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The Metallogenic Age of the Changshanbao Gold Deposit in Inner Mongolia, China

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1 Introduction

The Changshanbao gold deposit is located in Wulatezhongqi, Bayan Nur City, Inner Mongolia. It is located in the northwestern part of North China Craton, and it is also the western part of Proterozoic Bayan Obo platform margin depression. Up to 2012, the reserves of the Changshanbao gold deposit are 342,250,000 tons of ore, 213 tons of gold, with an average grade of 0.62 g / t Au. The Changshanbao gold deposit is a super large gold deposit found in low metamorphic clastic rocks in the Bayan Obo belt, and it is the largest low-grade open pit gold mine in northern China.

Several scholars have conducted some detailed study on geological characteristics, ore-forming fluid characteristics and deposit geochemistry of the Changshanbao region (Nie et al., 2002), there are also some scholars used different methods to limite the metallogenic epoch of the Changshanbao gold deposit (Xiao et al., 2012), their general opinion is that the mineralization is related to the tectonic and magmatic activity of Hercynian, but no detail. This paper is focused on the relationship of the magmatic activity and mineralization in the Changshanbao gold deposit, through a detailed analysis of the process from magmatic evolvement to hydrothermal exsolution, to discuss its impact on the gold mineralization.

2 Geological Characteristic

The strata exposed in the deposit are mesoproterozoic BayanObo Group which contains Jianshan segement, Halahuogegete segement and Bilute segement. The main ore-bearing rock are Bilute segement which composed of coarse sandstone, basaltic sandstone, sandstone, siltstone, shale, chert, and carbonate rocks, after regional metamorphism the rocks have became metamorphic

sandstone, metamorphosed siltstone, slate, phyllite, schist and crystalline limestone .The formation time of intrusive rocks in and surrounding the deposit was late Caledonian, Hercynian and Indosinian. The intrusive rocks which formattted in middle and late Hercynian are the main type. It is composed of biotite granite, potassic granite and granodiorite. Output scale and geometry of the orebody in Changshanbao gold deposit are strictly controlled by stratigraphy, structure and schistose fracture zone. The EW-NEE direction mineralization is divided into East and West two ore zones by a northeast-trending pressure-shear fracture, the entire NE trending gold mineralization has a length of 4500 m, width of 20-200 m (Hu et al., 2008; Nie et al., 2010). ore types consists of quartz veinlets ore and slate complex ore. Quartz veinlets are of rich metal sulfide minerals, such as pyrite, pyrrhotite, galena, sphalerite, chalcopyrite, cinnabar, etc. The gangue minerals are quartz and a small amount of sericite and calcite; slate complex ore has metal sulfides in veinlets and membranous, the main minerals are pyrite, pyrrhotite and minor chalcopyrite and gangue minerals are sericite, quartz, chlorite, albite and some carbonate minerals.

3 Isotopic Analysis Results

Sample CSH-17 and CSH-23 are muscovite in pyrite quartz veins, while Sample CSH-18 is biotite in pyrite quartz veins. From 700°C to 1400°C or from 800°C to 1400°C, the samples went throw 11 stage heating analysis, the obtained data constitutes a spectra of ⁴⁰Ar-³⁹Ar age which were not having significantly thermal disturbance.

According to the Isotopic analysis results, we can know the Ar-Ar ages of two muscovite samples in pyrite quartz veins in Changshanbao gold district are (246.0 ± 1.6) Ma, (250.9 ± 1.5) Ma, strictly speaking, they only represent Ar isotopic age at the time after muscovite formed cooling down to its closure temperature, only in the case of rapid

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cooling can be considered similar to the formation of muscovite ages; a Ar-Ar age of biotite sample is (256.3 ± 1.8) Ma, also, strictly speaking, it can only represent Ar isotopic age at the time after biotite formed cooling down to its closure temperature, only in the case of rapid cooling can be considered similar to the formation of biotite ages. Comprehensive Ar-Ar ages biotite and muscovite in the ore, it can be inferred the latest hydrothermal activity associated with gold mineralization in the Changshan Hao gold deposits is at the age of 246-256 Ma.

4 Discussions and Conclusions

Granite porphyry, monzonite granodiorite and biotite granite are surrounding Changshan Hao Mine outcrop by stocks or batholiths. Porphyry accounts for about 20% of the intrusive rocks, and diorite and monzonite porphyry take up around 30% of the intrusive rocks. Biotite granite outcrops in the northern and southern part of the mine by batholiths and small stocks. According to the size of the rock and geochronology results, following conclusion can be drawn. From around 290 Ma magmatic activity began, but the intensity of magmatic activity was still relatively weak, because only a small area of granite porphyry can be found in the study area. After that, during 287-267 Ma magmatic activity gradually peaked, since wide range of diorite, adamellite spots, and black cloud adamellite outcrop in this region, besides, they constitute the major part of the intrusive rocks. Afterwards, magmatic activity gradually declined to 246 Ma, only sporadic biotite granites trains outcrops in the study area. In late magmatic activity, hydrothermal activity gradually occupied the dominant position. As the temperature cooled to around 256 Ma, biotite whose closure temperature was higher crystallized first, followed by muscovite whose closure temperature was slightly lower crystallized during 250-246 Ma.

From the above process we can speculate that in the magma evolution before mineralization, the relationship between granitic magmatism and gold mineralization may be embodied in two aspects, first, to provide important metallogenic material sources, second, in order to provide important heat for mineralizing. The region was affected by various magmatism tectonic activities in late Paleozoic, granitic magma in the mining areas intrude along the

tectonic formation of weak surface or broken channel, mineralization component and ore fluid upward along the migration of magma. In the crystallization process in late magmatic activity, the ore-forming materials precipitated from magmatic hydrothermal forming hydrothermal with ore, as the temperature and pressure decreases, biotite and muscovite crystals in succession, while the ore-forming elements are precipitated during this gathering, then the Mineralization occurs. Usually the ore bodies are bedded or banded in the fractured zone or anticinal hinge zone. Geological survey show that there are many veins grow alone the strata such as granite porphyry veins and monzonite granite porphyry veins, the veins itself does not contain minerals, but the rock formations on both sides of the veins has generally higher gold grade and obviously hydrothermal. The veins are often on top or bottom plate of ore body, so it is a part of the ore body.

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