Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Melting in the Lower Mantle

Ilya Fomin, Paul Tackley

Geophysical Fluid Dynamics

What is our goal?

Fast & accurate set of routines to calculate phase assemblage and their chemical compositions in the lower mantle conditions.
Set is used in StagYY code for planetary geodynamics simulations.

Why we study it?

*Realistic numerical **model of the solid-liquid equilibrium** in the Earth's mantle is vitally important to simulate and understand **mantle convection dynamics** and formation of **lithospheric plates and igneous rocks***

Whole geodynamic system behavior (and numerical model results) depends a lot on properties of phases, especially melts.

Sinking of dense melt in the lowermost mantle is a hot topic in scientific discussion nowadays.

Who will use it?

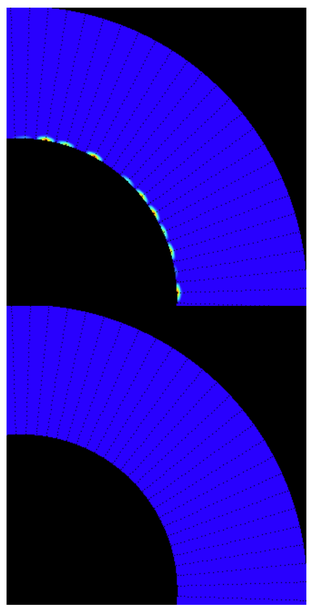
- ✔ *Geochemistry: Formation and composition of deep magmas*
- ✔ *Geophysics: Ultra-Low velocity zones origin*
- ✔ *Planetology: core formation, magma ocean crystallization etc.*

