Carbonate melt mobility in the upper mantle

X. RITTER[1]* AND C. SANCHEZ-VALLE[1]

[1]Institut für Mineralogie, Westfälische Wilhelms-Universität. (*correspondence: xenia.ritter@wwu.de)

Recent estimates suggest that almost all subducted carbon may be extracted from the subducting slab as hydrous carbonate-rich melts and fluids, which are released into the overlying mantle wedge, act as metasomatic agents in the lithospheric mantle, or may be parental magmas for kimberlites [1,2,3,4,5]. Knowing the physical properties (i.e. density and viscosity) of these carbonate-rich melts are key to understand the buoyancy relations compared to the surrounding mantle rock, the melt mobility or entrainment, upward migration back to surficial reservoirs, and thus, comprehend the role of carbonate-rich melts in the recycling and storage of carbon in the deep Earth.

Here we present densities and viscosities of carbonate-rich melts whose compositions cover broad geological settings: from incipient melts of subducted metapelites, near-solidus melts of metasomatized carbonated lherzolites, eclogites, or peridotites to common intrusive magnesiocarbonatites. Densities were determined by a combination of experiments using the synchrotron in-situ X-ray absorption method in a Paris-Edinburgh press and classical molecular dynamics simulations. We report for the first time equations of state for all measured carbonate melt compositions up to upper mantle conditions, determine pressure-dependent melt migration rates on their way back to shallow depths, place constraints on compositional effects on melt compressibility, quantify the influence of water on the alkaline carbonate melt compressibility and mobility, and evaluate the the role of partial molar volumes of dissolved water and carbon dioxide in carbonate melts.

This study provides not only a systematic dataset of density and viscosity values for carbonate-rich melts in a wide P-T regime, it also offers detailed insights into the role of these melts in the deep carbon cycle.

[1] Giuliani *et al.* (2012) *Geology* **40**, 967-970. [2] Kelemen and Manning (2015) *Proc. Nat. Acad. Sci.* **112**, E3997-E4006. [3] Russell *et al.* (2012) *Geology* **481**, 352-356. [4] Green and Wallace (1988) *Nature* **336**, 459-462. [5] Poli (2015) *Nat Geosci* **8**, 633-636.