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OPRI THE OCEAN POLICY RESEARCH INSTITUTE

Director's Message

As mankind moves into the 21st century, integrated policies of ocean governance are necessary for the sustainable development and use of our oceans and their resources and for the protection of the marine environment.

Towards this end, the Ocean Policy Research Institute of the Sasakawa Peace Foundation (formerly: Ocean Policy Research Foundation until March 31st, 2015) orients its research on ocean issues in line with the mission statement "Living in Harmony with the Oceans".

The Ocean Policy Research Institute of the Sasakawa Peace Foundation aims to conduct cross-sectoral research in ocean related issues in order to initiate debate on marine topics and to formulate both domestic and international policy proposals.

We publish a Japanese-language newsletter titled the "Ocean Newsletter" (previously known as "Ship & Ocean Newsletter") twice a month. "Ocean Newsletter Selected Papers No.22" contains English-language versions of papers from the Japanese Newsletter edition, published from No.391 (2016.11.20) to No.410 (2017.9.5).

The Ocean Newsletter seeks to provide people of diverse viewpoints and backgrounds with a forum for discussion and to contribute to the formulation of maritime policies conducive to coexistence between mankind and the ocean.

Our Foundation believes that the newsletter can expand effective communication on these issues by introducing timely research abroad to an informed readership. It also welcomes responses from readers, some of which appear in the Newsletter.

It is our sincere hope that these Selected Papers will provide useful insights on policy debate in Japan and help to foster global policy dialogue on various ocean issues.

Atsushi SUNAMI
President

■Publisher

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The Integration of Container-shipping Operations by Three Japanese Shipping Firms and the Start of a New Alliance

[KEYWORDS] economy of scale / competitive environment / M&A (mergers and acquisitions) in the shipping industry

Takayuki MORI
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(Ocean Newsletter No. 393, 20 December 2016)

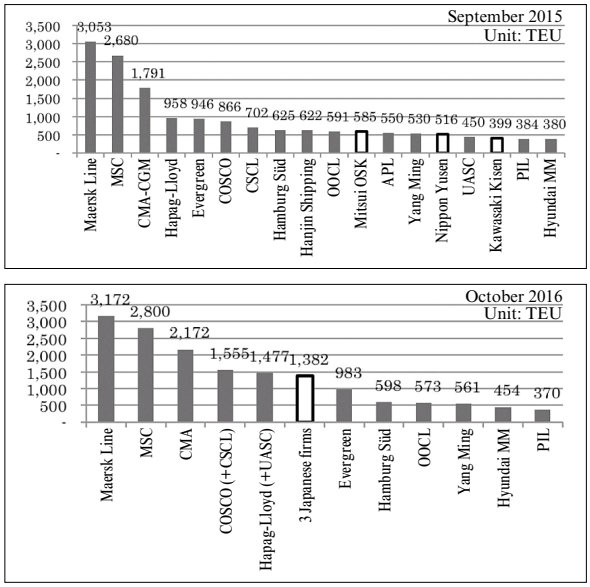
Amid the continued slump in the maritime transport market, since 2015 there have been significant merger and acquisition activities in the shipping industry, aimed at the enlargement of operation scales in order to increase competitiveness. Also, South Korean industry giant Hanjin Shipping filed for bankruptcy in August. Under such circumstances, three Japanese shipping firms announced the integration of their container-shipping operations this past October 31st. The structure of the container ship industry is experiencing changes on a global scale.

Introduction

2016 was a tumultuous year for the container shipping industry, with a succession of big news stories. In February, the Chinese government oversaw a merger between COSCO Group and the China Shipping Group to form the China COSCO Shipping Group. In June, Hapag-Lloyd of Germany and UASC of the Middle East announced a merger of container shipping operations. In July, CMA-CGM of France acquired APL of Singapore, and in August, the South Korean industry giant Hanjin Shipping filed for bankruptcy. And then, on October 31st, three Japanese shipping firms – Kawasaki Kisen, Mitsui OSK and Nippon Yusen – announced that they would integrate their container shipping operations. In the space of one year, the number of container shipping majors around the world had dropped from 18 to 12.

Container shipping is currently being operated under an alliance system. As such, the bankruptcy of Hanjin Shipping sent shock waves throughout the whole industry, particularly among members of the same alliance. The series of business mergers and acquisitions mentioned above will have the effect of promoting structural change not only in the alliance system but also in the industry as a whole. In this paper, I will explore the background to this reorganization of the container shipping industry as well as its future.

■ **Fig.1 Changing scale of operations by the world' s container shipping firms**
(Source: Compiled from Daily CARGO, Nov. 1, 2016.11.1)



Background to the integration of container shipping operations

In simple terms, what lay behind the reorganization of the industry was a cargo capacity oversupply owing to declining movements of goods and the increasing size of container ships. With the dramatic growth of the Chinese economy from around the end of the 20th century, the world's trade volume expanded hugely. Encouraged by this expansion, many shipping firms took steps to enlarge their operational scale. Even with a significant decrease in goods movements following the Lehman Brothers collapse, container ships were getting progressively larger. As there was no decrease in cargo capacity, the gap between supply and demand thus grew ever wider. Following the first recession in 2009 after the Lehman Brothers collapse, the shipping industry was hit by two more in 2011 and 2016.

These had a massive impact on the industry. In container shipping operations by the three Japanese shipping firms, losses were only avoided three times by Kawasaki Kisen in their accounts over the last nine years, twice by Nippon Yusen and just once by Mitsui OSK, underlining the harshness of the situation. And Japanese shipping firms were not the only ones in this situation. The two South Korean giants Hyundai Merchant Marine and Hanjin Shipping both fell into business difficulties, culminating in bankruptcy for the latter.

While the decline in movements of goods was partly blamed on the deceleration of the Chinese economy, a factor that cannot be overlooked is change in the trade structure. In the past, raw materials and components used to be supplied to emerging economies, mainly by Japanese manufacturers, and products would be assembled locally.

Many of these products were then exported. Recently, however, companies have been shifting to an integrated system whereby many of the components are sourced and assembled locally, and many of the final products are also marketed and consumed locally. This is having an impact on maritime cargoes.

The competition to enlarge container ships is thought to have started when Maersk Line of Denmark introduced an 18,000 TEU ship in 2013. There are currently 5,230 container ships plying the waters, and 239 or about 5% of these are large vessels of 12,000 TEU or more. In terms of transportation capacity, these account for 18% of the total. There are also 38 super-large container ships with 18,000 TEU or more. Of container ships ordered for construction, 134 are vessels in the class of 12,000 TEU or more, and 40% of those are the 19,000 TEU type. In 2017, fifteen 20,000 TEU ships will be completed, including six for Mitsui OSK.

Container shipping companies first attempted to survive in a harshly competitive environment through cost-cutting measures based on building larger vessels. The next strategy after this was to survive through "economy of scale." This has led to the progressive consolidation seen in the container ship industry since last year.

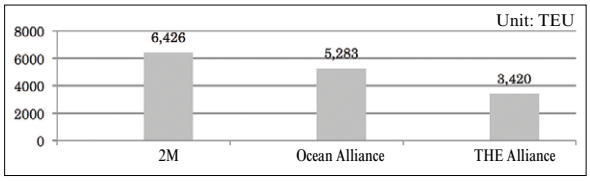
However, the three Japanese shipping firms were slightly different from these global trends. Many foreign shipping firms specialize in container ships, or adopt a business model close to that. By contrast, the three Japanese shipping firms are general shipping companies with many other business interests in addition to container shipping operations, such as bulk shipping, tankers, car carriers and LNG tankers. They operate under the so-called "department store model," with a structure whereby deficits in container shipping operations are covered by profits in other divisions. My surmise is that they embarked on the present business integration because they no longer had sufficient margin to compensate for losses in their container shipping operations based on profits in other divisions.

The three Japanese shipping firms are at the top end of the industry in each of the respective vessel types, i.e., car carriers, LNG tankers, bulk shipping, tankers, etc. The only exception to this is container ships, and the firms must have known that these were an Achilles heel common to all three of them. One cannot help feeling that they were already one or two steps behind the global trend.

Impact on alliances and future outlook for container shipping operations

The framework of existing alliances will inevitably change as a result of this series of mergers and acquisitions. Since all three of these Japanese shipping firms are members of "THE Alliance," which is due to start next year, the present business integration will have no direct impact on the alliance.

■Fig. 2 The new alliance system and a comparison of cargo capacity



Alliance name	Participating companies
2M	Maersk Line, MSC, Hyundai MM
Ocean Alliance	CMA-CGM, COSCO, OOCL, Evergreen
THE Alliance	3 Japan firms, Hapag-Lloyd, Yang Ming

(Source: Compiled from Daily CARGO, Nov. 1, 2016)

The new framework for the container ship industry will consist of three major alliance systems – 2M, Ocean Alliance, and THE Alliance. Hyundai MM's choice of alliance was a subject of some concern, but it decided to join 2M for the time being. Hanjin Shipping had been due to join THE Alliance, but that is now uncertain after its bankruptcy. The container shipping industry is thus a monopoly consisting of three alliances, and surviving as an independent entity is seen as difficult. In this sense, the future movements of Hamburg Süd of Germany [1] and PIL of Singapore, which do not belong to any of the three big alliances, are attracting considerable interest.

Conclusion

After integrating their container shipping operations, the scale of these three Japanese shipping firms is the 6th largest in the industry. Their operational scale (transportation capacity) is 1.38 million TEU, and their market share is only about 7%; even including ships completed in 2017, it is only 1.7-1.8 million TEU. Maersk Line, the industry's No.1, has an operational scale of 3.17 million TEU and a market share of 16%, making it twice the size of the three Japanese shipping firms put together. The world's container shipping firms can be classified by scale into (i) those with an operational scale of 2-3 million TEU and a share of more than 10%, (ii) those with a scale of 1.0-1.5 million TEU and a share of 5-10%, and (iii) those with a scale of less than 1 million TEU and a share of less than 5%. Of these, the three Japanese shipping firms belong to group (ii), not the top group. In order to survive in the container shipping industry, they will surely need to break into the top group.

A cost reduction of 110 billion yen is envisaged as the economic benefit of the integration, but this will not be easy to achieve. The business management of general shipping companies and container specialist shipping firms until now has not necessarily been the same. Unless differences of

corporate culture, staffing issues and many other problems can be resolved, the cost reduction of 110 billion yen could just be a pie in the sky. What must be avoided above all is allowing too many cooks in the kitchen.

With these differences in alliance scale, movements of unaffiliated shipping firms, and other issues, the reorganization of the industry still has some way to go. ■

1) On December 2, 2016, the Nihon Keizai Shimbun reported on the acquisition of Hamburg Süd by Maersk Line.

The Nippon Foundation's Ocean Innovation Consortium

[KEYWORDS] offshore development / human resource development / multi-sector collaboration

Mitsuyuki UNNO
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(Ocean Newsletter No. 394, 5 Jananuary 2017)

On October 4th, 2016, the Nippon Foundation launched "the Ocean Innovation Consortium," a platform with the aim of developing human resources for offshore development, in collaboration with industry, academia, and the government. The consortium is drawing interest as an all-Japan initiative for the strategic development of the offshore industry, which is expected to show great gains in the future.

Massive latent potential of the offshore industry

The oceans that cover about 70% of the earth's surface are home to many precious resources, and the markets for these are huge. The offshore oil and gas development market, in particular, is attracting global investments of some 30 trillion yen every year. This is forecast to grow further still in the medium to long term, with some predicting an investment scale of 50 trillion yen in 2030.

The oceans not only contain fossil fuels; in response to heightened concern over global warming, the development of offshore renewable energy is also advancing. Offshore wind power generation is growing rapidly, particularly in Europe, with the investment scale currently at more than 2 trillion yen. This is forecast to grow even more in future, including in Japan's coastal waters.

