A combined “top down” and “bottom’s up” approach to crystal records: Chemical and textural quantification of crystal populations at Mount Hood, Oregon

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Crystal populations carry important information regarding the nature and evolution of mgamatic systems. We present results from Mount Hood, Oregon, where we combine quantitative characterization of crystal populations using crystal size distributions (CSD) with *in situ* trace element analysis of individual crystalline phases. This powerful approach allows us to use CSD to recognize populations of crystals with common histories, and to use trace element compositions to examine the origin of individual populations.

Mount Hood consists primarily of andesitic lavas and associated rocks, and the current edifice has grown over the last ~500 ka. Eruptive products are remarkably homogeneous, >80% of lavas have SiO_2 between 57-63 wt.%, although textural and chemical trends suggest extensive magma mixing and mineral-melt disequilibrium throughout the lifetime of the volcano.

CSD of plagioclase are remarkably consistent. Five out the six lavas studied, ranging in age from 475 ka to 200 years, show concave up CSD, with two distinct line segments characteristic of two distinct crystal populations. We interpret this to reflect mixing of two magmas and this is supported by trace element analyses. Plagioclase from the smaller plagioclase population are enriched in Sr and Ti and depleted in Ba and REE for a given anorthite content, consistent with crystallization from relatively mafic magma. The larger population have lower Sr and Ti and crystallized from more evolved magmas. Crystal residence times are several decades for the larger felsic-derived population and <10 years for smaller crystals. Moreover narrow rims (< 50 µm) on larger crystals have trace elements compositions that match the smaller mafic crystal population. Thus we suggest that mixing occurred late and probably immediately prior to eruption. Overall Mount Hood has been characterized by repeated episodes of mixing between felsic and mafic magmas followed rapidly by eruption. The near constancy of this mixing over ~475 ka implies long term steady state behavior of the magma supply system

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Incorporation of Te and Se into ferromanganese (oxyhydr)oxides: The XAFS evidence

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Introduction

Tellurium is found enriched (relative to the continental crust) in marine ferromanganese (oxyhydr)oxides (FMO) by factors of ~5000-50000, much higher than any other element including its chemical homologue, Se. We have attempted to investige the mechanism(s) of Te incorporation and its enrichment in FMOs by probing in atomic enviroment using X-ray Absorption Fine Structure (XAFS) spectroscopy and compare the result to that of Se. We report the preliminary findings of the XAFS studies done on a FMO sample and laboratory adsorption experiments of Te and Se on Fe and Mn-oxides.

Results and Discussions

Tellurium K-edge XAFS measurements were carried out at the beamline BL01B1 at SPring-8 (Hyogo, Japan) and Se measurements were made at Photon Factory KEK (Tsukuba, Japan). Data analysis was done using the software REX2000 (Rigaku Co. Ltd.) following standard procedures.

The Te-XANES spectra of AD-14 show that it is roughly similar to that of $Na_2H_4TeO_6$ (w.r.t position of absorption edge energy and shape of spectrum), indicating that Te exists in +VI state in the FMO. This suggests that Te is incorporated into FMO from seawater as +VI and/or oxidized (on Fe (Mn) oxides) to +VI from +IV, after its incorporation. Both (+IV and +VI) states exist in seawater. Lower abundance of Se in FMO restricts the Se-XANES measurement.

The EXAFS spectra of samples reveal that Te and Se are linked to O in their first shell and Fe on their second shell. This probably suggests that under oxic marine conditions oxyanions of Te and Se are adsorbed onto the surfaces of FMOs and are associated with Fe-oxide phase. Eh-pH diagrams, pK values of their oxyanions, in conjunction with the preliminary XAFS data show that Te is enriched in FMOs because of the formation of strong inner-sphere complexation of Te at both +IV and +VI states with Fe as compared to the thermodynamically stable and dominant species of Se in seawater, Se(+VI), which prefers outer-sphere complexes.

We need to investigate in more details by performing laboratory experiments on adsorption of Se and Te on Fe- and Mn-oxides and, careful analyses of more natural FMO samples to corroborate our preliminary findings.