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Probing depth dependencies of melt emplacement on time dependent quantities in a continental rift scenario with melting and melt extraction

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Since some years seismological observations provide increasing evidence of a discontinuity near the mid of older mantle lithosphere. Explanation may be a melt infiltration front (MIF) as upper margin of an evolving network of veins. These are formed by crystallized melt supplied by episodic melting events in the asthenosphere.
To test this concept geodynamically we performed numerical modelling applying melting, extraction of melt and emplacement in a viscous matrix. Thereupon, we were faced to the problem defining an intrusion level for the melt. Findings of prior studies led to the need of movable, process dependent boundaries of the emplacement zone additionally making the process probably more self-consistent. Here we present a preliminary study exploring several empirical attempts to relate time dependent states to an upward moving boundary for intrusion.
Modeled physics is based on thermo-mechanics of visco-plastic flow. The equations of conservation of mass, momentum and energy are solved for a multi component (crust-mantle) and two phase (melt-matrix) system. Rheology is temperature-, pressure-, and stress-dependent. In consideration of depletion and enrichment melting and solidification are controlled by a simplified linear binary solid solution model. The Compaction Boussinesq Approximation and the high Prandtl number approximation are used, elasticity is neglected and geometry is restricted to 2D. Approximation is done with the Finite Difference Method with markers in an Eulerian formulation (FDCON).
Model guiding scenario is a extending thick lithosphere associated to by updoming asthenosphere probably additionally heated by a plume nearby. As the P-T conditions in the asthenosphere are near the solidus caused changes may increase melting and generate partial melt. Against conventional expectations on permeability at lithosphere-asthenosphere boundary (LAB) depth a fast melt transport into and sometimes through the lithosphere often is observed. The intruded or infiltrated, solidified melt modifies composition and physical properties of the affected lithosphere.
Above a critical fraction limit melt is extracted and intruded above. The uppermost front of extraction, petrophysically seen as LAB, defines the lower boundary of the emplacement zone. The upper boundary is related to various quantities, particularly temperature, melt curve, melt front, stress, dynamic pressure and more. Changes of intrusion level imply different convection patterns affecting intensity of erosion of the lower lithosphere, doming rate of asthenosphere and melt-induced weakening. Thus, the shape and location and therefore its dependence influences intensively the dynamics of rifting.