



Where's the Lithium? Elemental analysis and structural characterisation of Li-containing ore materials using advanced muon and neutron techniques.

A joint PhD studentship is available between the School of Chemistry at the University of Edinburgh and ISIS Neutron and Muon Source, Rutherford Appleton lab under the supervision of Dr Caroline Kirk (<http://www.chem.ed.ac.uk/staff/academic-staff/dr-caroline-kirk>), and Dr Adrian Hillier. The studentship is fully funded for 42 months and covers tuition fees and an annual stipend (starting at £15,285 per annum) and research costs, for a candidate satisfying EPSRC criteria:

<https://www.epsrc.ac.uk/skills/students/help/eligibility/>

Project Summary

The rapidly increasing demand for Li-ion batteries to power portable consumer electronics, electric vehicles and large power storage facilities has led to the EU classing Li as a critical element from Sept 2020. The Faraday Battery Challenge is a £274 million investment by UK government to fund research and innovation projects in the area of batteries. This is driven by the governments plan for replacement of all conventional petrol and diesel vehicles by electric and zero emission vehicles by 2035. To position the UK as a leader in the development of Li battery technologies the UK must ensure it is self-sufficient in terms of raw materials required for domestic production of Li batteries.

In the UK, the main Li ore types are Li-bearing micas such as zinnwaldite ($\text{KLiFe}^{2+}\text{Al}(\text{AlSi}_3\text{O}_{10})(\text{F},\text{OH})_2$) and lepidolite ($\text{KLi}_2\text{Al}(\text{Si}_4\text{O}_{10})(\text{F},\text{OH})_2$). Worldwide, other ores types are of interest which include Li-bearing clays, such as hectorite, ($\text{Na}_{0.3}(\text{Mg},\text{Li})_3\text{Si}_4\text{O}_{10}(\text{OH})_2$), spodumene ($\text{LiAlSi}_2\text{O}_6$)-petalite ($\text{LiAlSi}_4\text{O}_{10}$) containing ores and zeolitic-type ores such as jadarite ($\text{LiNaSiB}_3\text{O}_7(\text{OH})$). Methods for processing these ores are typically energy intensive high temperature treatments to release the Li. A better understanding of the structure of these minerals, specifically the crystallographic residency of the Li, and the quantities of Li they contain would inform the extraction and processing methodologies.

This project aims to develop Muonic X-ray Emission Spectroscopy (μ -XES) to probe the quantities of Li present in a range of Li ore materials. As well as determining the quantities of Li in these materials, understanding their crystal structures, to determine the crystallographic position of Li, is vital for Li extraction and processing. Neutron Diffraction techniques are invaluable at precisely locating light elements in the presence of heavy ones and will be used alongside in-house X-Ray Powder Diffraction techniques to structurally characterise this minerals. This will allow us to develop a better understanding of the quantity and residence of Li within the ore materials and will ultimately feed into developing new, more efficient and less energy intensive methods for Li extraction and processing.

Applicants must be in possession of (or expecting to obtain) a first class or upper-second class degree (or equivalent) in Chemistry, Physics, Geosciences or other cognate discipline before the start of the PhD. In the first instance, informal enquiries (accompanied by a CV) should be directed to:

Dr Caroline Kirk, School of Chemistry, University of Edinburgh, David Brewster Road, Edinburgh, EH9 3FJ
Email: Caroline.Kirk@ed.ac.uk

The position will remain open until filled.

Equality and Diversity

The School of Chemistry holds a Silver Athena SWAN award in recognition of our commitment to advance gender equality in higher education. The University is a member of the Race Equality Charter and is a Stonewall Scotland Diversity Champion, actively promoting LGBT equality. The University has a range of initiatives to support a family friendly working environment. See our University Initiatives website for further information. University Initiatives website: <https://www.ed.ac.uk/equality-diversity/help-advice/family-friendly>.