Paper Number: 2343

Subduction of the Indian lower crust beneath southern Tibet: Evidence of zircon Hf–O and whole-rock lithium isotopic characteristics of post-collisional potassic and ultrapotassic rocks in SW Tibet

Tian, S.H.[1, 2], Hou, Z.Q.[3], Yang, Z.S.[1], Zhao, Y.[1], Mo, X.X.[2], Hu, W.J.[4] and Zhao, X.Y.[1]

[1]MLR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing 100037, PR China (s.h.tian@163.com)
[2]School of Earth Science and Mineral Resources, China University of Geosciences, Beijing 10083, PR China
[3]Institute of Geology, Chinese Academy of Geological Sciences, Beijing 100037, PR China
[4]Jiangxi Provincial Institute of Geological Survey, Nanchang 330030, PR China

---

New major and trace elemental, Sr–Nd–Pb–Li isotope, and zircon Hf–O isotope data of post-collisional potassic and ultrapotassic volcanic rocks (PVRs and UPVs, respectively) along with geochemical data of PVRs, UPVs, and Mg-rich potassic rocks (MPRs) in the literature are used to constrain their mantle source and genesis. The PVRs, UPVs, and MPRs share similar geochemical features but with some discrepancies, suggesting that they were derived from subcontinental lithospheric mantle (SCLM) with isotopic heterogeneity resulting from the varying contributions of subducted Indian lower crust into the mantle source [1].

The zircon Hf–O isotopic compositions of the PVRs and UPVs can be classified into two groups, including Group I rocks with high $\delta^{18}O$ (6.7–11.3‰), low $\varepsilon_{Hf}(t)$ (−17.0 to −12.0), and old Hf crustal model ages (1.87–2.19 Ga) that indicate an ancient SCLM source, and Group II rocks with $\delta^{18}O$ values of 6.8–10.7‰, $\varepsilon_{Hf}(t)$ values of −11.8 to −6.3, and younger Hf crustal model ages (1.50–1.86 Ga) [1]. The negative correlation defined by $\delta^{18}O$ and $\varepsilon_{Hf}(t)$ of Group II samples suggests a two-component mixing between mantle- and crust-derived melts, in which the latter would be the subducted Indian lower crust as indicated by the similar negative $\varepsilon_{Hf}(t)$ values between Group II samples (−11.8 to −6.3) and the High Himalayan gneiss (−14.2 to +0.3) [1, 2]. The PVRs, UPVs, and MPRs are characterized by varying Li concentrations (11.2–64.9 ppm) and variable Li isotopic compositions (-4.9 to +3.5 ‰). Among them, the majority of the PVRs, UPVs, and MPRs have δ^7Li values between -4.4 ‰ and +1 ‰, which overlap with the unreported values for the Indian lower crust [3]; some have higher δ^7Li values between +1 ‰ and +3.5 ‰, similar to those of MORB and OIB [4]. These variable δ^7Li compositions could not have been produced by diffusive–driven isotopic fractionation of Li and thus may record the isotopic signature of the subcontinental lithospheric mantle. This paper demonstrates the existence of anomalous δ^7Li within the subcontinental lithospheric mantle, suggesting that the SCLM beneath the Lhasa block was modified by interaction with fluids/melts derived from subducted Indian lower crust.

Thus we propose two enrichment events to account for the Hf–O–Li isotopic compositions of the PVRs and UPVs/MPRs: the first involves the enrichment of the overlying SCLM that was metasomatized by fluids derived from dehydration of the subducted Indian lower crust, and the second invokes the enrichment of the overlying SCLM metasomatized by melts of the already dehydrated different proportions of the Indian lower crust. We argue that break-off of the northwards subducted Indian Plate in the early Miocene caused the asthenospheric upwelling under the Indian plate through slab window, resulting in varying degrees of partial melting of the overlying metasomatized heterogeneous SCLM to produce the primitive magmas of the PVRs, UPVs, and MPRs in an extensional setting. These observations and interpretations imply that the Indian lower crust was subducted beneath the Lhasa terrane in the early-middle Miocene [1].

References:

[1] Tian S et al. (2015) Gondwana Res 10.1016/j.gr. 2015.09.005

[2] Chu M et al. (2011) Earth Planet Sci Lett 307:479-486

[3] Tian S (2014) In: *Petrogenesis of the Miocene potassic–ultrapotassic rocks in the Lhasa terrane, Tibetan Plateau: lithium isotopic constraints (Unpublished Postdoctoral Research Report)*, 1-218

[4] Tomascak P et al. (2008) Geochim Cosmochim Acta 72:1626-1637