Cratons, metasomatism and metallogeny

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The single largest influence on the formation of Earth's ore deposits was the generation of the Archean subcontinental lithospheric mantle (SCLM). Convergent geochronology datasets including Hf-isotope model ages for zircons and Re-Os model ages for mantle sulfides indicate that over 75% of the SCLM and its then overlying crust (now mostly lower crust) formed at 3.5-3.0 Ga, probably in a global overturn event/events that marked a change in Earth's fundamental geodynamic behaviour.

The primitive SCLM has subsequently played a major role in crustal metallogeny for many ore types [1]. *#1:* the high degree of buoyancy of this ancient SCLM relative to the asthenosphere, results in the persistence today of low-density, rheologically coherent Archean domains and commonly, the preservation of old crustal domains. *#2:* the enduring (and volumetrically dominating) Archean lithospheric mantle domains are a reservoir for metasomatic enrichment over their 3.5 billion year history, creating a potentially metallogenically-fertile mantle impregnated with critical elements (ie.g., Au, Cu, Ni and PGEs [2]). *#3:* the formation of Archean cratons provided an architectural mantle-scape of regions with contrasting rheology, composition and thickness. These cohesive Archean domains control magma and fluid pathways around their margins and along old sutures between blocks, and may act as both sinks and sources for ore-forming elements depending on the geodynamic evolutionary stage. *#4:* if the first stabilisation of lithospheric mantle at 3.5 Ga signalled the end of a mantle overturn regime (either uniquely, or intermittent with subduction), then this is when long-lived tectonic regimes conducive to mineralising systems (e.g. back-arc basins, passive margins, cratonic boundaries) became available [3].

[1] Griffin *et al*. (2013) *Nature Geoscience* **6**, 905-910. [2] Begg *et al*. (2010) *Econ. Geol*. **105**, 1057-1070. [3] Griffin *et al*. (2014) *Lithos* **189**, 2-15.