

Ship & Ocean Newsletter

Selected Papers

No. **9**
March 2008

Ocean Policy Research Foundation

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 the protection of the marine environment.

Towards this end, the Ocean Policy Research Foundation (formerly: Ship & Ocean Foundation) has started an "Ocean Policy Research", with the mission statement "Living in Harmony with the Oceans".

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

We publish a Japanese-language newsletter called the "Ship & Ocean Newsletter" twice a month. The "Ship & 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 to achieve coexistence between mankind and the ocean.

Our Foundation believes that the Newsletter can expand effective communication on these issues through its function as editor, publishing timely research and welcoming responses from readers, which might then be published in turn.

"Ship & Ocean Newsletter Selected Papers No.9" contains English-language versions of papers from the Japanese Newsletter edition, published from No.131(2006.1.20) to No.150(2006.11.5).

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 issues.

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A New Energy Resource in Japan Sea: Exploration for Methane Hydrate

Ryo Matsumoto

Professor, Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo
(Ship & Ocean Newsletter No.131 January 20, 2006)

Interest in methane hydrate has been growing as part of the general trend towards energy conversion from oil to natural gas. This is because methane hydrate contains 164 times its own volume of methane gas. Japan is a world leader in the exploration of methane hydrate as a resource. Recently, we discovered a new source of methane hydrate accompanied by massive methane plumes on the floor of the Japan Sea.

Methane hydrate as an energy resource

Methane hydrate is an ice-like solid compound formed from methane gas and water. It contains large amounts of methane. For example, a 1 cubic centimeter block of methane hydrate (about the size of a sugar cube) contains 164 cubic centimeters of methane gas at one atmosphere, enough to fill a milk bottle. Methane hydrate is stable under conditions of low-temperature and high pressure, but becomes unstable and immediately dissociates at the ground surface conditions in which we live. When large concentrations of methane exist on low-temperature, high-pressure abyssal floors or in deep sea sediments, the methane changes from a gaseous to a solid state, known as methane hydrate. This is not the case in marsh, where even if marsh gas (methane) occurs it will not produce methane hydrate. Conversely, while deep sea sediments directly under the sea floor share the same low temperatures as seawater, their temperature gradually rises as the depth increases, and methane hydrate can no longer exist. In other words, the abyssal floor presents a stable zone for methane hydrate at a thickness of several tens to several hundreds of meters below the sea floor.

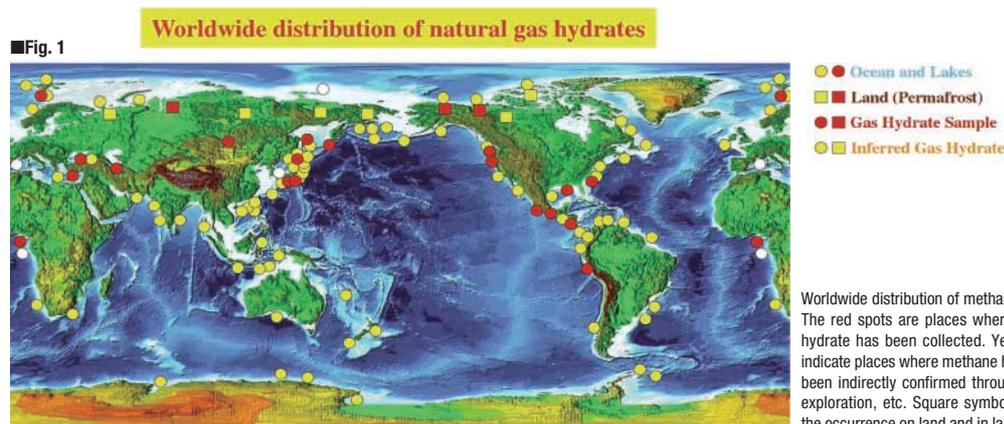
Interest in deep sea resources started to grow from around 1980. Today, thanks to advances in oceanic exploration using a variety of techniques (such as seismic reflection, deep sea drilling and submersible exploration), the existence of methane hydrate has been confirmed over a wide area in deep sea sediments (Fig. 1). However, it is generally distributed in "thin and broad" layers in which

methane hydrate occurs as interstitial cements of the sediments, and has a low level of accumulation as a resource. To convert methane hydrate to a resource, we need to find deposits where strata contains highly accumulated methane hydrate over a broad area.

As a reaction to the exhaustion of oil resources, inflation of crude oil prices and regulations on carbon dioxide emissions, we are now seeing a progressive conversion to natural gas and exploration of new resources. Methane hydrate is also gaining attention as a new energy resource, and efforts to use it as a resource have started in various countries. Japan has been a top runner in efforts to develop methane hydrate resources. A project implemented by the Agency of Natural Resources and Energy since 1995 has slowly but surely produced results; for example, it has identified the distribution of methane hydrate along the Nankai Trough to the south of Honshu Island, western Pacific. Meanwhile, relatively small-scale, university-led scientific surveys have also produced noteworthy results in the Okhotsk Sea and Japan Sea for the last few years. In this paper, I will introduce recent cases of exploration in Japan Sea.

Exploring for methane hydrate in the Sea of Japan

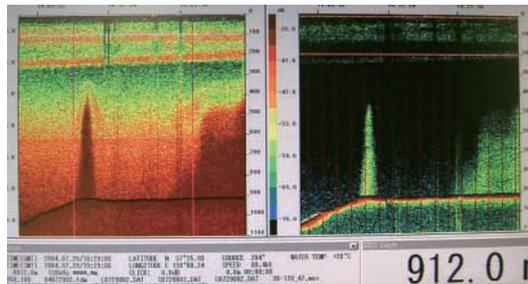
In July 2004, a research group consisting mainly of researchers from the University of Tokyo set out from Toyama Port on "Umitaka Maru", a research and training vessel of the Tokyo University of Marine Science and



Technology, heading to a small spur in the sea off Naoetsu. The primary purpose was to seek the origin of several large pockmarks that develop on top of the spur. However, we were expecting to find out the evidence that the pockmarks might originate from gas venting from the sea floor. In that case, methane hydrate could be present in the surrounding surface layer deposits. We might then succeed in discovering and retrieving sea floor methane hydrate for the first time in the seas around Japan.

Our first surprise was gigantic gas plumes rising from the sea floor at a depth of some 900m. The plumes were 500-600m in height, and rose from the sea floor to around 200-300m below the ocean surface. These gigantic plumes were confirmed in tens of locations within the survey area, which stretched 4km east-west and 5km north-south (Fig. 2). Such active gas plumes had never been found anywhere in the world, let alone in the seas around Japan islands. The phenomenon of methane seep from the sea floor means that the methane flux in sediments is very high, and is highly suggestive of the presence of methane hydrate. As such, it acts as a good yardstick for methane hydrate exploration. Methane seep can be detected by visual observation from a submersible, but since the survey range of submersibles is extremely narrow, they are not suitable to wide-area surveys of methane seep. We therefore worked with Dr. Chiharu Aoyama, an expert in fish-finding from Japan's Independent Institute Co., Ltd., and applied her technique of fishery echo-sounder to a wide-area survey of methane plume for the first time. Figure 2 shows a visualized image of a methane plume obtained in this way. Considering that methane hydrate must be produced near so many huge methane plumes, we carried out a piston coring survey, whereby we deployed pipes into the sea floor to collect deep sea sediments. As a result, it became clear that massive or tabular methane hydrate existed in large quantities in sediments at least 3m below the sea floor. Until then, the Nankai Trough had been seen as the most likely candidate area for the discovery of methane hydrate as a resource. It is therefore highly significant that sea floor methane

■Fig. 2



A methane plume from the sea floor, visualized using the fishery echo sounding method. It rises some 600m from the sea floor at a depth of 912.0m, reaching a depth of around 300m.



■Fig. 3

Methane hydrate collected from the Japan Sea floor off Naoetsu by the JAMSTEC research ship "Kaiyo" in August 2005.

hydrate, which has yet to be discovered in East Asian waters, let alone in the Nankai Trough, has now been confirmed and collected for the first time in Japan Sea.

In 2005, the research group was strengthened and expanded, and three trips were made by "Umitaka Maru", as well as "Natsushima" and "Kaiyo" belonging to the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). We carried out sea floor surveys using ROVs, long piston coring and fishery echo sounding, with simultaneous surveys of the precise topography. As a result, we found that (1) there are numerous mounds with a diameter of 200-300m and about 30m in height, (2) gas plumes rise up from various points around the summit of these, (3) pockmarks with a diameter of 500m and about 50m in depth lie immediately adjacent to the mounds, and (4) furthermore, these are more or less in linear alignment. We found that these mounds and pockmarks develop in parallel to the structural line (tectonic zone) running along the eastern edge of Japan Sea, which has started to contract along an east-west axis. Moreover, they develop on submarine ridges running in a north-south direction, in connection with this contraction of Japan Sea. Finally, we succeeded in collecting methane hydrate in such large volumes that there was not enough room in the containers we had taken with us (Fig. 3).

