

Research Advances

Early Palaeozoic Granites in the Northern Tian Shan, Kyrgyzstan: Their Zircon Ages and Evolution Processes

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The Tian Shan Orogenic Belt, which is a subsidiary of the Central Asian Orogenic Belt, is the largest accretion area of continental crust on the Earth during the Phanerozoic. It has experienced several accretionary processes during the Palaeozoic period and has attracted much concern among geologists. An Early Palaeozoic intrusive rock belt extends for 1000 km from east to west, occupying about 40% of the total area within the Kyrgyz Northern Tian Shan Orogenic Belt. Previous studies show that the petrology of these rocks is similar, consisting of granites and granodiorites, which are results of subduction of the Terskey Ocean underneath the North Tian Shan volcanic arc. The southern side of the Terskey Ocean is a passive margin of the Central Tian Shan that collided with the North Tian Shan along the Nikolaev Line. Subduction of the Terskey Ocean terminated during the Late Ordovician to the Early Silurian and hence, the collision between the Central Tian Shan and the North Tian Shan started. However, there are no isotopic geochronological records of this collision, and the exact timing is not yet restricted.

Zircons from nine granite and granodiorite samples in the Kunge Range and the Terskey Range on the Northern Tian Shan, Kyrgyzstan, have been analysed with LA-ICP-MS. All the samples have weighted average ages ranging from 417 to 450 Ma, of which seven samples are concentrated within the time range of 440–450 Ma. However, two samples diverge the time range, with sample KG 26 being 424±12 Ma and sample KG27 417±14 Ma.

Petrochemical analysis of these samples indicates that the seven samples with ages of 440–450 Ma are similar in chemical composition and these are granites and granodiorites. All the seven samples are plotted in the high-K calc-alkaline series on the K₂O vs. silica diagram with K₂O contents of 2.82%–5.56%. In the A/NK vs. A/CNK diagram, the Al₂O₃ contents are between 12.80% and 15.15%, whereas the A/NK ratio is 1.05–1.96 and the A/CNK ratio is 0.95–1.10, indicating that all the seven samples are sub-aluminous I-type granites. The total REE contents of the samples are 139×10⁻⁶–271×10⁻⁶, where the

ratio of light REE to heavy REE ($\Sigma\text{LREE}/\Sigma\text{HREE}$) is 5.36–11.88. This leads to curves that are tilted to the right on the REE distribution diagram. Europium anomalies are obvious with a δEu value of 0.18 to 0.27. On the Nb/Y and Rb/(Y+Nb) discrimination diagrams, the samples are plotted in the volcanic-arc granites (VAG) area. However, the other two samples are different from the above seven samples in chemical composition. The sample KG26 is plotted in the Shoshonite series, while KG27 plots in the calc-alkaline series on the K₂O vs. silica diagram. The total REE content of KG26 is 499×10⁻⁶ where the ratio of light REE to heavy REE ($\Sigma\text{LREE}/\Sigma\text{HREE}$) is 8.91, indicative of the depletion of heavy REE relative to the light REE. The Europium anomaly is obvious with a δEu value of 0.10. The total REE content of KG27 is 104×10⁻⁶ where the ratio of light REE to heavy REE ($\Sigma\text{LREE}/\Sigma\text{HREE}$) is 0.86. This indicates a very flat REE distribution curve and a significant Europium anomaly is observed with a δEu value of 0.01. Moreover, both KG26 and KG27 plot in the within plate granites (WPG) area on the Nb/Y and Rb/(Y+Nb) discrimination diagrams, while the other seven are plotted in volcanic-arc granites (VAG) area.

The zircon ages and geochemical analysis of the Early Palaeozoic granite samples suggest that: (1) the Early Palaeozoic granite plutons would intrude mainly during 450–440 Ma in Kyrgyz northern Tian Shan when the subduction of the Terskey Ocean occurred; and (2) the subduction would have terminated with the closure of the Terskey Ocean at around 420 Ma, while within-plate magmatism still occurred to some extent (Fig 1).

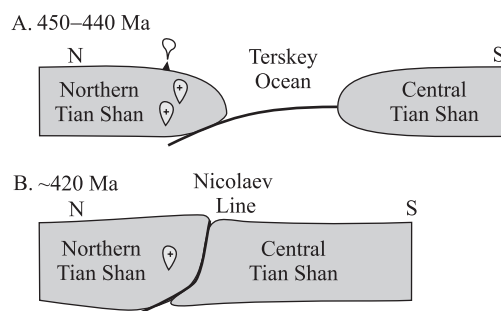


Fig. 1. Illustration of the subduction of the Terskey Ocean and later closure during the early Palaeozoic.

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