Heterogeneous excess argon and Neoproterozoic heating in the Usagaran Orogen, Tanzania, revealed by single grain $^{40}Ar/^{39}Ar$ thermochronology

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Abstract

Existing tectonic models for the evolution of the Usagaran Orogen place much significance on Palaeoproterozoic K–Ar and Rb–Sr ages. Laser $^{40}Ar/^{39}Ar$ data from single mica grains from the Isimani Suite near the western margin of the orogen indicate that excess ^{40}Ar is common in micas and this casts considerable doubt on tectonic models that are based on previously published K–Ar ages. Biotites lying within a well-developed S_2 foliation (previously constrained at 1999–1991 Ma) yield ages up to 3.3 Ga and contain a significant excess ^{40}Ar component that is variable at an intra- and inter-sample scale. Textural evidence indicates that muscovite grew or recrystallized after the synkinematic biotites and they also record younger $^{40}Ar/^{39}Ar$ ages with individual steps from 524 to 1055 Ma. It is shown that the mica age variation does not reflect different periods of growth but the preferential partitioning of excess ^{40}Ar into the biotite. The muscovite data also have a component of excess ^{40}Ar and the youngest muscovite $^{40}Ar/^{39}Ar$ date (535.4 ± 2.3 Ma) indicates a maximum age for greenschist facies metamorphism. This date corresponds to thermal activity associated with the East African Orogen. Greenschist facies deformation (D_4 and D_5) is interpreted to have been coincident with this thermal event and indicates localized tectonic activity associated with Gondwanan amalgamation. The data are also consistent with greenschist facies deformation, metamorphism and deposition of the Usagaran Konse Group being of Neoproterozoic–Early Palaeozoic age. These new data therefore preclude a solely Palaeoproterozoic tectonic history for the Usagaran Orogen and indicate a complex thermal-tectonic reworking in the Neoproterozoic–Early Palaeozoic.

Keywords

- Palaeoproterozoic;

- Usagaran Orogen;
- East African Orogen;
- Ar laser microprobe;
- $^{40}Ar/^{39}Ar$ geochronology;
- Deformation