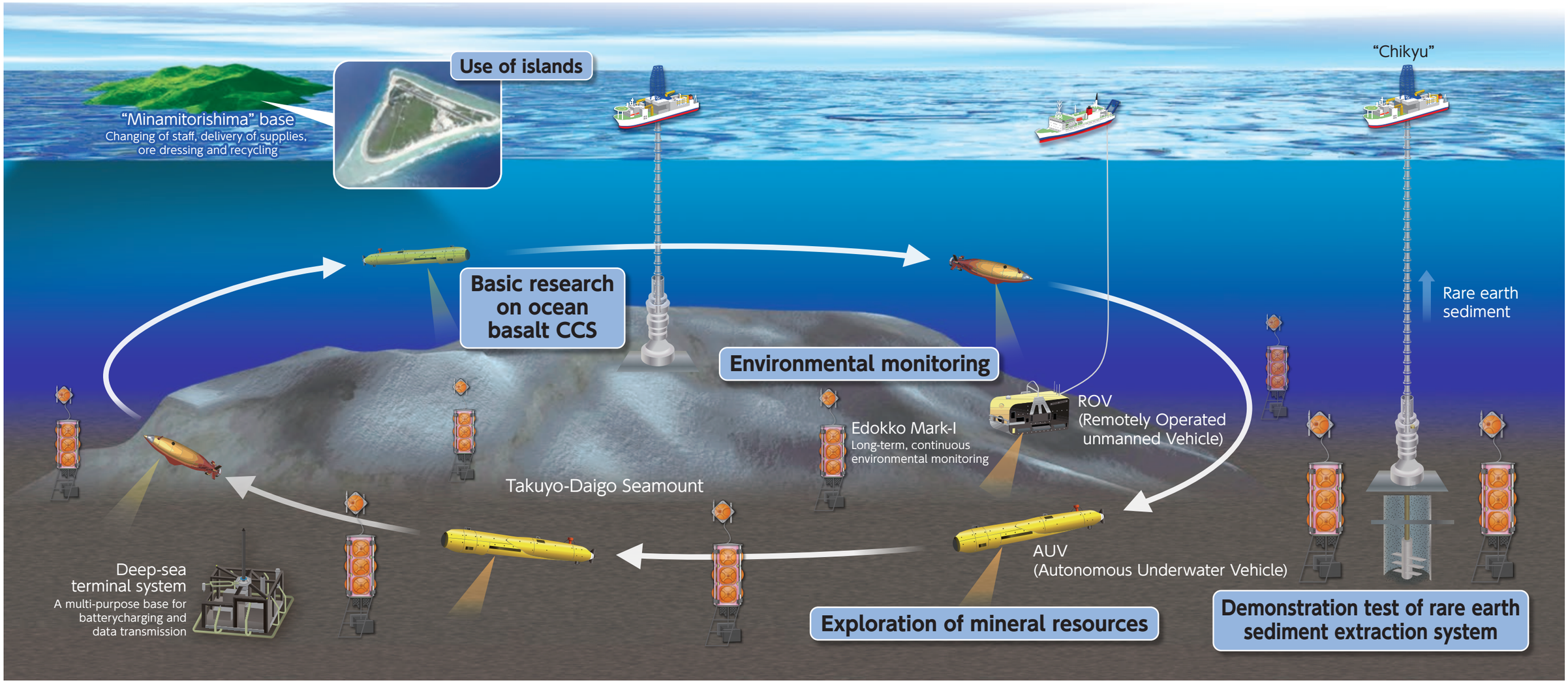
To conduct basic research on large-scale storage of carbon dioxide in oceanic basalts, contributing to the achievement of "carbon neutrality by 2050", and facilitating the widespread use of offshore CCS in Japan.

Theme Leader Fumio Inagaki (JAMSTEC)

Participating organizations
JAMSTEC
AIST

Overview of missions

To realize the vision of Society 5.0 and a carbon neutral society, it is necessary to make sustainable efforts for developing marine mineral resources that support sustainable development goals (SDGs), and conserving the marine environment. This will enhance Japan's maritime security and international presence.



