Biodiversity of seamounts with cobalt-rich crust

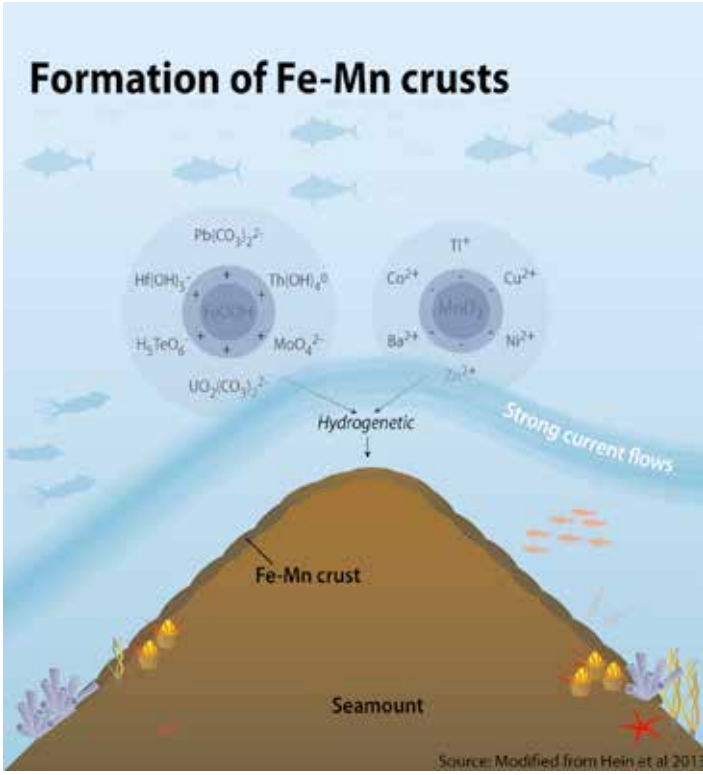
Seamounts are underwater mountains of volcanic origin rising hundreds or thousands of metres from the seafloor. Many seamounts are hotspots of biodiversity and have attracted significant deep-sea fishing activity. Some seamounts also have areas covered by thick pavements of cobalt-rich ferromanganese crust, which are of interest to the deep-sea mining sector. Both activities pose serious threats to seamount ecosystems and therefore appropriate management is essential to preserve their biodiversity, function, and protect the services they provide.

Seamounts are now known to be common in all the world's oceans, occurring in higher abundances around tectonic plate boundaries such as mid-ocean ridges and island-arc zones, and also above upwelling mantle plumes. The total global number of seamounts is unknown because only about 10% of the world's seafloor has been accurately mapped in high resolution. However, even the most conservative estimates based on satellite data suggest that at least tens of thousands (40,000 to 55,000) seamounts exist, representing a major habitat in the deep sea.

Cobalt-rich ferromanganese crusts

Cobalt-rich ferromanganese crusts are an important potential source of metals and rare earth elements such cobalt, titanium, cerium, nickel, platinum, manganese and many others. These crusts mainly form on the exposed hard rock bases of seamounts in areas of volcanic or hydrothermal activity, but they can also occur on ocean ridges and rocky plateaus. In all cases, a defining feature is the presence of strong currents that prevent the accumulation of sediments. Cobalt-rich crusts grow at extremely slow rates of 1 to 6 mm per million years by the precipitation of metals dissolved in seawater at depths at and below the oxygen minimum zone, between 800 - 2,500 metres. The crusts can form thick pavements of up to 26 cm thick, and cumulatively cover an area as large as Europe.

Seamounts, however, are very diverse and therefore deep-sea exploration for cobalt-rich ferromanganese crusts will likely target large, old, isolated and flat topped seamount features. Technology development for crust mining has been slow but the operations will most likely involve grinding the crust and transporting the ore up to the surface. Mining operations will destroy large areas of hard rock substrate and produce plumes of particles in the water column that will settle out across the seafloor.



Top image: Sketch showing formation of crusts on seamounts (image courtesy GRID-Arendal). Lower image: A cobalt-rich ferromanganese crust found at 1050m depth with Luso ROV, in the North Atlantic. Image courtesy of Task Group for the Extension of the Continental Shelf (EMEPC). 2013. Scientific Cruise EMEPC/PEPC/LUSO/2013.

