WANG Lixing, XU Deru, CHEN genwen and ZHU yuhua, 2017. Chronology and genesis of S-type granites in Hetai district, Guangdong province: Constraints from LA-ICP-MS zircon U-Pb dating and tourmaline Boron isotope In-situ analyses. *Acta Geologica Sinica* (English Edition), 91(supp. 1): 96-97.

Chronology and Genesis of S-type Granites in Hetai District, Guangdong Province: Constraints from LA-ICP-MS Zircon U-Pb Dating and Tourmaline Boron Isotope In-situ Analyses

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1 Introduction

Hetai district, which is a mountainous area, situated on Guangning and Zhaoqing city, west Guangdong Province. Hetai district is generally located on southwest of South China Caledonian fold belt, east margin of Yunkai post-Caledonian uplift. Multiple type granites are widely distributed in Hetai district, including Caledonian, Indosinian and Yanshanian granites. Based on different formation model, previous research classified granites into three types: Migmatite formation, Anatectic granite formation and Magmatic granite formation, these granites generally followed pegmatite veins (Wang et al., 2003). Previous study suggested they belong to S-type granites due to their petrology and geochemistry characteristics (Wang et al., 2003). A lot of gold deposits distributed in Hetai district, including Gaocun, Yunxi, Jingcun and so on. Generally, granites are wall-rocks of parts ore bodies in these gold deposits (Wang et al., 2012). Although granites have close relationship with ore-forming, for their research is relatively weak. In our study, we choose Jingcun and Gaocun granites as our research objects, through petrology, geochemistry, zircon U-Pb dating and tourmaline Boron isotope analyses, to discuss their formation ages and genesis.

2 Geochemistry and Geochronology

Jingcun and Gaocun granites both include coarse-grained muscovite, quartz and plagioclase, and some alumina-rich minerals like tourmaline and garnet. All our samples (ten samples) exhibit high SiO_2 (71.8–75.3 wt. %), high K_2O+Na_2O (4.67–8.53 wt. %), Al_2O_3 (12.5–15.7 wt. %) and low $Fe_2O_3^T$ (0.89–2.94 wt. %), MgO (0.25–0.89 wt. %), CaO (0.09–0.95wt. %) and P_2O_5 (0.12–0.67 wt. %). All the samples are strongly per-aluminous rocks with A/CNK ratios ranging from 1.50 to 2.55. They show similar chondrite-normalized patterns of rare-earth elements with strongly negative Eu anomalies (δEu = 0.36–0.81).

2.1 Jingcun granite

Jingcun granite exposed as stock in the southwestern Hetai district. It generally contains mafic enclaves, and contact metamorphism sign can also be observed in some places. These features probably indicate an allochthonous emplacement process. The zircons show idiomorphic or hypidiomorphic prismatic with no obvious zoning. Nearly half part zircons exhibit core and mantle structure, and most dark rims display well-preserved concentric oscillatory zoning. The rest zircons developed spongy zoning because of annealing crystallization, and this probably relate to hydrothermal activity of pegmatite stages. All zircons have a relatively higher U content range from 1000 ppm to 4000 ppm, low Th/U ratios (Th/U<0.4, most value <0.1). Eighteen dark rims of zircons yielded concordant $^{206}Pb/^{238}U$ ratios with a weighted mean $^{206}Pb/^{238}U$ age of 260.4±2.4 Ma (1σ; MSWD=1.60), representing the crystallization age of the Jingcun pluton. Twelve inherited zircon cores which are bright white yielded ages ranging from 513 Ma to 1067 Ma, which represent inheritance from the magma source or xenocrysts captured from country rocks.

2.2 Gaocun granite

Gaocun granite appears as dike, stripped migmatite or

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cystic inclusion in migmatite, probably representing an in-situ melting message (Wu et al., 2015). The zircons show idiomorphic prismatic with planar zoning. Most zircons exhibit core and mantle structure, and dark rims display relatively weak concentric oscillatory zoning. Likewise, all zircons have a relatively widely U content range from 167 ppm to 14000 ppm, low Th/U ratios (Th/U<0.4, most value <0.1). Twelve rims of zircons yielded concordant $^{206}Pb/^{238}U$ ratios with a weighted mean $^{206}Pb/^{238}U$ age of 255.4±11 Ma (1σ; MSWD=1.30), representing the crystallization age of the Gaocun pluton. Inherited zircon cores which are bright white yielded ages ranging from 380 Ma to 2387 Ma, concentrating 427–458 Ma and 912–960 Ma, which represent inheritance from the magma source or xenocrysts captured from Caledonian and Jinningian country rocks. Four dark rims yielded ages concentrate on 220–230 Ma, which probably relate to a Late Indosinian dextral shear deformation in Hetai district (Cai, 2012). Zircon U-Pb ages from Jingcun and Gaocun granites in accord with Yunlougang granite (Zircon U-Pb, 252.3±1.6 Ma, our unpublished data).

