

## Preliminary Fluid Inclusion Constraints on Fluid Evolution in the Bayan Obo Fe-REE-Nb Deposit, Inner Mongolia, China

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### Abstract

The Bayan Obo Fe-REE-Nb deposit, Inner Mongolia, China, is the world's largest REE resource and is also exploited as a major Fe oxide deposit. The deposit consists of replacement bodies hosted in dolomite marble and of magnetite, hematite, and REE minerals associated with apatite, aegirine, amphibole, fluorite, calcite, and barite. Fluid inclusions from monazite-(Ce), bastnäsitate-(Ce), apatite, aegirine, fluorite, and barite were studied from eight samples to provide new constraints on ore genesis.

During early disseminated monazite mineralization the fluids are best represented by the system H<sub>2</sub>O-CO<sub>2</sub>-NaCl, with salinities ranging from 1 to 5 wt percent NaCl equiv and X<sub>(CO<sub>2</sub>)</sub> values from 0.3 to 0.45, at temperatures of >280° to 330°C and pressures of >0.7 kbar. Fluids in apatite and bastnäsitate from the main-stage banded ores were initially aqueous, with salinities ranging from 6 to 10 wt percent NaCl equiv. They developed significant CO<sub>2</sub> contents (X<sub>(CO<sub>2</sub>)</sub> = 0.1–0.3) due to carbonate dissolution at temperatures of >400° to ~300°C and pressures of >0.9 to 1.4 kbars. Evidence for phase separation from coexisting brine and CO<sub>2</sub>-rich fluid inclusions in vein fluorite indicates pressures of 0.8 to 1.0 kbar during vein formation. These pressures can be used to infer temperatures of 430° to 460°C for aegirine alteration and of 340° to 240°C for apatite, bastnäsitate, and fluorite vein fill. Fluids responsible for aegirine alteration were dominantly aqueous, with salinities from 5 to 15 wt percent NaCl equiv, whereas those responsible for apatite and bastnäsitate mineralization had salinities of 1 to 6 wt percent NaCl equiv and X<sub>(CO<sub>2</sub>)</sub> values from 0.25 to 0.75. Inclusions in late-stage fluorite and barite have homogenization temperatures from 240° to 150° and 200° to 130°C, respectively. The general salinity trend in these inclusions suggests dilution from around 15 to 5 wt percent NaCl equiv down to very low salinities (<1 wt % NaCl equiv) during barite precipitation. Halite-bearing inclusions may indicate episodes of boiling or aqueous-carbonic fluid immiscibility.

These fluids are similar to those in some carbonatitic, alkaline igneous, and other igneous-related REE- and Fe-rich magmatic hydrothermal systems. However, they are different from fluids in igneous-related Fe oxide-Cu-Au-U-REE deposits, which have previously been compared to those at Bayan Obo.