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Research paper

Devonian alkaline magmatism in the northern North China Craton: Geochemistry, SHRIMP zircon U-Pb geochronology and Sr-Nd-Hf isotopes

Dingling Huang, Qingye Hou*

School of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, China

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ABSTRACT

The Wulanhada pluton is among the rare suite of Devonian alkaline plutons occurring along the northern margin of the North China Craton (NCC). The intrusion is mainly composed of quartz-monzonite. Here we report zircon SHRIMP U-Pb data from this intrusion which shows emplacement age of ca. 381.5 Ma. The rock is metaluminous with high ($\text{Na}_2\text{O} + \text{K}_2\text{O}$) values ranging from 8.46 to 9.66 wt.%. The REE patterns of the rocks do not show any Eu anomaly whereas the primitive-mantle-normalized spider diagram shows strong positive Sr and Ba anomalies. The Wulanhada rocks exhibit high initial values of $(^{87}\text{Sr}/^{86}\text{Sr})_t = 0.70762\text{--}0.70809$, low $\epsilon_{\text{Nd}}(t) = -12.76$ to -12.15 values and negative values of $\epsilon_{\text{Hf}}(t) = -23.49$ to -17.02 with small variations in $(^{176}\text{Hf}/^{177}\text{Hf})_t$ (0.281873–0.282049). These geochemical features and quantitative isotopic modeling results suggest that the rocks might have been formed through the partial melting of Neoproterozoic basic rocks in the lower crust of the NCC. The Wulanhada rocks, together with the Devonian alkaline rocks and mafic-ultramafic complex from neighboring regions, constitute a post-collisional magmatic belt along the northern NCC.

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1. Introduction

The North China Craton (NCC) is among the oldest cratons of the world that preserves evidence for multiple history of magmatism, metamorphism and metallogeny during the early Precambrian (e.g., Deng et al., 2000; Zhai and Peng, 2007; Zhai, 2010; Zhai and Santosh, 2011; Yang et al., 2016). After its final cratonization during late Paleoproterozoic, the interior domains of the craton remained mostly in a dormant stage until Paleozoic and Mesozoic when the margins of the NCC witnessed active tectonics and also extensive magmatism, decratonization and related metallogeny (Tang and Zhang, 1991; Xu et al., 2001, 2003; Zhang, 2007; Li et al., 2009; Zhang et al., 2010a; Li and Santosh, 2014). Alkaline plutonic rocks, although relatively rare (<1% of all igneous rocks), are generally important components in most orogenic belts of the globe. In the northern margin of the NCC, minor volumes of Devonian alkaline plutonic rocks are exposed (Luo et al., 2001;

Jiang, 2005; Zhang et al., 2007, 2009, 2010b; Shi et al., 2010; Zeng et al., 2012). The Devonian marks a key period in global tectonics with the transition from Caledonian to Hercynian movement, and therefore the magmatic and tectonic processes during this time in the NCC are important in understanding the evolution of the region. In this study, we investigate the late Devonian Wulanhada quartz-monzonite in the Shangdu area along the northern margin of the NCC. We report petrological, geochemical, and zircon U-Pb age data as well as Sr-Nd-Pb-Hf isotopic results. We also attempt to compare our data with those from adjacent plutons and discuss the petrogenesis and tectonic significance of the Devonian magmatism along the northern margin of the NCC.

2. Geological setting and sample descriptions

The Wulanhada quartz-monzonite is located approximately 30 km west of the city of Shangdu (co-ordinates: 113.15°–113.18°E, 41.60°N) in the central part of the northern margin of the NCC. The location is to the south of the Proterozoic Gaojiayao-Ulad Houqi-Huade-Chifeng Fault which separates the Central Asian Orogenic Belt (CAOB) in the north and the NCC to the south (Fig. 1a,b) (BGMRIM, 1991).

* Corresponding author. China University of Geosciences, No. 29, Xueyuan Road, Haidian District, Beijing 100083, China. Tel./fax: +86 10 82321817.

E-mail address: qingyehou@126.com (Q. Hou).

