

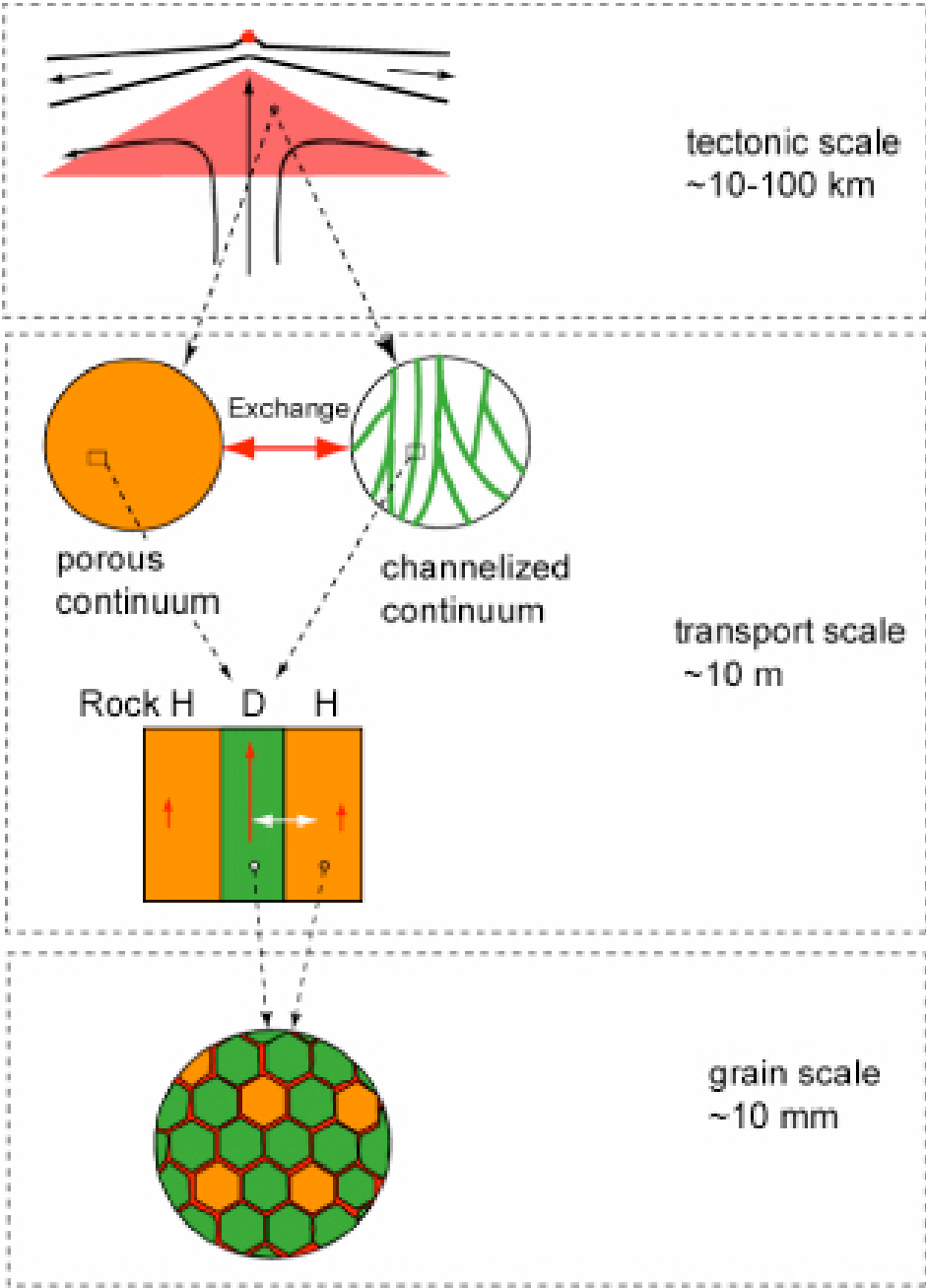
# Melt Migration: Overview for the CIG Science Steering Committee

