A refined view of the 'Mesoarchean gold event'

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A magmatic 'Mesoarchean gold event', which may have added the bulk of gold to the juvenile continental crust [1], might have been linked to a high degree of partial melting of the hot mantle [2]. Yet, this conclusion arises from controversial rhenium-osmium (Re-Os) isotope geochemistry data of non-detrital, but epigenetic gold from the Witwatersrand Basin [3] in which the high Os contents and subchondritic Os isotopic composition are likely the product of the incorporation of >3.0 Ga detrital osmiridium particles [2,3,4]. Here, we connect the 'Mesoarchean gold event' to the precipitation of ca. <3.19–2.98 Ga seafloor massive arsenopyrite bodies, in a reduced Mesoarchean ocean [4], coeval with ca. <3.19–3.01 Ga basalt magmatism. Hydrothermal alteration mobilized As, Re, Os and Au from serpentinized lower crustal harzburgite cumulates to produce arsenopyrite with invisible gold. In major shear zones within greenstone belts, retrograde greenschist-facies metamorphism caused local dissolution of arsenopyrite and liberated gold. With reduced sulfur activity through pyrite precipitation at ca. 2.66 Ga, gold deposition occurred as inclusion in pyrite ($^{187}Os/^{188}Os_i$ [Os_i] = 0.12 ± 0.02) or at the contact between this pyrite and arsenopyrite (0.13 ± 0.02) with reset Re-Os systematics. These Os_i overlap with the $^{187}Os/^{188}Os_{MANTLE}$ (0.11 ± 0.01) in the Mesoarchean and preclude contribution of radiogenic crustal Os. This ca. 2.66 Ga lode mineralization in the North Atlantic Craton may bear testament to the gold endowment of Earth's stabilizing continental crust through metamorphic upgrade of bulk gold originally extracted from the Mesoarchean mantle.

[1] Frimmel (2007) *Earth Sci. Lett.* **267**, 45–55. [2] Kirk et al. (2002) *Science* **297**, 1856–1858. [3] Heinrich (2015) *Nature Geosci.* **8**, 206–209. [4] Hannah et al. (2004) *GCA* **68**, A773. [5] England et al. (2002) *Sedimentology* **49**, 1133-1156.