Marine methane hydrate has been believed to occur in sediments at depths of several tens to several hundreds of meters below sea floor. As reported this time, however, it has become clear that in Japan Sea off Naoetsu, methane hydrate is produced quite close to the sea floor over a broad areas. This kind of case is rare anywhere in the world, with only a few examples in ocean areas (such as part of the Gulf of Mexico, off Vancouver, and in the Okhotsk Sea). The goal of our research was, by investigating processes that are currently in progress, to clarify possible impact of methane hydrate on the ocean environment. From next year onwards, however, we will add exploration of potential resources of methane hydrate to our study objectives, along with expanding the scope of investigation centering on the sea off Naoetsu, mapping the distribution density of methane hydrate, and elucidating the origin of methane using isotopes. In this way, we will also study the potential of methane hydrate as an energy resource. ■

An Outbreak of Giant Jellyfish and the Sustainability of East Asian Marginal Seas

Shin'ichi Uye

Professor, Graduate School of Biosphere Science, Hiroshima University
(Ship & Ocean Newsletter No.133 February 20, 2006)

In 2005, the Japanese archipelago suffered an unprecedented outbreak of the giant jellyfish (*Nemopilema nomurai*), causing serious and ongoing damage to the fisheries industry. The phenomenon of jellyfish outbreaks has occurred frequently in recent years, and symbolizes the deterioration of marine ecosystems. To assure the sustainability of East Asian Marginal Seas, which are among the most abundant sources of fishery products in the world, it is essential that Japan, China, South Korea and other countries make concerted efforts to solve this problem.

Tsushima, July 2005

Hiroshima University has a training/research ship called "Toyoshio Maru" (324 tonnes). Towards the end of July 2005, it left the port of Kure bound for Tsushima in Nagasaki Prefecture. Early the following morning, I was awoken by a knock on my door by one of the graduate students. "Professor, you must get up," he said. "The sea is full of jellyfish." Our ship had already passed the southern tip of Tsushima Island and entered the western channel of the Tsushima Straits. The calm surface of the sea, bathed in soft morning sunlight, was dotted with countless giant jellyfish, pink in color and the size of cabbages. Seeing this sight for the first time, I felt it strangely beautiful and stood momentarily transfixed on the bow as I watched. The jellyfish passed under my feet at intervals of some tens of meters, and sometimes more than twenty individuals would appear within a square field of around 15×15 meters. Even after we had traveled for another two to three hours the number of jellyfish showed no sign of diminishing. I gradually started to feel fear, wondering what exactly this all meant.

In 2002 there had been a major outbreak of giant jellyfish. From 2003 onwards we embarked on giant jellyfish surveys in Tsushima, and received information about jellyfish being caught in the nets of local fixed-net fishermen. In the period between late July and early August 2003, several

jellyfish were caught in the nets per day, on average. From mid-July 2005 onwards, however, they numbered several tens on a light day, increasing to several hundreds on heavy days. It just didn't bear comparison. We dragged a net with an opening of 1.4 meters from our ship, and estimated the density of giant jellyfish in the seas around Tsushima to be 2.5 individuals per thousand cubic meters. Readings on a fishfinder and current meter showed that the jellyfish were distributed more or less uniformly over the whole water column at a depth of 65 meters, and were drifting towards the Sea of Japan. The daily jellyfish transportation volume, calculated by multiplying the density by the flow of the Tsushima Current, was actually 300-500 million.

November 2005

This unprecedented outbreak of the giant jellyfish caused serious damage, mainly to net fisheries, in every area affected by the Tsushima Current. Also, the 2005 outbreak introduced at least three new phenomena that had not previously been seen: (1) The appearance of jellyfish around Tsushima started half a month to one month earlier than before. (2) Some of the jellyfish passed the southern edge of Kyushu, entered areas on the inside of the Kuroshio Current and were transported off Shikoku and Tokai District (jellyfish that entered the Bungo and Kii Channels penetrated as far as the interior of the Seto Inland Sea). (3) Jellyfish that flowed north along the west coast of Hokkaido passed Cape Soya, and some were transported through the Okhotsk Sea almost as far as Shiretoko Peninsula. As a result, the extent and degree of damage to fisheries expanded, until nearly the whole of the Japanese archipelago was surrounded by the giant jellyfish.

The average body weight of the jellyfish was around 3kg in late July, but by November this had reached around 100kg. Some individuals weighed easily more than 200kg, making them some of the biggest jellyfish in the world. Every day thousands of these jellyfish would become caught in fixed nets, blocking the mesh. Unable to withstand the pressure, the nets would break. Fishermen faced significant hardships as they had to repeat the work of removing jellyfish several times a day, merely in order to



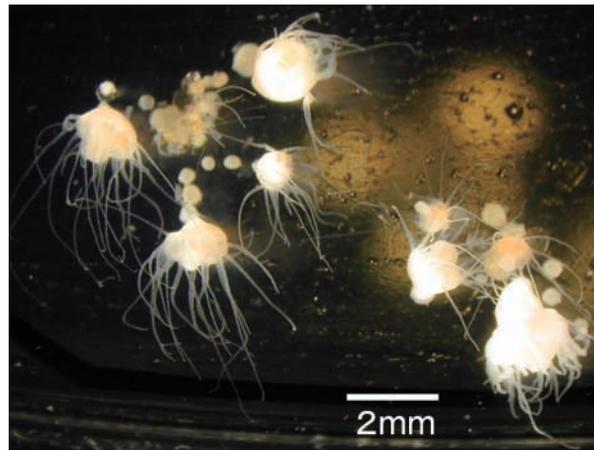
Survey in progress on the training ship "Toyoshio Maru"

protect their nets. Giant jellyfish only live for a year, at most. They will gradually become less active as water temperatures fall during the autumn and winter seasons, and will eventually die out. Nevertheless, since water temperatures are expected to be higher this winter, jellyfish damage will definitely continue until February.

Fears for normalization of outbreaks

The original breeding grounds of the giant jellyfish are the Bohai Sea, the Yellow Sea and the northern part of the East China Sea, an area surrounded by the Korean Peninsula and the Chinese mainland. The polyps from which jellyfish grow are anchored to the floor of these seas. Rising water temperatures at the beginning of summer stimulate the release of immature jellyfish from these polyps every year. These jellyfish rise on the Tsushima Current and swarm towards Japan. In the past, the giant jellyfish used only to appear at a frequency of once in several decades. Since 2000, however, major outbreaks have occurred nearly every year. Without doubt, this is caused by changes in the coastal marine environment due to development activity in China, among other factors. In fact, there are also precedents in Japan. There was a sudden increase in the moon jelly *Aurelia aurelia* in Tokyo Bay in the 1960s. The reasons included progressive coastal exploration and eutrophication inside the Bay at that time. From the 1990s onwards, when problems like global warming and the depletion of fishery resources became particularly conspicuous, there was an abnormal increase in *A. aurelia* in the Seto Inland Sea. Considering the current situation in China, where the full-scale operation of the Three Gorges Dam and development plans are being implemented simultaneously, rapid environmental improvement to coastal sea areas can hardly be expected. Therefore, outbreaks of the giant jellyfish are likely to continue for some time.

Giant jellyfish reach maturity in October. Normally, mature jellyfish would be expected to scatter fertilized ova in Japanese waters. Fortunately, there has been no evidence yet that polyps have settled around the coasts of Japan. Nevertheless, considering the repeated nature of the outbreaks, the expansion of the distribution range into the Pacific Ocean side of Japan for the first time, and other factors, the possibility that polyps will become established on Japanese coasts has now become extremely high. If larval or juvenile giant jellyfish should be discovered in the early summer of 2006, it would prove that this species has become established in Japanese coastal areas. When that happens, the normalization of outbreaks of the giant jellyfish originating in Japan will be inevitable.



Polyps and podocysts of giant jellyfish

The sustainability of East Asian Marginal Seas

The East Asian Marginal Seas, surrounded by China, the Korean Peninsula, the Japanese archipelago, etc., have the highest fisheries productivity in the world. Within marine ecosystems, jellyfish compete with many species of fish for zooplankton on which to feed. Until now, however, the two have maintained a suitable balance. In recent years however I think this has been lost due to human activity. Environmental changes and indiscriminate fishing activity in Chinese coastal areas in particular have caused a decline in fishery resources, and I believe that the giant jellyfish have increased as a result. Although some jellyfish species are used for human consumption, they could never surpass fish, with their high protein content, as bioresources. An overabundance of fish would signify seas that are rich for human beings; but seas swarming with jellyfish are symbolic of the decline of marine ecosystems.

How can we feed the growing populations of East Asia? Since the limitations of food production are becoming clear both on land and in the oceans, this problem will soon become a reality. As long as our oceans are properly managed, they will continue to bestow the blessings of their abundant produce forever. We must take steps to recreate healthy marine ecosystems in which the giant jellyfish do not increase, and aim for environmental and fishery catch management with a view to sustaining rich fishery production. To assure the sustainability of the East Asian Marginal Seas, it is essential that Japan, China, South Korea, and other concerned parties make concerted efforts to solve the jellyfish problem. ■

The International Pacific Research Center: A Japan-United States Collaboration for Climate Research

Julian P. McCreary, Jr.

Director, International Pacific Research Center

(Ship & Ocean Newsletter No.134 March 5, 2006)

In October 1997 the International Pacific Research Center (IPRC) was established. The Center's mission is "to provide an international, state-of-the-art research environment to improve understanding of the nature and predictability of climate variability in the Asia-Pacific sector, including regional aspects of global environmental change." Since its inception, the IPRC has grown into an internationally recognized center for climate research. The research staff is truly international in scope, with scientists from 10 different countries.