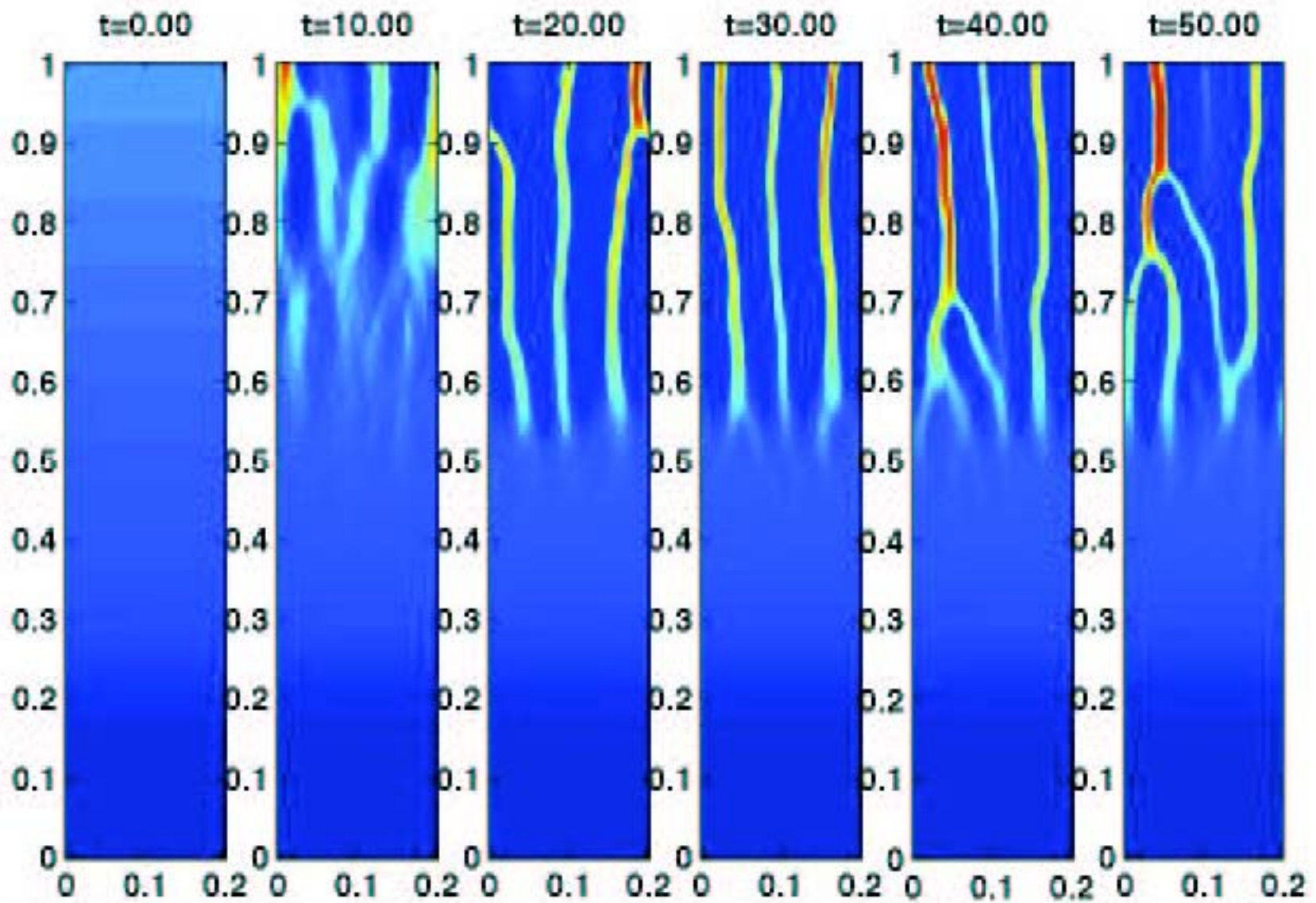
E. Marc Parmentier

Brown University

Nov. 17-18, 2005

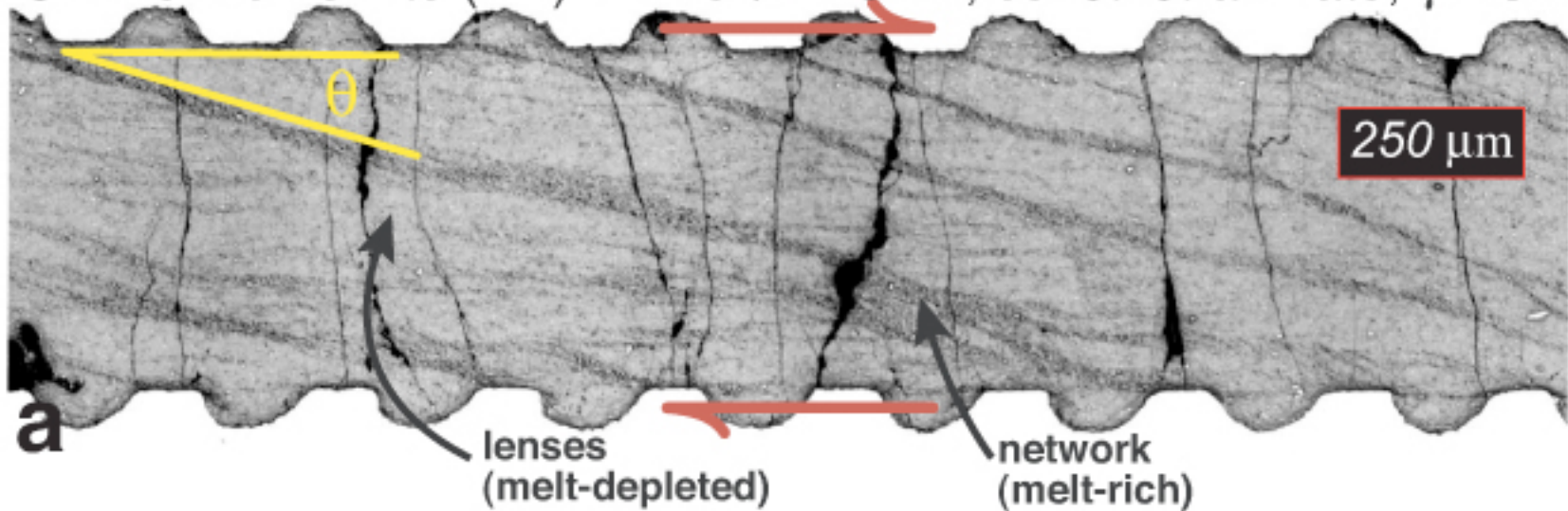
Melting and Melt Migration as a Multiple Length Scale Problem



