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# In-situ LA-ICP-MS trace element analysis of magnetite from the giant Beiya gold-polymetallic deposit, western Yunnan Province, Southwest China*

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The Beiya gold-polymetallic deposit is located in the junction zone of the "Sanjiang" Tethys-Himalaya orogenic belt and the Yangtze craton of SW China, and is the largest skarn-gold deposit in China. It also contains significant amounts of Fe, Cu, Ag, Pb and Zn, with an estimated reserve of 138 Mt iron (average grade: 33.3 wt.%). Although there are numerous studies on the gold mineralization, the origin of the considerable Fe mineralization is not well known. In this study, i*n-situ* geochemical analyses of magnetite have been conducted using laser ablation inductively-coupled-plasma mass spectrometry (LA-ICP-MS) to elucidate its genesis and reveal the mineralization process.

The magnetite ore bodies mostly occur in the contact zones between intrusions and the carbonate host rocks. In addition to the ore bodies, ore-related porphyry and contact zones were also selected for magnetite trace element analyses. Magnetite from the porphyry occurs as accessory minerals and is enclosed in, or is marginal to, the rock-forming minerals, suggesting a magmatic origin. It has high and stable contents of Ti and V (both higher than 1000 ppm), with higher concentrations of ΣREE relative to hydrothermal magnetite, consistent with a magmatic origin. In contrast, magnetite from the ore bodies and contact zones are significant depleted in most trace elements, with much lower contents of Ti, V and ΣREE, exhibiting the characteristics of hydrothermal magnetite [1-3]. In addition, two types of magnetite in Beiya have distinct concentrations of Sc, Ni, Zn, Ga, Ge, As, Nb, Ba, Hf and Th, suggesting different origins. Using discriminant diagrams for magnetite such as Ti+V-Ni/(Cr+Mn) and Al+Mn-Ti+V diagrams [1, 4] it is possible to discriminate different hydrothermal deposits. All of the hydrothermal magnetites from the Beiya deposit plot in the field of skarn or the overlap field of skarn and porphyry, which means the Fe mineralization in Beiya is of skarn origin.

Oxygen fugacity and temperature are both important factors that govern compositional variations in hydrothermal magnetite [5]. The extremely low V concentration of the hydrothermal magnetites indicates a relative oxidized ore forming environment in the Beiya deposit [5, 6]. The oxygen fugacity may also control the concentration of Al+Ti [6], and thus there is a positive correlation between V and Al+Ti in Beiya magnetite. Moreover, from the porphyry inner contact zone to the Fe ore bodies the concentrations of V and Al+Ti decrease gradually, reflecting an increase in the oxygen fugacity. The temperature dependence of Ti, V, Al, and Mn in magnetite can distinguish between low and high temperature mineral systems [5]. On an Al+Mn-Ti+V diagram, high temperature magnetite plots at high Ti+V and high Al+Mn values, whereas low temperature magnetite plots at low values. The temperature trend in this diagram shows that from the porphyry inner contact zone to the ore bodies, the crystalisation temperature appears to decrease gradually.

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