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Fluid inclusion characteristics of porphyry Mo systems in two contrasting tectonic environments: Insights from Shapinggou and Zhilingtou deposits in South China

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Porphyry deposits are the world's most important source of Mo, accounting for more than 95% of world Mo production. Porphyry Mo deposits have been classified into a Climax type and an Endako type [1]. The Climax type is characterized by high abundances of Mo (Mo>0.15 wt.%) and F (0.05–0.15 wt.%) in an intra-plate extensional environment [2]. The Endako type is characterized by relatively low contents of Mo (<0.15 wt.%) and F (<0.05 wt.%) in a continental arc setting [2]. The comparison of ore-forming fluids in porphyry Mo deposits in two different tectonic environments are still poorly constrained. In this contribution, the Shapinggou and Zhilingtou Mo deposits were selected to present the contrasting fluid features in two different tectonic regimes.

The Shapinggou porphyry Mo deposit in the Dabie Orogen, with the proven reserve of 2.43 Mt Mo metal, is the largest Mo deposit in China [3]. Hydrothermal alteration and mineralization at Shapinggou can be divided into four stages, i.e., stage 1 ore-barren quartz veins with intense silicification, followed by stage 2 quartz-molybdenite veins associated with potassic alteration, stage 3 quartz-polymetallic sulfide veins related to phyllic alteration, and stage 4 ore-barren quartz ± calcite ± pyrite veins with weak propylitization. CO_2-rich (type II) and coexisting halite-bearing (type III) inclusions in the potassic zone (stage 2), which hosts the main Mo orebodies, have homogenization temperatures of 240–440°C and 240–450°C, with salinities of 34.1–50.9 and 0.1–7.4 wt.% NaCl equivalent, respectively. Type II and coexisting type III inclusions in the phyllic zone (stage 3) display homogenization temperatures of 250–345°C and 220–315°C, with salinities of 0.2–6.5 and 32.9–39.3 wt.% NaCl equivalent, respectively. The abundant CO_2-rich and coexisting halite-bearing fluid inclusion assemblages in the potassic and phyllic zones highlight the significance of intensive fluid boiling of a NaCl–CO_2–H_2O system in deep environments (up to 2.3 kbar) for giant porphyry Mo mineralization [4].

The Zhilingtou Mo deposit is recently discovered and occurs in the Qin-Hang metallogenic belt, South China [5]. Three stages of mineralization and wallrock alteration were developed: the early stage quartz ± K-feldspar veins with potassic alteration, the ore stage quartz–molybdenite veins with strong phyllic alteration, and the late stage quartz–pyrite ± calcite veins with propylitization. Two-phase gas-rich aqueous (type II) and coexisting halite-bearing (type III) inclusions in the ore stage veins display homogenization temperatures of 335–433°C and 329–396°C, and salinities of 0.5–6.2 and 38.6–44.8 wt.% NaCl equivalent, respectively. Fluid boiling in the ore stage probably induced a rapid precipitation of molybdenite. Trace elements of the ore-bearing granite porphyry display obvious Nb and Ta depletion, indicating arc magma geochemical affinities. Intensive phyllic alteration, CO_2-poor ore fluids, and continental arc setting suggest that the Zhilingtou Mo deposit is likely to be an Endako type porphyry Mo deposit in subduction zone setting. It is different from porphyry Mo systems in the Dabie

orogen in a post-collisional setting and characterized by intensive potassic alteration and CO_2-rich ore fluids.

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