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Slow erosion of sub-rift continental lithospheric mantle : xenolith evidence for rising geothermal gradients beneath the Lambert-Amery Rift, East Antarctica

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Garnet and spinel peridotite xenoliths from the Lambert-Amery Rift in eastern Antarctica record several events during the transition from stable continental mantle lithosphere to upwelling asthenospheric mantle beneath a major rift, an aulagocen related to the drifting of India from Anarctica. The xenoliths can be used to decipher four stages before entrainment of the xenoliths in the host magma. The first is characterised by spinel lherzolites derived from harzburgitic protoliths for which thermobarometry returns low temperatures (830-850°C). Early olivines and orthopyroxenes have low concentrations of many transition elements and are Ca-poor. After a second stage of garnet growth, also from harzburgitic protoliths, there was a clinopyroxene growth event, probably in all xenolith groups: equilibrium with olivine and orthopyroxene was not attained in all samples, so that the non-judicious use of thermobarometers can produce erratic results. During the fourth stage, an enrichment episode affected all spinel-garnet peridotites and about half of the spinel peridotites. Enrichment in CaO, Al2O3 and trace elements occurred, the modal content of olivine was reduced, and garnets were almost completely transformed to kelyphite. The early 830-850°C temperatures are superceded by the main xenolith geotherm (20-24 kbar at 1040-1180°C), whereas kelyphite formation occurred at 180-200°C hotter than the main xenolith geotherm. The three progressively hotter geotherms can be related to the upward and outward movement of the lithosphere-asthenosphere boundary during development of the sub-rift mantle.