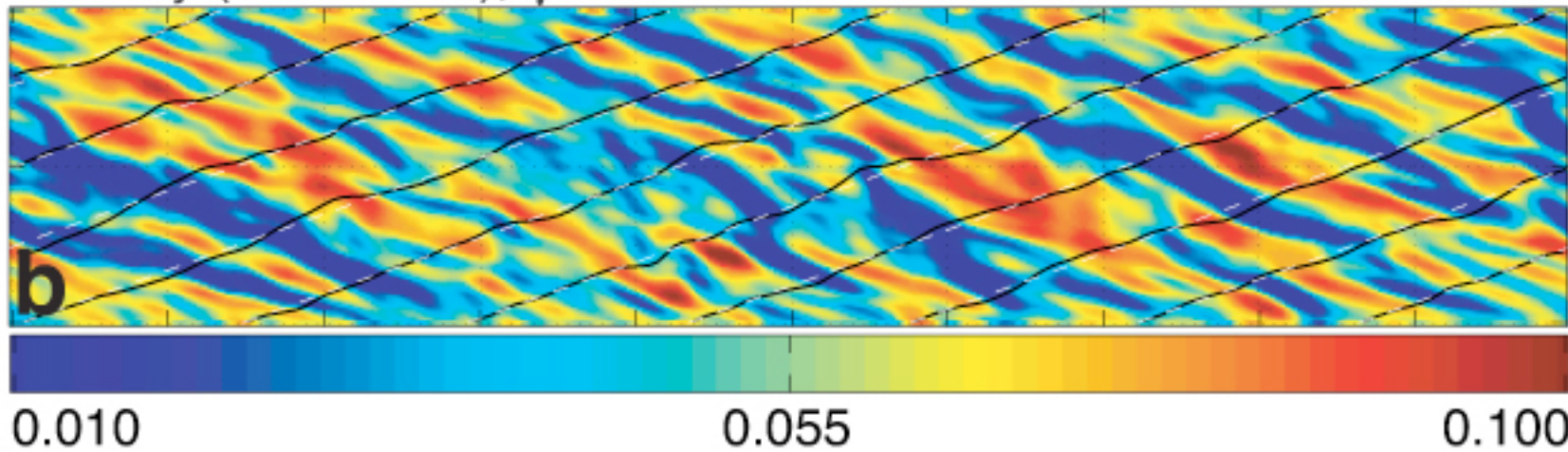


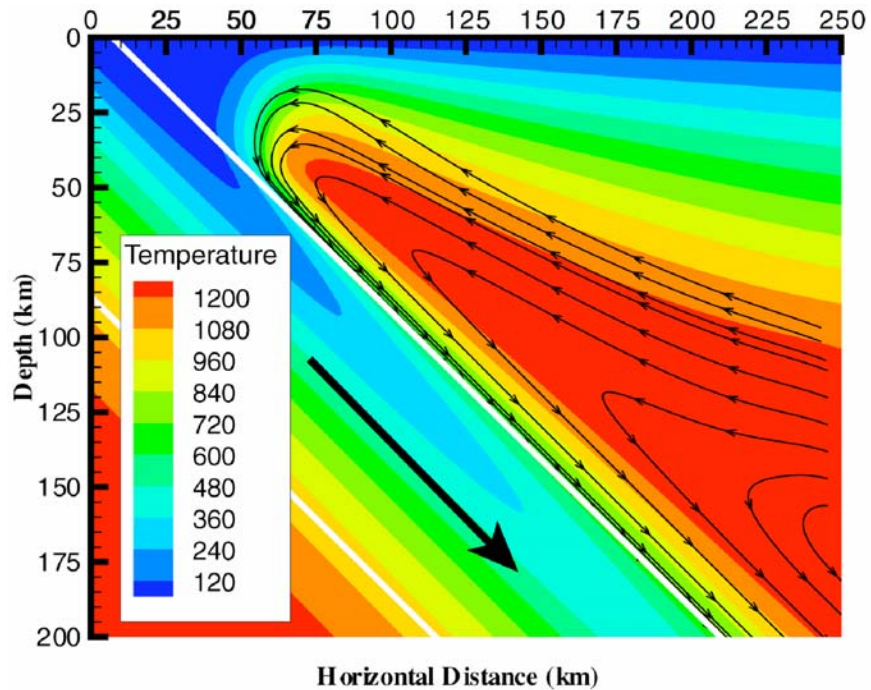
Spiegelman and Kelemen (2003)

