

Great Potential of Tin in the Magic Bayan Obo Fe-Nb-REE deposit, North China

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The giant Bayan Obo Fe-Nb-REE deposit located in Inner Mongolia, China is one of the world's foremost carbonatite type deposits. It is a focus of global interests owing to great resources of rare earth element (REE, reserve of 57.4 million metric tons @ 6 wt% RE₂O₃), niobium (reserve of 2.2 million metric tons @ 0.13 wt% Nb₂O₅) and huge ferrum reserve of 1500 million metric tons @ 35wt% Fe₂O₃. This deposit also has a potential in terms of other critical metal reserves.

Tin enrichment was first discovered in the Bayan Obo carbonatite-hosted deposit. For tin contents are notably up to 1500 ppm in vein type ores, and ubiquitous cassiterite grains in certain samples. The distribution characteristics and mineral symbiosis implied that cassiterite was present within magnetite grains as nanoscale inclusions in banded and massive ores during the early stage, and gathered in hydrothermal mineral veins such as fluorite, apatite, calcite and aegirine in vein-type ores during the late stage. Tin mineralization was further studied by the identification of cassiterite and other Sn-bearing minerals (rutile with ~ 6wt% SnO₂, titanite with ~9wt% SnO₂, bafertisitite with ~15wt% SnO₂) in ores. In combining textural information of ores, multi-stage hydrothermal activities played important roles in the activation and enrichment of tin in the Bayan Obo deposit. New evidence from geochronology has revealed the close mineralization time between tin and niobium in this deposit. The peak age of monazite co-existing with cassiterite is 425 Ma (375~663 Ma via LA-ICPMS, 281~932 Ma via SIMS), which is corresponded to columbite-Mn dating results of 419±18 Ma in the Caledonian period. Besides, the peak Th-Pb age of parisite co-existing with cassiterite is 275 Ma (124~672Ma via SIMS), indicating the following Hercynian hydrothermal activities had influenced the cassiterite as well as other Sn-bearing minerals.

Based on the results, tin mineralization has experienced magmatic and metasomatic stages similar to Nb and REE mineralization at Bayan Obo. Given the significant volume of magnetite and vein-type ores, it is presumable that the Bayan Obo deposit should host great resource of tin.

