Precambrian Research 304 (2018) 156–170

Contents lists available at ScienceDirect

Precambrian Research

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

Neoarchean magmatism and implications for crustal growth and evolution of the Kuluketage region, northeastern Tarim Craton

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ARTICLE INFO

Keywords:
Tarim
Kuluketage
Neoarchean
Amphibolite
Granitic gneiss

ABSTRACT

The Tarim Craton is well known as one of the oldest large blocks in China. The Kuluketage region is an important area for studying the Precambrian crustal evolution of the Tarim Craton because rare Precambrian basement rocks are exposed in the craton. In this study, amphibolites and granitic gneisses from the Pargangtage area of eastern Kuluketage have been studied using a combination of ICP-MC-MS zircon U–Pb dating and Lu–Hf isotopic analyses and whole rock major, trace element and Sm–Nd isotopic geochemistry to constrain their magmatic ages and sources. The amphibolites and granitic gneisses yield intrusion $^{207}Pb/^{206}Pb$ ages of 2524 ± 20 Ma and 2501 ± 17 Ma, respectively. The amphibolites are characterized by enriched LREE, flat HREE patterns, and pronounced negative Nb, Ta, Zr, Hf, Ti, and Y anomalies that indicate an arc affinity. The moderate positive $\varepsilon_{Nd}(t)$ values (+3.43 to +5.52) and zircon $\varepsilon_{Hf}(t)$ values (+1.36 to +6.53) suggest that the parental mafic magma of the amphibolites was mainly generated from a depleted lithospheric mantle source that was metasomatized by subduction-related components. The granitic gneisses show chemical features of high SiO_2; low $Mg^{\#}$, Cr and Ni with fractionated REE patterns; and high Sr, $(La/Yb)_N$, and Sr/Y ratios. These values are consistent with the chemical characteristics of Cenozoic adakites, which were derived from the partial melting of mafic rocks in an island arc tectonic setting. The positive $\varepsilon_{Nd}(t)$ values (+3.21 to +4.42) and $\varepsilon_{Hf}(t)$ values (+1.64 to +6.31) of the granitic gneisses indicate they were derived from the partial melting of juvenile crustal materials. This study, combined with previous analytical results, suggests that the northern Tarim Craton mainly experienced continental crustal growth episodes at ~3.2 Ga, ~2.9–2.8 Ga and ~2.65 Ga, and two magmatic events at ~2.7 Ga and ~2.5 Ga during the Archean. A continental (oceanic) arc probably played an important role in the ~2.7 Ga and 2.5 Ga crustal growth and reworking of the northern Tarim Craton.

1. Introduction

It is widely considered that Archean cratons are mainly dominated by TTGs, metamorphosed supracrustal rocks and mafic dyke swarms (Jahn et al., 1981). Many distinct models have been proposed for explaining the generation of Archean crust, with the two main models being the traditional slab subduction model (Condie, 1994; Smithies et al., 2007) and the non-uniformitarian model (Condie, 1997; Johnson et al., 2016, 2017). Studies of modern igneous rocks have shown that the petrologic, geochemical and isotopic features of igneous rocks are sensitive to tectonic setting and geodynamic processes. Thus, studies of the Archean TTGs and other igneous components in old cratons are crucial for understanding the generation of Archean crust.

The North China, South China and Tarim blocks are the three largest cratons in China. They were amalgamated during Phanerozoic orogenic processes (Zhao et al., 1998, 2001, 2005; Lu et al., 2008; Zhai and Santosh, 2011). Unlike the North China and South China cratons, where much more investigation of the tectonic evolution has been carried out, fewer studies have been made in the Tarim Craton because most of the craton is covered by Cenozoic desert with rare Precambrian basement rock exposure along the margins of the craton (Fig. 1). The Precambrian basements in these regions were invariably reworked strongly by Phanerozoic events, e.g., the Altyn Tagh-Dunhuang region (Zhang et al., 2001, 2005; Meng et al., 2011; Zong et al., 2012) and Korla region (Ge

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https://doi.org/10.1016/j.precamres.2017.11.016
Received 11 July 2017; Received in revised form 20 November 2017; Accepted 24 November 2017
Available online 24 November 2017
0301-9268/

