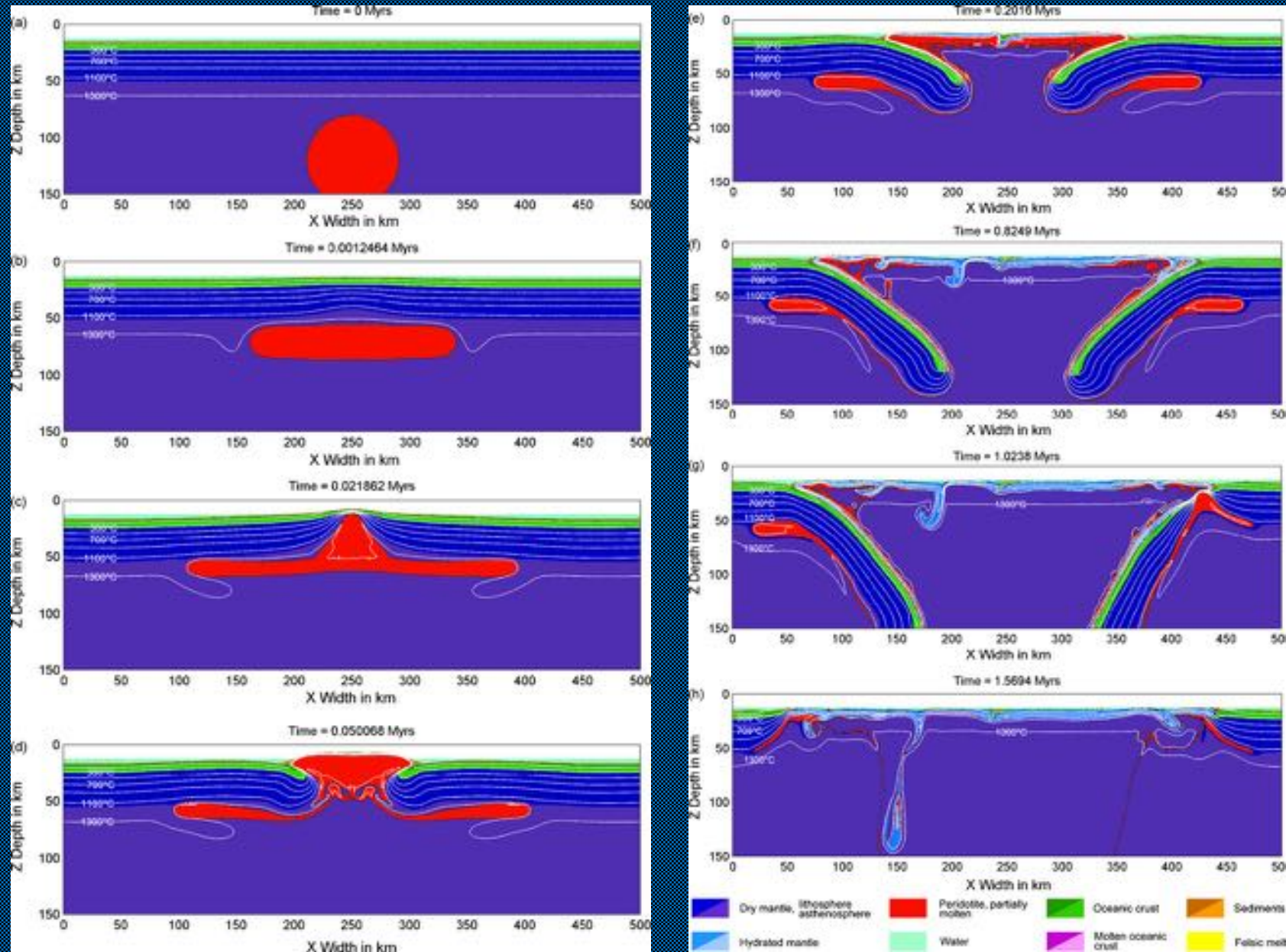


Effect of plate motion on Plume-induced subduction initiation

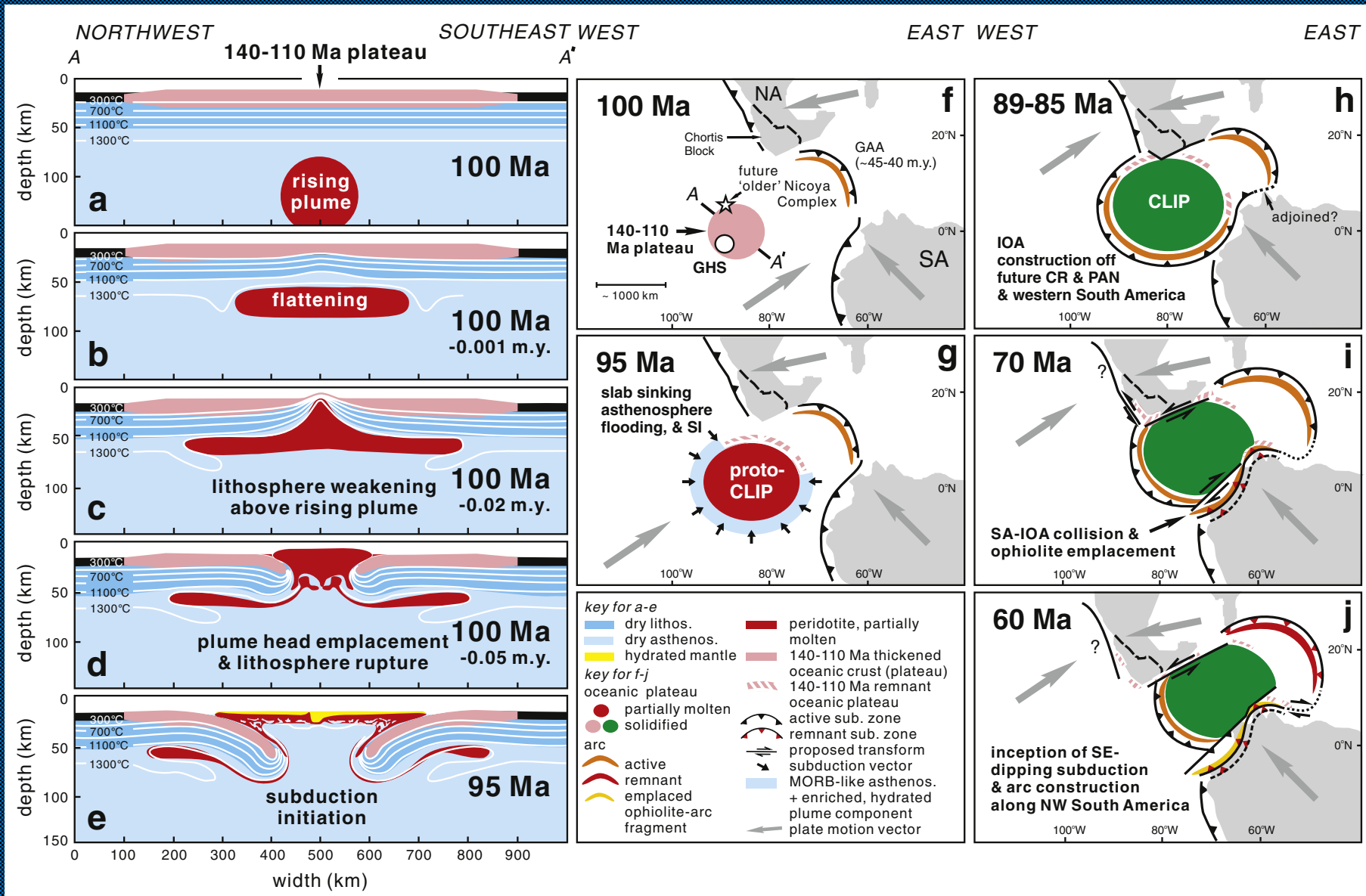
**Marzieh Baes(1,2), Stephan Sobolev(2,3), Taras Gerya(4), Robert Stern(5)
and Sascha Brune(2,3)**

