Lithos 266–267 (2016) 115–132

Contents lists available at ScienceDirect

Lithos

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

Geochronology and Geochemistry of Igneous Rocks from the Laoshankou District, North Xinjiang: Implications for the Late Paleozoic Tectonic Evolution and Metallogenesis of East Junggar

Pei Liang [a,b], Huayong Chen [a,*], Pete Hollings [c], Chao Wu [a,b], Bing Xiao [a,b], Zhiwei Bao [a], Deru Xu [a]

[a] Key Laboratory of Mineralogy and Metallogeny, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, 511 Kehua Road, Guangzhou, 510640, China
[b] Graduate University of Chinese Academy of Sciences, 19 Yuquan Road, Beijing, 100049, China
[c] Department of Geology, Lakehead University, 955 Oliver Road, Thunder Bay, Ontario, P7B5E1, Canada

ARTICLE INFO

Article history:
Received 15 November 2015
Accepted 18 August 2016
Available online 28 August 2016

Keywords:
Geochemistry
Igneous rocks
Island arc environment
Late Paleozoic
Laoshankou district
East Junggar

ABSTRACT

The Fe-Cu mineralization of the Laoshankou district is located in the Dulate Late Paleozoic island arc at the northern margin of East Junggar terrane, Northwest China and is hosted by volcanic rocks of the Middle Devonian Beitashan Formation. LA-ICP-MS U–Pb dating of zircon constrains the timing of crystallization of biotite diorites and quartz syenites in the Laoshankou district to 379 ± 2 Ma and 376 ± 2 Ma, respectively.

The volcanic rocks are calc-alkaline in composition and are characterised by LILE and LREE enrichments and HFSE depletions, consistent with a subduction-related affinity. The relatively depleted Nb, Ta, Zr, Hf and Th, enriched Sr and Ba, elevated Mg#, positive $\varepsilon_{Nd}(t)$ values (5.5 and 5.6), low $(^{87}Sr/^{86}Sr)_i$ ratios (0.7042 and 0.7044) and MORB-like Pb-isotope characters all suggest that they were derived from a depleted mantle wedge metasomatized by slab-derived fluids, without crustal contamination. The biotite diorite shows slightly metaluminous compositions and is geochemically similar to the volcanic rocks, suggesting that they were derived from the same depleted mantle source. The lack of correlation between SiO_2 and initial Sr, Nd ratios suggests that fractional crystallization dominated the petrogenesis of the biotite diorite with only weak crustal contamination. The geochemical characteristics of the quartz syenite are distinct from the volcanic rocks and the biotite diorite. The positive $\varepsilon_{Hf}(t)$, $\varepsilon_{Nd}(t)$, high Th/La (0.17–0.53), Th/Yb (1.62–4.39), low Ce/Th (2.87–10.13) ratios and positive trends of SiO_2 versus $(^{87}Sr/^{86}Sr)_i$ and $(^{143}Nd/^{144}Nd)_i$ indicate the quartz syenite is likely the product of a depleted mantle wedge metasomatized by slab-derived fluids and subducted sediment-derived melts that underwent crustal contamination during passage through the crust.

The low abundance of Th, Yb, Ta and La, indicate that all the intrusive rocks from 379 to 376 Ma in the Laoshankou district formed in an island arc rather than a continental margin arc. The northern margin of East Junggar was related to the southward subduction of the Kuerti-Erqis Ocean (a branch of the Paleo-Asian Ocean) between the Altay and the Dulate arcs in this period, consistent with the presence of Nb-enriched basalts and boninites in the north of the Dulate arc and the island arc rather than back arc setting of the igneous rocks in the Laoshankou district.