History and mission

The world's atmosphere and oceans know no national boundaries, making the effects of climate change a matter of international concern. At a meeting in Spring 1997, Japanese Prime Minister Hashimoto and U.S. Vice President Gore recognized that challenges facing humanity from global warming would benefit from a long-term collaboration between Japan and the United States and added the category of global-climate-change research to the "Japan-United States Common Agenda for Cooperation in Global Perspective." This governmental directive became a reality in October 1997 with the establishment of the International Pacific Research Center (IPRC) at the School of Ocean and Earth Science and Technology on the Manoa Campus of the University of Hawaii (UH) in Honolulu. The Center's mission is "to provide an international, state-of-the-art research environment to improve understanding of the nature and predictability of climate variability in the Asia-Pacific sector, including regional aspects of global environmental change."

Staff

Since its 1997 inception, the IPRC has grown into an internationally recognized center for climate research. Today, the IPRC has a staff of 39 scientists in the fields of oceanography and meteorology, consisting of 9 UH faculty, 17 non-faculty researchers, and 13 postdoctoral fel-

lows; there are also 8 computer system engineers and programmers. The research staff is truly international in scope, with scientists from 10 different countries. In particular, the IPRC members currently include 3 researchers, 4 postdoctoral fellows, and 3 graduate students from Japan. Additionally, 7 Japanese scientists, after several years of research at the IPRC, have returned to Japan, 4 taking faculty positions and 3 taking research positions at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and The University of Tokyo. In the next two years, the IPRC plans to expand its research staff from Japan by several new members.

Research

IPRC research is organized into 4 broad themes with the following goals: to understand climate variations in the Pacific and Indian Oceans (Theme 1); to determine the influences on Asia-Pacific climate of western-boundary currents, the Kuroshio/Oyashio Extension system, marginal seas, and the Indonesian Throughflow (Theme 2); to understand the processes responsible for climatic variability and predictability of the Asia-Australian Monsoon System and its hydrological cycle (Theme 3); and to identify the relationships between global environmental change and Asian-Pacific climate (Theme 4).

IPRC scientists have made significant advances in each of its themes. For example, the well-known El Niño phe-

nomenon and the Asian-Australian monsoon are prominent research areas in all IPRC research themes. Among other things, IPRC scientists have investigated the processes that cause rainy and dry spells during the summer monsoon, and this increased understanding will help to predict them one month in advance; described mechanisms that explain the decreased Asian monsoon rainfall in summers following an El Niño; and studied changes in ocean currents that may cause variability in El Niño on decadal time scales, a necessary step in improving the prediction of El Niño events. They also developed a tropical



"Symposium" Participants of the 2005 Annual IPRC Symposium gather in the Japanese Garden of the East-West Center, University of Hawaii in Honolulu.

cyclone model, and are studying the effects of global warming on the frequency and tracks of tropical cyclones in Asia-Pacific.

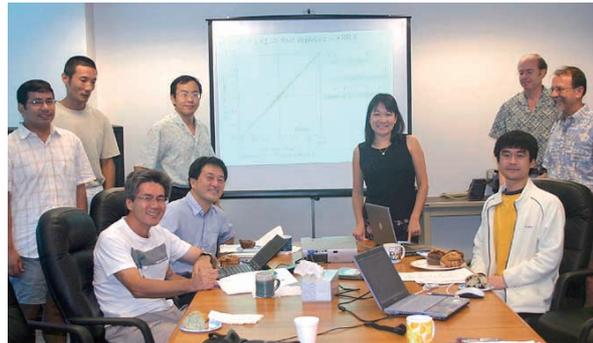
The importance of conditions in the Indian Ocean on climate in remote regions has recently been recognized, most notably by scientists at the Climate Variations Research Program within the Frontier Research Center for Global Change (FRCGC). IPRC scientists have contributed actively to this new area of climate research, one that holds much promise for improved prediction of climate variability in Asia and elsewhere. Moreover, satellite observations, especially those by cloud-penetrating microwave sensors, are revolutionizing our view of climate over the vast oceans. IPRC researchers have made a number of significant discoveries from these new satellite data, including that of the Kuroshio's influence on regional climate around Japan.

Finally, an area of direct collaboration between IPRC and scientists in Japan is analyses by IPRC researchers of output from atmospheric (AFES) and ocean (OFES) circulation models that are being run on Japan's supercomputer, the Earth Simulator. This joint effort has already uncovered valuable information. For example, analyses of OFES output, together with analyses of satellite images, has revealed the presence of a remarkable system of east-west currents in many regions of the world ocean, suggesting the existence of a previously unknown class of oceanic motions.

A final IPRC Theme is focused on developing the computational and data-management infrastructure necessary to make climate data readily accessible and usable by both the research community and the general public (Theme 5). To achieve this goal, the IPRC established the Asia-Pacific Data-Research Center (APDRC). In addition to data-management activities, APDRC scientists are developing data products that directly benefit society. For example, they are developing a regional, coupled ocean-atmosphere model that can be easily applied to any geographical location. Output from the model is expected to have a variety of societal applications, such as public safety (e.g., search and rescue operations), coastal-ocean management (e.g., coral reef protection), hazard assessment (e.g., accidental oil spills), and the economy (e.g., fisheries).

Funding

Financial support for the IPRC was originally provided almost entirely by Japan and the University of Hawaii. Soon after its inception, though, U.S. agencies also began to contribute to the IPRC. The current level of Japanese support is about 40% of the IPRC's total annual budget. From Japan, support for the IPRC is provided by JAMSTEC through FRCGC. From the U.S., institutional sup-



"Argo" The IPRC is collaborating with the Japan Agency for Marine-Earth Science (JAMSTEC) and Technology and the Australian Commonwealth Scientific and Research Organization on developing the Pacific Argo Regional Center (PARC), which will be responsible for Argo data and products for the Pacific Region.

port is provided by the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA). IPRC researchers also acquire research funds through individual grants from U.S. agencies.

Governance

The IPRC is governed jointly by representatives from Japan and the United States. The IPRC Governing Committee consists of representatives from the funding agencies that support the IPRC, as well as other interested parties. The IPRC Scientific Advisory Committee is composed of Japanese and U.S. scientists, who are internationally recognized for their expertise on climate research relevant to the IPRC mission; the committee provides guidance on scientific issues and meets every 1-2 years at the discretion of the Governing Committee.

Closing

In closing, in a short time the IPRC has become an exciting, world-class center devoted to the study of Asia-Pacific climate. It is an ideal place for east-west scientific collaboration on the most serious world-wide challenge facing us today—understanding the causes of climate variability and change and the effects of global warming. I invite you to find out more about the IPRC and its activities at <http://iprc.soest.hawaii.edu/>.

The partnership between the two countries on the two sides of the Pacific Ocean produced the world-leading IPRC in Honolulu. It is an ideal model of cooperation rarely seen in the historical context between Japan and the US. The further development of such bilateral cooperation will contribute not only to the science but the exchange and understanding between Asian and western cultures. ■

The Time to Establish a National Ocean Food Policy is Now

Yuriko Shiraishi

Women's Forum for Fish (WFF)

(Ship & Ocean Newsletter No.138 May 5, 2006)

There is no nation on earth whose culture is so entwined with the bounty of the sea as Japan. And yet, both the fisheries industry and the fish-eating culture of Japan are now in danger of collapse. In a bid to change this situation, the Women's Forum for Fish is attempting to convey information to consumers and educate children about the oceans and fish.

The nation that we love, the oceans and fish that we cherish. Are we prepared to let them go?

Until now, we Japanese have lived with the unspoken assumption that we will always be endowed with rich sea produce and that our lives will always be entwined with that produce. In any household anywhere in Japan, marine produce always accompanies the special moments of our lives, like seasonal festivals or the exchange of betrothal gifts at weddings. Not only that, but in the elongated Japanese archipelago, northern fish are caught in the north and southern fish in the south, and even the dietary cultures are different. Fish are the very culture of Japan.

While there are a lot of countries that face the sea, no nation on earth is more blessed with marine produce and has nurtured a fish-eating diet as part of its culture more than Japan. The Japanese have made use of ocean resources for countless generations, and their wisdom has been perpetuated by fishery laws that take account of fish ecology, as well as the day-to-day skill of using a single fish without wasting anything. What is this if not the pride of a nation? But this is all now in danger of disappearing, under the broadening impact of an urban-style diet that relies all too easily on imported and processed foods. Unnoticed by the nation, a major transformation is now taking place, as illustrated by the impact of the 200 nautical mile limit, pressure on fisheries from other countries, and the disappearance of fishing grounds from coastal areas.

And today, Japan - a country with jurisdictional rights over ocean areas measuring twelve times its total land area, the 6th highest ratio in the world - has a fish self-sufficiency of just 50%. Every year, we buy marine produce to the value of nearly two trillion yen from 147 countries around the globe. 20% of the horse mackerel that we eat on a regular basis depends on imports, tuna 50%, and prawns as much as 90%. Leading fishery corporations are withdrawing from the industry, small and medium enterprises are folding, and the number of fishermen in coastal areas is declining dramatically. Half of all remaining fishermen are now aged 60 or over. We are unaware that the fish we eat are being caught for us by foreign fishermen, and children are growing up without even knowing what fish look like - this is the reality of Japan today.



The author (center) inspecting a fishing village with a group of "young reporters".

Our country's natural environment, our fisheries and food culture - all of which could be described as the soul of the Japanese - have fallen into a state of crisis without our even knowing it. There are people who realize this. But unless they raise their voices, unless everyone involved in fisheries from the oceans to the dinner table bring their wisdom together and talk about it, the precious food culture of Japan that we have inherited from our ancestors will cease to exist.

We want children to know the delicious taste of fish and the importance of fisheries.

