Ore Geology Reviews 70 (2015) 61–79

Contents lists available at ScienceDirect

Ore Geology Reviews

journal homepage: www.elsevier.com/locate/oregeorev

Geology and geochemistry of listwaenite-related gold mineralization in the Sayi gold deposit, Xinjiang, NW China

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ARTICLE INFO

Article history:
Received 20 November 2014
Received in revised form 18 March 2015
Accepted 24 March 2015
Available online 27 March 2015

Keywords:
Listwaenite
Gold deposit
Ophiolitic mélange
Shear zone
Sartohay
Xinjiang

ABSTRACT

The Sayi gold deposit is part of the Sartohay ophiolitic mélange in west Junggar, Xinjiang, China, and is hosted by listwaenite, which was transformed from serpentinite in a shear zone via fluid–rock reaction. Gold mineralization is hosted by mylonitized listwaenites and quartz veins within listwaenite lenses, formed during shearing. Our study demonstrates that fluid concentrated Au, Ag, As, Sb, Cu, Cr, Ni, and Co during transformation from serpentinite to listwaenite and ductile deformation. Deformation due to shearing played an important role in focusing ore-forming fluid along the shear zone. Gold mineralization accompanied formation of hydrothermal minerals in the following stages: carbonate–quartz–pyrite (CQP, stage I), mariposite–gersdorffite–gold (MGG, II), quartz–carbonate–pyrite (QCP, III), gold-bearing quartz (IV) and dolomite–calcite stage (V). Geological characteristics of MGG in mylonitized listwaenite demonstrate that gold mineralization formed during the transition from ductile to brittle deformation, which was followed by gold-bearing quartz veins filling brittle fractures. The Au contents show a positive correlation with Ag, As, Cu, and Sb contents in mylonitized listwaenite samples, consistent with the coexistence of native gold, gersdorffite, arsenian pyrite, and chalcopyrite in mylonitized listwaenite. Pressure decrease due to hydraulic fracturing during the transition from ductile to brittle deformation induced gold deposition in the Sayi deposit.

1. Introduction

Listwaenite is defined as carbonatized and variably silicified serpentinite in ophiolite mélanges, and formed by the metasomatic transformation of mafic and ultramafic protoliths to a carbonated and silicified lithology (Halls and Zhao, 1995; Tsikouras et al., 2006; Zoheir and Lehmann, 2011); it also forms locally in greenstone belts (Kishida and Kerrich, 1987; Schandl and Gorton, 2012). Listwaenite usually occurs in a fault zone, which is the pathway of hydrothermal fluid and subsequent metasomatism (Tuysuz and Erler, 1993; Hansen et al., 2005; Emam and Zoheir, 2013). Listwaenite also occurs in highly serpentinized, porous and fractured ultramafic rocks with rare thrust fault-related occurrences (Ucurum and Larson, 1999; Ucurum, 2000). Hydrothermal fluids migrated along micro-fractures and stockworks in highly altered serpentinite to form listwaenite, consisting of a typical mineral assemblage of magnesite, dolomite, quartz, and mariposite with disseminated accessory minerals such as Cr-spinel and sulfides (Halls and Zhao, 1995).

Listwaenite can be spatially associated with gold deposits (Buisson and Leblanc, 1985; Ash and Arksey, 1990). In most cases, gold mineralization is related to quartz and quartz–carbonate veins in listwaenite, such as in the Mother Lode gold system of California (Weir and Kerrick, 1987; Böhlke, 1989), the Bridge River, Cassiar and Atlin gold district, British Columbia (Ash and Arksey, 1990), and the Barramiya gold mine, Egypt (Zoheir and Lehmann, 2011). The gold grade in listwaenite-related deposits varies widely (Azer, 2013), which may depend on numerous geological factors including shear deformation, pressure–temperature (P–T) condition, and fluid composition. High grade ore-bodies usually occur at or near intersection of quartz veins with listwaenite (Böhlke, 1989; Aydal, 1990).

