The lithosphere, geodynamics and Archean mineral systems

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Geochemical and geological evidence suggests that subduction processes, critical for the formation of many magmatic and hydrothermal ore deposits, have been active since about 3.9Ga. The emergence of the Sub-Continental Lithospheric Mantle (SCLM) between ca 3.6–3.0 Ga provided the ability to preserve such deposits for the first time. Pristine SCLM, a residue of high temperature plume melting, is depleted (Fe-poor), buoyant, refractory, and has very high viscosity. Integration of geological, geophysical and geochemical data from the crust and mantle, supported by Hf-isotopic studies, indicates that Archean SCLM underlies the majority of continental crust.

The physical properties, architecture, and metasomatic history (influenced by prior subduction) of the SCLM has had a profound influence on the location, style and preservation potential of many ore deposit types. Whilst translithospheric faults became conduits for magmas and ore fluids, fragmentation of SCLM provided backarc and pericratonic basins, host to many magmatic and hydrothermal deposit types. Continents appeared, with peripheral shelves and interior basins hosting giant bedded deposits, aided by an increase in metal mobility accompanying the rise of an oxygenated atmosphere. The appearance of the SCLM provided a place to store metals, structures to focus melts and fluids, a host of new ore deposit settings, and the means to preserve the resultant mineral deposits.