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The Evolution of Granitic Magmas and Implications for Mo Deposit Formation within the Luanchuan Metallogenic Belt, Eastern Qinling Orogen, Central China

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1 Research Background

The Luanchuan metallogenic belt, which is located within the eastern part of the Qinling Orogen, hosts world-class Mo deposits, which is closely related to small late Mesozoic plutons (Hu et al., 1988; Chen et al., 2000; Zhang et al., 2001; Mao et al., 2005, 2011; Yang et al., 2012; Li et al., 2012).

2 Analytical Results

Zircon U-Pb dating were carried out at the Laboratory Center for Physical Geology of China University of Geosciences, Beijing, China. Zircon U–Pb dating of lithologically distinct plutons has yielded ages of 153.2 ± 1.3, 154.1 ± 1.8, 151.5 ± 2.1, and 148.3 ± 1.0 Ma, with previously reported Re–Os ages of molybdenite from these granites being clustered around an age of ~146 Ma. Zircons of the mineralization-related granites have similar positive Ce anomalies, HREE distributions, and $(Eu/Yb)_N$ values. Lead isotope analyses were conducted at the Geochemistry Division of the National High Magnetic Field laboratory, Florida State University, USA. High-precision MC–ICP–MS Pb isotope analyses of K-feldspar megacrysts from mineralization-related granites yielded $^{206}Pb/^{204}Pb$ values of 17.3108–17.7514, $^{207}Pb/^{204}Pb$ values of 15.4601–15.5233, and $^{208}Pb/^{204}Pb$ values of 38.0454–38.6341 (2s), suggesting that these granites were derived from the lower crust. In addition, Pb isotope analysis of pyrite that was coprecipitated with molybdenite, yielding 206Pb/204Pb values of 17.491–18.028, 207Pb/204Pb values of 15.476–15.546, and 208Pb/204Pb values of 38.279–38.534, suggesting that the metals within these deposits were derived from both the mantle and the lower crust.

3 Discussion and Conclusions

In this study, a new model was present, in which mineralization-related granites are enriched in Mo during the evolution of a sequence of magma chambers. The volatile- and Mo-bearing granitic magmas ascended as diapirs from the deep crust, and were emplaced as dikes in the upper crust. Lithological differences between these granites may relate to differences in the evolution of individual magmas. Finally, ore-forming fluids were exsolved from the granitic melts in shallow crustal magma chambers, resulting in the formation of the Mo deposits of the Luanchuanmetallogenic belt.

Based on the discussion above, the following conclusions could be summarized:

(1) The Pb isotope compositions of pyrites that were coprecipitated with molybdenite in Luanchuan metallogenic belt indicate that the metals within the deposits in the study area were sourced from both the lower crust and the mantle.

(2) The development of Mo-rich granites was long lived, and the multiple stages of magmatic evolution within a series of sequential but linked magma chambers allowed associated Mo mineralization to reach economic levels. This model may well apply to late Mesozoic Mo-bearing granites across eastern China.

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