Journal of Asian Earth Sciences 77 (2013) 183–202

Contents lists available at ScienceDirect

Journal of Asian Earth Sciences

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

Paleozoic evolution of the Qimantagh magmatic arcs, Eastern Kunlun Mountains: Constraints from zircon dating of granitoids and modern river sands

Wei Li [a,b,*], Franz Neubauer [a], Yongjiang Liu [b], Johann Genser [a], Shoumai Ren [c], Guoqing Han [b], Chenyue Liang [a,b]

[a] Department of Geography and Geology, University of Salzburg, Hellbrunnerstraße 34, Salzburg A-5020, Austria
[b] College of Earth Sciences, Jilin University, Jianshe Street 2199, Changchun 130061, China
[c] Strategic Research Center of Oil & Gas Resources, MLR, Funei Street 88, Xicheng District, Beijing 100034, China

ARTICLE INFO

Article history:
Received 16 November 2012
Received in revised form 16 August 2013
Accepted 26 August 2013
Available online 5 September 2013

Keywords:
Paleozoic
U–Pb
Qimantagh
Paleo-Tethyan Ocean
Magmatic arc
Eastern Kunlun

ABSTRACT

The Qimantagh area, located along the northwestern margin of the Eastern Kunlun Mountains at the northern margin of the Tibetan plateau, is one of the less studied regions of Central Asia/Western China due to its remote location. In this study, we present new LA–ICP–MS U–Pb zircon ages from granitoids and modern sands collected at the northern slope of Qimantagh. Seven samples of diorites, granites and orthogneiss gave a variety of ages: (1) four samples from Wotoushan yield weighted average ages of 484.6 ± 7.3, 439.0 ± 5.9, 424.0 ± 3.5 and 261.5 ± 3.7 Ma; (2) the weighted average ages of two granite samples from Shuangshixia are 461.7 ± 8.4 and 428.6 ± 4.4 Ma; and (3) the diorite sample from Naitoushan shows the weighted average age of 446.2 ± 3.6 Ma. Early Paleozoic ages dominate while one sample gives a Late Paleozoic age. Together, the new ages representing distinct steps of Paleozoic magmatic evolution in the Qimantagh area.To assess further the overall composition of the North Qimantagh block, zircons of three modern sands samples from rivers draining the Qimantagh area into the Qaidam basin yield a wide age range of 3118–211 Ma. Based on new zircon ages from modern river-sand samples and granitoids, combined with previous geochronological age data, we suggest that two stages of tectonic evolution existed in the Qimantagh area: (1) northward subduction of the Qimantagh Ocean (513–420 Ma); (2) continental arc setting (290–257 Ma).

1. Introduction

The Tibetan plateau and the adjacent mountains to the south (Himalayas) and north (Altyn, Kunlun and its northern promontory Qimantagh; Fig 1) are certainly the most outstanding present-day features resulting from continent–continent collision (e.g., Yin and Harrison, 2000; Jolivet et al., 2001; Tapponnier et al., 2001). Therefore, this region have been the focus of many studies concerning mechanisms for accommodating continental collision, in particular the process of deformation partitioning between crustal and lithosphere thickening related to horizontal shortening, uplift and exhumation of deep tectonic units (e.g., Yin and Harrison, 2000). The Eastern Kunlun Mountains located at the northern margin of the Tibetan Plateau is a composite orogenic belt characterized by several orogenic cycles (Jiang, 1992; Yang et al., 1996, 2009; Pan et al., 1996; Yin and Zhang, 1997, 1998; Luo et al., 1999; Yin et al., 2003; Zhu et al., 1999, 2005), playing an important role in the tectonic evolution history of the Tibetan plateau (Jiang, 1992; Pan et al., 1996, 1997; Li et al., 1996; Guo et al., 1998; Gehrels et al., 2011). Presently, most geologists pay close attention to the research of Paleozoic tectonic evolution in the eastern, central and southern sectors of Eastern Kunlun (Pan et al., 1996; Zhu et al., 2005; Li et al., 2006; Zhao et al., 2008; Chen et al., 2008; Zhang et al., 2010; Liu et al., 2012). However, the western region is less studied.

