Quantification of Hydroxyl, Major Element and Trace Element Concentrations in Oxide Glasses by Quadrupole SIMS.

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Major and trace element calibrations have been established for positive and negative secondary ions measured by Quadrupole SIMS. A Cs+ primary ion beam is used exclusively and element secondary ions are measured directly, not by the MCs+ method. This affords greater sensitivity and is better matched to the operating characteristics of a quadrupole mass spectrometer than by using MCs+ for positive ion species only. Both natural well-studied geologic glasses and Corning research glasses that have been thoroughly characterized have been used to establish the calibrations.

The CAMECA 4550 Quadrupole SIMS is well-suited to measurement of oxide glasses. Charge-compensation is easily achieved for a Cs+ primary beam on uncoated samples of almost any size. This allows the measurement of concentration of species in the surface of glass (from a few nanometers to several micrometers) that can have a significant impact on the physical and chemical durability of the glass. Because oxide glasses contain oxygen as their major element both positive and negative ions can be generated by sputtering with Cs. Although the use of a Cs primary ion beam is generally associated with measurement of negative secondary ions or the use of MCs+ secondary ions, the presence of oxygen in the glass allows production of a significant quantity of positive ions yielding linear calibrations for species that typically would produce positive secondary ions with an oxygen primary beam. Of course, secondary negative ions are produced as well and for the appropriate elements and small molecular ions yield linear calibrations as well. An example calibration is shown in Figure 1.

Detection limits and details of the calibrations will be shown and discussed and examples-measurements of near surface composition changes in various oxide glasses will be shown. Connections of surface chemistry to other glass-properties will be made and explained.

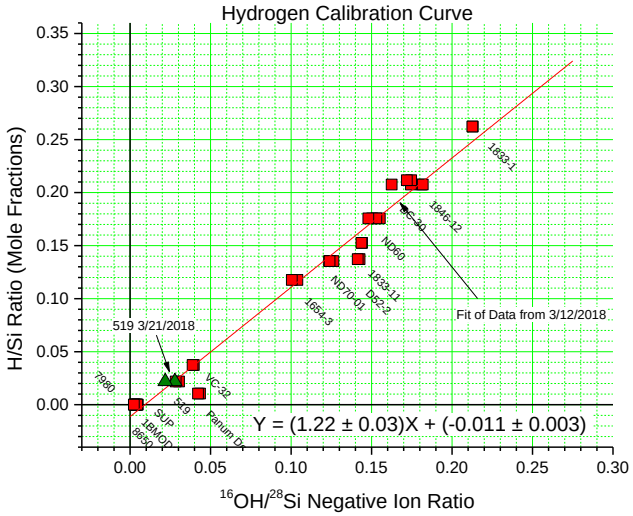

Figure 1. Quadrupole SIMS Calibration Curve for H in oxide glasses.