RESULTS

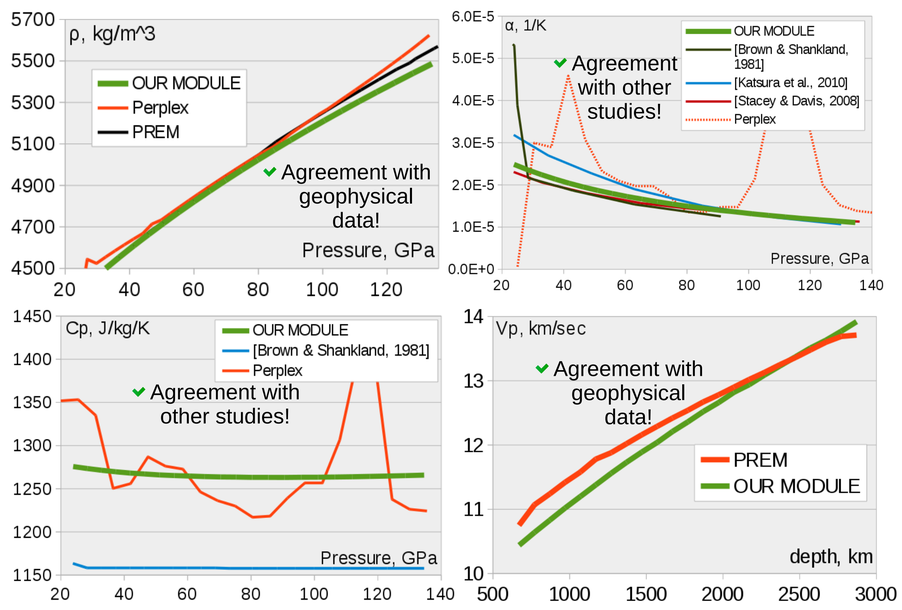
Melting at CMB

Now batches of melt (up to 10%) appears near CMB

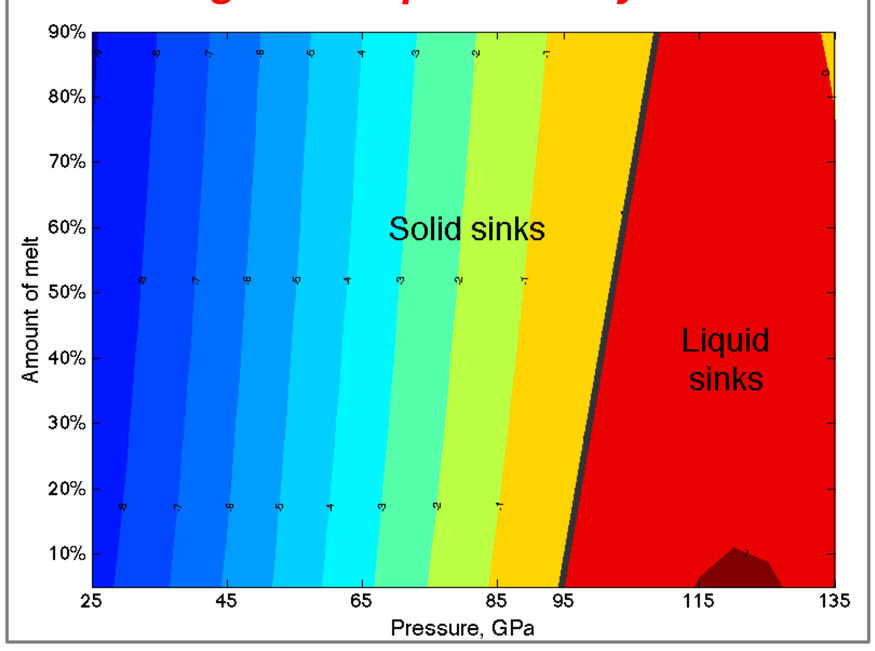
Before: no melt



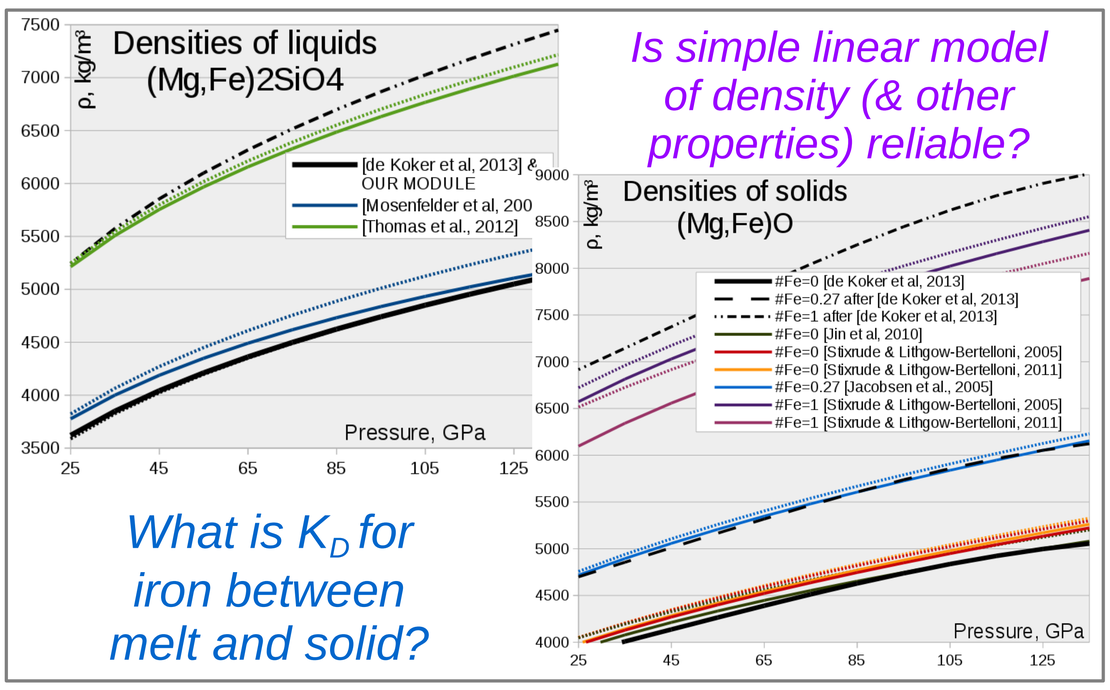
Fitting the properties



