Research Advances

Multi-Method Chronometric Constraints on the Thermal Evolution of the Central Tianshan, NW China

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The Tianshan orogenic belt is a major part of the southern Central Asian Orogenic Belt (CAOB), extending from west to east for over 2500 km through Uzbekistan, Tajikistan, Kyrgyzstan and Kazakhstan to Xinjiang in NW China, and contains the record of multi-phase tectonothermal evolution. Till now, various research methods have been employed to reveal the exhumation and uplift process of the Tianshan orogenic belt, such as Zircon (ZFT) and Apatite (AFT) Fission Track age. Previous researches have primarily revealed that the Tianshan orogenic belt is characterized by multiple phrases and stages of uplift-exhumation. Limited by sampling and analytical techniques, the exact timing and rate of uplift and exhumation and regional differential uplifting of Chinese Tianshan are not full understood. In order to further constrain the thermal evolution and uplift-exhumation history of the Tianshan Mountain, we conducted zircon U-Pb and Ar-Ar geochronology and paired Apatite (U-Th)/He thermochronology to reconstruct the thermal evolution of Tianshan.

The granites from the central Tianshan, which are associated with the southward subduction of the northern Tianshan Ocean (Fig. 1), have been dated at 362–354 Ma using the LA-ICP-MS Zircon U-Pb method. A younger

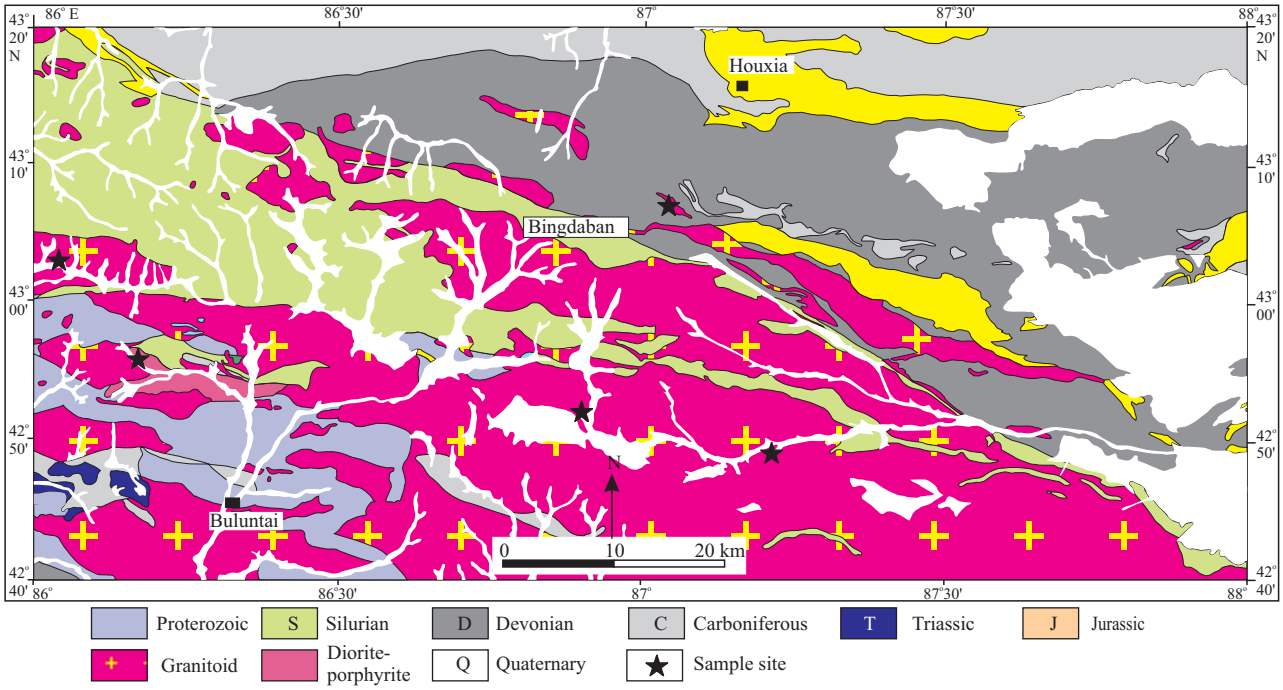

Fig. 1. Detailed geological map showing sampling sites in the Central Tianshan.

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diorite sample (282 ± 1 Ma, zircon U-Pb method by LA-ICP-MS) from northern Tianshan formed during the final closure of the Northern Tianshan Ocean when the Junggar Block collided with the Yili–Central Tianshan Block. The $^{40}Ar/^{39}Ar$ step–wise heating plateau dates (biotite Ar/Ar: 312–293 Ma; Plagioclase Ar/Ar: 270–229 Ma) from the Central Tianshan show rapid post-magmatic cooling during the Late Carboniferous–Early Permian followed by a more modest rate of cooling from the middle Permian to the middle Jurassic. The northern Tianshan diorite (biotite Ar/Ar: 240 ± 1 Ma) also reveals a middle Jurassic cooling. Apatite (U–Th)/He dates from the central Tianshan samples range from ca. 130 Ma to ca. 116 Ma. The apatite (U–Th)/He date for the northern Tianshan sample is ca. 27 Ma. Previous studies also reported apatite (U–Th)/He ages of ca. 44 Ma–11 Ma in the Baluntai area of the southern Central Tianshan. Two episodes of cooling have been distinguished by thermal history modeling: (1) Mesozoic cooling occurred as a result of the exhumation and tectonic reactivation of the central Tianshan; and (2) The Tianshan orogenic belt has been rapidly exhumed since the Middle Cenozoic.

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