Over the medium to long term, there is potential for resource development in Japan as well. Methane hydrate reserves, hydrothermal deposits, rare earth sludge and manganese nodules all exist in Japan's coastal waters. For example, reserves of methane hydrate in the eastern Nankai Trough sea area alone cover an area of 1.1 trillion m^3, equivalent to about 10 years' consumption of natural gas in Japan. If the development of these resources could be commercialized, it would surely open the door to huge business opportunities.

Current situation of the offshore industry, and the need for human resources

Japanese companies also have great expectations for the offshore development sector. So far, however, Japanese participation in this market has been extremely limited. For example, Japanese companies' share of global investment in offshore oil and gas development amounts to only about 1%. If Japan's offshore industry were to be developed and sales were to grow to five times the present level in future, the scale would be more than 2 trillion yen. Considering Japan's technological potential, this is certainly an attainable target.

On the other hand, attaining this target will depend on securing highly capable human resources. According to a survey by The Nippon Foundation, some 2,200 technicians work in offshore development for Japan's main companies, but in order to attain the target, this number will need to be increased five-fold to the 10,000 level. The offshore industry involves a combination of many projects, and in order to execute these projects properly, technicians need a broad range of knowledge in addition to their specialist expertise. Moreover, the skills required are now growing even more diverse and specialized, in response to heightened concern over reducing environmental impact, and intensified safety measures in response to the increasing depths of development in recent years, serious accidents in the Gulf of Mexico, and so on.

In view of this, human resources need to be developed strategically with a long-term perspective, starting with students as well as working professionals, in order to secure the technicians needed for offshore development in future. In the case of students, the following issues will need to be resolved before human resources can be developed.

(i)The offshore industry is not seen as attractive by young people (students).

(ii)Although it is important to accumulate experience in the field, including operations, there is no such field in Japan.

(iii)There is no curriculum that teaches offshore development technology in an interdisciplinary and comprehensive manner.

(iv)The mechanism for bridging the divide (encouraging collaboration) between students and companies is inadequate.

(v)There is no system of human resource development that matches corporate needs in order to solve the above issues.

Background to the launch of the Consortium and an outline

At The Nippon Foundation, we see offshore development as a sector that will trigger huge growth in Japan's marine industries in future. As such, we have played a central role in leading the discussion from the outset. In 2013, we set up an "Offshore Development Capacity Building

Press conference on the launch of The Nippon Foundation Ocean Innovation Consortium (October 4, 2016)

Research Committee" with the aim of discussing how to create a system of human resource development. As well as identifying the issues mentioned above, the Committee drew up measures to address them, in the form of proposals. Based on the recognition that a platform for turning the proposals into action was required, in May 2015 we set up a Consortium Founding Members Group consisting of key persons in political and financial circles, and started full-fledged approaches to industry, academia and government. In parallel with these developments, Prime Minister Shinzo Abe strongly advocated the need to create a consortium in his speech at the Marine Day commemorative ceremony that year. Then, following coordination among the parties concerned, "The Nippon Foundation Ocean Innovation Consortium" was launched on October 4, 2016 as an all-Japan platform comprising twelve of Japan's leading offshore development related companies, fourteen universities and four public bodies. The Consortium would be chaired by Nippon Foundation Chairman Yohei Sasakawa, with Koji Miyahara, a Board Counselor at Nippon Yusen, and Yuichiro Ichikawa, President of Japan Drilling, as Vice Chairmen, and with the Secretariat provided by The Nippon Foundation.

As for an outline of the Consortium, its targets are university undergraduates, graduate students, and young professional technicians. As specific examples of initiatives aimed at students, we hold orientation seminars designed to convey the attractions of offshore industries, while students learn about the technology of offshore development in field experience seminars aboard the deep sea drilling vessel "Chikyu" and the floating offshore wind farm "Haenkaze." Participants are sent to summer schools at universities overseas and internships in overseas companies. Students who take part in these seminars and schools receive "Certificates of Completion," so that prospective employers can "see" what the students have learnt when recruiting staff, etc. In addition, students who attend summer schools and other programs are recognized as "Nippon Foundation Ocean Innovation Consortium Fellows," and are given the role of conveying the attraction of the industry to their peers and juniors. More details on these and various other activities can be found on our special Consortium website (http://www.project-kaiyoukaihatsu.jp/).

Students who took part in a summer school

A scene from a field experience seminar on offshore development technology

Initiatives for the future

In future, we will continue to promote initiatives in the Consortium that are tailored to corporate needs, and will develop talented young technicians. Also, by communicating our outcomes widely, with the cooperation of our Fellows and partner companies, we plan to increase the number of motivated students who want to study offshore development (i.e., broaden our student base). Finally, with a view to strengthening technical abilities as well as developing human resources, we will prepare new collaborative programs with universities and companies in pioneering areas like Norway, Scotland, and Houston, Texas.

The Nippon Foundation aims to play a full role as a facilitator, in collaboration with Consortium Members and other stakeholders as well as the Ministry of Land, Infrastructure, Transport and Tourism. ■

On the Frontline of Research on Microplastics in the Ocean

[KEYWORDS] microplastics / harmonization and standardization of monitoring methods / marine debris

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(Ocean Newsletter No. 397, 20 February 2017)

Plastic marine debris floating in the ocean go through a repeated process of degradation and fragmentation, eventually becoming minute bits called microplastics. If marine organisms mistakenly consume these microplastics, there is the possibility that contaminated matter adhering to the surface of the microplastics will be ingested and developmental problems arise. In comparison with other areas, the East Asia ocean region has been identified as a hot spot, by a degree of magnitude, for microplastics floating in the ocean. Along with the standardization and harmonization of monitoring methods, countries in the region must coordinate efforts in order to gain a better understanding regarding the current situation of floating microplastics, and formulate projections for the future.

Microplastics floating in the ocean and environmental burdens

Waste plastics account for around 70% of coastal drifting debris. They become progressively degraded by exposure to ultraviolet light and changes in temperature, and break up into fragments under the additional impact of physical stimuli. Eventually these plastic fragments are returned to the sea by tides and wave motion, then drift back to the coasts once more in a repeated cycle. During this process, fragmentation must gradually progress. Beaches with multi-colored plastic fragments mixed with the sand are no longer an unusual sight (Photo 1).

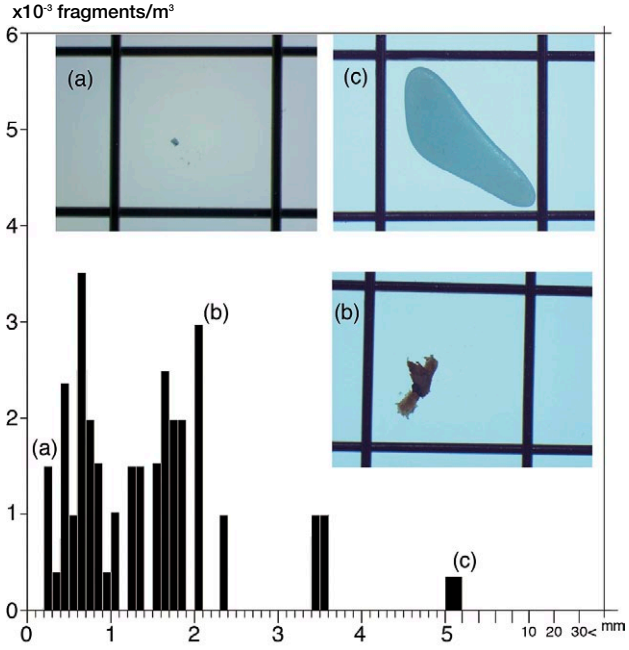
Plastic fragments reduced in size to less than 5mm are called microplastics. Once they shrink to this size, they can easily enter marine ecosystems when mistaken for food. In fact, microplastics have recently been discovered inside a variety of living organisms collected in actual sea areas, from whales to zooplankton. In seawater, persistent organic pollutants are spread so thinly as to be normally harmless, but these easily adhere to the surface of floating microplastics. There are reports that these pollutants are ingested efficiently by living organisms when microplastics are mistakenly consumed. It has also been pointed out that, although these plastics are not toxic in themselves, they do not promote growth either. As a result, they could inhibit the growth of marine organisms that repeatedly mistake them for food.

■Photo 1
Minute plastic fragments mixed with beach sand. Photographed by the author's group on Ishigaki Island.

However, research on the degree of damage to marine organisms is still a work in progress. There have been no reports of environmental risks caused by microplastics becoming manifest in actual sea areas. This must be because the volume of floating microplastics is still relatively small. But while waste plastics will continue to be discharged into our oceans in future, plastics do not easily biodegrade in nature. In other words, this world is a cul-de-sac for waste plastics, and floating microplastics in the ocean could increase in future. Our attention here should be on the future environmental risk of "marine plastic pollution" if the concentration of floating plastics continues to increase unabated.

The front line of microplastics research

But how many microplastics are floating in the world's oceans in the first place? Even if their impact on marine organisms can be verified, it is not sufficiently persuasive to design experiments on the assumption of floating volumes not supported by observed data. Ascertaining the volume of floating microplastics in actual oceans and formulating projections for the future could be seen as two of the most important research tasks in connection with microplastics. However, it was only very recently that microplastics started to be recognized as marine pollutants. Given the short history of research so far, there is still not enough uniformity in the methods of observation and analysis. In papers published over the last few years, there are even differences in the units used for expressing the volume of floating microplastics. There is no meaning in comparing different units, such as comparing the volume expressed as the number of floating fragments per volume of seawater



■Fig.1
Concentration of floating microplastics collected in the Antarctic Ocean by size (number of floating fragments per unit volume of seawater). The letters (a), (b) and (c) written above the bars correspond to photos (a), (b) and (c) of microplastics of the same size. The box in the photos measures 5mm and the thickness of the axes is 0.3 mm. Quoted from Isobe et al. (Marine Pollution Bulletin, 2017).

(for example, fragments/m^3) with the weight of floating fragments per area of sea (for example, mg/km^2). We will only be able to compare floating volumes in different sea areas and create integrated datasets when both the units and the methods of observation and analysis have been harmonized.

Fortunately, Japan could be described as a pioneer in sea area surveys of the volume of floating microplastics. Our systematic observation, based on oceanographic methods, is leading the rest of the world; my own group has been surveying floating volumes in the western Seto Inland Sea area since around 2010. The Ministry of the Environment, Tokyo University of Marine Science and Technology (TUMSAT), and Kyushu University have been continuously surveying floating volumes in the seas around Japan since 2014. These are simultaneous surveys of floating microplastic volumes using two TUMSAT training vessels (Umitaka Maru and Shinyo Maru). Observations are made at 50 to 100 measurement points that are maintained every year, a scale not seen in other countries. Observation methods in all sea areas are uniform, while the collected microplastics are exclusively provided for analysis by Kyushu University. Since 2015, these universities have been joined by researchers from Ehime University and Tokyo University of Agriculture and Technology, who have collaborated in surveys on the volume of floating microplastics and research aimed at assessing their impact (Environment Research and Technology Development Fund of the Ministry of the Environment, project code 4-1502).

These research efforts have revealed that the volume of floating microplastics in East Asian seas around the Japanese archipelago amounts to around 1.7 million fragments/km^2 (3.7 fragments/m^3). This is greater than in any other sea area around the world, by a degree of magnitude. In other words, East Asia is a "hotspot" for floating microplastics. Indeed, the seas of East Asia may be where environmental burdens caused by microplastics will first become manifest in future. In 2016, our research group confirmed the presence of microplastics floating in the Antarctic Ocean for the first time in the world (Fig.1). If these fragments can drift to the furthest ocean from the centers of consumer culture, there must no longer be any ocean on earth where there are no floating microplastics.

