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Zircon U-Pb age and geochemical characteristics of granodiorites from the western Qilian block

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1 Introduction

Qilian Block is located in between the South China Craton and the North China Craton and the Tarim Craton (Fig. 1a), which is one of the key area to study the tectonic evolution of China. The Phanerozoic tectonic framework of Qilian Block has become increasingly clear, however, the understanding about the Precambrian tectonic framework has still a great deal of controversy (Wan et al., 2003; Gehrels et al., 2003; Tung et al., 2007; Song et al., 2012; Tung et al., 2012; Tung et al., 2013; Yu et al., 2013).

The Liuhuangkuang granodiorite is located in the western Qilian block, and intrudes into Qingbaikouan weakly Metamorphic terrigenous clastic rocks and carbonate rocks (Fig. 1b). For a long time, due to the lack of accurate chronological data constraints, its age have different understanding, such as some researchers thought it was the product of the late Paleozoic magmatism (BGMRGP, 1972), but others believe that its age was Precambrian (BGMRQP, 1991). Therefore, a detailed research on geochronology and geochemistry has important significance for constraining the tectonic setting and petrogenesis of the granodiorites.

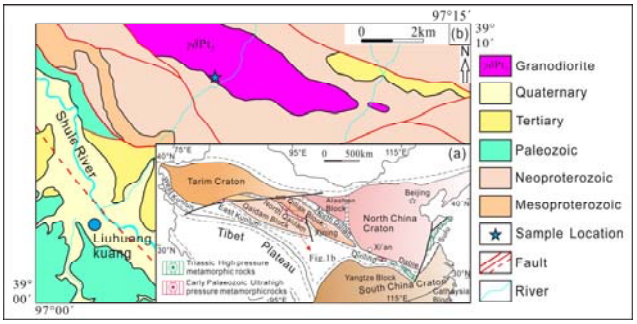

Fig. 1. (a) Tectonic sketch map of China (modified after Song et al. (2012)).
(b) geological map of the western Qilian block with sample location.

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2 Sample characteristics

2.1 Zircon U-Pb age

The zircon grains of the Liuhuangkuang granodiorites from the western Qilian block are mostly euhedral and show crystal lengths of 100~170 μm with an aspect ratios of about 2. Most of the zircon grains show homogeneous inner texture in cathodoluminescence images, very few contain inherited cores. All of them have moderate to good oscillatory zoning. Moreover, their Th/U ratios range from 0.20 to 0.41. These characteristics indicate that they are magmatic origin.

Twenty-five analyses were performed on the 25 zircon grains, and yield $^{206}Pb/^{238}U$ ages between 652±5Ma and 945±8Ma. One of them have a significantly younger $^{206}Pb/^{238}U$ ages (652±5Ma) than others, the reason may be the loss of Pb. The others fall on or close to the concordant curve with a weighted mean age of 926±4Ma (MSWD= 1.2, n = 24). The age result suggests that the granodiorites from the western Qilian block were formed in the early Neoproterozoic, which is consistent with the granites and metamorphosed mafic rocks from the Central to East Qilian block (Gehrels et al., 2003; Tung et al., 2007; Tung et al., 2012; Tung et al., 2013).

2.2 Geochemical characteristics

The Liuhuangkuang granodiorites from the western Qilian block have lower SiO_2 (59.47%~62.96%), TiO_2 (0.40%~0.59%) and P_2O_5 (0.12%~0.14%) and higher Al_2O_3 (14.56%~15.81), $Fe_2O_3^T$ (6.16%~7.68%), MgO (2.68%~3.64%) and $Mg^{\#}$ (43.3~49.6). In TAS diagram, the samples fall into field of diorites and granodiorites, in An–Ab–Qr diagram, Almost all are located in field of granodiorites. The rocks are calc alkaline or high-k calc alkaline series, show weak peraluminous characteristic with A/CNK ratios of 1.01~1.09.

All samples display a very uniform distribution, and their the total contents of rare earth elements range from

118.80×10^{-6} to 148.71×10^{-6}. These samples show varying light rare earth enrichment ($(La/Yb)_N$=7.87~10.32) and moderately negative Eu anomalies (δEu=0.57~0.68). in addition, the samples are depleted in Nb, Ta, Sr, P, and Ti and enriched in Th, U and Pb, implying that they may be volcanic arc granites. It is worth noting that these rocks have higher contents of Ni (17.82×10^{-6}~27.17×10^{-6}) and Cr (76.30×10^{-6}~101.20×10^{-6}).

In Rb/30-Hf-3Ta diagram and Yb-Ta diagram, the granodiorites from the western Qilian block fall into field of island arc granitoids, combined with geochemical characteristics of contemporaneous igneous rocks from the Central to East Qilian block, indicating the rocks were formed in active continental margin arc environment.

It is noticeable that the A/CNK values less than 1.1 for the Liuhuangkuang granodiorites, Furthermore, their P_2O_5 contents decrease with increasing SiO_2 contents, the granodiorites also show increase in Y and Th as increasing Rb, typical of I-type granite evolution trend.

Nb/Ta ratio (11.89~12.69) and distribution of rare earth elements and trace element for the granodiorites are similar to the upper crust, respectively. However, Their lower SiO_2 and higher MgO, $Mg^{\#}$, Ni and Cr Suggest that their origin is closely related to mantle material.

During the 20th century, geologists pay more attention to looking for magmatic sulphide deposits associated with large-size layered complex, because the biggest magma.

3 Conclusion

The above analysis shows that the granodiorites from the western Qilian block were formed in the early Neoproterozoic, rather than Ordovician or Precambrian. their geochemical characteristics imply the rocks were formed in active continental margin arc environment, may be the product of the ancient crust remelting accompanied by a small amount of mantle material.

Acknowledgements

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