The Qimantagh area is located at the northwestern margin of the Eastern Kunlun Mountains (Figs. 1 and 2a), recording the early stages of tectonic evolution in the region. The research in the Qimantagh area shows important significance for the tectonic evolution of Eastern Kunlun as well as the Tibetan plateau. At present, although some researchers studied some details of the tectonic evolution of Qimantagh area systematically (Shen et al., 1999; Yang et al., 2000; Tan et al., 2004; Liu et al., 2006; Lu et al., 2006; Ma et al., 2010; Cui et al., 2011; Feng et al., 2012; Wang et al., 2009, 2012), the Paleozoic evolution is not clear, particularly because protolith ages of abundant granitoids are scarce (Table 1). Many researchers suggested that the Qimantagh basically

* Corresponding author at: Department of Geography and Geology, University of Salzburg, Hellbrunnerstraße 34, Salzburg A-5020, Austria. Tel.: +43 66280445461; fax: +43 6628044621.
E-mail address: iceliwei@gmail.com (W. Li).

1367-9120/$ - see front matter
http://dx.doi.org/10.1016/j.jseaes.2013.08.030

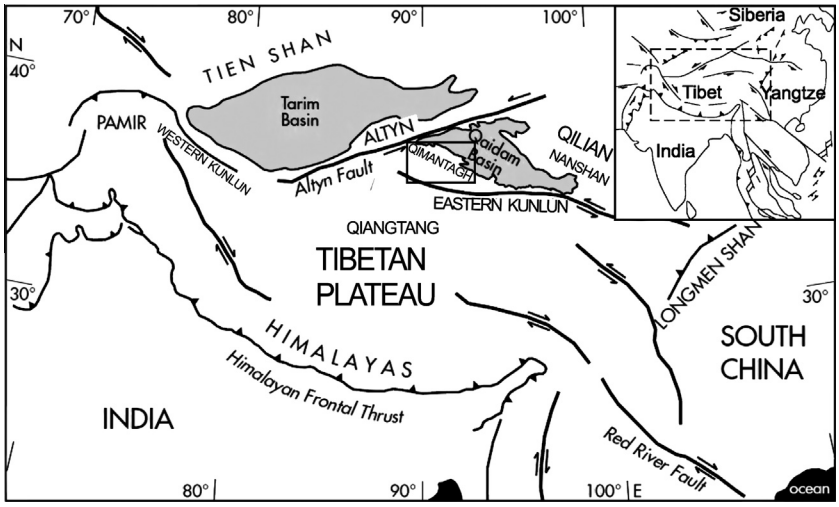

Fig. 1. Sketch geological map of Himalaya–Tibet system of Central Asia (after Rieser et al., 2005). The insert map shows the location of Himalaya–Tibet system in Eurasia plate and the black solid line rectangle indicates our study area (Fig. 2a).

