

Lithium mines ore and concentrate traceability using portable XRF instruments

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Traceability of mineral raw materials is a highly topical issue for today's society. Environmental and social issues, as well as supply shortage and geopolitical concerns are rising the need to trace the origin of primary materials to encourage and promote a more sustainable production.

Lithium is critical for the energy transition as it is used in most energy storage devices, in particular for electric vehicles. Lithium-ion Batteries (LiBs) are for now the only plausible alternative to fossil fuels engines, responsible of a consequent part of greenhouse gases emissions and air pollution. LiBs traceability is requested by the sector and policies for aforementioned concerns but is challenging due to the multiple process steps and ownership changes from the mine to the end product.

Several solutions are being studied, based on digital technologies. However, it is key to develop geochemical intrinsic traceability of lithium along battery supply chain, to understand and prevent possible frauds: falsification of the declared origins and material mixings. In this regard, lithium isotopic compositions analysis can be used to verify the origin of a material [1] but is expensive and time consuming. Analyzing the production of a mine plant site into a lithium refinery to verify the origin and check for anomalies requires mobile, fast and easy to set-up instruments.

In this regard, the potential of portable X-Ray Fluorescence (pXRF) devices is investigated in this work by analyzing lithium ore and concentrate samples from lithium hard rock mines around the world. Two handheld pXRF and a portable Energy Dispersive XRF instrument were used and compared in terms of capability, precision and practicability. The effects on results of sample preparation and analytical parameters were studied. Both classical and advanced data treatments such as machine learning were used.

The results suggest that it is possible to differentiate deposit origins using on-site XRF instruments and the possibility to determine the provenance of materials of unknown origins. This study is part of EU-funded "MaDiTraCe" project.

[1] Desaulty, AM., Monfort Climent, D., Lefebvre, G. et al. Tracing the origin of lithium in Li-ion batteries using lithium isotopes. *Nature Commun* 13, 4172 (2022)