I am involved in an activity called the "Umihiko Club", the aim of which is to teach children about our fish-eating culture. I first started this activity because I felt a sense of crisis that the Japanese people as a whole were starting to drift away from our traditional fish-eating culture without even being aware of it. That was 13 years ago. The first fruit to emerge from this sense of crisis was the Women's Forum for Fish (WFF), followed by the "Umihiko Club" for children as an extension of that. The "Umihiko Club" is a hands-on program of activities spread over the space of one year. Each time we link a primary school with a fishing village to show the children that "our lives depend on the seas". Though this is hard work for the children, the only



Children learning how to process fish with a knife

way of conveying our fish-eating culture to children is for adults to show their enthusiasm and commit their time and energy. I am literally devoting my whole life to this activity. There are always many people who help out, as well as our friends in the WFF, but it is still a challenge each time nonetheless.

Our Umihiko Club is involved in four hands-on activities throughout the year - "Talking to moms in fishing villages", "Hands-on tours", a "Children's forum" and a "Newsletter". This is a program in which children learn how to process fish themselves. They get up at 3:00 a.m. to report on fisheries in action, and learn to think for themselves. While all these experiences are profoundly significant for the children, I think what is even more important is that elementary school children act as "young reporters" to convey the reason for the existence of fisheries and fishing villages, the value of protecting the marine environment, and the importance of fish as food to society.

- The fishermen who devote their lives to catching fish from the sea seem very brave to me, and I think we need them. I again realized how important the oceans and fish are, and how beautiful and wonderful Shinminato is. -

This was written by one of our "young reporters" who attended the Umihiko Club last year.

The time to establish a national ocean food policy is now

Every country has its own unique food culture, nurtured by its own natural climate and environment. Food is not a philosophy, but represents the very existence of human

beings, the culture of a people. For that reason, all countries inevitably place greater priority on their own needs than on harmony with other countries when it comes to securing resources of food. This is eloquently illustrated by global disputes and arguments over fishing grounds both past and present. In any country, the first thing required of its government is surely to secure food. If it cannot achieve this, the regime will inevitably fall. And what is just as important as securing volume is to maintain and perpetuate the food culture that could be described as the heritage of the people, because food culture is the very wisdom by which people can continue to live.

Seen from this perspective, Japan's food policy cannot be described as anything but derisory. To make matters worse, the fisheries industry has really been treated half-heartedly by Japanese politicians and governments. Even in the Edo, Meiji, Taisho and Showa eras, it was given less prominence than agriculture as a "food industry". It was not until 2001, when more than 50 years had passed after the war, that a "Fisheries Basic Law" was at last enacted.

Fisheries are a food industry that provides the sustenance on which the life of the nation depends. They are also a regional promotion industry that protects seas in coastal areas and forms the core of fishing village culture. They should be seen as a cultural industry that nurtures Japanese minds and healthy bodies. What are we to do if the national government does not have this awareness? I think it will be no easy task to change government ways that have been built up over a long period of time. But unless we act now, Japan's fisheries and fish-eating culture will be lost. I firmly believe that the time has come to start a national dialogue on what we should do about Japan's oceans, fisheries, and dining habits, to refine "ocean food policy", and to put it into practice. ■

Co-existence of Ecosystems with Diverse and Sustainable Fisheries in Shiretoko, a World Natural Heritage Site

Yasunori Sakurai

Professor, Graduate School of Fisheries Sciences, Hokkaido University; Chairman, Shiretoko World Natural Heritage Scientific Committee Sea Area Working Group (Ship & Ocean Newsletter No.141 June 20, 2006)

To manage sea areas in the Shiretoko World Natural Heritage site, we need to scientifically investigate changes in marine and land ecosystems as affected by global climate change and human activity (including fisheries), as well as the patterns of fluctuation in the diverse living species that comprise these. We must also aim to protect ecosystems on a "landscape" level, and at the same time to stabilize and revitalize local economies.

Background to the registration of Shiretoko as a World Natural Heritage Site, and future tasks

At a meeting of the UNESCO World Heritage Committee in South Africa on July 14th, 2005, the Shiretoko Peninsula and surrounding sea areas (up to 3km offshore) were registered as a World Natural Heritage Site. This was the third area in Japan to be registered as World Natural Heritage, after Shirakami Sanchi and Yakushima. It was also the first to include sea areas in which fisheries are practiced. The reasons given for recommending Shiretoko were that it is at the southernmost extremity of seasonal sea ice in the northern hemisphere, and that there are significant reciprocal effects between marine and terrestrial ecosystems as well as an abundance of wildlife diversity, including endangered species, in both ecosystems. The sea around Shiretoko is covered alternately with seasonal warm and cold currents, and sea ice reach the coast from winter to spring. Meanwhile, from intermediate depths skirting the steeply mountainous coastal area and slopes of the continental shelf, stable low-temperature water reaches down to the deep sea region. The Nemuro Strait on the Rausu side, in particular, suddenly becomes shallow and its topography narrows from the tip of the peninsula towards the inside of the strait, creating a true "natural set net (dead end for fish)" (Fig. 1). In view of this oceanic environment, a diversity of coastal and offshore fisheries (including set net fishery, gill net fishery and longline fishery) are undertaken around the Shiretoko Peninsula as one of Japan's most prominent fishing grounds. The annual value of fish catches in Shari and Rausu in 2002 was as high as around 16.8 billion yen. However, while these catches include stable resources of salmon, arabesque greenling and kelp(kombu) on the one hand, problems such as sharply declining catches of wall-eye pollock and unstable trends in Japanese common squid

catches in Rausu have occurred since the 1990s.

All living species in marine ecosystems are impacted by global climate change and human activity, particularly fisheries. There is now an urgent need to understand changes in marine resources based on natural cycles, and to maintain the rich marine environment and ecosystems around Shiretoko while seeking fisheries that make sustainable use of resources. The International Union for the Conservation of Nature and Natural Resources (IUCN) has set Japan the task of submitting sea area management plans (by the end of 2008) to ensure the coexistence of marine ecosystem protection and sustainable fisheries in this heritage site.

Independently-managed fisheries presented by Japan

In recent years, some fierce disputes have arisen over the exploitation of fishery resources around the world. For example, there have been reports that the decline in tuna, cod and other large fish species owing to indiscriminate fishing has altered marine ecosystems, and that non-selective trawl fisheries and others are threatening the diversity of marine ecosystems. On the other hand, changes in marine ecosystems owing to global warming have also been pointed out; in the case of Atlantic cod, for example, these include a decline of spawning grounds in low-latitude sea areas accompanying a rise in seawater temperature. Many fisheries in the world are corporate fisheries based on free competition, with rigorous state-led management of resources and fisheries. Owing to a sharp decline in target resources, however, measures such as establishing Marine Protected Areas (MPA) with a total ban on fishing have been taken in some cases.

On the other hand, management of fisheries in Japanese coastal areas currently consists mainly of TAC (total allowable catch) management based on scientific evaluation of resources, and independent management of fisheries by fishery cooperatives and others in coastal areas. Non-selective trawl fisheries are restricted in coastal areas, and a variety of selective fisheries (gill nets, longline, set nets, hoop nets, etc.) are mainly practiced. Also, fishing zones, seasons, methods and others are subject to regulation and adjustment under the Fisheries Law and the Fishery Resources Conservation Law, as well as independent agreements on fisheries management between fishery orga-



Fig. 1
A shoal of arabesque greenling (*Pleurogrammus azonus*) awaiting spring on the ocean floor of the Rausu coastal area at a depth of 330m (photographed by author using an ROV(remote operated vehicle), March 22nd, 2004)

Unlocking the Mystery of the Eel

Katsumi Tsukamoto

Professor, Ocean Research Institute, The University of Tokyo
(Ship & Ocean Newsletter No.142 July 5, 2006)

In June last year, a great number of two-day-old larval eels (known as "pre-leptocephali") were found to the west of the Suruga seamount on the West Mariana Ridge. It would be safe to say that this virtually settled the age-old issue of eel spawning grounds. Nevertheless, this is only the beginning of research on eels and the abyssal floor. In order to achieve rewarding developments in ocean research, we believe that training oceanographers who will be responsible for the next generation is critical.

The problem of eel spawning grounds is virtually settled...

Here is a photograph from earlier times, a group photograph from the 2nd eel spawning ground survey mission in 1973 (Fig. 1). So much time has passed since then that I actually had difficulty identifying myself, bunched together in the back row. I was a postgraduate student at the time, and had nothing at all to do with eel research. I had a different research theme, and only joined this mission to assist in its main theme, the search for eel spawning grounds. Day after day we set large plankton nets in the eastern seas off Taiwan. We caught 54 larvae (leptocephalus larvae) of Japanese eels (*Anguilla japonica*), which were comparatively large, with a total body length of around 50mm. Since the previous record for capture of Japanese eel larvae was a single individual, it can be easily appreciated what a great achievement this was at the time. The professors in the center of the photograph, who were instrumental in carrying out the mission, look quite pleased with themselves, and the students under their direct supervision appear to be puffed up with pride. They all thought they had now solved the problem of eel spawning grounds. The newspapers all reported that "The spawning grounds of the Japanese eel have been found in the eastern seas off Taiwan".

