Lithos 179 (2013) 120–136

Contents lists available at ScienceDirect

Lithos

journal homepage: www.elsevier.com/locate/lithos

The metasedimentary rocks from the eastern margin of the Tarim Craton: Petrology, geochemistry, zircon U–Pb dating, Hf isotopes and tectonic implications

Zhong-Mei Wang [a,b,*], Chun-Ming Han [a,**], Ben-Xun Su [a], Patrick Asamoah Sakyi [c], Sanjeewa P.K. Malaviarachchi [d], Song-Jian Ao [a], Luo-Juan Wang [a,b]

[a] State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
[b] University of Chinese Academy of Sciences, Beijing 100049, China
[c] Department of Earth Science, University of Ghana, P.O. Box LG 58, Legon, Accra, Ghana
[d] Department of Geology, Faculty of Science, University of Peradeniya, Peradeniya 20400, Sri Lanka

ARTICLE INFO

Article history:
Received 13 March 2013
Accepted 11 August 2013
Available online 20 August 2013

Keywords:
Tarim Craton
Metasedimentary rocks
Provenance
Zircon U–Pb dating
Hf isotopes

ABSTRACT

The Dunhuang Block, located in the eastern Tarim Craton, widely exposes Precambrian TTG gneisses and metamorphosed supracrustal rocks. A suite of metasedimentary rocks of the Dunhuang Group in the Hongliuxia area on the eastern margin of the Tarim Craton are characterized by moderate contents of quartz, plagioclase, and biotite, with minor amounts of garnet or kyanite, most of which have experienced strong deformation, resulting in well-developed amphibolite-facies foliations. The examined samples are characterized by moderate Fe_2O_3 + MgO and TiO_2 contents, and Al_2O_3/SiO_2 and K_2O/Na_2O ratios with low Chemical Index of Alteration (CIA) and high Index of Compositional Variability (ICV) values, suggesting that the protolith sediments originated from continental island arc environment. The U–Pb ages of magmatic-type detrital zircons from the Hongliuxia metasedimentary rocks range between 2476 Ma and 1950 Ma, with a peak at 2417 Ma. Detrital zircons of metamorphic origin yielded an age peak at 1832 Ma, which may represent a tectono-thermal event in the Paleoproterozoic. Considering that the main age populations of the analyzed samples are consistent with the tectono-thermal events in the Tarim Craton during the early Paleoproterozoic, we propose that the Tarim Craton was possibly the major source for the protolith sediments of the metasedimentary rocks in the Hongliuxia area. Zircon Hf isotopic compositions ($\varepsilon_{Hf}(t) = -5.8$ to $+2.9$) suggest voluminous addition of juvenile materials to the crust and minor reworking of old materials in the eastern Tarim Craton during the Mesoarchean (T^c_{DM} = 2.8–2.9 Ga). The metasedimentary rocks of the Hongliuxia area provide clear constraints to the evolution of the Tarim Craton. A possible tectonic model is that multiple thermal events (~2.4 Ga, 2.2 Ga, 2.0 Ga and 1.8 Ga) occurred in the study area, and the time period of Mesoarchean was important for crustal growth in the eastern Tarim Craton, whereas the ~1.83 Ga metamorphism might represent a thermal event associated with the Tarim Craton within the supercontinent Columbia.

1. Introduction

The Tarim Craton in northwestern China, which is one of the three major cratons in China (i.e., the North China, the Yangtze and the Tarim Cratons), is believed to have experienced multiple tectono-thermal events from Neoarchean to Neoproterozoic times (Chen et al., 2012; Lu et al., 2008b; Zhu et al., 2011a). Because of its extensive desert coverage, the Tarim Craton has been much less studied than the other two cratons. Sufficient, well-preserved geological records in the Tarim Craton are related to the assembly and breakup of the supercontinent Rodinia (He et al., 2012; Long et al., 2011b; Shu et al., 2011; Yin et al., 2009; Zhang et al., 2007a; C.L. Zhang et al., 2009; Z.Y. Zhang et al., 2009; Zhu et al., 2011a), indicating that the Tarim Craton was part of Rodinia (Li and Mu, 1999; Long et al., 2011b; Lu et al., 2008a; Santosh et al., 2013). In contrast, very little investigation has been conducted into the evolutionary history of the Tarim Craton during the Archean–Paleoproterozoic, based on which two main hypotheses have been proposed: (1) the northern Tarim Craton experienced its history of crustal growth and was a separate entity before the early Paleoproterozoic (Long et al., 2010b; Lu et al., 2008a), and (2) the Tarim Craton was part of the North China Craton in its early history but rifted away and joined the Yangtze Craton prior to the Neoproterozoic (Chen et al., 2012; Gong et al., 2012; He et al., 2012). The basement rocks are

* Correspondence to: Zhong-Mei Wang, State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China. Tel.: +86 10 82998522; fax: +86 10 62010846.
** Corresponding author. Tel.: +86 10 82998522; fax: +86 10 62010846.
E-mail addresses: wangzm@mail.iggcas.ac.cn (Z.-M. Wang), cm-han@mail.iggcas.ac.cn (C.-M. Han).