3 Boron Isotope

We analyzed 64 Boron isotopes of tourmalines from Jingcun and Gaocun granites using in-situ LA-MC-ICPMS analyses (Nie et al., 2015). The results show Jingcun and Gaocun tourmaline Boron isotopes are nearly the same, which are range from -12.33‰ to -10.88‰. There is a great difference between our data and $\delta^{11}B$ in marine evaporate (18‰ to 32‰), but same as a non-marine evaporate (-31‰ to 10‰) (Oi et al., 1989). Our data are consistent with detrital tourmalines (-13‰ to -11‰) from Silurian to Devonian sedimentary samples in Southwest of Yangtze plate, which are located on east of Ailaoshan belt (Nie et al., 2015). But these data are slightly higher than the value of tourmalines (-19.5‰ to -13.9‰) in South China tin-bearing granites (Jiang et al., 2001). Boron isotope feature indicates Jingcun and Gaocun S-type granites generated by melting from Boron geochemistry-alike sediments.

4 Discussion

During late Permian, the closures of Paleo-Tethys ocean lead Pangea beginning to form, and Hetai district located on an intensive compression setting in South China intra-continent orogeny (Wang et al., 2013). Huge heat generated by plate subduction and crust thickening lead deep sedimental material to melt, then produce per-aluminous granitic magma, finally formed tourmalines-bearing S-type granites.

We suppose that Jingcun and Gaocun S-type granites generated in a same geological setting, their source materials and emplacement times are consistent. Their difference is that Jingcun granite pluton is a product of allochthonous emplacement process, but Gaocun leucogranite dikes are generated by in-situ melting. Their formation age predate dextral shearing deformation in Hetai district (Muscovite Ar-Ar, 187–200 Ma) and their adjacent gold deposits (Pyrrhotite Re-Os and Muscovite Ar-Ar, 159–175 Ma) (Cai, 2012; Wang et al., 2012). Even though Jingcun and Gaocun granites are closely related to ore bodies in the space, they have no relationship with gold forming.

Acknowledgements

This study is co-funded by the China Geological Survey (No.12120114052801) and the DREAM project of MOST, China (NO. 2016YFC0600401)

References

Cai Jianxin, 2012. Hetai Dextral Ductile Shear Zone, Western Guangdong, and Its Controlling on Formation of Gold Deposit. Geological Review (in Chinese with English abstract).

Jiang Shaoyong, 2001. Boron isotope geochemistry of hydrothermal ore deposits in China: a preliminary study. Physics and Chemistry of the Earth, Part A: Solid Earth and Geodesy 26(9-10): 851-858.

Nie Xiaosong, Xia Xiaoping, Zhang Le, Ren Zhongyuan and Li Ling, 2015. In-situ boron isotopic analyses of tourmalines by LA-MC-ICPMS and its application to provenance analyses: A case study for the Ailaoshan Belt. Geochimica (in Chinese with English abstract).

Oi, T., Nomura, M., Musashi, M., Ossaka, T., Okamoto, M., and Kakihana, H., 1989. Boron isotopic compositions of some boron minerals. Geochimica et Cosmochimica Acta, 53(53), 3189-3195.

Wang Chenhui, Zhang Changqing, Wang Yonglei, Qiu Xiaoping and Gong Chaoyang, 2012. Chronological Research of the Hetai Gold Mine in Gaoyao County,Guangdong Province. Geotectonica Et Metallogenia 36(3): 427-433 (in Chinese with English abstract).

Wang Liankui, Sha Liankun, Xu wenxin, Deng Gaoqiang, Zhang Shaoli and Liang Yuelong, 2003. The theory of granite formation and series (Instanced in the granite of Hetai Area and West Guangding Province in South China)---and discussion on genetic classification of granite by three grades (in Chinese).

Wang Yuejun, Fan Weiming, Zhang Guowei and Zhang Yanhua, 2013. Phanerozoic tectonics of the South China Block: Key observations and controversies. Gondwana Research 23(4): 1273-1305.

Wu Fuyuan, Liu Zhichao, Liu Xiaochi and Ji Weiqiang, 2015. Himalayan leucogranite: Petrogenesis and implications to orogenesis and plateau uplift. Acta Petrologica Sinica 31(1): 1-36 (in Chinese with English abstract).