Magmatic-hydrothermal Evolution of the Donggou porphyry Mo deposit at the southern margin of the North China Craton: Evidence from chemistry of biotite

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Late Mesozoic granitoid intrusions are widespread in the southern margin of the North China Craton (NCC), occurring commonly as both small porphyritic stocks and large batholiths. Most of the Mo deposits are closely associated with the small porphyritic bodies. In order to determine the relationship between Mo mineralization and the granitoids, a systematically geochemical study of biotite from the Taishanmiao batholith and the Donggou porphyry associated with the porphyry Mo mineralization was conducted.

The MgO-FeO-Al_2O_3 contents, X_{Mg}, $\log(X_F/X_{Cl})$ and Al^{VI} values of the magmatic biotites reaveal that the Taishanmiao and Donggou granitoids are highly fractionated I-type granites. Trace element features of biotites suggest a differentiation trend from the Taishanmiao batholith to the Donggou porphyry, as revealed by systematically decreasing K/Rb ratios and compatible element contents (Co, Ba, V and Ti), and increasing of incompatible element contents (such as Cs, Li, Ta and Tl).

In addition, the compositions of magmatic biotite follow a more magnesium-rich trend, and mostly plot above the NNO buffer. The Fe^{3+}/Fe^{2+} values of biotite gradually increase from the batholith to the porphyry, which indicates the progressive increasing fO_2 during magmatic differentiation. The earlier fluids associated with the Taishanmiao batholith are relatively Cl-rich with $\log(fHF/fHCl)<0$, whereas the later fluids associated with the Donggou porphyry are relatively F-rich with $\log(fHF/fHCl)>0$. The high degree of melt fractionation and progressive increasing of oxygen fugacity is beneficial to concentrate Mo in the residual melt, whereas later relatively F-rich fluid is able to extract Mo from the melt, and thus favorable for the Mo mineralization.