

Widespread metasomatism in the sub-African mantle: Fossil evidence from kimberlitic zircon megacrysts

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New U-Pb age constraints and Hf-isotope compositions are presented for megacrystic zircons derived from kimberlites erupted at 19 locations across southern Africa. Neodymium isotope data are also presented for zircons from some sites. We demonstrate that these zircons preserve a record at least two temporally and compositionally discrete metasomatic events. The influence of these events extends over length-scales of thousands of kilometres, apparently unaffected by lithospheric structure.

A detailed investigation of the most recent event reveals that the metasomatic agent is best characterised as a carbonatite melt with a high Lu/Hf composition. This carbonatite was itself derived from a source carrying an unradiogenic Hf isotope signature similar to source rocks that generate lamproite magmas, and was stored and subsequently tapped by successive kimberlite magmatic events. As a consequence, zircon megacrysts that formed shortly prior to kimberlite eruption, preserve a circa 60 Ma record of this metasomatised mantle source, including the evolution of its Hf-isotope composition through time.

This model has important implications for kimberlite petrogenesis as, although the latter are slightly younger (based on independent geochronological data) there is a close similarity between the Hf (and Nd) isotope compositions of the zircon megacrysts and their host kimberlite magmas. The latter, like the zircon megacrysts, also preserve a correlation between Hf isotope composition and age.