You can connect but you can't drain: Percolation and trapping of iron-sulphide melts in silicate mantle

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The formation of the core via percolation is an attractive pocess to form planetary cores early in the planets evolution. Even magma ocean scenarios require percolation of the iron-sulfide melt through underlying solidified silicate mantle. There is currently a debate whether he dihedral angle of iron-sulphide melts in an olivine matrix is low enough to allow the formation of a percolating network. However, even if the iron-sulfide melt reaches melt fractions large enough that it can percolate, it may not be able to drain completely from the silicate portion of the mantle. Here we use three-dimensional computations of texturally equilibrated networks in irregular polycrystalline media to study the hysteresis in the topology of the pore space. For dihedral angles above 60 degrees we show that even an initially percolating melt network eventually disconnects as the melt drains and the porosity drops. This inevitably traps iron-sulfide melts in the silicate mantle. We suggest that it has to be evaluated if this is consistent with geochemical observations, otherwise the percolation hypothesis has to be revaluated.