Trace element mobilization during pyrite-goethite alteration in supergenic oxidation processes in till: usability in the fingerprinting analysis of the mineral deposit's formation

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Introduction

Compositional information on sulfide minerals, especially the trace element content of pyrite has proven to be an effective discriminating tool to identify mineralization stages and separate relating or non-relating pyrite of the formation of the mineral deposit in question (e.g., George et al., 2017; Duran et al., 2019; Raić et al., 2022). The concept of mineral fingerprinting is based on trace element and isotope analyses of minerals having different geochemical signatures related to their crystallization environment. Pyrite (FeS_2) is one of the most common sulfide in various mineral deposits and can form under various conditions (e.g., Berner 1970).

In studies of pyrite from bedrock samples, LA-ICP-MS (Laser Ablation Inductively Coupled Mass Spectrometry) technique enables in-situ analyses of individual sulfide grains providing robust information of the compositions in different textural associations within the samples. The information gathered from the pyrite in primary mineral deposits can be used to compare compositions of pyrite grains found in the glacial tills. However, in the case of transported sediments, the successful recovery of fresh pyrite grains from the sediment fractions can be difficult as the pyrite grains are often highly oxidized, resulting alteration partly or totally goethite. Usability of goethitized pyrite grains for fingerprinting has not been studied and the trace element mobility during the transition is poorly known. Preliminary trace element analyses of goethite rims show enrichment of some elements (e.g., Co, Ni, and Mn) compared to the unaltered pyrite core. In this study, multiple micron scale lamellae are prepared from partially goethitized pyrite using FIB-SEM (Focused Ion Beam Scanning Electron microscope) and followed by TEM (Transmission Electron Microscopy) investigations of the nanoscale characteristics of the alteration. Nanoscale Information is combined with in-situ major- and trace element analyses of the grains in order to understand the geochemical properties, i.e., the mobilizing and immobilization of different elements during oxidation. Finally, the usability of oxidized pyrite grains in till for mineral deposit fingerprinting, is evaluated.

References

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