

Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Probing the geochemistry of ancient oceans with banded iron formations (BIFs)

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Summary:

The aim of the PhD is to tackle major scientific questions related to the formation and composition of early continents, oceanic and atmospheric oxygenation, and ancient mantle geodynamics from a new perspective, using the geochemistry of the ancient oceans that is recorded in Precambrian BIFs. Banded iron formations are emblematic sedimentary deposits of the Archean. They are made of an alternation of iron- and silica-rich bands, which potentially recorded the geochemical composition of ancient seawater. A large collection of nicely-preserved BIFs from worldwide cratons will be analyzed as part of the project.

The first objective of the PhD is to develop a new isotopic tool to date the depositional age of BIFs with high precision. A good knowledge of the depositional age of BIFs is critical to properly interpret their geochemical signatures. Many of these deposits, however, are not well dated, including some of the world's largest ones such as Krivoy Roh in Ukraine, for which the age is uncertain and could be anywhere before or after the Great Oxidation Event (GOE). Poor age constraints arise from the lack of a direct geochronological system to date the age of BIFs. We propose to develop a new dating method as part of the PhD project.

The second objective of the PhD is to gain a better understanding of the mechanisms of BIF formation and the composition of the first emerged continents using ^{147}Sm - ^{143}Nd and ^{176}Lu - ^{176}Hf isotopic compositions. These measurements will be combined with high-precision ^{142}Nd isotopic analyses, a unique tracer of differentiation events that occurred prior to 4 Ga, to additionally probe the origin of ancient continents.

The PhD position is fully funded through a European program (ERC Starting grant 2020-2025) and will be conducted at the Laboratoire Magmas et Volcans (LMV) in Clermont-Ferrand, France. Candidates should have a strong interest in Geochemistry. A first experience in clean lab and mass spectrometry techniques is preferable.

Methods: Clean lab chemistry, ion chromatography, isotope dilution, mass spectrometry (Q-ICP-MS, MC-ICP-MS, TIMS)