(1) Leibniz Universität Hannover, Institut für Geologie, Hannover, Germany (baes@geowi.uni-hannover.de) (2) GFZ German Research Center for Geosciences, Potsdam, Germany (3) Institute of Geosciences, University of Potsdam, Potsdam, Germany (4) Department of Earth Sciences, ETH-Zurich, Zurich, Switzerland (5) Department of Geosciences, University of Texas at Dallas

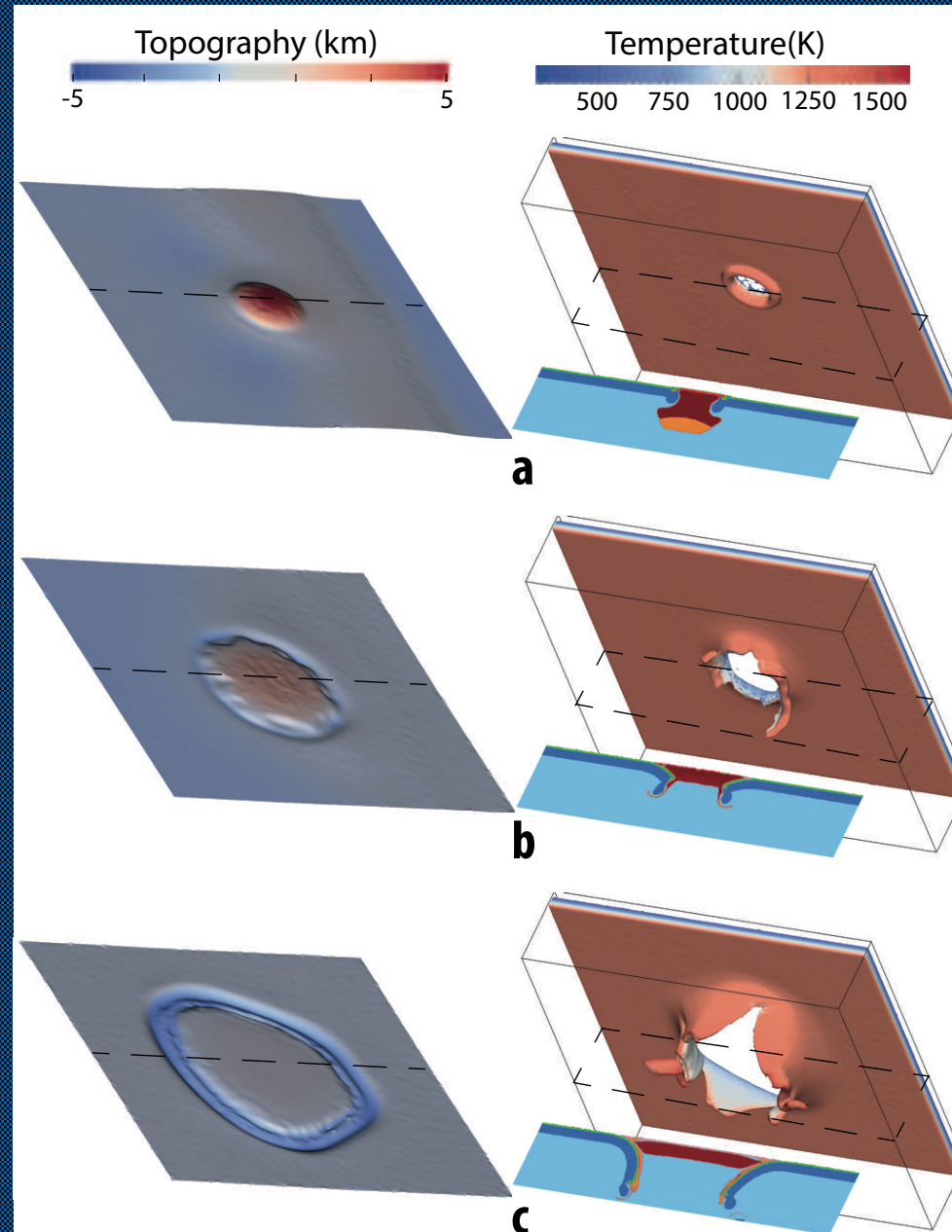
Plume-induced subduction initiation: Previous Studies