Mission 1

Study of the domestic rare earth supply chain

To contribute to a stable supply of Rare Earth Element, we are scheduled to complete demonstration experiments for survey, mining, dressing, smelting and refining of REE using off Minamitorishima rare earth sediments by the end of the final year. The mission helps accelerating efforts to develop rare earth supply chain, coexistent with the marine environment. Based on the revision of the Mining Act in 2023, we are aiming for collecting basic geological data, which is necessary to establish rare earth mine concession.

Mission 2

Development of monitoring system for a marine mineral resources development and wide-area marine environment

We are aiming for "visualize the Ocean" by collecting information at the deep sea, using new marine robotics technologies, and integrating stationary and mobile deep-sea observation networks. We will link "Edokko Mark-I", AUVs and a deep-sea terminal through the Internet of Things (IoT), and complete an integrated marine environment monitoring system by the end of the final year. The integrated system can be used to observe rare earth sediment mining experiments and protected marine areas. After this program, the wide-area environment monitoring system will be used as marine industries' facilitate to expand marine resource exploration and environmental surveys.

Mission 3

Basic research on ocean basalt CCS

Contributing to the achievement of carbon neutrality by 2050, we will conduct basic research on carbon dioxide capture and storage (CCS) in oceanic basalts. More specifically, we are studying the geological structure of the Takuyo-Daigo Seamount in the EEZ around Minamitorishima, conducting laboratory experiments on the behavior of carbon dioxide in oceanic basalts, and technologies to ensure CO_2 injection and fixation. Our final goal is to develop a conceptual design of ocean basalt CCS based on simulations, including maritime CO_2 transport and offshore CO_2 injection.

Main research and development themes

SIP Phase 3, "National Platform for Innovative Ocean Developments" (FY2023 – FY2027), consists of various research and development themes to achieve our missions. The main four themes are as follows:

Theme 1

Development of Production Technology for Rea Earth Element (REE)

In the EEZ around Minamitorishima, Japan, there are rare earth element resources (rare earth sediments), expected to be an industrialization. The effective use of those resources frees Japan from dependency on the particular countries for the supply of rare earth elements. To achieve this goal, we continue close investigations of the distribution and the reservation of rare earth sediments. We plan to conduct demonstration experiments of mining rare earth sediments existed under 6,000 meters water by using the deep-sea scientific drilling vessel "Chikyu." Conducting series of mining, lifting and smelting activities help devise technologies and obtain data necessary to consider the development of deep-sea rare earth elements. These efforts promote the development of a seamless, cost-effective supply system to be commercialized and speed up the practical application of domestic rare earth elements production.

We offer opportunities of technology transfer to the private companies in Japan that have had few opportunities for deep-sea survey and help invigorate domestic marine industries.

Giant Piston Corer (GPC) sampling sea floor sediments

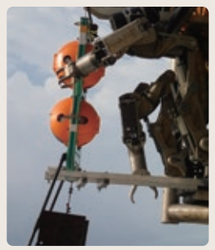
Autonomous Underwater Vehicle (AUV) capable of doing exploration down to 6,000m

Theme 2

System Development of Marine Environment Impact Assessment

In order to develop the system, activities will include method improvement of environmental impact assessment using the best available technology, construction of a data utilization scheme, industrialization model and international deployment. In the area of improving environmental impact assessment methods, in addition to biodiversity surveys, environmental measurements, and marine environmental monitoring, we will develop monitoring technology that links the "Edokko Mark-1," which is capable of long-term observation, with autonomous underwater vehicles (AUVs), which can survey a wide area. In the development of a data utilization scheme, we are achieving the methods using artificial intelligence (AI) and digitizing marine environment models. We make an industrialization model based on prototype marine environmental management combined with data utilization in the private sector, marine environmental management, and study its usefulness. For international deployment, we will publish the results and technologies through journals, seminars or side events at international conferences. The Pacific-island countries are an important area for technical cooperation in research and observation in this project.

