

New constraints on the origin and post-depositional history of Neoproterozoic Braemar ironstones from South Australia: Insights from micro-scale mineral mapping and in-situ Rb-Sr dating of illite and U-Pb dating of hematite

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The Braemar Iron Formation is located in the Yunta-Olary region in South Australia (SA), 400km north-east of Adelaide, and is one of the largest undeveloped Neoproterozoic iron formations in the world. The Braemar iron formation (BrIF) was deposited during the Sturtian glaciation (dated between ~717 Ma to 660 Ma) almost coeval with the less weathered Holowiliena ironstone located in the Flinders Ranges, which are composed mostly of hematite, while the Braemar Iron Formation is dominated by magnetite. A model for the depositional environment of the BrIF suggests that iron was deposited in the glaciomarine environment under an ice shelf.

Here we present results from new laser-based Rb-Sr and U-Pb dating applied to authigenic illite and hematite phases, identified in the Braemar iron formation, which were analysed via in-situ LA-ICP-MS/MS (Redaa et al., 2022). Briefly, our U-Pb dating of hematite yielded the age 501 ± 34 Ma, pointing to later / post-depositional recrystallisation during the Cambrian, in line with the timing of the peak of Delamerian Orogeny or deformation. The in-situ Rb-Sr illite dating yielded systematically younger ages, ranging from $\sim 451 \pm 7$ Ma to $483 \text{ Ma} \pm 8$ Ma, likely linked to post-Delamerian cooling and associated resetting of the Rb-Sr isotope system in studied illites. Future work done as part of this project will employ redox-sensitive metal isotope tracers such as Fe and Cr isotopes and REE to further test possible depositional models and scenarios for the Braemar iron formation. A comparison from the relatively more 'pristine' Holowiliena ironstones will also be undertaken to assess the effect of secondary processes on geochronological data, redox-sensitive metal isotopes and local Fe enrichments in the above and rather unique Sturtian ironstone deposits in South Australia.

References:

Redaa A., Farkaš J., Gilbert S., Collins, A. Lohr, S. et al. (2022) Testing nano-powder and fused-glass mineral reference materials for in situ Rb-Sr dating of Glauconite, Phlogopite, Biotite and Feldspar via LA-ICP-MS/MS. *Geostandards and Geoanalytical Research*, Vol. 47. p. 23-48, <https://doi.org/10.1111/ggr.12467>.