Expectations of Japan in microplastics research

At the G7 Elmau Summit in 2015, Japan proposed that methods of monitoring marine debris including microplastics should be standardized and harmonized. This was then incorporated in the Leaders' Declaration, with the approval of the other G7 countries. In response, the standardization and harmonization of monitoring methods was also advocated in the "G7 Environment Ministers' Toyama Communiqué" following the G7 Toyama Environment Ministers' Meeting in Toyama in 2016. And at the 6th Japan-China High-Level Consultation on Maritime Affairs held in December 2016, cooperation between the two countries in research on microplastics was the fourth of ten matters raised for agreement. I hope mutual visits between Japanese and Chinese researchers will be repeated in future, and that a path will be opened up for joint surveys on the volume of floating microplastics in the hotspot of East Asia.

The distribution of microplastics, carried by ocean currents, is expanding with no regard to territorial waters or exclusive economic zones. The floating volume cannot be ascertained or future projections attempted through the efforts of one country alone. It is important that monitoring is carried out continuously, and that two- and three-dimensional maps of the floating volume in sea areas are created through data exchanges with other countries. Japan, located in the hotspot, is expected to play a pioneering role in microplastics research, while leading the world in standardizing and harmonizing observation methods supported by scientific knowledge. ■

Towards the Sustainable Revitalization of Communities Affected by the Great East Japan Earthquake

[KEYWORDS] learning disaster prevention / sustainable revitalization of communities / creating local culture

Hisao HASHIMOTO
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(Ocean Newsletter No. 398, 5 March 2017)

In the reconstruction efforts following the Great East Japan Earthquake and Typhoon Lionrock, we believe in the importance of creating local culture as we rebuild our community, while also continuing efforts to accurately convey the history of the disasters. Our community's history and culture have deep roots in the region, having been shaped by interactions with its inhabitants' ways of life. Here, I would like to focus on the importance of history within the context of social change and reconstruction efforts from disasters, and connect it to further cultural growth.

Introduction

On March 11, 2011, an earthquake struck off the Pacific coast of Tohoku, causing the disaster known as the Great East Japan Earthquake – a disaster far beyond all of our imaginations. Coastal regions were ravaged by a tsunami that reached heights of more than ten meters, swallowing up whole districts and claiming untold lives. Ports and reclaimed land were largely destroyed by the phenomenon of liquefaction caused by the earthquake, while many solid tidebreakers and revetments built for protection were also destroyed.

The tsunami had a massive impact not only on people's lives, property and day-to-day living, but also on the natural environment of the shores that had been so carefully maintained by the community until then.

The disaster-affected areas will soon be approaching their sixth spring since then. Now, various developments are underway with a view to restoring and reconstructing the disaster-affected areas, with the main focus being on rebuilding people's lives. To make matters worse, coastal areas of Iwate Prefecture were attacked by Typhoon Lionrock at the end of August last year, causing a "mountain tsunami" comparable with a marine tsunami in river basins and elsewhere. The havoc it wrought meant that things had to be rebuilt and reconstructed all over again. But even so, people are still working desperately to rebuild without losing sight of their hope for the future, however long it may take. I hope it will be understood that the reconstruction of the disaster-affected areas is by no means complete.

The Hikage Bridge in the Moichi district of Miyako City was washed away during floods caused by Typhoon Lionrock.

Our humble request to pass on for posterity

The main focus in the reconstruction of the Sanriku coast should be on sustaining our fertile seas and promoting our core industry of fisheries, as well as tourism and other industries, based on the diverse wishes of residents in each community. Many of the disaster-affected areas have built up cultures supported by the produce of the sea. What must be done to protect lives from tsunamis and to maintain our close relationship with the sea? I think we all need to think about this from a variety of perspectives.

Partly due to ground subsidence caused by the earthquake disaster, our previously beautiful beaches are being narrowed and hemmed in by concrete tide breakers, and their appearance as beaches is gradually being lost. Those beaches were formed by sand transported from mountains to rivers and from rivers to the sea, over a span of hundreds or thousands of years. Tidelands or beaches with white sand and green pines used to spread far across Miyako Bay. Beaches like that were commonplace in our childhood but now have all but disappeared.

Now that the unnatural landscape of concrete blocks stretching endlessly around our coasts has become normal, beach revival projects designed to restore beautiful coasts and beaches is surely something we need to think about from a variety of perspectives in order to keep living together with the sea.

I think the path for the next generation should lie in inviting the attention of the world by raising the "world heritage value" of Sanriku, where we live according to the principle of nature symbolized by the "Mori wa Umi no Koibito" ("The forest is longing for the sea, the sea is longing for the forest") movement.

How should this disaster be recorded and conveyed to posterity?

As well as teaching us some valuable lessons, this earth-

The first "earthquake disaster ruin" in Japan, the former Taro Kanko Hotel. This is an important facility for Learning Disaster Prevention.

A tsunami memorial erected in the Kanehama district of Miyako. It was erected by the residents to convey the lessons learned.

quake disaster also helped us to notice a number of things. Of course, it was a tragedy that we never want to face again. But sooner or later, the memory of its horrors will fade and, in time, will be forgotten. The history of disasters does not usually remain unless someone makes the effort to accurately convey it.

Miyako City is offering "Learning Disaster Prevention" tours for that very purpose. A hotel in the Taro district that was damaged by the tsunami has been left as a new "earthquake damage ruin" where the history of the disaster is conveyed. Guides ask "Why don't people run away?" as they tell the lessons learnt from the disaster in this "Learning Disaster Prevention" tour. Rather than creating new public works or systems, or raising breakwaters, they teach us to awaken our individual risk awareness and raise our own "mental breakwaters."

Although it is now five years since "Learning Disaster Prevention" started, this kind of tourism helps to increase the number of visitors to the disaster-affected areas and prevent them from tailing off. A continuous flow of visitors helps to energize the disaster-affected areas. There are also expectations that the tours will revive economic activity. And for those visitors, we hope that learning how the disaster-affected areas are being reconstructed will provide suggestions for future reconstruction.

One means of preventing memories from fading is the tsunami memorial. After the 1933 Sanriku Earthquake, donations collected by a newspaper company were partly used to build monuments in memory of the tsunami. Tsunami memorials after the Great East Japan Earthquake consist of marker stones indicating the point reached by the tsunami, erected by various charitable organizations that support the disaster-affected areas. The newly erected tsunami memorials often carry the message of conveying tsunami experiences to children for the sake of the future. They are also a new form of folk tradition.

The target of creating local culture

As we continue the reconstruction effort, creating local culture will also be important in future attempts to rebuild communities. The starting point for rebuilding communities is the culture of that community – its treasure, indeed. However, many forms of culture are being lost with the changing times. What's more, streets and things with a tangible shape were destroyed by the tsunami, and some of them only remain in people's memories. In future efforts to rebuild communities, I think we will need to start by re-discovering what has been cultivated and accumulated in local communities as their "treasure," then properly confirming and sharing it. An important part of this process will be to highlight things that have not been visible until now, like the cultural background and history of our communities.

One kind of culture that helps to form this "treasure" is the culture of ocean-based communities. Our history is bound up with salmon, the fishing culture built up by our forebears, traditional customs, dialects, the history of ships of the Nanbu Fief, the history of shipwrecks leading to exchanges with Okinawa and Tarama Island, and so on. Again, in 1745, sailors from Miyako and elsewhere were washed ashore in Russia, leading to the compilation of a Russian-Japanese glossary. This later culminated in the Russian-Japanese dictionary *Leksikon* (compiled by their descendants in 1783, now kept by the Russian Academy of Sciences), an episode that is not very well known. The language of the shipwrecked sailors was perpetuated in the form of a dictionary, enabling Japanese to be understood in Russia at the time. It reflected the Iwate coastal dialect, and is a valuable cultural material for research on the dialects of Japanese at the time. There are numerous other topics that should be preserved for posterity, such as the Battle of Miyako Bay, the first western-style sea battle in the modern era and a defining moment in the Meiji Restoration.

The history and culture of a community are rooted in its natural features and have been shaped by interaction with its inhabitants' ways of life. Based on the multi-tiered nature of history within the context of social change and reconstruction from disasters, I would like to connect this to further cultural growth. ■

Birth of the North Pacific Fisheries Commission (NPFC)

[KEYWORDS] North Pacific Fisheries Commission(NPFC) / Regional Fisheries Management Organization(RFMO) / fisheries resource management

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(Ocean Newsletter No. 400, 5 April 2017)

The North Pacific Fisheries Commission (NPFC) was born with the objective of ensuring the long-term conservation and sustainable use of fisheries resources in the area established by its convention, while protecting the marine ecosystems of the North Pacific Ocean. Complying with the relevant United Nations General Assembly fisheries resolutions, we aim to achieve this objective through developing Commission work plans including science and compliance, conducting stock assessments of target species, establishing a data management system, and cooperating with other organizations.

The Fishing Environment in the North Pacific

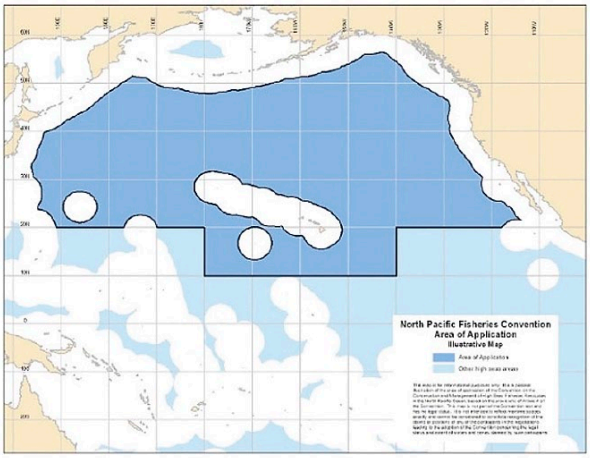
From ancient times, humans have relied on the oceans for many reasons mainly for food, economic opportunities, recreation and so on. According to FAO, in 2013, fish accounted for about 17% of the global population's intake of animal protein and 6.7% of all protein consumed, and about 56.6 million people were engaged in the primary sector of capture fisheries and aquaculture in 2014. However, increased human impacts along with rapid population growth and substantial developments in technology have continuously pushed commercial fish stocks and they have decreased, resulting in significantly lower levels of fish resources now available. It is not surprising that more than 50% of fish stocks are fully exploited and only about 10% are underfished stocks.

The North Pacific Ocean where we live is the most productive area in the world due to its surrounding environments, which has allowed the Pacific Rim States to enjoy the freedom of access to high seas fisheries resources. More recently agreed international instruments have been established to conserve and manage these resources for sustainable use for the future. Currently around fifty such governing bodies called Regional Fisheries Bodies (RFB) or Regional Fisheries Management Organization (RFMO) focus on high seas fisheries, coastal fisheries, inland fisheries and aquaculture on the world's oceans. However, despite these numerous RFBs, there have been relatively few such organizations in the North Pacific Ocean and it was clearly recognized by the UN that there needed to be a bridge in this region to manage fisheries resources and protect marine ecosystems. This was the beginning of the birth of the North Pacific Fisheries Commission.

Who Are We?

The North Pacific Fisheries Commission (NPFC) is an inter-governmental organization, headquartered in Tokyo, Japan, established by the Convention on the Conservation and Management of the High Seas Fisheries Resources in the North Pacific Ocean. The objective of the Convention is to "ensure the long-term conservation and sustainable use of the fisheries resources in the Convention Area while protecting the marine ecosystems of the North Pacific Ocean in which these resources occur". The initial meetings to establish the NPFC commenced in 2006, in accordance with the United Nations General Assembly Resolution 59/25 (2004), 60/31 (2005), 61/105 (2006) and it took 9 years of negotiation processes for Canada, China, Japan, Korea, Russia, Chinese Taipei, USA to reach the point where we are now a Commission. The Convention was adopted on 24th February 2012 and came into force 180 days after receipt of the 4th ratification on 19 July 2015. The current Members of the NPFC include: Canada, China, Japan, Republic of Korea, the Russian Federation, and Chinese Taipei.

