Complex high-strain deformation in the Usagaran Orogen, Tanzania: structural setting of Palaeoproterozoic eclogites

Author(s)

S.M Reddy[a,*],
A.S Collins[a],
A Mruma[b]

Abstract

The Palaeoproterozoic Usagaran Orogen of Tanzania contains the Earth's oldest reported examples of subduction-related eclogite facies rocks. Detailed field mapping of gneisses exposed in the high-grade, eclogite-bearing part of the orogen (the Isimani Suite) indicates a complex deformation and thermal history. Deformation in the Isimani Suite can be broadly subdivided into five events. The first of these (D_1), associated with formation of eclogite facies metamorphism, is strongly overprinted by a pervasive deformation (D_2) at amphibolite facies conditions, which resulted in the accumulation of high strains throughout all of the exposed Isimani rocks. The geometry of foliations and lineations developed during D_2 deformation are variable and have different shear directions that enable five D_2 domains to be identified. Analysis of these domains indicates a geometrical and kinematic pattern that is interpreted to have formed by strain and kinematic partitioning during sinistral transpression. U–Pb SHRIMP zircon ages from a post-D_2 granite and previously published geochronological data from the Usagaran eclogites indicate this deformation took place between 2000 ± 1 Ma and 1877 ± 7 Ma (at 1σ error). Subsequent greenschist facies deformation, localised as shear zones on boundaries separating D_2 domains, have both contractional and extensional geometries that indicate post-1877 Ma reactivation of the Isimani Suite. This reactivation may have taken place during Palaeoproterozoic exhumation of the Usagaran Orogen or may be the result of deformation associated with the Neoproterozoic East African Orogen.

U–Th–Pb SHRIMP zircon ages from an Isimani gneiss sample and xenocrysts in a "post-tectonic" granite yield ~2.7 Ga ages and are similar to published Nd model ages from both the Tanzanian Craton and gneiss exposed east of the Usagaran belt in the East African Orogen. These age data indicate that the Isimani Suite of the Usagaran Orogen reflects reworking of Archaean continental crust. The extensive distribution of ~2.7 Ga crust in both the footwall and hangingwall of the Usagaran Orogen can only be explained by the collision of two continents if

the continents fortuitously had the same protolith ages. We propose that a more likely scenario is that the protoliths of the mafic eclogites were erupted in a marginal basin setting as either oceanic crust, or as limited extrusions along the rifted margin of the Tanzanian Craton. The Usagaran Orogen may therefore reflect the mid-Palaeoproterozoic reassembly of a continental ribbon partially or completely rifted off the craton and separated from it by a marginal basin.

Keywords

- Tectonics;
- Kinematics;
- Shear zone;
- Transpression;
- SHRIMP U–Pb geochronology