The Critical Role Portable XRF Played in the Discovery and Delineation of the Rarest Economic Mineral Deposit on Earth - Pollucite at Sinclair, Western Australia.

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Pollucite [$(Cs,Na)_2(Al_2Si_4O_{12})$ $2H_2O$] is a mineral with a high value attributed to its high caesium content (~29.66% Cs_2O) and only forms in extremely fractionated lithium-caesium-tantalum (LCT) pegmatite systems. Economic caesium deposits are extremely rare, with only three known mining operations having produced commercial quantities of pollucite, including the Bernic Lake Mine (Manitoba, Canada), Bikita Mine (Zimbabwe) and the Sinclair Mine (Western Australia).

Mineral exploration for lithium-caesium-tantalum (LCT) pegmatites has grown exponentially over the past four years and the development of a "Lithium-Index" calibration for a field portable XRF has aided in this exploration effort (Brand and Brand, 2017). While the pXRF analyser cannot directly detect Li, a proprietary algorithm to estimate the Li content based on results from a suite of co-existing elements provides a proxy for Li.

This "Lithium-Index" has been used by Pioneer Resources Limited to analyse over 7,000 conventional soil samples collected over mapped pegmatites within greenstone rocks of the East Pioneer pegmatite corridor. Results, confirmed by laboratory four acid analyses, identified 9 high priority targets including PEG008a, host to the eventual Cs discovery.

Using the "Lithium Index" during initial borehole testing of PEG008a, PDRC015, the discovery hole, returned values of 7m @ 1.78% Li_2O from 52m depth and 6m at 5.16% Cs_2O from 47m depth using the pXRF. Confirmation laboratory assays returned 7m at 1.52% Li_2O from 52m and 6m at 27.7% Cs_2O from 47m. Whist the comparative Li values (1.78% pXRF vs 1.52% laboratory Li_2O) are considered "fit for purpose" for decision making in the field, the discrepancy between comparative Cs values (5.16% pXRF vs 27.7% laboratory Cs_2O) was due to the lack of high grade Cs reference materials.

Subsequently high grade Cs material from the project has been used to develop a matrix matched Cs-calibration and for the delineation and development of Sinclair. This enabled rapid assay turnaround and accurate dataflow, which was of critical importance due to the short time scale of operational cycles of the mining operation. The role pXRF played in the discovery, delineation and development of the Sinclair Mine, host to pollucite the rarest economic mineral deposit on Earth, will be presented.

Brand N. W. and Brand C. J. (2017) Detecting the Undetectable: Lithium by Portable XRF. Oral presentation, S3, Denver X-Ray Conference, Big Sky, Montana.