Using Melt Inclusions to Constrain Magma Evolution and Pre-eruptive Plumbing System Architecture of Mutnovsky Volcano, Russia

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Melt inclusions provide much more detailed samples of melt compositions than can be accessed with whole rock analyses alone. As such, melt inclusions have become an increasingly powerful tool for improving our understanding of magmatic processes owing to their ability to record discrete time steps during the polybaric and polythermal evolution of a particular magmatic system. In this study, we report and discuss melt inclusion data for samples from Mutnovsky Volcano, located on the Kamchatka island arc, that elucidate the causes for compositional diversity, and the iterative assembly of the pre-eruptive subvolcanic magma chamber.

Mutnovsky has formed a series of four stratocones over its ~100 ka history. Erupted rocks are dominantly basalt and basaltic andesite, and also include andesite, dacite and rhyodacite. We analyzed melt inclusions from all erupted compositions and eruptive centers to investigate the causes of the compositional heterogeneity, melt evolution, and pre-eruptive magma storage system. Melt inclusion compositions range from low silica (44 wt. %), hosted in olivine and clinopyroxene and plagioclase, to high silica (78 wt. %), hosted mainly in plagioclase and orthopyroxene. The melt inclusion compositions span a wider range than whole rocks. Geochemical modeling of the melt inclusion data, combined with field evidence and plagioclase phenocryst zoning, indicate that fractional crystallization and magma mixing operated in tandem to produce compositional diversity of the rocks erupted at Mutnovsky. The data are consistent with a model wherein fractional crystallization of individual aliquots of magma in an evolved subvolcanic magma chamber drove the melt(s) toward more felsic bulk compositions. Textural and compositional evidence also indicate that the subvolcanic magma chamber was effected by periodic injection and admixture of new olivine- ± clinopyroxene-saturated basaltic magma. This finding is consistent with observations from other volcanic systems.

The new twist that we employed was to calculate apparent pressures and temperatures of entrapment of orthopyroxene- and clinopyroxene-hosted melt inclusions by using the chemistry of melt inclusions and host mineral with the mineral-liquid thermobarometry equations from [1,2]. The results suggest that orthopyroxene and clinopyroxene crystallized at distinctly different levels in the magma plumbing system, which allows us to assess the variation in melt compositions as a function of vertical position in the evolving magma plumbing system. We will discuss these results, and the role that post-entrapment modification of melt inclusions may have on the model thermobarometry results, in the context of the iterative assembly and evolution of crustal magma chambers.

[1] Putirka et al. (2003) *American Mineralogist* **88**, 1542-1554. [2] Putirka (2008) *Reviews in Mineralogy and Geochemistry* **69**, 61-120.

Magnetic, mineralogical and geochemical (μXRF) properties of a central Baffin Bay sedimentary sequence spanning the last 100 ka

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A terrigenous sedimentary sequence from central Baffin Bay (core HU2008-029-016PC – 70°46.14'N/-64°65.77W – 2063 m) was analyzed for its magnetic, mineralogical and geochemical (μXRF - Itrax) properties in order to 1) link the sedimentary history to ice-margin dynamics along the surrounding coastlines (W. Greenland, E. Baffin Island and N.E. Ellesmere Island), and 2) eventually associate the continental ice dynamics to specific climate events of the last glacial cycle. A chronology based on relative paleointensity (RPI) and paleomagnetic secular variation (PSV) has been set. It provides an age model for a site where current chronological approaches (^{14}C and isotope stratigraphy) failed for various reasons. This age-model indicates a mean sedimentation rate of ~6.5 cm/ka, but also illustrates increases (> 15 cm/ka) linked to major sedimentological events of local origin. The timing and properties of these sedimentological events are discussed with special emphasis on their source and mode of deposition, as well as their linkage with specific ice margin responses to climate changes along surrounding islands. On one hand, coarse-grained and rapidly-deposited detrital carbonate-rich layers seem broadly coeval with major interstadials of the GISP2 ice core record. This suggests fast retreat episodes along related ice-stream routes during major interstadials. Rock magnetic data point to coarser magnetic grain size in these layers. This is especially the case during the 11– 12 ka (~YD) and 14.8–16 ka (H1) intervals. On the other hand, feldspar-rich layers also depicting high clay and silt size material contents are characterized by a finer magnetic grain size in the pseudo single domain to single domain ranges. Magnetic grain size ratios such as k_{ARM}/k_{LF} and Fe/k_{LF} show finer magnetic grains during the locally extendedLast Glacial Maximum interval (16 – 24 cal ka BP). This suggests that, during glacial maxima, mechanical grinding of the bedrock by surrounding ice sheets (in particular along the continental shelves of Greenland and Baffin Island) released large amounts of “glacial flour” characterized by feldspar-rich and finer magnetic supplies.