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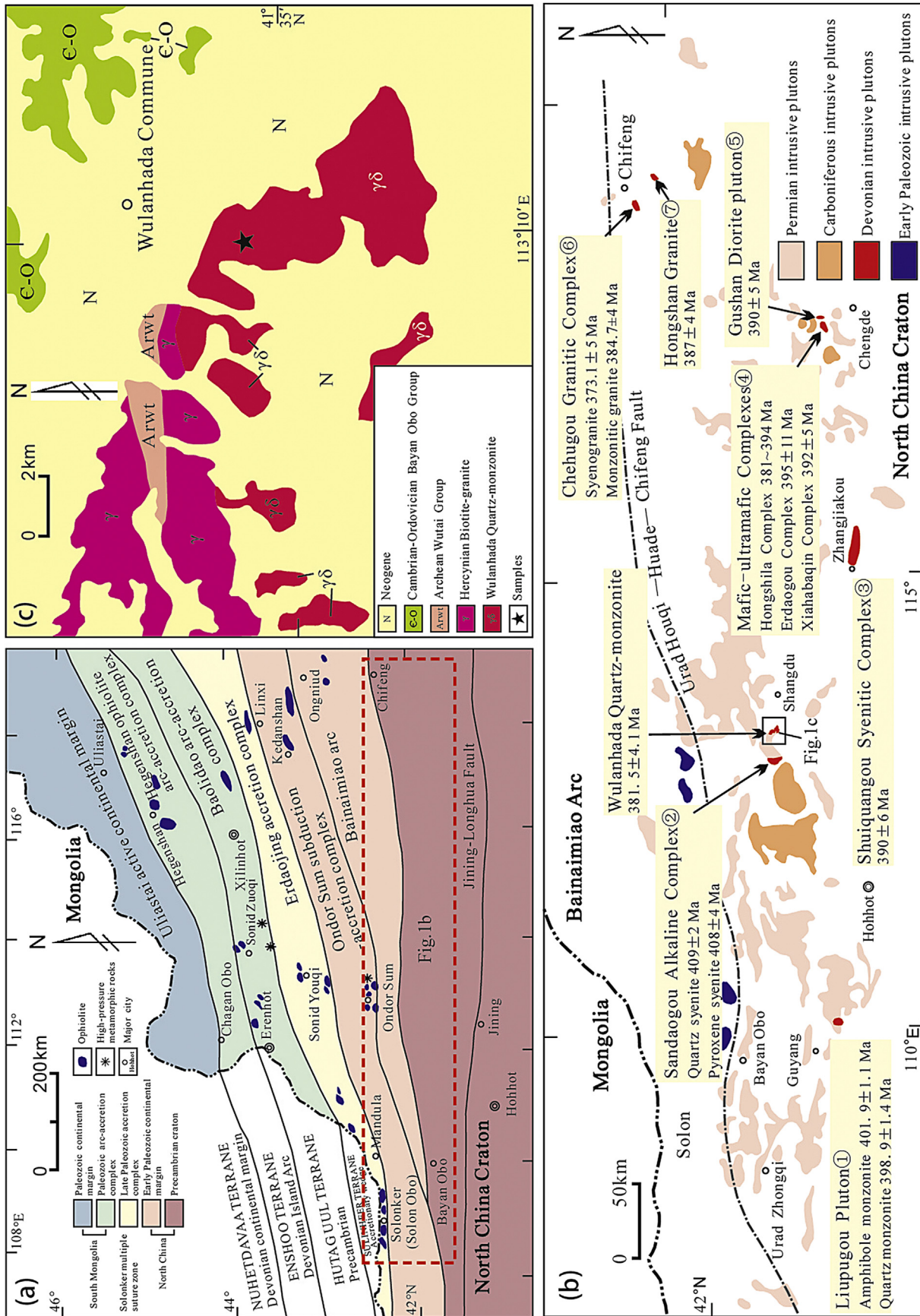


Figure 1. (a) Major tectonic framework of central and southern Inner Mongolia (compiled with Xiao et al., 2003). The rectangle marks the area of (b). (b) Sketch geological map of the northern margin of the North China Craton (compiled with Zhang and Zhai, 2010). The rectangle marks the area of (c). (c) Sketch geological map of the Wulanhada quartz-monzonite in Shangdu (compiled with BGMRIM, 1991).

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