Olivine + chromite (4:1) + 4 vol% MORB, const. strain rate,  $\gamma = 3.4$



Porosity (Simulation),  $\gamma = 2.79$



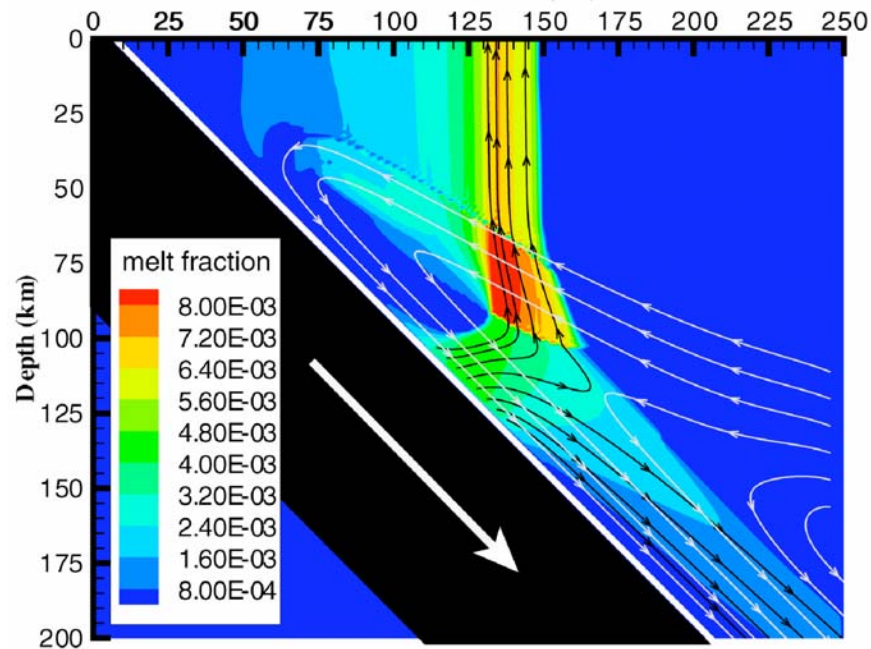


Empirically derived permeability  
melt fraction relationships

Neglect solid flow pressure gradients

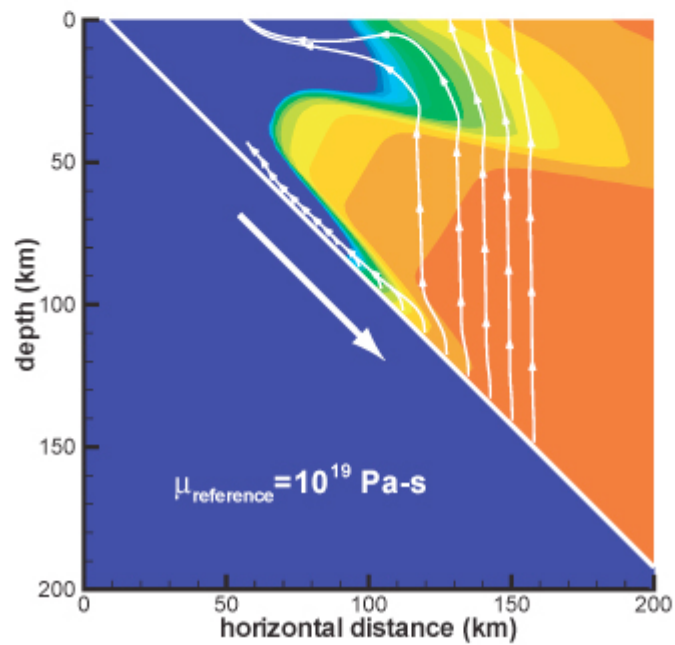
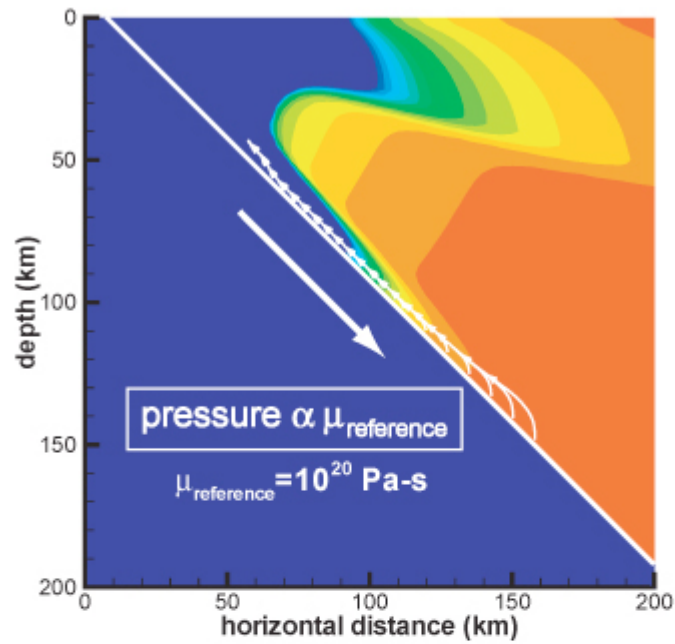
Two dimensional

