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Geochronology and Geochemistry of Zengga Mesozoic Grantoids from East Gangdese Batholith, Implications for the Remelting Mechanism of Granite Formation

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1 Geological Background

This paper reports geochemistry (major and trace elements), zircon U-Pb and Lu-Hf isotope studies of leucogranite, granodiorite and clinopyroxene-bearing diorite from the Zengga intrusive body, eastern Gangdese batholith, Tibet. Massive granodiorite is mainly composed of fine- and medium-grained plagioclase (65 modal %), amphibole (17 modal %), quartz (13 modal %) and a lesser amount of clinopyroxene (3 modal %) and magnetite (2 modal %). Clinopyroxene-bearing diorite is mainly composed of medium-coarse grained plagioclase (40 modal %), amphibole (38 modal %), clinopyroxene (12 modal %) and lesser sericite (2 modal %) and magnetite (2 modal %). Biotite granite is mainly composed of medium-coarse grained plagioclase, amphibole, potassium feldspar, quartz and biotite. Leucogranite is mainly composed of fine-grained quartz, plagioclase and sericite. Leucogranite itself is crosscut by veinlets composed of medium-grained quartz, epodite, zoisite and calcite.

Dong and Zhang (2013) discovered the early Jurassic (J_1) magmatism in the Zengga region within the highly deformed and metamorphosed Gangdese rock group, which was thought to be the basement of the Lhasa Terrane. A large proportion of the Cretaceous and Paleocene granitoids also occur in the Zengga and nearby areas, which make our research area an ideal place for the study of Mesozoic and Cenozoic magmatic evolution of this part of the Gangdese batholith. The carefully selected and analyzed lithologies in this study are spatially related: granodiorite and clinopyroxene- bearing diorite mainly occur in the southern part of our research area as early intrusive bodies. These are intruded by biotite granite covering most of the northern part of the region. Leucogranites occur as dykes within the biotite granite.

2 Analytical Results and Conclusions

Geochemical data show that: (1) Harker diagrams of major elements show certain linear correlations between J_1 magmatism, leucogranite, granodiorite and biotite granite compared with the Zengga Cpx-bearing diorite and gabbro (Fig. 1); (2) J_1 magmatism, leucogranites and granodiorites have similar normalized REE and trace element patterns. Bi-granite patterns are similar but with larger LREE/HREE ratios, while Zengga Cpx-bearing diorites and gabbros have different patterns.

Zircon LA-ICP-MS, U-Pb isotope studies of the three lithologies show that they were formed in the late

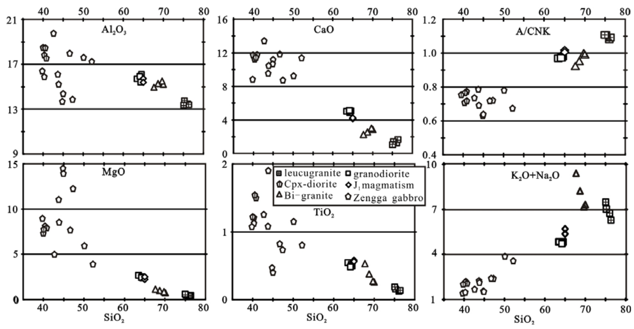

Fig. 1 Covariation diagram of selected major oxides of Al2O3, CaO, Total Fe2O3, MgO, TiO2, A/CNK and (K2O+Na2O) versus SiO2 of Zengga granudiorite, leuogranite, Cpx-bearing diorite and other intrusive rock in nearby areas. other data after Xu, 2010; Dong and Zhang, 2013; Ma et al., 2013.

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Cretaceous. Cpx-bearing diorite formed at ~88Ma without inherited cores, leucogranite formed at ~70 Ma and granodiorite formed at ~92 Ma. Zircon cores of granodiorite record an early Jurassic magmatic event. Zircons separated from leucogranites record the same magmatic event recorded by the granodiorite (both for cores and rims), and a Late Devonion to Early Carboniferous magmatic event.

Hafnium isotopes of granodiorite zircon cores and rims show weakly depleted features, with $\varepsilon_{Hf}(t)$ values= 1.6-9.2, T_{DM}^{C}=827-1511Ma for the cores and $\varepsilon_{Hf}(t)$= 1.6-6.0, T_{DM}^{C}=1053-1456Ma for the rims. We document the Hf data of the Gangdese batholith (Ji et al., 2009), East Gangdese batholith (Ji et al., 2014), J_1 Magmatism (Dong and Zhang, 2013), Zengga gabbro (Ma et al., 2013), and the Bi-granite (Xu, 2010) in Fig. 2. Hafnium isotopes show that: (1) 90-175 Ma, weakly depleted Hf isotopes ($\varepsilon_{Hf}(t)$<10); 90-60 Ma, strongly depleted Hf isotopes. The obvious jump in the Hf isotopes at ~90 Ma in the Zengga area may indicate mantle input and this may be related to mid-ocean ridge subduction (Zhang ZM et al., 2010). (2) Between 90-175 Ma, the Hf isotopes were much lower compared with the coeval magmatism of the Gangdese batholith.

The genetic relations reflected by geochemistry and zircon U-Pb and Hf isotope data of different lithologies in the Zengga area showi that remelting of pre-existing granitoids is important in controlling the Zengga granitoid formation and that the geological features of later magmatism iare closely related to earlier magmatism.

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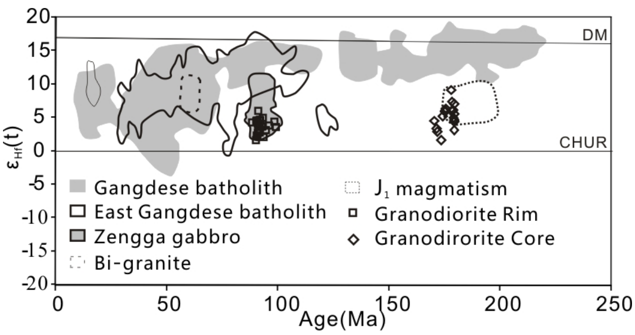

Fig. 2 Zircon epsilon Hf (t) values vs. age (Ma) diagram of the Zegang granodiorite. Other data after Ji et al., 2009; Ji et al., 2014; Ma et al., 2013; Dong et al., 2013; Xu et al., 2010.

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