New challenges for science from exploration and exploitation of deep-sea mineral deposits

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As our society transforms from hydrocarbon-dominated to green-tech-dominated economy their will be an increasing global demand of strategic and critical raw metarials (SCRM). Mineral resources from the deep-sea such as manganese nodules (as resource for Co, Cu, Ni, Mn, REEs), ferromanganese crusts (Co, Mn, Te, REEs, Pt) and seafloor massive sulfides (Cu, Zn, Pb, Ge, In, Au) could contribute to secure the supply of SCRM to the society.

Manganese nodules form vast, two-dimensional deposits on the sediment-covered seafloor in 4000 – 6000 m water depth. Current major challenges include the assessment of the local variation of the nodule abundance and the impact of future mining on the benthic ecosystem. To tackle the first problem new methods for high-resolution mapping of vast areas must be developed, e.g. based on ultrasound. The second task may need an holistic, integrated approach based on modular observatories and the development of new, miniaturized sensors (“lab-on-chip”) for in-situ measurements of (bio)geochemical parameters as well as the application of autonomous active and passive sampling systems.

Ferromanganese crusts cover the sediment-free slopes of seamounts in about 800 m to 4000 m water depth. To measure crust occurrence and thickness in-situ over vast areas is one major problem with respect to resource assessment. The impact of a long-term mining project on the oceanography and ecology of seamounts is poorly understood and the importance of seamounts as ecological hotspots and linking sites for the migration of species add up to the necessity of such investigations.

Seafloor massive sulfides occur as small, three-dimensional ore bodies at or close to the seafoor in mid-ocean ridge and back-arc basin settings. Current major challenges for exploration include the detection of inactive sites under thin sediment cover and their 3d-extension within the basaltic crust. Apart from drilling, geophysical methods such as electromagnetics and self potential as well as geochemical modelling of shallow subsurface processes based on data from high-temperature hydrothermal fluids are other approaches to tackle this task.

This keynote will provide an overview of those challenges related to exploration and exploitation of mineral deposits in the deep sea.