Crust-mantle evolution in NW Spitsbergen: Re-Os, U-Pb, and Hf isotope data

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In situ isotopic analyses have been carried out on sulfides in mantle xenoliths and on detrital zircons from NW Spitsbergen to explore the relationship between thermal events in the sub-continental lithospheric mantle and the overlying crust. *In situ* Re-Os analysis on mantle sulfides indicate multiple events from Archean (ca. 2.9 Ga) to Phanerozoic age (ca. 0.4 Ga). The oldest sulfide population preserved in most depleted peridotites (ca. 2.7–2.9 Ga), represents a minimum age for the oldest melt depletion event. The sulfide populations between ca. 1.3 and 1.7 Ga broadly correlate with the recorded crustal ages, while the sulfide populations ca. 1.8–2.3 Ga have no crustal equivalent, suggesting that they may result from overprinting of older sulfide populations by metasomatic addition of radiogenic Os. One significant age population (T_{MA} model age ca. 0.94 Ga) correlates well with a major crustal tectonic event. The youngest sulfide population (T_{RD} model age ca. 0.59 Ga) may represent refertilisation of the lithospheric mantle by metasomatic fluids introduced during Caledonian time.

Detrital zircon grains were collected from outwash streams of the Adolfbreen glacier that covers a large area of outcropping local crustal rocks (Hecla Hoek formation). *In situ* U-Pb and Hf isotope analysis on these zircons show that the oldest population has Archean inherited ages (ca. 2.5–2.9 Ga) similar to the oldest mantle sulfide population. The Grenvillian zircons (ca. 0.94 Ga) have Hf isotope compositions that indicate reworking of older continental crust without juvenile input. In contrast, the Hf isotope composition of zircons ca. 1.3–1.8 Ga show juvenile magma input as well as reworking of pre-existing continental crust. Several Caledonian events (ca. 0.58–0.32 Ga) also reveal both juvenile input and a reworked component.

Therefore the major mantle events correspond in timing with crustal melting and reworking episodes indicating that tectonic events affected the whole lithospheric column in this region since ca. 2.9 Ga.