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Geochronological bracketing of hydrothermal events at the newly discovered Bianjiadayuan porphyry and base metal deposit, NE China

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Many new discoveries of base metal (Ag-Pb-Zn-Cu) veins in the Great Hinggan Range ore district have made this region the most important Ag-Pb-Zn metallogenic belt in northern China. The newly-discovered Bianjiadayuan deposit is one of the new discoveries, which is characterized by diverse mineralization styles including porphyry Cu-Mo-Sn, breccia Sn-Pb-Zn, and base metal vein types. This well-preserved ore system provides a good opportunity to discriminate and bracket magmatic-hydrothermal events, and evaluate their temporal and genetic relationship with local magmatism. The present geochronological studies reveal that two separate mineralization events are identified.

The early dated magmatic-hydrothermal event is represent by two robust zircon U-Pb ages of $140.8 \pm 0.9$and 140.2 ± 0.6Ma for the ore-hosting quartz porphyry intrusion, which are indistinguishable from aRe-Os ageof140.0 ± 1.7Ma for molybdenite veins/veinlets hosted inthe porphyry. The above obtained ages are slightly older or consistent with a sericite $^{40}Ar/^{39}Ar$ age of 138.7 ± 1.0Ma for base metal (Ag-Pb-Zn) veins adjacent to the porphyry. Thus, an early mineralization event was bracketed between ~140 and ~138 Ma, which is attributed to a typical porphyry ore system. A late mineralization event is evidenced by numerous Cu-Pb-Zn mineralized veins hosted in a gabbro intrusion displaying a zircon U-Pb age of 133.2 ± 0.9Ma, which provides a maximum age constraint for this mineralization. The late base metal veins are speculated to be coeval with the local diorite dikes that intruded bothgabbro and slate, demonstrating analogous zircon U-Pb ages of $130.5 \pm 0.8$and 130.0 ± 2.8Ma, respectively.

Thus, our geochronological data reveal that the Bianjiadayuan magmatic-hydrothermal system comprises discrete magmatic-hydrothermal events, which are responsible for producing porphyry, breccia, and polymetallic vein type mineralization in the studied deposit. Consequently, an integration of geological crosscutting observations and various geochronological constraints (i.e., U-Pb, Re-Os and $^{40}Ar/^{39}Ar$ methods) allows temporal discrimination between superimposed mineralization events in relatively complex magmatic-hydrothermal systems. The current new discovery and idea are helpful for local and regional exploration and targeting.