Apatite and melt inclusion compositions from the Buena Vista deposit, Nevada

W Bain[a]

[a] *Department of Earth and Atmospheric Science, University of Alberta, Edmonton, Canada*

Genetic models for Kiruna-type iron-oxide apatite (IOA) deposits are controversial and span a spectrum between orthomagmatic and hydrothermal endmembers. Core to this controversy are questions regarding the mechanism for iron transport and precipitation in these systems and the role of magmatic versus hydrothermal fluids. Several recent studies have proposed hybrid orthomagmatic-hydrothermal models for IOA systems in which mineralizing fluids contain both magmatic and hydrothermal components. These models remain controversial but account for the observation of overlapping magmatic and hydrothermal features in many IOA systems and suggest that endmember systems might be rarer than previously thought.

The Buena Vista IOA deposit (Pershing County, NV) was previously characterized as an endmember hydrothermal IOA system related to the intrusion of gabbro into carbonate-bearing sedimentary rocks and the subsequent circulation of amagmatic brines around the igneous heat source. Here we present petrography, Raman analysis, and laser ablation - inductively coupled plasma - mass spectrometry (LA-ICP-MS) on apatite and apatite-hosted fluid inclusions from magnetite ore, and carbonate dikes which cross-cut the Fe-oxide orebody. Our data show that multiple generations of apatite inclusions throughout the paragenesis of the Buena Vista IOA deposit contain coexisting assemblages of brine and hematite-bearing, carbonate melt inclusions. The ubiquitous occurrence of carbonate melt inclusions is a strong indication that fluids in the Buena Vista system contained a distinctive magmatic component and that this system is not purely hydrothermal but is more akin to the hybrid orthomagmatic-hydrothermal systems described elsewhere. Furthermore, Raman and LA-ICP-MS analysis showed that carbonate melt inclusions commonly contain ~8-10 wt% Fe_2O_3 and are significantly enriched in Fe relative to coexisting brines. This data indicates that a new model should be applied to the Buena Vista system in which Fe-transport is accomplished by coexisting carbonate and aqueous fluids. The ultimate source of the carbonate fluid is unclear, but the cross-cutting relationship between gabbro and carbonates in this system offers an intriguing possibility in which carbonate melt is generated by the partial melting of evaporite-bearing carbonate rock. This scenario is supported by experimental evidence which shows that the eutectic of CaO- and MgO-bearing carbonate systems can be <600°C and possibly lower in the presence of excess H_2O and NaCl.

Corresponding author: wbain@ualberta.ca