Application of portable X-ray diffraction to lithium exploration and mining in pegmatites and coal-bearing sequences

D Burkett[1,2], L Zhao[3] and I T. Graham[4]

1.

Applications Manager, Olympus Corporation of Asia Pacific, Singapore, 119968. Email: dane.burkett@olympus-ossa.com

2.
Adjunct Associate Lecturer, PANGEA Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, Kensington, NSW, 2052. Email: dane.burkett@olympus-ossa.com

3.
Senior Lecturer, State Key Laboratory of Coal Resources and Safe Mining, China University of Mining and Technology, Beijing, 100083, China. Email: lei.zhao@y7mail.com

4.
Senior Lecturer, PANGEA Research Centre, School of Biological, Earth and Environmental Sciences, University of New South Wales, Kensington, NSW, 2052. Email: i.graham@unsw.edu.au

ABSTRACT

Understanding the composition of ore minerals and associated gangue minerals in lithium-caesium-tantalum (LCT) pegmatite deposits and mineral matter in lithium-bearing coal-sequences is crucial during exploration programs when scoping project viability. This information is also of importance to metallurgists as it can improve and optimise the mineral separation process.

Powder X-ray diffraction (XRD) is a well-established technique in the Earth Sciences, as it allows for the identification and quantification of mineral assemblages. Recent advances in XRD sample holders and X-ray sources have allowed for the development of portable XRD devices where the sample preparation is simpler and does not require regular calibrations by a technical expert. This allows for quantitative mineralogical data to be obtained in time frames short enough to enable geologists and metallurgists to optimise their exploration programs and metallurgical processes in near real time.

During exploration of LCT pegmatite deposits and lithium-bearing coal seams, portable XRD provides the geologist with a knowledge of the lithium-bearing phases present, as well as their quantities. The results of quantitative mineralogy can then be used to estimate Li_2O grade. This information allows the geologist to make more informed decisions such as; whether to abandon or extend a drill hole, and whether to continue mapping in a specific area. A knowledge of the ore mineralogy and gangue mineralogy also enables more productive process strategies (e.g. blending) and ongoing process optimisation. In lithium-bearing coal seams understanding the mineral matter is of importance as it can be used to predict ash and slag properties and thus the potential for lithium recovery.

This study provides examples where portable XRD has been applied to the exploration and mining of LCT pegmatite deposits in Western Australia and lithium-bearing coal seams from the Jincheng Coalfield, Northern China. Results of quantitative mineralogy obtained from portable XRD are

compared with laboratory XRD data as well as Li_2O chemical data from inductively coupled plasma optical emission spectrometry and inductively coupled plasma mass spectrometry.