Volatile species heterogeneity in basaltic glasses determined by SIMS and Imaging FTIR

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The analysis of volatile species in basaltic glass has been performed by a number of techniques in recent years to directly determine volatile contents present during the generation and evolution of magmatic systems. Analyses have ranged from micron-scale to bulk sample techniques, and yet the reproducibility of results between techniques remains uncertain, obscuring any small-scale variation in volatile species contents.

Here, we present volatile element data from an arc glass from the Southwest Pacific Kermadec Arc – Havre Trough convergent margin, and a glass from the Mid-Atlantic Ridge. Analyses were undertaken using two microanalytical techniques: imaging Fourier Transform Infrared Spectrometery (FTIR), at the Institute for Frontier Research on Earth Evolution, Japan Marine Science and Technology Center, Yokosuka, Japan; and Secondary Ion Mass Spectrometry (SIMS), at the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

Water, C, F, S and Cl were analysed by SIMS for each glass along several transects, comprising up to 50 analyses on 20 micron diameter areas. Transects were from the glass rim to the groundmass interior, and between vesicles to investigate any remnants of degassing of volatiles at rim margins and through vesicles. Infrared 4-D spectrochemical images of species of water (molecular and OH^-) and carbon (CO_3^-) were then obtained by FTIR along the SIMS transects. The data obtained consist of 4096 spectra over the frequency range 900-4000 cm^{-1}, and over two spatial dimensions covering an area 400 microns by 400 microns, with a spacial resolution of 6 microns. Using these techniques, we can obtain a direct comparison of analytical results from both methods on the same analytical areas, and use this to constrain volatile species heterogeneity at the micron-cm scale.