



Petrogenesis of the early Cretaceous intermediate and felsic intrusions at the southern margin of the North China Craton: Implications for crust–mantle interaction



Xin-Yu Gao, Tai-Ping Zhao ^{*}, Zhi-Wei Bao, Alexandra Yang Yang

Key Laboratory of Mineralogy and Metallogeny, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China

ARTICLE INFO

Article history:

Received 17 December 2013

Accepted 10 July 2014

Available online 30 July 2014

Keywords:

Early Cretaceous magmatism

Geochemistry

Petrogenesis

Southern margin of the North China Craton

ABSTRACT

New major and trace element, whole rock Sr and Nd isotopes and zircon U–Pb ages and Hf isotope data are presented for rocks from the early Cretaceous Tianqiaogou dioritic and Taishanmiao granitic plutons at the southern margin of the North China Craton (NCC), in order to investigate their petrogenesis and geological evolution. LA-ICP-MS U–Pb analyses for zircons from these two plutons yield similar $^{206}\text{Pb}/^{238}\text{U}$ ages of 122 Ma and 115–125 Ma, respectively. Monzodiorites from the Tianqiaogou pluton have whole rock $\varepsilon_{\text{Nd}}(t)$ values ranging from -6.2 to -1.3 and zircon $\varepsilon_{\text{Hf}}(t)$ values from $+2.9$ to $+6.2$. They are variably enriched in Ra, Ba, and Sr, and depleted in Nb, Ta, Zr, Hf and Ti, indicating that they were derived from a depleted mantle and underwent subsequent magma differentiation and crustal contamination. The Taishanmiao pluton is composed of metaluminous to peraluminous highly fractionated I-type granites that have high SiO_2 , Na_2O , K_2O , Rb, Th, and U, and low P, Ba, Sr, Ti and Eu contents. The granites have strong negative whole rock $\varepsilon_{\text{Nd}}(t)$ values (-16.1 to -7.5) and zircon $\varepsilon_{\text{Hf}}(t)$ values (-20.9 to -6.1). Their Nd T_{DM} ages (1.19 to 2.01 Ga) and zircon Hf TC DM ages (1565 to 2490 Ma) are much younger than the basement rocks beneath the southern margin of the NCC, suggesting derivation from an ancient crustal source with minor involvement of mantle-derived components. Therefore, rocks from the Tianqiaogou dioritic pluton were partial melts of the mantle source. Underplating of the mafic magmas initiated partial melting of the ancient continental crust, resulting in the formation of the Taishanmiao granitic pluton. Their complex petrogenesis reflects a strong crust–mantle interaction process related to lithospheric thinning beneath the southern margin of the NCC in early Cretaceous.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

It has been generally considered that the North China Craton (NCC) underwent craton destruction and lithospheric thinning during the late Mesozoic (e.g. Gao et al., 2004; Wu et al., 2005; Zhang, 2012; Zhang et al., 2013; Zheng et al., 2007). More than 100 km of the ancient lithosphere may have been removed beneath the NCC, and this was accompanied by voluminous mafic to felsic magmatism and large-scale Mo–Au–Ag polymetallic mineralization (e.g. Chen et al., 1998; Goldfarb and Santosh, 2014; Guo et al., 2013; J.W. Li et al., 2012; Li and Santosh, 2014; Mao et al., 2011; Zhai and Santosh, 2013). The igneous rocks along the southern margin of the NCC are important for constraining their spatial and genetic relationships with ore deposits (e.g. Mao et al., 2011), crust–mantle interaction and the tectonic evolution of the NCC (e.g. Mao et al., 2010).

