Microanalysis for oxygen fugacity by SIMS: Development and application to ilmenite

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We are working to develop, refine, and apply a new microanalytical technique to directly measure the activity of oxygen on ilmenite crystals retrieved from kimberlites. The technique uses secondary ion mass spectrometry (SIMS) to study relative proportions of M^+ and MO_x^+ ions as an indicator of oxygen activity, following on an earlier study [1].

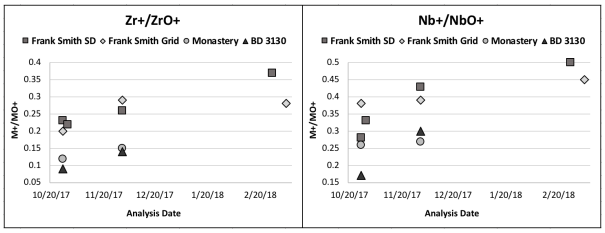

Figure 1: M^+/MO^+ ion ratios at the MO^+ peak for zirconium and niobium. The two Frank Smith samples represent different fragments of Frank Smith ilmenite mounted in two different sample mounts. Both were analyzed to test for sample heterogeneity.

Discussion of Results

The ilmenite samples analyzed were compared for their M^+/MO^+ ion ratios which allow us to classify (relativly) oxidized and reduced ilemnites (Figure 1). Absolute values of ion ratios for each sample have varried from session to session as we modified (slightly) our approach, including the exact energy bandpass and the mass resolving power applied.

The measurements on three mantle-derived ilmenite samples shows different behavior for Zr and Nb (as well as ZrO and NbO) energy spectra, suggesting that each formed under different oxygen fugacities.

Relative variations in oxygen activity can be suggested but not confirmed because ilemnite standards formed at known fO_2 are not available. However, even the implication of relative differences represents a significant step toward a technique where absolute values of oxygen activity can be obtained.

A complete discussion of the importance of these results will be made once further analyses have been completed.

[1] Williams & Hervig (2000) *Secondary Ion Mass Spectrometry (SIMS)* **12**, 139-142.