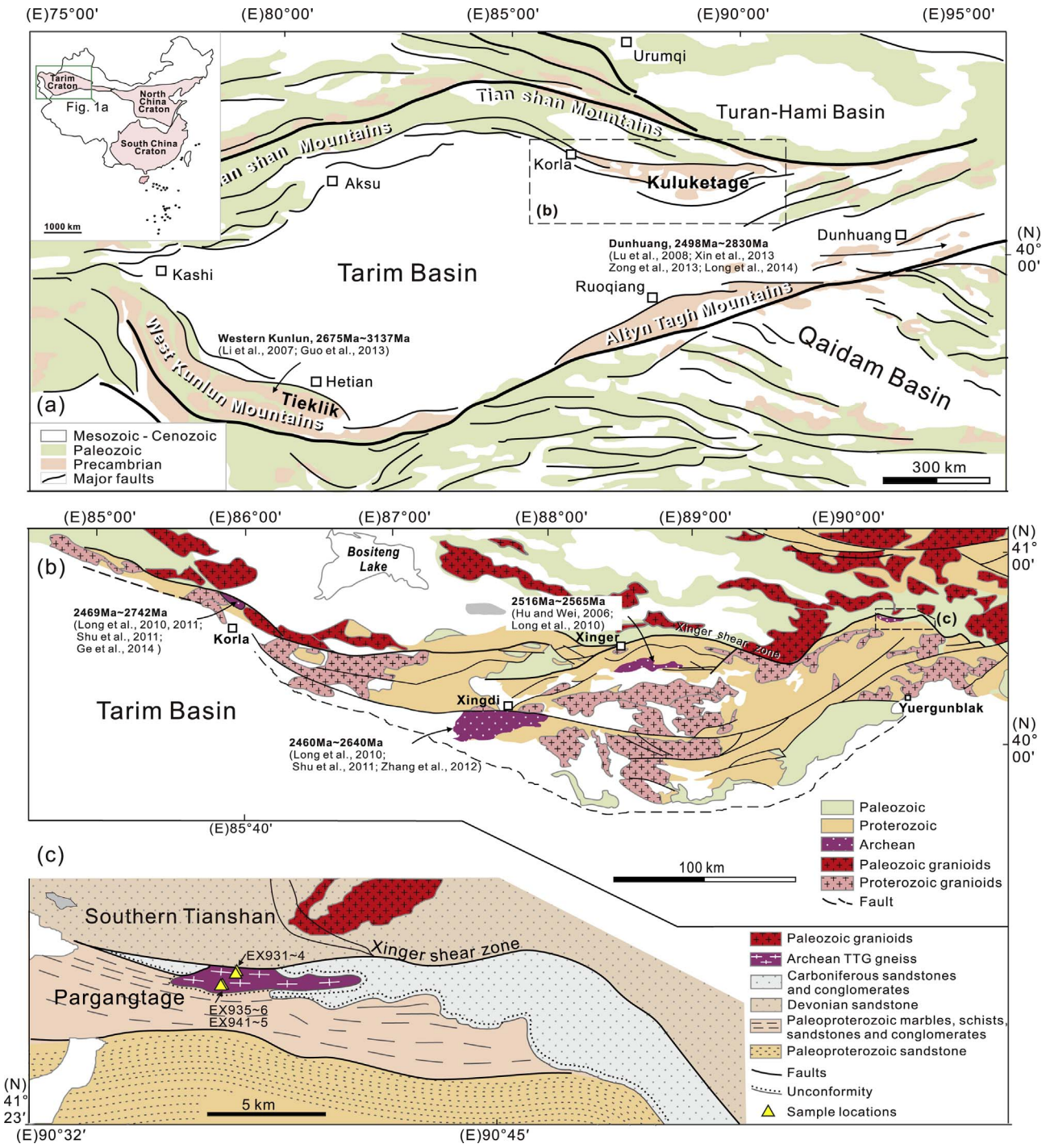

Fig. 1. (a) Geological map of the distribution of Precambrian basement rocks in the Tarim Craton and adjacent area (modified from Xu et al. (2013)); the insert map shows the locations of the three cratons in China: North China, South China and Tarim. (b) Geological map of the Kuluketage region (modified from XBGMR (1960)). (c) Geological map of the Pargangbulak area (modified from XBGMR (1960)) and the sample localities.

et al., 2012a). Despite the drawback of naturally poor accessibility, significant achievements have been made in understanding the Precambrian evolution of the Tarim Craton in recent decades.

Zircon Hf and whole rock Nd model ages of Mesoarchean to Paleoproterozoic plutons reveal that the Tarim Craton crust was generated as early as the Paleoarchean (Long et al., 2011b, 2014; Zong et al., 2013; Ge et al., 2014), and the most significant peak in magmatism was the period at 2.7–2.35 Ga (Hu and Wei, 2006; Lu et al., 2008; Ge et al., 2014; Long et al., 2010, 2011b; Zhang et al., 2012, 2013a; Lu et al., 2008; Shu et al., 2011). During the late Paleoproterozoic (1.9–1.8 Ga), the Tarim Craton experienced a regional magmatic–metamorphic event (Zhang et al., 2007; Shu et al., 2011; Long et al.,