

Unconventional Resources for Sustainable Future: Advanced Characteristics and Valorisation Potential of Glauconitic Sandstone

Summary

Glauconitic sandstones, with K- and Fe-rich complex clay mineral glauconite, are widespread, albeit heterogeneous, lithologies. The PhD project focuses on finding novel industrial usage, such as alternative green fertilisers, for those materials based on an interdisciplinary study combining applied mineralogy, geochemistry, and mineral processing. The study involves characterising mineral features, crystallochemistry and textural properties of glauconitic sandstones with various routine and state-of-the-art technologies. The other part of the project is based on experiments on the mechanical activation of glauconite. The main targets will be Ordovician glauconitic sandstones from Estonia. The study aligns with the zero-waste mining concept, as in Estonia, the glauconitic sandstone is a potential waste rock of phosphorite mining. The project is jointly supervised by the TalTech Department of Geology and the Geological Survey of Estonia. It will be carried out under the research project TEMTA100.

Research field:	Earth sciences
Supervisors:	Rutt Hints Lauri Joosu
Availability:	This position is available.
Offered by:	School of Science Department of Geology
Application deadline:	Applications are accepted between June 01, 2024 00:00 and June 30, 2024 23:59 (Europe/Zurich)

Description

Several favourable features of glauconite, such as high potassium content, micronutrients binding, high adsorption, and cation exchange properties, along with its wide geological distribution, make it a promising resource for various sustainable industrial applications, including green fertilizers and water purification. However, these neoformed clay phases are crystallochemically and texturally complex and heterogeneous at different scales, depending on their formation environment. Therefore, advanced characterization and tailored testing experiments are necessary to develop viable industrial solutions. Such studies are also essential to identify potential deleterious compounds or effects related to the processing of glauconite.

The planned PhD project aims to collect state-of-the-art information on the physicochemical characteristics and variability of extensive Ordovician glauconitic sandstone complexes from Estonia. This will be based on multi-instrumental studies, including XRD with Rietveld refinement, SEM-EDX with automated mineralogy applications, and textural analyses. Systematic geochemical-mineralogical research has yet to address those glauconite-rich deposits formed in shallow marine settings of the Baltic Palaeobasin. However, those resources have gained novel interest recently as they are stratigraphically bound to extensive shelly phosphorite deposits.

The project's second objective is to investigate potential valorisation pathways for glauconite resources, focusing primarily on novel mechanical activation and the potential production of alternative green fertilizers.

Jointly supervised by the TalTech Department of Geology and the Geological Survey of Estonia, the project also involves collaboration with the TalTech Laboratory of Inorganic Materials and the private sector.

Responsibilities and foreseen tasks

- Collect representative samples from drill cores based on an understanding of glauconite natural variability
- Perform qualitative and quantitative crystallochemical, mineralogical and textural investigations using XRD and various microanalytical techniques
- Design and execute a series of lab-scale experiments on the comminution and activation of glauconite resources
- Analyze multi-instrumental data sets obtained from raw materials and processing products
- Interpret and model the results of mineral processing tests

- Contribute to the organization of research and practitioner workshops where project findings are presented

Applicants should fulfil the following requirements:

- a master's degree in Earth or mineral sciences
- a clear interest in the topic of the position
- a strong background in mineralogy, geochemistry and an interest in related analytical techniques
- relevant experience in executing laboratory studies
- readiness to work on multidisciplinary research problems
- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of an international team
- capacity and willingness to provide assistance in organizational tasks relevant to the project

The following experience is beneficial:

- working with sedimentary deposits
- working knowledge of statistics

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

We offer:

- 4-year fully funded PhD position in one of the leading geo-research centres in Estonia with a considerable portfolio of European and national research projects on mineral resources
- The chance to do high-level research in quickly developing field utilizing in-depth mineralogical and particle properties knowledge to develop innovative pathways for sustainable mineral applications
- Opportunities for conference visits, research and lab stays in various partner institutions across Europe

About the department

The Department of Geology (<https://taltech.ee/en/department-geology>) is the centre of expertise in 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 programmes on Earth systems and georesources, host various labs and the largest geocollections in Estonia.

Additional information

For further information, please contact Rutt Hints rutt.hints@taltech.ee



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