Microanalysis of Cl, Br and I in apatite, scapolite and silicate glasses by LA-ICP-MS

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The distribution of the halogens in geological systems is important as they trace the transport of volatiles. We present a new LA-ICP-MS method for the determination of Cl, Br and I in apatite, scapolite and silicate glasses. The technique offers rapid, spatially resolved data acquisition using widely available instrumentation and the data reduction software Iolite. Protocols were developed using five well known apatite occurrences [1], three gem quality scapolites [2], MPI-DING glasses and two USGS doped basaltic glasses. Cross-calibration of selected samples was achieved using combustion ion chromatography (CIC). Results are compared with available data obtained using LA-ICP-MS, SIMS, EMPA, TXRF, INAA and the Noble Gas method to offer insights into sample homogeneity and recommendations for analytical 'best practice'.

Halogen data were acquired using a Teledyne Photon Machines Analyte G2 193 nm Excimer laser ablation system coupled to a Thermo Scientific iCAP Qc ICP-MS. The sampled material was transported via an Aerosol Rapid Introduction System (ARIS). Ablation parameters comprise a 50 Hz repetition rate, 2.75 J cm^{-2} laser energy, 30 – 85 μm square spots and 20 s acquisition time. Extended analyte dwell times of up to 250 ms were employed to improve sensitivity and signal stability. A duty cycle of 1 s was achieved though a restricted analyte list (^{35}Cl, ^{79}Br, ^{81}Br, ^{127}I, ^{39}K, ^{32}S, ^{43}Ca), with external standardisation using matrix matched materials.

Limits of detection are on the order of 400 μg/g Cl, 10 μg/g Br and 500 ng/g I. We demonstrate the capability of the method through the determination of halogen concentrations in glassy ol-hosted melt inclusions and in apatite crystals in sub-volcanic lamprophyre.

[1] Chew et al. (2014). Geostand. Geoanal. Res., 38, 23-35.
[2] Kendrick et al. (2013). Geochim. Cosmochim. Acta, 123, 150-165.