Numerical modeling of mantle flow, melt migration, and MORB compositions

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Volcanic activity at mid ocean ridges produces on average about 21km3 of mid ocean ridge basalt (MORB) each year. These basalts have a fairly constant composition commonly known as MORB–composition. The heat flux at mid ocean ridges settings is found to be on the order of 500-1000mW/m2. Small parts of the mid ocean ridges, however, show significant deviations form these average values. A particularly complex situation of an anomalously shallow and geochemically distinct section of the Mid-Atlantic ridge exhibiting an unusually high production of MORB is observed between the Ascension and Bode Verde fracture zones in the Southern Atlantic. This abnormal MORB is believed to be either caused by a weak mantle plume, proposed to be located underneath the ridge or at various distances from the ridge, or small-scale mantle heterogeneities. In the framework of this proposal we explore the possible fluid dynamic consequences of these scenarios for such an anomalous mid ocean ridge setting using a finite element code that is currently under development as well as dedicated analogue laboratory experiments. Our model calculations that will take into account various observations from other researchers of the SPP will help to hopefully tightly constrain which model (weak plume or small-scale mantle heterogeneities) is the most realistic for this mid ocean ride setting.