Fluid Inclusion Studies of a New Type of Ore Deposit: Porphyry Tungsten Occurrence in China

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Abstract

Lianhuashan mine in South China represents a new type of tungsten ore which can be described as a porphyry tungsten deposit. It is associated with a quartz porphyry stock of Yenshanian age (about 70—135 m. y.). The ore occurs in zone surrounding the contact of the quartz porphyry with Jurassic sandstone and extends into both rock bodies. The ore occurs either as the matrix of breccia or in the form of a very fine network of cross cutting veinlets. The major tungsten minerals are wolframite and scheelite associated with sulfide minerals of Mo, Fe, Cu, Pb and cassiterite. The minerals are fine-grained. There is zoned alteration in the wall rocks. From the center of the quartz porphyry toward the wall rocks one finds: potassic alteration, silicification-sericitization, and chloritization. All these features are similar to those of porphyry copper mineralization.

Fluid inclusion studies show three types of inclusion: liquid-rich (Type I), gas-rich (Type II), and polyphase with daughter minerals (Type III) fluid inclusions. The homogenization temperatures of Type I range from 210° to 380°C, with a salinity of 2—15 wt.% NaCl equiv., those of Type II from 270° to 420°C, and those of Type III from 240° to 400°C with a salinity of 31—33 wt.% NaCl equiv. The closely associated group of gas-rich and daughter mineral-bearing fluid inclusions homogenized at almost the same temperatures. Such results indicate boiling of oreforming fluids. These fluid inclusion data indicate that low salinity (Type I) and high salinity fluids (Type III) responsible for porphyry copper deposits are the same as those for porphyry tungsten ore deposits.

These observations suggest that the Lianhuashan tungsten ore deposit is a porphyry tungsten deposit and was formed by hydrothermal fluids similar to those responsible for the well-known porphyry copper deposits.

Introduction

Porphyry-type tungsten ore deposits have not been described elsewhere in the world. The Lianhuashan mine is a typical example.

The Lianhuashan tungsten mine is located near Shantou City on the South China Sea coast of Guangdong Province (Fig. 1). It was discovered in the 1950s and all previous geological data are of proprietary nature and have not yet been published. Li Tong (1955) studied the Lianhuashan mine and concluded that it was a wolframite-scheelite sulfide ore deposit associated with a granite. Subsequently, the Lianhuashan deposit was considered to be a veinlet or disseminated ore type related to the granite. During the 1970s, data on the nature of porphyry copper deposits were introduced to China, and some porphyry copper deposits were also found in China. Chinese geologists then considered if porphyry tungsten ore deposits occurred anywhere throughout the world. Mo Zhusun and Tu Guangzhi (1973) pointed out: "It is possible to find
porphyry-type tungsten ore deposits in the South China Sea coastal region. Volcanic rocks and the youngest intrusive rocks of South China are well developed in this region since it is located near a subduction zone." They thought that some ore deposits, including the Lianhuashan deposit are indeed typical examples of porphyry-type tungsten ore deposits. In 1980, the author did a geological survey of this mine, and his data agreed with the above conclusions.

The Lianhuashan tungsten ore deposit occurs as breccia, veinlets, and disseminated ore bodies in quartz porphyry and silicarenite, and their contact zones. The pipe-shaped bodies are related to the quartz porphyry. The main ore minerals are wolframite and scheelite. The wall-rock alterations include potassic metasomatism, silicification-sericitization and chloritization. Those features are similar to those found in the well-known porphyry copper deposits in the world.

General Geology of Lianhuashan Mine

The Lianhuashan mine is located in the South China plateau near the Changle-Dongshan deep fault. In this region there are spread granite, porphyry, Mesozoic volcanic rocks, and Lower Jurassic sedimentary rocks (Fig. 2).

Igneous rocks

In the region are recognized the following rock types. They are listed in the order of formation as indicated by cross-cutting relationships: quartz-porphyry, granite, quartz-diorite-porphyry, diabase, granite-porphyry, and lamprophyre.

The ore bodies are related to the quartz-porphyry stock, which has an outcrop of 0.5 km². The modal and chemical compositions of the quartz-porphyry are listed in Tables 1 and 2. The major minerals in the quartz-porphyry are quartz, K-feldspar, muscovite and plagioclase. In the quartz-porphyry $\text{Al}_2\text{O}_3 > \text{CaO} + \text{Na}_2\text{O} + \text{K}_2\text{O}$ and