Early Eocene thickening revealed by Tibetan garnet

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Tectonic reconstructions of the Himalayan orogen require knowledge on the timing of crustal thickening. Early (~35 Ma) extensional fabrics in the Northern Himalaya and Eocene plutons (~44 Ma) cutting older fabrics in the low-grade Tethyan Himalaya indicate that thickening commenced before the Oligocene. Nevertheless, reliable records of any early metamorphism and deformation have been largely obliterated during post-Eocene overprinting. This hiatus in the geological record is a major obstacle in reconciling the evolution of Himalayan mountain building and its link to the ~55-Ma collision between Eurasia and the Tibetan-Himalaya microcontinent. The goal of this study is to investigate the early Himalayan history. To this end, we performed Lu-Hf geochronology on kyanite- and sillimanite-grade metapelites from the high-grade cores of North Himalayan gneiss domes at Mabja and Kangmar, Tibet.

Garnet from Mabja and Kangmar exclusively yielded early Eocene Lu-Hf ages. On the basis of microstructural, and major-element and REE zoning observations, we interpret these ages as recording garnet growth during middle crustal contractional deformation at ~54 Ma, followed by variable recrystallization during subsequent high-temperature ductile extension. The new Lu-Hf ages are the first to confirm the suggestions made from field data and geodynamic models that significant crustal thickening and contraction in the Tibetan Himalaya started during the early Eocene. These processes were broadly synchronous with the collision between the Tibetan Himalaya micro-continent and the Eurasian plate, and the development of the Tethyan fold-and-thrust belt. This synchronicity implies that thickening of the deep crust of southern Tibet commenced during collision, proceeded rapidly, and caused rocks to become buried to about twice their orginal depth on a million-year time scale.