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Analysis of Gold Mineralization in Tectonic-Magmatic Environment: A Case Study of Ertix Gold Metallogenic Zone

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1 Geological Background

Ertix gold metallogenic belt is located in transitional zone of Siberia and Kazakhstan-Junggar plates with advantageous geological setting for mineralization. A number of middle-large scale gold deposits are distributed in this area. Gold deposits occurring in the Paleozoic volcanic-clastic rocks, mostly were formed during the Late Carboniferous-Permian period, namely strike-slip stage after collision orogeny and transformation period from strike-slip mechanism to extensional one(Shen et al., 2007; Yan et al., 2006).

2 Characteristics of Typical Deposits

Gold deposits within the tectonic-magmatic environment include Duolanasayi, Saidu, Aktas, Keksayi, etc. All of them occurred near suture zone between two plates with the tectonic setting of island arc , and are characterized by long -lasting mineralization, wide distribution range, multi-stage metallogenesis, zonal distribution and sectional concentration. Ductile and brittle-ductile shear zones control the distribution of rock masses (dykes), transformed clastic-pyroclastic formation, and decide the morphology and occurrence of ore bodies. Metallic minerals in ore are dominated by pyrite, gold and chalcopyrite, while the alteration mainly presents silicification, sericitization and pyritization. The study on fluid inclusions shows that gold was remobilized, migrated and concentrated accompanying with mixed fluid of magmatic hydrotherm and atmospheric precipitation in meso-low temperature (140-310 centigrade) and moderate shallow-moderate deep environment.

3 Gold Mineralization

3.1 Relationship between ore-bearing formation and mineralization

Gold deposits within the tectonic-magmatic environment mainly occur in the Lower Devonian Tuoranggekuduke Formation (D_1t), and Middle Devonian Tuokesalei Formation (D_2t) and Beitashan Formation (D_2b). There are mainly three types of gold mineralization: altered mylonite-type, quartz vein-type and granitoid dyke-type. Results of primary halo survey indicate that gold abundance of clastic rocks, volcanic rocks and carbonate rocks in mining area is low (0.17×10^{-9}-2.49×10^{-9}). Considering the migration law of gold, we argue that part of gold for mineralization was derived from strata, while most directly from the lower crust and mantle (Guo et al., 1996; Xiao et al., 2002).

3.2 Relationship between ductile shearing and

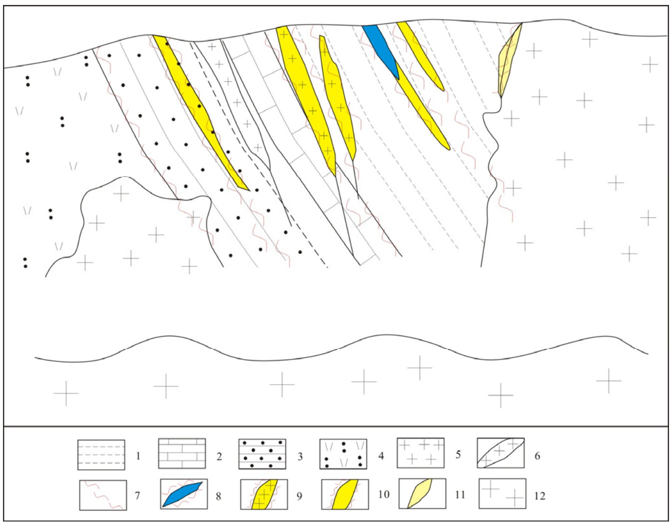

Fig. 1. The model of ductile shear-magmatic coupled mineralization in Ertix region
1-phyllite; 2-limestone; 3-metasandstone; 4-tuff; 5-granitic intrusion; 6-granitic dyke; 7-shearing deformation zone; 8-quartz vein type of gold body; 9-granitic dyke type of gold body; 10-mylonite type of gold body; 11-gold mineralized body; 12-deep magma chamber.

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diagenesis and mineralization

Diagenesis and mineralization are closely related to ductile shearing. Ertix deep fault with shearing deformational features, and its secondary faults control the occurrence of magmatite, prerequisite for gold mineralization. In space, intersections of faults and concentrated areas of ductile shear are advantageous locations for ore bodies. Most of the dominant ore bodies are located in zones with strong shear deformation, and occur as veins, lenticles, irregular veins, branched veins and branched-coalescent veins. They mainly extend along the direction of tectonic lines (Wang et al., 1992). In time, dominant gold deposit-forming period are in accordance with the most active period of Ertix deep nappe stracure (Zhang et al., 2011).

3.3 Relationship between intrusive bodies (dykes) and mineralization

Magmatic activity is another important ore-controlling factor of gold mineralization. The close relationship between granitoid bodies (dykes) and gold deposits mainly appears as: (1) granitic stocks (bodies) outcrop in mining areas, or gold deposits locate near outer contact zones of granitic batholiths, especially protruding and turning area of batholiths; (2) ore bodies mainly occur near contact zone of batholiths or superimposed positions of batholiths and shear zones; (3) ore bodies generally lie in or paralleled to diorite and albite granite dykes.

The dominant magmatite closely related to gold mineralization are granodiorite, plagiogranite, albite granite, diorite (porphyry), quartz monzonite, etc. The rocks are mainly composed of plagioclase, quartz, potash feldspar, biotite, and small amount of hornblende, and exhibit geochemical characteristics of I-type granite of crust-mantle mixed source, with intermediate acid, high Al_2O_3 and Na_2O contents (Xiao et al., 2002).

3.4 Ductile Shear-Magmatic Activity Coupling and Mineralization

Ductile shear and magmatic activity within Ertix gold zone has significant characteristics of complex ore-controlling and multi-period and multi-stage coupled mineralization (Fig. 1).

Ertix fracture, the one deep-rooted reaching upper mantle and displays features of transform fault, controls the emplacement of magma. Moderate acidic magma with some ore-forming materials intruded interspaces of secondary faults, and made gold scattered in country rocks activate and migrate. Granite dykes intruded into strongly deformed zone near batholiths often are gold mineralized bodies.

As regional tectonic stress lasting and strengthening, moderate acidic granitic masses and strata superposed by tectonic deformation separated out a good deal of gold-bearing fluid. As emergence of enlarged space, mixed ore-forming hydrotherm rose rapidly. Sharp change of physical and chemical conditions made gold-bearing complexes in fluid be disassembled. Finally, quartz vein-type gold deposits were formed in shallow, altered mylonite-type ones in medium-deep, and granite dyke-type ones were formed by further concentration of gold in dykes.

During the late stage of mineralization, evolved magma intruded into tensile cracks and formed alkaline granite dykes. Magmatic hydrothermal resulted in superposition of gold mineralization again.

4 Conclusions

Gold deposits of tectonic-magmatic environment in Ertix gold zone occurred in Late Paleozoic island arc setting and were formed in post-collisional extension stage. Tectonic and magmatic activities are dominant ore-controlling factors. Further research is needed to summarize essential characteristics and indicators for this type of gold deposits. The current study shows as follows:

(1) Emplacement of moderate acidic granite masses, as a significant exploration indicator, not only provides heat source, fluid and dynamic for gold mineralization, but also the source of most of the gold.

(2) Ductile and brittle-ductile structural deformation controls the emplacement of magmatic bodies, and the activation, migration and concentration of gold. There is a positive correlation between the intensity of tectonic activity and degree of gold enrichment.

(3) Coupled mineralization of ductile shearing and magmatic activity contributes to the formation and occurrence of ore bodies. Dykes outcrop experienced with dynamic deformation and intensive deformed area near batholiths are favorable location for gold deposits.

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