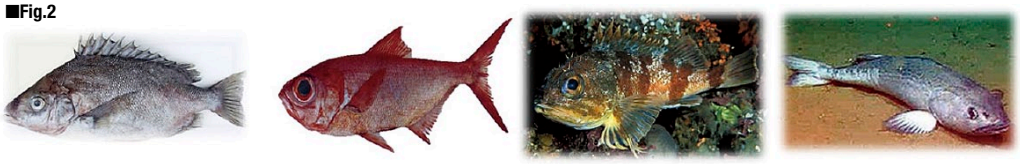
■Fig.1 NPFC Convention Area



What Do We Do?

Day-to-day running of the Commission is through the Secretariat under the direction of the Executive Secretary. With support from two professional staff responsible for scientific and compliance matters, the Executive Secretary assists the Commission Members in the presentation and adoption of conservation management measures (CMMs) that will govern the fishing practices of their fleets when

■Fig.2



Major target species of North Pacific Bottom fisheries. From left to right, North Pacific Armorhead, Splendid Alfonsino, Rockfish, Sablefish.

operating in the NPFC Convention Area. The Commission has two key areas of work, the first being the scientific area which addresses status of fish species and impacts of fishing activity on fish stocks and marine ecosystems to provide advice to the Members for sustainable management of the resources and protection of ecosystems. Second, is the compliance component where rules and regulations (CMMs) are endorsed for approval by the Commission for sustainable management of the resources and ecosystems. Fishing vessels operating in the NPFC Convention Area are monitored at sea and in port to ensure compliance of their operations with the agreed regulations/CMMs of the Commission. The Area of Competence of the NPFC includes the high seas of the North Pacific Ocean. Fisheries resources covered by the Convention include all the fish, mollusks, crustaceans and other marine species caught by fishing vessels within the Convention Area, excluding sedentary species insofar as they are subject to the sovereign rights of coastal States, indicator species of vulnerable marine ecosystems, catadromous species, marine mammals, marine reptiles and seabirds, and other marine species already covered by pre-existing international fisheries management instruments within the area of competence of such instruments.

Currently the fish species targeted by the NPFC Members include bottom fish stocks and pelagic fish stocks. As for bottom fish stocks, in the Northwestern Pacific Ocean, bottom trawl fisheries, bottom gillnet fisheries and bottom longline fisheries have been conducted over the Emperor seamounts by Japan, Korea and Russia. The primary target species of the bottom trawl fisheries have been North Pacific armorhead, and splendid alfonsino, and the primary target species of the bottom gillnet fisheries have been splendid alfonsino, oreo and mirror dory. In the Northeastern Pacific Ocean, four seamount aggregations have been fished by Canada, via longline hook and longline trap gear. Since the inception of the fishery, the target species of both the longline hook and longline trap harvesters has been sablefish. As for pelagic fish stocks, Pacific saury has been harvested by China, Japan, Korea, Russia and Chinese Taipei. These fleets mainly use stick-held dip nets or lift nets to catch Pacific saury. While Japanese and Russian vessels operate mainly within their EEZs, Chinese, Korean and Chinese Taipei vessels operate mainly in the high seas of the North Pacific. Besides Pacific saury, neon flying squid has been harvested by squid jigging fisheries within the Convention Area. More recently, the chub mackerel fishery is commencing in the NPFC Convention Area in the Northwestern Pacific Ocean.

As a new RFMO, NPFC is now in its early developmental stage of setting up the Secretariat, developing internal rules and procedures, and liaising and cooperating with other RFMOs to enable exchange of pertinent information on research, processes and operational activities. It is notable, however, that the NPFC with cooperation of six Members has made significant progress by adopting important CMMs which include Vessel Registration, limitation on Pacific saury, listing of IUU fishing activities, interim transshipment procedures, addressing vessels without nationality, measures for the management of bottom fisheries and protection of vulnerable marine ecosystems (VMEs) in both the Northwestern and Northeastern Pacific Oceans, and limitation on fishing effort for chub mackerel.

Challenges and Future Plans

As other existing RFMOs, the NPFC also is facing challenges in attaining its Convention objectives. Among those are first and foremost commitment of Members and Participants to good governance, transparency, and sustainable management of renewable marine resources and protection of the marine ecosystems, which is an absolute and basic requirement to the success of RFMOs. Leadership for sustainable management by current Commission officers is also critical to a potential success of the NPFC, since politics will always play a part in regional resource management. In addition, understanding the complexity of resources and ecosystems that encompass dependent or associated species within their larger surrounding environments is also a challenge that the NPFC has to overcome in the short and long-term. In summary, the NPFC, as a recently established RFMO, is fully committed to making every effort for the conservation and management of high sea fisheries resources in the North Pacific Ocean. This will be achieved by complying with relevant UNGA fisheries resolutions, the development of Commission work plans including science and compliance, conducting stock assessments of target species, establishing data management system, and cooperation with other organizations. ■

What the World's Oldest Fishing Hook Tells Us about the Lives of Paleolithic People in Okinawa

[KEYWORDS] shell objects / aquatic resources / Paleolithic people

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(Ocean Newsletter No. 400, 5 April 2017)

The excavation of Sakitari Cave has shed light on the lifestyles of Okinawa's Paleolithic people, which had previously been shrouded in mystery. The excavation revealed an unexpected lifestyle, in which people captured Japanese mitten crabs (*mokuzugani*) and giant mottled eels from rivers, fished at sea, and gathered shells to create tools and ornaments. These people were familiar with aquatic resources, to a much further degree than what we had previously imagined.

The riddle of Okinawa's Paleolithic history

The world's oldest fishing hook from the Paleolithic era, dated to 23,000 years before present (BP), was discovered at the Sakitari Cave Site in Nanjo City, Okinawa Prefecture. Although one cannot know whether it is directly linked to modern-day fishing culture, it is somehow uplifting to think that Paleolithic people were also familiar with fishing activity.

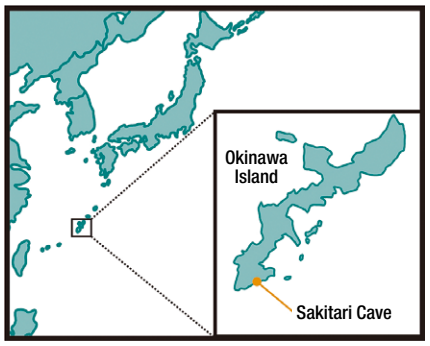
The popular image of Paleolithic people is one of hunting mammoths and other massive beasts armed only with stone-tipped spears. But how were they to live on islands where there were no large beasts? Crossing seas to reach islands is an important characteristic of *Homo sapiens* in the historical process of spreading all over the world. In that case, humans must also have found a way of living on the islands they reached in this process. Evidence that Paleolithic people fished for marine produce had already been discovered in the islands of Southeast Asia, but almost nothing had been found anywhere else.

Okinawa was no exception; for here, although numerous Paleolithic skeletons such as that of "Minatogawa Man" (around 20,000 years BP) had been found, there had only been very few Paleolithic discoveries, and little was known about the culture and lifestyles of people in those far off days. But then, a team from the Okinawa Prefectural Museum & Art Museum (including the author) conducted an excavation survey at Sakitari Cave, and had the good fortune to find the object mentioned in the title.

World's oldest fishing hook found!

Sakitari Cave is located some two kilometers inland from the coast at the southern end of Okinawa Island. Amongst a complex network of caves (known as the Gyokusendo cave system) formed by the flow of the Yuhi River, it is unusually large and spacious; the floor area measures about 620m^2. A refreshing breeze wafts through the cave mouths, which open to both east and west, and the strong subtropical sun shining in through the broad opening on the east side softly illuminates the interior. It's such a pleasant place, in fact, that it is now being used as a "cave café."

People lived in this cave in the Paleolithic era. On surveying deposition layers between 13,000 and 35,000 years old that still remain in one corner of the cave, we unearthed a continuous stream of charcoal, crab and freshwater snail shells in very large quantities. When our survey at last reached the layer dating to 20,000 years BP, we started to make sporadic finds of human bones and seashells. It was incontrovertible proof that Paleolithic people had been in the cave.



Sakitari Cave is located some two kilometers inland from the southern coast of Okinawa Island. Although sea levels decreased during the last glacial maximum about 20,000 years BP, even then it is thought to have been around 5-6 kilometers from the coast.

Sakitari Cave seen from the eastern cave mouth. The excavation area is on the right at the back of the photo. Modern-day people are enjoying coffee in a cave where Paleolithic people once lived.(Photo by Dr. Masaki Fujita)

As the survey continued amid some excitement, we noticed that all of the shells were split. When we eat shellfish, we don't split the shells. Thinking it strange, we carefully observed the surface of the split, and discovered marks that looked as if the shells had been used to scrape wood or bamboo. Here on Okinawa Island, where stone suited to making tools was in scarce supply, it seems as if the Paleolithic people had split the shells and used them as scraping tools. Beads made by boring holes in small bivalves were also found. No one involved in the survey had ever imagined that the long-awaited Paleolithic tools and ornaments might perhaps be made of shell.

The world's oldest fishing hook. Made by splitting the base of a Trochidae (sea snail) shell, then polishing the flat part with a whetstone. It has a width of around 14mm.
(Fujita et al., 2016, Photo by Okinawa Prefectural Museum and Art Museum)

As we continued the survey in amazement, the now famous fishing hook suddenly appeared. Found in a stratum dating to 23,000 years BP, this hook fashioned from shell shone iridescently as it caught the light from our head lamps in the dark of the cave. It formed a semi-circular arc, one end of which was sharp. When we realized, from the shape, that this was a fishing hook, we were speechless. We had been convinced that Paleolithic people had hunted deer and wild boar, and had never expected to find a fishing hook.

What did Paleolithic people eat?

However surprising it may have been, the discovery of the fishing hook meant that Paleolithic people must have angled for fish. So where were the remains of the fish they had caught? When we hurriedly re-examined the unearthed remains, we found that they included two fish bones. A find of just two fish bones would not normally be accorded much importance, but the discovery of the fishing hook changed all that. In the conviction that there must be more fish bones, we washed all of the excavated earth and picked out all the fine animal bones, then, all day and every day, worked on sorting these little bones that looked like *furikake* seasoning. And it paid off, for one after the other, we found bones of giant mottled eels from a river, as well as Japanese parrotfish, mottled spinefoot and others from the sea.

One should stress that only a few tens of fish bones were found. Seen in terms of the remains as a whole, this was a very small number; the shells of mitten crabs and freshwater snails were overwhelmingly numerous by comparison. All of them were partly burnt, and it is beyond doubt that they were used as food. Perhaps they had been caught in the Yuhi River that flows to the west of Sakitari Cave. Mitten crabs are nocturnal, and so have to be caught at night. It would have been somewhat inconvenient to carry a whole catch of mitten crabs by hand over long distances at night. If there were a large cave alongside a river, it would only be human to want to rest there. Thus it would seem that Paleolithic people rested in Sakitari Cave while feasting on mitten crabs.

Paleolithic people enjoyed seasonal foods

Some may baulk at the use of subjective expressions like "feasting," but we firmly believe that Okinawa's Paleolithic people enjoyed the taste of crab. This is because they only seem to have visited Sakitari Cave in autumn, when mitten crabs are in season.

Evidence of seasonal use survives in the shells of freshwater snails. When water temperatures change in line with the seasons, the oxygen isotope ratio in river water also changes. This change is reflected in the shells of freshwater snails, which grow underwater. In that case, by measuring the oxygen isotope ratio at each millimeter along the growth line of freshwater snails, we could estimate the season from the water temperature at the point when the growth stopped (in other words, when they were eaten by people). The result of this analysis revealed that about 70% of the freshwater snails we investigated had been eaten in autumn and the other 30% or so in summer.

