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# Geochronology and geochemistry of basaltic rocks from the Sartuohai ophiolitic mélange, NW China: Implications for a Devonian mantle plume within the Junggar Ocean

Gaoxue Yang [a,b,*], Yongjun Li [a,b], M. Santosh [c,d], Baokai Yang [a,b], Jing Yan [a,b], Bing Zhang [e], Lili Tong [a,b]

[a] School of Earth Science & Resources, Chang'an University, Xi'an 710054, China
[b] Ministry of Education, Key Laboratory of Western China's Mineral Resources and Geological Engineering, Xi'an 710054, China
[c] Dept. of Natural Environmental Science, Kochi University, Kochi 7808520, Japan
[d] Journal Center, China University of Geosciences, Xueyuan Road, Haidian District, Beijing 100083, China
[e] No. 7 Geological Survey Team, Xinjiang Bureau of Geology and Mineral Resource Exploration, Wusu 833000, China

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ABSTRACT

The West Junggar domain in NW China is a distinct tectonic unit of the Central Asian Orogenic Belt (CAOB). It is composed of Paleozoic ophiolitic mélanges, arcs and accretionary complexes. The Sartuohai ophiolitic mélange in the eastern West Junggar forms the northeastern part of the Darbut ophiolitic mélange, which contains serpentinized harzburgite, pyroxenite, dunite, cumulate, pillow lava, abyssal radiolarian chert and podiform chromite, overlain by the Early Carboniferous volcano-sedimentary rocks. In this paper we report new geochronological and geochemical data from basaltic and gabbroic blocks embedded within the Sartuohai ophiolitic mélange, to assess the possible presence of a Devonian mantle plume in the West Junggar, and evaluate the petrogenesis and implications for understanding of the Paleozoic continental accretion of CAOB. Zircon U–Pb analyses from the alkali basalt and gabbro by laser ablation inductively coupled plasma mass spectrometry yielded weighted mean ages of 375 ± 2 Ma and 368 ± 11 Ma. Geochemically, the Sartuohai ophiolitic mélange includes at least two distinct magmatic units: (1) a Late Devonian fragmented ophiolite, which were produced by ca. 2–10% spinel lherzolite partial melting in arc-related setting, and (2) contemporary alkali lavas, which were derived from 5% to 10% garnet + minor spinel lherzolite partial melting in an oceanic plateau or a seamount. Based on detailed zircon U–Pb dating and geochemical data for basalts and gabbros from the Sartuohai ophiolitic mélange, in combination with previous work, indicate a complex evolution by subduction–accretion processes from the Devonian to the Carboniferous. Furthermore, the alkali basalts from the Sartuohai ophiolitic mélange might be correlated to a Devonian mantle plume-related magmatism within the Junggar Ocean. If the plume model as proposed here is correct, it would suggest that mantle plume activity significantly contributed to the crustal growth in the CAOB.



## 1. Introduction

The Central Asian Orogenic Belt (CAOB), also named as the Altaids, is one of the largest accretionary orogens in the world (Fig. 1a; Şengör et al., 1993; Şengör and Natal'in, 1996; Khain et al., 2002; Jahn et al., 2004; Xiao et al., 2004, 2009, 2010, 2012; Windley et al., 2007; Rojas-Agramonte et al., 2011; Choulet et al., 2011, 2012a,b). It is widely accepted that the CAOB was built through prolonged and complex accretion-collision processes of Precambrian micro-continents, island arcs, seamounts, accretionary complexes and ophiolites during the evolution of the Paleo-Asian Ocean from Late Mesoproterozoic to Mesozoic (e.g. Coleman, 1989; Jahn, 2004; Windley et al., 2007; Kröner et al., 2008; Xiao et al., 2008, 2010; Xiao and Kusky, 2009; Wong et al., 2010). Many ophiolitic mélanges have recently been reported in areas around of the West Junggar, such as Kalamaili ophiolitic mélange in East Junggar (Jian et al., 2005), Kuerti and Armantai ophiolitic mélange in Chinese Altai (Zhang et al., 2003; Xiao et al., 2006), Hegenshan ophiolitic mélange in Inner Mongolia (Zhang and Zhou, 2001) and Bayingou ophiolitic mélange in Tienshan range (Xu et al., 2005). The ages of the ophiolites in Chinese Altai and Tienshan range from 540 Ma to 325 Ma, and no ophiolite younger than 320 Ma has ever been documented.

As part of CAOB, the West Junggar is located at the southern margin of the CAOB (Fig. 1b), and is a key area for understanding

* Corresponding author at: School of Earth Science & Resources, Chang'an University, No. 126, Yanta Road, Shaanxi Province, Xi'an 710054, China. Tel.: +86 029 82339078.
*E-mail address:* mllygx@126.com (G. Yang).

