Linking Tarim with North India in northern Gondwana due to final closure of the Proto-Tethys Ocean: Insights from provenance of early Paleozoic sedimentary rocks in the Altyn Tagh orogen

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There is a consensus that final amalgamation of the Gondwana interior occurred in the early Paleozoic associated with subduction and accretion along the southern and eastern margins of Gondwana. However, the tectonic evolution of the northern margin of Gondwana involving a wealth of present-day East Asian blocks due to final closure of the Proto-Tethys Ocean remains enigmatic. Much controversy regards when and where the Tarim craton was linked with 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 reconstruction of sedimentary rocks based on U-Pb ages and Hf isotopes of detrital zircons has been efficiently applied to identify source regions and constrain paleo-locations of major tectonic units. This forms the justification of this study, which carried out detrital zircon U-Pb dating and Hf isotopic analyses for early Paleozoic sedimentary rocks in the Altyn Tagh orogen, southeastern Tarim. New age data reveals that the studied sedimentary rocks were deposited from ca. 494 to 426 Ma. Provenance reconstruction suggests a local Altyn Tagh source region to the north of the North Altyn Ocean for the ca. 494-477 Ma samples. In contrast, the ca. 465-449 Ma samples are characterized by an obvious increase of ca. 840-780 Ma, 2.0-1.7 Ga, and 2.7-2.4 Ga detrital zircons, indicating an augmented detrital supply from the Tarim craton to the north of the North Altyn Ocean. This provenance shift marks the timing of final closure of the North Altyn Ocean between ca. 477 and 465 Ma. U-Pb-Hf isotopes of detrital zircons from the ca. 444-426 Ma samples are comparable to those from the ca. 465-449 Ma samples, suggesting local sediment recycling after final closure of the North Altyn Ocean. Coupled with ophiolitic, (ultra)high-pressure metamorphic, magmatic, and structural records in the Altyn Tagh orogen, final closure of the North Altyn Ocean can be constrained to have occurred in the Middle Ordovician, postdating final closure of the South Altyn Ocean in the latest Cambrian-Early Ordovician. Considering the other branches of the Proto-Tethys Ocean within East Asia, we infer progressive closure of the entire Proto-Tethys Ocean at ca. 500-420 Ma, resulting in amalgamation of most East Asian blocks in northern Gondwana. In comparison with detrital zircon U-Pb-Hf-isotopes for the possibly associated Gondwana terranes, the Tarim craton was most likely linked with North India and many East Asian terranes (such as North Qilian, North Qinling, South China, Indochina, South Qiangtang, etc.), rather than with Arabia-Iran or other terranes (e.g., Lhasa and Sibumasu) adjacent to western Australia along the northern margin of Gondwana (Figure 1). This contribution would be a significant impact on understanding the configuration of northern Gondwana associated with the evolution of the Proto-Tethys Ocean.

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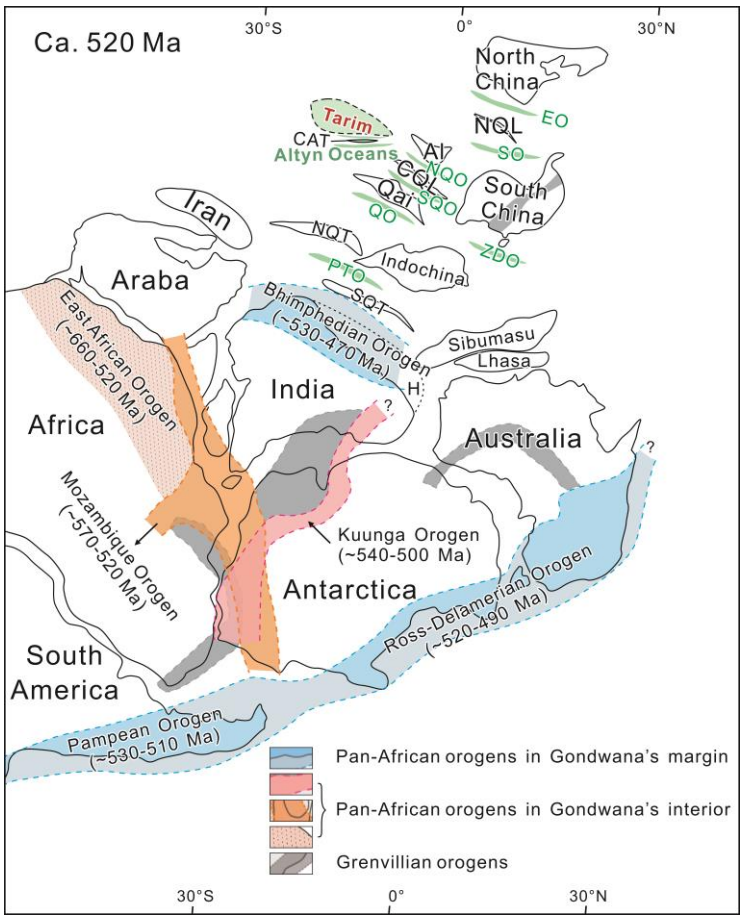

Figure 1. Reconstruction of Gondwana at ca. 520 Ma showing location and timing of major orogens (modified after Boger and Miller, 2004; Veevers, 2004; Cawood et al., 2007; Gray et al., 2008; Horton et al., 2008; Zhu et al., 2011; Zhao et al., 2018). Al— Alxa; CAT— Central Altyn Tagh; CQL— Central Qilian; Qai— Qaidam; NQL— North Qinling; NQT— North Qiangtang; SQT— South Qiangtang; H— Himalaya; NQO— North Qilian Ocean; SQO—South Qilian Ocean; QO— Qimantagh Ocean; EO— Erlangping Ocean; SO— Shangdan Ocean; ZDO— Zhenghe-Dapu Ocean; PTO— branch of the Proto–Tethys Ocean between North and South Qiangtang.

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