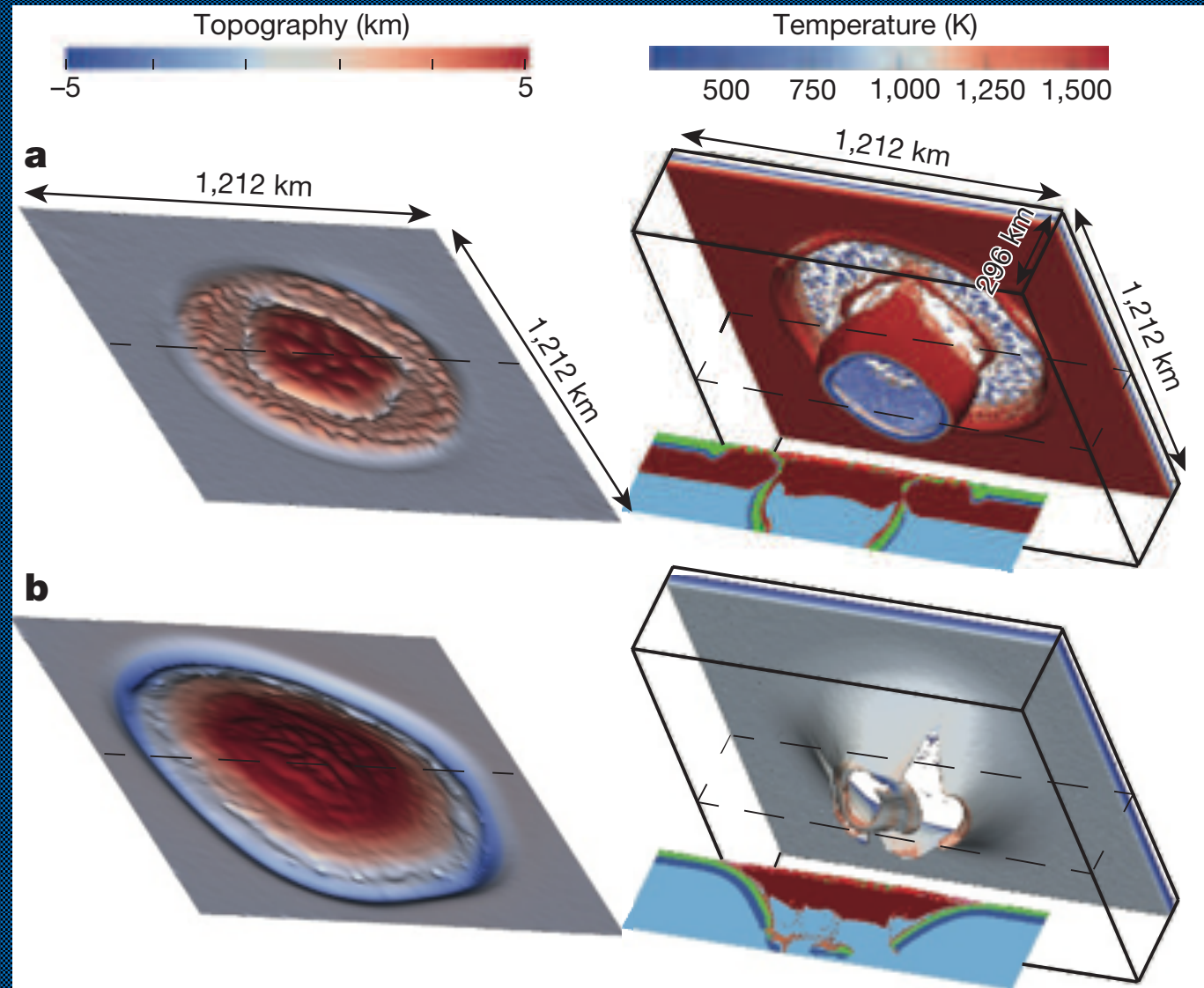
Plume-induced subduction initiation: Previous Studies



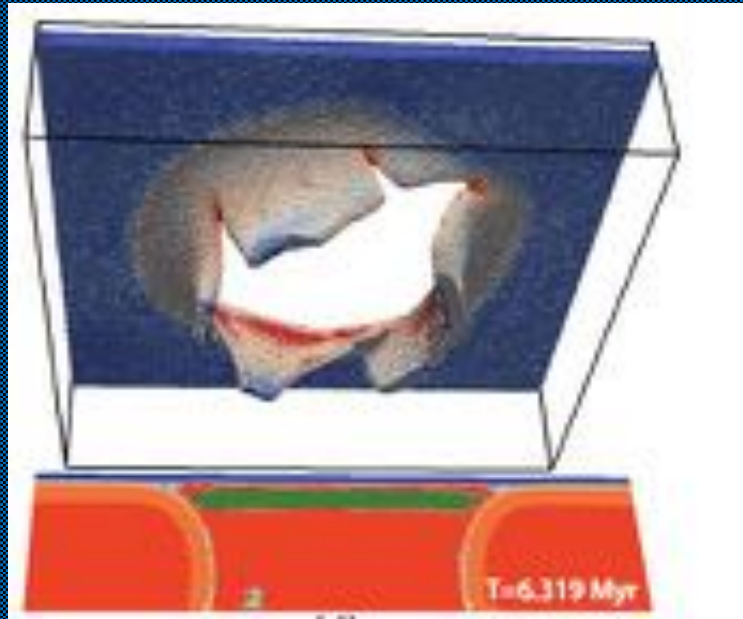
Plume-induced subduction initiation: Previous Studies



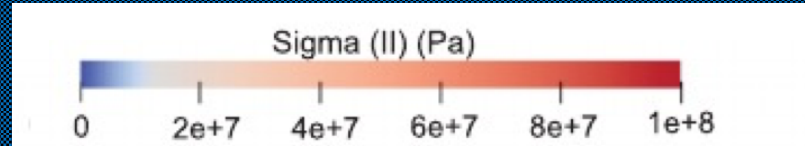
Plume-induced subduction initiation: Previous Studies



Plume-induced subduction initiation: Previous Studies



Multi-slab subduction initiation



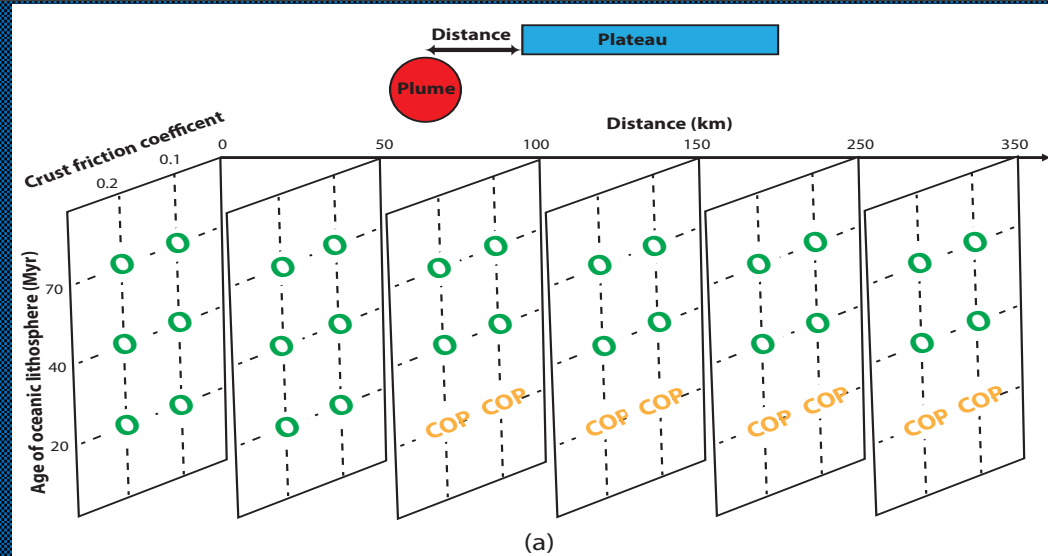
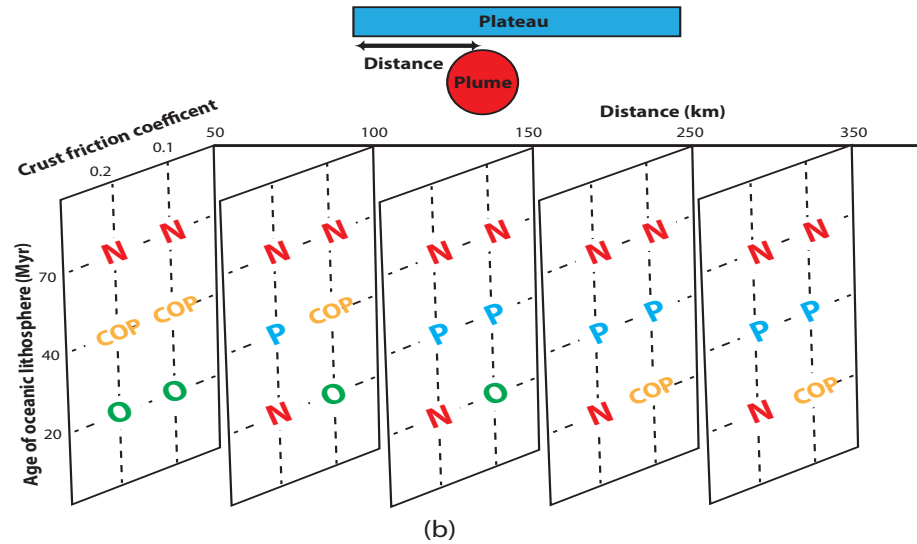
Single-slab subduction initiation



