Paper No. 36-7

Presentation Time: 2:55 PM-3:15 PM

ROLE OF OXIDIZED, SULFUR-RICH MAFIC MAGMAS FOR PORPHYRY COPPER MINERALIZATION

HATTORI, Keiko H.[1], DE HOOG, Jan C.M.[1], and KEITH, Jeffrey D.[2], (1) Earth Sciences, Univ of Ottawa, Ottawa, ON K1N 6N5, Canada, khattori@uottawa.ca, (2) Geology, Brigham Young Univ, Provo, UT 84602

Large amounts of sulfur are present in porphyry Cu deposits and their alteration haloes. We have shown that felsic magmas, having little sulfur, cannot account for large deposits and that the supply of sulfur from country rocks is not supported by $\delta^{34}S$ values, ~ 0 ‰ (Hattori & Keith, 2001). Mafic rocks associated with porphyry deposits show evidence of the transfer of sulfur and other volatiles to the mineralized felsic intrusions.

Mt. Pinatubo on the Bataan arc, Philippines, hosts the Dizon porphyry Cu mine. It is well documented that mafic magma from the mantle depth, > 35 km, triggered the 1991 cataclysmic eruption and discharge of >20 Mt SO_2. Our new data, S-speciation and spinel-olivine oxybarometry, from mafic fragments show that the mafic magma was oxidized (> NNO+1.2) and S-rich (>2,000 ppm). The fO2 was comparable with that of the felsic magma (NNO+1.6, recalculated with calib. by Scaillet & Evans). Ascent of the mafic magma caused the loss of much of sulfur as SO2 as evidenced by low sulfur (< 50 ppm) in the groundmass glass. The sulfur released from the mafic magmas was incorporated as anhydrite and late, Cu-rich sulphides in the overlying felsic magmas (~ 800 C), and also as dissolved sulfur in co-existing, aqueous fluids. Mafic magmas with high sulfur(>2,200 ppm) from other volcanoes suggest the prevalence of oxidized, S-rich magmas in the Bataan arc and that they were important for the numerous Plio-Pleistocene porphyry Cu mineralization in the arc, including Santo Tomas and Lepanto.

New data on mafic fragments contemporaneous with mineralized felsic intrusions at Bingham, Utah, show that the mafic magmas are also sulfur-rich and oxidized (~NNO+ 1) based on spinel-olivine oxybarometry. This is supported by the occurrence of early-formed barite with olivine Their ascent and injections into felsic magmas transferred sulfur from the mafic to the felsic magmas. The data from Pinatubo and Bingham indicate that: (1) the oxidized nature of mineralized felsic intrusions, which is characteristic of porphyry Cu deposits, is intrinsic, and (2) the ascent of oxidized mafic magmas is important for porphyry Cu mineralization by transferring large quantities of sulfur and other volatiles from mantle to shallow crust.

2002 Denver Annual Meeting (October 27-30, 2002)

Session No. 36
Role of Mafic Magmas in the Generation of Porphyry Copper Deposits
Colorado Convention Center: C109
1:00 PM-3:45 PM, Sunday, October 27, 2002