

Molybdenum isotopic constraints on slab inputs to subduction zone magmatism: A case study

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The subduction zone is the major site for material exchange between the mantle and the crust. Such geochemical recycling process is crucial for the diversity of magmatism and mineralization in arc setting. However, few studies are carried out on variation of material inputs through time in a subduction zone. The Erguna Massif is an ideal site for answering this issue because it experienced the early Mesozoic southward subduction and Middle Jurassic closure of the Mongol-Okhotsk Ocean, as well as late Mesozoic extension. First, The Late Triassic (~210 Ma) and Early Jurassic (~180 Ma) mafic–intermediate rocks formed in an active continental margin setting related to the southward subduction of the Mongol-Okhotsk oceanic plate. They have $\delta^{98/95}\text{Mo}$ values of -0.26‰ to +0.24‰, most of them are higher than the normal mantle value (-0.20‰ $\pm$ 0.01‰). Combined with their low Mo/Ce ratios, $(^{87}\text{Sr}/^{86}\text{Sr})_i$ ratios (0.7050–0.7078), and Nd isotope data ($\epsilon\text{Nd}(t) = -2.12$ – $+2.04$), their primary magmas were derived from partial melting of depleted lithospheric mantle modified by subducted slab-derived fluids and seafloor sediment-derived hydrous melts (with heavy Mo isotope). Second, the Late Jurassic (~155 Ma) and late Early Cretaceous (~120 Ma) mafic–intermediate rocks formed in an extensional setting after the closure of the Mongol-Okhotsk Ocean. They have $\delta^{98/95}\text{Mo}$ values of -1.15‰ to -0.07‰, dominance of them are lower than that of the mantle, implying that their magma sources had been modified by residual sediment-derived melts (with light Mo isotope). Third, the early Mesozoic magmatisms are related mainly to porphyry Cu–Mo deposits, whereas late Mesozoic magmatisms are related closely to epithermal deposits. Taken together, we conclude that the Erguna Massif experienced change of input material from subducted slab-derived fluids and hydrous sediment melts in early Mesozoic to residual sediment melts in late Mesozoic, and that nature of subducted input material controls regional mineralization. Therefore, our results provide strong evidence for the variations of slab inputs to subduction zone magmatism and their metallogenic effects through time.

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