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Partial meltig and reenrichment events in the mantle underneath Archean and Proterozoic crust of southern Africa and relationships with the tectonomagmatic evolution of the crust

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Processes connected with the formation and modification of the sub-continental lithospheric mantle are recorded in the trace element abundances and isotope ratios of peridotites and their constituent minerals. The main hosts for lithophile elements are garnet and clinopyroxene in grt-peridotites. Their analysis will yield uncontaminated bulk rock information on the nature of partial melting and enrichment processes. We analysed major and trace elements and the Sm-Nd and Lu-Hf isotope systematic of single crystal subcalcic garnets and cpx and grt separates from grt-harzburgites and -lherzolites from Bellsbank, Finsch, Roberts Victor and Bultfontein diamond mines (Kaapvaal craton; Archean crust) and from grt-lherzolites from the Gibeon province in Namibia (Rehoboth terrane; mostly Proterozoic crust). Similarities of the mantle beneath these crustal segments lie i) in coinciding conductive geothermal gradients, ii) in geochemical tracers which suggest that the majority of the peridotites are residues of partial melting at shallow depth with subsequent subduction and iii) in geochemical tracers which show metasomatic overprint to various extent. Differences are i) that a distinct departure of the geothermal gradient to high temperatures occurs at shallower depth beneath the Gibeon Province than for the Kaapvaal craton and ii) that the average degree of partial melting is higher underneath the Kaapvaal craton than underneath Gibeon.

Literature data indicate a separate history of the Kaapvaal E- and W-block until 2.88 Ga ago when they collided. Crust formation on the E-block began at 3.7 Ga. No such old mantle age is recorded, but a 3.3 Ga Lu-Hf enrichment age shows that a previously depleted mantle existed underneath this old crust by then which was stable enough to hold a crust with TTG's and greenstone belts. The next recording of a mantle event is a 2.95 Ga Lu-Hf partial melting isochron from Roberts Victor which implies an oceanic lithosphere between the two blocks.

The existence of the W-block begins at 3.2 Ga as recorded by Re-depletion mantle ages and zircon crustal ages. The next mantle event is a Lu-Hf enrichment age at 2.62 Ga from Finsch which coincides with the 2.6 to 2.8 Ga craton-wide Ventersdoorp magmatism. Further metasomatism occurred at 1.9 Ga whichbe connected with the attachment of the Kheis-Magondi belt to the Kaapvaal craton. Such a time is also recorded in the Gibeon peridotites as a Lu-Hf age for an enrichment event. This widely occurring time in crust and mantle may mark the time when the southern African proterozoic and Archean building blocks were unified. The accretion of the Namaqua-Natal belt may have finally led to ubiquitous metasomatism throughout this huge block as indicated by a Lu-Hf isochron and several Sm-Nd error chrons in the mantle samples. Our work shows that multiple mantle events can be correlated with the tectonomagmatic evolution of the crust.