Journal of Asian Earth Sciences 75 (2013) 158–173

Contents lists available at ScienceDirect

Journal of Asian Earth Sciences

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

Petrogenesis and tectonic settings of the Late Carboniferous Jiamantieliek and Baogutu ore-bearing porphyry intrusions in the southern West Junggar, NW China

Ping Shen [a,*], Wenjiao Xiao [a], Hongdi Pan [b], Lianhui Dong [a,c], Chaofeng Li [a]

[a] Key Laboratory of Mineral Resources, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
[b] Collage of Earth Sciences, Chang'an University, Xi'an 710054, China
[c] Xinjiang Bureau of Geology and Mineral Resources, Urumqi 830000, China

ARTICLE INFO

Article history:
Received 22 March 2013
Received in revised form 10 July 2013
Accepted 16 July 2013
Available online 24 July 2013

Keywords:
Zircon U–Pb age
Sr–Nd–Pb isotope
Jiamantieliek
Baogutu
West Junggar
Xinjiang

ABSTRACT

Porphyry Cu deposits occurred in the southern West Junggar of Xinjiang, NW China and are represented by the Baogutu and newly-discovered Jiamantieliek porphyry Cu deposits. Petrographical and geochemical studies show that both Jiamantieliek and Baogutu ore-bearing intrusions comprise main-stage diorite stock and minor late-stage diorite porphyry dikes and are the calc-alkaline intermediate intrusions. Based on U–Pb zircon SHRIMP analyses, the Jiamantieliek intrusion formed in 313 ± 4 Ma and 310 ± 5 Ma, while, based on U–Pb zircon SIMS analyses, the Baogutu intrusion formed in 313 ± 2 Ma and 312 ± 2 Ma. Rocks in the Jiamantieliek intrusion are enriched in light rare earth elements (LREE) and large ion lithophile elements (LILE) with negative Nb anomaly. Their isotopic compositions ($\varepsilon_{Nd}(t)$ = +1.6 to +3.4, $(^{87}Sr/^{86}Sr)_i$ = 0.70369–0.70401, $(^{207}Pb/^{204}Pb)_i$ = 15.31–5.41) suggest a mixing origin from depleted to enriched mantle sources. In the Baogutu intrusion, the rocks are similar to those of the Jiamantieliek intrusion. Their Sr-Nd-Pb isotopic composition ($\varepsilon_{Nd}(t)$ = +4.4 to +6.0, $(^{87}Sr/^{86}Sr)_i$ = 0.70368–0.70385, $(^{207}Pb/^{204}Pb)_i$ = 15.34–5.42) shows a more depleted mantle source. These features suggest generation in an island arc. The Jiamantieliek and Baogutu intrusions have similar characteristics, indicating that a relatively uniform and integrated source region has existed in the southern West Junggar since the Palaeozoic. A larger contribution of calc-alkaline magma would be required to generate the Jiamantieliek intrusion, which may reflect the development of magma arc maturation towards the western section of the southern West Junggar.

1. Introduction

The Central Asia Orogenic Belt (CAOB) is the largest Phanerozoic juvenile crustal growth orogenic belt in the world (Şengör and Natal'in, 1996; Jahn et al., 2000, 2004; Xiao et al., 2008, 2009, 2010) and have plentiful mineral sources (Seltmann and Porter, 2005; He and Zhu., 2006; Zhu et al., 2007; Shen et al., 2010a,b, 2013). As a part of the CAOB, the West Junggar terrain in Xinjiang (NW China) is economically important, not only as a potential target for Cu–Au–Mo–W–Cr exploration (Shen et al., 1993; He and Zhu, 2006; Zhu et al., 2007; Shen et al., 2010a,b, 2012, 2013), but also as a critical area to study the subduction-accretion history of the CAOB.

