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Analysis of the Ore-Controlling Structure of Ductile Shear Zone Type Gold Deposit in Southern Beishan Area, Gansu, Northwest China

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ABSTRACT: The ductile shear zone-type gold deposit is a kind that both the ore-forming mechanism and ore-controlling factors are closely related to the ductile shear zone and its evolution. Ductile shear zone develops in Beishan area, Gansu of Northwest China, and develops especially well in the south belt. The controls of the ductile shear zone on gold deposits are as follows. (1) The regional distribution of gold deposits (and gold spots) is controlled by the ductile shear zone. (2) The ductile-brittle shear zone is formed in the evolution process of ductile shear zone and both are only ore-bearing structures and control the shape, attitude, scale, and distribution of mineralization zones and ore-bodies. (3) Compresso-shear ductile deformation results in that the main kind of gold mineralization is altered mylonite type and the main alteralization is metasomatic. (4) Ore-bearing fracture systems are mainly P-type ones, some D-type and R-type ones, but only individual R'-type and T-type ones. (5) Dynamic differentiation and dynamic metamorphic hydrothermal solution resulting from ductile deformation is one of the sources of ore-forming fluid of gold mineralization, and this is identical with that ore-forming materials are mainly from metamorphic rocks, and ore-forming fluid is mainly composed of metamorphic water, and with the fluid inclusion and geo-chemical characteristics of the deposit. (6) There is a negative correlation between the gold abundance and susceptibility anisotropy (*P*) of the altered mylonite samples from the deposit, which shows that the gold mineralization is slightly later than the structural deformation. All above further expound the ore-forming model of the ductile shear zone type of gold deposits.

KEY WORDS: analysis of ore-controlling structure, gold deposit, ductile shear zone, Beishan area of Gansu, Northwest China.

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Sibson (1977) and Ramsay (1980) first reported the article on the ductile shear zone; Boyle (1979) proposed ductile shear zone-type gold deposit—a new kind of gold deposit that both the mineralization

mechanism and the ore-controlling factors are all closely related to the ductile shear zone. Meanwhile, the study on the characteristics of the ductile shear zone-type gold deposit, the mineralization and the ore-controlling effect of the ductile shear zone, and the relationship between gold abundance, and the structure deformation and the enrichment mechanism of gold mineralization, has made great advance. Among these, the three-stage model of auriferous mineralization in some shear zone by Bonnemaison and Marcoux (1990), the ore-bearing fracture system set up on the Riedel shear break theory (R-type, R′-type, T-type, D-type and P-type), the fault valve-model about high-angle reverse fault, paleoseismic events, fluid-pressure and mineralization mechanics (Boullier and Robert, 1992; Sibson et al., 1988), and the ore-forming model of the ductile shear zone type-gold deposit found upon the temporal and spatial evolution feature of ductile shear zone (Chen, 2000; Chen et al., 1999) are famous and representative.

After the first discovery of the ductile shear zone in the Beishan area in the beginning of the 1990s, the middle-scale Xiaoxigong gold deposit and other gold spots were found and prospected in it. Meanwhile, the relationship between the gold deposit and the ductile shear zone was analyzed by Zuo and Cheng (1991) and Fan (1998). In this article, the authors make a systematic exposition about the ore-control feature and the ore-control mechanism of the ductile shear zone.

GEO-TECTONIC SETTING

The Beishan area of Gansu Province, Northwest China, is situated in the condensation zone of the Chinese-Korea–Trim plate and the Hasakstan plate (Zuo and He, 1990), it is also the west part of the Tianshan–Yinshan latitudinal structural system. The strata and rocks are composed of three parts: first, medium-high grade metamorphic rocks of the Changcheng System and the Pre-Changcheng System, including different geneisses and schists of Dunhuang Group, Baihu Group, Lebaquan Group, and intrusive rock of Archean and Lower Proterozoic; second, medium-low grade metamorphic rocks of Middle Proterozoic to Lower Paleozoic, including epimetamorphic graywacke, epimetamorphic silistone, silty shale, phyllite, marble, and volcanic rock; and third, non-metamorphic sedimentary rock of Upper Paleozoic to Mesozoic, including conglomerate, sandstone, pelitic siltstone, mudstone, biocalcirudite, carbonaceous shale, quartz-keratophyre, rhyolite, tuff, and andesitic porphyrite.

The main regional structures consist of three structural deformation types of E-W-trend: (1) ductile and ultra-ductile deformation structural layer occurring in medium-high grade metamorphic rocks of the Changcheng System and the Pre-Changcheng System with a well-developed mylonite schistosity and a-type lineation; (2) medium-shallow ductile and ductile-brittle deformation structural layer occurring in the Lower to Middle Paleozoic medium-low grade metamorphic rocks, with well-developed replacement schistosity and cleavage of an E-W trend, a high dip angle (70°–90°), and well-developed appressed fold, but poor-developed a-type lineation; (3) shallow nappe structure presenting that dolostone of the Jixian system thrust up on the medium-low grade metamorphic rocks of the Qingbaikou System of Middle Proterozoic to Lower Paleozoic (Zuo et al., 1992; Zuo and He, 1990).

CHARACTERISTICS OF THE DUCTILE SHEAR ZONE IN THE SOUTH BEISHAN AREA

The ductile shear zone is best developed in the south Beishan area (i.e. north area of Dunhuang massif); it is about 240 km in length in the E-W direction from the south of Guobaoquan through Baidunzi, Shibandun, Panjiajing, Xijianquan, Xiaoxigong, and Xijianshan to Yuejinshan and 8–15 km wide in the S-N direction. The ductile shear zone is E-W trending (NEE trending in the west part from Baidunzi to Xijianquan and NWW-trending in the east part from Xiaoxigong to Yuejinshan) (Fig. 1).

There is well-developed demylonite schistosity of the E-W trend in the ductile shear zone with an average attitude of 75°–85°/SE70°–85° in its western part and 115°/SW65°–86° in its eastern part. The sub-horizontal a-type lineation with an average pitch angle of 6°E in the west and 5°–10°W in the east part is well developed.