The late Mesozoic granites along the southern margin of the NCC are thought to have been derived from ancient continental crust of the NCC (e.g. Ding et al., 2011; Gao et al., 2010; N. Li et al., 2012; Zhao et al., 2012;

Zhu et al., 2013) or from the subducted Yangtze Craton (e.g. Bao et al., 2014). There is a consensus that underplating of the mantle-derived magmas triggered partial melting of the lower crust (Bergantz, 1989; Y.G. Xu et al., 2009). Nevertheless, it remains unclear whether and to what extent mantle-derived components were involved in the petrogenesis of the granitic magmas in the southern margin of the NCC during the late Mesozoic (Ding et al., 2011; N. Li et al., 2012; Zhao et al., 2012) due to lack of evidence of contemporaneous mantle-derived magmatic activity. The key to these debates is to identify primary granites and associated intermediate to mafic rocks. The sparsely distributed mafic intrusions in the southern margin of the NCC may bear information of the geochemical composition of the mantle and regional tectonic evolution. However, the genetic relationships between the temporally and spatially coexisting granitic rocks and the intermediate to mafic rocks in this region are still unknown.

Late Mesozoic granitoid intrusions in the southern margin of the NCC were formed in two main magmatic intervals, the late Jurassic to early Cretaceous (ca. 160–135 Ma) and the early Cretaceous (ca. 130–110 Ma), in distinct tectonic settings (Mao et al., 2010). Many researchers have demonstrated that the 160–135 Ma adakitic granites were produced by partial melting of thickened lower continental crust

^{*} Corresponding author. Tel.: +86 20 85290231; fax: +86 20 85290130.

E-mail address: tpzhao@gig.ac.cn (T.-P. Zhao).

(Ding et al., 2011; Gao et al., 2010; N. Li et al., 2012b; Zhao et al., 2012). However, the 130–110 Ma granites are geochemically different from the adakites, and have not yet been well-documented (Ye et al., 2008). The latter offers important information about the evolution of continental crust and specific tectonic regimes.

In this paper, we report geochronological and geochemical data for the Tianqiaogou dioritic and the Taishanmiao granitic plutons in the Waifangshan area of the southern margin of the NCC, to investigate their petrogenesis and tectonic implications, as well as to explore the possible crust–mantle interaction related to the Mesozoic lithospheric thinning beneath the NCC.

2. Geological background

The North China Craton is bordered by the Central Asian Orogenic Belt to the north, the Qinling–Dabie Orogenic Belt to the south and the Su–Lu Orogenic Belt to the east (Fig. 1A). The southern margin of the NCC is generally confined by the Sanmenxia–Lushan Fault to the north and Luonan–Luanchuan Fault to the south (Fig. 1B). The region shares the same basement–cover sequence to the NCC, namely the

Archean to early Paleoproterozoic basaltes and the overlying late Paleoproterozoic to Phanerozoic unmetamorphosed cover sequence.

The basement of the southern margin of the NCC is represented by the Neoproterozoic–Paleoproterozoic Taihua Group (2.26–2.84 Ga) that is composed of metamorphic rocks, such as amphibolite, felsic gneiss, migmatite, and metamorphosed supracrustal rocks (Kröner et al., 1988; Wan et al., 2006; X.S. Xu et al., 2009). The Taihua Group is unconformably overlain by the Xiong'er Group that is up to 7600 m thick and covers an area of >60,000 km² (Zhao et al., 2004). The Xiong'er Group formed in the period of 1.75–1.78 Ga (Zhao et al., 2004) and consists mainly of intermediate to acidic lavas and pyroclastic rocks intercalated with minor sedimentary rocks (<5%). The Xiong'er Group is covered by the Meso- to Neoproterozoic sedimentary rocks of the Guandaokou and Luanchuan Groups. The southern margin of the NCC lacks Paleozoic–Jurassic strata and no Jurassic rocks can be observed (Fig. 1B). Since the beginning of the Cretaceous, lacustrine or alluvial sediments began to develop in the region.

Granitic rocks are widespread on the southern margin of the NCC. The Precambrian granitic rocks include the Neoproterozoic (2.9–2.5 Ga) tonalite–trondhjemite–granodiorite (TTG) gneiss, Paleoproterozoic

