Pre-eruptive conditions of the Bruno-Jarbidge Rhyolite, Snake River Plain-Yellowstone hotspot track

Kuschel, Lars[1] Almeev, Renat[1] Holtz, Francois[1] Cathey, Henrietta[2] Nash, Barbara[2]
[1]Institute of Mineralogy, Leibniz University of Hannover [2]Department of Geology and Geophysics, University of Utah

We conducted an experimental study with the aim to constrain the storage conditions of rhyolitic magma of the Cougar Point Tuff, Bruno-Jarbidge eruptive center (Cathey & Nash, 2004), which is representative of the silicic magmatism of the Snake River Plain - Yellowstone volcanic province. Crystallization experiments with rhyolitic ignimbrite BJR (Unit 9j) were performed at 200 MPa in the temperature range 800 to 1000°C. The water activity ($a H_2O$) of the experimental charges was varied by adding a fluid composed of a mixture of H_2O and CO_2. At 1000°C rhyolitic melt was coexisting with magnetite in the range of all studied $a H_2O$. With decreasing temperature magnetite was followed by the crystallization of pigeonite and sanidine up to $a H_2O$˜0.5 in the system. At $a H_2O > 0.5$ and T>800°C sanidine was not stable, and pigeonite was followed by clinopyroxene. In H_2O-rich charges ($a H_2O = 0.9$) and at low temperatures only clinopyroxene and magnetite were identified to be in equilibrium with melt. At low $a H_2O$, quartz was observed at T=950°C and clinopyroxene was observed at T=900°C. At T=850°C and $a H_2O$ between 0 to 0.3 fayalite was also stable and the melt was coexisting with a maximum number of the mineral phases. The phase relationships determined experimentally can be used to bracket the conditions of crystallization of natural Cougar Point Tuff rhyolitic magmas. Natural rhyolitic ignimbrites are characterized by the presence of Pl+Fsp+Cpx+Pig+Mt+Qtz±Fa mineral assemblage. According to our data these phases may only coexist at low $a H_2O$ ($a H_2O < 0.3$), corresponding to a water content of the melt of less than 1.5 wt% H_2O. Taking the crystallinity of natural samples into account, the pre-eruptive temperature of the investigated rhyolitic magma must have been in the range 850 – 950 °C. Our new experimental results are in principal agreement with previous data (Cathey & Nash, 2004; Christiansen & McCurry, 2007; Honjo et al., 1992; Nash et al., 2006), suggesting that rhyolite magmas of the Snake River Plain are relatively hot, dry and were crystallized at low $f O_2$. Ongoing experiments at pressures 50 and 500 MPa should constrain the crystallization conditions of plagioclase.
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R. ALMEEV1, L. KUSCHEL1, F. HOLTZ1, H. CATHEY2, B. NASH2
1Institute of Mineralogy, Leibniz University of Hannover
2Department of Geology and Geophysics, University of Utah

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