DEEP OCEAN STEWARDSHIP INITIATIVE STATEMENT TO THE INTERNATIONAL SEABED AUTHORITY

Increasing demand for food, energy and raw materials has turned the attention of nations and industry to the deep sea, with its vast repositories of resources. Developing technologies are providing easier access to marine living and non-living resources and growing demands by developing economies are making their exploitation more pressing. Here we focus on mineral resources associated with the seabed beyond the continental shelf in international waters (termed The Area).

With deep-sea mining exploration well underway, additional exploration permits pending, and exploitation regulations under development, the future health of the deep sea is now at a critical juncture. Mining in international waters (the Area), including exploitation of manganese nodules, massive sulfide deposits and cobalt crusts is regulated by the International Seabed Authority (ISA). The United Nations Convention on the Law of the Sea (UNCLOS) addresses these resources as the common heritage of mankind. The ISA has developed exploration regulations and is now developing regulations for the exploitation of seabed mineral resources in the Area. Each of the targeted deep-sea resources occurs in a different setting with distinct attributes: nodules in the abyssal plains, massive sulfides at hydrothermal vents and cobalt crusts on seamounts. As part of its mandate, the ISA is tasked with protecting the marine environment, as expressed in Article 145 of UNCLOS.

Exploration of mine leases is well advanced, but full-scale test mining and commercial exploitation has not yet commenced. Exploitation licenses could be granted within the next 3-5 years. Before it does, effective environmental management systems are needed to consider, address and minimize environmental impacts. In particular, robust regulations are needed for networks of protected areas, environmental impact assessment, monitoring, environmental management effectiveness, transparency, and liability.

Mining will without question alter the structure of the targeted environment, including non-living resources and associated ecosystems, with recovery occurring on time scales of decades to millennia, depending on the system. The impacts of at least some mining will extend beyond the boundaries of individual claims. Multiple claims in an area are likely to be impacted before any single claim recovers from mining disturbance, necessitating a holistic and synoptic understanding of the deep sea that extends beyond the site-specific level.

Recent deliberations by DOSI and others have identified key knowledge gaps of deep-sea ecosystems that can be addressed through cooperative work, to inform good environmental policy. Thorough baseline characterization of the deep sea before the onset of mining is fundamental to evaluating and monitoring mining effects. A critical research effort is needed to understand how the structure of marine ecosystems is translated into their basic functions. Functions that are critical to the deep sea include nutrient cycling, habitat provision, maintenance of population connectivity, benthic pelagic coupling, and regulation of food webs or buffering of environmental disturbances. Robust functions help an ecosystem to remain resilient under stress. Humans often examine ecosystems to determine how they deliver important services such as food, carbon burial and gas regulation. We are only beginning to understand such values for the deep sea and mining activities will have an impact on the delivery of these services to humans. Key areas for which information must be acquired include:

- Abiotic properties of the seabed (sediment characteristics, oxygen penetration, redox zonation and metal reactivity) and overlying waters (physical and hydrographic variables, suspended particles, sound, and optical properties), organic carbon flux and hydrographic conditions affecting that flux.
- Biological properties (biomass, abundance, biodiversity, size structure, productivity and distribution).
- The role of organisms in ecosystem function and assessment of functional redundancy.
- Habitat use by commercially harvested, foundation, rare or endangered species.
- Prevailing natural disturbance regimes (e.g., natural tectonic disturbance, benthic storms).
- Existing impacts of human interventions (e.g., fishing, dumping, acidification, deoxygenation, and climate change) and how they may interact with further stress caused by mining.
- Response of organisms and assemblages to sedimentation, oxygen depletion, metal remobilization, turbidity and other features of mining plumes.

Information on how ecosystems are connected across the vast deep sea is crucial to spatial management and the designation of areas of no impact. Current theory for marine protected area design in shallow waters draws heavily on connectivity; the deep sea is no different. For many organisms, currents carry the larvae to new locations so currents and suitable habitat are critical to maintain natural source-sink dynamics. Such migrants carry genetic diversity to maintain an adaptive species. Both the impacts of mining and the dispersal of organisms may extend beyond the boundaries of individual claims. Key information includes:

- The spatial distribution of habitats types and their suitability.
- Alpha, beta and gamma biological diversity and the spatial scales on which these are manifest.
- Genetic structuring, endemism, and geographic distributions of species affected by mining.
- Larval connectivity and identification of source populations for potentially affected taxa.
- Physical and ecological linkages among target and non-target ecosystems.
- Colonization patterns and successional time-scales and trajectories.
- Ecosystem resilience to different intensities and duration of disturbance.

Very little of this information presently exists. Study of the deep sea is expensive, and requires advanced technology. While the ISA has initiated important work with contractors to develop and compile baseline data, standardize taxonomy, and establish protected areas, there is much more to be done. Generation and accumulation of the required knowledge will benefit substantially from large-scale, international partnerships that promote shared funding, seagoing resources, taxonomic expertise, and data. International programs such as ARGO, WOCE and GEOTRACES illustrate the power of global multidisciplinary teamwork to provide comprehensive, synoptic oceanographic data. Although biological investigations are challenging, previous experience suggests that an uneven, piecemeal approach to the problem will not deliver informed and sustainable resource use.

We recommend an international field program and coordinated data repository be developed in conjunction with the International Seabed Authority and the Intergovernmental Oceanographic Commission of UNESCO's Ocean Biogeographic Information System (OBIS) and possibly other global networks. Such a program should generate in a systematic and transparent way the baseline information necessary to evaluate and model impacts, enact protections, and regulate the mining of mineral resources in the deep sea. Key elements of an international effort should be determined by an independent advisory committee, but are likely to include extensive ship-based and in situ sampling and measurement programs, a representative sensor array, transparent data infrastructure for real time monitoring, molecular systematic data base generation, strategic, large-scale modeling and spatial planning. The spatial and temporal scales of these studies will vary with the ecosystem targeted for mining and with the mined area. They will require careful formulation by expert teams of ocean scientists experienced with working in the challenging conditions of the deep sea.

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