Raised in a rich river environment, mitten crabs all migrate downstream together on autumn nights in order to spawn in the sea. Having stored up nutrients for reproduction, their bodies are firm and their brown meat plentiful; they are reaching the prime time for eating. Okinawa's Paleolithic people seem to have targeted a season when crabmeat would be delicious. In that case, they must have known that "mitten crabs are best in autumn."

Paleolithic people appreciated seasonal mitten crabs and were practiced in fishing. This is the image of Okinawa's Paleolithic people we are now proposing. This image is quite different in character from that of spear-wielding Paleolithic people bravely hunting massive beasts. But this more elegant way of life seems better suited to the southern islands. This was a case of adapting to the environment; it mattered not that there were no big beasts, nor sufficient resources of stone. Eating food from the river as the seasons dictate, going out to sea to catch fish, and gathering up the abundant seashells to make fishing hooks, scraping tools and beads. Paleolithic people seem to have lived a rich life on the islands of Okinawa. ■

50 Years Since the Start of Japan Meteorology Agency's Repeat Hydrographic Observations Along 137°E

[KEYWORDS] Japan Meteorology Agency hydrographic observations / repeat observations along 137°E / Jotaro Masuzawa

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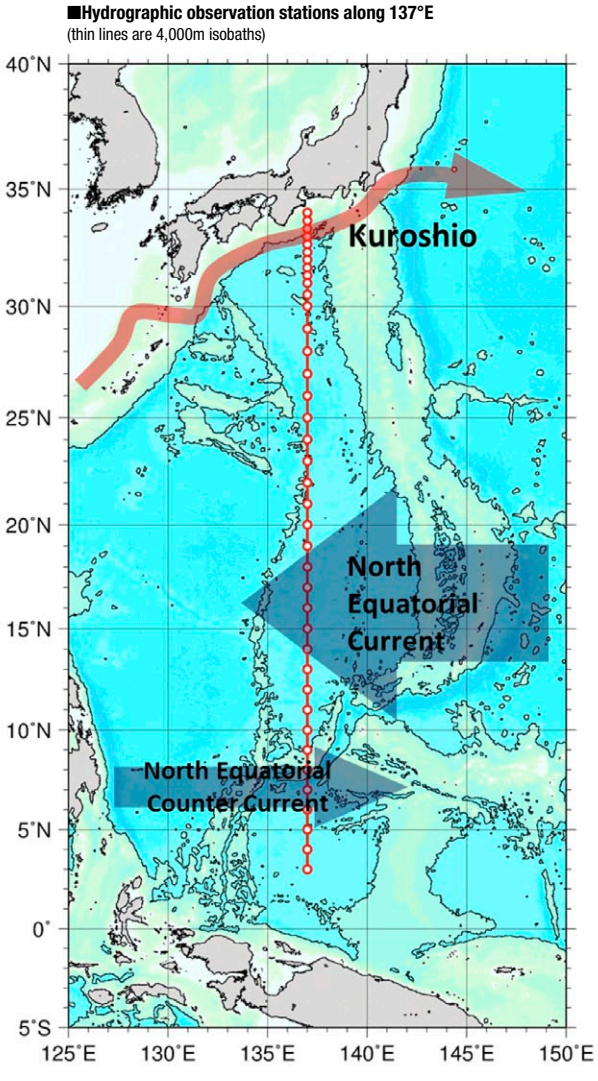
(Ocean Newsletter No. 402, 5 May 2017)

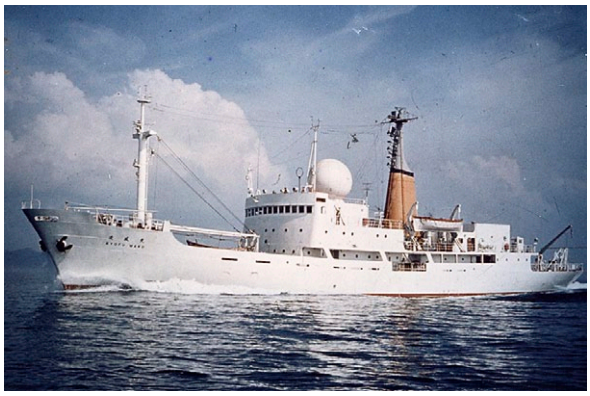
The Japan Meteorological Agency has conducted repeat hydrographic observations along 137°E since 1967, and launched the 51st observation with the departure of its research vessel on January 10th, 2017. Not only is the continuation of such a repeat observation unprecedented anywhere in the world, but the observation is also known, since the very first time, for releasing its entire data collection. These data are open for use by all researchers, leading to high acclaim from both domestic and international organizations working in the ocean field. We believe repeat observations along 137°E are invaluable assets that should be passed on to future generations.

Repeat hydrographic observations along 137°E

The Japan Meteorology Agency has established a repeat observation section in the Northwest Pacific Ocean, including the area around Japan, and conducts hydrographic observations along this section not only on the ocean surface but also below it [1]. The most representative of these repeat observation sections is the one going along 137°E (hereinafter the 137°E section). Observations along this section were started in the winter of 1967 (the year after Ryofu Maru II came into service), through our participation in the "Cooperative Study of the Kuroshio and Adjacent Regions (CSK)," planned as an official program by the Intergovernmental Oceanographic Commission (UNESCO-IOC). The aim of the program, in which Japan played a central role, was to observe ocean circulation in the West Pacific, including the Kuroshio. Dr. Jotaro Masuzawa, who served as both Director-General of the Japan Meteorology Agency and President of the Oceanographic Society of Japan in later years, explained the reason for selecting the 137°E section as follows: "A observation section that conveniently crosses the major ocean currents of the North Pacific such as the Kuroshio and the North Equatorial Current with little localized impact from islands, sea mounts, etc., enabling us to observe general variation in large-scale phenomena as much as possible." The line extends for about 3,900km from 34° N off the southeast of Cape Daio on the Shima Peninsula to 1° S off New Guinea [2].

Dr. Masuzawa was also a researcher who analyzed hydrographic observation data, and was responsible for coining the term "Subtropical Mode Water," an important concept for understanding climate change [3]. In *Kuroshio kyōdō chōsa (CSK) to watashi* ("The CSK and Me," Kaiyo Kagaku, 1978), published about ten years later, he gave an account of the time when observations were first carried out. As he recalls, "Even if the purpose was to investigate large-scale and long-term variation, I always suspected that not enough could be achieved by observing only once a year, and I felt that it would take about 30 years before we could make any value judgments." In fact, observation data on the 137°E section over the last 50 years have produced a wealth of knowledge through more than a hundred papers on the structure of the Northwest Pacific, El Niño and other climate change phenomena, ocean physics connected with variation in biogeochemical cycles, and long-term variation in biogeochemistry. This knowledge was even cited in "The Fifth Assessment Report of the Intergovernmental





The R/V Ryofu Maru II. Two research vessels are currently used for the observations – Ryofu Maru III, which came into service in 1995, and Keifu Maru II.

Panel on Climate Change (2013)". Our efforts have also been warmly praised at the international level; at the 2016 annual meeting of the North Pacific Marine Science Organization (PICES) held last November, for example, we were awarded the PICES Ocean Monitoring Service Award (POMA) for long-term ocean monitoring that contributes to the growth of ocean sciences in the North Pacific. Now that the advance of global warming and changes in the global environment are becoming serious social problems, one is again full of admiration for the forethought and vision of Dr. Masuzawa and the others who started observing the 137°E section from such a long-term viewpoint.

The parameters observed in those early days were water temperature, salinity, dissolved oxygen, nutrient salts and chlorophyll a, physical parameters and biochemical data that are still being collected today. In the 1980s, observations of ocean atmosphere and carbon dioxide in surface seawater were started in order to monitor greenhouse gases as a cause of global warming, reflecting social trends of the time. These data have also been accumulated for more than 30 years. Today, we also observe carbonate parameters in seawater (total carbon dioxide, alkalinity, pH) and Chlorofluorocarbons with the aim of further clarifying variation in the carbon cycle. These observation data are all published in *Kaiyō no kenkō shindanhyō* ("Marine Diagnosis Report") on the Japan Meteorological Agency website [4].

Surveys of the 137°E section in international projects

Our observations of the 137°E section have also played their part in national and international observation projects. The most representative of these was our participation in the World Ocean Circulation Experiment (WOCE) during the 1990s. In this project, the 137°E section was positioned as the one-time observation section "P9" in the Northwest Pacific area, and we conducted observations at all points going down to seabed level in 1994 ("P9" was one of just over 30 observation sections established in the Pacific Ocean). After this, we again conducted observations in 2010 and last year (2016), and are currently taking part as a high-frequency observation section in the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP), and in the Global Ocean Acidification Observing Network (GOA-ON).

Future hydrographic surveys by research vessels

In recent years, the main players in hydrographic observations have been shifting to Argo floats [5] and automatic observing platforms such as space satellites. However, collecting observation data on physical parameters and many biogeochemical parameters to a high degree of precision from the ocean surface to the seabed still depends on observing by research vessel. With the advance of global warming and ocean acidification, long-term observations by research vessel will continue to be important in detecting minor but important variations in the oceans, as well as helping to clarify the situations and mechanisms of long-term variation and change. In fact, they will probably be used even more as data for verifying future prediction models of climate and the global environment. Our observation data on the 137°E section over these last 50 years should be preserved for posterity as a precious asset of mankind, and I hope they will remain at the center of hydrographic observations by the Japan Meteorology Agency in future. ■

1) See "Oceanographic and Marine Meteorological Observations by Research Vessels" in "Oceanographic Observation" on the Japan Meteorology Agency website (http://www.data.jma.go.jp/gmd/kaiyou/db/vessel_obs/data-report/html/ship/ship_e.php)
2) Currently goes as far as 3°N.
3) Subtropical Mode Water: Distributed broadly and thickly in the surface of the Northwest Pacific Ocean south of Japan, it transports heat, carbon dioxide and others from the ocean surface to the interior ("mode" is a term used in statistics to signify the value that appears most often in a set of data).
4) See http://www.data.jma.go.jp/gmd/kaiyou/shindan/index_obs.html
5) See http://www.jamstec.go.jp/J-ARGO/overview/overview_1.html

The Antarctic Ross Sea to become the World's Largest Marine Protected Area — Its True Meaning

[KEYWORDS] marine ecosystems / Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) / fishing ban

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(Ocean Newsletter No.403, 20 May 2017)

In October 2016, parties came to an agreement on establishing the world's largest marine protected area (MPA) in the Antarctic Ross Sea. While an MPA gives an image of a permanent and total fishing ban in the area concerned, the Ross Sea MPA in reality includes the gathering of scientific data through fishing, management and research monitoring plans following the establishment of the MPA, and periodic review of effectiveness and needs of the MPA.
It remains to be seen whether the Ross Sea MPA will be able to achieve the management required for the objectives of an MPA in its true meaning, including the conservation of marine ecosystems and sustainable use of marine living resources based on scientific data.

At the end of October 2016, the BBC and other global media organizations reported that the world's largest marine protected area (MPA) had been established in the Ross Sea Antarctic. The decision to establish the MPA had been made on October 28th, at the close of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), of which Japan is a member. In the media reports, it was only stated that fishing had been banned for 35 years in a sea area covering 1.57 million square kilometers, that the last untouched nature left on earth would be protected, and that the (then) US Secretary of State John Kerry and the New Zealand Foreign Minister Murray McCully had praised the decision.

On the other hand, the establishment of the Ross Sea MPA was also met with a sense of alarm, particularly among fishery-related concerns; some asked why Japan had not opposed the decision.

When an MPA is being proposed, a debate is often held in the context of whether to protect fisheries or the marine environment, and this tends to produce conflict. In this article, I will explain the circumstances surrounding MPAs, with particular reference to the content of the Ross Sea MPA.

What is a marine protected area (MPA)?

