Thermal evolution of the Mozambique Belt in northern Tanzania: Accessory phase U-Pb depth profiling

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The Mozambique Belt outboard of the Tanzanian Craton formed in the Neoproterozoic by continental collision between East and West Gondwana during the Himalayan-scale East African Orogeny (EAO). Recently erupted xenoliths and surface outcrops, which were metamorphosed at amphibolite to granulite facies during collision, allow comparison of the thermal history of different crustal levels following the EAO. New U-Pb zircon, rutile and apatite dates from xenoliths and outcrops—measured using depth profiling by single shot laser ablation ICP-MS—are consistent with slow cooling in the present-day middle and lower crust (~1–2 °C/Ma) and faster cooling of the present-day upper crust (~2–5 °C/Ma) following the EAO.

Granulite xenoliths from Naibor Soito and Kisiete in northern Tanzania are interpreted to be derived from the lower crust, whereas a xenolith from Olmani is inferred to originate in the middle crust. Zircon from the lower crustal xenoliths yield Archean dates (2.8–2.6 Ga) that show low degrees of Pb loss in the Neoproterozoic. Rutile and apatite have low Pb/U despite containing appreciable amounts of U (~0.5–8 ppm), indicating residence above the closure temperatures (Tc) to volume diffusion of Pb before being erupted. Zircons from the mid-crustal xenolith have thin (<13 µm) concordant c. 550 Ma rim dates that mantle Archean (c. 2.7 Ma) cores. This is the first evidence of zircon growth in the deep crust of the EAO. Rutile in this sample has low Pb/U and also indicates residence above rutile Pb Tc prior to eruption. Apatite in this sample yields dates between 500–400 Ma and imply that the middle crust relaxed above apatite Pb Tc after collision at c. 550 Ma.

Zircon from surface granulites from Loibor Serrit, the westernmost extent of the Mozambique Belt in Tanzania, have a range of concordant dates between c. 900–650 Ma. Rutile analyzed in one sample yields concordant or near concordant dates at c. 550 Ma. Apatite in these samples have a spread of ages from 500–450 Ma; apatite in the granulite sample from which rutile was also dated are c. 500 Ma. The close range of dates recorded in the rutile and apatite, in conjunction with previously reported c. 560 Ma U-Pb monazite dates from similar sample suites, imply that the surface granulites cooled quickly following the EAO.