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Precambrian gold mineralization at Djamgyr in the Kyrgyz Tien Shan: Tectonic and metallogenic implications

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ABSTRACT

The Djamgyr gold deposit is located within the Neoproterozoic basement of the Middle Tien Shan terrane immediately west of the Talas-Fergana fault. The deposit comprises a system of auriferous quartz veins cross-cutting the Beshtor plagiogranite. The veins are surrounded by hydrothermal alteration aureoles and are oriented parallel to the Talas-Fergana fault. The Beshtor granite sampled in the vicinity of the deposit yielded a Neoproterozoic (Tonian) U-Pb zircon age of 815 ± 6 Ma, which is the first single grain zircon age of the Middle Tien Shan basement west of the Talas-Fergana fault. Ar-Ar dating of two muscovite fractions from the alteration aureoles of the auriferous quartz veins yielded ages of 804 ± 3 and 805 ± 3 Ma suggesting that the mineralization in the Djamgyr deposit occurred during the Neoproterozoic ca. 10 m.y. after emplacement of the Beshtor granite. The structural pattern of the auriferous quartz veins and the new geochronological data, combined with the results of previous structural studies, may tentatively constrain the age of pre-existing major fault possibly marking an inherited terrane boundary in the northern part of the present-day Talas-Fergana strike-slip fault. The discovery of Precambrian gold mineralization in the Middle Tien Shan suggests re-evaluation of the metallogenic potential of its Precambrian basement that occupies significant areas west and east of the Talas-Fergana fault.

1. Introduction

The Tien Shan orogenic belt, stretching from the western deserts of Uzbekistan to the eastern Xinjiang in China for more than 2000 km, is known for its world-class ore deposits making this region the richest gold province of Eurasia. The majority of ore deposits in the Kyrgyz Tien Shan have formed during the late Paleozoic (Hercynian) evolution and final closure of the Turkestan (or Paleotethys) Ocean (e.g., Yakubchuk et al., 2002; Djenchuraeva, 2010). However, the implementation of advanced geochronological methods revealed older ages for several deposits, which increased the metallogenic potential of terranes that formed prior to middle Paleozoic times (e.g., Yakubchuk et al., 2010; Konopelko et al., 2014). Although Precambrian, mostly Neoproterozoic, blocks occupy significant parts of the Tien Shan (see Kröner et al., 2013 for review), gold mineralization in the Precambrian rocks is usually interpreted to be of late Paleozoic origin, while geochronologically constrained Precambrian gold deposits have not been reported in the whole belt until now (Rui et al., 2002; Nikonorov et al., 2007; Djenchuraeva, 2010; Goldfarb et al., 2014).

The Djamgyr gold deposit is located within a large Neoproterozoic block in the Kyrgyz Tien Shan and comprises a system of auriferous quartz veins, which occur parallel to the regional scale Talas-Fergana strike-slip fault that was active since the late Permian (cf. Rolland et al., 2013). Our sampling and investigation of the deposit area was aimed to constrain the timing of motions along the fault and its metallogenic potential. However, the obtained results of Ar-Ar and U-Pb dating revealed a Neoproterozoic age of the hydrothermal alteration and thus gold mineralization of the Djamgyr deposit. Below we describe the discovery of the first Precambrian gold deposit in the Kyrgyz Tien Shan and discuss the metallogenic and tectonic implications on a regional scale.

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2. Principal terranes of the Kyrgyz Tien Shan and geological setting of the Djamgyr gold deposit

The Tien Shan orogenic belt formed during the late Paleozoic collisions between the Precambrian microcontinents of Karakum and Tarim in the south and the early Paleozoic Kazakhstan continent in the north (Zonenshain et al., 1990; Şengör et al., 1993; Windley et al., 2007; Biske and Seltmann, 2010; Biske et al., 2013; Burtman, 2015). The western Tien Shan in Kyrgyzstan is composed of three tectonic units (Fig. 1): (1) the Northern Tien Shan, the deformed margin of the Paleo-Kazakhstan continent; (2) the Middle Tien Shan, a middle to late Paleozoic continental arc developed at the southern margin of the Paleo-Kazakhstan; and (3) the Southern Tien Shan, a fold and thrust belt of tectonically superimposed Paleozoic passive margin and accretionary wedge units formed during the final closure of the Turkestan Ocean (Zonenshain et al., 1990; Biske and Seltmann, 2010; Burtman, 2015). Several major EW trending faults divide the Tien Shan into a series of linear terranes. These terranes are crosscut by the NW trending Talas-Fergana fault, which demonstrates a total dextral offset of about 200 km and separates the western Tien Shan terranes from the eastern terranes (Fig. 1).