Plateau formation without subduction initiation

Air	Upper crust	Lower crust
Lithosphere	Asthenosphere	Plume
Volcanic crust	Molten volcanic crust	Molten mantle

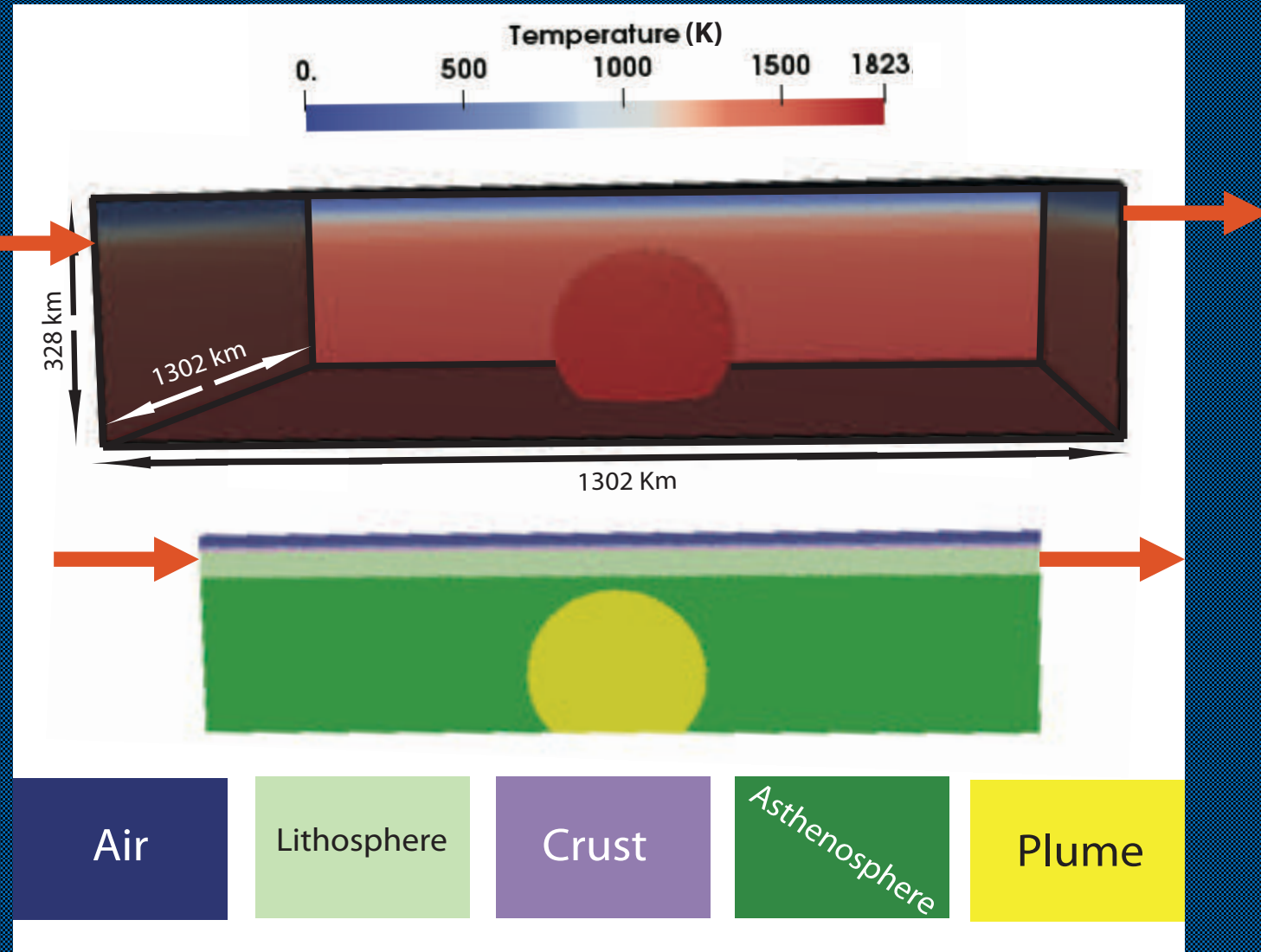
Plume-induced subduction initiation : Previous Studies



O : Oceanic trench formation
COP : Circular Oceanic-Plateau trench formation
P : Plateau trench formation
N : No trench formation