The West Junggar terrain largely comprises Palaeozoic volcanic arcs in the northern West Junggar and accretionary complexes in the southern West Junggar (e.g., Windley et al., 2007; Xiao et al., 2008, 2009, 2010; Zhang et al., 2011a,b), which were accreted onto the Kazakhstan plate as the Tarim, Kazakhstan and Siberian plates converged (Jahn et al., 2000; Chen and Jahn, 2004; Chen and Arakawa, 2005; Xiao et al., 2008). This geodynamic process led to the formation of voluminous granitoids and small ore-bearing stocks. The former are I- and A-type granites with highly-depleted isotopic signatures ($\varepsilon_{Nd}(t)$ = +6.4 to +9.2) (Jahn et al., 2000; Chen and Jahn, 2004; Chen and Arakawa, 2005; Han et al., 2006). The latter are diorites that are associated with the porphyry copper deposits (e.g. Baogutu and newly-discovered Jianmantieke) in the southern West Junggar (Fig. 1b, Shen et al., 2009, 2013). Previous studies were mainly concentrated on the voluminous granitoids in the area (e.g. Jahn et al., 2000; Hu et al., 2000; Chen and Jahn, 2004; Chen and Arakawa, 2005; Han et al., 2006; Zhou et al., 2008), with few attention to these ore-bearing stocks. In addition, the intrusions tectonic setting of the southern West Junggar is controversial. They have been attributed either to subduction-related sources in an island arc setting (Xiao et al., 2008, 2009; Shen et al., 2009; Geng et al., 2009, 2011; Tang et al., 2009, 2010; Zhang et al., 2011a) or to depleted mantle contributions in a post-collisional extensional setting

* Corresponding author. Tel.: +86 10 82998189; fax: +86 10 62010846.
E-mail address: pshen@mail.iggcas.ac.cn (P. Shen).