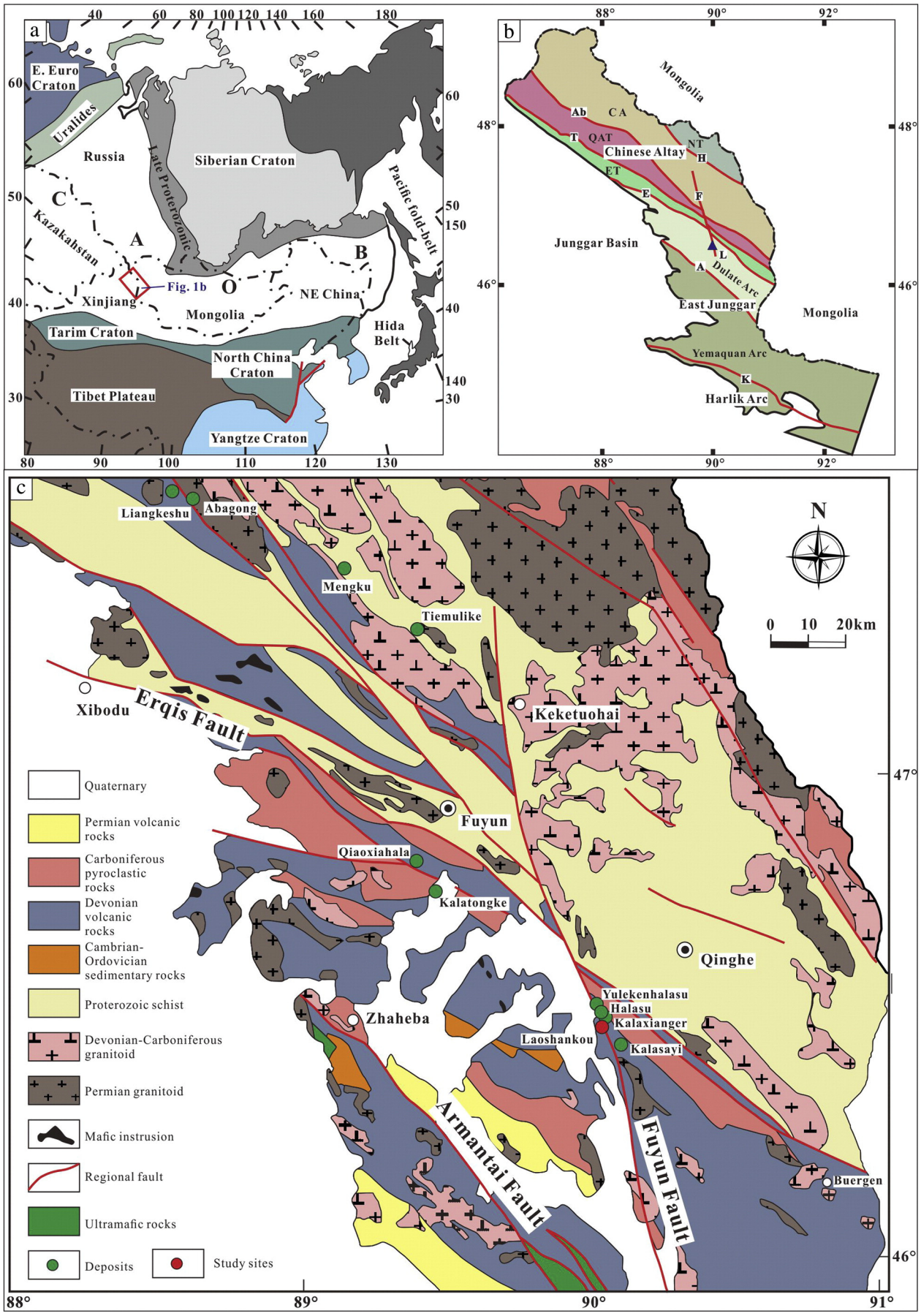
For metallogenesis in the northern margin of East Junggar, arc-related Fe-Cu-Au and porphyry Cu mineralization was dominated. There is large potential to find several Late Paleozoic arc-related Fe-Cu-Au mineralizations in North Xinjiang.

1. Introduction

The Central Asian Orogenic Belt (CAOB; Fig. 1a), the largest Paleozoic to Mesozoic accretionary orogeny in the world, is situated between two major Precambrian cratons: the Siberian to the north and the North China-Tarim to the south and extends from the Urals in the west to the Pacific Ocean in the east. The belt contains numerous tectonic units including island arcs, ophiolites, accretionary complexes, oceanic plateaus, and continental blocks or microcontinents (Huang et al., 2014; Jahn et al., 2000; Sun et al., 2008; Wang et al., 2006; Windley et al., 2002; Xiao et al., 2008). Since the 1990s, the CAOB has been the subject of considerable study as it is critical to the understanding of the development of accretionary orogenies in central Asia. However, the allochthonous nature of many of the terranes and their complicated collisional history make unraveling the tectonic evolution of the CAOB difficult. A number of models have been proposed to explain the development of the area, including (1) successive accretion of the long-lived Kipchak-Tuva-Mongol arc (Sengor and Natalin, 1996; Sengor et al., 1993); (2) the accretion-collision of multiple-subduction systems,

* Corresponding author.
E-mail address: huayongchen@gig.ac.cn (H. Chen).

http://dx.doi.org/10.1016/j.lithos.2016.08.021
0024-4937/


a
E. Euro Craton
Uralides
Russia
Late Proterozoic
Siberian Craton
Pacific fold-belt
C
Kazakahstan
A
B
O
Fig. 1b
Xinjiang
NE China
Mongolia
Tarim Craton
North China Craton
Hida Belt
Tibet Plateau
Yangtze Craton
b
Mongolia
Ab
CA
T
QAT
Chinese Altay
NT
H
ET
E
F
Junggar Basin
L
A
Dulate Arc
East Junggar
Mongolia
Yemaquan Arc
K
Harlik Arc
c
Liangkeshu
Abagong
Mengku
Tiemulike
N
0 10 20km
Xibodu
Erqis Fault
Keketuohai
Fuyun
Qiaoxiahala
Kalatongke
Qinghe
Yulekenhalasu
Halasu
Kalaxianger
Zhaheba
Laoshankou
Kalasayi
Armantai Fault
Fuyun Fault
Buergen
Quaternary
Permian volcanic rocks
Carboniferous pyroclastic rocks
Devonian volcanic rocks
Cambrian-Ordovician sedimentary rocks
Proterozoic schist
Devonian-Carboniferous granitoid
Permian granitoid
Mafic instrusion
Regional fault
Ultramafic rocks
Deposits
Study sites