Through these efforts, we aim to promote the advancement of the marine industry and contribute to addressing a wide variety of marine environmental issues.



"Edokko Mark-I COEDO" installed by the ROV

Upper) Phyto Alert System monitoring ocean photosynthesis
Lower) "Edokko Mark-I 365" approaching the depths of 6,000 m

Theme 3

Development of marine robotics survey technologies

In order to explore submarine resources and achieve the "30 by 30" goal under the COP15 biodiversity agreement, it is required to deploy an effective, wide-area marine monitoring system using autonomous underwater vehicles (AUVs). To operate AUVs efficiently for monitoring a wide area, it is necessary to control groups of AUVs in a cooperative manner, and link systems such as "Edokko Mark-I" , the seabed observation platform, and the deep-sea terminal system through the Internet of Things (IoT).

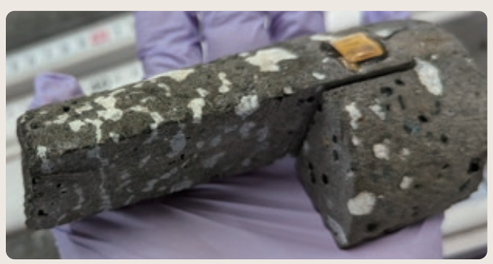
To achieve this goal, research and development teams put their focus on two main technologies useful for wide-area marine environment monitoring, i.e.,1) Cooperative group control of autonomous underwater robots. And 2) A deep-sea terminal with which navigational AUVs are docked. Both technologies are scheduled to be developed by 2027 through tests and improvements by stages toward practical applications. Through the linkage of observation systems via the IoT and improvement of various equipment, we are developing a system that collects a large amount of underwater observation data rapidly. Further, we will verify the entire system on site including design and production of small-sized reasonable AUVs that will arouse new needs of society. Through these technological developments, we aim to conserve the marine environment and cultivate marine businesses through collaboration with universities and private companies.

Demonstration test of AUV group control technology

Theme 4

Basic research on large-scale carbon dioxide storage and fixation technologies using oceanic basalts

This theme focuses on basic research on carbon dioxide capture and storage (CCS) technologies using oceanic basalts with the aim of achieving carbon neutrality in Japan by 2050, and further promoting the widespread use of CCS. Specifically, we are conducting a geological survey at the Takuyo-Daigo Seamount located in the EEZ around Minamitorishima to clarify the internal structure of the seamount comprised of basalts, and its physical and chemical properties. We also conduct lab experiments to verify the changes in permeability and physical properties due to CO_2 injection into oceanic basalts, study the best-suited injection and fixation technologies, and run simulations of ocean basalt CCS. As a final goal, we are aiming to develop conceptual designs of ocean basalt CCS in view of maritime CO_2 transport and offshore CO_2 injection systems.



Authigenic carbonate minerals in oceanic basalt

Pillow lava on the sea floor around Minamitorishima

Cross-ministerial Strategic Innovation Promotion Program (SIP)

Cross-ministerial Strategic Innovation Promotion Program (SIP) is a national project established by the Council for Science, Technology and Innovation (CSTI) of the Cabinet Office toward the achievement of scientific and technological innovation in Japan. The program has entered the third phase and started a five-year project with 14 subjects from FY2023, and is working on themes in various fields to contribute to the recovery of the Japanese economy. Under the leadership of Program Directors (PD) for each subject, SIP promotes research and development covering fundamental research to industrial application with cross-ministerial efforts in collaboration with domestic industries, universities and research institutes.

内閣府 Cabinet Office

JAMSTEC 国立研究開発法人 海洋研究開発機構 JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY

SiP Cross-ministerial Strategic Innovation Promotion Program

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For the latest research and development information, visit the website, "National Platform for Innovative Ocean Developments"

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