Determination of water concentration in volcanic glasses using Laser Induced Breakdown Spectroscopy (LIBS)

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Improvements in Laser Ablation for material sampling over the past few decades have led to the emergence of several applications of this in-situ technique to some important geochemical measurements. The technique is commonly used for both elemental [1] and isotopic analyses [2], and has multiple advantages compared to dissolution techniques, notably higher spatial resolution, easier and faster sample preparation, and for many applications it is a non-destructive method. A significant advantage of this technique in geochemistry is full characterization of a sample (e.g., glass or mineral) using a single spot of limited size (i.e., 20-80 μm) to eliminate or minimize complexities due to potential chemical zonations. Major advancement is being realized in the analysis of volcanic glasses for their elemental and volatile concentrations using a new approach that combines the capabilities of the two most common laser ablation techniques – Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) and Laser Induced Breakdown Spectroscopy (LIBS). LIBS is based on direct measurement of the optical emission originating from the laser-induced plasma [3] whereas LA-ICP-MS involves transport and excitation of the ablated aerosol to a secondary source (ICP), before entering a mass spectrometer [4].

Analysis by these two techniques can complement each other quite well, as every laser pulse for ablation provides the optical plasma for emission spectroscopy and particles for ICP mass spectrometry. We will present data demonstrating that H_2O concentrations in volcanic glasses can be determined accurately and precisely using LIBS (2-3% external RSD with 60 μm spot size), which is not possible using only LA-ICP-MS but now achievable with the tandem LA-ICP-MS/LIBS technique.

[1] Longerich *et al* 1996, *J. Anal. Atom. Spec.*, **11**, 899-904. [2] Gerdes and Zeh, 2009, *Chem. Geol.*, **261**, 230-243. [3] Russo *et al* 2008, In *Laser Induced Breakdown Spectroscopy*, p. 49-79. [4] J. Koch and D. Gunther, *Applied Spectroscopy*, 2011, **65**, 155–162.