Raising the Gangdese Mountains in southern Tibet

DI-CHENG ZHU[1,2,*], QING WANG[1], PETER A. CAWOOD[3], ZHI-DAN ZHAO[1], XUAN-XUE MO[1]

[1] State Key Laboratory of Geological Processes and Mineral Resources, and School of Earth Science and Resources, China University of Geosciences, Beijing 100083, China

[2] CAS Center for Excellence in Tibetan Plateau Earth Sciences, Beijing 100101, China

[3] Department of Earth Sciences, University of St Andrews, North Street, St Andrews KY16 9AL, UK

Tibet has the world's largest and highest plateau and the thickest continental crust (60–80 km). When and how the plateau achieved these features is one of the most intriguing issues in the Cenozoic history of our planet. The surface uplift of mountain belts reflects the combined effects of crustal thickening and mantle dynamic processes (e.g., lithospheric delamination or slab breakoff). Understanding the history and driving mechanism of uplift of the plateau requires accurate knowledge on the crustal thickening over time. Here we determine spatial and temporal variations in crustal thickness following the method of Profeta et al. (2015), which involves whole-rock La/Yb ratios of intermediate rocks, using a large dataset of the intermediate intrusive rocks from the Gangdese arc in southern Tibet. Our results show that the Gangdese crust began to thicken from a normal thickness of ca. 37 km at ca. 70 Ma, reaching ca. 58 km at 60−45 Ma, due to magmatic underplating as a consequence of rollback and then breakoff of the subduction Neo-Tethyan slab (Zhu et al., 2015), before attaining a thickness of ca. 68 km at ca. 20−10 Ma, due to the underthrusting of India and associated thrust faulting. The Gangdese Mountains attained an elevation of over ca. 4000 m at ca. 60 Ma locally, became broader at ca. 54−45 Ma as a result of isostatic surface uplift driven by crustal thickening and slab breakoff, and reached their present-day elevation by 20−10 Ma. Our paleoelevation estimates are in good agreement with evolving paleoelevations reconstructed by stable isotopic data from Linzhou (ca. 4500 m at ca. 54 Ma; Ding et al., 2014), Oiyug (ca. 5200 m at ca. 15 Ma; Currie et al., 2005), and Kailas (ca. 4800 m at ca. 25 Ma; DeCelles et al., 2011).

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