Melting parameterized from MELTS

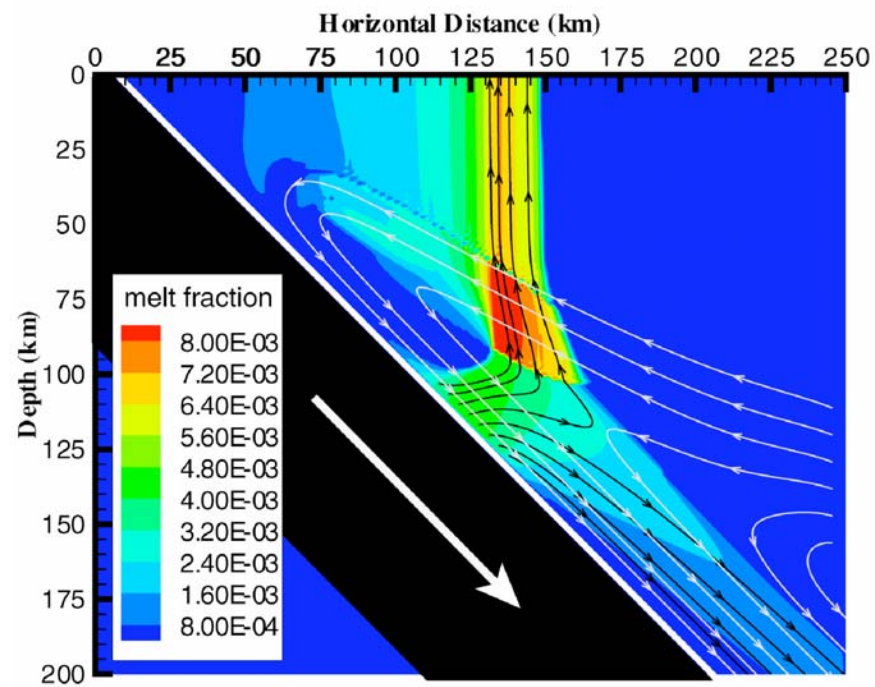
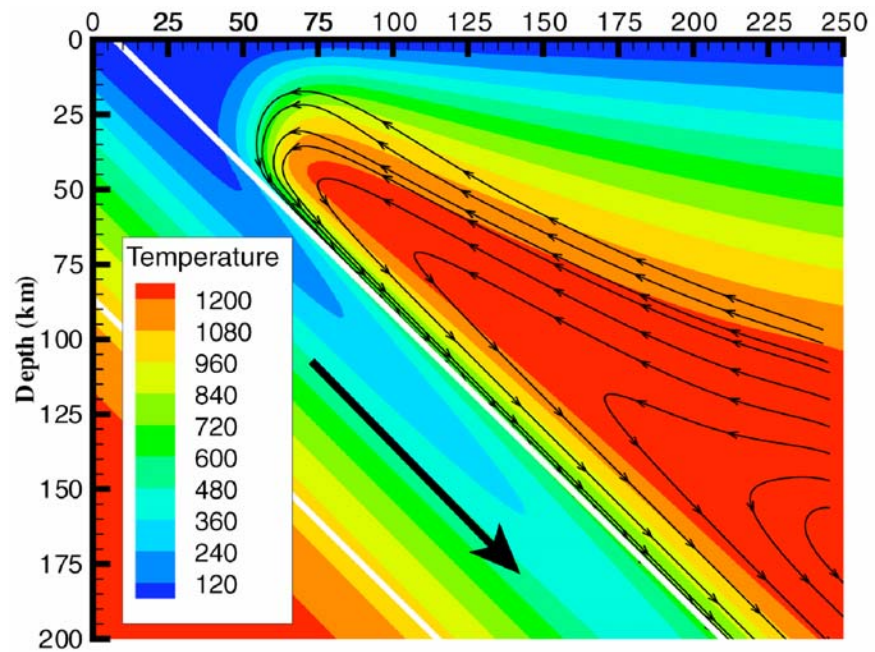


