ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences in Earth sciences

Geochemical characterization of sulfides from Archean cherts

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Context

Microbial mats are one of the earliest traces of Life and have been recorded in sedimentary Archean cherts from the Barberton Greenstone Belt (3.5-3.2 Ga, South Africa)[1,2]. Extensive studies have proposed that biological signatures are still preserved in these cherts despite extensive post deposit fluid circulations. Sulfides can be formed either during abiotic reactions or through microbial metabolisms, either sulfate reduction or iron dissimilatory reactions. Recent studies have proposed that trace element concentrations in sulfides is a new proxy for past ocean and atmosphere evolution[3]. However experimental studies have challenged this hypothesis[4]. Middle Marker and Buck Reef chert formations contains various sulfides like pyrite, chalcopyrite and galene located in the chert matrix, associated with the organic matter laminae or in the quartz veins. The proposed study aims to characterize mineralogically and geochemically sulfides in sedimentary cherts from the Middle Marker and the Buck Reef formations (3.47-3.41 Ga) in order to decipher the pathway formation of these various sulfides. The trace element concentration proxy will be then tested by comparing pyrite formed during fluid circulations with pyrite formed in the microbial mats. Therefore, this study will allow to test the biosignatures preservation versus the post deposit circulations in sulfide record.

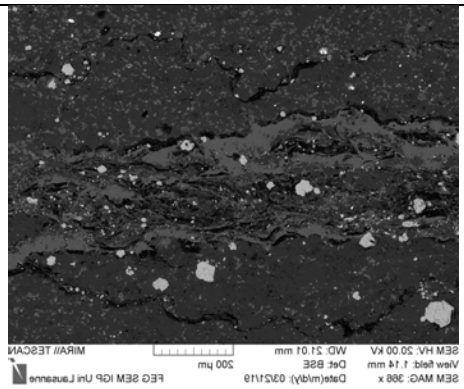
Objectives and Methods

Possible Field work in early September for completing the sampling of the Buck Reef cherts.
Mineralogical characterization of sulfides by optical microscope and SEM-EDS. Detailed characterization of the mineral associated with organic laminae interpreted as fossil microbial mats by Raman.
Trace element concentrations measured in sulfides by EMPA and LA-ICP-MS.
Comparison with literature data and coupling with Fe and S isotope composition published

Literature

[1]Tice and Lowe (2004) Photosynthetic microbial mats in the 3.416 Myr old ocean. Nature vol 432. 549-551
[2]Hickman-Lewis et al. (2018) Most Ancient evidence for Life in the Barberton Greenstone Belt: Microbial mats and biofabrics of the 3.47 Ga Middle Marker Horizon. Precambrian Research, vol 312, July 2018, 45-67
[3]Large et al. (2014) Trace element content of sedimentary pyrite as a new proxy for deep-time ocean-atmosphere evolution. Earth and Planetary Science Letters, vol 389, 1., 209-220.
[4]Swanner et al. (2019) Fate of cobalt and nickel in mackinawite during diagenetic pyrite formation. American mineralogist in press.

View of the Barberton Greenstone Belt, South Africa



Fossil microbial mats with sulfides in grey

Choice of orientation :

1) Sedimentary, Environmental and Reservoir Geology **/** 2) Geochemistry, Alpine tectonics, Ore Deposits **/**