Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27603

# Giant REE accumulation related to voluminous, highly evolved carbonatite at Bayan Obo, China

**XIAOCHUN LI**

Institute of Geology and Geophysics, Chinese Academy of Sciences

The giant Bayan Obo deposit in China represents the largest REE resource in the world, but the mechanisms for its highly anomalous REE enrichment have long been controversial. The central debate concerns the nature and origin of the ore-hosting dolomite. Given the dolomite rocks experienced extensive hydrothermal alteration, a texturally constrained, in-situ Sr isotopic study was conducted to resolved their origin. The results show that the primary unaltered dolomites have $^{87}Sr/^{86}Sr$ ratios <0.704, contrasting with obviously higher $^{87}Sr/^{86}Sr$ ratios (>0.705) of Mesoproterozoic sedimentary carbonates globally. Thus, the primary unaltered dolomite is proposed to be a mantle-derived carbonatite.

We further conduct studies to unravel the rock-forming process of the carbonatite. The dolomite rocks contain two major components, the early-stage coarse-grained dolomite (CD) and the late-stage fine-grained dolomite (FD). The CD is locally present (~10 vol.%), while the FD is widely distributed (~90 vol.%). Compared with dolomite grains from the CD, most of the unaltered dolomite domains within the FD are more enriched in FeO and MnO and have higher $\delta^{13}C_{V\text{-}PDB}$ (-4.9 to 0.3 ‰) and $\delta^{18}O_{V\text{-}SMOW}$ (9.4 to 17.1 ‰) values. In addition, the FD contains abundant REE- and volatile-rich hydrothermal minerals and Fe-Mg carbonates, which are rare in the CD. The geochemical and mineralogical data in conjunction indicate that the melts forming the late-stage FD were much more evolved than those forming the early-stage CD.

When compared with other carbonatite complexes, the Bayan Obo carbonatite suite is notable for having a large surface area (~ 48 $km^2$ in outcrop) and containing an anomalously large proportion of highly evolved components. The voluminous evolved carbonatite clearly provided a basis for the accumulation of significant ore metals. Therefore, the giant-size REE deposit is proposed to be associated with large-volume, highly evolved carbonatite at Bayan Obo.