Late Mesozoic magmatism and associated porphyry Mo mineralization in the the Xiong'ershan area, East Qinling Orogen, China

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The Late Mesozoic granitoids representing prolonged magmatism during 160-108 Ma, are widely distributed in the East Qinling Orogen Belt (EQOB). Previous studies show that the Late Mesozoic molybdenum mineralization in the EQOB is spatially and temporally associated with the Late Mesozoic magmatism. Even so, the petrogenesis of the Late Mesozoic granitoids, magma sources remain debated. This study presents integrated whole-rock geochemistry, zircon U-Pb geochronology and Hf-O isotopes for Late Mesozoic ore-bearing granite porphyry stock (Leimengou granite porphyry) and ore-barren plutons (Haoping and Jinshanmiao plutons) in the Xiong’ershan area of the EQOB. The 130-127 Ma ore-barren granitoids are characterized by high-K subalkaline, metaluminous, and show negative correlations between Al_2O_3, MgO, TiO_2, MnO, CaO, FeO^T and P_2O_5 with SiO_2. However, the Leimengou granite porphyry yield a zircon U-Pb age of 130.9 ±0.4 Ma and is peraluminous, high-K alkaline and shoshonitic, and lacks distinctive linear correlation between major oxides with SiO_2 except Al_2O_3, K_2O and Na_2O. These granitoids are enriched in LREE over HREE with slightly negative europium anomalies. Most samples show enrichment of Rb, Ba, Th, U, K and Pb, and depletion of Nb, Ta, P and Ti, mostly overlapping the ranges of the Taihua Group. The Hf-O isotopic features of zircon from the Leimengou granite porphyry ($\delta\,^{18}O_{zircon}$ = 5.03‰ - 5.86‰, $\varepsilon\,Hf_{(t)}$ = -24.3 to -14.4) are markedly similar with the Haoping pluton ($\delta\,^{18}O_{zircon}$ = 5.17‰ - 5.61‰ and $\varepsilon\,Hf_{(t)}$ = -26.6 to -21.4). Zircon grains from the Jinshanmiao pluton have unique $\delta\,^{18}O_{zircon}$ ranging from 6.01‰ to 8.90‰ and $\varepsilon\,Hf_{(t)}$ from -15.6 to -12.2. We propose that Haoping pluton and Leimengou granite porphyry were derived from mixing of partial melts of the Taihua Group with mantle-derived material, whereas the Jinshanmiao pluton originated from a mixture of Xiong’er Group and mantle-derived material, with minor Taihua Group. The zircon grains from the Leimengou granite porphyry have significant higher Ce^{4+}/Ce^{3+} (mean 547) and δEu (mean 0.65) ratios than those in the ore-barren Haoping pluton (mean 207 and 0.54, Ce^{4+}/Ce^{3+} and δEu, respectively) and the Jinshanmiao pluton (mean 235 and 0.62, respectively). The main controlling factors for porphyry-type Mo mineralization are likely the oxygen fugacity (fO_2) of the magma and input of mantle-derived material in the Xiong'ershan area.

Keywords: Geochemistry, Zircon geochronology, Zircon Hf-O isotope, Late Mesozoic granitoid, East Qinling

