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Cylindrical whiskers of merelaniite give Re-Os minimum age for close of Pan African deformation, Merelani tanzanite deposit, Tanzania

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The Merelani Hills region of Tanzania hosts spectacular gemstones including blue vanadium-bearing tanzanite, a variety of zoisite. The region underwent a long polycyclic metamorphic history commencing with upper granulite facies conditions at ~1000-900 Ma, followed by multiphase retrograde deformation events associated with crustal uplift between 850-600 Ma, and subsequent overprinting deformation and later brittle structures from 560-500 during the Pan African orogeny [1,2]. Two distinct processes, retrograde reaction of grossular garnet, and later hydrothermal fluids invading brittle shear zones and tensional structures, are associated with tanzanite formation [2]. Our study addresses the timing of open-space, deformation-free mineralization.

Tanzanite is hosted in graphite-kyanite units within a garnet-sillimanite gneiss [3]. Five tanzanites yield an imprecise 607 ± 95 Ma Sm-Nd isochron; $^{40}Ar/^{39}Ar$ dating of micas produces 525-505 Ma ages [4]. Negative ^{13}C isotope data for graphite and a Re-Os age of 586.9 ± 2.4 Ma with an Os initial ratio of 1.68 ± 0.04 for graphite [5], together with V-Cr enrichment in the hydrothermal system, affirm a black shale protolith for graphite-rich gneisses.

Working with slender, tightly wrapped, cigar-like spindles of the newly discovered mineral merelaniite ($Mo_4Pb_4VSbS_{15}$), tens of micrometers in diameter and typically <1 mm in length [6], we show that single merelaniite spindles provide precise Re-Os model ages, with a Re-Os isochron age of 524.4 ± 3.7 Ma. Rhenium concentration data and Os isotopic compositions of merelaniite mimic molybdenite showing no common Os. Maneuvering tiny cylinders presented challenges, and we resorted to working with “whole rock” samples consisting of merelaniite whiskers in calcite crystals.

The association of undeformed graphite with merelaniite documents at least one additional phase of graphite deposition [6]. Putting time pins in polycyclic processes is challenging, but here we provide a minimum age of ~525 Ma for cessation of deformation associated with the Pan African orogeny in this region.

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