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The Formation of High-Grade Iron Formation-Hosted Iron Ores of the Northern Cape Province of South Africa: Insights from Hematite Ages

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Most of South Africa's high-grade iron ores occur on the western margin of the Kaapvaal Craton in the Northern Cape Province. The ores are hosted within the Paleoproterozoic Transvaal and Keis Supergroups, respectively occurring directly below and above the pre-Gamagara unconformity. Advances in hematite age dating utilizing the combined (U-Th)/Ne and (U-Th)/He technique provide an opportunity to better understand the formation of these ores. Samples were taken from the northern and southern Maremane Dome, Wolhaarkop Dome, Kalahari Manganese Field (KMF) and Griqualand West region. Iron formation-hosted laminated, massive and brecciated ores occurring in the Asbesheuwels, Koegas and Voëlwater Subgroups of the Transvaal Supergroup and conglomeratic ores and iron-rich sandstones occurring in the basal Gamagara Formation of the Keis Supergroup were analyzed.

Three hematite (U-Th)/Ne age populations occur in the analyzed samples: ~2100-1800 Ma; ~1700-1400 Ma; and ~1200-1000 Ma. Hematite (U-Th)/He (cooling) ages were more variable and were always either similar or younger than their respective hematite (U-Th)/Ne ages.

The oldest hematite (U-Th)/Ne age population is prevalent in the northern Maremane Dome and overlaps with the age of the pre-Gamagara unconformity (~2.2-2 Ga) as well as the lower Keis Supergroup (~2.0-1.9 Ga). This hematite likely formed by supergene enrichment below the pre-Gamagara unconformity and endoclastic deposition above the unconformity. The middle age population has no overlap with any known major geological events in the region, occurs across most of the study area, and falls within the depositional age range of the Keis Supergroup (~2.0-1.3 Ga). The youngest age population appears more commonly towards the south and southwest of the Maremane Dome and in the KMF and corresponds well to the age of the Kheis-Namaqua orogeny (~1.2-1.0 Ga). This implies that there was either further ore formation or hematite age resetting due to orogeny-driven hydrothermal fluid flow along the pre-Gamagara unconformity.