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**Submarine mineral resources: who mine them and who will reap the benefits?**

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Mineral deposits on the sea floor will eventually be mined, if not in the next few years, then in coming decades. Hein et al. [1] estimate that potential resources of high-technology metals such as Tl, Te, Mn, Ni, Co and Y in submarine deposits are greater than those in all terrestrial deposits. There are three main types of deep sea mineral deposits; seafloor massive sulfides (SMS) which contain Cu, Zn, Ag and Au; polymetallic nodules which are potential sources of Mn, Cu, Ni and Co in addition to minor elements, and Co-rich crusts which may yield Mn, Co, Pt and Ti. Many essential features of seafloor mining have been employed for decades during the exploitation of detrital diamonds in shallow water (50-200m) off the coast of Namibia. There, remote-controlled crawlers scrape or dig up gravels that are conveyed through riser tubes to production vessels. Whether these techniques can be adapted for deep-sea mining at depths of 1000-5000m remains to be demonstrated. In past decades, advanced technologies have also been developed for deep sea oil and gas production; these may be transferred to deep sea mining. The most advanced operation is the Solwara project in the Bismark Sea, Papua New Guinea, where Nautilus, a Canadian company, plans in 2018 to start mining a small SMS deposit. Mining of polymetallic nodules and Co-rich crust lies well in the future, led, very probably, by private or public enterprises from China, Japan, S Korea, India, Russia and maybe Germany and France. After limited treatment on production vessels, ores will be shipped directly to metallurgical plants and smelters on surrounding continents; to China, Japan, S Korea for deposits in the Pacific, and to India or perhaps South Africa for deposits in the Indian Ocean. There is a risk that the benefits of future seafloor mining may accrue to a limited number of major players, and not to the populations of island nations. As with terrestrial operations, mining on the sea floor will have major, but as yet poorly understood, impacts on the local ecological systems. The deep sea floor is only sparsely populated, but future mining may destroy colonies of endemic species. Although most mining will be in international waters under the umbrella of International Seabed Authority, some mining of Co-crusts and SMS deposits will be in the exclusive economic zones (EEZ) of a small number of island nations. A multi-disciplinary commission under the auspices of the French Institut de recherche pour le développement (IRD) is currently evaluating the potential of resources in the EEZ of French Polynesia.

*References:*

- [1] Hein, J.R. (2013) *Ore Geology Reviews* 51: 1–14

