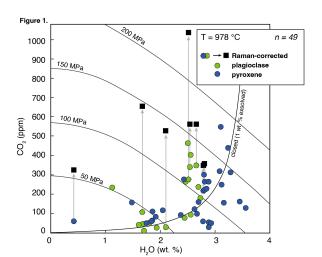
## Redoubt 2009 revisited: A melt inclusion volatile perspective on staging and degassing of early erupted andesite

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Redoubt Volcano is a frequently active, very high threat<sup>[1]</sup> stratovolcano located in the Cook Inlet near Anchorage, Alaska. Here, we present pre-eruptive volatile concentrations measured within melt inclusions (MIs) for two early explosions (events 5 and 6) from the 2009 eruption. These measurements are the first for any Alaska-Aleutian volcano to incorporate both glass and vapor bubble volatiles in plagioclase- and pyroxene-hosted MIs, and thus enable us to present direct petrologic storage pressure estimates and context for surface gas emissions. Volatile contents (H<sub>2</sub>O, CO<sub>2</sub>, S, Cl, F) in MI glass were measured by secondary ion mass spectrometry, with vapor bubbles analyzed by Raman spectroscopy to constrain total CO<sub>2</sub>. Electron probe microanalysis was conducted on groundmass glasses and a subset of MIs. MI glasses are highly evolved (70.0-77.5 wt.% SiO<sub>2</sub>) and contain 0.42–3.56 wt.% H<sub>2</sub>O<sub>2</sub>, 9–548 ppm CO<sub>2</sub>, 9–400 ppm S, 586-6851 ppm Cl, and 121-1157 ppm F. Co-erupted groundmass glass exhibits S up to 260 ppm and Cl concentrations from 670-2300 ppm. Raman spectroscopic measurements of MI vapor bubbles reveal additional CO<sub>2</sub> contributions of 100-950 ppm, doubling melt CO<sub>2</sub> estimates and yielding maximum reconstructed MI CO<sub>2</sub> concentrations of 1030 ppm (Figure 1). Solubility model-derived MI entrapment pressures, factoring in vapor bubble CO2 concentrations when available, range from ~50-235 MPa, in general agreement with seismic<sup>[2]</sup> and geodetic<sup>[3]</sup> constraints, and extending current petrologic estimates (90-160 MPa)<sup>[4]</sup> by up to 75 MPa. Mass balance calculations suggest that melt CO2 and S account for <15% of cumulative gas emissions from the erupted 2009 magma, while observed gases were much richer in CO2 and S. This requires an alternative volatile source for gas emissions, such as an excess fluid phase or gas sparging from a deeper, unerupted mafic magma. Further integration of MI and gas data

- will facilitate the development of a robust degassing model for the 2009 eruption of Redoubt.
- [1] Ewert et al. (2018), USGS Scientific Investigations Report 2018-5140, 1-40.
- [2] Power et al. (2013), JVGR 259, 31-44.
- [3] Grapenthin et al. (2013), JVGR 259, 115-132.
- [4] Coombs et al. (2013), JVGR 259, 349-372.



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