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Palaeoproterozoic eclogites: exhumation and burial convolution of P-t histories

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One of the first appearances of eclogite-facies assemblages in the geological record is documented in the Palaeoproterozoic Usagaran Belt in central Tanzania, where the extended margin of the Tanzanian Craton is interpreted to have been subducted (Moller et al., 1995; Reddy et al., 2003). The c. 2000 Ma eclogites contained the assemblage garnet + omphacite + rutile + quartz ± kyanite and have subsequently been overprinted by diopside + plagioclase + hornblende + ilmenite ± orthopyroxene. Mineral equilibria forward modelling indicates the eclogites reached minimum peak pressures of c. 18 kbar, and Zr-in-rutile thermometry yields peak temperatures of 755–770 °C. Peak pressure–temperature (P–T) conditions are consistent with a cool geothermal gradient of c. 460 °C/GPa. The retrograde history of the eclogite-facies rocks is characterised by post-peak near-isothermal decompression to high thermal gradient granulite-facies conditions of c. 6.5–7.5 kbar and 800 °C. The relic eclogite domains are encased within highly strained mafic and metapelitic lithologies. The metapelites contain garnet-kyanite-biotite-staurolite-hornblende-plagioclasie-rutile-quartz. P–T modelling incorporating assemblages included in garnet and in the matrix indicates that the metapelites experienced peak pressures of c. 7.3–8.3 kbar and 680–700 °C, coinciding barically with the retrograde assemblages in the eclogites. Thus, burial of the lower-grade metapelites to maximum depths conceivably occurred while the eclogites where being exhumed. This may have occurred as rock volumes were mixed together in a continental subduction channel with burial and exhumation paths convolving. However, given the continental nature of the materials, the mixing of rocks with contrasting thermobarometric histories may reflect an upper plate (metapelite)-lower plate (eclogite) architecture developed during extension, but not recognised structurally during sampling. The retrograde reaction textures in the metapelites point to isobaric cooling suggesting that after the contrasting baric histories merged, the drivers for exhumation ceased.