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Genesis of A-type Granites in the East Junggar, Xinjiang and Growth of Continental Crust—Evidence from Geochronological and Sr-Nd Isotopic Compositions

TANG Hejun[1, 2, *], MENG Guixiang[1, 2], WANG Zhaolin[1, 2] and DENG Zhen[1, 2]

[1] *Chinese Academy of Geological Sciences, Beijing 100037, China*
[2] *Sino Probe Center, Chinese Academy of Geological Sciences, China Geological Survey, Ministry of Natural Resources, Beijing 100037, China*

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The magma source, petrogenesis, tectonic setting and its geochronology of the Late Paleozoic A-type granites, which widely exposed in Zhaheba area, East Junggar, have not been well constrained so far (Fig. 1a, b). A better understanding of above issues will help us to reveal the magmatic processes and the continental growth of Central Asia (Xiao et al., 2009). This study aims to determine the formation ages, petrogenesis and tectonic settings of the A -type granitoids in the Ulungur granite belt in East Junggar, clarify their temporal relationships with the southern Kalamaili A-type granite belts, and further provide insights into the tectonic setting in East Junggar during the end of the Early Carboniferous. Therefore, the study of A-type granites is one of the keys to understanding the laws and mechanisms of crustal accretion during the Phanerozoic period, and is also of great significance for understanding the Paleozoic accretion.

The East Junggar terrane, which is situated to the south of the Chinese Altai and north of the Tianshan orogenic belts (Fig. 1a, b), is bounded by the Irtysh fault and the Kalamaili fault (Fig. 1b). The terrane is divided by the Ulungur fault into the Dulate arc to the north and the Yemaquan arc to the south (Xiao et al., 2004, 2006). Two ophiolite belts (the Zhaheba-Armantai in the north and the Kalamaili in the south) are spatially associated with the Ulungur fault and the Kalamaili fault. Liu et al. (2013) called the associated occurrence of mafic–ultramafic rocks, alkali-rich intrusive rocks and continental volcanic rocks in the deep fault zone the trinity. Before the Early Paleozoic, the Eastern Junggar was a part of the Sino Korean-Tarim plate. After the Early Ordovician, it gradually separated from the Altai plate to form the Paleo-Asian Ocean, then subduction, accretion and collision occurred. After the Early Devonian, the Paleo-Asian Ocean began to close. By the end of the Early Carboniferous, it was completely closed. The Junggar region entered the post collisional orogenic evolution stage, and the postcollision plutonic magmatism was very intense (Li et al., 2004; Zhang et al., 2010).

In this study, we selected ten alkaline granite and syenogranite samples from the Ashutasi pluton and Yuyitasi pluton in the Zhaheba area to investigate geochronological and geochemical characteristics. The Yuyitasi and Ashutasi plutons are covered by Quaternary gravel. There are four alkaline granite plutons exposed on the surface, which are not in contact with each other. The plutons are mainly composed of arfvedsonite alkali granite. The Yuyitasi pluton is covered by Quaternary gravel, and in the south, it invades in the Middle Devonian Beitashan formation. The pluton is divided into two lithofacies belts; the middle part is arfvedsonite alkali granite, and the outer part is syenogranite, they are shown surge intrusive contact, including the later granite-porphyry, syenite-porphyry and quartz-porphyry intrusions.

