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P-T Conditions and Mechanisms for Precipitation of Gold in the Xincheng Deposit, Jiaodong Peninsula, China

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The Jiaodong Peninsula, the largest gold producer in China with reserves of 2300 t gold, is located in southeast North China Craton (Deng et al., 2009, Wang et al., 2014a). Gold deposits in the area occur as disseminated- and stockwork-style mineralization ("Jiaojia-type"), mainly consisting of disseminated- and stockwork-style pyrite-sericite-quartz-altered ores that are controlled by major regional-scale faults such as the Sanshandao, Jjiaojia and Xincheng faults (Yang et al., 2014), as well as auriferous quartz-veins ("Linglong-type") (Deng et al., 2000, 2006; Li et al., 2006), composed of single or multiple quartz veins and occur along the second- or third-order faults that cut the Mesozoic granitoids (Deng et al., 2008, 2011; Wang et al., 2014b; Yang et al., 2007a). Fluid inclusion studies show that the ore-forming fluids through the Jiaodong province are H_2O-CO_2 ±CH_4-bearing fluids with low-medium salinity (1.2-13.6 wt.% equiv. NaCl) (Fan et al., 2003; Yang et al., 2008, 2009). Minimum mineralizing *P-T* conditions were regarded as being 170-377°C and 500-3,160 bars (Hu et al., 2007; Yang et al., 2007b). However, few studies reported more than the homogenization temperature, salinity and / or pressure for the fluid inclusions, with little discussion about the gold-bearing fluids' composition and the physico-chemical constraints, as well as the precipitation mechanisms of gold mineralization.

The Xincheng gold deposit, located along the Jiaojia fault zone in west Jiaodong Peninsula, is a representative lode gold deposit hosted in the granitoids in Jiaodong. It has been exploited since 1979 by the Xincheng Gold Company and has a proven reserve of >200 t gold. However, so far, no information on the gold-bearing fluids and gold deposition of the deposit has been published in English. Our recent fluid inclusion work at the Xincheng deposit showed the quartz-pyrite and quartz-sulphide veins contain H_2O-CO_2, aqueous, and CO_2 inclusions, and they often occur within the same growth plane. This provides a good chance to investigate whether fluid immiscibility took place at the deposits in the Jiaodong province, and to reveal the ore fluids *P-T-X* conditions of Mesozoic granitoid-hosted gold deposits.

Four paragenetic stages: pyrite-quartz-sericite (stage 1), quartz-pyrite (stage 2), quartz-polysulfide (stage 3) and quartz-carbonate (stage 4), were identified at Xincheng deposit based on the crosscutting relationships and mineral paragenesis. Gold was deposited during the quartz-pyrite and quartz-polysulfide stages. With careful petrography, microthermometry, and Raman spectroscopy, we identified three types of fluid inclusions trapped in gold-bearing quartz veins that are related to the ore forming even: (1) type 1 H_2O-CO_2 inclusions that show high temperatures (ca. 260 °C), low salinities (2.4-8.9 wt.% equiv. NaCl) and variable X_{CO2} (0.03 to 0.20), (2) type 2 aqueous inclusions with medium temperatures (ca. 220 °C) and low to moderate salinities (3.1-13.3 wt.% equiv. NaCl); (3) type 3 pure CO_2 inclusions with a carbonic phase density of 0.712±0.03 g/cm^3. Types 1 and 2 inclusions appear in the same growth phase of the quartz grains from the breccias and tensile auriferous veins. These coexisting inclusions are likely formed by fluid immiscibility due to unmixing from a single homogeneous H_2O-CO_2 parent fluid at trapping *P-T* conditions of 221 to 304 °C and 780 to 2,080 bars. The fluid immiscibility was likely initiated by fluid pressure reduction at about 300 °C.

The ore-fluid P-T conditions of the Xincheng gold deposit are consistent with those of the mesothermal lode-

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gold deposits (Hagemann and Luders, 2003; Mikucki, 1998). Gold was most probably transported as $Au(HS)^{2-}$ complex at Xincheng, which is also supported by the fact that gold is closely associated with sulfides (especially pyrite). The gold precipitation from the H_2O-CO_2-NaCl fluid was probably controlled by the immiscibility at the temperature of 221-304 °C. The fluid immiscibility and accompanying decrease of $Au(HS)^{2-}$ solubility may explain the gold deposition of granitoid-hosted Xincheng lode-gold deposit.

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