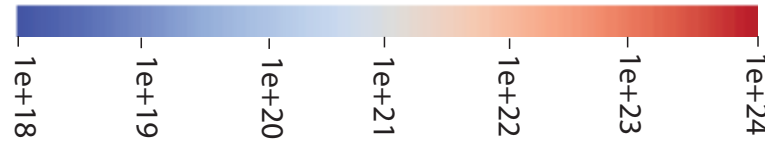
PISI: Effect of plate motion

Lithospheric age : 20Myr
Plume radius : 140km
Plate motion: 5 cm/yr

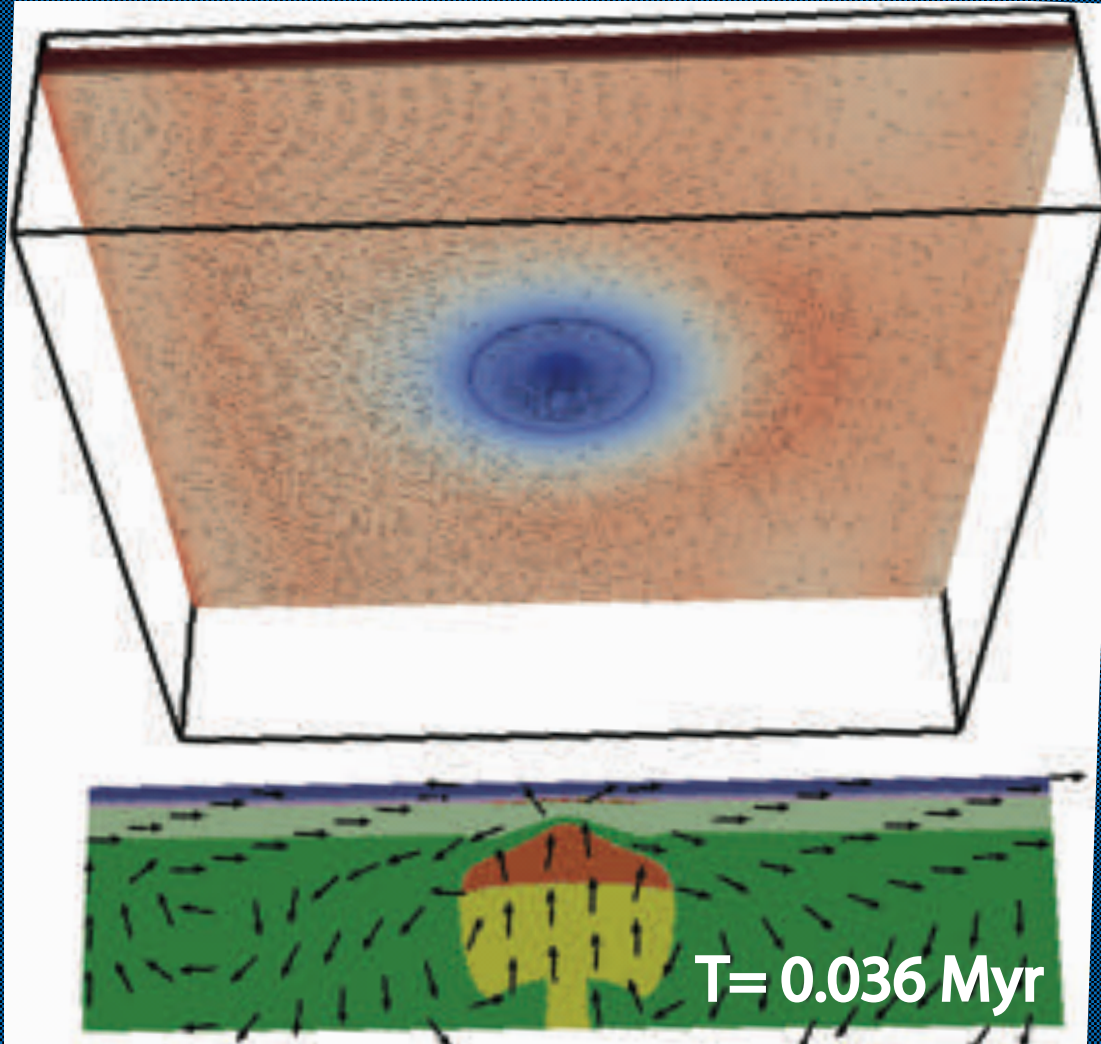
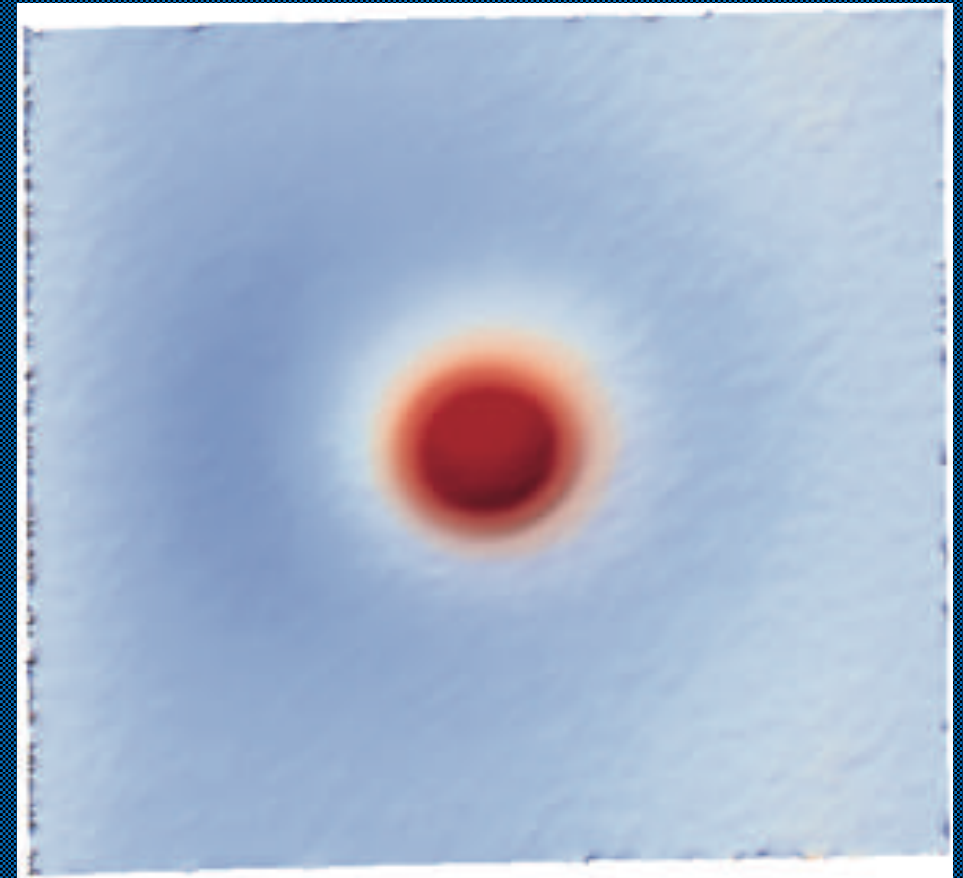


PISI: Effect of plate motion

Log Viscosity (Pas)



Elevation (km)



