Detection of H in spinel-structured oxides via SCAPS isotopography

DANIEL A. COULTHARD JR.[1], NAOYA SAKAMOTO[2], GEORG F. ZELLMER[1], MORIHISA HAMADA[3], HISAYOSHI YURIMOTO [2,4]

[1]Volcanic Risk Solutions, SAE, Massey University, Palmerston North, New Zealand (correspondence: d.a.coulthard@massey.ac.nz)

[2]Isotope Imaging Laboratory, Creative Research Institution, Hokkaido University, Sapporo, Japan

[3]Research Institute for Marine Geodynamics, JAMSTEC, Yokosuka, Japan

[4]Japan Aerospace Exploration Agency, Sagamihara, Japan

Spinel-structured oxides (spinels) are near ubiquitous components of ultramafic-intermediate igneous systems. The ability of these nominally anhydrous minerals to host trace concentrations of hydrogen is difficult to assess, as the detection of hydrogen in iron-bearing spinel cannot be achieved through standard spectroscopic methods due to the strong interference of tetrahedrally coordinated ferrous iron on the OH band region [1].

Using internally-heated pressure vessels, spinels were synthetically equilibrated for < 6 hours with hydrous basaltic and boninitic melts at 2 kbar. Temperatures ranged from 1100 to 1200°C, with oxygen fugacities buffered between *c*. NNO-1 to NNO+4.8.

To image and quantify secondary ion intensities distributed between spinel and adjacent glass, run products were analysed via a stacked CMOS active pixel sensor [2] attached to a secondary ion microscope.

Spinels exhibit distinct secondary ion intensity characteristics. In some crystals, trace concentrations of hydrogen have partitioned into the spinel structure.

In basaltic melts, the recrystallization of magnetite into a complex spinel solid solution has resulted in crystals that return higher observed OH intensities than chromite in boninitic melts, which did not react with melt in the same manner and do not yield detectable OH signals. These positive and negative examples demonstrate the capability of secondary ion mass spectrometry to detect water in nominally anhydrous spinel. Quantification of hydrogen contents will employ relative sensitivity factors, cf. Zellmer et al., this meeting.

[1] Lenaz et al., *Geo. et Cosmo. Acta*, 72 (2008)

[2] Yurimoto et al., *App. Surf. Sci.*, 203-204 (2003)