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Ore genesis, metallogenic age and tectonic setting of the Shajingou gold deposit in Jilin Province, NE China

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The Shajingou gold deposit, located in the eastern segment of the northern margin of the North China Craton (NCC), is a medium scale Jurassic gold deposit that has been found recently in the eastern area of Jilin Province, NE China. The gold mineralization in this deposit is hosted by the Yanshanian diorite intrusion, and characterized by ore-bearing quartz-polymetallic sulfide veins controlled by NW-trending faults. By field investigations, analysis on cross-cutting relationships, and mineral paragenetic associations, three stages of hydrothermal process can be determined: (1) quartz–pyrite, (2) quartz–gold–polymetallic sulfide, and (3) quartz–carbonate, with gold being introduced mainly in the second stage.

The petrography, microthermometry and laser Raman spectroscopy analysis of fluid inclusions show that the initial ore-forming fluids of the Shajingou gold deposit belong to the mid-high temperature and mid-low salinity H_2O–CO_2–NaCl fluids system. In addition, the stage I hydrothermal quartz FIs have relatively high δD and calculated $\delta^{18}OH_2O$ values, similar to those gold deposits formed in magmatic–fluid systems in the Jiapigou-Haigou metallogenic belt. The fluids then evolved during mineralization stage II into immiscible H_2O–CO_2–NaCl fluids that facilitated the transport of metals and their separation from the ore-bearing magmas due to heated meteoric water. With the increase of pH in residual ore-forming fluids on account of CO_2escape, continuous decrease of ore-forming temperatures, exsolution of H_2S from the ore-forming fluid and accompanied by a substantial drop in the temperature and pressure of the fluid, this process made the Au–S complexes unstable and reduced their solubility, resulting in the precipitation of abundant gold, quartz, polymetallic sulfides, and gangue minerals. In summary, we consider that the Shajingou gold deposit is similar to these gold deposits in Jiapigou-Haigou gold belt, such as Haigou, Jiapigou, Xiaobeigou, Erdaogou and Erdaodianzi, which belong to mid- high temperature hydrothermal vein type gold deposit, and fluid immiscibility played an important role in gold mineralization at Shajingou deposit.

To determine the metallogenic age, ore genesis, the tectonic setting, the relationships between mineralization and associated magmatism, and the metallogenic processes in ore district, we have carried out some studies including pyrite Re–Os dating, zircon U–Pb dating. The gold- bearing pyrite Re–Os dating yielded a isochron age of 169 $\pm$ 18 Ma that is consistent with zircon U–Pb age of 171.7 $\pm$ 0.9 Ma for the diorite from the Shajingou gold deposit, which constrain the timing of emplacement and the associated gold mineralization in the Shajingou gold deposit to the Middle Jurassic ($\sim$171 Ma). These ages indicate a close spatial, temporal, and genetic link between magmatism and gold mineralization and are also broadly consistent with the mineralization age of numerous gold deposits located in the Jiapigou-Haigou metallogenic belt, which show that large scale tectonic–magmatic–hydrothermal gold mineralization event occurred in central and eastern Jilin Province due to the subduction of the Pacific Plate beneath the Eurasian continent during the Middle Jurassic.

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