A Tarim-North India connection in northern Gondwana related to final closure of the Proto-Tethys Ocean: Constraints from provenance of early Paleozoic sedimentary rocks in the Altyn Tagh orogen

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Evolution of the northern margin of Gondwana, especially to the north of India and Australia, remains enigmatic. The primary reason for this enigma is complex amalgamation of northern Gondwana involving a wealth of present-day East Asian blocks associated with consumption and closure of the Proto-Tethys Ocean during early Paleozoic time. Compared to considerable progress on configuration of some other Asian blocks in northern Gondwana (e.g., South China, North China, and Lhasa, etc.), much controversy still concerns when and where the Tarim craton was amalgamated with northern Gondwana due to final closure of the North and South Altyn Oceans (two branches of the Proto-Tethys Ocean between southeastern Tarim and northern Gondwana).

Provenance tracing of sedimentary rocks based on detrital zircon U-Pb-Hf isotopes has been widely applied to constrain paleotectonic relationships among major tectonic units. This forms the justification of this study, which focused on systematic field-based zircon U-Pb dating and Hf isotopic analyses for early Paleozoic sedimentary rocks in the Altyn Tagh orogen, southeastern Tarim. New dating results reveal depositional ages from ca. 494 to 426 Ma. Provenance tracing indicates the ca. 494-477 Ma samples dominantly sourced from local Altyn Tagh to the south of the North Altyn Ocean, whereas an augmented supply of detritus from Tarim to the north of the North Altyn Ocean characterizes the ca. 465-449 Ma samples based on remarkable increase of ca. 840-780 Ma, 2.0-1.7 Ga, and 2.7-2.4 Ga detrital zircons. This change indicates a major provenance shift from a single to multiple source regions between ca. 477 and 465 Ma, marking the timing of final closure of the North Altyn Ocean. Zircon U-Pb-Hf isotopic data from the ca. 444-426 Ma samples resemble those from the ca. 465-449 Ma samples, suggesting local sediment recycling related to a post-collisional regime. Together with ophiolitic, (ultra)high-pressure metamorphic, and magmatic records in the region, final closure of the North Altyn Ocean can be constrained to occur in the Middle Ordovician, slightly later than final closure of the South Altyn Ocean during latest Cambrian-Early Ordovician time. Considering the other branches of the Proto-Tethys Ocean, we infer that the entire Proto-Tethys Ocean might have been progressively closed at ca. 500-420 Ma, leading to amalgamation of most East Asian blocks with northern Gondwana. Detrital zircon U-Pb-Hf isotopic comparison indicates that Tarim shares a closer affinity to North India than to other tectonic units located further to the east of Australia or west of Arabia-Iran along the northern margin of Gondwana. This work would be a significant contribution towards understanding configuration of Gondwana associated with evolution of the Proto-Tethys Ocean.

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