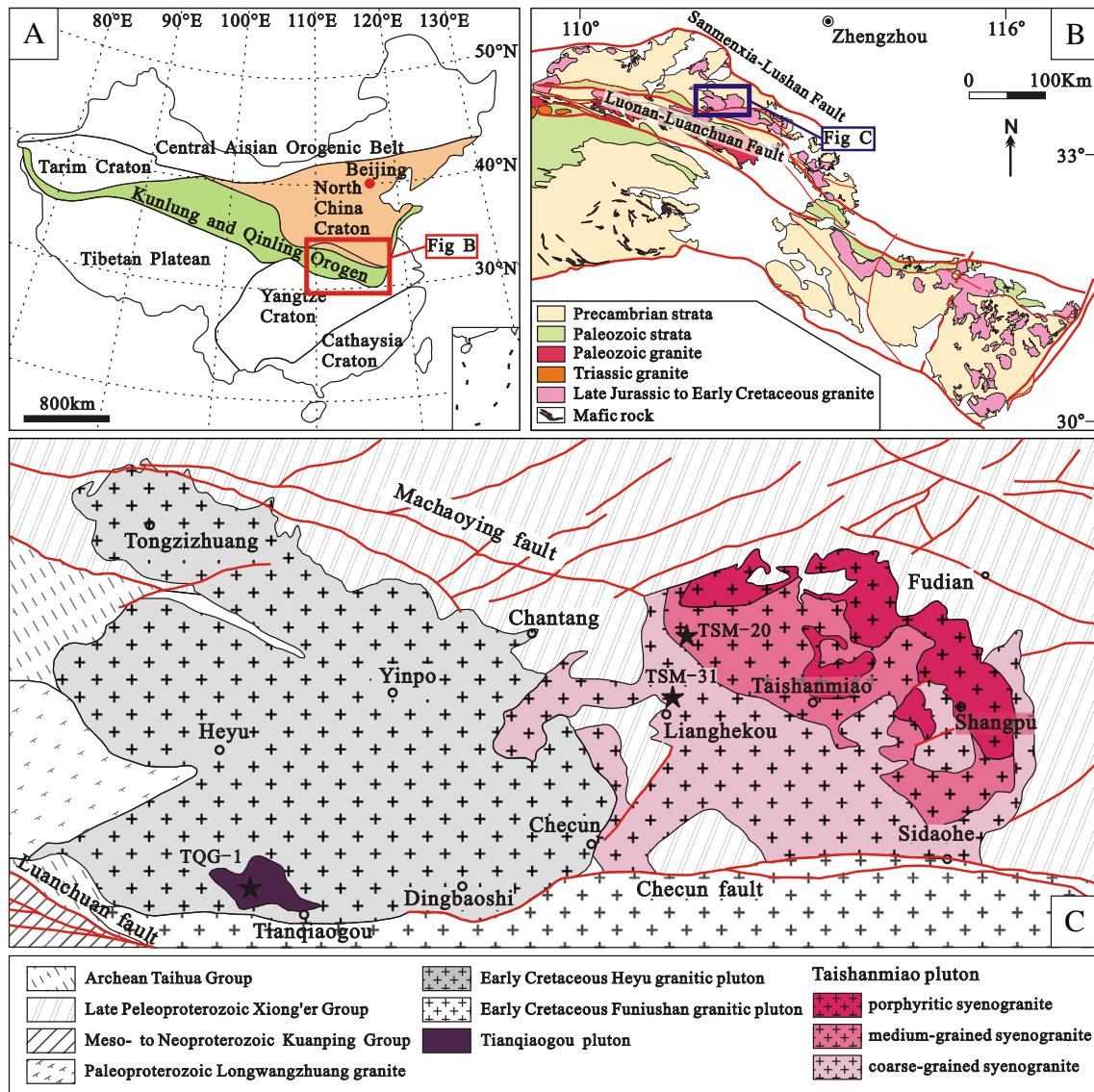


Fig. 1. Geological map in Waifangshan area, southern margin of the North China Craton. (A) Simplified tectonic map of China showing major tectonic phases surrounding the North China Craton and the location of the Qinling Orogen Belt. (B) Geological map of the Qinling Orogen Belt (modified from Zhang et al., 1996). (C) Geological map of the early Cretaceous intrusion in Waifangshan area.

Download English Version:

<https://daneshyari.com/en/article/4715939>

Download Persian Version:

<https://daneshyari.com/article/4715939>

[Daneshyari.com](https://daneshyari.com)