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CO_2 degassing in ascending magmas: from MORBs to kimberlites.

Bertrand Guillot, Nicolas Folliet, and Nicolas Sator
Lab. Phys. Theor. Matière Cond., Univ. Pierre et Marie Curie (Paris 6), Paris, France (guillot@lptmc.jussieu.fr)

Kimberlites and MORB samples exhibit very different CO_2 contents (generally much less than 1wt% CO_2 for MORBs and up to 15 wt% or more for kimberlites). For MORBs a majority of the CO_2 content is found in the vesicles whereas for kimberlites it is dissolved in the groundmass. These differences in CO_2 abundance are assigned to a large variation of the CO_2 solubility with melt composition. However, the composition of MORBs is well established while that of kimberlite magmas is badly constrained due to alteration. Recent studies (Canil and Bellis, 2008; Sparks et al., 2009; Brooker et al., 2011) have suggested that primary kimberlite magmas originally had lower SiO_2 contents than the commonly reconstructed compositions, and that the latter ones could be *transitional* between silicate ($\geq$25 wt% SiO_2) and carbonate ($\leq$5wt% SiO_2) melts. Indeed, CO_2 solubility data suggest that a melt composed of 25-35 wt% SiO_2 (as estimated in reconstructed compositions) should be almost fully degassed in CO_2 when the magma enters the root zone of kimberlites ($\sim$1-2 kbar) whereas the observed CO_2 abundance mostly exceed 10 wt% CO_2. This has prompted us to investigate by molecular dynamics (MD) simulations the degassing trajectory of CO_2-rich silicate melts of various composition ascending adiabatically. In using a force field recently developed by us to describe CO_2-bearing silicate melts (Guillot and Sator, 2011), we have simulated three magma compositions in the CO_2-CMAS system: a basaltic (with $\sim$49 wt% SiO_2 on a volatile free basis), a kimberlitic ($\sim$36 wt% SiO_2) and a *transitional* ($\sim$13 wt% SiO_2) composition. In considering a CO_2-rich source region located at 250 km depth in the astenosphere (T_p $\sim$1450°C), the three CO_2-saturated magmas are then decompressed adiabatically in the course of the MD simulation. The adiabatic expansion of the melts induces at once a cooling effect and a CO_2-degassing which are consistent with observations. In particular, our simulations show that only the *transitional* composition accounts for the high CO_2-content found in the groundmass of kimberlites.

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