The late Archean Au epoch: By - product of electrical instabilities on the core-mantle boundary?

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Late Archean Au systems, east Yilgarn Craton, WA

The Late Archaean gold deposits are known from five continents, hosted within supra-crustal volcano-sedimentary sequences and spatially associated with trans-crustal structures, 100s of kilometres in length, as exemplified by the deposits of the eastern Yilgarn Craton,WA. All the productive gold camps of the eastern Yilgarn gold province show evidence of deposit to district scale mineral zoning and systematic patterns in $^{13}C_{carbonate}$ and $\delta^{34}S_{sulfide}$ that can be related to chemical gradients sustained by fluxes of reduced (H_2, CH_4) and oxidized gases (SO_2).

By-product of Earth degassing

Late Archean Au deposits can be interpreted as one manifestation of planetary degassing of highly reduced and oxidized volatiles at ~ 2.7 to 2.5 Ga and provide insight into the fluid history of a significant section of the Earth's crust for this epoch. Arguably there is a common heritage with other phenomena of the late Archean including large amplitude mass-independent fractionation (MIF) of ^{33}S. Oxidised volatiles were of magmatic/mantle affinity ($\delta^{34}S$ $SO_{2(g)}$~1 ‰; $\delta^{13}C$ $CO_{2(g)}$ ~ -5 ‰). Possible sources of reduced volatiles include serpentinisation reactions in the deep-crust or mantle wedge. Thermodynamic studies and inclusion mineralogy of diamondiferous kimberlites and lamproites suggest hydric fluids could dominate at depths greater than 300 - 400 km

Electrical instabilities on the core-mantle boundary?

It is hypothesized that the ultimate driver of reduced volatile fluxes and of late Archean Au metallogeny was an electron flux from the core-mantle boundary that released H from the mantle ($e + OH^{1-}_{min} = O^{2-}_{min} + H$) leading to reduction of oxidized C and S species in the upper mantle. Interaction of mantle volatiles and crustal hydrothermal systems constrained the formation of Au deposits/camps.