Timescale of continental collision: Neoproterozoic eclogite-to granulite-facies transition in the Paleoproterozoic Ubendian Belt (SW Tanzania)

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In collision-type orogens, where high-pressure and ultrahigh-pressure (H*P*–UH*P*) metamorphism usually occurs, deeply subducted continental slabs with eclogitized mafic rocks often undergo recrystallization/overprinting with various geothermal gradients after the peak conditions at lower-to-middle-crustal levels. During the crustal stabilization, the transition from eclogite-to granulite-facies is common. We conducted metamorphic petrology and zircon geochronology on (1) Neoproterozoic bimineralic and (2) partially granulitized kyanite-bearing eclogites associated within Paleoproterozoic Ubendian granitoids (Ganbat et al., 2021) from the Northern Ufipa Terrane of the Ubendian Belt, SW Tanzania (Morita et al., 2022). As documented in Morita et al. (2022), microtextural relationships and mineral chemistry define three metamorphic stages: eclogite metamorphism, granulite-facies overprinting, and amphibolite-facies retrogression. The bimineralic eclogite has a basaltic composition and lacks granulite stage minerals. In contrast, the kyanite eclogite is characterized by a gabbro-dioritic whole-rock composition and contains inherited ~1.92–1.85 Ga magmatic zircon; note that the eclogite-hosting high-K and calc-alkaline granitoids contain ~1.89–1.85 Ga zircons with rare ~570 Ma metamorphic overprints. Although the matrix of kyanite eclogite is highly granulitized, garnet and kyanite contain eclogite-facies mineral inclusions. Phase equilibria modeling revealed *P*–*T* conditions of 2.1–2.6 GPa and 650–860°C for the eclogite stage and 1.4–1.6 GPa and 750–940°C for the granulite stage. Zircon with eclogite-facies mineral inclusions from the bimineralic eclogite lacks Eu anomaly in the REE patterns and yielded the eclogite metamorphic age of 588 ± 3 Ma. Zircon overgrowths surrounding the inherited Paleoproterozoic magmatic cores in kyanite eclogite yielded 562 ± 3 Ma. A weak negative Eu anomaly in the REE patterns and the absence of eclogitic mineral inclusions suggest the zircon growths at the granulite-facies metamorphic stage. These new data indicate an eclogite-to granulite-facies transition time of 26 ± 4 million years (Myr), suggesting a rate of H*P* rock exhumation toward a lower crustal level of 0.7–1.5 mm/year. Furthermore, the density evolution model indicates that buoyant host orthogneiss with low-density gabbro-dioritic eclogite plays an important role in carrying high-density basaltic eclogite. Our 2D thermomechanical modeling also suggests that a slab break-off with a lower angle subduction of <20° triggers the exhumation of the H*P* slab sliver with 20–30 Myr eclogite-to granulite transition time of large H*P*–UH*P* terranes in major collision zones.

Ganbat, A., Tsujimori, T., Boniface, N., Pastor-Galán, D., Aoki, S., Aoki, K., 2021. Crustal evolution of the Paleoproterozoic Ubendian Belt (SW Tanzania) western margin: A Central African Shield amalgamation tale. *Gondwana Research* 91, 286-306, https://doi.org/10.1016/j.gr.2020.12.009

Morita, I., Tsujimori, T., Boniface, N., Flores, K., Aoki, S., Aoki, K., 2022. Neoproterozoic eclogite-to granulite-facies transition in the Ubendian Belt, Tanzania, and the timescale of continental collision. *Journal of Petrology* 63, 1-24, https://doi.org/10.1093/petrology/egac012