

Discovery and geological significance of a cobalt-only deposit at Bayan Obo, Inner Mongolia

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Cobalt is mostly present as an isomorphic phase in minerals, and most of the cobalt resources used in industry are presently associated with deposits of copper, nickel, and iron. In recent years, a cobalt-only deposit, located in the Bayan Obo rift zone along the northern margin of the North China Craton and 25 km from the super-large Bayan Obo Fe-Nb-REE deposit, has been found in the Bayan Obo region of Inner Mongolia. The stratigraphy of the deposit is defined by the second and third units of the Hujier Formation of the Proterozoic Bayan Obo Group. The units are mainly composed of an actinolite- and epidote-rich rock, a garnet- and andalusite-bearing chert, silty mudstone, quartzite (with carbon and sericite), silty slate, and quartz metasandstone. In addition, there are widespread intermediate to felsic intrusive bodies and diorite that were emplaced in late Variscan. A metamorphosed rock that is highly fractured and the protolith unit for the epidote- and actinolite-bearing Hujier Formation, is located along the contact between the intrusions and the sedimentary units.

Two belts of cobalt mineralization, the larger 3 km x 50 m, were investigated in the structurally deformed and altered rocks of the contact zone. Nine cobalt mineralized bodies in the inner zone of mineralization belt range from 30 m x 6 m to 200 m x 15 m, and the cobalt grades of orebodies range from 0.012% to 1.11%, with an average of 0.05%. Parts of the nine bodies are mineralized also with gold and copper. The alteration minerals of the cobalt enriched rocks mainly include limonite, jarosite, pyrite, magnetic pyrite, and magnetite, with development of zones of hornfels, silicification, chloritization, and carbonatization. There is a close relationship between the degree of pyritization and abundance of cobalt.

The genesis of the cobalt deposit relates to hydrothermal deposition and remobilization. The high cobalt background of the epidote- and actinolite-bearing rocks of the Hujier Formation, higher than that of other units, suggests it is more favorable for the superimposed remobilization by a magmatic hydrothermal fluid during intrusive activity. A dense and hard quartzite layer overlying the epidote actinolite provides a good physical barrier for magmatic-hydrothermal metasomatism, which enriched cobalt in the underlying reactive host rock.

The mining of cobalt ores below quartzite occurs in the layer of epidote- and actinolite-bearing rock. This lithological control can be used as an effective targeting tool for cobalt mineralization, and thus targeting this layer at the contact of the Permian intrusion, near hornfelsed and other types off altered sedimentary rock, defines favorable prospecting areas. The presently defined resources are just small- and medium-sized due to the limited current exploration. The target horizon and the contemporaneous intrusions that are widely developed in the Bayan Obo area, therefore, have important significance for the expansion of discovery of similar cobalt deposits.