However, this discovery was merely the start of a long search for spawning grounds still to come. In fact, 21 larvae in the 30mm range were collected in seas east of the Philippines in 1986, another 28 in the 20mm range in 1988 and 1990, and finally about 1,000 individuals of around 10mm in seas west of the Mariana Islands in 1991. As the size of the captured larvae grew ever smaller, the supposed spawning grounds moved ever further south, then ever eastwards. After that, however, no larvae smaller than this were found in surveys over a period of more than 10 years. Grown juveniles are distributed over a wide area as they drift in currents over a long period of time. Conversely, newly hatched eggs and smaller larvae remain in dense groups called batches near the original spawning grounds. This means that, simply by making the appropriate effort, we should always be able to collect larger larvae, albeit in small numbers. Smaller larvae, meanwhile, could be col-



■Fig. 1
Group photograph from the 2nd eel spawning ground survey mission (December 1973). The author can be seen third from the left in the back row.

lected in considerable quantities if only we could locate the batches, but this was not going to be so easy. That is why it took so many more years between the collection of larvae of around 10mm in length and the discovery of freshly hatched larvae of less than 10mm (known as pre-leptocephali).

On the day of the new moon in June last year, the scientific research vessel "Hakuho Maru" (JAMSTEC) at last succeeded in discovering a large number of pre-leptocephali on the second day after hatching (when they had formed neither eyes nor mouths) west of the Suruga seamount on the West Mariana Ridge. Although no eggs have yet been collected, with this it would be safe to say that the age-old issue of the spawning ground of eels has virtually been settled. The discovery was widely reported on television and in newspapers and magazines. However, this means nothing more than that the location of spawning grounds has been identified. This is only the beginning of real research for the future. What route do adult eels take to arrive at the spawning grounds? Do they spawn in pairs or in groups? And why do they have to migrate thousands of kilometers to return to the spawning grounds in the first place? It is endlessly fascinating. A journalist is once said to have asked Pablo Picasso, "Which of your many works do you consider the finest?" To which the old master immediately answered, "The next one!" Though perhaps presumptuous to compare our efforts to those of a great artist, research is another endeavor that knows no end.

Research on eels requires an interdisciplinary approach

While our research on eels tends to be seen as an adventure in search of spawning grounds, or merely as a single

research theme in the field of marine biology, it is in fact an interdisciplinary research effort that straddles a number of oceanographic fields. It is comprehensive research that concerns not only marine biology but also spreads laterally into the fields of marine physics, chemistry, geology, fisheries, and engineering. For example, why are the eel spawning grounds located on a specific seamount on the West Mariana Ridge of the Philippine Plate? How do eel leptocephali carried by the North Equatorial Current cross the bifurcation in the Philippine seas to the Kuroshio Current? And how does the success or failure of this transfer affect the volume of larvae approaching our coasts? There are various other problems besides these, moreover; for example, estimating the metamorphic process and spawning water depth of eels from analysis of trace elements in the otolith and comparative analysis of stable isotopes, or developing microscopic data loggers (called "pop-up tags") to trace the migratory routes and nektonic water depth of parent eels. Such problems can only be solved by mobilizing the most up-to-date knowledge and technology in various fields of oceanography.

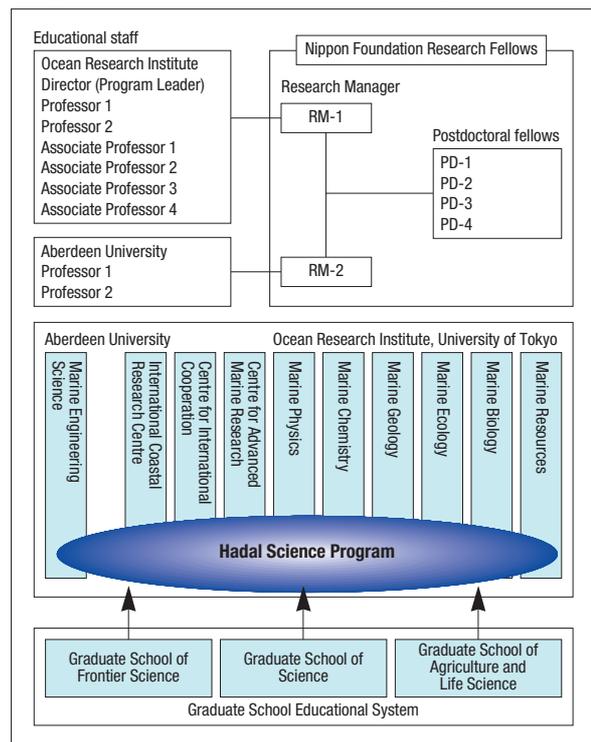
In our Ocean Research Institute, such interdisciplinary research that crosses various fields of oceanography is positively encouraged. Nevertheless, this kind of comprehensive oceanography that transcends the frameworks of individual fields is still novel. To train oceanographers who practice this as a matter of course, we need to review the very structure of our education. I would like to see a succession of young people researching oceans tirelessly across all boundaries, both vertical and horizontal, who are not even aware of the word "interdisciplinary" but apply new ideas that transcend established academic domains.

Expectations of the Hadal Environmental Science Education Program

Fortunately, an educational program designed to further the interdisciplinary and comprehensive nature of oceanography was launched in the present fiscal year (Fig. 2). This is the "Hadal Environmental Science Education Program" (HADEEP), supported by the Nippon Foundation. HADEEP is a new system of education that aims to teach interdisciplinary, comprehensive oceanography based on the key word of "hadal (deep sea) environmental science" to students from various graduate schools who specialize in different academic disciplines. Another characteristic of the Program is that it promotes education and research on hadal environmental science through international cooperation between Japan and the United Kingdom. The team from Aberdeen University in Scotland (UK) excels in long-term observation lander technology; by cooperating with

■ Fig. 2
Organizational diagram of the Hadal Environmental Science Education Program (HADEEP)

The Nippon Foundation "Hadal Environmental Science Education Program(NF-HADEEP)"



them, we will be able to develop various deep sea studies at low cost over a wide range of the abyssal floor. In this summer's missions by Hakuho Maru, we actually plan to carry out eel spawning ground surveys using these landers and give students of the Program practical experience of taking part in such missions. In future, meanwhile, we also intend to hold student exchanges and summer schools.

The abyssal floor is the final frontier of our planet. It plays a large part in major ocean cycles, climate change and other global processes. At the same time, it contains a wealth of resources such as minerals, medicines, microorganisms and methane hydrate, and has become a target for human development. However, our understanding of abyssal floor resources and biogeochemical processes is still poor. We now need to urgently promote a comprehensive understanding of the abyssal floor. To this end, rather than being confined by established academic genres, the quicker way would be to train young researchers who can promote deep sea research in a flexible fashion. We hope that many hadal environmental scientists will emerge from the Hadal Environmental Science Education Program (HADEEP), which started this year. And on a personal level, it is my secret dream to sail to the Mariana seas on Hakuho Maru in future, together with some of the young people who have been educated under this Program. ■

Towards the Enactment of a Basic Ocean Law

Keizo Takemi

Member, House of Councillors; Chairman, Special Committee on Ocean Policy, Liberal Democratic Party; Representative Facilitator, Basic Ocean Law Study Group (Ship & Ocean Newsletter No.143 July 20, 2006)

Japan faces a national crisis of historical proportions in relation to its ocean areas. To solve this crisis, it is essential that we formulate a systematic national ocean policy, improve governmental systems, and implement a basic program on the oceans that will extend over the short, medium, and long terms. Now is the time for Japan, as an ocean state, to draw up a proper policy on the oceans. The foundation for this will be provided by the enactment of a Basic Ocean Law.

The historical background to ocean policy

After the Meiji Restoration in 1868, Japan's strategy for outward growth as a modern nation-state always included an ocean-related strategy as one of its key concepts. This was a strategy of expansion, with hues of imperialism backed by naval power. Upon defeat in the Pacific War, however, this strategy completely collapsed. After the war, Japan's national strategy as a demobilized commerce-oriented nation under a system of free trade was occasionally reappraised from an ocean state perspective. However, the government never explicitly compiled an ocean-related policy for Japan as an ocean state. In fact, even after the United Nations Convention on the Law of the Sea took effect in November 1994, Japan's initiatives on ocean-related problems failed to make any real progress, and there is an undeniable sense that Japan has been slower to develop than other neighboring countries in this respect.

The first reason for this is that ocean-related problems fall under the jurisdiction of individual government bodies (such as the Cabinet Secretariat, Ministry of Land, Infrastructure and Transport, Ministry of Economy, Trade and Industry, Ministry of Agriculture, Forestry and Fisheries, Ministry of Education, Culture, Sports, Science and Technology, Ministry of the Environment, Foreign Ministry and the Defense Agency) based on a vertical split of administrative responsibilities. No postwar Cabinet has made any effort to tackle these problems in a concerted fashion. The second is that, for fear of aggravating territorial problems and sensitive issues with neighboring countries (such as establishing the boundaries of exclusive economic zones, etc.), priority was always given to a diplomatic approach to securing Japan's ocean-related rights and interests inside non-exclusive economic waters, among other issues. As a result, the problems tended to be deferred.

Since the end of the Cold War, however, there has been a growing understanding of the need to formulate a new ocean-related strategy in Japan, as a result of China's development of ocean-related strategies in the Pacific Ocean, that are backed by its economic growth, etc. This was triggered by the emerging friction between Japan and China over ocean-related rights and interests in the East China Sea.



