Danger of Deep-Sea Mining
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ECOLOGY

Danger of Deep-Sea Mining

Plans for deep-sea mining could pose a serious threat to marine ecosystems.

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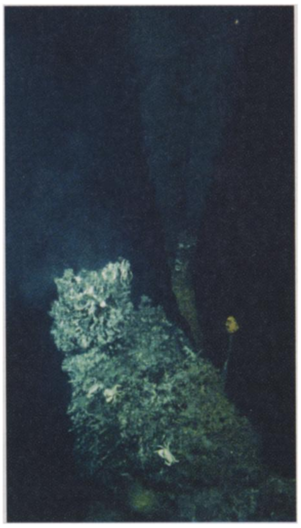
Over the past few months, the possibility of mineral exploitation in the deep sea (*1*) has moved closer to reality with completion of the first undersea exploration for massive sulfide deposits. Analyses of target deposits in a zone of active hydrothermal vent systems in the territorial waters of Papua New Guinea (PNG) have revealed gold, copper, zinc, and silver in concentrations that far surpass those of current terrestrial mining ventures (*2*). With mining technology in an advanced stage of development, skyrocketing metal prices, and depletion of metal-rich terrestrial mines, sea-floor mining activities are now scheduled to begin by 2009.



Initial interest in deep-sea mining was centered on extracting manganese nodules from spatially extensive sea-floor deposits in international seas distant from continents. However, ratification of the United Nations Convention on the Law of the Sea in 1994, which imposed financial burdens and environmental safeguards, together with low metal prices, drastically lowered interest in nodule mining. Prospecting and exploration activities have since shifted to the Exclusive Economic Zones (EEZs), where it is the responsibility of individual nations to issue mining licenses and define environmental safeguards. Discovery of extensive massive sulfide deposits at commercial ore grades within the EEZs of PNG and, more recently, New Zealand has set off a new phase of exploration (*3*).

The first site for such mining is expected to be the Manus backarc basin of PNG, in close proximity to active sulfide-forming hydrothermal vent systems. Hydrothermal vents are home to unique and diverse ecosystems (*4*). They are not only of scientific interest, but are being explored for pharmaceutical and biotechnological applications (*56*). Whereas individual manganese nodule mine claims extend across sea floor areas the size of Switzerland, massive sulfide mining will concentrate on small (1 km^2 in size), high-grade deposits within the uppermost 20 m of the sea floor. An average of 2 megatons of ore per year is to be extracted by Nautilus Minerals, Inc., in a single strip-mining operation using remotely operated underwater mine cutters. It will be transferred from the sea floor to a mining platform by hydraulic pumps (*6*).

Environmental risks including benthic disturbances, sediment plumes, and toxic effects on the water column have been assessed for the large manganese nodule mining endeavors in the equatorial Pacific (*7*). These risks were judged to be so large and unpredictable that a number of studies recommended the abandonment of manganese mining efforts to avoid a large-scale and long-term risk to Pacific ecosystems and fisheries (*8*). Benthic disturbances and far-reaching sediment plumes would probably be less during massive sulfide mining (relative to nodule mining) because of the absence of sediment cover on the recently created ocean floor of active hydrothermal vent systems. However, explored mining sites are less than 1 km from active vents, where there is a likely potential of smothering, clogging, and contamination of vent communities by drifting particles.

Organisms surviving these perturbations would be subject to a radical change in habitat conditions with hard substrata being replaced by soft particles settling from the mining plume (*5*). Mining could also potentially alter hydrologic patterns that supply vent communities with essential nutrients and hot water. A further problem may arise during dewatering of ores on mining platforms, resulting in discharge of highly nutrient enriched deep-water into oligotrophic surface waters, which can drift to nearby shelf areas.

These impacts may not be limited to ecosystems within the EEZ of the country issuing mining permits and could thus be in violation of international environmental law (*9*). If the first deep-sea mining effort is successful, a wave of interest in deep-sea mining of massive sulfide deposits is likely to result. In fact, 250 of these deposits have been identified in deep-sea areas worldwide (*10*).

There has been little progress toward creation of environmental regulatory systems specific to deep-sea mining by governments with jurisdiction over massive sulfide deposits. Some of these governments have a poor track record of mine oversight and regulation on land, so prospects appear poor for sound regulation of underwater mining (*11*, *12*). It is time to implement scientific, technological, and legal measures to minimize negative environmental impacts (including discouraging deep-sea mining activities near sensitive habitats) and to set up mechanisms to recover costs of regulation and enforcement from this nascent industry. Large capital investments and generation of revenues by underwater mining operations are likely to make regulation after onset of commercial operations even more difficult once deep-sea mining becomes a reality.

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