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Geological Features and Ore Genesis of Blihe Porphyry Au Deposit on the Northern Margin of North China Craton

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1 Geological Setting

Bilihe large scale porphyry gold deposit locates in the Early Palaeozoic accretionary orogenic belt of the northern margin of North China Craton, which also in Bainaimiao-Hadamiao Cu-Mo-Au mineralization concentrated area. The deposit was a epithermal porphyry type gold deposit that formed after paleo-Asia ocean subducting collision and accretion of north-margin of North China in Early Paleozoic, superimposed continental -margin volcanic-magmatic setting of Later Palaeozoic. (Ge et al，2009)

Three geological units were recognized in the region. (1) The later permian Elitu Fromation is composed of conglomerate, greywacke, arkose, silt-slate and limestone. (2) The upper Jurassic Manitu Froation is the ore-bearing strata. Andesite, andesite breccia, andesite breccia lava, basaltic andesite and crystal tuff are distributed in the Bilihe gold deposit. (3) The Late Jurassic Yinggaolao Formation is composed of intermediate-acid and acid volcanic rocks (Zhang et al，2012) .

2 Deposit Geological Characteristics

2.1 Intrusive rock

Intrusive rocks in mining area comprises gold-bearing subvolcanic intrusive complex which mainly are granodiorite porphyry and moyite porphyry that outcropping widely in surface. Content of SiO_2 in subvolcanic complex is 61.5%~71.4%, that belongs to sub -alkaline cal-allaline series; REE partition of the rock locates in LREE enrichment, less Eu negative anomaly, enriches relatively large-ion lithophile elements (LILEs), deficits high field strength elements (HFSEs) and Ba, which are all indicative of mixing of crustal materials with mantle components; except loss Ba, similar to granites from epicontinental arc. (Lu et al，2012)

2.2 The structure characteristics of the ore field

The Bilihe goldfield was controlled by Pal-Asiatic geodynamic system in Paleozoic. The goldfield is located in an ancient caldera which is defined by nearly EW and NE striking faults. The faults, caldera and the contacts of intrusions control the occurrence of the ore deposit. The nearly EW, NE and NW striking faults, especially the intersections of the NE and NW triking faults controlled the distribution of volcanism centers, the sub-volcanic rocks and related orebodies. Quartz vein and tectonite type gold mineralization (orebody) are usually controlled by NW striking faults; breccia type orebody is controlled by the caldera and sub-volcanism center; porphyry type orebody is controlled mainly by sub-volcanism center, distributions of orebodies were co-controlled by contact zone of ore-bearing porphyry, pre-existing fractures, breccia and overlapping structural fissures. Usually, the concentrated upper contacted structural zone of orebodies occur in gently inclined part (hanging wall), deflection and transition parts of contacted zone and local apophyses protrusion parts.

2.3 The geological features of ore-body

The main characteristics of the deposit are as follows: (1) the concealed ore body occurs in the contact zone (mainly in the inner-contact zone) between granodiorite porphyry and volcanic rocks; (2) a large ore body 500m long，300m wide and averagely 52.85m thick was identified，which contains 21916 kg Au at the average grade of 4.5x10 (the highest grade being 54.76x10-6)；(3) ores can be classified into altered granodiorite porphyry type and andesite porphyrite type, with the former type having typical unidirectional solidification texture (UST)．There are only small amounts (<1％)of metallic minerals，such as pyrite, chalcopyrite and molybdenite, in

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the ore; gold mainly occurs in lumpy or veinlet quartz formed during alteration (Ge et al, 2009).

2.4 Metallogenic age

LA-ICP-MS zircon U-Pb dating got the lithogenetic age of gold-bearing subvolcanic intrusive complex and moyite prophry. They are 283.8±4.2Ma~279.9±6.8Ma and 264.2Ma separately belong to the Early and Middle Permian. It fits the field geological body interpenetrative relationship (Lu et al, 2012). Qing et al used Re-Os isotope to test 6 molybdnite samples collected from the porphyry, which yielded the isochron age is 272.7±1.6Ma (MSWD=0.57) (Qing et al, 2011) .

The weighted average $^{206}Pb/^{238}U$ ages of andesite and andesitic tuff were 281±4.3Ma and 281±12Ma (the Early Permian), by LA-ICP-MS zircon U-Pb dating respectively, and consistent with the crystallization age (279Ma) of granodiorite porphyry that related to gold mineralization and ore-forming age (272Ma), which indicated that diagenesis metallogenesis of mining area was associated with collisional orogeny between the North China plate and the Siberian plate in the Late Palaeozoic, and suggesting that it had the great potential to find Late Palaeozoic epithermal-porphyry type gold (copper) deposit in northern margin of the North China Craton. U-Pb ages of the ancient inherited zircons presents in the volcanic rocks and intrusive rocks associated with mineralization were 1.8Ga, 2.0Ga and 2.4Ga, implying that the mining area was presence of ancient basement of the North China Craton, and as a major factor in generating gold mineralization (Qing et al, 2012) .

2.5 Alteration type

Four types of mineralization have been identified, namely quartz vein type, tectonic fracture zone altered rock type, explosion breccia type and porphyry altered rock type. The most important mineralization type is the porphyry alteration type. The porphyry alteration occurs in the inner- and exo-contact zone between hypo-volcanic complex body and overlying volcanic rocks as well as volcanic clastic rocks, especially in the inner-contact zone.

Alterations around ore-body include silicification, calcilization, K-feldspathization, sericitization, pyritization and tourmalinization, which occur mainly along with structural fracture belt and shows an close spatially relations to the mineralization .

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