Listwaenite and related gold mineralization occurs in the Sartohay ophiolitic mélange of west Junggar, Xinjiang, China. Such occurrences include the Sayi gold deposit, where mining has been conducted since the Qing Dynasty. Quartz veins with native gold were the main target of mining at that time, with historic production of at least 10 t (Fengjun Zhang, personal communication, 2012); the grade of gold-bearing quartz veins was up to several tens of g/t. In addition, some listwaenite lenses are gold mineralized at Sayi; since the 1990s, gold-mineralized listwaenite became the major mining target, as gold-bearing quartz veins were largely mined out. Despite mining activity, the relationship between listwaenite and gold mineralization in the Sayi gold deposit

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http://dx.doi.org/10.1016/j.oregeorev.2015.03.017
0169-1368/

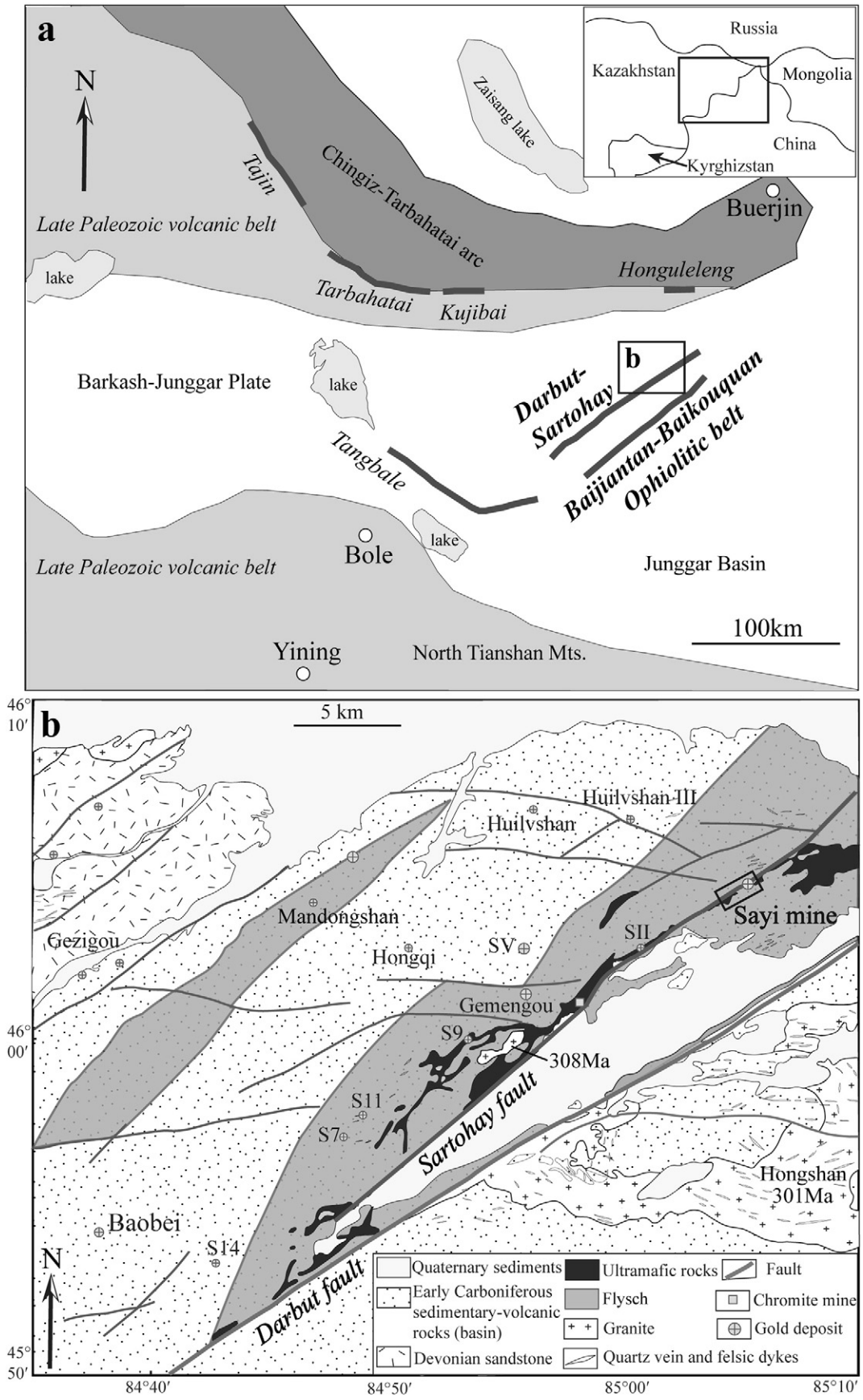

Fig. 1. (a) Major tectonic units in the core of the Central Asian Metallogenic region. (b) Geologic map of the Sartohay region, west Junggar. Modified from Zhu et al. (2013).