



Genesis of Permian granites along the Kangguer Shear Zone, Jueluotage area, Northwest China: Geological and geochemical evidence



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ABSTRACT

Permian mafic and felsic intrusions occur along the Kangguer Shear Zone (KSZ) in the Jueluotage area, Eastern Tianshan, northwest China. This study focuses on the Permian felsic intrusions (288–276.2 Ma). Systematic geological and geochemical investigations show that granite plutons in the western KSZ (Dikan, Guandao and Hongshi) have lower Al and higher alkali contents than those in the eastern KSZ (Longdong, Huangshan and Baishandong). The western granite plutons experienced higher degrees of crystal fractionation than the eastern granite plutons. Both of the western and eastern Permian granite intrusions along KSZ were derived from juvenile crust, the Nd–Pb isotopic characteristics of which exhibit mixed compositions of DM and EMII type mantles. Both of the western and eastern Permian granites along KSZ were formed within post-collision background. The Dikan, Guandao and Hongshi plutons in the west KSZ sector were formed in an extensional tectonic setting, whereas the Longdong, Huangshan and Baishandong plutons in the east KSZ formed in a compressional tectonic setting.

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1. Introduction

As one of the significant metallogenic belts in China, the Jueluotage area has been the subject of intense studies for many years (Chen et al., 2009), aimed at understanding its geodynamics (Qin et al., 2002; Wang and Xu, 2006; Xiao et al., 1992; Xiao et al., 2012), petrogenesis (Chen et al., 2011; Gu et al., 2006; Han et al., 2004; Su et al., 2011; Yuan et al., 2010; Zhou et al., 2010) and mineralization (Han et al., 2006; Mao et al., 2005; Zhang et al., 2013). The north–south zonation of the petrology in the Jueluotage area is well documented (Han et al., 2006; Hou et al., 2006; Wang et al., 2008), whereas the west–east petrological zonation has received little attention.

Permian coeval mafic and felsic intrusions are widely distributed along the Kangguer Shear Zone (KSZ) in the Jueluotage area (Zhou et al., 2010), and numerous magmatic copper–nickel deposits in the Permian mafic intrusions form a significant Cu–Ni metallogenic belt (Qin et al., 2009; Song et al., 2011). Much research has focused on Cu–Ni mineralized mafic intrusions, including their geochronology (Mao et al., 2005; Tang, et al., 2009; Zhou et al., 2004), petrogenesis (Deng et al., 2011; Han et al., 2010; Song et al., 2011; Sun et al., 2008), tectonic setting (Pirajno, 2010; Sengör et al., 1993; Song and Li, 2009; Su et al., 2011; Wang et al., 2008; Xiao et al., 2010) and mineralization (Deng et al., 2014; Qin et al., 2009). However, there is still no publication on the petrogenesis of the coeval felsic intrusions along the KSZ.

Building on previous systematic geochronology (Zhou et al., 2010), this study focuses on the Permian granite plutons along the KSZ by investigating their petrogenesis, with emphasis on the geological and geochemical characteristics. Following field mapping, sampling and petrographic observations, we performed whole rock geochemical analyses and Sr–Nd–Pb isotopic determinations to constrain the petrogenesis of the Permian granitic plutons along the KSZ, including their petrologic series, magmatic source and evolution, and tectonic setting. Although data for the Permian granite intrusions along the KSZ is limited (15 samples from six granite plutons), this work provides important evidence for the petrogenesis of the KSZ Permian granitic plutons. In addition, this enabled us to investigate the late Paleozoic petrogenesis and geodynamic setting of the Jueluotage area as well as the Tianshan region of the Central Asian Orogenic Belt (CAOB).

2. Geology

2.1. Regional geology

The Central Asian Orogenic Belt (CAOB, Fig. 1a) is a Neoproterozoic to Phanerozoic giant accretionary orogen (Charvet et al., 2007; Kröner et al., 2008; Pirajno, 2010; Sengör et al., 1993; Xiao et al., 2008). As part of the CAOB, the Tianshan Orogenic Belt is the suture zone of the Tarim and Junggar Basins; the orogenic belt is subdivided into numerous subunits by eastern trending crust-cutting deep faults. One of the subunits of the orogenic belt is the Jueluotage region, which consists of a Carboniferous volcanic–sedimentary belt (Fig. 1b) between the Turfan–Hami (Tu–Ha) Basin and the Central Tianshan Orogenic Belt.

