Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24739

Coupled U-Pb and (U-Th)/He dating techniques investigate the timing and genesis of hematite ore mineralization and subsequent thermal histories

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The Neoarchean (~2700 Ma) Algoma-type banded iron formations (BIF) of the Soudan Iron Mine, NE Minnesota, are located within the southeastern Superior Province of the Canadian Shield in North America and host massive to semi-massive hematite ore bodies. Hydrothermal alteration of these BIF is a well-accepted process for hematite ore formation [1], but the timing of ore genesis is poorly known. Previous research hypothesized that hematite mineralization in this region occurred either during Neoarchean regional transpression, or during Mesoproterozoic formation of the Midcontinent Rift System at ~1100 Ma [2,3]. Two distinct hematite textures—primary microcrystalline and secondary microplaty—are characterized by reflected light microscopy and electron probe microanalysis to determine the relative timing of hydrothermal mineralization. We dated the hematite ore using a novel radiometric technique [4] that couples U-Pb geochronology and (U-Th)/He thermochronology. Preliminary U-Pb results on the two textures range from 1740.4 ± 72.5 Ma to 1640.8 ± 47.2 Ma. These dates are consistent with timing of distal accretion of the Yavapai and Mazatzal Proterozoic terranes and associated magmatism. Younger (U-Th)/He thermochronometric dates of 1093.1 ± 16.4 Ma indicate the hematite likely underwent re-heating and cooling as a result of the Midcontinent Rift System development. This study demonstrates that hematite can be used to date hydrothermal alteration and ore formation and can record subsequent thermal histories.

References:

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