Cagnioncle, et al, submitted to JGR

# Solid flow pressure field and melt force lines

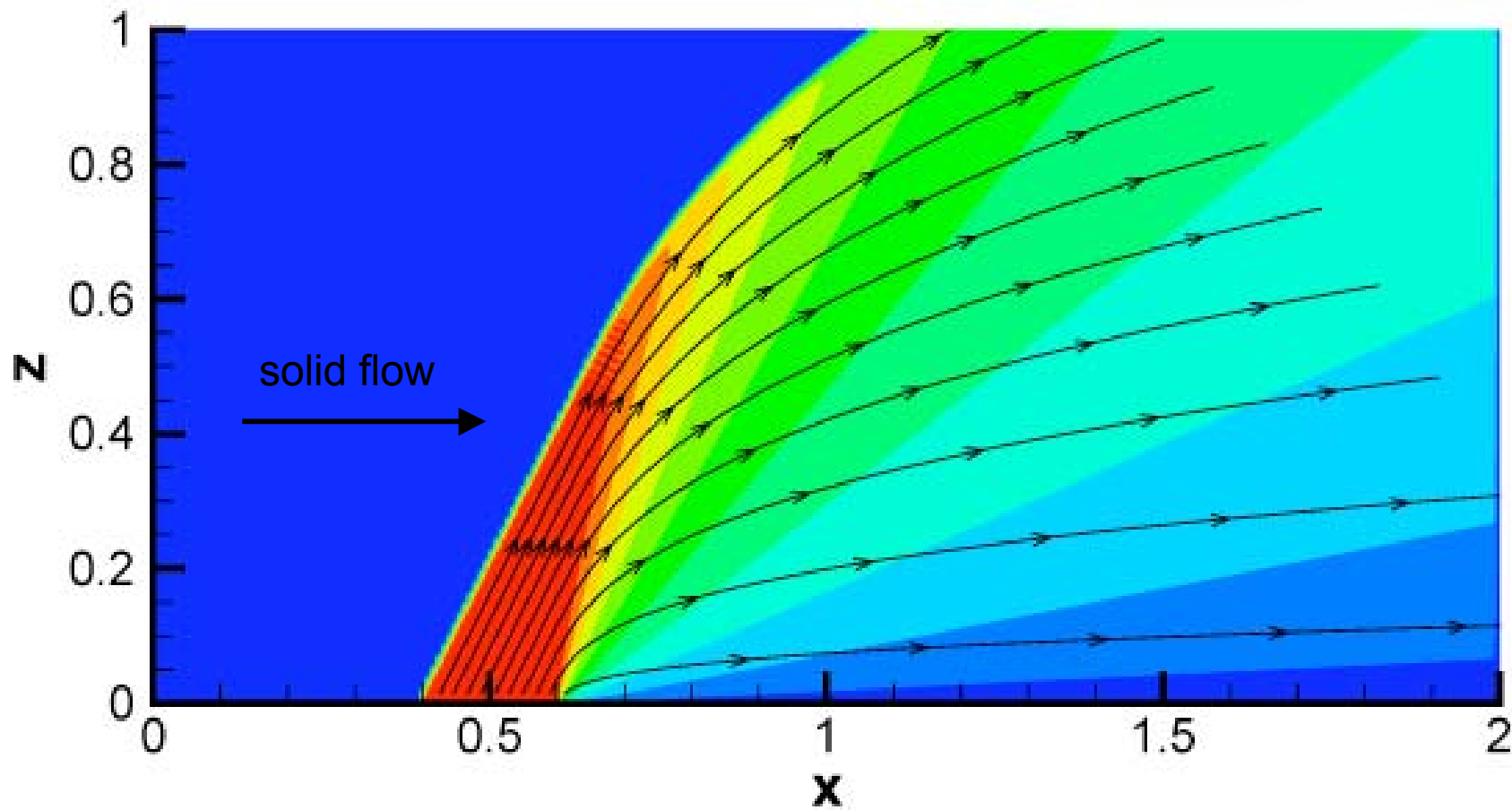
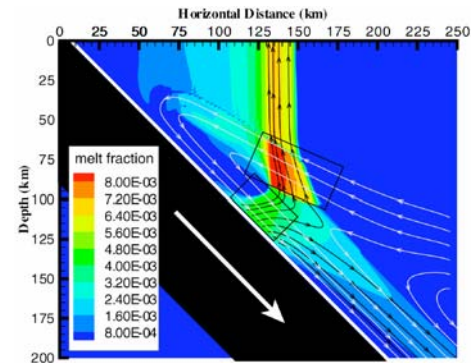


