Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Formation and evolution of primitive crusts as recorded by U-Th-Pb and Rb-Sr isotope systems in apatite.

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Summary :

Rocky planets of the Solar System, such as the Earth, are differentiated, which means that they are made of major reservoirs of various compositions that formed through large-scale geological processes. Among these reservoirs, the crust is almost the only one directly accessible. The Earth's crust (continental) has recorded the Earth's evolution since approximately 4.4 billion years (Ga), which represents almost the entire Earth's history. However, processes recorded in the continental crust become less constrained as we go back in time. As a consequence, the mechanisms and chronology of Archean (>2.5Ga) crust formation and evolution remain blur. The same is true for extraterrestrial crusts for which only a handful of samples is available. **Bringing constrains on the formation and evolution of primitive crusts** would allow better understand the early differentiation of planets and, hence, constrain their physical and chemical evolutions.

The primitive crust has been the focus of numerous studied and notably using U-Pb and Lu-Hf isotope systems in zircon, which allow many breakthroughs in the understanding of the crust formation chronology and involved sources. Zircon is a very powerful mineral for such studies but it also has its downfalls which could be compensated by apatite. Zircon essentially crystallizes in evolved magmas such as granite (*sensus lato*) and is poorly sensitive to metamorphism, which is not the case for apatite that crystallizes in a much broader diversity of magmatic rocks and can more readily record metamorphic events. Consequently, **studying U-Th-Pb and Rb-Sr isotope systems in apatite** would allow a more in-depth understanding of the formation and evolution of primitive crusts since the former system is a precise and accurate geochronometer and the latter is a powerful source tracer. This approach is relatively novel and has very strong potential for future applications much like what coupled U-Pb and Lu-Hf in zircon represented 20 years ago.

This PhD project has three main objectives. First, the selected student will **acquire skills in U-Th-Pb dating of apatite using laser ablation ICP-MS mass spectrometry (LA-ICP-MS) and develop Rb-Sr isotopic measurements using LA-MC-ICP-MS in the LMV analytical facility**. Then, these techniques will be applied to the study of formation and evolution of an Archean crustal segment, the Western Dharwar (India), which comprises rocks formed between 3450 and 2500 million years. Finally, these techniques will be applied to extraterrestrial rocks in order to bring constrains on planetary differentiation processes and compare them to terrestrial processes. **This PhD thesis will, hence, rely on skills and competences pertaining to geochemistry, mineralogy and igneous and metamorphic petrology, as well as early Earth.**

Keywords :

Early Earth, Isotope Geochemistry, Apatite, Laser-ablation ICP-MS