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Geochemistry Characteristics of Granodiorite Porphyry in the Degongniuchang Copper Deposit, Muli, Sichuan Province, China

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1 Introduction

The Sanjiang region in SE Tibet Plateau and NW Yunnan is known to have formed by amalgamation of Gongwanaderived continental blocks and arc terranes as a result of oceanic subduction followed by continental collision from Paleozoic to Mesozoic (Deng et al., 2014). Garzê-Litang suture zone is the important component of this region in the tectonic framework, and is also the important Au polymetallic metallogenic belt in SW China (Li et al., 2010). The Degongniuchang Cu polymetallic deposit is characterized by porphyry Cu (–Mo–Au) deposits which found recently in the southern section of Garzê-Litang suture zone. In this study, we present geochemistry and geochronology of the ore-related granodiorite porphyry to provide the metallogenic dynamics mechanism of this Cu (–Mo–Au) deposits in order to acquaint the evolution history of Garzê-Litang ocean in the Tethys tectonic domain, and thus to have further reveal the deep process and development mechanism of Sanjiang orogenic belt.

2 Genetic Types

Analysis results show that SiO_2 contents of samples are 66.35% ~ 71.86%; K_2O contents are 3.11% ~ 4.57%; Na_2O contents are 0.13% ~ 3.57%; CaO contents are 1.65% ~ 3.98%. These major contents indicate that the rocks belong to the high-K clac-alkaline series. Al_2O_3 contents are 12.82% ~ 14.61% with aluminium saturation index A/CNK=0.96 ~ 1.49, manifesting granodiorite porphyry is characterized by peraluminous affinity. The analysis of trace elements show that the obvious depleted in Sr ($Sr=52.2\times10^{-6}$ ~ 181×10^{-6}), P ($P=301.16\times10^{-6}$ ~ 458.28×10^{-6}) and Ti ($Ti=1942.4\times10^{-6}$ ~ 2739.7×10^{-6}). All of element characteristics indicate that granodiorite porphyry belong to I-type granite (fig. 1). Furthermore, Fe_2O_3/FeO ratios of samples are from 0.39 to 1.73, with an average of 1.11. Those high ratios (greater than 0.4) also show I-type granite characteristics. Thus, the above characteristics indicate that the Degongniuchang granodiorite porphyry belong to high-K clac-alkaline peraluminous I-type granite.

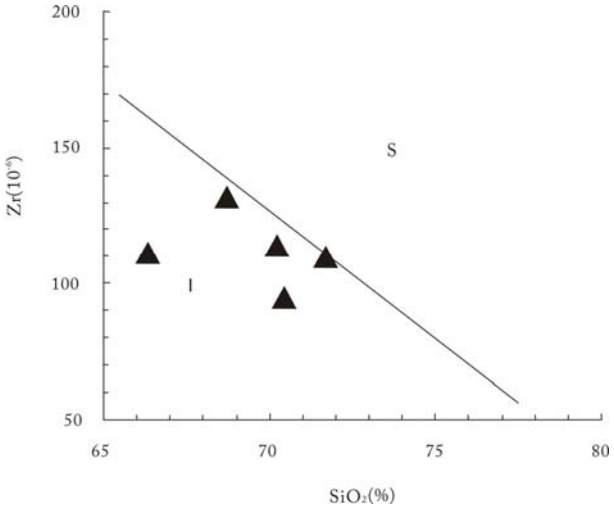

Fig. 1. SiO_2-Zr Diagram.

3 Source and Tectonic Setting

Primitive-mantle normalized spider diagram of granodiorite porphyry show enrichment in the large ion lithophile elements (LILE) (Rb、K、La) and high field strength elements (HFSE) (Th、U) as well as with marked negative Nb、Ta、P、Ti and some large ion lithophile elements Ba、Sr. The negative of high field

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strength elements reflects that rocks are originated from the crust, because the typical crust melt have low content of high field strength elements (Ryerson et al., 1987), and P negative anomaly in the spider diagram reflect the magma could derive from mantle source. However, the relative enrichment of Zr、Hf manifest that crust is the most important source area. Therefore, these elemental characteristics indicate that the source of the granodiorite porphyry have continental crust and mantle-derived features. In the Y–Nb discrimination diagram of granite (fig. 2), we can see that most of samples fall into the range of volcanic arc granite (VAG) and SynCollision (Syn-COLG), also showing that the rocks have features of volcanic arc environment.

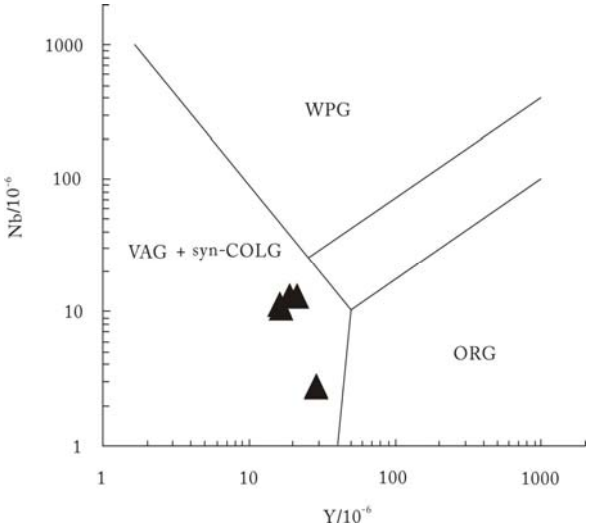

Fig. 2. Y–Nb Diagram of Granite (after Pearce et al. 1984)

4 Conclusions

Geochronological studies indicate that the age of granodiorite porphyry in the Degongniuchang is 216 Ma (fig. 3), suggesting granodiorite porphyry in this study should belong to the same period of tectonic activity (e.g. Indosinian subduction orogenic activity 238 Ma–210 Ma) with the Yongjie granodiorite (214 Ma)、Chajiu granodiorite (219 Ma) (Lu et al., 1993). Combining with the analysis of discrimination diagram, the granodiorite porphyry in the Degongniuchang most likely formed in the island arc environment result from the westward subduction of the Garzê–Litang oceanic plate beneath the Zhongza block.

With the upward subduction of the oceanic crust which resulted in temperature and pressure increase, the dehydration fluid originating from the subduction plate mantle triggered the mantle to melt which result in partial melting of the lower crust and formed calcine alkaline magma with high concentration of LREE and LILE, and low content of HFSE; and then, the structural setting transform into the collision environment in the process of collision between the Yangtze plate and the edge of the Yidun island arc. At that time, the magma began to intrude upward and formed the Degongniuchang granodiorite porphyry.

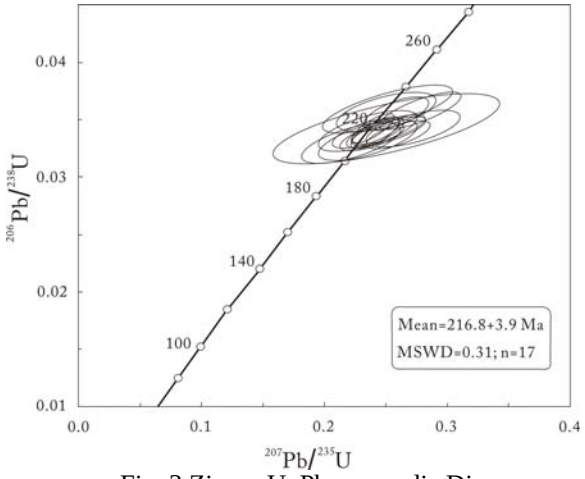

Fig. 3 Zircon U–Pb concordia Diagram.

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