Phipps Morgan 1987  
Spiegelman & McKenzie 1987

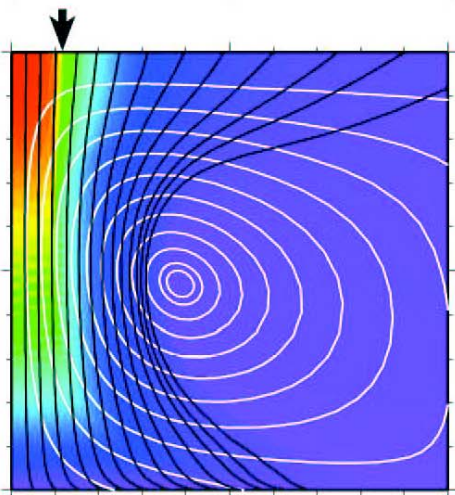
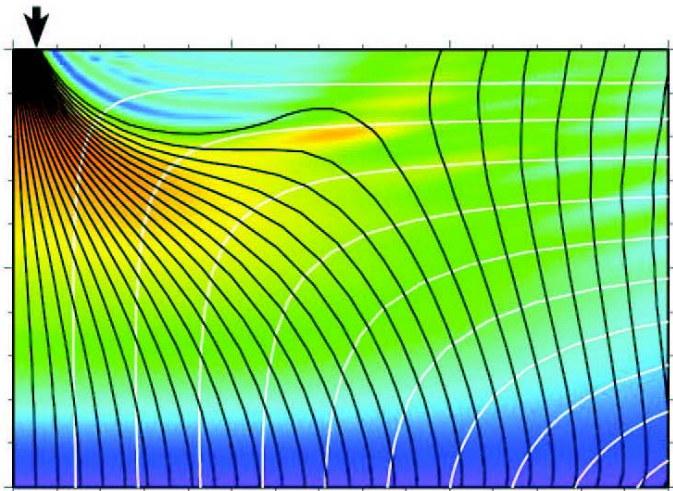


Cagnioncle, et al, in prep

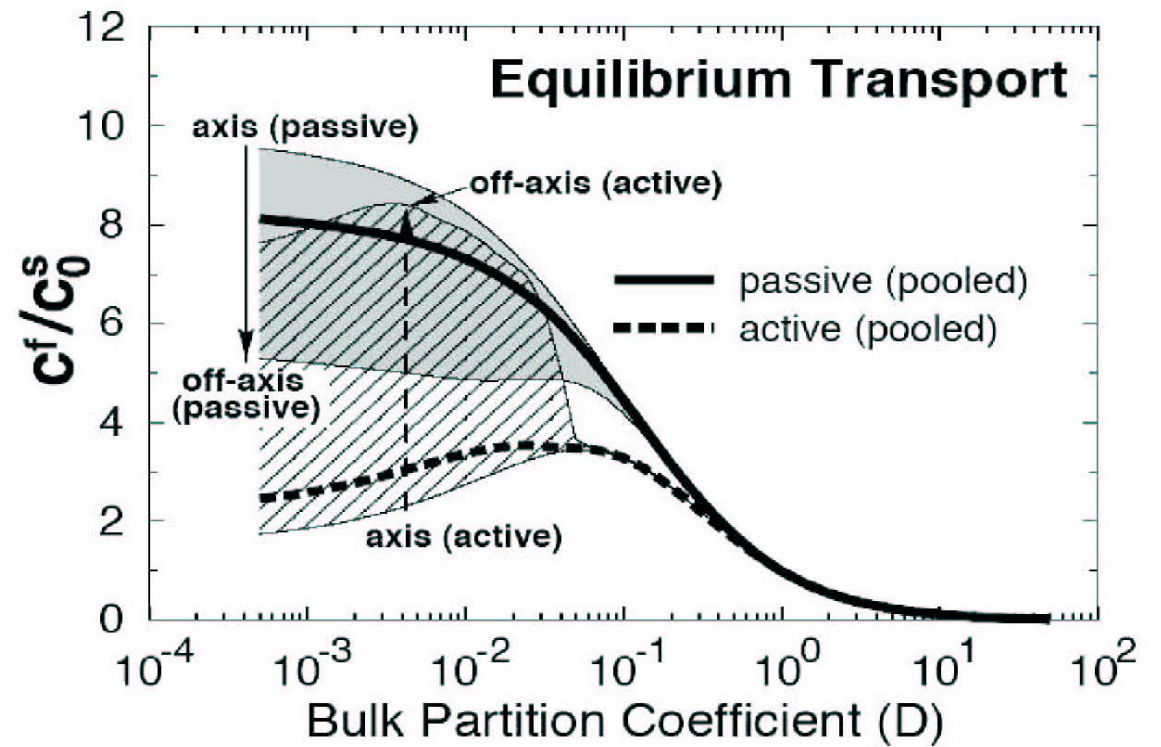
colors – fluid volume fraction  
streamlines – fluid flow



