EXPERIMENTAL INVESTIGATION OF THE EFFECT OF METASOMATISM BY CARBONATE MELTS ON THE MINERAL AND CHEMICAL COMPOSITION OF THE DEEP UPPER MANTLE.

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We obtained additional evidence confirming that some inclusions in diamonds from Brazil and China originated in the lower mantle. The same inclusions required rapid, single-stage transport by kimberlitic melts to the Earth's surface, in support of the lower-mantle origin for these melts. Since the carbonate melts originating in the lower mantle are not kimberlitic in composition, exchange of material between the melts and the mantle is necessary for these melts to become kimberlitic by the time they reach the surface. The resulting metasomatism taking place over a long period of time could modify to an unknown degree the mineral and chemical composition of the upper mantle. We have conducted experimental studies at 4 - 24 GPa to quantify the effects of metasomatism by percolating carbonate melts on the upper mantle. These include experiments in simplified carbonate systems, such as Mg_2SiO_4-K_2SiO_3-K_2CO_3-Na_2CO_3, as well as in complex natural systems, such as the study of melting relations of a primitive kimberlite and the studies of chemical interactions between carbonate melts and peridotite or basalt. Experiments are also carried out to investigate the role of carbonate melts in the petrogenesis of diamonds and peralkaline rocks. The process of metasomatism appears to have the potential of producing compositional heterogeneities in the mantle, and could operate continuously in the course of the Earth's history to generate and maintain such heterogeneities even in a highly dynamic Earth. Our results will be used to evaluate the potential significance of this process in the evolution of the upper mantle.