Baes et al., under review

Air

Crust

Lithosphere

Asthenosphere

Plume

Molten
Mantle

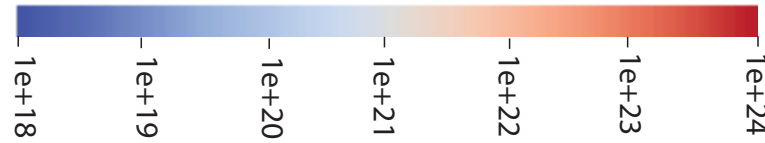
Volcanic
Crust

→ 5 cm/yr

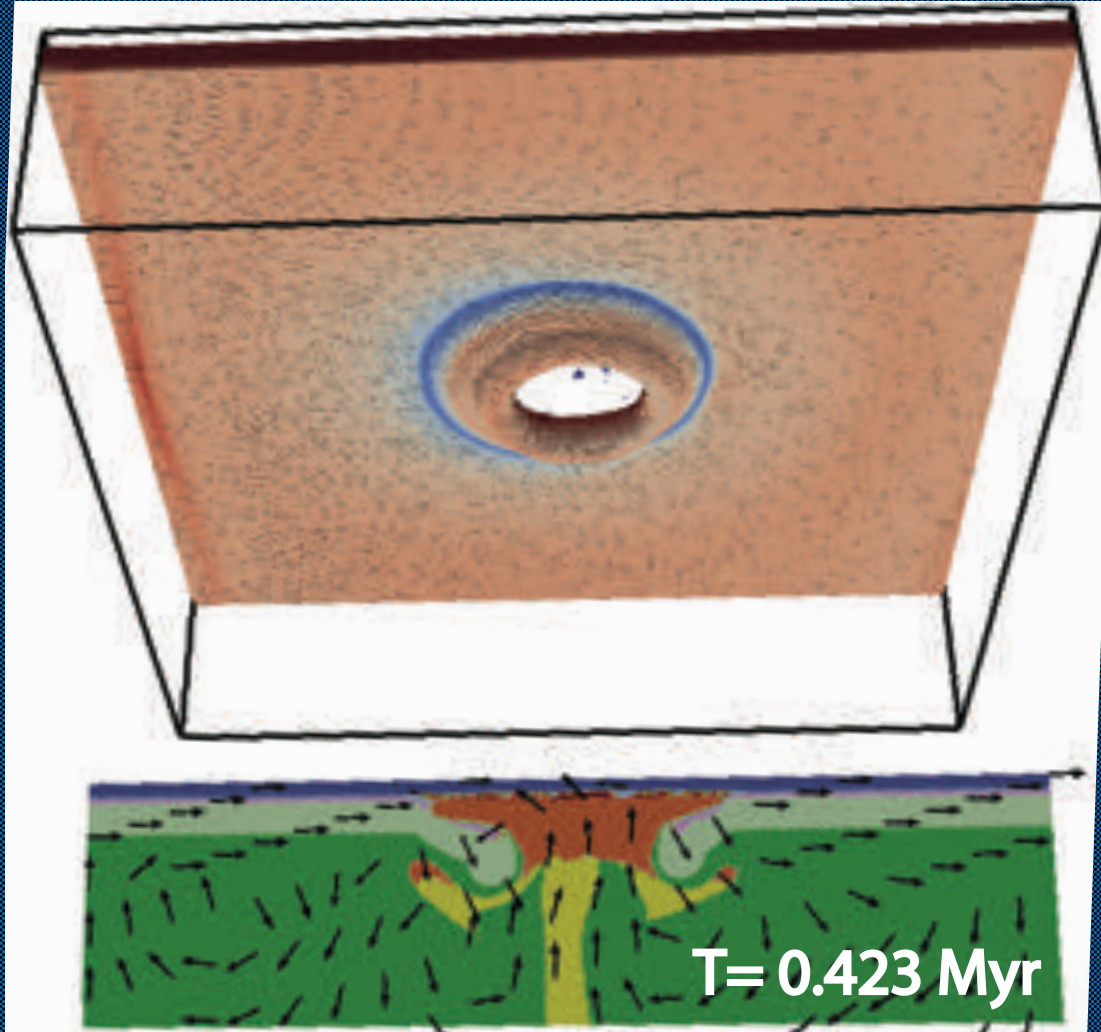
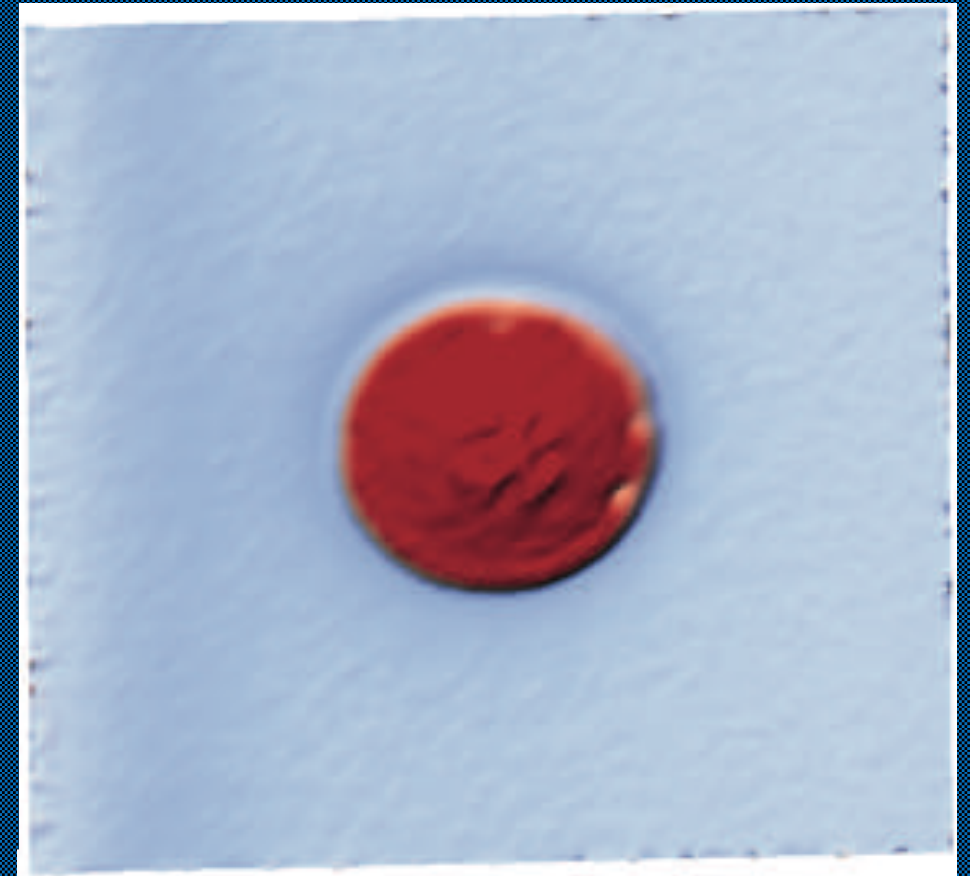
$T = 0.036 \text{ Myr}$

PISI: Effect of plate motion

Log Viscosity (Pas)



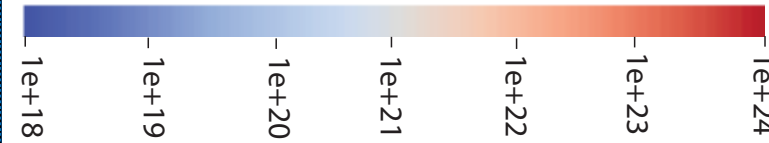
Elevation (km)