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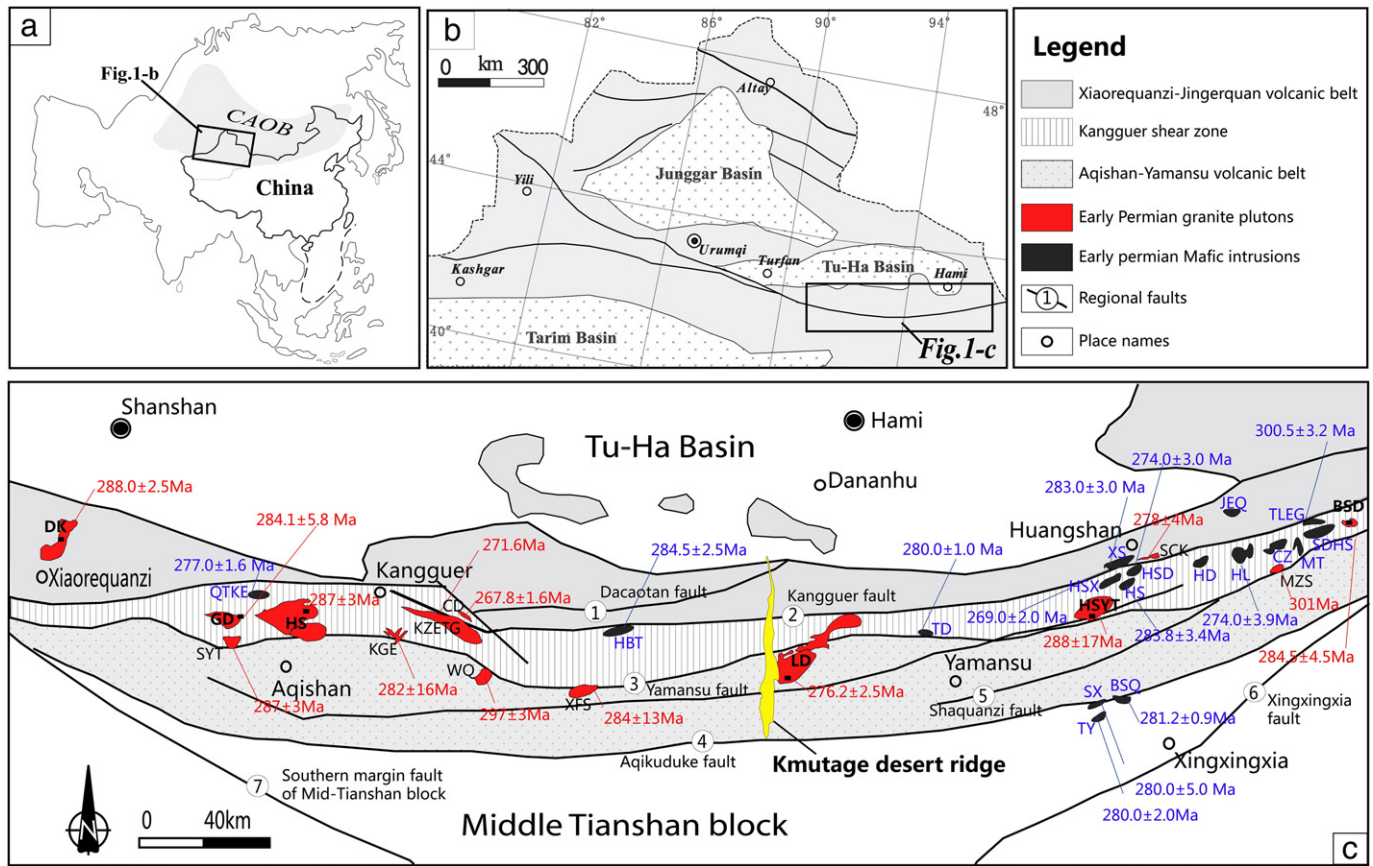


Fig. 1. Sketch map of the study area: a) location of North Xinjiang; b) sketch map of the Northern Xinjiang area (modified after Wang and Xu, 2006); c) geologic sketch map of the Jueluotage area and the Permian magmatic rocks (modified after Bureau of Geology and Mineral Resources of Xinjiang Uygur Autonomous Region, 1993); chronological data from: Zhou et al. (2010), Li et al. (2003, 2006), Li et al. (1998), Zhang (2000), Mao et al. (2005), Chen et al. (2007), Ao et al. (2010), Su et al. (2011), Zhou et al. (2004), Han et al. (2004), and Sun et al. (2008).

