Temporal constraints on Palaeoproterozoic eclogite formation and exhumation (Usagaran Orogen, Tanzania)

Author(s)

Alan S. Collins*
Steven M. Reddy
Craig Buchan
Abdul Mruma

Abstract

In-situ rock suites that preserve assemblages consistent with metamorphism to eclogite-facies conditions are absent from the Archaean. Their Palaeoproterozoic appearance is one of the markers of the onset of tectonic processes similar to those seen in the Phanerozoic Earth. We report new U–Pb Secondary Ion Mass Spectrometry (SIMS) zircon data from the oldest known eclogites (the ~2.0 Ga Usagaran eclogites, Tanzania) that constrain the timing of high-grade metamorphism, deformation and exhumation of these eclogites and constrain the speed of these processes at this critical period in Earth history.

Direct dating of metamorphic zircon from mafic eclogites, and isostructurally recrystallised zircon rims from pelites and felsic gneisses indicates that high-grade metamorphism occurred at 1999.1±1.1 Ma. The rocks were quickly cooled and exhumed at rates of ~25 °C/Ma and 0.06–0.22 GPa/Ma, respectively, at least in part, by amphibolite-facies sinistral transpression constrained by a 1991±2 Ma pegmatite dyke that crosscuts foliation. Detrital zircons in metasedimentary gneiss protoliths were dominantly derived from two sources: (1) the Tanzanian craton, and (2) a 2400–2640 Ma source region that is compatible with a belt of reworked Archaean and Palaeoproterozoic rocks that lie in the East African Orogen.

Keywords

- eclogite;
- Palaeoproterozoic;
- SHRIMP;
- U–Pb isotopes;
- Usagaran Orogen;
- exhumation;
- zircon;
- dating deformation;
- Tanzania;

- geochronology