

Can we use variations in volatile concentrations in volcanic glass to study degassing?

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Decompression of volatile rich magma results in the exsolution of a separate gas phase. Major volatile species, H₂O, CO₂, SO₂, as well as many minor volatile species, PbCl₂, ZnCl₂, Hg, AsS etc, will be partitioned between the gas and the melt phase. However, the rate of magma ascent and eruption does not always allow for the equilibrium distribution between gas and melt of such species to be reached. Instead elements are quenched in transition towards an equilibrium that constantly changes as the magma ascends. Volatile elements can thus display diffusive profiles towards gas escape features, such as bubbles, tubes or fractures. This exploratory study aims to map out the extent of heterogeneity in rhyolitic glasses. Samples with different gas pathways, bubbles, fractures, channels and tuffsite veins have been selected and will be mapped for H₂O and selected trace metals (Cu, Zn, Bi, Pb) using synchrotron FTIR and XRF. The results of this study will allow us assess the extent to which volcanic gases can be in equilibrium with a melt shortly before eruption.

Calcium isotopes in lunar crust

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Calcium isotope compositions were determined in lunar crustal rocks in order to quantify possible mass-dependent (MDF) and mass-independent (MIF) isotope fractionation. Anorthosites show ~0.4‰ variation in δ^{44/40}Ca; pristine anorthosite 60025 has an identical value to previous reports [1] but appears to be slightly heavier than the other anorthosites (δ^{44/40}Ca=0.65–0.91‰) which may reflect a larger proportion of isotopically heavy olivine. Norite 77215 has δ^{44/40}Ca=1.06‰, which is identical to pristine terrestrial mantle rocks [2] and likely represents a mixture between isotopically light plagioclase and heavy orthopyroxene. In general, anorthosites and norite mimic the range of terrestrial and Martian basalts [2–4] as well as lunar low-Ti and high-Ti lithologies [4]. The δ^{44/40}Ca uniformity of lunar crust and mantle-derived rocks is dissimilar to the Ca systematics of major terrestrial reservoirs with predominantly light Ca isotope signature in continental crust and may suggest cessation of magmatic activity early in the lunar history without further material exchange with deeper parts of the Moon. A tight negative correlation of δ^{44/40}Ca with K contents could reflect either the chemical development of the magma ocean or a collateral effect of immiscibility between Ca and K feldspars. However, only a detailed experimental investigation could provide tight constraints on the role of plagioclase in lunar Ca budget. This may be particularly important for the Moon considering that, in contrast to the Earth where >99% Ca budget is dominated by mantle, lunar crust is a significant Ca repository and hosts ~11% of the total lunar Ca. New data for lunar mare basalts coupled with data for anorthosites could help constrain the lunar Ca evolution in the context of lunar magma ocean crystallization.

The MIF effects are indiscernible for individual Ca isotopes in all investigated lunar rocks in this study. This is in agreement with previous findings for some Solar System material [5–7]. In particular, lack of resolvable MIF variations in lunar samples may imply Ca isotope homogeneity on the planetary scale.

[1] Farkaš *et al.* (2010) *LPSC* **41**, #2266; [2] Amini *et al.* (2009) *GGR* **33**, 231-247; [3] Huang *et al.* (2010) *EPSL* **292**, 337-344; [4] Simon & DePaolo (2010) *EPSL* **289**, 457-466; [5] Huang *et al.* (2010) *LPSC* **41**, #1379; [6] Moynier *et al.* (2010) *ApJ* **718**, L7-L13; [7] Simon *et al.* (2009) *ApJ* **702**, 707-715