When we hear about an MPA, we often tend to think of it as a sea area where fishing and other human activity is permanently banned. In fact, during the five-year negotiations on the proposed Ross Sea MPA, CCAMLR participants, including myself, received numerous appeals by email every year from members of the public and individuals connected with non-governmental organizations (NGOs), such as the following:

"Please create a legacy for humanity by agreeing at CCAMLR in 20XX to large scale, permanent, marine protected areas and no-take marine reserves in Antarctica's Ross Sea region and East Antarctica. Antarctica's waters are a remarkable home for wildlife and include some of the least impacted parts of the world's oceans. We're relying on our leaders to show leadership to protect our oceans for future generations."

The goals of establishing MPAs have been agreed at meetings of various international bodies. For example, the World Summit on Sustainable Development (WSSD), held in Johannesburg in 2002, ruled that a representative network of MPAs would be established by 2012 (for example, in cases where the migratory routes of protected species are covered by more than one MPA, though no definition has been agreed). Again, the 10th Conference of Parties to the Convention on Biological Diversity (CBD), held in Nagoya in 2010, set the target of protecting 10% of coastal and marine areas by 2020, particularly when they are of great importance for biodiversity and ecosystem services.

The image produced by all this is that an MPA means that fishing is permanently banned over an extensive area in order to protect ocean environments and marine ecosystems, with numerical targets like 2020 and 10% of sea areas being set.

But how do the various international bodies feel about MPAs, and how do they define them?

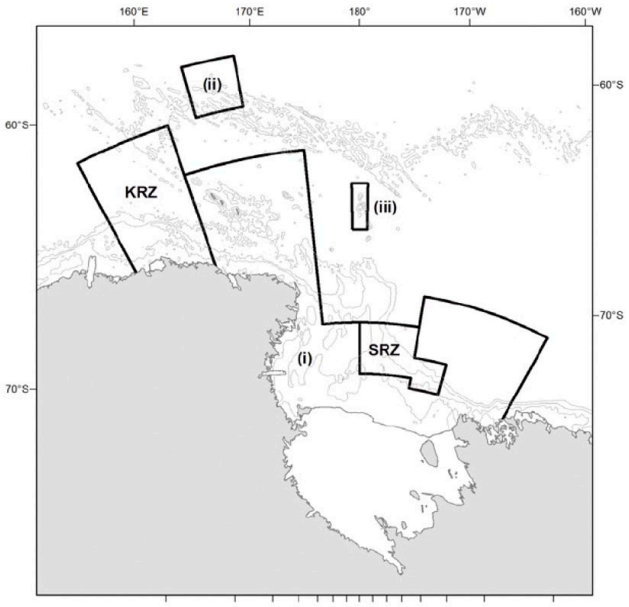
The International Union for Conservation of Nature (IUCN), famous for its red list of endangered species, defined an MPA as follows in 1994: "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." Meanwhile, the 7th Conference of Parties to the Convention on Biological Diversity (CBD) in 2004 agreed on the definition, "any defined area within or adjacent to the marine environment, together with its overlying waters and associated flora, fauna and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings."

Although these are complicated descriptions, what should be stressed here is that neither of these makes any mention of the concept of a total fishing ban; they focus instead on flexibility in the degree of protection, as implied by the expression "a higher level of protection than its surroundings." This interpretation is supported by the categorization of MPAs by IUCN. According to this, diverse formats including the use of resources are recognized within the scope of MPA categories, from strict nature reserves managed for science or wilderness protection, to national parks and other protected areas managed for ecosystem protection and recreation, and managed resource protected areas for sustainable use of natural resources.

The Ross Sea MPA

So what about the Ross Sea MPA, whose establishment has now been agreed? As shown on the map below, the Ross Sea MPA involves a complex combination of sea areas with different objectives and different functions; it is not simply a case of applying a fishing ban over a wide sea area. The various boundary lines are based on scientific data, corresponding for example to the seabed ecosystem that needs protecting. In the Special Research Zone (SRZ), fishing of toothfish (such as Patagonian toothfish) and krill is permitted, and scientific data are gathered through those fishing operations. In the Krill Research Zone (KRZ), again, the aim is to gather data from fishing operations. And while fishing is banned in the general prohibition areas (marked (i), (ii) and (iii) on the map), marine ecosystems, etc., that need to be protected from fishing are clearly designated. As a measure to compensate for the fishing ban, moreover, new fishing grounds outside the MPA were made available for use.

■Sea areas established as marine protected areas in the Ross Sea, Antarctica.



SRZ is the Special Research Zone, KRZ is the Krill Research Zone, and (i)-(iii) are general prohibition areas.

Although the establishment of an MPA tends to be seen as a goal in itself, based on numerical targets, etc., a true MPA is just the start of an effort to conserve and manage marine ecosystems.

Management plans and research monitoring plans are prescribed under the MPA established for the Ross Sea. Activities in the MPA and the effects of the MPA will be reviewed by the CCAMLR Scientific Committee every five years, while the content of the MPA will be reviewed and revised if necessary by the CCAMLR Annual Meeting every ten years. Finally, the MPA protection is set to expire in 35 years.

These details are hard to glean from media reports that focus only on the fishing ban and other matters mentioned at the top of this article.

What is the aim of a true MPA?

CCAMLR has taken five years to create the Ross Sea MPA for conserving marine ecosystems and managing their use, based on scientific data. The practice of establishing no fishing zones or no fishing seasons, whereby fishing is banned within a specific area or period of time, has long been the custom in Japanese fishery management. These are also MPAs. A big difference between the MPAs subject to international debate in recent years and Japan's fishery management is that the former are not only aimed at conserving and managing a single fish species, but aim for conservation and management of whole marine ecosystems. It is the so-called ecosystem approach.

Unfortunately, amid the international dialogue involving MPAs, there have also been cases of "paper MPAs," in which establishing the MPA itself is the objective and no subsequent follow-up is made in terms of management or research. The true meaning and validity of an MPA lies in whether the management and its effects are appropriately monitored after establishment, and whether the MPA itself is revised as and when necessary. This is an approach based on adaptive management, in which the existence of scientific uncertainty in marine ecosystems is accepted as a premise and this uncertainty is addressed through monitoring.

Whether the Ross Sea MPA will be a paper MPA or will function as an effective means of promoting the conservation of marine ecosystems and management of their use will depend on how the MPA is operated from now on. Its "legacy" has only just begun. ■

Exploring Oceans and Life in the Solar System

[KEYWORDS] Saturn's moon Enceladus / underground ocean / hydrothermal environment

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(Ocean Newsletter No. 406, 5 July 2017)

According to recent studies, it has become apparent that several objects in the solar system have, or used to have, liquid oceans. In recent years, such extraterrestrial liquid oceans have been subjected to sampling and analysis, ushering in a new era of exploring oceans and life in outer space. Here, I will focus on Saturn's moon Enceladus and introduce current discussions regarding probes for underground seas and the possibility of life.

In search of oceans – the cradle of life

"On the islands, lights are lit; the ocean in spring" – Masaoka Shiki

For some reason, we feel a sense of tranquility and nostalgia whenever we see a view of a calm sea. Perhaps the sight of the sea somehow conjures up images of our collective home. For even after 4.6 billion years of the earth's history, the sea could still be called our original home. Because the sea is the very place where our earliest ancestors were first born as living organisms on our primeval planet.

The oceans were the stage where terrestrial life evolved; they were a cradle for a mother who nurtures herself. But this life-nurturing ocean is not something that could only exist on this earth. Ever since exploration of the solar system started in the 20th century, mankind has been searching for seas, or in other words liquid water, on extraterrestrial bodies. The result of this search has revealed that liquid water once existed extensively over the surface of Mars as it does on the earth, and that some of the moons orbiting Jupiter and Saturn have vast oceans under their surfaces. In recent years, probes have collected extraterrestrial seawater or at least accessed places where water once existed there, making it possible to discuss not only the presence or absence of oceans but also their environments and even the possibility of life. A new era of exploring oceans in outer space has indeed arrived.

Saturn's moon Enceladus

In the outer solar system beyond Jupiter and far from earth, we enter a world of extreme cold in which ice plays the leading role and water on the surfaces of solid extraterrestrial bodies is completely frozen. On the surfaces of satellites called "icy moons" that orbit Jupiter and Saturn, not only water but also carbon dioxide and other volatile elements are solidified and exist in frozen form.

One of Saturn's icy moons is Enceladus, a medium-sized body with a diameter of around 500km. Its surface temperature is about minus 200°C, and there can be no hope of oceans existing there. If we look closely at that surface, however, we realize that it has very few of the impact craters that are frequently seen on Saturn's other moons.

The relatively low presence of impact craters means that the surface is being actively renewed. The craters that do form are filled by fluids erupting from below the ice crust and the geological activity of ice flow. This kind of surface renewal also takes place actively on earth, and clearly reveals that Enceladus is a geologically "living" body.

The existence of this geological activity means that some kind of heat is being generated inside Enceladus. Conceivable heat sources are the decay heat of radionuclides contained in rock, and tidal heating due to the gravitational pull between Enceladus and Saturn. Tidal heating is frictional heat arising from the deformation of Enceladus, as its orbit around Saturn is slightly elliptical.

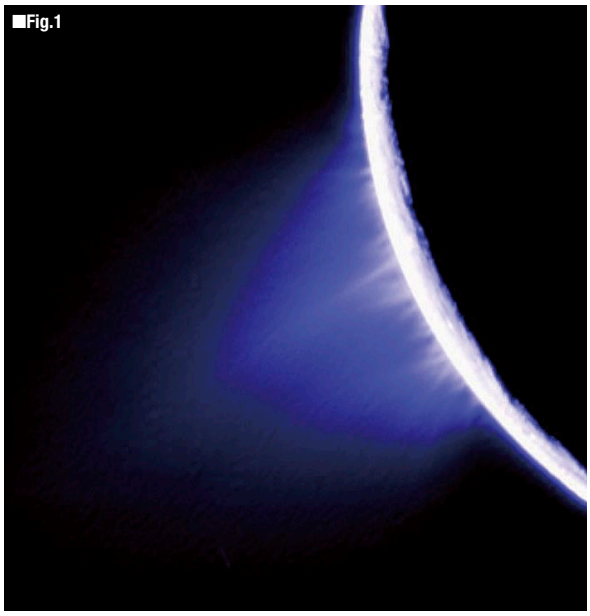
On earth, surface oceans are maintained by solar energy. But on icy moons like Enceladus, the interior is heated by tidal energy arising from the gravitational pull of other bodies. Considering this tidal heating and decay heat of radioactive elements, it is conceivable that an underground sea of melted ice could exist under the ice of Enceladus.

Sampling extraterrestrial liquid oceans and the search for life

When it started exploring Saturn in 2004, the Cassini probe had the task of finding an underground sea on Enceladus and identifying its environment, using methods based on geodesy, geophysics and geochemistry.

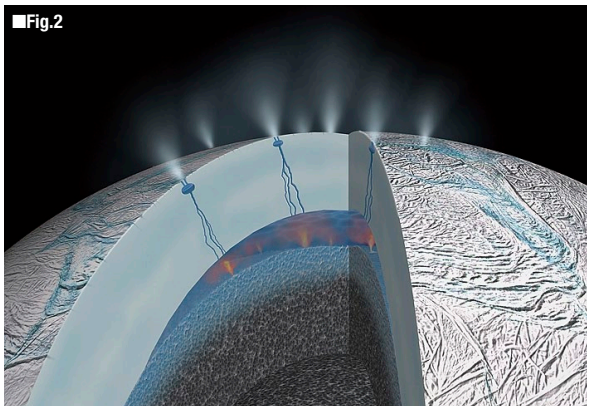
First, detailed gravity measurements revealed the existence of a vast underground sea with a depth of more than 50km lying 30km beneath the surface of Enceladus. Seawater was also found to be erupting from underground through fissures in the surface near the south pole (Fig.1). The probe collected some of the erupted seawater during its flyby of Enceladus, and analyzed it on the spot. As well as water, the ejecta included carbon dioxide, ammonia, diverse organic matter, silicates and carbonates, among others. From the composition of the seawater, its pH was estimated to be around 9. It also included an abundance of sodium salt, like the earth's oceans. This shows that the sodium contained in rock had leached into seawater, or in other words that the

■Fig.1



Scene of seawater plumes erupting into the space from near the south pole of Enceladus. (Image source NASA/JPL)

■Fig.2



An imaginary view inside Enceladus. A liquid ocean exists around a core of rock, with a localized hydrothermal environment in excess of 90°C near the south pole. (Image source NASA/JPL)

underground sea was in contact with rock at the sea bottom (Fig.2).