The Northern Tien Shan in Kyrgyzstan and southernmost Kazakhstan is represented by the early Paleozoic continental magmatic arc built up on Precambrian basement. The arc formed as a result of subduction to the north with subsequent closure of the Terskey Ocean and accretion of the Middle Tien Shan to the Northern Tien Shan in the middle Ordovician (Lomize et al., 1997; Ghes, 2008; Degtyarev et al., 2017). East of the Talas-Fergana fault, the Northern and Middle Tien Shan terranes are separated by the Nikolaev Line, a late Paleozoic sinistral strike–slip fault generally following an early Paleozoic suture. The Talas-Karatau terrane of the Northern Tien Shan located on the NE wall of the Talas-Fergana fault (Fig. 1) represents a fragment of the Neoproterozoic – to early Paleozoic passive margin that is less affected by the early Paleozoic collisional events compared to other parts of the Northern Tien Shan (Maksumova et al., 2001).

Prior to accretion to the Northern Tien Shan, the Middle Tien Shan terrane developed as a southern passive margin of the Terskey Ocean (Ghes, 2008). A general feature of the Middle Tien Shan is a lack of early Paleozoic granitoids. To the west of the Talas-Fergana fault, the Neoproterozoic basement of the Middle Tien Shan is overlain by the latest Neoproterozoic clastic sediments that change upwards into Vendian diamictites and early Paleozoic shales, carbonates, cherts and turbidites (Osmonbetov and Knauf, 1982). Similar geological structures point to possible tectonic links between the Talas–Karatau terrane, the Middle Tien Shan, and the Tarim during the Neoproterozoic to early Paleozoic (Eganov and Sovetov, 1979). The Chatkal-Kurama volcano-plutonic belt, occupying a significant portion of the Middle Tien Shan, formed in a continental arc setting when the southern part of the Paleo-Kazakhstan continent developed as a northern active margin of the Turkestan Ocean during the middle and late Paleozoic (Fig. 1; Yakubchuk et al., 2002; Burtman, 2015). Final closure of the Turkestan Ocean in the late Carboniferous (e.g., Mühlberg et al., 2016) formed the Turkestan and Atbashi-Inylchek sutures separating the Middle and Southern Tien Shan terranes.

Major ore deposits of the Northern Tien Shan in western Kyrgyzstan are related to early and middle Paleozoic magmatism and include Cu-Au-Mo porphyry-type deposits, skarns and low sulfide Au deposits. The Middle Tien Shan west of the Talas-Fergana fault is known for its world-class Cu-Au-Mo porphyry-type deposits, skarns and epithermal Au deposits associated with suprasubduction Carboniferous and post-collisional early Permian magmatic pulses which formed the Chatkal-Kurama volcano-plutonic belt (Yakubchuk et al., 2002; Nikonorov et al., 2007; Djenchuraeva, 2010).

The Djamgyr gold deposit, which is hosted by the Neoproterozoic basement rocks of the Middle Tien Shan and juxtaposed to the Talas-Karatau terrane of the Northern Tien Shan, occurs almost immediately SW of the Talas-Fergana fault zone (Figs. 1 and 2). Auriferous quartz veins similar to those at the Djamgyr deposit comprise the Korumtor deposit and a number of occurrences in Kyrgyzstan and the adjacent territory of Uzbekistan (Nikonorov et al., 2007; Dunin-Barkovskaya and Koloskova, 2012).

3. Geology of the Djamgyr deposit area and previous geochronological studies

The Djamgyr gold deposit is located in the Talas range 2 km WSW of the Karabura mountain pass and ca. 1.5 km SW from the Talas-Fergana fault (Fig. 2). The area around the deposit is mapped at scales of 1:50,000 and 1:25,000 (Seliverstov and Datov, 1987; Shubin et al., 1992). The Neoproterozoic and early Paleozoic rocks in the deposit area are strongly deformed and metamorphosed under greenschist-facies conditions within a wide zone along the Talas-Fergana fault. On the NE wall of the Talas-Fergana fault, clastic metasediments of the Mesoproterozoic (middle Riphean) Karabura and Uzunakhmat Formations in the Talas–Karatau terrane are deformed in tight and subisoclinal folds parallel to the fault, overturned to the NE and cut by top-to-NE thrusts (Shubin et al., 1992; Rolland et al., 2013). On the SW wall of the Talas-Fergana fault, in the Middle Tien Shan terrane, deformed granites are dominant while minor metasediments are represented by siltstones and sandstones with subordinate volcaniclastics, cherts, carbonates and schists of the Korumtor, Ayaterek, Yaisamtor and Chakmak

Fig. 1. Principal tectonic zones and lineaments of the Tien Shan in Kyrgyzstan. Abbreviations: *NTS* – Northern Tien Shan, *MTS* – Middle Tien Shan, *STS* – Southern Tien Shan. Cross-hatched area shows outcrops of Precambrian basement, after Degtyarev et al. (2017), modified by the authors.