"Basic Ocean Law Study Group" (1st Meeting)

Efforts so far

Ever since I was elected to the House of Councillors 11 years ago, I have attempted to tackle problems of ocean-related rights and interests, as part of a Diplomatic Study Group within the Liberal Democratic Party and as a member of a Foreign Affairs Committee in the House of Councillors. At first, the reaction to these problems was negligible, but gradually the gravity of the matter came to be noted. In November 2003, a working team (WT) on ocean-related rights and interests, chaired by myself, was established under the LDP's Political Affairs Study Group. After that, a succession of important ocean-related problems occurred in sea areas surrounding Japan, while China began to rapidly promote development of marine oil and gas fields in the East China Sea. In response to this, the WT compiled and announced "Nine proposals aimed at protecting ocean-related rights and interests" on June 15th, 2004.

This WT was later reorganized as the Special Committee on Ocean-Related Rights and Interests, of which I continued to serve as Chairman. In March of last year we drew up "Emergency Proposals to Protect Ocean-Related Rights and Interests in the East China Sea" as the opinion of the LDP, and also reported this to (then) Prime Minister Koizumi. In April, I flew in a Japan Coast Guard aircraft to inspect oil and gas fields in the Senkaku Islands and Shirakaba, among others, together with a suprapartisan group of 14 Diet members. Moreover, in December of last year, the long-discussed "Bill Concerning the Establishment of



"Basic Ocean Law Study Group" (2nd Meeting)

Safe Sea Areas Pertaining to Marine Structures, etc." was drawn up. In April of this year the Bill was passed by the Ruling Party Policymakers' Meeting, but unfortunately it was subjected to continued deliberation and is scheduled to be presented during an Emergency Session of the Diet. Meanwhile, the Japanese budget for FY2005 includes the total sum of 24.7 billion yen as the treasury burden over three years for constructing a high-performance, three-dimensional physical exploration vessel. Bidding for this contract is currently underway, and work aimed at procurement is now being pursued with a view to operation from FY2008. Following the procurement of the three-dimensional physical exploration vessel, we plan to use it in systematic exploration for oil, natural gas, methane hydrate and other resources in sea areas surrounding Japan over a period of around 10 years.

Towards the formulation of a Basic Ocean Law

In the process of drafting the "Bill Concerning the Establishment of Safe Sea Areas Pertaining to Marine Structures, etc.", many lawmakers expressed the strong desire for a law that would govern the nation's fundamental policy on the oceans. Under instructions from the party, the name of the above-mentioned Special Committee on Ocean-Related Rights and Interests was changed to the "Special Committee on Ocean Policy" on April 24th last. This Committee would conduct full-scale studies on the Basic Law on the Oceans and all other aspects of ocean policy from the LDP's point of view. Meanwhile, in parallel with this, a "Basic Ocean Law Study Group" (Representative Facilitator: Keizo Takemi; Joint Chairmen: Lower House Diet-member Shigeru Ishiba, and Tadao Kuribayashi, Professor Emeritus of Keio University; Secretariat: Ocean Policy Research Foundation) consisting of experts and members from all parties was also launched on the same day. The Study Group meets approximately once a month, with personnel at Director-General level from relevant government organs participating as observers, and is now engaged in debate aimed at enactment of the Law.

At this Study Group, Professor Tetsuo Yuhara of the

University of Tokyo (Leader of the Marine Technology Forum) stated the opinion that "Rights and interests can only be secured through industrial activity in an EEZ", and I am completely in agreement with that view. Securing ocean-related rights and interests is no vain hope, but is something that can be realized by actually developing activities involved in sustainable development, such as scientific research on Japan's EEZ and continental shelf, scientific surveys and observation, environmental management, resource exploration and development, industrial use, etc. Incidentally, the pursuit of ocean-related rights and interests, on the one hand, and international harmony, on the other, tend to be perceived as two concepts that stand diametrically opposed to each other. Of course, securing ocean-related rights and interests in Japan, a country surrounded by oceans, ought firstly to be given a high order of precedence as national policy, while taking national security aspects into account. When doing so, however, Japan must remain mindful of sustainable development on a global scale, and establish an ocean policy based on universal values and scientific justification as the basic framework for this, with the aim of forming an order for the survival of the human race. Ocean policy has to be a national policy based on noble, rational goals of this sort.

To promote the formulation of such an ocean policy, the following are needed. Firstly, to explicitly position systematic ocean policy as Japan's top-priority basic national policy. Secondly, to improve administrative systems that guarantee collaboration between related government organs, with a view to executing this national ocean policy in a unified manner. Thirdly, to specifically formulate a basic plan for the oceans, as a country that gives substance to the content of its national ocean policy, and to convert this into action over the short, medium or long term. And fourthly, to develop ocean education aimed at enhancing the broad knowledge and understanding of the Japanese public on a wide spectrum of ocean-related problems.

There is now growing public concern with securing ocean-related rights and interests, sparked by disputes with neighboring countries over these issues. We must ensure, however, that this concern does not take the form of a short-sighted, narrow pursuit of national interests. Now, at the beginning of the 21st century, we must gather our country's scientific wisdom and construct a vision of Japan as an ocean state that will also provide intelligent leadership to the international community. The foundation for this will be provided by the "Basic Ocean Law". I sincerely hope we can achieve enactment of this Law during next year's regular Diet session. Towards this, I hope I can count on the understanding, support and cooperation of everyone connected with the oceans. ■

Academic Exchanges with Southeast Asia in Marine Science

Makoto Terazaki

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(Ship & Ocean Newsletter No.147 September 20, 2006)

The Japan Society for the Promotion of Science first started exchanges through the core university system aimed at ASEAN members in 1978. In line with this, the Ocean Research Institute of the University of Tokyo started an exchange program in the field of marine science in 1988. Since FY2001, to achieve even greater results based on the record of exchanges so far, there have been exchanges through large-scale collaborative projects in the fields of coastal and marine sciences. At present, researchers from six Southeast Asian countries are actively collaborating in four projects.

Introduction

After gaining my doctorate in Agricultural Science in March 1973, I was sent to Thailand by the Overseas Technical Cooperation Agency (OTCA), the predecessor of the Japan International Cooperation Agency (JICA). In Thailand, I was registered at the Fisheries Bureau of the Ministry of Agriculture and Cooperatives, and was employed in a program for shrimp nursery development, which had not yet been fully established in Southeast Asia at the time. I would travel all over the provinces of Samut Sakhon, Rayong, Phuket and Songkhla, and would there conduct continuous surveys and experimental research aimed at mass production of shrimp through nursery propagation, together with researchers from the Thai Fisheries Bureau.

The Director-General and Department Directors of the Fisheries Bureau at the time included five gentlemen who, during the war, had been invited to Japan under the concept of the "Greater East Asia Co-Prosperty Sphere". They had studied fisheries at the Imperial Fisheries Institute of the Ministry of Agriculture and Forestry (now Tokyo University of Marine Science and Technology) or Hakodate Fisheries College (now the Faculty of Fisheries at Hokkaido University). In the 1970s, however, there was only one person in the Fisheries Bureau who went to study fisheries science or oceanography at a Japanese university (obtaining an M.Sc. in Fisheries Science from Kagoshima University) and one other at Kasetsart University (an M.Sc. from the Agricultural Faculty of the University of Tokyo). Similar situations pertained in Indonesia, Malaysia and other countries. At the time, many Thai researchers would go to western universities to study for their degrees, and, after their return to Thailand, would be active in government agencies or Thai universities. When I saw this for myself, I started to harbor the faint hope that in future, many of these young people would go to study oceanography in Japan, a country in the same Asian sphere. Now, more than 30 years later, so much has changed. Young people travel to Japan on state scholarships, to take part in projects of the Japan Society for the Promotion of Science (JSPS), training by the Japan International Cooperation Agency (JICA), and so on. After

gaining their M.Sc. or Ph.D. degrees, they go to take positions of leadership in Thai ministries, universities and elsewhere, and I find this truly gratifying. Already, more than 100 such persons have experienced overseas study in Japan in the field of oceanography, including fisheries science.

The Bilateral Core University Program

In 1978, the Japan Society for the Promotion of Science (JSPS) started exchanges through the core university system aimed at ASEAN countries. In the field of oceanography, the Ocean Research Institute of the University of Tokyo started an exchange program with Indonesia in 1988 (core institution: Research and Development Center for Oceanology, Indonesian Institute of Sciences), with Thailand in 1989 (Chulalongkorn University) and Malaysia in 1991 (Putra University, followed by University College of Engineering & Technology). These programs consisted of three main components, namely general researcher exchanges, joint research and combined seminars. Until 1995 researcher exchanges were the principal component, but from 1996 onwards joint research was started in each country and the proportion of this joint research grew larger by the year. As a separate effort, a few researchers from these three countries were invited for long-term study (6 months) every year. Of the researchers who visited Japan on these programs, five were subsequently awarded doctor-



2nd Combined Seminar on "Coastal Oceanography" (August 2005)

■Table 1-1 Researchers sent from Japan (FY1988-2000)

Country	General Exchange	Joint Research	Total
Indonesia	83	87	170
Thailand	98	55	153
Malaysia	68	41	109
Total	249	183	432

■Table 1-2 Researchers invited from Southeast Asia (FY1988-2000)

Country	General Exchange	Joint Research	Long-term Invitation	Total
Indonesia	85	59	3	147
Thailand	90	30	6	126
Malaysia	48	26	3	77
Total	233	115	12	350

ates by Japanese universities with support from the JSPS "Ronpaku (Dissertation PhD) Program", which provides assistance for researchers hoping to acquire dissertation-based Ph.D. degrees. Besides these, many young researchers came to Japan and acquired degrees as overseas students funded by the Ministry of Education in a special framework for core institutions.

