Shear heating and subduction initiation

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Shear Heating ?

$$\rho c_p \frac{DT}{Dt} = \nabla \cdot (k \nabla T) + \rho H_r + H_a + H_s$$

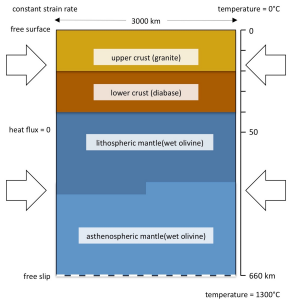
$$\eta \sim \exp \frac{Q}{RT} \Rightarrow \tau = 2\eta\dot{\varepsilon} \Rightarrow H_s = \tau : \dot{\varepsilon}$$

Methodology

- numerical modelling (using the FE-Code MILAMIN_VEP)
- test the range of parameters that lead to localization and subduction
- compare results to previous work (here: Crameri and Kaus (2010))

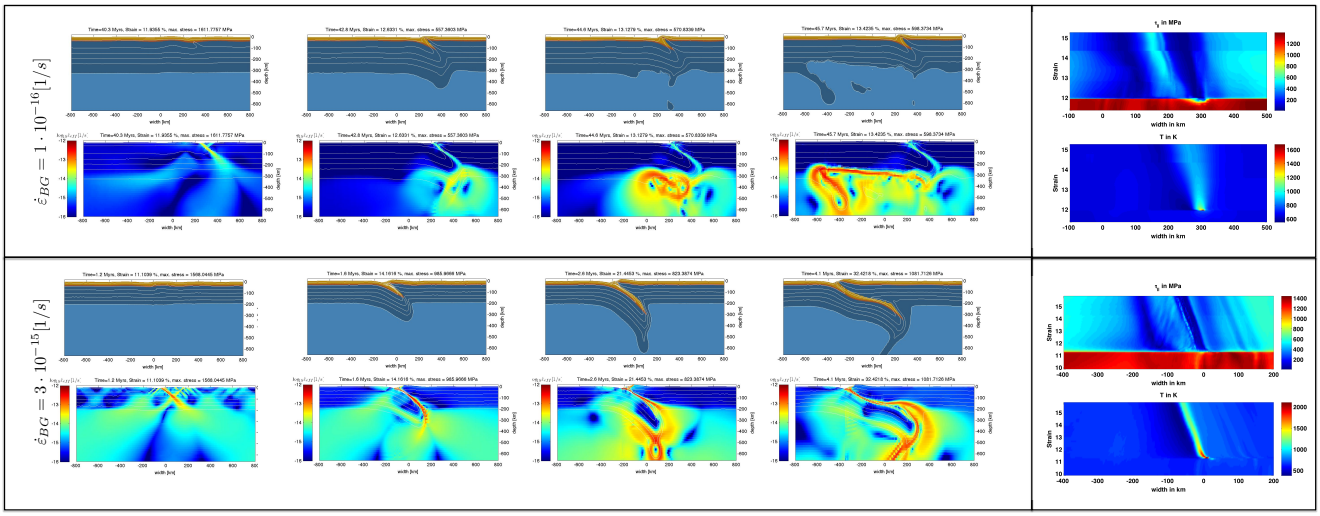
Model Setup

- visco-elasto-plastic rheology
- thickness of lithosphere T-dependent
- Resolution: 2 km x 2 km in the middle and close to the surface
- quadratic elements (Q_2P_{-1})
- regular remeshing
- alternatively oceanic crust (wet quartzitic, plagioclase)



Contintents collide...

horizontal cut at 50 km depth

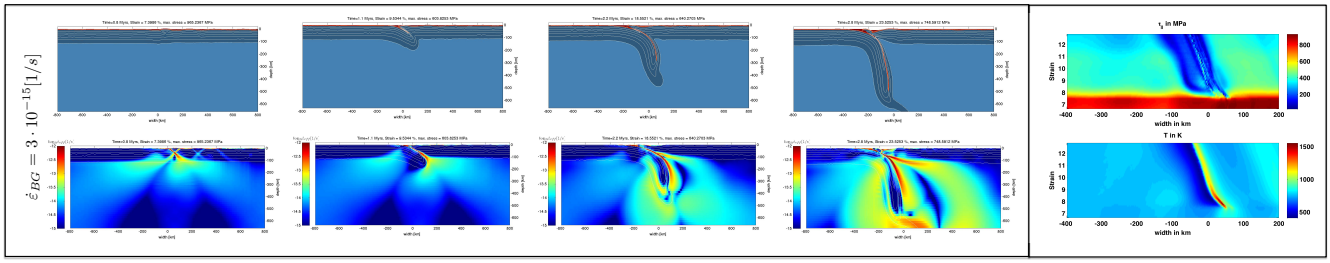


time ⟶

... no self-consistent subduction

Oceanic crash...

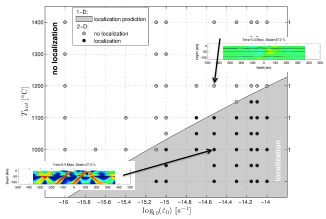
horizontal cut at 30 km depth



time ⟶

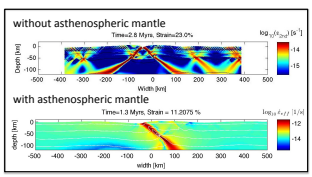
... self-consistent subduction

Theory for localization



Crameri & Kaus, 2010

Mantle influence?



Conclusions

- lithospheric shear zones do not necessarily result in subduction zones
- small scale convection inhibits subduction initiation
- density of crustal layers is crucial for subduction initiation
- localization occurs earlier than in Crameri and Kaus (effect of underlying mantle)
- temperature increase and stress drops are large
- decay time of extreme peaks is relatively low (depends on setting)

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