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Characteristics of veins in hornfels and their implications for exploration at the Jiama porphyry deposit, Tibet, China

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Veins are important records of events in hydrothermal deposits, which can give indications of mineralization stages (e.g., type EB, M, A, B, and D veins in porphyry systems). The Jiama deposit is a very large magmatic-hydrothermal deposit in the Gangdise Metallogenic Belt, Tibet, China. In recent years, drilling has exposed large quantities of veins in the hornfels wallrock. It is significant to observe these vein characteristics for summarizing the metallagenic characteristics of the porphyry system and guiding exploration.

The Jiama deposit is located in Gangdise volcano-magma arc belt that includes three types of orebodies: copper polymetallic orebody in skarn, copper (molybdenum) orebody in hornfels, and molybdenum (copper) orebody in porphyry. These three type of orebodies are related to the same granite porphyry at depth that has a close relationship with mineralization. Through logging of drill core, three type of veins can be recognized from early to late stage: type a (quartz + biotite halo/chlorite halo/silicified halo ± pyrite ± pyrrhotite ± chalcopyrite); type b (quartz + biotite halo/chlorite halo/silicified halo + pyrite ± chalcopyrite ± molybdenite); and type c (quartz ± pyrite ± chalcopyrite ± molybdenite). Type a veins are developed along bedding and lack well defined boundaries, with alteration haloes generally developed adjacent to the veins. This type of vein is widespread in the deposit, showing a trend from an inner biotite halo, to pyrite close to center, a silicified halo, and pyrrhotite outwards. Type b veins crosscut type a veins, also have a poorly defined boundary, and also generally develop external alteration haloes. Type c veins crosscut type a and type b veins, have a clear boundary, and there are no alteration haloes. Type b and type c veins occur close to the intrusion center, and the two type of veins contribute to more than 80% of the mineralization in hornfels. Moreover, there might still be other types of veins crosscutting type c veins near the intrusion center, but it is difficult to divide the latter types of vein in such a complicated stockwork.

Through study of fluid inclusions in veins from the porphyry and hornfels, it is considered that many of the different veins types are almost coeval. For defining the prospective area for potential magmatic-hydrothermal mineralization, it is important to observe the vein characteristics in wallrock during exploration. In most of cases, veins develop in wallrock but commonly show weak mineralization. If wallrocks develop a halo surrounding veins, particularly the veins containing high-temperature alteration minerals such as biotite, then it indicates that these are of magmatic-hydrothermal origin. Moreover, the pyrite-bearing veins are more closely associated with the porphyry intrusion center than are the pyrrhotite-bearing veins, and biotite-halo-bearing veins are closest to the porphyry intrusion center than any vein type within the alteration halo. These trends can provide evidence for guiding porphyry exploration.