So does the ocean of Enceladus also have an environment that could nurture life? Without a source of energy that could be used, life could not sustain its activity, even if there were water and organic matter. Most forms of terrestrial life depend on solar energy for their activity, either directly or indirectly, but sunlight does not reach the underground ocean on Enceladus.

Even on earth, however, there are places that are teeming with life on deep sea beds where no sunlight can reach. These are seafloor hydrothermal vents existing in volcanic regions. There, reducing agents like hydrogen are generated through contact between hot water and rock, and primitive microbes obtain energy through the reaction between these agents and the surrounding oxidants. In that case, could an environment like the hydrothermal vents on earth also exist on Enceladus?

In 2015, a discovery was made to answer this question. Specifically, the erupted seawater was found to contain nanometer-sized silica particles called “nanosilica.” In hydrothermal environments on earth, rock components are known to leach due to a reaction between rock and water at high temperatures; nanosilica form when this cools rapidly. My own research group conducted a high-pressure hydrothermal experiment simulating the underground sea of Enceladus, and clarified that a hydrothermal environment of at least 90°C would be required for nanosilica to be generated. In other words, the presence of nanosilica was incontrovertible proof that there is a hydrothermal environment inside Enceladus that could nurture life. If there is a hydrothermal environment of 90° or more, it must be possible for life-sustaining hydrogen to be generated from rock. In 2017, in fact, it was confirmed that large quantities of hydrogen erupt together with the erupted seawater. This proved that Enceladus is an extraterrestrial body where primitive microbes could theoretically survive.

Planetary probe research based on terrestrial oceanography and life sciences

The discovery of extraterrestrial life, not only on Enceladus but also elsewhere including Mars, is becoming a realistic target for next-generation probes. Is chemical evolution progressing toward life on Enceladus? How stable is the ocean, and what sort of ecosystems could be formed? The answers to these questions cannot be found without knowledge of terrestrial oceanography and biosphere sciences. Objects in the solar system that have oceans, precious entities for discovering extraterrestrial life and even exploring the universality of terrestrial life, could be seen as a rich unbreached frontier for marine sciences and terrestrial life sciences alike. ■

Review: 10 Years Since the Establishment of the Basic Act on Ocean Policy

[KEYWORDS] ocean governance / Study Group on the Basic Act on Ocean Policy / Advisory Committee

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Ocean Newsletter No. 407 (20 July 2017)

It has been 10 years since the establishment of the Basic Act on Ocean Policy. The Basic Plan on Ocean Policy, which works in accordance with this law, is in the process of its 3rd revision, following the 1st and 2nd revisions.While there have been efforts to implement both top-down and bottom-up policies focusing on governance, building up the system has not necessarily led to the results that were expected, and many issues still remain.The second revision presented a good specific plan, but in implementation faced many issues that remained unsolved. The third revision must ensure a plan that will be accurately implemented by each of the relevant ministries and agencies.

When drawing up Japan's ocean policy, "governance" is important. The Basic Act on Ocean Policy became law in April 2007 and took effect on July 20 ("Marine Day") that year. On the same day, the Headquarters for Ocean Policy came into being. An honest appraisal of these ten years, however, is that the Act hasn't really functioned as we originally hoped, even if its form is complete. Comparing it to a climb up Mount Fuji, we are still only at about the third stage (out of ten).

Looking back at the process behind the establishment of the Basic Act on Ocean Policy, there were originally three main streams. The first was the ratification of the United Nations Convention on the Law of the Sea by Japan in 1996. Based on this Convention, policy issues concerning Japan's sea areas surfaced, such as management of the Exclusive Economic Zone and the continental shelf. The second was that concern started to widen from the aspect of maritime security. From around 2000, problems such as the presence of Chinese ocean research ships in the East China Sea started to emerge. And the third concerns the efforts of the Nippon Foundation and the Ocean Policy Research Foundation (as it was then known). They are significantly concerned with the oceans, and have advocated the need for Japan to have a comprehensive ocean policy. When these three streams combined to form a single flow, it led to the establishment of the cross-party Study Group on the Basic Act on Ocean Policy in April 2006.

Cross-party formulation of the Basic Act on Ocean Policy

A characteristic of the Study Group on the Basic Act on Ocean Policy was that its members included private-sector ocean experts as well as Diet members, and moreover that they played an important role in it. Besides these, various government agencies connected with the oceans were involved as observers. This enabled the Study Group on the Basic Act on Ocean Policy to take the initiative in

Scene at the press conference after the 10th meeting of the Study Group on the Basic Act on Ocean Policy (December 7, 2006), when the "Guideline for Ocean Policy" and the "Outline Bill for the Basic Act on Ocean Policy" were drawn up.

Scene at the Strategic Study Group on the Basic Act on Ocean Policy (successor to the Study Group on the Basic Act on Ocean Policy)

enacting the bill as a very strong driving force. I happened to serve as Lead Facilitator, with Shigeru Ishiba as Chairman and a number of cross-party lawmakers as members. These included Seiji Maehara, Akihisa Nagashima and Koji Hosono of the Democratic Party of Japan (as it was then known), and Hiroshi Takano and Yoshinori Ohguchi of Komeito.

As the Basic Act on Ocean Policy was also supported by the Communist Party, it resulted in an unusual bill that enjoyed cross-party support in various senses. It was my

idea to make it a cross-party effort, the reason being that ocean-related problems are a matter of huge concern for the nation as a whole, transcending specific interests, and I believed it would be a mistake to approach them in a partisan fashion.

Until then, problems of the oceans were finely divided amongst the various government agencies, each tackling them from its own particular standpoint. Because there was no framework for these agencies to collaborate with each other in setting objectives strategically and to cooperate in promoting policies, we focused on a framework that would enable agencies connected with the oceans to collaborate when creating the Basic Act on Ocean Policy.

Strong leadership is vital when proposing, formulating and implementing policies that involve several government bodies. We therefore created a system that would enable leadership to be demonstrated, by setting up the Headquarters for Ocean Policy inside the Cabinet and making maximum use of the Prime Minister's authority. Besides this, the Secretariat set up inside the Cabinet Secretariat was staffed with personnel from each agency, enabling their respective views to be coordinated.

However, new policies cannot be produced simply by adjusting proposals made by different agencies ("bottom-up"). I therefore had the idea of creating a system whereby new policies could be formed top-down. We then set up an Advisory Committee consisting of experts in the Headquarters, and created a framework in which their wisdom about the oceans could be gathered and their views directly recommended to the Prime Minister. This combining of both top-down and bottom-up policies and implementing them collectively under the leadership of the Headquarters was the rationale of the Basic Act on Ocean Policy's approach to "governance." Under the Basic Act, the 1st revision (decided by the Cabinet in March 2008) and 2nd revision (ditto, April 2013) of the Basic Plan on Ocean Policy were drawn up, and this year is exactly ten years since it all began.

Revival of the Advisory Committee

Though playing an important role, the Advisory Committee was not functioning adequately in the 1st revision of the Basic Plan on Ocean Policy.

I myself had been away from ocean issues for a while, as I had lost my seat in the Upper House in the election of 2007, when the Basic Act on Ocean Policy passed into law. When I again became involved at a later date, I was astonished at what I saw. The Advisory Committee was not functioning, and no advisors had been appointed. Since the DPJ was in power at the time, I informed Seiji Maehara, who had been one of our group when the Basic Act on Ocean Policy was established and now served as Minister for Ocean Policy, that the framework of the Basic Act on Ocean Policy we had created together was not functioning. He then re-appointed advisors. This again made me strongly aware of the merits of creating the Basic Act on Ocean Policy as a cross-party exercise. But luckily, we were able to save the Advisory Committee from going defunct.

We made it possible to establish a PT for discussing specific policies in the Advisory Committee, and with Chairman Hiroshi Komiyama and Advisor Tetsuo Yuhara playing central roles in the 2nd revision of the Basic Plan on Ocean Policy, we succeeded in systematically incorporating the recommendations of the Advisory Committee. However, even if specific policies were created top-down, it could not be guaranteed that each agency would necessarily implement them. In fact, even though the 2nd revision of the Basic Plan on Ocean Policy was an excellent revision with a very detailed content, problems remained in that much of it was not implemented.

What should be the political driving force?

The third revision of the Basic Plan on Ocean Policy, to be drawn up from now, must be a plan that is capable of being implemented, and will definitely be implemented, by the various agencies. This is what we have learned from the previous two experiences.

What is needed to unite the agencies is a political driving force. The three main streams mentioned above provided the driving force when the Basic Act on Ocean Policy came into law. After that, however, that force had weakened and the Advisory Committee had effectively ceased to exist. When I revived it and tried to create a new driving force, I hoped we could make the development of legislation related to the Exclusive Economic Zone (EEZ) the central issue, and unite the agencies around this. There are various problems connected with the EEZ, including problems of diplomacy, coordination of existing and new industries, environmental protection and sustainable development; how to develop legislation that would overcome these was an important issue. As well as the PT in the Advisory Committee, a Working Group on preparing legislation has also been set up in the Liberal Democratic Party and is proceeding with discussions, but no cross-party consensus has yet been reached on presenting a Bill.

Issues for the third revision of the Basic Plan on Ocean Policy

Nurturing marine industries has been an urgent task ever since the Basic Act on Ocean Policy was established. In

spite of that, however, hardly anything has been achieved and no progress has been made in collaboration between government agencies. Our efforts to develop ocean bed resources and cultivate domestic industries need to be properly linked together.

In the 2nd revision of the Basic Plan on Ocean Policy, we launched the Strategic Innovation Promotion Program (SIP) for nurturing ocean survey industries involved in ocean bed mineral resources. Here too, strong leadership was required in connection with nurturing industries. I felt strongly that the oceans are a really difficult area in which someone always needs to take a firm grip and ensure collaboration among government agencies.

In the third revision of the Basic Plan on Ocean Policy, important issues will include the development of ocean bed mineral resources, maritime security, the development, use and conservation of the EEZ, and the cultivation of marine industries. ■

Hopes for Science and Technology Innovation Aimed at Achieving SDGs

[KEYWORDS] science and technology diplomacy / SDGs / blue innovation

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Ocean Newsletter No. 407 (20 July 2017)

Across the world, there have been increased efforts to achieve the Sustainable Development Goals (SDGs) through science and technology innovation. With science and technology innovation known as Japan's strengths, expectations for such innovation are high within the international community. Now Japan, as an "ocean state," needs to work together with the world through science and technology diplomacy in order to create a sustainable system that can link the earth to the future. At the same time, there is also an urgent need to create an ecosystem that reflects the science and technology innovation of our nation, especially as a nation surrounded by the ocean, which determines the future of our planet's health.

STI for SDGs

Efforts to achieve the 17 goals in the "Sustainable Development Agenda" (SDGs) are now taking firm shape through concerted action between developed and developing nations, with activities led by the United Nations now spreading on a global scale. These efforts adopt an approach that differs from the previous Millennium Development Goals. In particular, science and technology innovation is being highlighted as an important solution connected with nearly all of the 17 goals.

