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An Early Paleozoic collisional event along the northern margin of the Central Tianshan Block: Constraints from geochemistry and geochronology of granitic rocks

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ABSTRACT

The Tianshan orogen was formed by multiple-stage accretionary events. Ophiolites exposed in the northern margin of the Central Tianshan Block (CTB) indicate the existence of an Early Paleozoic ocean between the Tuha terrane and the CTB, i.e., the Paleo-Tianshan Ocean. However, the closing history of this ocean is still controversial. Granitoids exposed extensively in the CTB can place a good constraint for this collisional process. In this study, geochemical and geochronological analyses are carried out on four granitic plutons from the CTB. One mylonitic granodiorite intruding the CTB basement has a zircon U–Pb age of ca. 496 Ma and shows geochemical affinity to adakite. Its formation can be attributed to the subduction of the Paleo-Tianshan Ocean. The ~426 Ma old gneissic granite that intrudes the Gangou ophiolitic zone presents geochemical features of A-type granite, and gives an upper limit for the closure time of the Paleo-Tianshan Ocean. The metamorphic age of 430.5 ± 4.6 Ma of the zircons from the mylonitic granodiorite possibly represents the event caused by the collision. Two other granitic samples, a granodiorite and a monzodiorite yield ~330 Ma and ~319 Ma in age and display the chemical characters of I-type granites. That indicates a magmatic arc setting mostly related to the subduction of another ocean, called the North Tianshan Ocean.

1. Introduction

The Central Asian Orogenic Belt (CAOB, Windley et al., 2007), or Altaids (Sengör et al., 1993), is one of the largest accretionary orogens on the earth (Fig. 1a; Cawood et al., 2009). It is situated between the Siberian Craton in the north, the European Craton in the west, and, the Karakum, Tarim and North China Cratons in the south. The formation of the arcuate CAOB is considered as a result of the Paleo-Asian Ocean closure, involving lateral accretion/collision of island arcs, seamounts, oceanic plateaus, accretionary wedges and micro-continents, as well as vertical underplating of mantle-derived magma (Coleman, 1989; Allen et al., 1992; Sengör et al., 1993; Xiao et al., 2004, 2008, 2009, 2013; Windley et al., 2007; Gao et al., 1998; Gao and Klemd, 2003, Gao et al., 2009, 2011). The west-east trending Tianshan orogenic belt, that extends at least over 2500 km from Uzbekistan to Xinjiang of western China, is the southernmost part of the CAOB. The Chinese part of the Tianshan belt represents the final collision zone between the Siberian and Tarim cratons (Sengör et al., 1993). Thus the Chinese Tianshan is a key area for understanding the tectonic history of the CAOB (Xiao et al., 2009, 2013).

Tectonically, the Chinese Tianshan can be separated into the North Tianshan Accretionary Complex (NTAC), Central Tianshan Block (CTB) and South Tianshan Accretionary Complex (STAC) that are bounded by the North Tianshan fault (NTSF) and the South Tianshan fault (STSF), respectively. (Fig. 1b; Allen et al., 1992; Xiao et al., 2004, 2013; Charvet et al., 2011; Jiang et al., 2014). The NTSF is a right lateral strike-slip shear zone that post-dates the main accretionary events (Gao et al., 2009; Charvet et al., 2007, 2011). Ophiolitic fragments exposed in Bingdaban, Mishigou and Gangou areas along the NTSF prove the existence of an Early Paleozoic ocean i.e., the Paleo-Tianshan Ocean between the CTB and the Tuha terrane (Ma et al., 1993; Guo et al., 1993; Allen et al., 1992; Dong et al., 2006, 2007). But due to a lack of geochronological data the age of subduction and closure is still controversial.

Voluminous granitoid intrusions, formed in subduction, syn- and/or post-collisional settings, are exposed in the CTB (Fig. 2). The characters and ages of these plutons and their relationships

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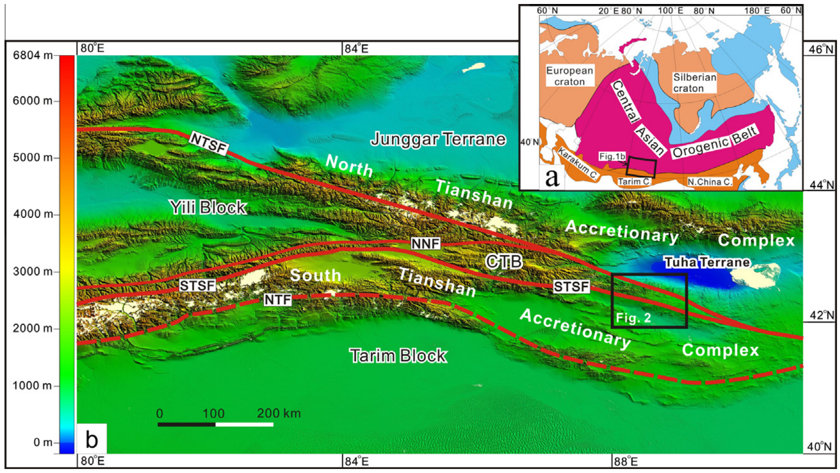

Fig. 1. (a) Tectonic framework of the Central Asian Orogenic Belt (modified from Sengör et al., 1993 and Xiao et al., 2013). (b) Topographic and schematically tectonic map of the Chinese Tianshan orogenic belt. NTSF-North Tianshan Fault; NNT-North Nalati Fault; STSF-South Tianshan Fault; NTF-North Tarim Thrust; CTB- Central Tianshan Block.

