



Reactive solubility approach to the dissolution of halogens in basaltic melts

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Partitioning of halogens between gas and basaltic melts at 1200-1265°C and 10-2000 bar (Alletti, 2008) has been analyzed in detail by means of the CTSEFG model (Moretti and Ottonello, 2005) in order to: 1) evaluate redox conditions consistent with related experimental information such as P_{H_2} and S^{2-}/S^{6+} ratio, 2) estimate the relative abundance of H_2O , CO_2 , KCl , $NaCl$ and HCl of the gas phase, 3) investigate the solubility mechanisms of chlorine and fluorine in (basaltic) melts. For chlorine-based runs, it was found that for input $[Na+K]/Cl$ atom ratios > 0.45 the proportion of gaseous $NaCl$ and KCl exceeds that of HCl . In terms of solubility mechanisms, halogen chemical reactivity can be assessed in terms of dissolution into the melt as chloride or fluoride ion, i.e. Cl^- and F^- . A complementary solubility mechanism can be invoked to improve the precision and explain somehow unexpected features, such as i) a P-independent background values of halogen solubility, and, for chlorine only, ii) a $X_{Cl,melt}$ -squared dependence shown by Cl dissolution. In this additional mechanism, undissociated alkali-halogenides dissolve in the melt up to a solubility limit which depends on structural conditions, i.e. on melt composition for the same T. Although this could be a fascinating hypothesis, somehow recalling the concentration limits of Henry's law behavior for trace element dissolution into minerals, it is then questioned whether this may reflect or not mixing of a molten salt-like component with the silicate melt.

Partition coefficients derived from equilibrium constants of reactions involving Cl^- and F^- show well the role of water vapor as stripping agent of chlorine. Therefore, the more the CO_2 in the system, the more the amount of chlorine getting dissolved

into the melt phase.