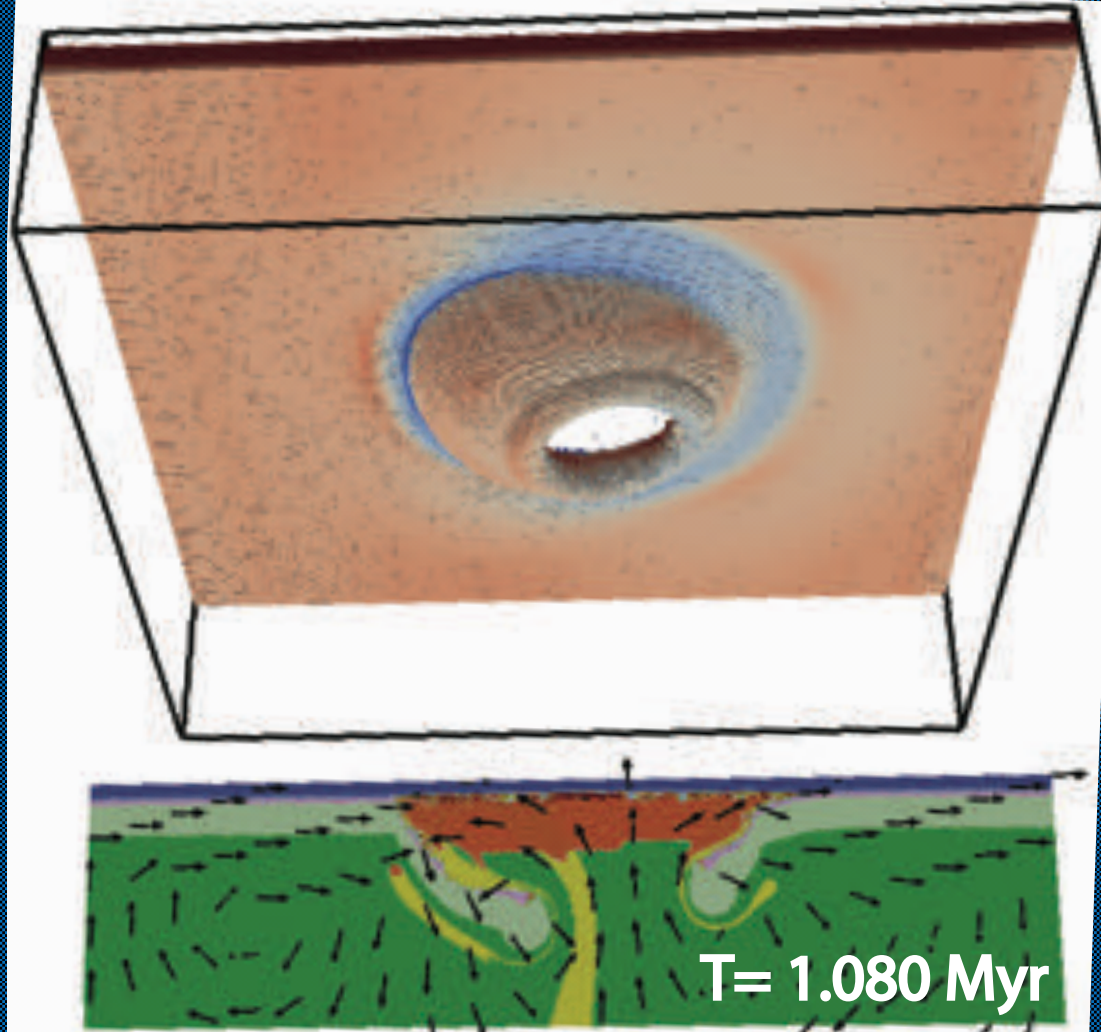
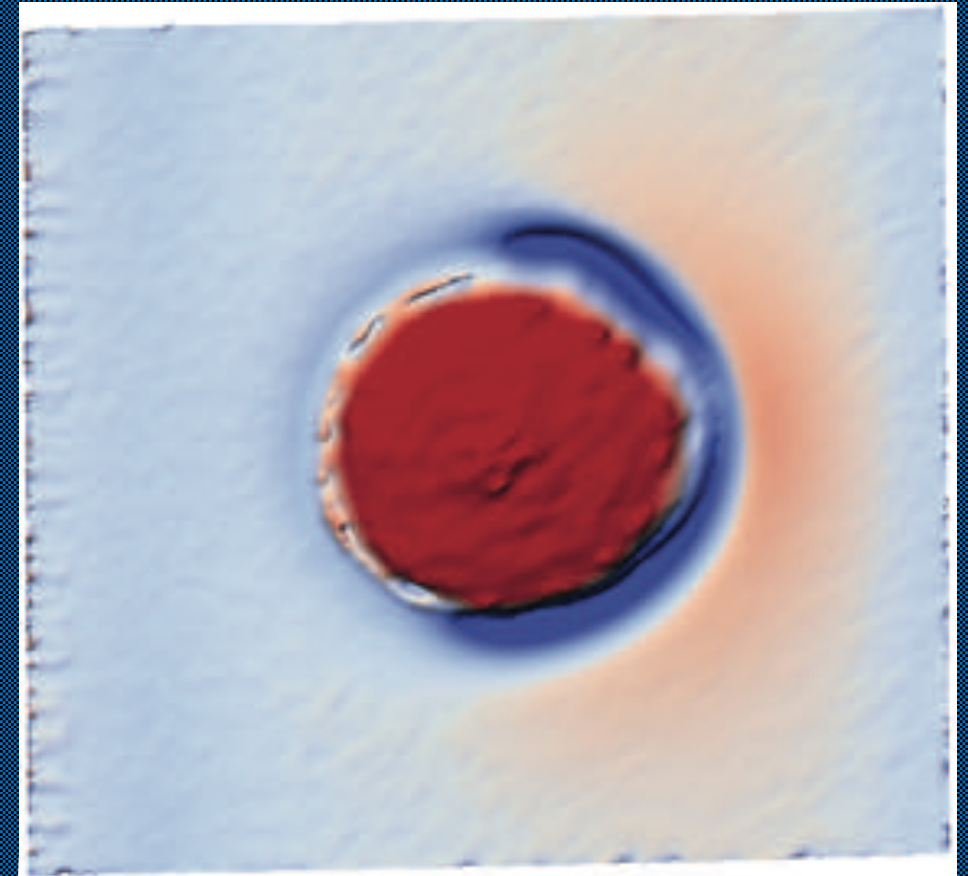
Baes et al., under review

PISI: Effect of plate motion

Log Viscosity (Pas)



