Origin of Late Cretaceous-Paleocene granites from Tengchong terrene, Western Yunnan: implications for continental arc evolution and lithosphere subduction

Xijie Chen[1], Zhiqin Xu[1], Zhihui Cai[1], Huaqi Li[1]

[1]State Key Laboratory of Continental Tectonics and Dynamics, Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China, xijiechen2008@gmail.com

The Cenozoic geology of West Yunnan is characterized by widespread Jurassic to Cretaceous igneous rocks consisting predominantly of granites and rhyolites and subordinate mafic lithologies. However, the tectonic regime responsible for the inland Eocene granites remains controversial. We report here U–Pb zircon ages, geochemical and Sr–Nd–Hf isotopic data for Tengliang granitoid belt (Guyong Pluton, Lushui pluton, Mangdan Pluton) and West Yingjiang complex Batholith in West Yunnan. Mineralogical and geochemical features suggest that the West Yinjiang and Tengliang granitoid rocks are I- and aluminous S-type granites, respectively. LA-ICPMS U–Pb zircon analyses yield consistent ages ranging from 50.4 Ma to 60.8 Ma for three samples from the Yinjiang Batholith, and three ages of 68 Ma, 68 Ma and 66 Ma from Guyong pluton, Lushui pluton and Mangdan pluton.

The rocks from West Yingjiang are characterized by metaluminous and weakly peraluminous hornblende-bearing gneissic granites with A/CNK = 1.01-1.11, $K_2O > Na_2O$, coupled with low initial Sr isotopic values of 0.7076–0.7106 and high εNd(t) values from -4.6 to -11.9. The metamorphosed granitoids crystallized during the early Eocene (~60–50 Ma) with zircons showing εHf(t) values from +10.88 to −2.75 and crustal model ages of 1.30 to 0.59 Ga, comparable to those of coeval I-type granitoids from the Gangdese batholith, southern Lhasa. Meanwhile, the granite of 60-50 Ma which mostly distributed in the western Yingjiang area could be the direct products of Neo-Tethys northern subduction. The Tengliang granites situated west of the Gaoligong belt, were emplaced in late Cretaceous (66-68 Ma) and displayed a strong peraluminous affinity and negative εHf(t) (-24~-4) and crustal model ages of 1.41 to 2.66 Ga, indicating a provenance from a Proterozoic sedimentary source with little mantle contribution. While the magmatic arc was related to eastward subduction of the Neo-Tethys beneath the Asian continent, the S-type granites represented the melting products of thickened crust in the hinterland. Initial $^{87}Sr/^{86}Sr$ ratios are 0.7101-0.7139 and εNd(t) values from -8.91 to -13.8, considerably lower than High Himalayan leucogranites (0.74-0.79), and are indicative of a lower continental crust source. The Mesozoic granitoids of this area may have been generated mainly by reworking of deeply-buried Neoproterozoic biotite-rich pelitic materials due to thermal perturbations triggered by the subduction of Neo-Tethys in Mesozoic time. Intrusion of mantle melts provided heat to promote crustal melting and may have selectively contaminated the granite magma.

On the basis of geological, geochemical data of Late Cretaceous - Cenozoic igneous rocks in West Yunnan, we suggest that during the period from 80 to 40 Ma, the slab dip angle of Neo-Tethys plate subduction underneath Tengchong terrane increased from a very low angle to a median angle. Consequently, magmatic activity of the West Yunnan continental margin migrated oceanward to the west.

During subduction process, various degrees of mantle wedge melting and basaltic underplating provided the necessary heat to cause partial melting of lower- and middle- crust, and generation of voluminous felsic magmas. A combination of these processes is responsible for the formation of the famous Cenozoic granitoids, volcanic rocks and related ore deposits in West Yunnan.

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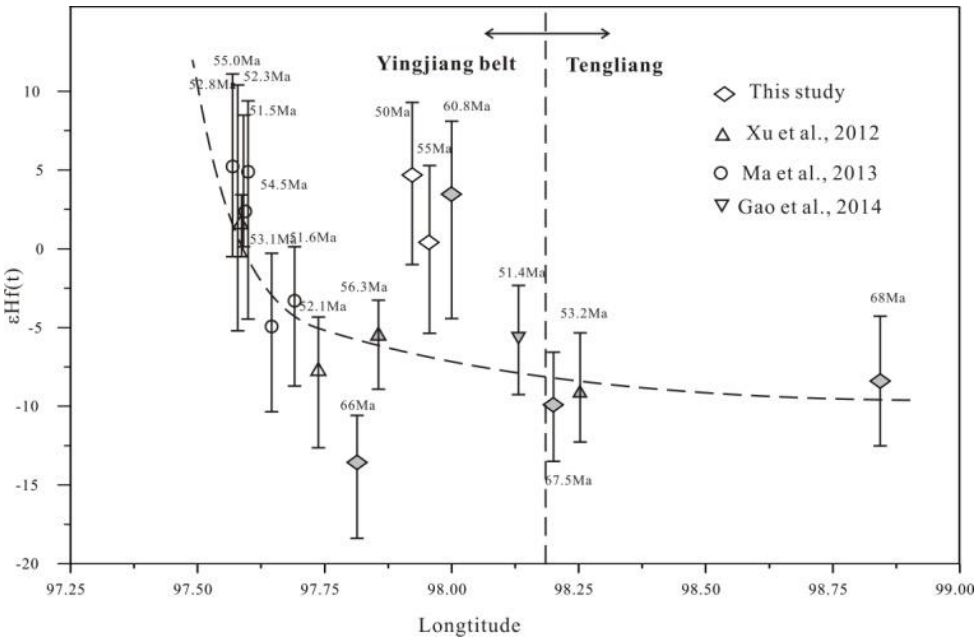

Figure 1. The spatial variation of average εHf(t) for zircons from the early Eocene granitic samples from west Yingjiang across Tengliang area. The gray color denotes the S-type granite; the white color denotes the I-type granite.

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