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The mechanism of metal precipitation in the Dexing giant ore cluster, South China: evidence from fluid inclusions

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The Dexing ore cluster is one of the most important producers of Cu, Mo, Au, and Ag of South China. It includes the giant Dexing Cu–Mo–Au ore field (8.3 Mt Cu, 299,000 t Mo, and 228 t Au), the large Yinshan epithermal Cu–Au–Pb–Zn–Ag deposit (1 Mt Cu, 107 t Au, 107 Mt Pb–Zn, and 3445 t Ag), and the giant Jinshan Au ore field (200 t Au). The mechanisms of metal precipitation for these three deposits are hotly debated. Some researchers have proposed that these three deposits were related to the emplacement of the Late Mesozoic porphyries, and thus they belonged to porphyry to epithermal systems [1]. In contrast, others have argued that the Jinshan gold deposit was hosted in ductile shear zones [2], and that the ore-related porphyries in the Yinshan deposit were contrasting with ore-bearing porphyries in the Dexing deposit [3]. In addition, although the Dexing deposit is a typical porphyry system, the ore-forming processes remain unclear.

Using newly obtained samples from recent drilling work together with detailed field observations, we propose that the Dexing ore cluster was formed in two episodes, namely Neoproterozoic and Middle Jurassic. Auriferous ores are hosted by brittle-ductile zones in the Jinshan gold deposit. The main ore stage veins are characterised by the coexistence of CO_2-rich and aqueous fluid inclusions. These two populations of fluid inclusions have similar total homogenization temperatures but different salinity values, suggesting that fluid immiscibility occurred during gold precipitation. In view of Rb–Sr dating of quartz-hosted fluid inclusions (ca. 750 Ma), the Jinshan orogenic Au system was linked to the Neoproterozoic Jiangnan orogeny [4].

The Dexing ore field is characterized by four stages of veins: stage 1 barren quartz-K-feldspar ± biotite veins; stage 2 quartz-molybdenite veins with potassic alteration; stage 3 quartz-pyrite-chalcopyrite veins with phyllic alteration; and stage 4 barren quartz-pyrite-calcite-chlorite ± epidote veins with propylitization. Fluid inclusion studies revealed abundant evidence for boiling in stages 2 and 3 veins, and these fluid inclusions share common homogenization temperature ranges, suggesting multi-stage boiling events during large-scale porphyry-style mineralization. Studies on high salinity inclusions in the Dexing ore field demonstrated that homogenization by halite disappearance was not formed by fluid boiling, and these inclusions generally yielded extremely high estimated pressures [5].

Fluid inclusions from epithermal-style mineralization demonstrated the pervasive occurrence of liquid-rich aqueous fluids with low to moderate temperatures and salinities, consistent with an epithermal environment. By contrast, gas-rich and halite-bearing inclusions from deeper levels below the Cu–Au ore bodies share similar homogenization temperatures of 317–448°C and contrasting salinities of 0.2–4.2 and 30.9–36.8 wt.% NaCl equivalent, respectively, indicating that boiling occurred. The local boiling beneath the epithermal Cu–Au ore-forming system indicates the possibility that porphyry-style ore bodies may exist at even greater depths [6].

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