Biological communities

Biological communities associated with cobalt-rich ferromanganese crusts have been poorly studied, and may not differ significantly from similar cobalt-poor areas. Therefore, seamounts covered by crust are likely to have environmental conditions that favour a variety of life forms, creating oases in the comparatively empty open ocean.

The topography of some seamounts can accelerate water currents, generate upwelling of nutrients, and create retention of water masses, therefore increasing local productivity and external flow of organic matter. But seamounts with shallow summits may also trap small migratory animals such as zooplankton, mesopelagic fish, crustaceans and cephalopods, thus facilitating trophic exchanges toward top predators. These oceanographic phenomena make seamounts of paramount importance for promoting the coupling between pelagic and benthic communities.

The surface of many seamounts are covered with luxuriant invertebrate fauna. Large colonies of cold-water corals, sponges, anemones, crinoids, and other animals find ideal locations for growing and feeding on the suspended organisms brought by the current flow. Many of these animals, particularly cold-water corals, have significant ecological and economical importance. They provide habitat for a wide variety of organisms and help regulate the climate through carbon sequestration. Most cold-water corals grow extremely slowly and can live for thousands of years, resulting in a reduced capacity to recover from disturbance.

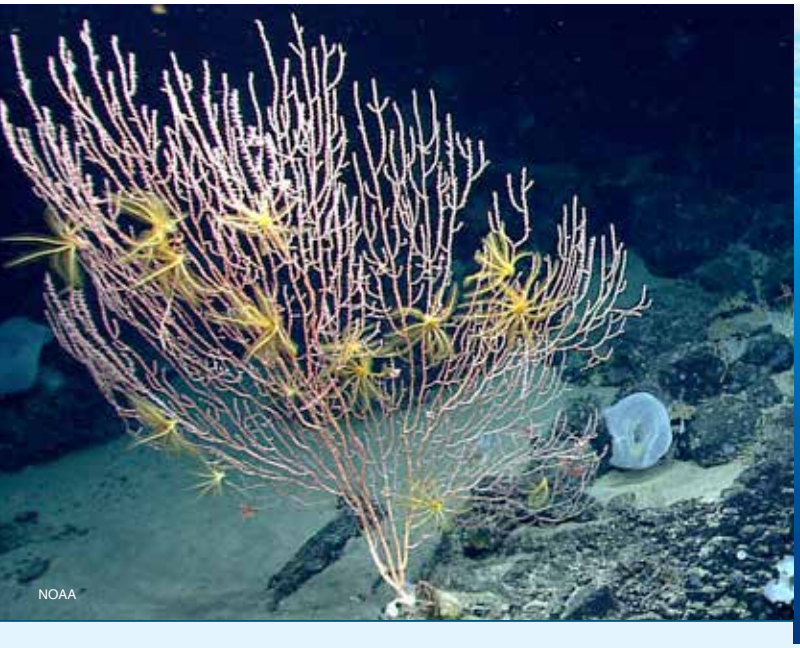
The midwater regions of many seamounts also harbour dense aggregations of commercially important fish such as orange roughy or alfonsinos that visit these areas to feed and sometimes spawn. They became the prime target of a highly technological deep-sea fishery. Some of these fish can live up to a hundred years and can only withstand very light pressure from fishing activities.

Close to the summit of many seamounts, seabirds, sharks, tuna, billfish, sea turtles and marine mammals join the feast, taking advantage of the increased concentrations of food. Seamounts are therefore important hotspots for pelagic biodiversity and visitor organisms.

However, seamounts are very heterogeneous and the properties described here may not be common to all submarine features. In fact, seamounts can have very diverse topographic characteristics, which affect the biological diversity and productivity of resident and associated organisms.

Human impacts and conservation concerns

Seamounts provide valuable direct and indirect goods and services, but in recent decades human pressures on these systems has sharply increased, threatening their health, biodiversity and resilience. Fishing is considered one of the major threats to seamount ecosystems, creating long-term impacts on different habitats, such as coral and sponge aggregations and on vulnerable, long-lived fish stocks. The deep-sea mining industry is now emerging and even though no substantive exploitation has started, mining cobalt crusts from seamounts is likely to pose a serious threat to these ecosystems in the near future. Therefore, appropriate management is essential to prevent or mitigate impacts from mining and to preserve seamount biodiversity, functions and the services they provide.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