As if to underline this, the 2nd "STI Forum" promoting science and technology innovation with the aim of achieving the SDGs was hosted by the Economic and Social Council at the United Nations Headquarters in May of this year. Japan, as the object of constant global expectations in terms of science and technology, sees this Forum as an opportunity to fully demonstrate her stance of helping to achieve the global SDGs through science and technology innovation. This year, we broadly introduced our record in science and technology cooperation to date, as well as initiatives on issues common to mankind, including problems of the global environment, infectious diseases and public health. The message of achieving the SDGs by using science and technology innovation, one of Japan's strengths, was met with considerable praise even from the participating nations. As well as SDG diplomacy, this highly significant first step could truly be seen as one of the fruits of Japan's science and technology diplomacy.

Panel discussion at UN Headquarters

"Science and technology diplomacy" means aiming to solve global issues by linking science and technology with diplomacy, which are two quite different worlds. In 2015, the Ministry of Foreign Affairs set up the post of Science and Technology Advisor to Foreign Minister Fumio Kishida, appointing Teruo Kishi (Emeritus Professor of the University of Tokyo) as the inaugural Advisor. To support him, an Advisory Board for the Promotion of Science and Technology Diplomacy, consisting of 17 experts, was also set up. As well as supporting Science and Technology Advisor Kishi, the purpose of this Board is to promote Japan's science and technology diplomacy and to select and discuss important diplomacy issues such as the Arctic and other oceans, in addition to SDGs. For example, SDG No.14 (conservation and sustainable development of the oceans) is a truly representative theme concerning a global issue. However, there is still much that has yet to be understood scientifically, and it is regarded as essential that science and technology should be successfully linked with policy.

Toward global governance based on evidence

In terms of the contribution to the SDGs through science and technology, one aspect that is subject to particular expectation is that of establishing governance over the exploitation of the earth's limited resources. In particular, sustainable use of marine resources is an important long-term issue for the human race. Until now, humans have mainly used the land as the focus of their development, but when it comes to the oceans that cover more than 70% of the earth's surface, much is still unknown. If we expand our focus to include deep seas in addition to the overall state of the vast oceans, we could say that the vast majority of these areas remain obscure to us.

The seas form an environmental system for the whole world, and science and technology innovation concerning the oceans will be increasingly important in future, in terms not only of protecting the global environment but also of achieving sustainable economic growth. In this era of IOT and big data, moreover, gathering and analyzing data concerning the seas, together with knowledge about earth sciences, including ocean research, will be a basis for global governance in future.

Last year, Japan passed a Basic Law on the Advancement of Public and Private Sector Data Utilization, with the aim of switching to a more evidence-based administrative system. For Japan to make a positive contribution to ocean policy and the establishment of governance aimed at achieving sustainable terrestrial systems as a future global initiative, further promotion of ocean research will be essential. If Japan is to lead the world as a maritime nation, it will first be necessary to make its achievements as a leading-edge research hub known to the world on a continual basis.

Achieving the SDGs through "blue innovation"

Last year, there was an international convention on the future of the marine economy at the international Arctic Environment Research Center in the Svalbard Islands (Norway). I took part in this at the invitation of the host country, Norway. What left a particularly lasting impression on me at the convention was a young entrepreneur named Boyan Slat, who had launched an operation called "The Ocean Cleanup" at the age of 17 (established in Delft, Netherlands, in 2013). He was inspired to start the project when, traveling on a boat as a student, he noticed the excessive amounts of plastic waste drifting on the sea.

CEO Boyan Slat (photo, top) and an activity of the Ocean Cleanup fund (Source: The Ocean Cleanup.com)

The Ocean Cleanup is a system whereby plastic waste can be collected automatically just by placing nets in appropriate locations, based on finely detailed calculations of ocean currents. The nets themselves include numerous technological innovations, and this is truly a good example of problem solving based on science and technology innovation, using research on ocean currents and the latest simulations. His courageous action has received praise from all over the world; he was even invited to the White House by then President Obama, who is said to have given his endorsement. A demonstration experiment will start in the Pacific Ocean off California this year, and in future I hope for further experiments in Japan's coastal waters.

The Ocean Economy in 2030,OECD, 2016
http://www.oecd.org/environment/the-ocean-economy-in-2030-9789264251724-en.htm

Last year, the OECD published a report entitled "The Ocean Economy in 2030." This is an epochal research report in which the OECD revised its assessment of the oceans from the viewpoint of sustainable growth of the global economy; while largely neglecting the oceans in its previous projects, it now sees them as an important asset for the whole planet. The report proposes that "open innovation" be achieved in connection with the oceans as a way of developing a sustainable ocean economy. To this end, it asserts that a platform for science and technology innovation needs to be formed through international cooperation, and that data and indices need to be developed so that the ocean economy in the broad sense can be understood more accurately.

There is no doubt that achieving a "blue economy," and the "blue innovation" that will bring about its sustainable growth, will be one of the most important solutions to the SDGs. We must make haste to build a marine innovation ecosystem that will allow us to transmit as many "blue innovations" from Japan as possible. ■

Ocean Floor Topography Survey in Micronesia, and the Future View of International Cooperation in the Oceans

[KEYWORDS] Pacific Ocean island states / ocean floor survey / new international cooperation

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Ocean Newsletter No. 409 (20 Aug 2017)

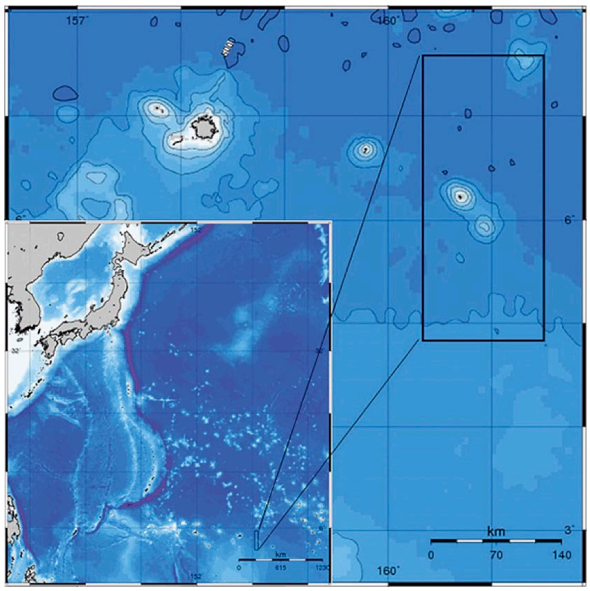
The research vessel "Kairei" of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), carried out an ocean floor survey in March 2016, focusing on the ocean area of the Federated States of Micronesia. Based on this experience, I will discuss potential forms of international cooperation with island states and others in future, through effective utilization of JAMSTEC's research vessels and facilities. I believe it will be of utmost importance to build up a relationship in which both sides can cooperate on an equal footing.

Ocean floor topography survey to the east of Pohnpei

At 9 a.m. on February 24, 2016, the JAMSTEC research vessel "Kairei" departed from Yokosuka bound for the seas east of Pohnpei in the Federated States of Micronesia, with a representative of the Micronesia National Oceanic Resource Management Authority (NORMA) on board. Blessed with good weather during the journey, the vessel arrived at the research area on March 3, and conducted surveys of bathymetry and shallow strata over a period of 48 hours using a multibeam echosounder and sub bottom profiler equipped on the vessel, and completed acquiring data as planned. On March 6, the vessel entered Pohnpei Port and ended its research cruise.

The process of implementing this cruise started some three months earlier, when a meeting was held at Geoscience Australia to discuss a plan of wide range deep seismic survey. The purpose of this was to elucidate the geological structure of the area across Lord Howe Rise off the east coast of Australia. During the stay, we received an inquiry from other department staff responsible for the West Pacific and seas around island states. Because an ocean floor topography survey was urgently needed by the Federated States of Micronesia, we were asked if the research vessel "Kairei," which would be heading to conduct deep seismic survey around Lord Howe Rise, could be utilized to carry out that survey as well.

The research vessel "Kairei" that undertook the ocean floor survey. (Photo source: JAMSTEC)



The sea area off the east of Pohnpei in the Federated States of Micronesia, where the research cruise was carried out.

After receiving this information, we had several email exchanges with the Micronesian National Oceanic Resource Management Authority (NORMA) as well as a face-to-face meeting in Pohnpei. In the course of these, we were informed that the information from this ocean floor survey was important for ongoing discussions and review by the United Nations Commission on the Limits of the Continental Shelf, but that there was not enough funding available to independently charter a research vessel and conduct the survey. Partly due to a strong support request from Geoscience Australia, we reached a conclusion, which was that the minimum requirement of four research days would be added to the Lord Howe Rise survey cruise and the cost of those days would be provided by the Federated States of Micronesia. Thus, after a short coordination period of just under three months, this research cruise was finalized and executed.

The process from proposing the plan of this survey

cruise to its implementation differed greatly from normal survey cruise using JAMSTEC research vessels, and particularly from cruises outside Japan's territorial waters, in several respects. In normal research cruises, a proposal is first submitted as a research plan using a research vessel, either independently by JAMSTEC researchers or jointly by JAMSTEC researchers and those at other institutions. The Internal Research Cruise Planning Committee in JAMSTEC conducts a rigorous review, taking JAMSTEC's budgetary situation into account, and then decides at least one year in advance whether the research cruise can go ahead or not. After this, JAMSTEC makes all the preparations for the cruise, including acquiring the survey permit.

Since these cruises are implemented with funding from the national budget (the JAMSTEC grant), the feasibility of implementing the cruise will naturally be affected by the Committee's review and the fiscal budget. By contrast, because this cruise was for research required by an organization or foreign government institution other than JAMSTEC, and was implemented at the expense of another organization or government, and moreover, because it could be implemented as an addition to an already planned research cruise, the cruise could be carried out in a relatively short time after the proposal submission.

Background and the current situation of JAMSTEC's research vessels

In recent years, international laws such as the United Nations Convention on the Law of the Sea and systems of international standards and criteria such as environmental impact assessments have been clearly recognized and widely spread through international or multilateral dialogue. In the process, the importance of objective scientific data has increased.

Under the United Nations Convention on the Law of the Sea, island states and developing coastal states are positively planning activities to apply for extensions of their continental shelf to the United Nations Commission on the Limits of the Continental Shelf. The reality is, however, that some countries, federations and regions are unable to carry out survey and obtain the scientific data (evidence, proof) necessary for this application by themselves. Similarly, they are sometimes unable to embark on environmental surveys or environmental protection in the waters around them, or on surveys or development for new resources in the ocean or on the ocean floor, owing to a lack of facilities, human resources, or technical capabilities in their own countries.

On the other hand, JAMSTEC has been reducing its research vessels and days of facility operation in connection with the recent situation of science and research budgets of the Japanese government. If this situation continues, we may arrive at a situation in which we can only maintain large facilities including research vessels but will be unable to undertake actual research activities.

The future view of international cooperation

International cooperation based on Japan-led joint research and research cruises is just as important now as it ever was. However, considering China's recent moves into oceans and international cooperation on the back of her recent national strength, there are thoughts to be limits to Japan's capacity to exert her presence on the same stage.

As seen in this case in Micronesia, however, it will be even more important in future to build cooperative relationships in which both parties are on an equal footing, in terms of gaining some kind of recompense. This can be done, for example, by efficiently providing and supporting research vessels or other large-scale facilities, scientific research technology, etc., when these are lacking in the partner country or region, for surveys or projects being independently considered by that partner country or region.

In connection with the international standards and criteria lying behind this, similarly, international cooperation will further heighten Japan's presence in the oceans. This could take the form of collaborating sincerely with island states and developing coastal states and entering partnerships with them while standardizing environmental impact assessments in marine resource development led by Japan, for example, so that they will also be more easily accepted by the partner country.

Sharing of information between the parties concerned is indispensable to building these new international cooperative relationships. From JAMSTEC, in particular, it is important to transmit information on ship track of research vessels, the state of facility use, efforts on international standards and criteria, etc. The various networks created between Japan and island states are very important as platforms for transmitting that information, and we should take steps toward international cooperation in collaboration with them. ■