Migration and storage of magma are two extremely important processes in the geodynamic and chemical evolution of the interior of the Earth. Mechanisms of magma migration determine the location and magnitude of volcanism beneath midoceanic ridges and volcanic arcs. Magma storage atop the core-mantle boundary of the Earth plays a crucial role in thermal and chemical evolution of the planet. Both magma transport and storage are controlled by a coupling between processes taking place at extremely different length scales.

While the typical length between regions of magma generation and regions of volcanism can range from a few hundred meters to thousands of kilometers, the motion of magma takes place through nanometer-scale channels dispersed along edges of mineral grains. Under the elevated temperature of the planetary interior, rocks deform in a viscous manner, leading to redistribution, opening, and pinching of these channels. A robust description of magma migration and storage, therefore, must incorporate the dynamic melt geometry at the grain-scale. In this presentation, we present a cross-scale model where we track the geometry of a magmatic melt pocket under stresses arising from viscous deformation of the rocky matrix.