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Experimental investigation on the effect of Cl in Martian basaltic systems

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Chlorine is abundant across the surface of Mars, as shown by GRS global maps, in situ rock analyses, and studies of Martian meteorites. The source of chlorine may be volcanic outgassing (i.e., acid fog), so we have been investigating Cl outgassing through high p-T experiments. We have determined liquidus phase equilibria for a Mars-analog basaltic composition without and with chlorine, and will extend this work to chlorine solubility and degassilng behaviour.

Our work has shown that Cl depresses the liquidus p and T of our Mars-analog basalt far more than equi-molar H2O does. This result is consistent with other studies that show Cl in basaltic melts forms complexes with low-valent cations (Fe, and probably Mg, Ca & Na). This complexation increases silica content of magma outside the complexes, and leads to greater silica saturation and polymerization. In turn these effect yield a lower liquidus T and increased stability of pyroxene. Therefore, small amounts of Cl in the Martian mantle will enable production of basalts at lower temperatures and pressures.

Ongoing experiments are investigating the solubility limits of Cl in Martian basaltic systems. These experiments will constrain the volatile budget of the Martian interior and the Cl-content being removed from the mantle through basalt genesis. Further once Cl-solubility is reached excess Cl will react with the basalt producing a brine. These experiments will place constraints on the availability of Cl for surface alteration models (i.e. acid fog models).

In summary experiments conducted have shown that Cl has large effects on Martian basalt phase equilibrium and degassing and Cl may play a larger role in Martian basalt

genesis and mobility than in typical terrestrial basaltic systems.