Mechanism of melt migration in the earth mantle studied by melt migration experiments

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Melt migration mechanism in partially molten rocks is mainly driven by gravity in a macro scale. Equations which describe these processes are established by Mckenzie (1984JPet), as a compaction theory. On the other hand, melt migration is mainly driven by capillary forces in a laboratory scale, and is almost free from the influence of gravity. Riley and Kohlstedt (1991EPSL) proposed an extended compaction theory, which includes the effect of the capillary forces. Further, they carried out melt migration experiments of felsic melts into olivine aggregates, and then compared with the results of numerical simulations of melt migration. These works showed that, resistance (matrix viscosity) during compaction/dilation with deformation of aggregates in the extended compaction theory can be determined.

By comparing the result of the numerical simulation and the experiments, they concluded that permeability of melt into the rocks is proportional to the first power of the melt fraction, which differs from common relationship for porous flow. Their model considers deformation of the matrix alone during the melt infiltration, and it might be necessary to take in account of dissolution and precipitation process to analyze their experimental results. Further, better resolution of measurement of melt fraction is required.

In this study, we prepared high-purity forsterite aggregates synthesized by vacuum sintering. Felsic glass powders were deposited onto the surface of the aggregates and annealed at 1200C and vacuum condition of ~$5*10^{-3}$Pa. Melts infiltrated into sample depth of about 0.5 mm, which is similar to the result of Riley and Kohlstedt (1991EPSL). In the presentation, we will show some data obtained from different melt compositions, different annealing temperatures and times with newly developed melt migration model.