This Program came to an end in March 2001, having enjoyed the cooperation of 15 Japanese universities, 18 administrative departments and the National Science Museum of Japan. In the Program, Japan had sent a total of 432 researchers to the three countries and had invited 350 researchers from those countries (Table 1).

The combined seminar was held once a year from 1991 onwards, with the purpose of announcing research results and exchanging information. The seminar was held four times in Japan (Tokyo), three times in Indonesia (Semarang, Jakarta, Bali), twice in Thailand (Songkhla, Chiangmai), and twice in Malaysia (Selangor, Malacca), totaling 11 times in all. The Seminar Proceedings were published every year.

Publications resulting from this Program so far include a field guide to the Lombok Island area, a guidebook on methods of classifying and cultivating harmful algae, and a register of Japanese and Southeast Asian researchers, including research information. Currently, bilateral exchanges between core universities in the field of fisheries science are underway between the Faculty of Marine Science of Tokyo University of Marine Science and Technology and Kasetsart University in Thailand, and between the Fisheries Faculty of Kagoshima University and the University of the Philippines in the Visayas.

Multilateral Cooperative Research Program

To achieve even greater results in cooperation with Asian researchers, based on the track record of exchanges under the core university scheme until then, exchanges in the field of "Coastal Oceanography," based on large-scale

joint research, were started in FY2001. The four countries (including Japan) were joined by the Philippines (core institute: the Institute of Marine Fisheries and Oceanology at the University of the Philippines) and Vietnam (Haiphong Institute of Oceanology). This is a ten-year program running until 2010, and, following an interim evaluation in October 2005, the decision was made to continue it. The Japanese coordinators have been Makoto Terazaki of the Ocean Research Institute, followed by Professor Katsumi Tsukamoto and most recently by Professor Nobuyuki Miyazaki. In 2003, the reorganized and expanded International Coastal Research Center in Otsuchi-cho, Iwate Prefecture, became the center for this Program, and joint research, workshops and other activities are currently being held.

Of the more prominent research tasks undertaken by UNESCO IOC (Intergovernmental Oceanographic Commission) / WESTPAC (the IOC Sub-Commission for the Western Pacific Region), the following four projects are being actively carried out in collaboration with Southeast Asian researchers.

1. Research on the process of material transport in coastal areas and marginal seas of East and Southeast Asia (Japanese coordinator: Professor Tetsuo Yanagi, Kyushu University)
2. Bioecology of harmful marine algae (Professor Yasuo Fukuyo, University of Tokyo)
3. Research on biodiversity in coastal areas of East and Southeast Asia (Keiichi Matsuura, Chief of Fish Division, National Science Museum of Japan)
4. Research on eco-environments and pollution of coastal area environments by toxic chemicals (Professor Nobuyuki Miyazaki, University of Tokyo)

Besides local joint surveys, each of these projects have involved workshops and various training programs in Japan and Southeast Asia. The results of these were presented at the 1st Combined Seminar (Chiangmai, December 2003) and 2nd Combined Seminar (Tokyo, August 2005), as well as being announced in scientific publications and receiving high acclaim both in Japan and abroad.

Japan ratified the United Nations Convention on the Law of the Sea in 1996. However, for the countries of Southeast Asia, a region with vast coastal areas, sustainable management of coastal areas is also an important task in terms of securing food resources to cope with population growth. I am confident that the results of core university exchanges accumulated so far will serve a useful purpose in each country's ocean policy, among other aspects. ■

●Japan Society for the Promotion of Science <http://www.jsps.go.jp/j-bilat/asia/main.htm>

Overseas Shipping Businesses Aiming to Enter the Integrated Logistic Industry

—Who is the Ideal Leader of International Logistics?—

Yuji Hirano

Adviser to the President, NYK Logistics and Megacarrier
(Ship & Ocean Newsletter No.149 October 20, 2006)

The world's economic structure has become increasingly globalized and Japan's manufacturing industry has also been expanding globally. Shortening lead times, reducing stocks to the basic minimum requirement, and enhancing customer satisfaction are now significant business challenges. As a logistics provider, what can we do? Who are preferred as integrated logistics solution providers? The challenge for overseas shipping businesses continues.

These days, distances between the world's regions are shrinking and global strategies by corporate enterprises are increasing in intensity. It would be no exaggeration to say that the global expansion of manufacturing bases is now limitless, mainly to meet demand from European and American markets.

Distribution businesses involved in logistics are assuming an increasing diversity of titles - SCM (Supply Chain Management) Provider, Logistics Provider, Solution Provider, and Logistics Integrator, to name but a few - in line with the globalization of the client base (shippers, manufacturers, etc.). At the same time, these businesses are involved in a desperate game of survival in their respective sectors, with a view to meeting customer needs by diversifying functions and expanding their geographical reach. In this paper, I will first look back over developments to date, and then investigate the "ideal" logistics business that is expected and preferred by clients in the global era.

1. The appearance of container ships and reform of overseas shipping business

In 1968, a full container ship plied the route between Japan and the west coast of America for the first time. It was "Hakone Maru", a ship with a cargo capacity of 800 TEU¹⁾. Today, some four decades later, we have witnessed a succession of large ships with a capacity of 9,000 or 10,000 TEU. Nevertheless, despite being relatively small at less than one-tenth of these, the first appearance of full container ships was extremely significant as the harbinger of a major historical transformation - the shift of overseas shipping companies towards integrated logistics. Firstly, it meant that shipping companies had shifted the range of their transportation responsibility to dry land. Previously, their responsibility had been from ship to ship. This now

changed to responsibility from gate to gate of container terminals. The distance involved may have been no more than a few hundred meters, but this transfer of responsibility to land served to encourage a sudden move by shipping companies to land bases, such as inland yards or customer facilities in later times.

Meanwhile, customers also shifted from cost management based on units of transportation segments to management strategies that optimized the overall cost of logistics, by evaluating total cost as a combination of transportation cost and inventory cost. Coinciding with the period in which this kind of movement started to take place, this rapidly ushered in the era of integrated logistics. This trend was further spurred by the increasing size of aircraft, greater economic competitiveness, and the dramatic advance of IT, and with this, shipping businesses also joined the flow towards integrated logistics.

2. Carriers and forwarders

Logistics businesses can be broadly divided into those that actually provide means of transport and undertake transportation (actual transporters), and those that use the means provided by these actual transporters to construct and provide transportation services (user transporters). The former are called "carriers" and the latter "forwarders". The former consist of overseas shipping companies, airline companies, overland haulage companies, railway companies and the like, while the latter include shipping cargo handlers²⁾ and air freight forwarders.

There are some very major basic differences between these two, as I have attempted to show in the Table above.

Carriers are limited by the quantities of logistical goods manufactured (prepared) by them. Their competitiveness derives from reduced cost per unit, due to product standard-

■Differences between carriers and forwarders

	Carriers	Forwarders
How goods are assembled for transportation	Manufacturing (heavy industry) type	Commercial (purchase and sell) type
Competitive edge	Fewer products, larger quantities (selling point: low cost)	More products, smaller quantities (selling point: product lineup)
Marketing strategy	Share	All-in approach

ization, small product variety and large volumes. Meanwhile, taking into account the volume distributed per client company, their sales strategy takes the form of dividing market share with competitors. This is amply illustrated by the trend towards endless enlargement of container ships by overseas shipping companies, and the formation of international consortia for commissioned shipping together with several competitor shipping companies.

Forwarders, on the other hand, handle a theoretically infinite number of logistical goods, due to their commercial format, whereby they purchase and sell goods. Their competitiveness lies in how many transportation and cargo handling menus they can cover in meeting diverse client needs. In other words, the mainstay of their strategy is to aim for an all-in approach in which they accept subcontracts for all aspects. Given these differences between the two, carriers and forwarders are each vying to overcome their respective problems in an attempt to succeed.

3. Selection of integrated logistics business

In the logistics industry, 3PL (third party logistics) has already become an established concept. In a word, this is outsourced logistics business. There is no reason for 3PL to exist unless there are present greater merits for customers (shippers, manufacturers, etc.) than if they were to do the same work themselves or through their immediate organizations. In the following, I will attempt to enumerate the merits and demerits of outsourcing logistics business for customers.

Merits

- (1) Fixed costs become variable costs.
- (2) Prioritized concentration of management resources.
- (3) Benefits of leading-edge expertise.

For the customer, this means a change from taking the full burden of cost, to bearing cost based on specific volumes and actual performance. The customer's investment in its own logistics division is entrusted to the third party, and investment can be concentrated in divisions that require direct investment from the customer, such as planning, marketing, and R&D. Moreover, by fostering employees and personnel through training and education, they are able to apply the experience and know-how of the specialized third party. For the logistics business, having a wide spectrum of customers that can absorb fluctuations in cargo volumes as much as possible, having investment power, and having sufficient specialized know-how are the conditions for becoming a 3PL business.

Demerits

However, once a relationship with a logistics partner has become established, it engenders complacency in the logistics business, and a lack of loyalty may arise. If, as a measure to combat this, an attempt is made to maintain tension among a plural number of businesses, etc., logistics businesses would inevitably be reluctant to satisfy the above conditions 1-3 for merits.

