

Chalcophile elements constraint on the mineralization of subduction-related magmatic Ni-Cu sulfide deposits: A case study of the Early Permian Halatumiao Ni-Cu sulfide deposit, NE China

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Magmatic Ni-Cu sulfide deposits associated with mafic-ultramafic intrusions are mostly formed in intraplate setting. Arc setting related magmatic Ni-Cu sulfide deposits were rarely reported, until Xiarihamu, the world-class magmatic Cu-Ni sulfide deposit, was explored at 2011 in the East Kunlun Orogenic Belt, northern Tibet-Qinghai plateau, NW China. Hence, origin of magmatic Ni-Cu sulfide deposits in arc background still lacks effective constraints.

In recent years, several arc magma related magmatic Ni-Cu sulfide deposits were reported in the South Central Asian Orogenic Belt, Inner Mongolia, NE China (e.g. Heishan, Erbutu and Beiligaimiao). The newly discovered Halatumiao magmatic Ni-Cu sulfide deposit, is close to the Erbutu and Beiligaimiao deposits. The Halatumiao mafic-ultramafic intrusion trends nearly EW and intrude into the Devonian sedimentary rocks, with ~900 m in length and ~150 m in width. Such intrusion is composed of wehrlite, websterite and gabbro. Massive and semi-massive sulfides were presented in the mafic-ultramafic rocks, with average grades of 1.43 wt.% Ni and 0.3 wt.% Cu.

The high sulfur and Ni contents, and Ni/Cu ratios (6.7 in average, except one sample) and low concentrations of Cu and PGEs in the Halatumiao sulfide samples, suggesting that the Halatumiao intrusion is produced by moderate-degree partial melting of a pyroxenite mantle source. The excellent positive correlation between IPGEs and PPGEs (Ir vs. Os, Ru and Rh, and Pt vs. Pd), indicating that the fractional crystallization of monosulfide solid solution is the key factor for the PGE tenors. The $\gamma_{Os}(t)$ values (at 292 Ma, 46–68) and mantle-like sulfur isotopic compositions (mostly between -1.5 and 0.5‰), as well as the characteristics of trace elements, showing that the crustal contamination (5-10%) has occurred in the process of magma emplacement. Compared to the mixing of magmas, the fractional crystallization and crustal contamination were likely resulted in the sulfide saturation in the Halatumiao magma.

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