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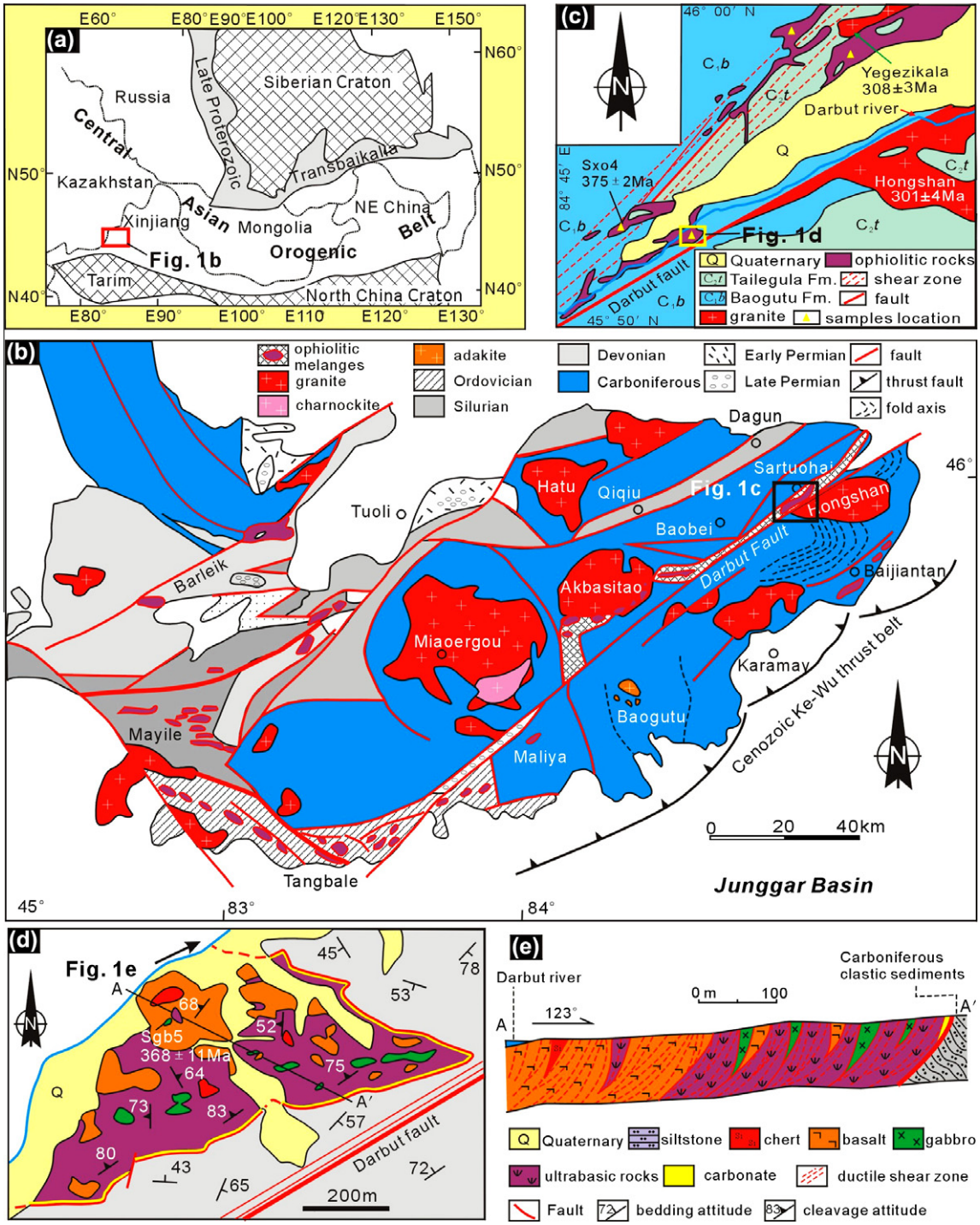


**Fig. 1.** (a) Location of the study area in the Central Asian orogenic belt (modified after Jahn et al., 2004; Windley et al., 2007). (b) Geological map of the West Junggar region (modified after BGMRXUAR, 1993; Han et al., 2006; Geng et al., 2009; Xiao et al., 2009; Tang et al., 2010; Yin et al., 2010; Zhang et al., 2011b; Yang et al., 2012a). (c) Simplified geological map of the Sartuohai ophiolitic mélange. (d and e) Detailed geological map and cross-section of the Sartuohai ophiolitic mélange in the West Junggar.

the Paleozoic tectonic evolution of the CAOB. Several recent studies have reported new data and models on the Paleozoic tectonic framework and evolution, and associated mineral deposits of the West Junggar and adjacent regions (e.g. Coleman, 1989; Buckman and Aitchison, 2004; Xiao et al., 2008; Shen et al., 2009, 2012; Zhang et al., 2010; Ma et al., 2012; Xu et al., 2012). The West Junggar consists of arcs and accretionary complexes and preserves crucial evidence for Early Paleozoic intra-oceanic subduction and terrane amalgamation (Feng et al., 1989; Zhang et al., 1993; Wang et al., 2003; Buckman and Aitchison, 2004; Xiao et al., 2008, 2010), followed by the emplacement of voluminous Late Carboniferous–Permian post-collisional granitoids (e.g. Chen and Arakawa, 2005; Chen and Jahn, 2004; Han et al., 2006; Su et al., 2006; Zhou et al., 2008; Chen et al., 2010). During the progressive accretion, several ophiolitic mélanges were formed and preserved in the accretionary complexes, including the Barleik, Mayle, Tangbale, Durbut, Karamay and Sartuohai (Fig. 1b) (Feng et al., 1989; Zhang et al., 1993, 1995).