

Origin of the ~3.5 Ga Bon Accord Ni deposit, Barberton, South Africa

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The ~3.5 Ga Bon Accord Ni deposit is located in the Barberton Greenstone Belt of the Kaapvaal Craton, South Africa. The deposit is known for its unique assemblage of Ni-rich minerals. It was initially interpreted as an extraterrestrial body [1], a theory recently ruled out by Cr isotope data [2], and subsequently as a fragment of the Earth's core [3]. More recent suggestions invoke formation of Bon Accord via the interaction of komatiite magma and sediment in an ocean floor setting, or as a black smoker [4]. Here, we present a combined rare earth and highly siderophile element (REE and HSE), and isotopic (⁸⁷Rb–⁸⁷Sr, ¹⁸⁷Re–¹⁸⁷Os) study to further elucidate the origin of Bon Accord.

Bon Accord is enriched in the REE relative to CI chondrite, with a pattern that resembles that of Al-depleted komatiites [5]. Bulk rocks have broadly chondritic relative abundances of Ru, Pt, Pd and Re, with Ir and Os between 1 to 0.1 × CI chondrite, and yield radiogenic measured ¹⁸⁷Os/¹⁸⁸Os. Trevorite, silicates and two bulk rock samples are consistent with chondritic initial ¹⁸⁷Os/¹⁸⁸Os at the time of Bon Accord deposit formation. Bon Accord has low Sr concentrations (0.3–1.6 ppm) and a radiogenic measured ⁸⁷Sr/⁸⁶Sr of 0.73460(18). The new REE data implicate komatiite in the formation of Bon Accord, and the HSE data bear striking similarities to typical Archean Ni-sulfide deposits. A later desulfurisation process seems the most likely explanation for the complex and diverse mineral assemblage for which the Bon Accord deposit is so well known.

References: [1] DeWaal (1978) Mineralisation in Metamorphic Terranes pp 87-98. [2] Tredoux et al. (2014) Chem. Geol, 390:182-190. [3] Tredoux et al. (1989) JGR, 94 (B1): 795-813. [4] O'Driscoll et al. (2014) Min. Mag, 78:145-63. [5] Robin-Popieul et al (2012) J. Petrol., 53, (11), 2191-2229.