

The importance of melting of a crystalline mush on the volatile transport from an underlying intrusion

CHRISTIAN HUBER¹, OLIVIER BACHMANN²
AND MICHAEL MANGA¹

¹Department of Earth and Planetary Science, University of California, Berkeley, USA (chuber@seismo.berkeley.edu, manga@seismo.berkeley.edu)

²Department of Earth and Space Sciences, University of Washington, USA (bachmano@u.washington.edu)

The interaction between magmas with different compositions is an important process in the cycle of magmatic systems. Latent heat buffering of magmas cooling to near solidus temperatures prolongs the life of magma batches as crystalline mushes. We study the role of the crystallinity-temperature relationship in the overlying mush on the cooling, crystallization and volatile exsolution of an underplating intrusion. We solve numerically for the enthalpy coupling between the two magmas, the partial melting of the crystal mush and the volatile transfer from the intrusion into the overlying mush in one dimension. We find that the exsolution of volatiles from the intrusion rather than the permeability and melting of the mush is the limiting process for their transport. We also show that partial melting of the mush does not favor volatile transport but, rather, inhibits it by decreasing the local volatile volume fraction. We also show that one dimension models for volatile transport through a mush saturated with a wetting phase (silicate melt) do not take into account a channelization instability of the non-wetting phase (volatiles) due to capillary effects. This channelization instability localizes the volatiles and increases the mass and enthalpy transport through the mush.

First results of a new time-of-flight noble gas mass spectrometer

L. HUBER*, I. LEYA, P. WURZ AND D. ABPLANALP

Physikalisches Institut, Space Research & Planetary Sciences,
University of Bern, Switzerland

(*correspondence huber@space.unibe.ch)

Recent advances in noble gas sector field instruments comprise the development of a compressor ion source for increasing the sensitivity for light noble gases, especially He and Ne [1], and the introduction of multi-detector systems, either with multiple Faraday-Cups or Channeltrons, for simultaneous ion detection. The latter set-up has been developed to reduce analysis times and thereby increasing the accuracy of the measurements. However, compressor ion sources are technically very challenging and multi-detector systems usually suffer from alteration of the various channeltrons, which compromise precise measurements of isotope ratios and require regular calibrations. The latter usually compromises precise measurements, especially those for low gas calibrations, by producing memory in the spectrometer.

In contrast, Time-of-Flight (ToF) systems enable the measurement of the total mass spectra with high transmission (there are essentially no slits) and, depending on the length of the flight tube and the dimension of the ion source, also high mass resolution. In addition, in ToF systems background gases, which are not primary objects of the analysis but which often compromise detailed noble gas studies, are measured routinely together with the isotopes of interest. We therefore developed a new type of noble gas mass spectrometer, the first Time-of-Flight machine able to measure He, Ne, Ar, Kr, and Xe isotopes with high precision and high sensitivity in static operational mode, the EGT. The ion source of the EGT is an ion trap with a variable pulse frequency (up to a few kHz) and the detector is a self-made multi-channel plate (MCP). The overall volume of the spectrometer is less than 1000 cm³ and the (calculated) overall transmission is about 80%. At the conference we will present some of the impressive facts of the EGT, i.e., the huge dynamic range of more than 10⁶, the relatively high mass resolution of Δm/m ~700 (at Kr), the relatively high sensitivity, and its robustness. Besides the performance in the laboratory we will also present some data from the balloon experiment P-Bace, where an identical spectrometer has been used to measure atmospheric gases in about 40 km height [2].

- [1] H. Baur, *EOS Transactions, AGU Volume* **80** (46)
- [2] D. Abplanalp et al. A neutral gas Mass spectrometer to measure the chemical composition of the stratosphere, *Advances in space Research*, submitted