The Jueluotage belt can be subdivided into three parts by approximately eastern trending deep faults. The three parts are the Xiaorequanzi–Jingerquan volcanic belt (north), the KSZ (Central) and the Aqishan–Yamansu volcanic belt (south; Fig. 1c). The exposed Jueluotage belt consists of mainly early Carboniferous volcanic rocks with some sedimentary strata, dominantly limestone and shale, which include the early Carboniferous Gandun Formation, the Yamansu Formation, the late Carboniferous DiKaner Group and the Wutongwozi Formation. The KSZ is characterized by right-lateral strike-slip ductile shear, whereas the Carboniferous volcano-sedimentary rocks are intensely metamorphosed and deformed into dark schist and meta-conglomerates. There are four eastern trending deep faults across the Jueluotage belt; from north to south they are the Dankaotan, Kangguer, Yamansu and Aqikuduke faults (Fig. 1c). The Kangguer and Yamansu deep faults form the north and south margins of the KSZ, and there are also several minor eastern trending sub-faults subparallel to the deep faults. Mafic and felsic intrusions are widespread along the KSZ, constituting a bimodal igneous system. The granitic plutons exhibit convex ellipsoid shapes; from west to east they are Dikan (DK), Shiyintang (SYT), Guandao (GD), Hongshi (HS), Kangguer (KGE), Kezier (KZETG), Caidong (CD), Weiyan (WQ), Xifengshan (XFS), Longdong (LD), Huangshan (HSYT), Sanchakou (SCK), Mazhuangshan (MZS) and Baishandong (BSD) (Fig. 1c). These granite plutons are controlled by the E–W structures, and their long-axes follow a generally E–W direction. Based on field geomorphological features, the Jueluotage plutons can be subdivided into a western sector and an eastern sector separated by the north–south Kumutage desert ridge (Fig. 1c).

2.2. Granites

This study focused on the Dikan, Guandao, and Hongshi granitic plutons on the western side of the KSZ, and the Longdong, Huangshan, and Baishandong granitic plutons on the eastern side. Their geological and petrographic characteristics are described below:

- (1) *Dikan granite pluton*: The pluton is located in the west of the Jueluotage area, and crops out over an area of 25 km² (Fig. 1). It intruded into the Lower Carboniferous Xiaorequanzi formation, north of the Kangguer deep fault, which has been metamorphosed to schist. The Dikan pluton is brown to red in color with a weak porphyritic texture, and mainly contains K-feldspar (50 vol.%), plagioclase (20 vol.%), quartz (20 vol.%) and biotite (5 vol.%). The K-feldspar is euhedral with grain sizes ranging from 0.5 to 2 mm; some microcline can be also found (Fig. 2). The plagioclase is euhedral to subhedral and intergrown with K-feldspar. Quartz and biotite are subhedral to xenomorphic with grain sizes ranging from 0.1 to 0.5 mm, and are disseminated in the gaps of the K-feldspar and plagioclase grains. There are also some accessory minerals, including zircon, apatite and magnetite. The LA–ICPMS U–Pb age of zircons from the Dikan granite was reported as 288.0 ± 2.5 Ma (Zhou et al., 2010).
- (2) *Guandao granite pluton*: This pluton is about 8 km northeast of Aqishan and crops out over an area of 20 km² (Fig. 1). It intruded into the Lower Carboniferous Dikan formation, and is red in color with granitic texture. The granite mainly contains plagioclase (40 vol.%), K-feldspar (30 vol.%), quartz (15 vol.%), biotite (5 vol.%), with some zircon and apatite. The plagioclase and

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