In this way, a business that amplifies merits for the customer, maintains loyalty, and sustains a sense of tension as if it were a division of the client company will be the integrated logistics business that is preferred as a 3PL. Whether carriers or forwarders, related businesses are now entering the arena and vying for supremacy. There will still be fierce competition to become the true integrated logistics business that is chosen by customers. Overseas shipping businesses also ought to make this shift to becoming chosen integrated logistics businesses. ■



(1) The container ship "NYK Aphrodite" in Southampton docks
(2) Warehouse of NYK Logistics (China)
(3) Carson warehouse of NYK Logistics (Americas)
(4) Derby warehouse of NYK Logistics (UK)

1) TEU (twenty-foot equivalent unit) = a unit for counting the number of containers. One 20-foot container = 1 TEU.

2) Shipping cargo handler = A business that receives commissions from shippers for receiving and transferring shipped cargoes at docks.

On Becoming A World Leader in Seabed Resources Development

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Japan's economic zone and extendable continental shelf area contain the world's leading reserves as far as cobalt-rich crusts, hydrothermal ore deposits, and methane hydrates are concerned. To make good use of seabed resources within our nation's sovereignty and achieve independent development of global seabed resources in future, we will need to make efforts and capital investment aimed at maintaining a leading global position in terms of technology for seabed resources development.

Introduction

Here, seabed resources are taken to mean ocean floor energy and metal ore resources. There are three types of energy resource (oil, natural gas, and methane hydrate) and three types of metal ore resource (manganese nodules, cobalt-rich crusts, and hydrothermal ore deposits). Of these seabed resources, only oil and natural gas resources are actually being mined and produced. Exploratory development research is currently in progress with a view to mining and producing methane hydrate and hydrothermal ore deposits in the near future. As for the others - manganese nodules and cobalt-rich crusts - exploratory development research was vigorously pursued by various countries with a view to mining and production between 1980 and 2000. However, owing to advances in the development of terrestrial metal ore deposits, and the fact that seabed resources only exist at considerable depths, the current reality is that no prospects have been found for mining and production, even though exploration of the state of resources is in progress.

Japan's seabed resources

In its EEZ and extendable continental shelf area, Japan has all these types of seabed resources. In particular, Japan is estimated to have the world's leading reserves of methane hydrate, hydrothermal ore deposits, and cobalt-rich crusts¹⁾ (see the map below). Japan's ocean floor oil resources are regrettably poor, but as for natural gas resources, commercially exploitable reserves are known to exist on the East China Sea continental shelf and other areas of the continental shelf around Japan, and these are moderately abundant. With CO₂ emissions lower than those of oil, natural gas is an important resource that is suited to global warming countermeasures. As such, developing and producing seabed natural gas within Japan's EEZ, albeit not in great quantities, is important for maintaining our technology for independent resource development. Oil and mineral deposits, which take a long time to mature in geological terms, are formed on stable continental margins (non-active continental margins). It was therefore inevitable that Japan, a typical example of an active continental margin, was not to be endowed with them. Nevertheless, Japan is well-endowed with conditions for the formation of other seabed

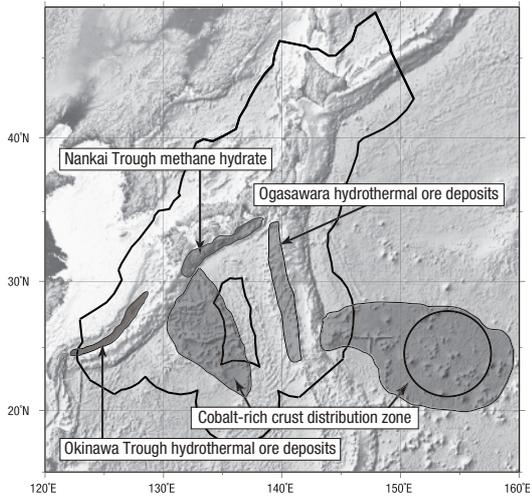
resources.

On an active continental margin, the plate on the ocean side collides with the plate on the land side and is thrust underneath it, thereby causing lively earth crust movement and volcanic activity on the land side. Methane hydrate and hydrothermal ore deposits are formed in sea areas around Japan as a result of this interaction between plates. The Nankai Trough in the sea off southwestern Japan is known as one of the world's richest sources of methane hydrate. Although there are fears over a future earthquake in the Tokai region due to the movement of plates in the Nankai Trough, this movement of plates also has the effect of gradually accumulating deposits rich in organic matter that have settled on the plates on the landward slopes. Methane gas produced by the organic matter forms a layer of methane hydrate over the whole of the slope area in the Nankai Trough. The methane hydrate layer is formed when CO₂ and methane gas under temperature and pressure conditions at around 300m below the ocean floor merge together and form a sherbet-like solid, below which methane gas is trapped. Unlike oil and natural gas, this will not flow spontaneously when wells are drilled, and revolutionary mining technology therefore needs to be developed.

Hydrothermal ore deposits are more correctly called hydrothermal metal sulfide mineral deposits, and are formed in association with ocean floor volcanic activity. Seawater flows in along faults in the earth's crust, circulates actively inside the earth's crust, becomes heated to several hundred degrees, and dissolves various metal constituents existing inside volcanic rock. This then deposits large quantities of metal sulfides around eruptions on the ocean floor, thereby forming mineral deposits. Numerous hydrothermal ore deposits, among the largest in the world, have been discovered in the volcanic archipelago formed by the Okinawa Trough and the Iwojima Ridge within Japan's EEZ. Many of Japan's now closed terrestrial metal mines, notably the Sado Island gold mines, were formed by similar processes in past geological ages.

Cobalt-rich crusts are deposits solidified to a thickness of 10cm-20cm, containing cobalt, copper, platinum and other useful ores, sedimented from seawater over the space of tens of millions of years at the base of undersea mountains (seamounts). In Japan, the floor of the Pacific Ocean east of

Seabed resources in the vicinity of Japan



The 200 nautical mile exclusive economic zone of the Japanese archipelago (solid lines) and distribution zones of seabed resources (cobalt-rich crusts are distributed on the slopes of seamounts within the distribution zone).

the Ogasawara Islands and near Minamitori Island (Marcus Island) was formed some 150 million years ago. As well as being the oldest ocean floor on the planet, this is also the world's largest concentration of seamounts. These seamounts were formed when countless ocean floor volcanoes, created through violent mantle activity occurring in the distant southeastern Pacific some 150 million years ago, rode on the Pacific Ocean plate and moved towards Japanese seas while depositing cobalt-rich crusts. Since such large-scale volcanic activity only occurs once in every several hundred million years, Japan's cobalt-rich crust resources could truly be described as "a blessing of nature". Alongside the USA (which has control over the West Pacific islands), Japan is estimated to be a world leader for reserves of cobalt-rich crusts. If an extension of the continental shelf based on the United Nations Convention on the Law of the Sea could be achieved, those reserves would increase still further. Conversely, manganese nodules, which are similarly sedimented on the abyssal floor over a long period of geological time, are found in rich mineral belts in central oceanic regions set apart from any country's economic zone. Since these are in international waters, development rights are divided fairly among countries that have ratified the UN Convention on the Law of the Sea.

The path to be taken by Japan as a leading nation of seabed resources

As stated above, Japan, lying in one of the world's most

prominent areas of seismic and volcanic activity, also has the world's largest reserves of methane hydrate, hydrothermal ore deposits, and cobalt-rich crusts, thanks to the associated movement of plates. As such, Japan is in a fitting position to be called a major nation in terms of seabed resources. However, research on exploratory development has not progressed to the stage of mining and production for any of these resources. To make economically effective use of these resources, a high level of technology is required, and more investment is still needed to develop this technology. As concerns methane hydrate, the hopes of Japan as a country poor in energy resources are being shouldered by the MH21 Plan²⁾ initiated by the Ministry of Economy, Trade and Industry. Research for exploratory development is being energetically pursued with a view to starting mining and production in 2016, and the level of this technology development is attracting attention from the rest of the world. As for development research on cobalt-rich crusts, Japan has until now ranked with China, South Korea, Germany and the USA as a world leader. Recently, however, we have slipped behind the pace of exploratory development research set by China. As for research on the exploratory development of hydrothermal ore deposits, Japan is now clearly lagging behind Canada, New Zealand, Germany, the UK, and Australia. Most hydrothermal ore deposits are found at depths of less than 1,000m, making them easier to mine than other resources. For this reason, a joint venture between Canada and Australia is currently aiming for commercial production in the South Pacific Ocean in the near future, and active exploratory development is underway. For cobalt-rich crusts, manganese nodules, and hydrothermal ore deposits, the International Seabed Authority³⁾ is leading an effort to create international mining regulations that take the conservation of ocean floor environments and deep sea ecosystems into account. Preparations for mining development of these resources are now complete.

Compared to that of land resources, the development of seabed resources entails many unknown quantities, as well as considerable risks. Nevertheless, Japan should not spare any effort or investment in leading the world in technology for seabed resource exploratory development. By doing so, it will be possible not only to make good use of the abundant resources with which Japan's EEZ and extendable continental shelf are endowed, but also to achieve independent resource development in future, taking account of global seabed resources. ■

1) Reserves = A value theoretically calculated for the volume of existing resources, not taking account of conditions that restrict their exploitation.

2) MH21 Plan = "A project involving research on technologies for developing methane hydrate as a future energy resource"
Research Consortium for Methane Hydrate Resources in Japan (MH21 Research Consortium)
<http://www.mh21japan.gr.jp/english/index.html>

3) International Seabed Authority (ISA) <http://www.isa.org.jm/en/default.htm> (English version)

An outline description of ISA in Japanese can be found at http://www.mofa-irc.go.jp/link/kikan_info/isa.htm (Ministry of Foreign Affairs website).