



Geological and spectral characterizations of the Li-rich pegmatites from the Iberian Belt

Joint PhD between Université de Lorraine (Nancy, France) and University of Porto (Porto, Portugal)

Period: September 2018 – September 2021 (36 months)

Supervisors: Cécile Fabre (PhD, HDR, GeoResources lab, Université de Lorraine), Julien Mercadier (PhD, GeoResources lab, Université de Lorraine), Alexandre Lima (PhD, University of Porto)

Funding: this project is financed through Eramin project LIGHTS (Lightweight Integrated Ground and Airborne Hyperspectral Topological Solution), with a consortium between Université de Lorraine (France), University of Porto (Portugal), Université de Lyon (France), GeoForschungsZentrum GFZ Potsdam (Germany) and Beak Consultants GmbH (Germany).
Contact : cecile.fabre@univ-lorraine.fr

Objective of the project LIGHTS and description of the PhD

Rechargeable lithium-ion batteries have become indispensable for consumer electronics and for powering electric cars. However, the supply of Li to the European industry relies on importations from other continents. On the contrary to other commodities, Li-resources can be found on the European continent and local supply could sustain the industry. Those Li-deposits are mainly associated with pegmatites. As the geological system is poorly understood, accurate targeting of ores becomes unpredictable. Beyond the geological unknowns, Li-exploration also suffers from technical difficulties. As light element, Li is hard to measure using classical techniques. Recent developments could provide direct recognition of Li and Li-bearing minerals, such as LIBS (Laser-Induced Breakdown Spectroscopy) that now is packed as handheld spectrometers. For mineral recognition, SWIR (short-wave infrared) wavelength region technique provides cameras (light weighted and size reduced) that are now currently compatible with installation on drones. As a result of technological advances, it has only recently become possible to apply these techniques for mineral exploration. For this end, we are introducing the world-unique LIGHTS (Lightweight Integrated Ground and Airborne Hyperspectral Topological Solution) system that comprises cutting edge drone, camera, ground-checking and software technology. For the first time the proposed technology will enable the mapping of lithium such that for a given area, the likelihood of the element is clearly displayed for each geographic point.

The LIGHTS project is divided in work packages (WP) dedicated to solving the several problems listed. Among them, two work packages are specifically dedicated to provide the geological framework of the selected targets (WP4) and to acquire field data, by handheld SWIR and LIBS, to calibrate the remotely sensed data (WP3). These two packages will provide a ground-check on the drone-sensed SWIR data and complete it with information not accessible from the air. The knowledge

on the ore and related alterations will moreover provide information on which minerals and elemental signatures to look for. The achievement of these tasks is the basis of the proposed PhD subject.

Targeted achievements of the PhD:

- integrate all the existing datasets on Li-rich pegmatites in the Iberian Belt with the best resolution achievable to generate primary targeting model.
- Improve the geological model based on new observations on the field and on analyses at lab, with application on the Li-rich pegmatites from Fregeneda-Almendra pegmatite field (Portugal). Classical and new lab techniques (petrography, SEM, EMPA, LA-ICP-MS, SIMS, spectral tools) will be applied to define the features (mineralogical, chemical, geophysical) of these mineralized objects, based on the comparison between mineralized and barren case studies.
- calibrate the LIBS technique on the Li-rich pegmatites from lab and field approaches. This part will be based on tests on standards (with standard developments needed) and on natural minerals, with both field and lab instruments. Li and associated trace elements (Sn, Be,...) will be first targeted. The objective is to solve the potential methodological locks with the use of LIBS in the context of filonian Li-deposits and to build a specific spectral database.
- Provide textural, mineralogical and spectral indicators for Li exploration in the Iberian Peninsula, based on the Li-rich pegmatites from Fregeneda-Almendra pegmatite field (Portugal). This work will provide quantifiable and mappable footprints to vector these objects using the combination of methods proposed in the LIGHTS project.
- Publish the results in papers in top journals, with objectives of publication in journals in i) geological and geochemical developments and ii) mineral deposits.

Qualification and requirements:

- enjoy working in team, with international partners.
- enjoy working in the field and remote areas, with several weeks (up to 4) per year on the Fregeneda-Almendra pegmatite field (Portugal)
- enjoy testing new methods and instruments of analysis on geological objects
- Very good written and spoken English are essential (international research program)
- Willingness to travel and reside in different European countries (France and Portugal)

This position requires a degree equivalent to Master of Sciences in the field of geosciences and/or mineral deposits.

The successful candidate will join the Ore Deposit Team of GeoRessources Lab (Université de Lorraine), with 12 permanent researchers and several PhDs and postdocs. This team is the leading team in France on the topic of ore deposit.

The successful candidate, according of his motivation, will be able to give courses to students of Licence and Master degrees at Université de Lorraine.