SEG 2017 Conference

Allanite-dominant REE mineralization in the Sin Quyen IOCG deposit, NW Vietnam

Xiaochun Li*, Mei-Fu Zhou

*The University of Hong Kong, Hong Kong, China, Email: lixiaochun86@gmail.com

The Neoproterozoic Sin Quyen deposit in northwestern Vietnam is a rare example of an allanite-(Ce)-rich IOCG-type deposit. This deposit contains economic concentrations of Cu, Au and LREE, and a subeconomic concentration of U in massive or banded replacement ores hosted by metapelite. Three main stages of alteration and mineralization have been identified, namely sodic alteration (stage I), Fe-LREE-(U) mineralization and associated Ca-K alteration (stage II), and Cu-Au mineralization (stage III). The LREE are hosted mainly in allanite-(Ce), and there are also subordinate REE-bearing fluorapatite and rare monazite-(Ce) and chevkinite-(Ce).

Based on oxygen isotope thermometry, the ore-forming fluids in stages I and II were at high temperatures, 466 to 588 ºC. The $\delta^{18}O_{VSMOW}$ values of these fluids ranged from 8.3 to 12.7 ‰, and are similar to those of magmatic zircon (7.3 to 12.4 ‰) from nearby Neoproterozoic felsic intrusions. Sulfide minerals, including chalcopyrite, pyrrhotite and pyrite, have a narrow range of $\delta^{34}S$ values near zero per mil (-0.8 to +3.1 ‰), indicating a magmatic source for the sulfur. We propose that the ore-forming fluids were dominantly of magmatic-hydrothermal origin. This involvement of magmatic-hydrothermal fluids in the ore-forming process is consistent with the temporal association between the mineralization and Neoproterozoic subduction-related magmatism in the region. The bulk ores have $\varepsilon_{Nd}(t)$ values ranging from -4.6 to -3.4, similar to those of the crust-derived, subduction-related Neoproterozoic felsic intrusions in the region.

The gangue minerals in the Sin Quyen deposit are dominated by Cl-bearing amphibole and biotite. Although minor F is also present in some minerals, F- and CO_2-rich minerals are rarely encountered. These observations are consistent with Cl-rich ore-forming fluids that have relatively low concentrations of F and CO_2. We propose that the REE and, by inference, the other metals were transported mainly as chloride complexes in magmatic hydrothermal fluids exsolved from Neoproterozoic crust-derived, subduction-related felsic magmas (such fluids are typically chloride rich). The abundance of allanite-(Ce) and scarcity of REE-fluorocarbonates and REE-phosphates (the principal ore mineral in many deposits) is interpreted to reflect the high-Cl and high-temperature nature, and high silica and calcium activity of the fluid.