

Iron-manganese concretions of the Gulf of Finland, Baltic Sea: formation mechanisms and economic potential

Summary

Iron-manganese concretions are mineral nodules on the sea bottom formed of concentric layers of iron and manganese hydroxides around a core. As concretions can be found in vast quantities, and contain valuable metals, they have been identified as a potential economic interest. The goal of this project is to better understand the interplay between geochemical and microbial processes occurring on the seafloor and in the shallow subsurface that control the growth rates and precipitation of FeMn-concretions. The study area is the Gulf of Finland and the aim is to identify key element sources and fluxes using detailed mineralogical, geochemical and isotopic characterization of the concretions via high-spatial resolution spectroscopic and mass spectrometric techniques. These data will be integrated with sediment and porewater profiling to determine redox changes and nature of microbial communities. The successful candidate will be employed as an early-stage researcher at TalTech with a net income starting from €1200.

Research field:	Earth sciences
Supervisors:	Prof. Dr. Aivo Lepland Dr. Atko Heinsalu
Availability:	This position is available.
Offered by:	School of Science Department of Geology
Application deadline:	Applications are accepted between October 01, 2022 00:00 and October 23, 2022 23:59 (Europe/Zurich)

Description

How seafloor FeMn-concretions form and what controls their spatial distribution in the Baltic Sea is poorly understood. Current thinking recognizes a complex interplay between sedimentary processes, groundwater discharge and microbial mediation in controlling the supply of reactants and redox conditions. However, the relative importance of these processes as well as consequent specific triggers of Fe-Mn precipitation and incorporation of economically strategic trace elements remains unknown. This PhD project will study the FeMn-concretions in the Gulf of Finland, Baltic Sea, with the aim to determine the causative mechanisms of their formation. The research will involve: (i) seafloor inspection and documentation of the sedimentologic framework of concretion formation, (ii) characterization of concretion morphology, mineralogy, geochemical composition and growth patterns, (iii) determining redox conditions on the seafloor and shallow subsurface sediments, (iv) evaluation of biogeochemical carbon and sulfur cycling, microbial communities and importance of groundwater discharge involved in forming concretions, and (v) assessment of the overall economic importance of the concretions. Studied materials will be Fe-Mn concretions collected during previous and up-coming cruises in the Gulf of Finland, as well as comparative materials from other analogous areas.

Responsibilities and (foreseen) tasks

- seafloor inspection and sampling of concretions and sediments during scientific cruises
- lithologic logging and geochemical analyses of sediment cores
- petrographic characterization of concretions and identification of growth patterns
- mineralogical and geochemical analyses using bulk and high-spatial resolution in situ methods
- assessment of microbial communities associated with concretions

Applicants should fulfill the following requirements:

- a Master's degree in Natural Sciences (preferably in marine geology and/or geochemistry)
- expertise in geochemistry and an interest in the topic of the position
- excellent command of English



- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of an international team
- capacity of developing own ideas within the framework of the PhD project

We offer:

- 4-year PhD position in one of the largest, most internationally recognized and leading science research centers in Estonia
- The opportunity to do exciting, high-level research
- Opportunities for international conference visits and collaboration with globally leading universities and research centers
- Employment as an early-stage researcher, with net income starting from EUR 1200 (increase possible based on student's performance)

About the department

The Department of Geology is a center of expertise on geology, mineral resources, and mining at TalTech. Our researchers focus on bedrock geology, paleoenvironments, mineral resources, mining engineering and circular economy. We are responsible for study programs on Earth systems and georesources and host various labs and the largest geocollections in Estonia.

The PhD project is supervised by Prof. Aivo Lepland and by co-supervised by Senior Researcher Atko Heinsalu.

Additional information

For further information, please contact Senior Researcher Dr Atko Heinsalu atko.heinsalu@taltech.ee and/or Prof Aivo Lepland aivo.lepland@ngu.no or visit <https://taltech.ee/en/department-geology>



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