The A-type granites in Zhaheba include the Ashutasi alkaline granites and Yuyitasi syenogranites, which were emplaced at 321.5 ± 4.8 Ma and 321.7 ± 0.6 Ma, respectively. The major rock-forming minerals are orthoclase, perthite, arfvedsonite and quartz, and exhibit the following main geochemical characteristics of A2-type granites. (1) Their REE distribution curves each exhibit a "V"-shaped pattern and a marked depletion in Eu. They are rich in large-ion lithophile elements Rb, Th, and U as well as high-field-strength elements Nb, Ta, Zr, and Hf, but significantly depleted in Ba, Sr, P, and Ti. (2) Their $(^{87}Sr/^{86}Sr)_i$ values (0.7021–0.7041), $\varepsilon_{Nd}(t)$ values (4.57–5.16), and REE distribution patterns are in basic agreement with those of the Kalamaili A-type granite belt in East Junggar. The T_{DM2} values of the alkaline granites and syenogranites range from 661 Ma to 709 Ma. The A-type granits may be the products of upwelling asthenosphere triggered partial melting of juvenile lower crust. The alkaline granites were later-stage products of crystallization and differentiation. Compared to the syenogranites, the alkaline granites are significantly lower in K_2O, Na_2O, Al_2O_3, FeO, MgO, and CaO but significantly higher in incompatible elements (e.g., SiO_2, Rb, and Sr). The magmatic crystallization temperatures of the syenogranites and alkaline granites are 874℃ and 819℃, respectively.

The A-type granites in the Ulungur and Kalamaili belts were primarily emplaced at 320–325 Ma and 301–320 Ma,

* Corresponding author. E-mail: 03206125@163.com

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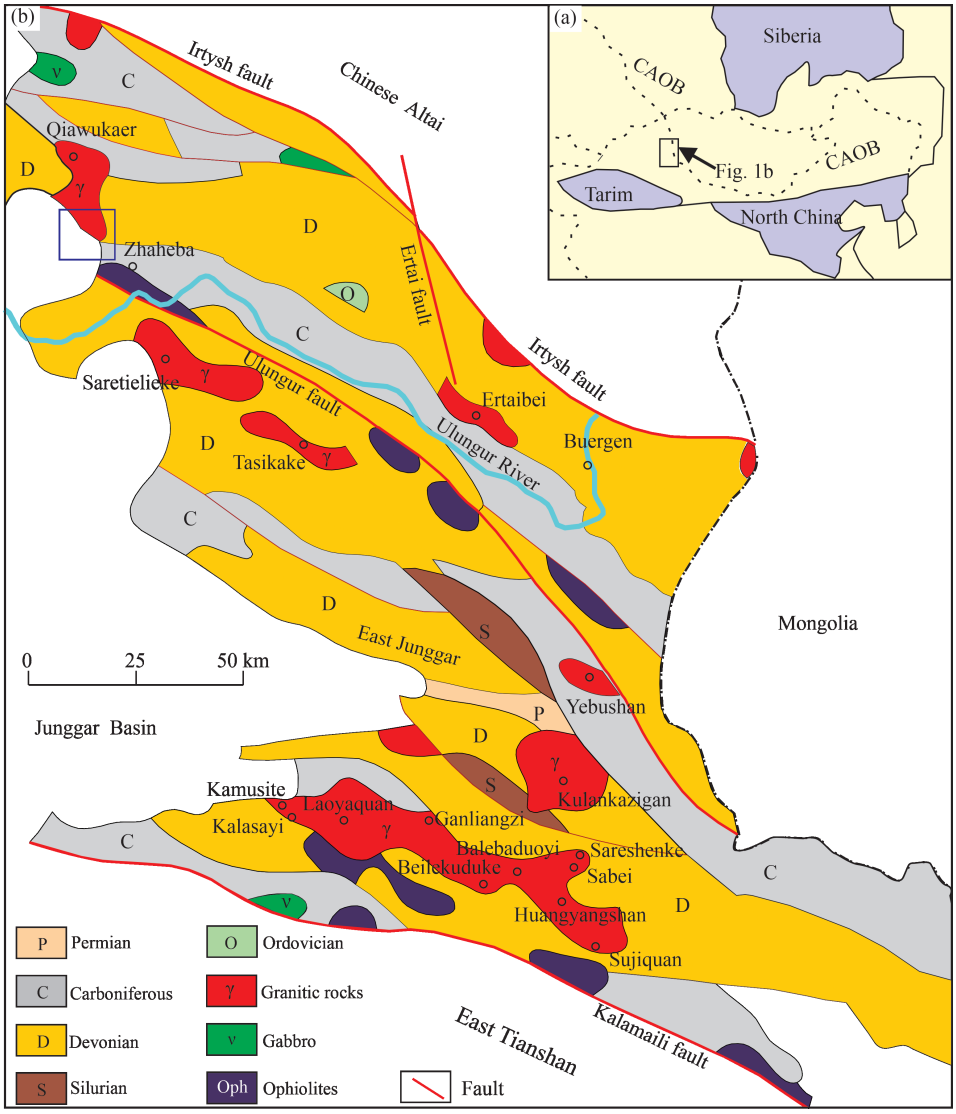

Fig. 1. Location of the study area (a) and geological map of the East Junggar orogeny (b).

