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Abstract

The new industry of deep-sea mining (DSM) potentially offers abundant supplies of several metals from the deep ocean, but the ores will need to be recovered from pristine environments in which the ecosystems are often poorly known. Information that is available for some of these environments suggests that organisms may struggle to recover from the impacts of DSM, whilst in other areas the impacts may be somewhat less.

Deep-sea mining is focussed on three distinct resources – manganese nodules (also known as polymetallic nodules), cobalt crusts and seafloor massive sulphides (SMS) (sometimes called polymetallic sulphides). These occur in different seafloor settings, each hosting very different ecosystems and each with its own set of environmental issues.

Manganese nodules occur in the deep basins of the ocean where lack of sediment supply results in very slow sediment accumulation – rates that can be as low as 1 mm per thousand years – thus allowing nodules to form from slow precipitation of metals. Interest in mining manganese nodules is focussed mainly on the Clarion Clipperton Zone in the eastern equatorial Pacific and Central Indian Basin in the Indian Ocean. Here the seabed faunas are sparsely distributed but are very varied in composition. Many different species live in the upper few centimetres of the sediment or attached to the nodules. The mining process will disrupt this surface sediment layer and remove the nodules. Experiments have shown that species are very slow to return to the disrupted areas. Combined with the large areas that will need to be mined for manganese nodules, this gives rise to potentially a high environmental and ecological impact.

Cobalt crusts occur as layers up to 26 cm thick coating the rocky tops and upper flanks of seamounts, with the most promising deposits occurring between 800 and 2500 m water depth. The absence of sedimentation due to currents in these areas allows the

boundaries. This process creates three-dimensional ore bodies extending metres into the seabed which are similar to some ore bodies that occur on land. Ecosystems comprising specialist organisms that can tolerate and make use of the harsh biochemical conditions are often found at active hydrothermal vents. These vent sites are probably too hot to ever be mined, so ore bodies are being sought some distance away from the active ridge axis in areas where venting is weaker or has stopped. The species occurring 'off axis' are more akin to those from the surrounding rocky slopes and possibly on the continental slopes in the same ocean basin. The species may occur over wide areas, and the impact of localised mining may be relatively small.

In all types of deep-sea mining, the generation of plumes of sediment-laden water, both by the mining process and the transport of ores to a support ship, will have an impact on benthic and mid-water ecosystems away from the mining site. If uncontrolled, such impacts could be comparable to or of greater scale to impacts in the mined areas.