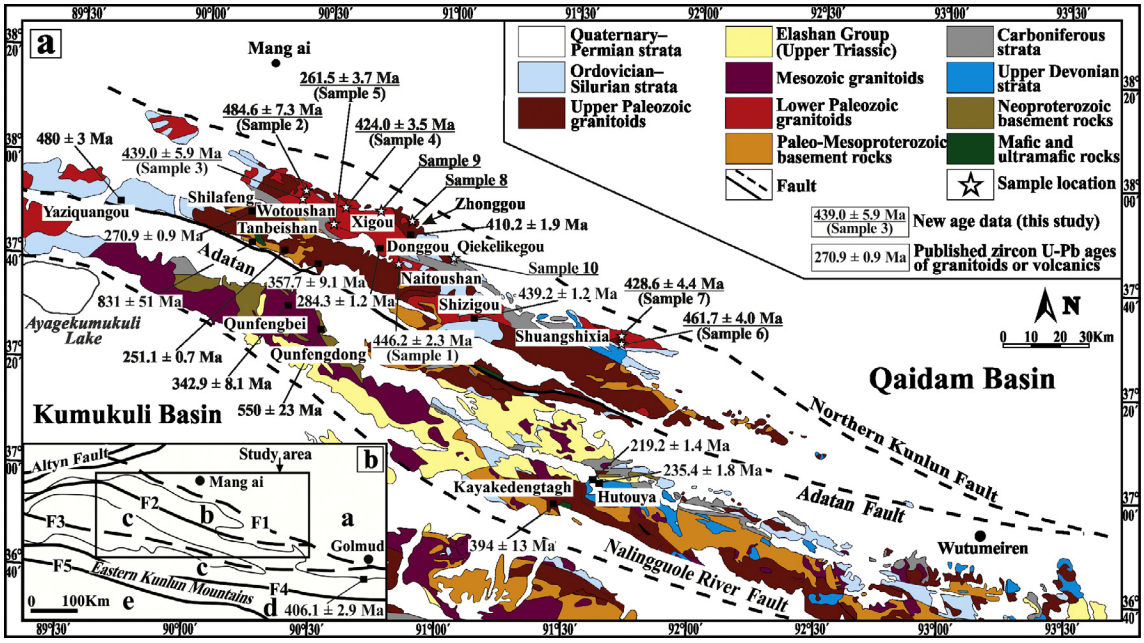

Fig. 2. (a) Geological map of the Qimantagh area (based on the Geological Map of Qaidam Basin, Qinghai Oilfield Company and Petroleum University, 1998). (b) Sketch map of tectonic units division in the Qimantagh area (after Wang et al., 2009). a – The Qaidam block; b – The juncture between the Early Paleozoic North Qimantagh magmatic arc and the Early Paleozoic Qimantagh suture zone; c – The Kunlun block; d – The South Kunlun subduction collision mélange belt; e – Yulongtagh – Baryan Har peripheral foreland basin; F1 – Golmud concealed fault (North Kunlun fault); F2 – Adatan fault; F3 – Nalingguole River fault; F4 – Fault belt in the central part of Eastern Kunlun; F5 – South Kunlun fault; the black square indicates the sample location of Zhang et al. (2010).

represents an Early Paleozoic magmatic arc (Li et al., 2001, 2008; Liu et al., 2003; Wu et al., 2010). In this study, we investigated the western Qimantagh and present new LA–ICP–MS U–Pb zircon ages from granitoids collected at the northern slope of the area. We also present U–Pb detrital zircon ages from three modern river-sand samples to get a first-order overview of the distribution of zircon ages in the granitoid-dominated drainage basins. Combined with previous geochronological data (Table 1), we provide evidence for the Paleozoic tectonic evolution of the Qimantagh area.

2. Geological background

The Qimantagh area is part of the Paleozoic magmatic arc belt of Eastern Kunlun (Fig. 1; Li et al., 2001, 2008; Liu et al., 2003; Wu et al., 2010). The Cenozoic petroliferous Qaidam basin is exposed to the north, and the Mesozoic–Cenozoic Kumukuli basin to the south (Fig. 2a; Jiang, 1992; Pan et al., 1996; Bureau of Geology and Mineral Resources of Xinjiang Province, 1998). The division of tectonic units in the Qimantagh area resulted on several distinct models. Based on five major faults, Pan et al. (2002) divided the Qimantagh and its adjacent area into five major tectonic units from north to south (Fig. 2b), which include: (a) the Qaidam block; (b) the juncture between the Early Paleozoic North Qimantagh magmatic arc and the Early Paleozoic Qimantagh suture zone; (c) the Kunlun block; (d) the South Kunlun subduction collision mélange belt; (e) Yulongtagh–Baryan Har peripheral foreland basin. Li et al. (2008) and Wu et al. (2009, 2011) suggested a division into three tectonic units according to the boundary of North Kunlun and Middle Kunlun faults. These units are: (1) the Early