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Zircon U–Pb and muscovite $^{40}Ar/^{39}Ar$ geochronology of the gold-bearing Tianger mylonitized granite, Xinjiang, northwest China: Implications for radiometric dating of mylonitized magmatic rocks

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ABSTRACT

This study focuses on zircon U–Pb and muscovite $^{40}Ar/^{39}Ar$ geochronology of gold-bearing mylonitized granite in the north Tianshan of China. All zircon samples have euhedral hydrothermal rims, which have replaced their igneous mantles. Igneous zircon mantles with narrow hydrothermal rims in sample TS06 give a weighted average U–Pb age of 403.7 ± 5.6 Ma (1 standard error, MSWD = 1.5, n = 18). Zircons in TS277 show a complex texture with core (detrital origin, 1276–2215 Ma) indicating igneous mantle and a hydrothermal rim. The igneous mantles give a weighted average U–Pb age of 443.4 ± 3.3 Ma (MSWD = 3.1, n = 10). Two younger ages (394 and 400 Ma) have been obtained on hydrothermal rims. The mantles plus rims of all zircons have positive $\varepsilon Hf_{(t)}$ values with an average of 3.99 ± 0.86 (MSWD = 2.8, n = 23). The positive $\varepsilon Hf_{(t)}$ values suggest that the granite magma is derived from melting of juvenile crustal rocks. The shearing deformation post-dated granite intrusion and introduced fluid, which replaced igneous zircons via dissolution and reprecipitation. However, the age data for zircon hydrothermal rims do not represent the time of the dissolution re-precipitation. The zircons crystallized in granite in the Early Silurian (~443 Ma) have been replaced on their rims during Middle Triassic deformation (248–238 Ma), which was followed by brittle deformation accompanied by gold deposition at ~220 Ma, based on $^{40}Ar/^{39}Ar$ dating of muscovite.

1. Introduction

West Tianshan, consisting of three parts (north Tianshan, Yili terrane, and south Tianshan; Fig. 1a, b), has been a focus of attention by geologists during the last decade (e.g., Charvet et al., 2007; Chiaradia et al., 2006; Han et al., 2010; Konopelko et al., 2009; Mao et al., 2004; Pickering et al., 2008; Wang et al., 2007; Xiao et al., 2004; Zhang et al., 2007; Zhu et al., 2009). Compared with widespread Late Paleozoic magmatic rocks, Early Paleozoic magmatic rocks are rarely reported in West Tianshan. Recently, some plutons have been recognized to have formed in the Early Paleozoic, which had previously been thought to have formed in the Late Paleozoic (e.g., Konopelko et al., 2008; Seltmann et al., 2010; Yang and Zhou, 2009; Zhang et al., 2010; Zhu et al., 2006). For example, the Early Paleozoic granitic plutons in south Tianshan have ages of about 443–465 Ma (Glorie et al., 2010). However, biotite and K-feldspar $^{40}Ar/^{39}Ar$ step-wise heating plateau-ages indicate a Silurian–Early Devonian initial phase of rapid post-magmatic cooling, and the K-feldspar data suggest slower cooling of the batholith that continued until the Late Triassic (Glorie et al., 2010). The Early Paleozoic magmatic rocks might have suffered a magmatic heating and/or related fluid effect, which could reset the radioisotope system (e.g., Glorie et al., 2010; Seltmann et al., 2010). In such cases, chronological studies of Early Paleozoic magmatic rocks, which are sporadic within lithological units consisting mainly of Late Paleozoic volcanic–sedimentary rocks and intrusions, need to be carefully evaluated.

As a second possibility, shear zones that cut magmatic bodies also could modify chronological results. Shear zones are well developed in west Tianshan and cut through mainly Early Paleozoic granitic bodies and metamorphic units, and have been dated from the Permian to Triassic (Charvet et al., 2007); some appear to control the location of gold deposits within the area (Rui et al., 2002; Yang et al., 2006; Zhu et al., 2007).

This contribution presents an example of the chronologic results of Early Silurian granite that was complicated by the shear deformation in the Triassic.

