The migration of carbonate melt in mantle

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Carbonatitic melts are often invoked as a major metasomatic agent in the upper mantle because of their unique chemical and physical properties. Recent experimental studies demonstrate that $NaCO_3$ melt can percolate very quickly in mantel peridotite (Hammouda and Laporte, 2003) and responsible for the origin and rapid asending of kimberlitic magma (Russell et al., 2012). However, high pressure and high temperature partial melting experiments indicate that mantle derived carbonate melt is mainly composed of $CaCO_3$ and $MgCO_3$ (Dasgupta and Hirschmann, 2007; Dalton and Presnall, 1998). Here we report infiltration experiments of dolomite-melt ($CaCO_3$:$MgCO_3$~1:1) in harzburgite, which demonstrate that the infiltration rate of such melt is much lower than that of $NaCO_3$. Dolomite-melt can travel over several kilometers in 1-10my, which far away from accounting for the rapid ascending of kimberlite (Sparks et al., 2006; Peslier et al., 2008), at pressure of 1.5GPa and temperature over 1400°C. The infiltration rate is greatly decreased with decreasing temperature and kinetically controlled by cation diffusion and dissolution of orthopyroxene in the melt. Meanwhile, it is found that dolomite-melts are preferred to disseminate in the surrounding mantle. Our experimental results didn't support the hypothesis, which suggest that melts parental to kmberlite originate as carbonatitic or near-caronatitic melts.