Predicting solid-liquid density inversion



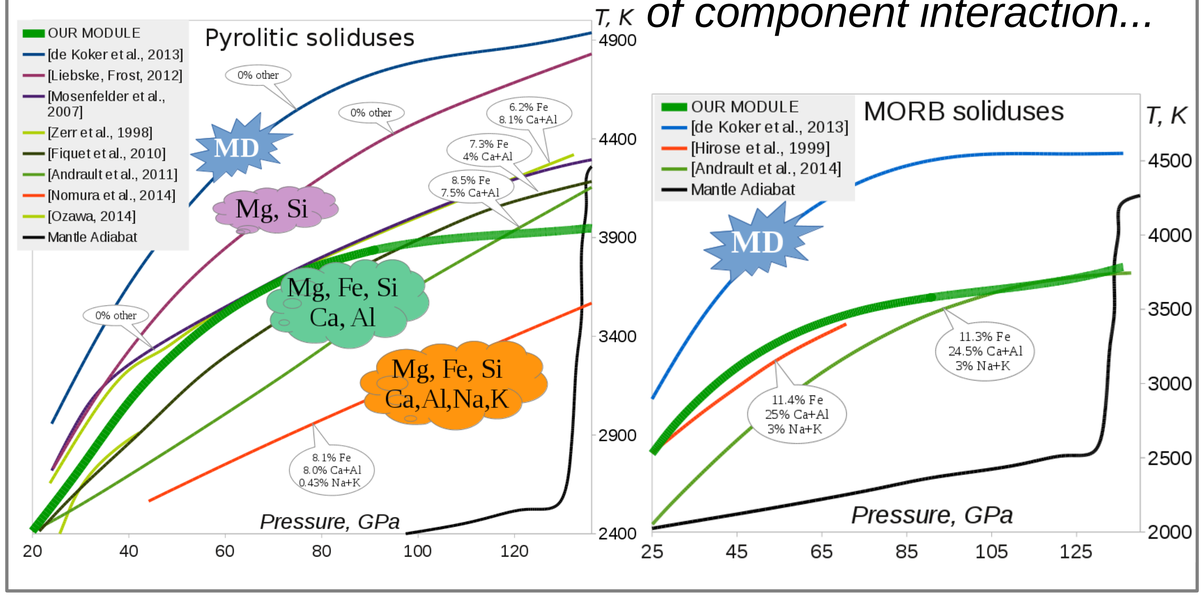
DISCUSSION



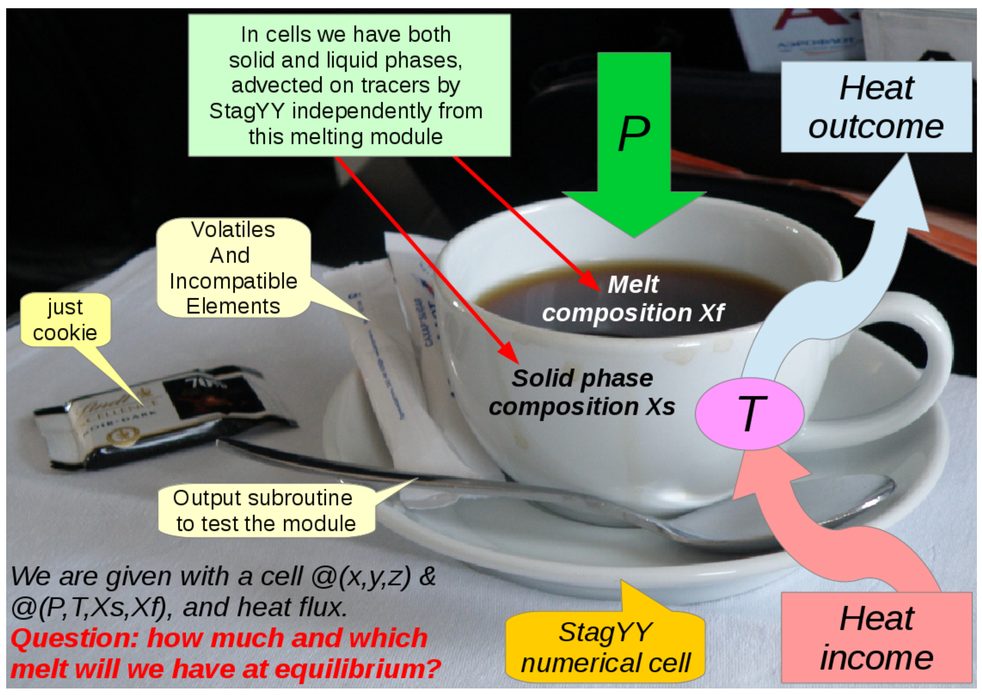
Is simple linear model of density (& other properties) reliable?

What is K_D for iron between melt and solid?