2. Geology and sample descriptions

The tectonostratigraphy and styles of magmatism and metamorphism are distinctively different along the northern Tianshan (e.g., He et al., 1994), implying a complex, diachronous subduction and

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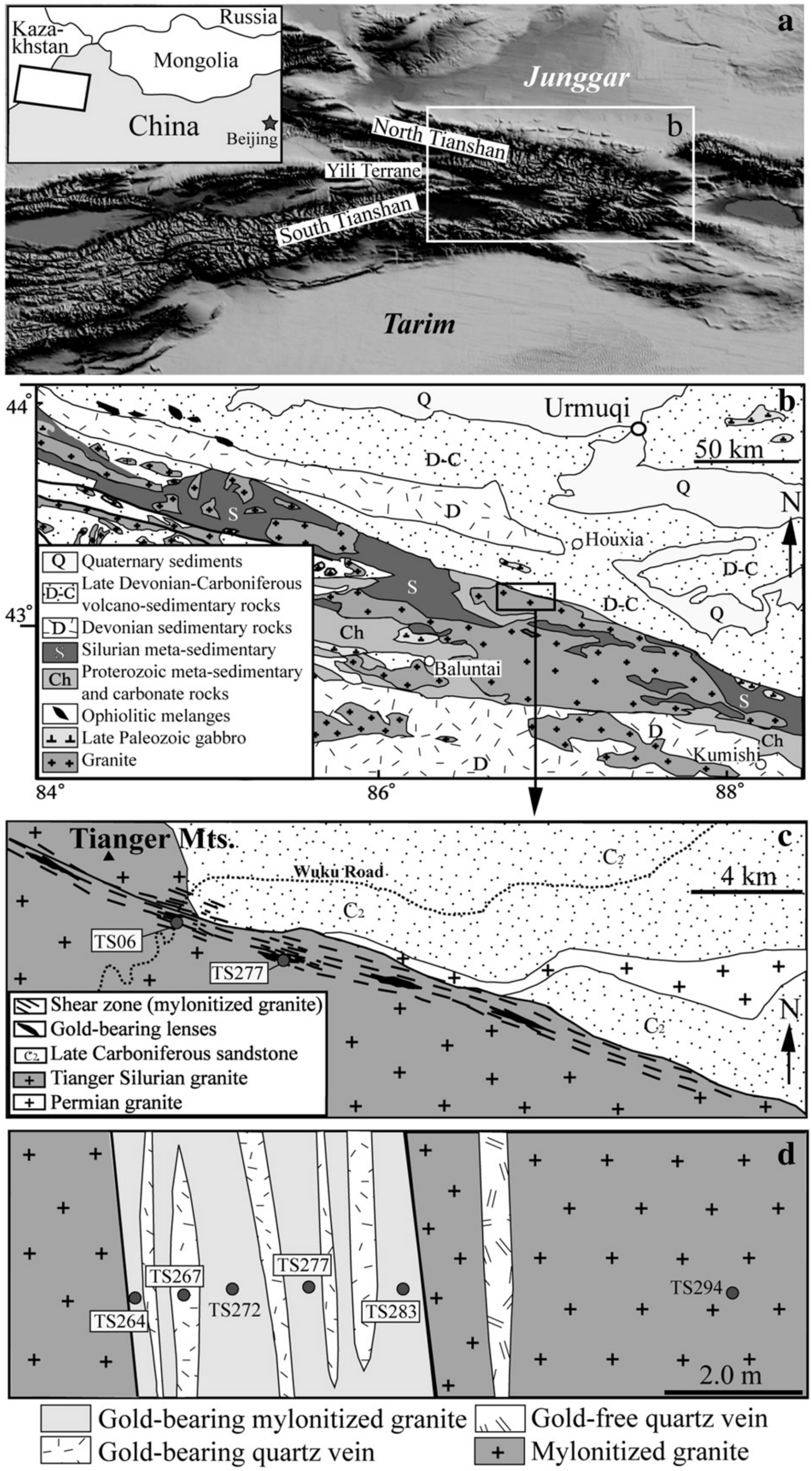

Fig. 1. a) Tomography of west Tianshan consisting of north Tianshan, Yili terrane, and south Tianshan; b) Geological map of the Chinese north Tianshan (modified from He et al., 2004); c) Geological map of the Tianger area showing the shear zone and locations of sample TS06 and TS277. Permian granite intruded into Carboniferous sandstone; d) Section across the Tianger gold deposit showing sampling locations. Muscovites separated from gold-bearing sample TS264 and TS267 were dated to be 221 Ma and 223 Ma, respectively (Zhu et al., 2007).