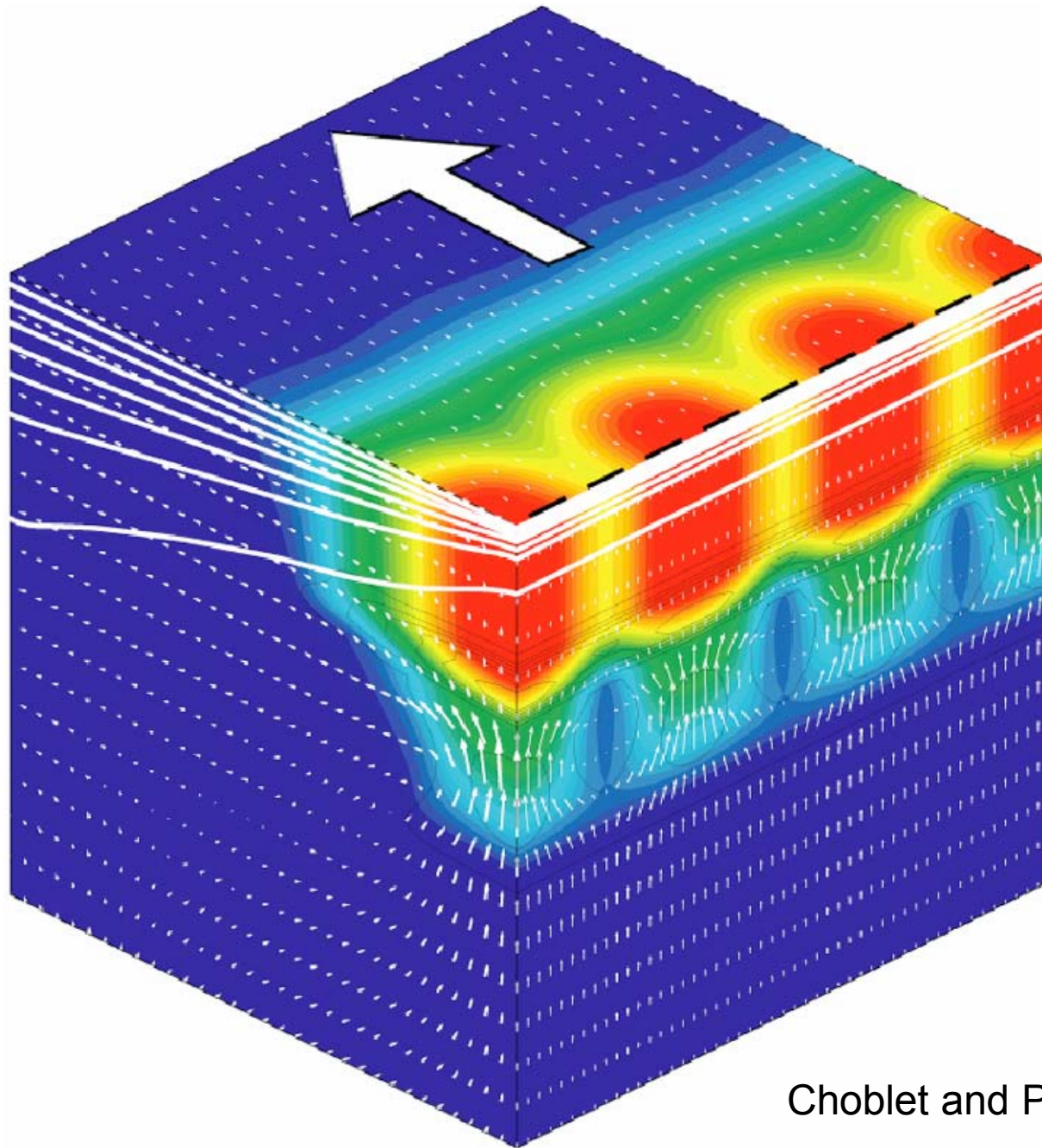
Passive (plate driven) flow



Active (buoyant) flow



Spiegelman (1996)



Choblet and Parmentier (2001)

## Numerical challenges

- \* Advection
  - semi-Lagrangian
  - higher order field methods (Smolarkewicz, WENO)
  - tracer particles
  
- \* Interfaces across which material properties change discontinuously
  - level set method
  - marker chains
  
- \* Accurate solutions for pressure field in viscous flow with dilatation

## Software synergies

compressional (dilatational) solid state convection  
chemistry of melting (MELTS)  
...  
...