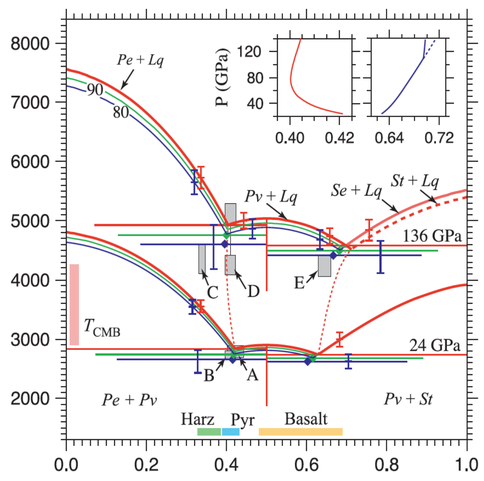
Melting temperatures: *first steps in deep thickets of component interaction...*



METHODS & NOTES



Phase diagram



*Thermodynamic parameters from **[de Koker et al., 2013] & [Stixrude & Lithgow-Bertelloni, 2005,2011]***

Compositions

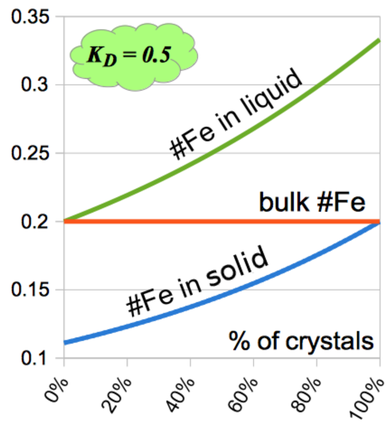
*Mantle composition is expected to be **between pyrolite and MORB**.*

MgO and SiO_2 are the most important components of the Lower Mantle to determine topology of phase diagram

Molecular Dynamics method tends to overestimate melting temperatures because of oversimplicity of described systems and some numerical issues.

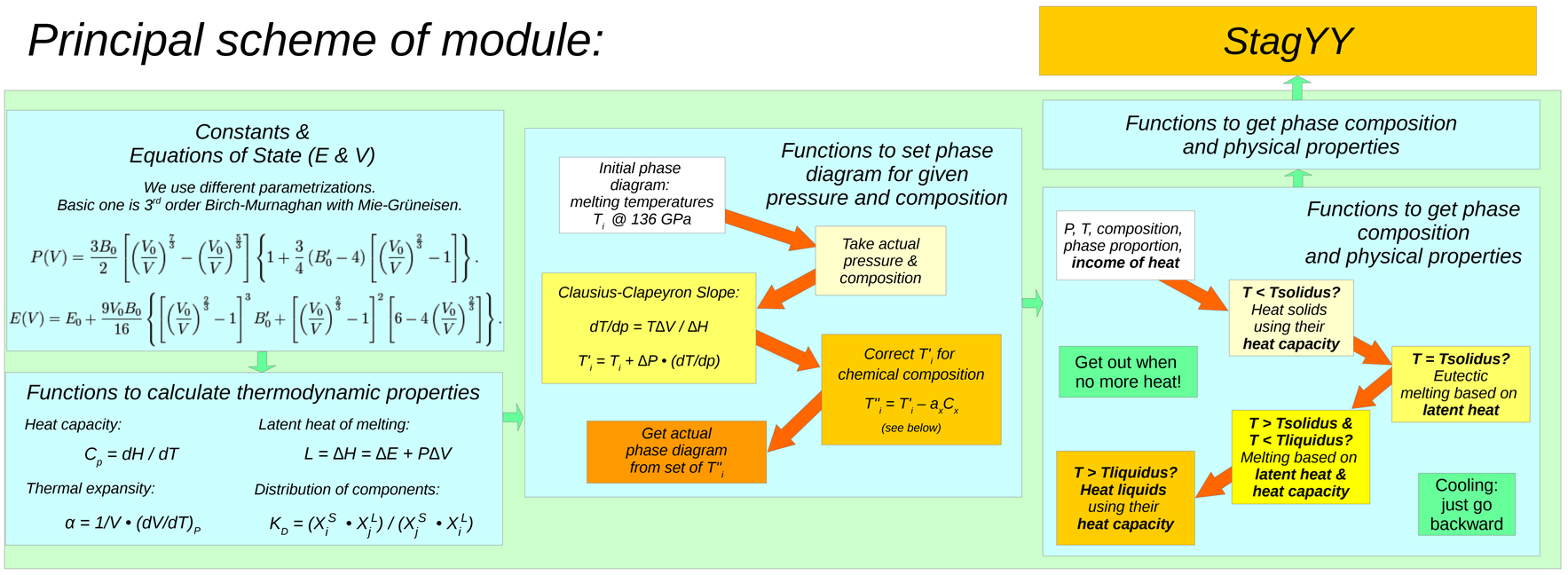
So we use experimentally derived soliduses.

Partitioning



No data for other components...

Principal scheme of module:



CONTACT

Ilya Fomin
ilya.fomin@erdw.ethz.ch