Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.21879

Porphyry-skarn Cu polymetallic mineralization in the north margin of the Chinese Western Tianshan

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Porphyry-skarn type Cu-Mo polymetallic mineralization in the north margin of the Western Tianshan, Xinjiang, China is genetically associated with the late Paleozoic intermediate to acid intrusions with zircon U-Pb ages concentrated at 390-350 Ma and 315-280 Ma. The middle Devonian to early Carboniferous (390-350 Ma) intrusions were emplaced during the southward subduction of the North Tianshan ocean under the Yili block. The parent magma originated from partial melting of the lower crust triggered by the underplating of mantle-derived mafic magmas formed by the metasomatism of subduction-zone melts and fluids. Mineralization related to these intrusions include skarn-type Cu-Fe (e.g., Kekesala-Aimusidaiyi, Kuokuqueke, Halegati, and Saibo-Lamasu deposits) and porphyry-type Cu-Mo (Kexiaxi and Lailisigaoer deposits). The late Carboniferous to early Permian (315-280 Ma) intrusions were emplaced in the post-collisional setting after the closure of the North Tianshan ocean and the collision between the Junggar and Yili blocks, with parent magmas mainly derived from partial melting of the lower crust in response to slab breakoff or lithospheric delamination. They are causative rocks of porphyry- and skarn-type Cu-Mo mineralization at Kekesai, Dabate, Seleteguole, and Kendenggaoer. Compared to barren intrusions, fertilized granitoids are less acid and fractionated and have higher contents of volatiles and higher crystallization temperature. The Cu-Fe mineralized intrusions are commonly more oxidized, less fractionated and have higher Cl/F ratios than the intrusive rocks related to Cu-Mo mineralization. In addition, the fertilized granitoids typically contain abundant mafic microgranular enclaves of magma mixing origin, suggesting that crust-mantle interactions and the injection of mantle-derived magmas should have increased the fertility of the felsic magmas. Interestingly, the amphibole species in the mineralized granitoids is dominated by the recently approved new mineral “magnesio-ferri-hornblende” (IMA2021-100), while magnesio-hastingsite and hastingsite predominate in barren intrusions, and so that the extensive occurrence of magnesio-ferri-hornblende should be a potential indicator for identifying fertile porphyry-skarn systems.