Magmatism and deformation in the Mt. Edgar granitic complex at ~ 3.3 Ga, Pilbara Craton

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The origin and evolution of continental crust over geologic time remains an intensely studied and debated topic. Early Paleoarchean terrains such as the Pilbara craton of Australia provide a record of the timing and mechanisms underlying the growth and stabilization of Earth's earliest continents. The so-called "dome and keel" granite-greenstone architecture—which occur in many Archean terrains—characterizes the East Pilbara craton. Existing models interpret these granitic domes as diapir style emplacements of TTG material into a basaltic proto-crust in a vertical tectonic regime unique to the early Archean [1, 2]. The East Pilbara terrain is exceptionally well preserved since the Paleoarchean and has excellent surface exposure. We focus on the Mt. Edgar granitic complex (MTE) in the East Pilbara Terrane to address the central question: what role did vertical tectonics play in the formation and modification of Earth's earliest continents at 3.5 Ga?

We report new Lu-Hf garnet ages for Warrawoona rocks at ~ 3320 Ma, coincident with the Emu Pool magmatic event—the major igneous episode during the evolution of the MTE [2]. For the Emu Pool rocks, we used the laser ablation split stream technique to determine new U-Pb ages coupled with Hf and Nd isotope compositions for zircon and titanite, respectively. The initial isotope compositions of these accessory phases (ε_{Hf} of -0.5 to +0.5 and ε_{Nd} of +1), are broadly chondritic and provide an important linkage between Hf and Nd isotope compositions of phases datable by the U-Pb system. These data together 1) illuminate a temporal relationship between magmatic activity in the dome and metamorphism in the greenstone belt, and 2) indicate that the Emu Pool rocks are derived from a broadly chondritic mantle source.

[1] Van Kranendonk et al. (2007) Terra Nova 19, 1-38. [2] Kemp et al. (2015) Precambrian Research 261, 112-126.