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Recognition and tectonic implications of an extensive Neoproterozoic volcano-sedimentary rift basin along the southwestern margin of the Tarim Craton, northwestern China

Chao Wang[a,*], Liang Liu[b], Yong-He Wang[a], Shi-Ping He[a], Rong-She Li[a], Meng Li[a], Wen-Qiang Yang[b], Yu-Ting Cao[c], Alan S. Collins[d], Chao Shi[a], Zhong-Nan Wu[a]

[a] MLR Key Laboratory of Genesis and Exploration of Magmatic Ore Deposits, Orogen Research Centre of China Geological Survey, Xi'an Center of China Geological Survey, Xi'an 710054, China
[b] State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an 710069, China
[c] College of Geological Science & Engineering, Shandong University of Science and Technology, Qingdao 266510, China
[d] Centre for Tectonics, Resources and Exploration (TRaX), Department of Earth Sciences, University of Adelaide, SA 5005, Australia

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ABSTRACT

The Tiekelik Belt includes a large outcrop area of Precambrian continental crust, which is exposed along the southwestern margin of the Tarim Craton, NW China. It is characterized by the occurrence of high-grade metamorphic rocks and volcano-sedimentary successions. In this contribution, we present zircon U–Pb results from 10 samples of rocks from these volcano-sedimentary successions for provenance and age determinations, and geochemical analyses on basalts of the bimodal volcanic rocks from the Sailaji-azitage Group. Four schist and paragneiss samples from the Ailiankate Group contain numerous zircons with ages of 650–850 Ma, suggesting that this group was deposited after the late Neoproterozoic and is not part of the Paleoproterozoic crystalline basement of the Tarim Craton as previously believed. One sample collected from marble of the Bochatetage Formation suggests a depositional age below 773 Ma. Three sandstone samples from the Sukuluoke and Qiakemaklike formations contain zircon ranging in ages from 630 Ma to 830 Ma, suggesting deposition of these formations after the Ediacaran. One andesite clast from the Qiakemaklike conglomerate gave a $^{206}Pb/^{238}U$ age of 793 ± 5 Ma, while a rhyolite from the Sailajiazitage Group gave a $^{206}Pb/^{238}U$ age of 881 ± 6 Ma. The basalts of the bimodal volcanic rocks from the Sailajiazitage Group show enrichment of light rare earth elements (La_N/Yb_N = 4.92–8.51) and high field strength elements (HFSE) (e.g. Nb, Zr and Ti), similar to continental flood basalts (CFB), indicating bimodal volcanism in a within-plate tectonic setting.

Our new data, combined with previous sedimentary facies analysis, suggest the presence of a large Neoproterozoic volcano-sedimentary rift basin. This rift basin records the change from a fluviolacustrine to a marine environment along the southwestern margin of the Tarim Craton. The zircon U–Pb ages indicate initial rifting at ~880 Ma, followed by extensive rifting at ~790 Ma. The detrital zircons of the Tiekelik Belt are dominated by four populations of Neoproterozoic (630–670 Ma, ca. 740–745 Ma, ca. 785 Ma, and ca. 800–850 Ma), with some Paleoproterozoic and Archean grains (2800–1800 Ma). The major detrital zircon populations approximately match the ages of widespread magmatism documented along the northern margin of the Tarim Craton. We consider that sourcing of these components from the northern Tarim could explain the age probability patterns of the Tiekelik Neoproterozoic sediments. We speculate that this process might be linked to far-field tectonics causing uplift and erosion of the northern Tarim rocks and predominantly large-scale southwards transport of sediments over the craton. The rifting environment of the sedimentary basin in the Tiekelik Belt, however, suggests a bidirectional source.

1. Introduction

Volcano-sedimentary successions deposited in continental rift basins are important records of the processes that occur during continental break-up (e.g. Pilote et al., 2012), and deciphering the

* Corresponding author. Tel.: +86 29 87821743; fax: +86 29 88304789.
E-mail address: wangc-mail@163.com (C. Wang).

