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The genesis of the Beina sub-rhyolite rocks: Implications for the potentiality of Pb-Zn deposits in the middle Gangdese

Jun Liu*, You Ye Zheng, and Shun Bao Gao

China University of Geosciences (Wuhan), Wuhan, China, *e-mail, 1757765503@qq.com

The Linzizong Group volcanic successions, located in the southern part of Gangdese belt, have long been regarded as the magmatic response to the continental collision between India and Asia, in which a large amount of information regarding the transformation from a syn-collision to post-collision setting have been documented. We report zircon U–Pb ages, geochemical characteristics, and Sr–Nd–Pb–Hf isotopic data for the Beina subvolcanic rhyolites in the middle Gangdese. Zircons from three subvolcanic rhyolites yield a consistent age of ~65 Ma. The subvolcanic rhyolites have a narrow range of SiO_2 (72.93–76.52 wt. %) and are enriched in K (K_2O = 4.53–5.06%) with a relatively high A/CNK (0.97–1.33). The subvolcanic rhyolites are characterized by enrichment in LILE (Rb, Th, K, LREEs) and depletion of HFSE (Nb, Ta, Ti, P) with significant negative Eu (δEu=0.27–0.48). The samples have extremely radiogenic Sr ($^{87}Sr/^{86}Sr(i)$ = 0.7126 to 0.7184) and Pb ($^{206}Pb/^{204}Pb$ = 18.61–18.74, $^{207}Pb/^{204}Pb$ = 15.65–15.68, $^{208}Pb/^{204}Pb$ = 38.99–39.14) isotopes. However, they show non-radioactive Nd (εHf(t) = –8.6 to –7.2) and Hf (εHf (t) = –8.6 to –4.7) isotopes with old Nd depleted mantle model ages (TDMNd) ranging from 1616 to 1792 Ma and Hf crustal model ages (TDMCHf) of 1433–1684 Ma. Based on our data and previous research, we propose that the Beina subvolcanic rhyolite is the product of remelting of ancient crustal basement in the middle Gangdese heated by mantle–derived basic magma in the process of subduction of the Neo–Tethys slab during India and Asia collision.

It was confirmed that the middle segment of the southern Lhasa subterrane is also an ancient block by Hf isotope mapping, which indicates that the heterogeneity of crustal basement is a key factor for the diversity within Linzizong Group volcanic successions and the distribution of different mineral deposits in the Gangdese belt. Crustal reworking leached Pb and Zn from the cover strata by felsic intrusion-driven fluids, which was critical for the formation of Pb-Zn ore deposits. The known large Pb-Zn deposits (e.g., Yaguila, Mengya'a, Longmala, Narusongduo) are mainly located in the oldest crustal areas or developed along the Hf isotope margins of the central crustal block in the eastern Gangdese belt. Recently, some deposits and mineral occurrences (e.g., Chagele, Bangbule, Nuocang, Beina) have been discovered in the Cuoqin-Ngamring area, implying the enormous potential for Pb-Zn deposits in the middle Gangdese belt.