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Geochronology and Geochemistry of Intrusive Rocks Related to the No.258 Hill Gold Deposit, Heilongjiang Province

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1 Ore Deposit Geology

The Wandashan metallogenic belt in the eastern Heilongjiang Province is a part of the giant circum-Pacific metallogenic belt. The No.258 Hill gold deposit is located at the junction of the Wandashan eugeosyncline and the Sanjiang fault basin, and is one of the most promising magmatic hydrothermal deposits at the northern Wandashan precious and polymetallic metallogenic belt (Mao *et al*, 2003; Huang, 2010; Qi, 2005; Li, 2011; Xue, 2012).

The exposed strata in the No.258 Hill gold deposit consist mainly of Upper Triassic Dajiahe Formation and Lower Jurassic Dalingqiao Formation. The Mesozoic Hamahe granite is the largest intrusions in the mining area and is the host of the gold deposit. In addition, there are numerous stocks of dikes ranging in composition from diorite, diorite porphyrite and gabbro, locally intruding the Hamahe granite. Gold mineralization mainly occurred in the Hamahe granite and altered diorite porphyrite. Previous studies suggest that a close relationship between gold mineralization and the Mesozoic magmatism. The area is marked by numerous NE-directed folds, NW- and NE-direction faults. The NE-striking structure is the most important host structure, which controlled the location and occurrence of the orebodies.

The No.258 Hill gold deposit, consists of auriferous quartz veins and sulfide disseminations in hydrothermally altered rocks. The deposit consists of 25 ore bodies that formed four mineralized blocks ranging in length from 100 to 260 m and in width from 20 to 200 m. These ore bodies are parallel to the diorite porphyrite emplaced along the NE-trending fracture, and mostly dip towards NE with a steep angle of > 85°. These ore bodies are roughly 100 m long and 1.0-3.8 m thick with Au grade of $0.62\text{-}8.28\times10^{-6}$(averaging 2.66×10^{-6}).

Hydrothermal alteration is well developed in the deposit, dominated by silicification, pyritization, sercitization, kaolinization, choloritization and carbonatization. The gold orebodies mainly occur within the zone of silicification, pyritization and sercitization.

2 Geochronology and Geochemistry

2.1 Sampling

Two monzonitic granite samples of the Hamahe granite (258-N-001 and 258-N-002) and one diorite porphyrite sample (258-N-003) were collected for zircon separation. Seven monzonitic granite and five diorite porphyrite samples were collected from exploratory trenches and drill cores of the No.258 Hill gold deposit for whole-rock geochemistry analyses.

2.2 U-Pb zircon dating

LA-ICP-MS Zircon U-Pb dating was used to determine the emplacement ages of the monzonitic granite and diorite porphyrite. These ages also provide good constraints on the time of gold mineralization as the intrusive rocks are closely associated with the No.258 Hill gold deposit. The monzonitic granite samples yield concordant U-Pb ages of 122.05 ± 0.72 Ma (258-N-001) and 118.01 ± 0.94 Ma (258-N-002), whereas the diorite porphyrite sample has a U-Pb age of 119.50 ± 1.30 Ma (258-N-003). The results demonstrate that the monzonitic granite and diorite porphyrite were emplaced in the Early Cretaceous, rather than in the Jurassic as previously thought (Huang, 2010). Considering that monzonitic granite and diorite porphyrite are the ore-bearing rocks in the No.258 Hill gold deposit and have close spatial relations to the ore bodies, we suggest that gold mineralization of the No.258 Hill gold deposit occurred in the 118 to 120 Ma interval.

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2.3 Whole-rock geochemistry

Whole-rock major and trace element data show that the two plutons largely belong to high-K calc-alkaline series with high K_2O/N_2O >1. They are classified as peraluminous rocks with A/CNK >1.3.

Monzonitic granite shows moderate fractionation between LREE and HREE in the chondrite-normalized REE patterns with variable but prominent negative Eu anomalies (Eu/Eu*=0.14~0.60). They are enriched in LILE (e.g. Rb, Th, K) and depleted in Sr, Ba and HFSE (e.g., Nb, P and Ti) in primitive mantle normalized spider diagram. These characteristics are typical of continental crust, and thus may suggest that monzonitic granite were derived from partial melting of crust. The diorite porphyrites show strong enrichment of LREE coupled with slight HREE depletions and minor negative Eu anomalies (Eu/Eu*=0.79-0.99). They show enrichment in Rb, Ba and K and depletion in Nb, Ta and Ti in primitive mantle normalized spider diagram. The features of low Th and Y coupled with high Sr and Ba are significantly different from monzonitic granite, which may suggest that they were formed in an active continental margin setting.

On the tectonic discrimination diagram, the monzonitic granite and diorite porphyrite samples plot in the field of volcanic arc granite field (VAG), suggesting they were originated from the active continental margin. We conclude that the Early Cretaceous granitoids occurred in an active continental margin setting related to the westward subduction of the Paleo-pacific plate beneath the East Asian continent during the late Mesozoic. The U-Pb zircon age of the magmatic samples show that they were formed during the late Early Cretaceous. Therefore, both magmatism and gold mineralization in the No.258 Hill gold deposit resulted from the subduction of Pacific plate during Early Cretaceous.

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