The influence of natural alteration on the quality of spodumene ores

J. CHISCHI[1]*, H.C. OSKIERSKI[1*], M.F. ALHADAD[1], B. SCHULZ[2], G. SENANAYAKE[1], B.Z. DLUGOGORSKI[3]

[1]College of Science, Health, Engineering and Education, Murdoch University, Murdoch, WA 6150, Australia (*correspondence: Johannes.Chischi@murdoch.edu.au)
[2]Institute of Mineralogy, Technical University Bergakademie Freiberg, D-09596, Freiberg, Germany
[3]Office of Energy and Resources Institute, Charles Darwin University, Darwin, NT 0909, Australia

Natural alteration poses a significant challenge for the economical processing of spodumene ores into concentrates suitable for conversion into battery grade lithium chemicals. Converter plant specifications of > 6 wt.% Li_2O and < 1 wt.% Fe_2O_3 for spodumene concentrates result in poor recoveries during processing from deposits with naturally altered spodumene and thus in the loss of valuable lithium to waste [1]. High Fe_2O_3 contents in the spodumene concentrate can further lead to clinker formation during calcination, lowering subsequent Li-extraction via leaching [2].

Here we use PXRD, EPMA, LA-ICP-MS and MLA to analyse the mineralogy, geochemical compositions and liberation characteristics of two Western Australian spodumene ores to develop processing strategies for increasing spodumene recovery while maintaining low Fe_2O_3 contents. Besides up to 0.9 wt.% of chemically substituted Fe_2O_3 present in spodumene itself, we identify micas among other alteration phases that are finely intergrown with spodumene as the main Fe_2O_3 carrier, containing up to 3.2 wt.%. For one of the ores liberation characteristics are primarily independent of particle size. For the other ore sample particle composition liberation of 90 - 95 % and expected spodumene recovery of 80 - 90 wt.% can only be achieved for smaller particle sizes between 125 and 500 µm. Depending on alteration, grinding to smaller particle sizes could thus enable the rejection of almost all Fe-rich micas during spodumene processing.

Higher recoveries can offset the energy required for additional grinding and result in increased resource utilisation. Our study highlights that natural alteration of spodumene has a profound effect on ore quality and its suitability for the production of lithium chemicals suitable for the battery market.

[1] La Brooy & Harman (2018) *ALTA Conf. Proc.*, p. 216.
[2] Aylmore et al. (2020) *ALTA Conf. Abs.*