Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12786

Pb Isotopes of the Curnamona Province, an example of extreme crustal fractionation in the Proterozoic.

DR. BRYANT WARE[1], JANNE LIEBMANN[2], CHRIS L. KIRKLAND[2], SVETLANA G TESSALINA[1], DAVID R. MOLE[3], KATHRYN WALTENBERG[3], DAVID L. HUSTON[3], GEOFFREY FRASER[3] AND DAVID C. CHAMPION[3]

[1]John de Laeter Centre, Curtin University
[2]Timescales of Mineral Systems Group, School of Earth and Planetary Sciences, Curtin University
[3]Geoscience Australia

Presenting Author: bryant.ware@curtin.edu.au

The Proterozoic Curnamona Province in Australia hosts the world's largest Pb-Zn-Ag ore body, the 300 Mt Broken Hill Pb-Zn-Ag deposit [1, 2]. High-temperature deformation and metamorphism at 1620-1580 Ma caused widespread isotopic disturbance in this region that has made determining the genesis of this ore body and its source challenging; fueling controversy throughout the long history of research into this world-class ore deposit.

New Pb isotopic information has been obtained from a suite of (meta-) igneous rocks collected across the Curnamona Province. K-feldspar analyses from in situ laser ablation MC-ICPMS coupled with analyses of whole rock and K-feldspar/galena separates measured via TIMS, yield an isochron age of 1685.01 ± 0.12 Ma (Figure 1), identical to the maximum age of the Broken Hill ore body (1685 ± 3 Ma [1]). μ values (Pb evolution model [3]) from the southeastern Curnamona, between 9.7 and 10.0, are similar to Broken Hill galena. However, extremely radiogenic Pb isotope ratios ($^{206}Pb/^{204}Pb$ up to 167.3 in K-feldspar and 188.7 in leached whole rock) with accordingly high μ values of up to 14.9, imply a source unusually enriched in U in the northwestern Curnamona Province. This extreme source enrichment in U is similar to that observed in the Olympic Dam ore body in the northeastern Gawler Craton. Moreover, the isochron age is coincident with emplacement of a widespread granite bloom (Tunkillia Suite) in the central western Gawler Craton.

These new Pb isotopic results; (i) indicate a widespread lithospheric scale process at 1685 Ma which formed a distinct lead isotope reservoir that was periodically tapped during subsequent magmatism; and (ii) such extreme enrichment necessitates a major fractionation event linked to large-scale crust generation in the eastern Gawler Craton and northwestern Curnamona Province. This study investigates the spatial scale and potential mechanisms of this 1685 Ma fractionation event, highlighting the role of lithospheric thinning (plume?; delamination?; back-arc?) in causing heterogeneous extreme isotopic enrichment.

[1] Page et al. (2005), Economic Geology 100, 663-676.
[2] Parr et al. (2004), Geology 32(7), 589-592.
[3] Stacy and Kramer (1975), EPSL 26, 207-221.
[4] Vermeesch (2018), Geoscience Frontiers 9, 1479-1493