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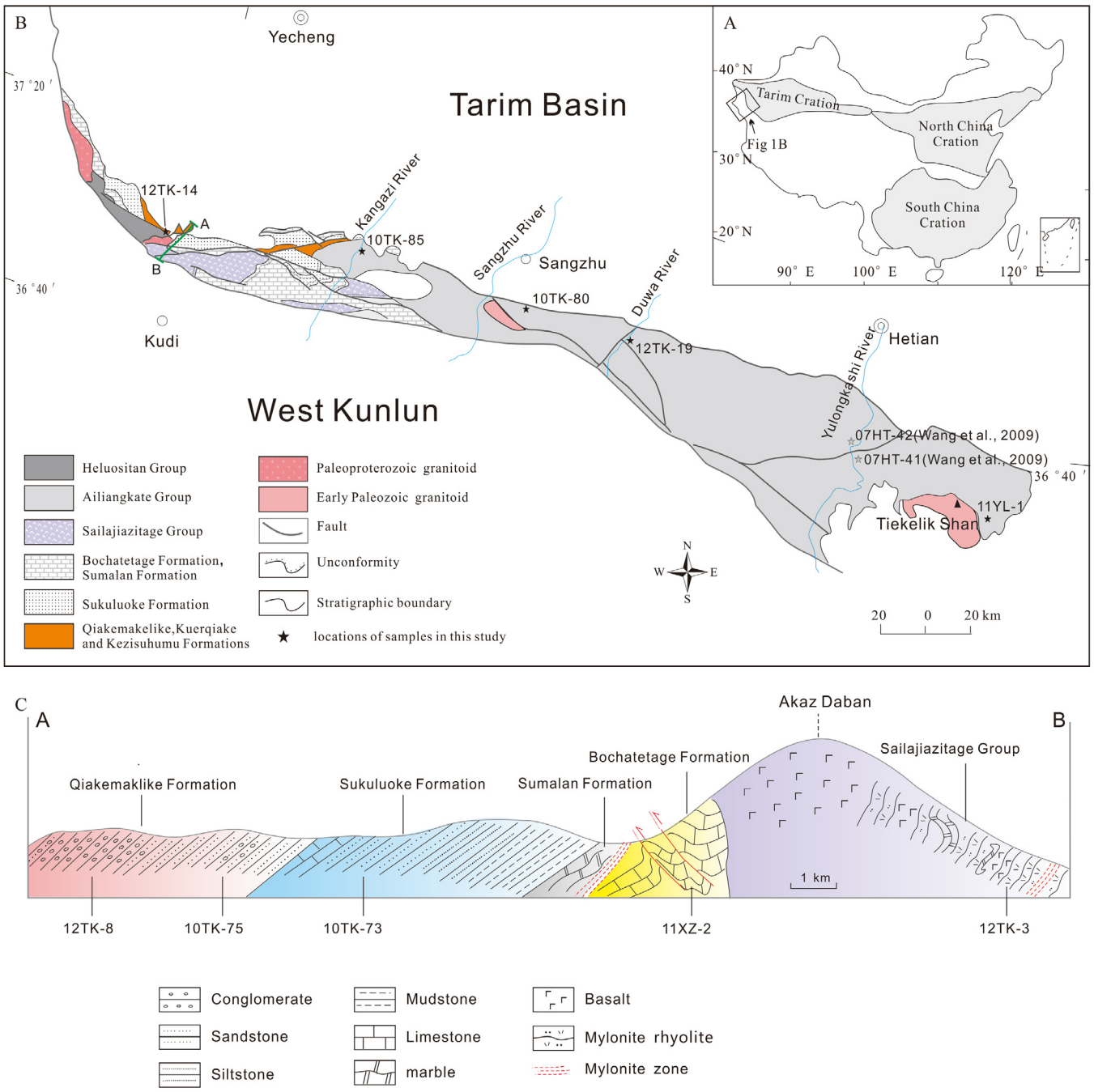

Fig. 1. (A) Simplified craton map of China. (B) Sketch regional geological map showing the Precambrian stratigraphic units of the Tiekelik Belt in SW Tarim, with the locations of geochronological samples presented in this study (modified after He et al., 2012a; Wang et al., 2009). (C) Interpreted geological cross-section across the Xinzang highway with locations of geochronological samples.

rift basin record around Neoproterozoic continents has long been a major tool to unravel the palaeogeographic conundrum of global geography as Rodinia broke up and Gondwana formed (Collins and Pisarevsky, 2005; Dalziel, 1991; Hoffman, 1988; Li et al., 2008; Moores, 1991). Much recent research on the Tarim Craton of northwest China has demonstrated clear signs of Neoproterozoic orogenesis superimposed by rift margin and break-up processes (Xu et al., 2005, 2013a; Guo et al., 2005; Zhang et al., 2007, 2009, 2010, 2011a, 2013a; Shu et al., 2011; Lu et al., 2008; Turner, 2010; Wang et al., 2006, 2013). Along the southwestern margin of the Tarim Craton lies a narrow, but important, NW to E-W-trending region known as the Tiekelik Belt (Fig. 1A). Rocks exposed in the Tiekelik Belt are mainly composed of Palaeoproterozoic and Neoproterozoic greenschist to amphibolite facies gneisses, schists, migmatites, amphibolites, quartzites, volcanic rocks and conglomerates, which are overlain by late Palaeozoic to Cenozoic terrigenous sedimentary rocks (Fig. 1B) (e.g. RGXR, 1993). The depositional ages of some Precambrian strata in the Tiekelik Belt were previously interpreted as Palaeoproterozoic and Mesoproterozoic on regional geologic maps, based on their metamorphic character and on stromatolite biostratigraphy, coupled with limited Rb–Sr isochron ages of keratophyre (RGXR, 1993). Recently, new geochronological determinations have suggested that some previously assigned Palaeoproterozoic and Mesoproterozoic rocks are really Neoproterozoic (Wang et al., 2009). Additionally, Wang et al. (2004) suggested that the lower part of the Neoproterozoic