0024-4937/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.lithos.2013.08.010

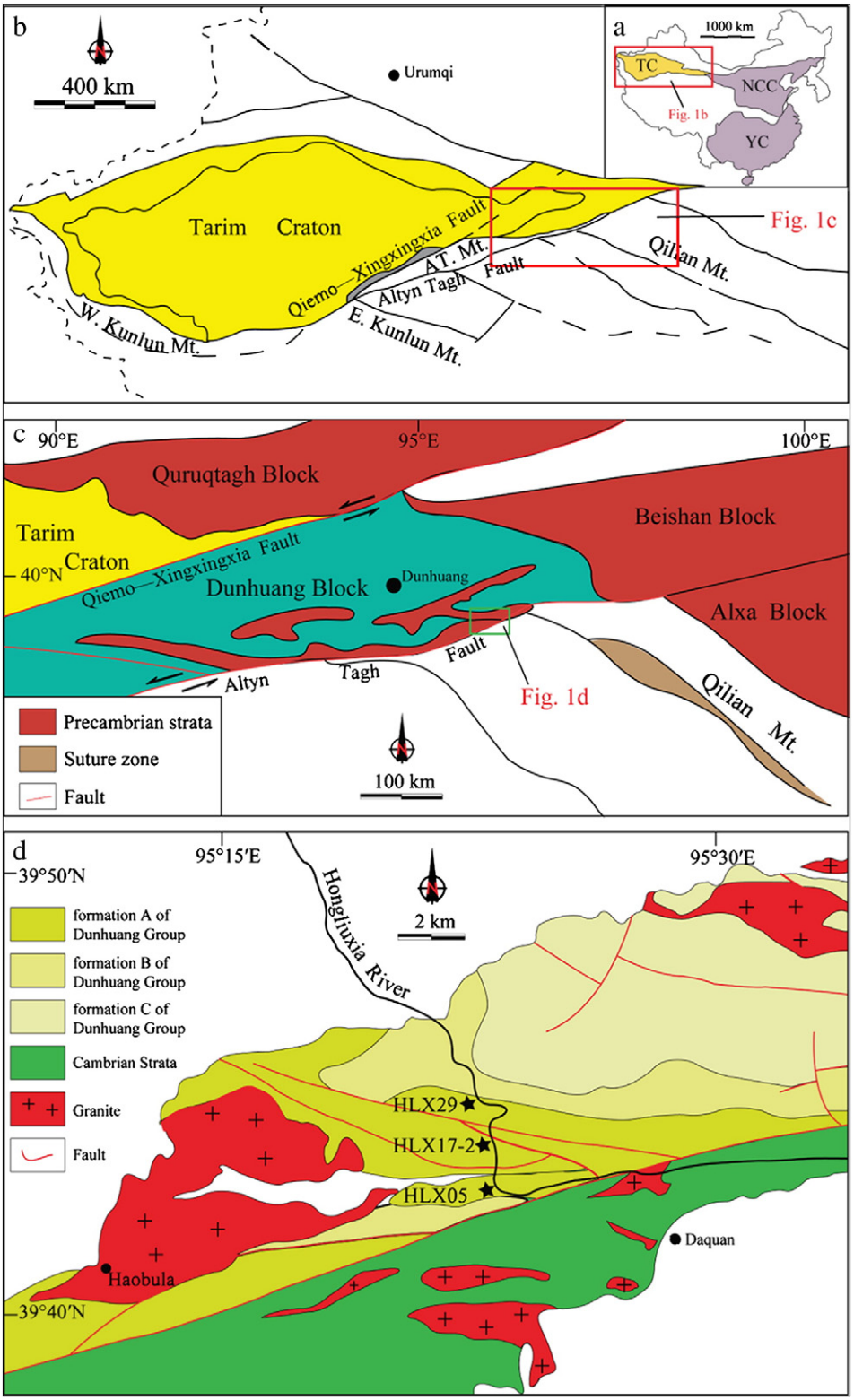

Fig. 1. (a) The major divisions in China showing the position of the Tarim Craton (after Zhao et al., 2005); NCC, North China Craton; TC, Tarim Craton; YC, Yangtze Craton; (b) Simplified sketch of the Tarim Craton showing it's tectonic framework (after Lu et al., 2008a); (c) Simplified geological map of Dunhuang and surrounding area (after Ge and Liu, 2000); (d) Geological map of the Hongliuxia area, northeastern Tarim Craton.

prominently exposed in the eastern Altyn Tagh Mountains and in the Quruqtagh area on the northern margin of the Tarim Craton (Chen et al., 2012; Long et al., 2010b; Lu, 2002b; Lu et al., 2008b; Zhu et al., 2011a). Despite the major advancements in reconstructing the evolutionary history of the northern Tarim Craton in the past decades (Guo et al., 2003; He et al., 2012; Long et al., 2010b, 2011a; Mei et al., 1998; Meng et al., 2011; Shu et al., 2011; Su et al., 2011, 2012; Zhu et al., 2011a,b), many issues regarding the formation and evolution of