Influence of grain boundary wetting on migration and retention of melt

Saswata Hier-Majumder[1], **Yanick Ricard**[1,2], **and David Bercovici**[1]

[1] *Department of Geology and Geophysics, Yale University*
[2] *Laboratoire de Science de la Terre, Ecole Normale Supérieure de Lyon*

We employ the theory of two-phase flow to investigate the influence of grain boundary wetting during segregation of magma in a partially molten aggregate. Tensions on grain-grain and grain-melt interfaces in the partially molten aggregate play an active role in the dynamics of melt migration. The 'disaggregation melt fraction', the volume fraction of partial melt at which grain boundaries are completely wetted, is crucial in determining the total interfacial force per unit volume. Tensions on both grain-grain and grain-melt interfaces contribute to the total interfacial tension at melt fractions less than the disaggregation melt fraction. In contrast, only grain-melt interfaces contribute to the total interfacial tension when melt fraction exceeds the disaggregation fraction and grain boundaries are wetted.

Strong tension on grain-grain interfaces tend to homogenize melt distribution by capillary action. Buoyant magma ascends as solitary pulses in a compacting partially molten column. Capillary action arising from grain-grain interfacial tension in the matrix drains melt away from these ascending discrete magma pulses. As a consequence, a fraction of the melt is retained as a wake consisting of small melt tubules along grain edges behind an ascending pulse of magma. Thus surface tension reduces the efficiency of gravity-driven melt extraction, even in well-connected and highly buoyant melt networks.