International Scientific Exploration of the Deep Ocean: Progress and Opportunities

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More than 76% of the world's oceans are deeper than 3,000 m, but much of the inner space of our blue planet is still unexplored. The deep ocean is linked to some of the most pressing global science issues of our time, ranging from the role of deep waters in climate change, to diversity and conservation of deep-sea ecosystems, to geo-hazards from deep-trench earthquakes and resultant tsunamis, and to the sustainable use of deep-sea resources. These science issues have direct societal relevance to the Asia Oceania region, as illustrated vividly by the devastating tsunamis triggered by deep-sea earthquakes off Sumatra in 2004 and Japan in 2011. It is imperative for us to understand the role of the deep ocean as a major part of the Earth system in the past, present, and future.

Up to now, perhaps the most active area of deep ocean exploration has been the international, interdisciplinary research of the global mid-ocean ridge system. Encircling the globe for more than 60,000 km, it is the largest single volcanic feature on Earth and in the solar system, playing an essential role in the renewal of the surface of our planet. Nearly 75% of Earth's total heat flux occurs through oceanic crust, much of it at mid-ocean ridges through complex hydrothermal interactions between the lithosphere and oceans. The study of chemosynthetic life at deep-sea hydrothermal vents and the sub-seafloor biosphere bears direct implications on understanding the origin of life on Earth. Established in 1992, the *InterRidge* < www.interridge.org > program coordinates and promotes international ridge-crest research, reaching more than 2,500 individual researchers in 60 countries and regions, including many in the Asia Oceania region. InterRidge working groups focus on active scientific themes for which the program's coordination could make a significant difference; the current themes include 1) *Arc-backarc systems*; 2) *Hydrothermal energy and ocean carbon cycles*; 3) *Mantle imaging*; 4) *Oceanic detachment faults*; 5) *Seafloor mineralization*; 6) *Vent ecology*; and 7) *Circum-Antarctic ridges*. InterRidge played a pivotal role in promoting and facilitating the first international explorations of the Gakkel Ridge under the Arctic Ocean, the remote Southwest Indian Ridge, and the deepest spreading center on Earth – the Cayman

Trough. Recognizing that scientific exploration and the increased commercial interests in mining sulfide deposits could create anthropogenic impacts to the unique ecosystems of deep-sea hydrothermal vents, InterRidge developed the “Statement of commitment to responsible research practices at deep-sea hydrothermal vents” and encouraged researchers to follow six voluntary “code of conduct” guidelines. The last two decades have witnessed tremendous growth in ridge-crest research by scientists from the Asia Oceania region.

Global deep ocean exploration is now entering a period of unprecedented opportunity thanks to the rapid development of deep-sea vehicles, ocean and seafloor observatories, ocean drilling technologies, and a new generation of physical, chemical, biological, and geological sensors. Among today’s most advanced deep-sea technologies are those developed by researchers of the Asia Oceania region, as exemplified by the first direct measurements of seafloor motion caused by the 2011 Japan earthquake and the development of world’s deepest (7,000 m) manned submersible for scientific exploration. Considering that the Asia Oceania region accounts for more than 60% of world’s population and close to 30% of GDP, it is anticipated that the scientific community of the region will play a leading role in deep ocean research in the coming decade. This presentation will highlight these progresses and opportunities and advocate the strengthening of collaboration at the regional and international levels.