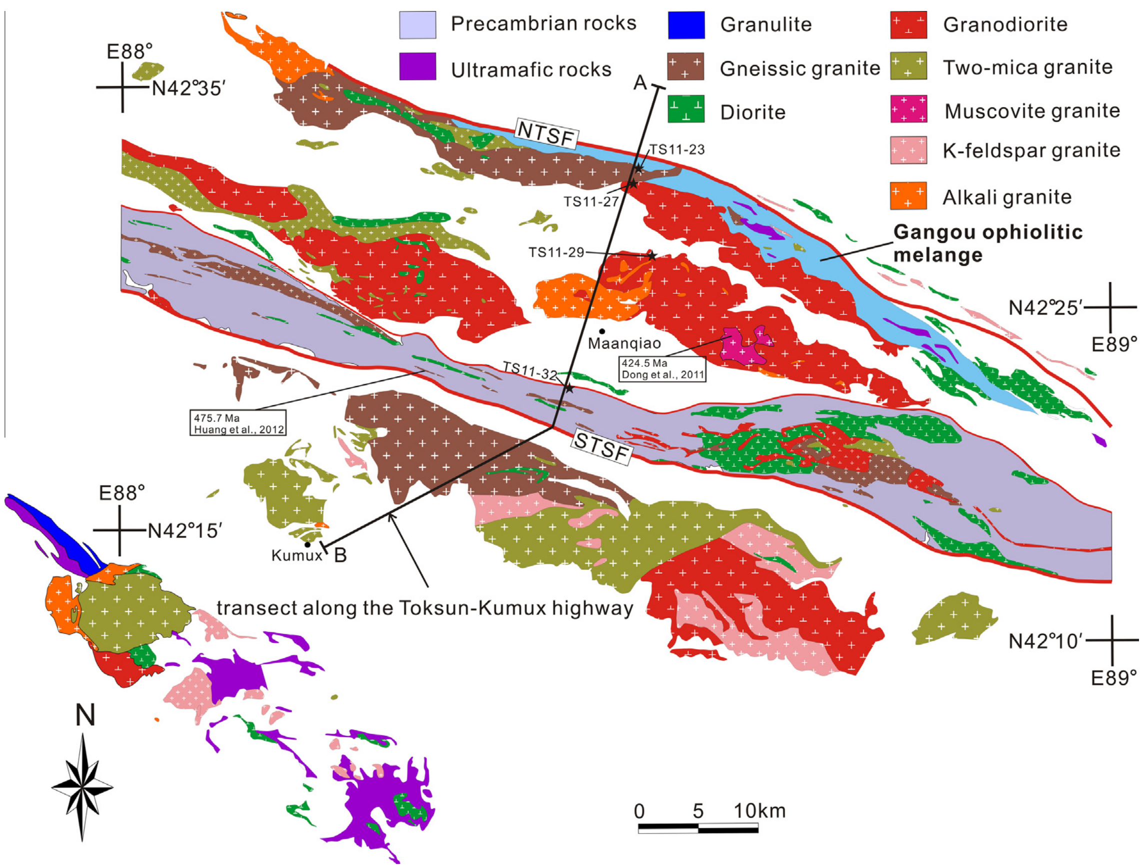

Fig. 2. Simplified map that shows the distribution of granitoids in the CTB and sample locations of the studied granitic rocks (modified from the 1:200,000 Toksun geological map and Dong et al., 2006, 2011). The abbreviations for faults are the same as to Fig. 1.

with the country rocks are important for understanding the closing history of the Paleo-Tianshan Ocean and hence, the tectonic evolutionary history of the Tianshan orogen.

In this contribution, we present new geochemical and geochronological data of granitic rocks from the CTB along the Toksun-Kumux highway (Fig. 2). Based on these data, we discuss the tectonic setting of the granitoids, the closing history of the Paleo-Tianshan Ocean and the tectonic evolution of the Chinese Tianshan orogen.

2. Geological setting

The CTB is further divided into an eastern segment and a western segment roughly along longitude 88°E (Han et al., 2011). The study area is located in the eastern part of the CTB and the study focus on the CTB along the Toksun-Kumux highway (Figs. 1 and 2).

The NTAC is comprised of different tectonic unites, including ophiolitic mélanges and a composite arc system (Xiao et al., 2004, 2013). The southern part of the NTAC, which is mostly