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The role of magma mixing between rhyolitic and basaltic magmas in the Bruneau-Jarbidge eruptive center, Snake River Plain (USA): an experimental study

Daniele Morgavi (1), Diego Perugini (2), Cristina De Campos (1), Yan Lavallèe (1), Lisa Morgan (3), and Donald Bruce Dingwell (1)

(1) Dept. Earth and Environmental Sciences, Ludwig-Maximilians München (LMU), Theresienstrasse 41/III, 80333 München, Germany. (morgavidaniele@hotmail.com), (2) Dept. Earth Sciences, University of Perugia, Piazza Universitá, 06100 Perugia, Italy, (3) U.S. Geological Survey, 973 Federal Center, Box 25046, Denver, CO 80225-0046, USA

Volcanic and magmatic activities in the Snake River Plain (SRP) have been characterised by a rhyolitic-basaltic bimodal geochemical character. The Bruneau-Jarbidge eruptive center (BJEC; southwestern SRP) is a 95 km by 55 km structural basin formed, ca.12 to 8 Ma, by multiple eruptions of rhyolitic pyroclastic and lava flows. The rhyolitic units are intercalated with a series of basaltic lava flows (e.g. Bonnichsen et al., 2008). The BJEC is an example in which basalt underplating induced partial melting of the crust and where mantle and crustal derived melts experienced mutual interaction (Leeman et al., 2008).
The aim of this work is to study experimentally the physical and chemical interaction of basaltic and rhyolitic magmas and to evaluate whether this process can explain the variation in major and trace elements in the BJEC rhyolitc units.
According to geochemical data by Cathey and Nash (2009), Leeman (2008) Bonnichsen (1982), the Mary's Creek basalt (MCB) and the Cougar Point Tuff rhyolite unit V (CPTV) were chosen as end-members for mixing experiments. Petrographic analyses indicate that MCB is constituted by clinopyroxene, phenocrysts of plagioclase, and olivine in a glassy ground mass with micro-crystals of plagioclase. CPTV is constituted by phenocrysts of plagioclase, quartz, sanidine, elongated vesicles, in a glassy groundmass.
Chaotic mixing experiments were performed using completely molten end-members in a newly developed experimental apparatus (De Campos et al., 2010) working at constant temperature (1450°C) under controlled flow fields. The determination of the temperature dependence of the viscosity of each sample using concentric cylinder and micropenetration methods has been also performed to have full control on the rheological properties of melts. Samples resulting from the mixing experiments have been analyzed for their major and trace elements contents and compared to natural data.
Results indicate that efficient physical and chemical mixing between the end-members occurred (despite the high viscosity ratio, of the order of 10^3). This produced a strong modulation of compositional variability leading to the complete extinction of the basaltic composition and to significant compositional variations in the rhyolitic magma. The geochemical variability in inter-elemental plots display a clear similarity to the compositional variability of natural samples indicating that magma mixing can be considered as an important process to induce compositional variability in the SRP magmatism.

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