

SUJET DE STAGE MASTER 2 - TERRE

Titre: The fate of Tl during the formation of iron sulphides

Encadrant (avec contact) Romain Guilbaud (romain.guilbaud@cnr.fr)

Collaborations possibles: Sune Nielsen (CRPG), Marc Blanchard (GET)

Lieu du stage: GET (Géosciences Environnement Toulouse, Observatoire Midi-Pyrénées, Toulouse, France)

Connaissances souhaitées : inorganic chemistry, geochemistry, marine sciences, Earth sciences

Résumé :

Thallium (Tl) isotope signatures preserved in ancient sedimentary rocks are increasingly used as a redox proxy to reconstruct past ocean oxygenation events. Indeed, Tl removal from oxygenated seawater during precipitation of Mn oxides is accompanied by a large isotope fractionation, during which the heavier Tl isotopes are incorporated into the solid phase, and therefore into the sediment. By contrast, it is widely assumed that under anoxic conditions, Tl is efficiently removed from seawater in association with pyrite, and so without any significant Tl isotope fractionation. In such conditions, it is believed that the sediment records the Tl isotope signature of seawater.

In this project, we will perform experimental syntheses that will be used to test this hypothesis.

Effects of Tl co-precipitation and adsorption onto FeS, a precursor to pyrite, will both be explored at near-marine pH, for both high sulfide environments and low sulfide environments. The student will synthesise the mineral phases and perform the experiments under strictly anoxic conditions (<1 ppm O_2) in an anoxic chamber (Fig. 1).



Fig. 1. Anoxic glovebox at GET.

The fate of Tl will be explored by tracking the evolution of dissolved Tl concentrations in the system by ICP-MS. Solids will be characterized by X-ray diffraction and transmission electron microscopy (TEM). This will enhance their skills in experimental geochemistry, nanoparticle synthesis, anoxic environments, mineralogical and elemental analyses, all valued both in research and industry. This project will permit to prepare a large number of experimental samples for later Tl isotope analysis.

References:

- Nielsen, S.G., et al., Thallium isotopes in early diagenetic pyrite – A paleoredox proxy?, 2011. *Geochim. Cosmochim. Acta.*, 75: 6690-6704.
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- Ostrander, C.M., et al., Fully oxygenated water columns over continental shelves before the Great Oxidation Event, 2019. *Nature Geoscience*, 12(3): 186-191.
- Guilbaud, R., et al., Fe isotope exchange between Fe (II) aq and nanoparticulate mackinawite (FeSm) during nanoparticle growth, 2010. *Earth Planet. Sci. Lett.*, 300(1-2): 174-183.