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Implication of Biotite Adamellite at Gangtang Co of Qiangtang to Crust-Mantle Interactions Based on Zircon Saturation Thermometer

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1. Rock mass Characteristics

Geochemical analysis of biotite adamellite shows that SiO_2 content is 68.30%~71.42%, K_2O+ Na_2O-SiO_2 diagram shows that the granite belongs to the sub-alkaline series. It is regarded as weak or calc-alkaline granite of peraluminous because of its A/CNK at 1.08-1.14. The chondrite-nomalized REE patterns indicate that the samples enriched in LREE, and negative Eu anomaly (delta Eu=0.43~0.64). Trace elements showed the loss features of Ba, Sr, Zr, Ti and Rb,Th and U relative enrichment. Granite's color is grey or red, and morphology is block structure or plate structure. Its phenocryst is plagioclase and potassium feldspar phenocryst. Potassium feldspar, plagioclase, quartz, biotite, etc, constitute of the matrix of this biotite adamellite (Zhang et al., 2009; Sang et al., 2013).

2 Calculation of Zircon Saturation Thermometer

Generally, granite is in richer in adiabatic and zircon's crystallization is earlier, so the zircon saturation temperature can be approximately considered to the liquid temperature of the magma. In addition, the distribution coefficient of Zr in zircon is extremely sensitive to temperature and less affected by other factors. Based on Zr's content and the principle of related to the magmatic crystallization temperature, granite zirconium saturated temperature can be approximately represent magma source area of the initial temperature (magma floor or ceiling temperature), when the structure and formation of zircon is clear (Calvin et al., 2010; King et al., 2003).

In this paper, the zircon saturation temperature can be obtained by the zircon saturation temperature calculation formula of Watson et al (1983):

(1)

$$\ln D_{(Zr)}^{(49600/melt)} = [-3.8 - 0.85(M\text{-}1)] + 12900/T$$

$$t_{Zr}(℃) = \{12900/[\ln D_{(Zr)}^{(49600/melt)} + 0.85M + 2.95]\} - 273.15$$

(2) $\ln D_{(Zr)}^{(49600/melt)}$

Where is the concentration ration of Zr in the stoichiometric zircon to that in the melt M(=(2Ca+K+Na)/(Si×Al)) is rock geochemical parameters. T is absolute temperature, and t is centigrade degree. Equation (2) is transformed from equation (1). Zircon is deputy minerals whose content is very few in the granite, so this article adopts the Zr content of whole rock instead of Zr content in the melt to calculate the saturation temperature and does not calibration of Zr, using 496000^{-6} as a pure Zr content of zircon(Qin, et al., 2005).

Calculation results show that the author studies on the zircon saturation temperature of this biotite adamellite is at 807-826 ℃, and the average temperature is at 815 ℃.The zircon saturation temperature of its micro-granular enclave is at 818—865℃and the average temperature is at 845℃, which is higher than that of granite. Such results suggest that the external heat plays a important role in the formation of the rock mass.

3 Discussions and Conclusions

Miller according to zircon saturation thermometer,

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puts forward the concept of the hot and cold granitic magma. Generally, the former is greater than 800 ℃, which includes less source residue, whose formation is associated with the join of external heat. Crust produces partial melting magma which requires the participation of fluid (water), because in the case of no water melting produce melt need high temperature (Wang et al., 2011). The data of rock experiment shows that only under the condition of high temperature (>800 ℃), biotite and calcium hornblende can occur dehydration reaction (excluding cannot produce magma of the low pressure environment). So the formation of high temperature granitic magma can use the source area of hydrous minerals dehydration reaction to explain its melting mechanism. Combined with it's the tectonic environment, the aqueous mineral's dehydration reaction of its microgranular enclave seems to be the only possible source of fluid. In this paper, zircon saturated temperature's calculations show indication that the parental magma of this biotite adamellite has high temperature (807-826),which higher than the north Himalayan Miocene light color granite (667-769),which formed under the background of the thickened crust's remelting owed to crust's shortening of the middle of Gangdese (Zhang et al.,2004; Li et al.,2007).But it is between of the temperature of Fogang granite in South China, whose formation had the mantle-derived material's blend. It illustrates that the granite of the article had mantle-derived material's contamination.

Zhang et al. (2009) described the mimeralogy and petrology characteristic of the giant K-feldspar phenocryst and detailed analysis of the component variation from the edge to the core within this phenocryst by using electronic microprobe method, then, got that the granite was formed because of magma mixing.

Mafic enclave can be formed from crust-mantle magma mingling and represents the energy exchange between the crust-mantle, which recognized by many scholars. Sang et al. (2013) discussed the mafic enclave's petrography and geochemical characteristic of this biotite adamellite; ruled out the causes of the capture of the surrounding rock, the refractory residue of source and the separation. Finally, confirmed it as magma mixing, which hinted that mantle-derived material joined the forming process of this biotite adamellite.

Combined with zircon U - Pb geochronology, which was 210Ma (another article will publish) and later than the syn-collision of Longmu Co - Shuanghu suture, this paper argues that this biotite adamellite might form from the extensional process collision of Gondwana and Yangtze, which led to the mantle-derived magma which was high temperature in the bottom invade into the crust and cause the crust substance's partial melting forming the granitic melt. Then, the two magmas occurred strong mixing and formed this biotite adamellite by upward invasion.

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