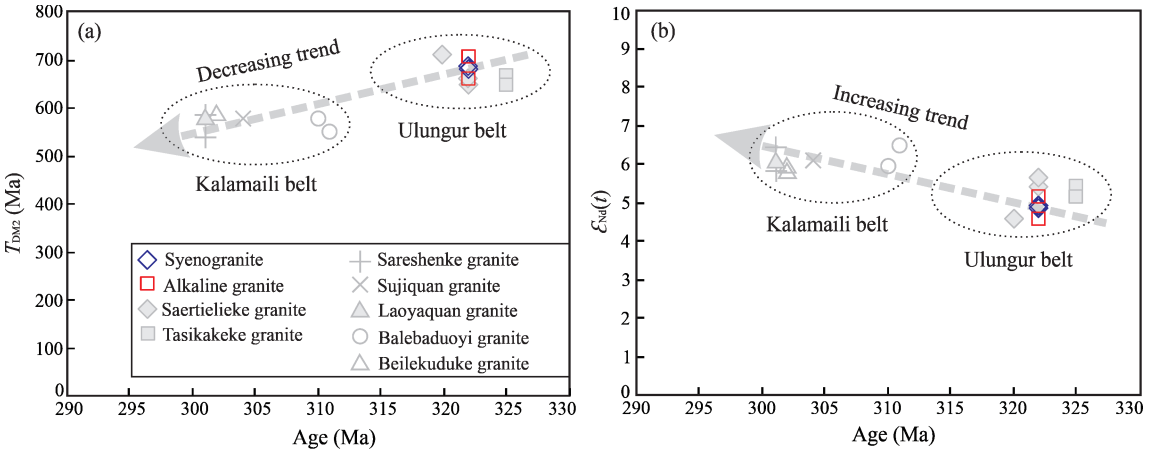

Fig. 2. T_{DM2} value vs. zircon U-Pb age diagram (a) and $\varepsilon_{Nd}(t)$ value vs. zircon U-Pb age diagram (b) for the A-type granitoids in East Junggar.

Field in gray data are from Chen et al. (1999), Li et al. (2007), Lin et al. (2007), Su et al. (2008), Guo et al. (2010), Yang et al. (2011) and Wang et al. (2012).

respectively. From north to south, there is a gradual decrease in the ages of the Ulungur and Kalamaili A-type granite belts. In addition, there is a gradual decrease in the T_{DM2} of the A-type granites and a gradual increase in their $\varepsilon_{Nd}(t)$ value from the Ulungur belt to the Kalamaili belt in East Junggar (Fig. 2a, b). This suggests a gradual decrease in the age of the deep crustal materials and a gradual increase in the proportion of the depleted mantle component from north to south. This indicates possible continuous upwelling of mantle-derived magmas during the collision process, suggesting continuous southward accretion of the CAOB. In addition, the migration of the A-type granites from Ulungur to Kalamaili may indicate a difference in the lithospheric structure. Further discussion is necessary to determine whether this indicates changes in the properties of the mantle zones or the composition of the mantle from Zhaheba–Aermantai to Kalamaili.

Key words: A-type granite, Sr-Nd isotopic, post-collision, East Junggar

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About the first and corresponding author

TANG Hejun, male, born in 1987 in Fuxin City, Liaoning Province; Ph.D., graduated from Chinese Academy of Sciences; assistant professor of Chinese Academy of Geological Sciences. He is now interested in the study of mineral system exploration and deep earth exploration. E-mail: 03206125@163.com; phone: 13426314608.