

## Preface

# Thematic Section: Geology and geophysics of the Philippine Sea and adjacent areas in the Pacific Ocean

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### THE PHILIPPINE SEA AND ADJACENT AREAS IN THE PACIFIC OCEAN

This volume can be regarded as a progress report on the latest survey efforts in the Philippine Sea and adjacent areas in the Pacific Ocean. The Philippine Sea occupies a large part of the western Pacific and the Philippine Sea Plate (PSP) forms the floor of this sea. The Izu-Ogasawara (Bonin), Mariana, Yap and Palau Trenches comprise a continuous, arcuate system which defines the eastern boundary of the PSP, and which is often referred to as the Izu-Bonin-Mariana (IBM) Arc system. The Pacific Plate subducts beneath the PSP along the IBM trenches. The PSP is composed of several large back-arc basins and this region evolved through several episodes of arc formation, rifting and back-arc spreading (Karig 1971). This region has been targeted by several international scientific programs. Early pioneering work of Murauchi *et al.* (1968) gave us a first glimpse of the crustal structure of the important components of the PSP. Japanese Geodynamics Project (GDP) 1973–78 gave us a first overview of the geology and geophysics of the northern PSP (Shiki 1985). Furthermore, Deep Sea Drilling Project (DSDP) Legs 6, 31, 58, 59 & 60 and Ocean Drilling Program (ODP) Legs 125, 126 & 195 drilled and cored the PSP, and established the current framework of our understanding of PSP structure and evolution (e.g. Karig 1975). Crustal structure of an oceanic island arc was determined for the first time in the IBM arc with improved seismic techniques (Suyehiro *et al.* 1996). More recently, the IBM arc has been a focus site of the NSF-MARGINS Subduction Factory experiment (<http://www.nsf-margins.org/SF/SF.html>).

### SURVEYS DRIVEN FROM THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (UNCLOS)

This thematic section primarily grew out of the community working for Japan's legal continental shelf survey project in the Philippine Sea and

adjacent areas in the Pacific Ocean, aimed to gather information to help define Japan's continental shelf in the context of the United Nations Convention on the Law of the Sea (UNCLOS), which became effective in 1994 (see the latest summary by Hutchinson & Rowland 2007). Japan's legal continental shelf survey project is now (as of summer 2007 [June–August]) in the final stage of field survey, because Japan has to make a submission for extended continental shelves to the Commission on Limits of the Continental Shelf under UNCLOS by May 2009. The USA has also started its UNCLOS program in the Philippine Sea region, consisting of swath-mapping of the sea floor west of the West Mariana Ridge.

Japan's continental shelf survey project consists of two major phases. The first phase started in 1983 with swath-mapping of the northern Philippine Sea and adjacent areas in the northwest Pacific Ocean by the Hydrographic and Oceanographic Department of Japan (HODJ). The project used survey vessels *Takuyo* and *Shoyo* to acquire narrow multi-beam echo sounder SeaBeam swath bathymetry, single- and 24-channel seismic reflection, magnetic and gravity data and dredged bottom materials. Ship tracks were spaced at 9–11 km apart (Ohara *et al.* 1997). The first phase greatly increased our understanding of the PSP, allowing reconstruction of the first detailed evolutionary history of the Shikoku and Parece Vela Basins (Okino *et al.* 1994, 1998, 1999) and discovery of Godzilla Mullion (Ohara *et al.* 2001), the world's largest oceanic core complex (OCC) in the Parece Vela Basin, for example.

Along with the HODJ's swath-mapping project, Japan Oil, Gas and Metals National Corporation (JOGMEC) in 1998 started a national project 'Deep Sea Survey Technologies for Natural Resources in Japan', sponsored by Ministry of Economy, Trade and Industry (METI). The project's main objective is to gather information about the natural resources in the Philippine Sea and adjacent areas in the Pacific Ocean, and to develop survey skills for studies of deep sea areas. The project acquired

a large amount of state-of-the-art multichannel seismic reflection data and cored bottom materials with a wire-line rock drill, Deep-Sea Boring Machine System (D-BMS; Matsumoto & Sarata 1996) in the Philippine Sea and adjacent areas in the Pacific Ocean.

After 20 years of HODJ's continued efforts, the Japanese government in 2003 started the second phase of the Law of the Sea-related continental shelf survey. In this phase, the project is directly supervised by the Prime Minister's cabinet office, involving all Japanese institutions that have capabilities of marine geological/geophysical research. The JOGMEC's project on natural resources has become a part of the legal continental shelf survey project in this phase. Along with HODJ and JOGMEC, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and Geological Survey of Japan (GSJ-AIST) also took responsibility for the project. The principal structure of the project is as follows:

- HODJ is responsible for swath-mapping and seismic reflection/refraction surveys using ocean bottom seismometers (OBS).
- JOGMEC is responsible for multichannel seismic reflection surveys and bottom sampling mainly with D-BMS.
- JAMSTEC is responsible for seismic reflection/refraction surveys with OBS, especially in the IBM region.
- GSJ is responsible for geochemical analysis of bottom samples.
- Many scientists in universities are also working in sample analysis and geophysical interpretation.

## ABOUT THIS THEMATIC SECTION

This thematic section presents parts of the scientific outcomes of Japan's legal continental shelf survey project.

- Ishihara and Koda compiled the gravity data of the northern Philippine Sea and calculated crustal thickness variations there, revealing very thin crust in the West Philippine Basin, for example.
- Yamashita *et al.* determined the deep crustal structure of the Parece Vela Basin related to initial arc rifting using pre-stack depth migration (PSDM) technique on the multichannel seismic reflection data.
- Ohara *et al.* found that, using seismic reflection/refraction data, the OCC in the Parece Vela

Basin is gabbroic, sharing a common characteristic with the Atlantis Massif OCC in the Mid-Atlantic Ridge.

- Tsuji *et al.* applied a specific velocity analysis method to the JOGMEC's multichannel seismic reflection data of the eastern Ogasawara Plateau region in the northwest Pacific Ocean and determined the geometry of the Moho.
- Higuchi *et al.* established Cenozoic stratigraphy and sedimentation history of the northern Philippine Sea based on the JOGMEC's multichannel seismic reflection data. They identified five sediment units, corresponding to the Early Eocene, Middle to Late Eocene, Oligocene, Miocene, and Pliocene-Pleistocene.
- Takayanagi *et al.* used cores obtained with D-BMS to determine lithology and age of carbonate deposits in the northern Philippine Sea and northwest Pacific Ocean, revealing that shallow-water carbonates in this region largely deposited during Oligocene time.
- Usui *et al.* found that the growth rate of ferromanganese deposits from the northern Philippine Sea is higher than those from the Pacific Ocean.

This thematic section is the third Japanese monograph in the English language devoted to the geology and geophysics of the Philippine Sea and adjacent areas in the Pacific Ocean. The first was Tokuyama *et al.* (1995), published as a monograph of the 5th Japan-USSR symposium in 1985, entitled 'Geology and geophysics of East Asian Marginal Seas'. The second was Stern and Arima (1998), published in *Island Arc* as a result of the first IBM Arc system workshop in 1996. It should be noted, however, that there are several other volumes that partly deal with the Philippine Sea: Uyeda *et al.* (1979), Hayes (1980, 1983), Hilde and Uyeda (1983), Nasu *et al.* (1985) Taylor and Natland (1995) and Eiler (2003). Our thematic section is the first result of Japan's legal continental shelf survey project and more papers will be published from this project in the future. We thus hope that this thematic issue stimulates interest and further research on the Philippine Sea and adjacent areas in the Pacific Ocean.

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