Resource potential and impact of mining deep-sea minerals compared to land-bound deposits

ANDREA KOSCHINSKY

Department of Physics and Earth Sciences, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany; a.koschinsky@jacobs-university.de

Deep-sea mining refers to the retrieval of minerals from manganese nodules, ferromanganese crusts and massive sulphide deposits in the deep-sea, which contain a variety of metals that serve as crucial raw materials in the production e.g. of renewable energy technology. Metals of economic interest include Cu, Co, Ni, Mo, rare earth elements, Au, Ag, Pt, Te, and others. These marine mineral deposits differ among each other with respect to their physical and chemical properties, metal content, geographic distribution, required extraction technology and the environmental and social impacts they cause, but also compared to most land-bound deposits. While massive sulphide deposits have been exploited on land for a long time and established processing technologies could be applied to marine sulphides, to date no corresponding extraction technology exists for oxidic marine minerals such as in polymetallic nodules and crusts that would allow the recovery of the wealth of valuable metals associated with the iron-manganese oxide matrix.

Despite several international projects investigating the potential environmental impact of deep-sea mining, knowledge remains limited on the potential short- and long-term effects on the ecosystems, and it is currently difficult to reliably predict the effects of deep-sea mining on biodiversity and the distribution of species. While in hydrothermally active areas forming massive sulphides the fauna can be assumed to be adapted to short-term challenges, this is not the case for the ecosystems associated with ferromanganese crusts on seamounts, and for manganese nodule fields, where all procesess occur very slowly on longer time scales. Here, also the formation of a sediment cloud is of major concern. Biogeochemical traces of surface sediment disturbances have been shown to be detectable even several decades later, but the risk of larger-scale release of toxic metals from the sediment appears to be rather small. However, also land mining goes along with significant environmental impact such as destruction of habitats and acid mine drainage.

To successfully approach the highly complex topic of deep-sea mining, natural scientists and engineers as well as social scientists, economists, and legal experts will need to join forces to incorporate the different perspectives early in the planning, exploration and extraction processes.