1367-9120/$ - see front matter
http://dx.doi.org/10.1016/j.jseaes.2013.07.024

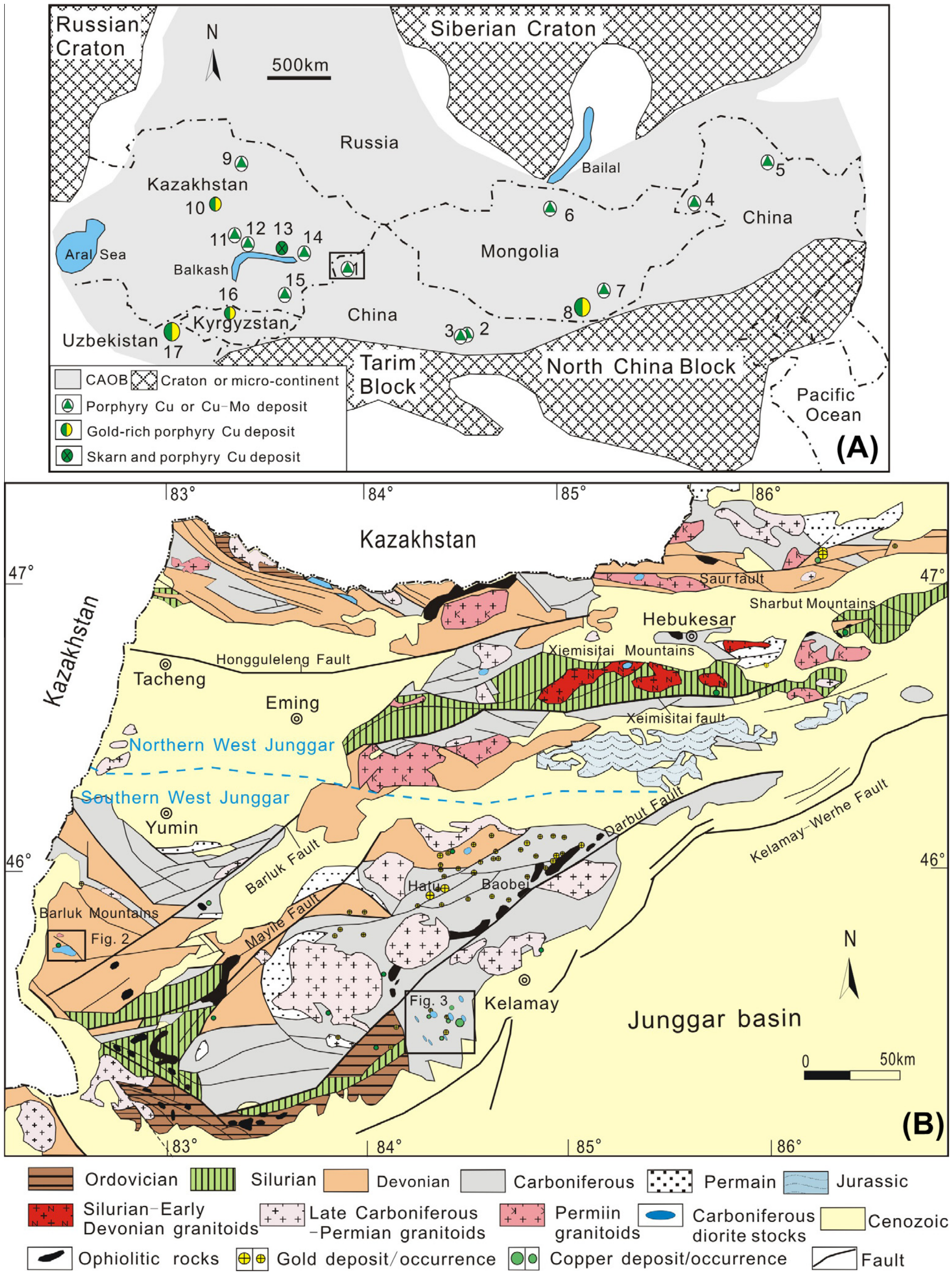

Fig. 1. A Schematic map of the Central Asian Orogenic Belt (Xiao et al., 2009; Shen et al., 2010a) showing principal porphyry copper deposits (1 – Baogutu; 2 – Tuwu; 3 – Yandong; 4 – Wunuhetushan; 5 – Duobaoshan; 6 – Erdenet; 7 – Tsagaan-Suvarga; 8 – Oyu Tolgoi; 9 – Boshekul; 10 – Samarsk; 11 – Borly; 12 – Kounrad; 13 – Sayak; 14 – Aktogai; 15 – Koksai; 16 – Taldy Bulak; 17 – Kal'makyr). Fig. 1B. Geological map of the West Junggar region, showing the location of the Jiamantieliek and Baogutu porphyry copper deposits occurred in the southern West Junggar.

(Chen and Arakawa, 2005; Han et al., 2006; Zhou et al., 2008). These models clearly have significantly different implications for intrusion petrogenesis and associated mineralisation.

In this paper, we first report the major elements, trace elements and Sr–Nd–Pb isotopic geochemical data for whole rocks and for U–Pb zircon SHRIMP ages from the Jiamantieliek ore-bearing intrusion in the Barluk Mountains. For comparison, we have also added new results for the Baogutu intrusion in the Kelamay Region relating to 10 whole-rock major and trace element analyses, and four Sr–Nd–Pb isotope ratios. Our aim was to provide constraints to the tectonic setting and associated ore-bearing magma in the West Junggar, Xinjiang. All these factors have significant implications for understanding the continental growth and associated mineralisation in the CAOB.

2. Geological outline

The West Junggar terrain is bound by the Altai orogen to the north and by the Tianshan orogen to the south and extends westward to the Junggar–Balkhash region in adjacent Kazakhstan and eastward to the Junggar Basin in North Xinjiang, NW China. The southern West Junggar is located between latitudes 45°05′ and 46°15′ north and longitudes 82°15′ and 86°00′ east (Fig. 1b). Geologically, the southern West Junggar is characterised by several