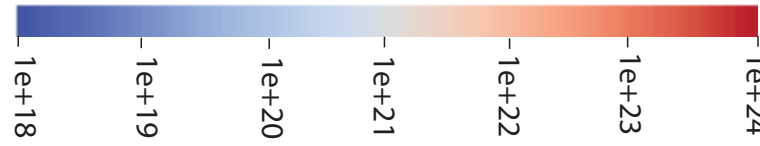
Elevation (km)



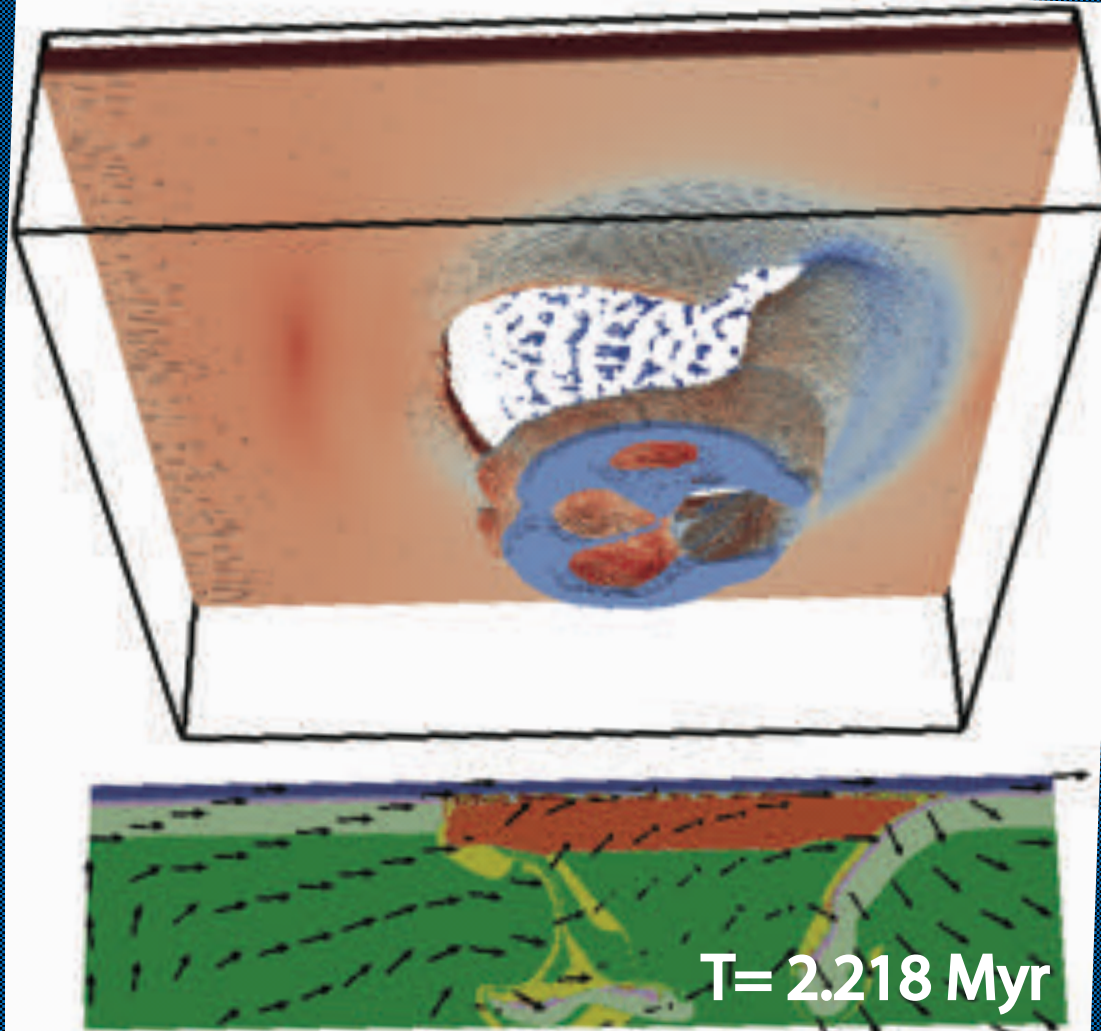
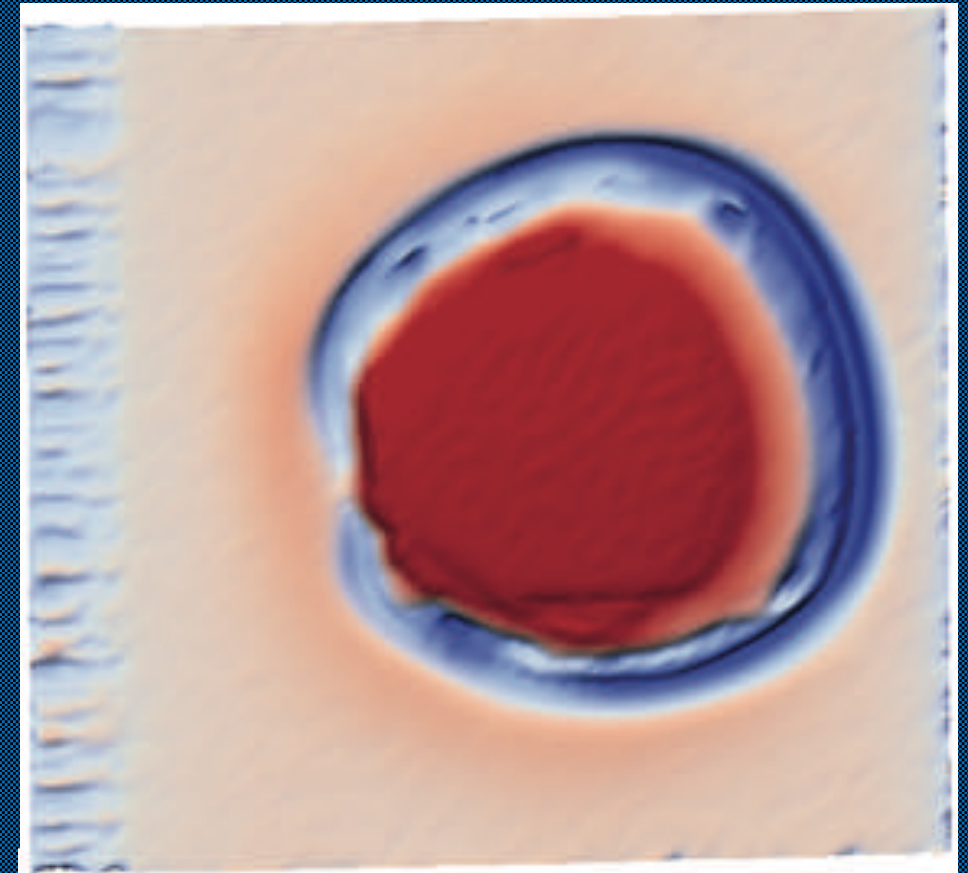
Baes et al., under review

PISI: Effect of plate motion

Log Viscosity (Pas)



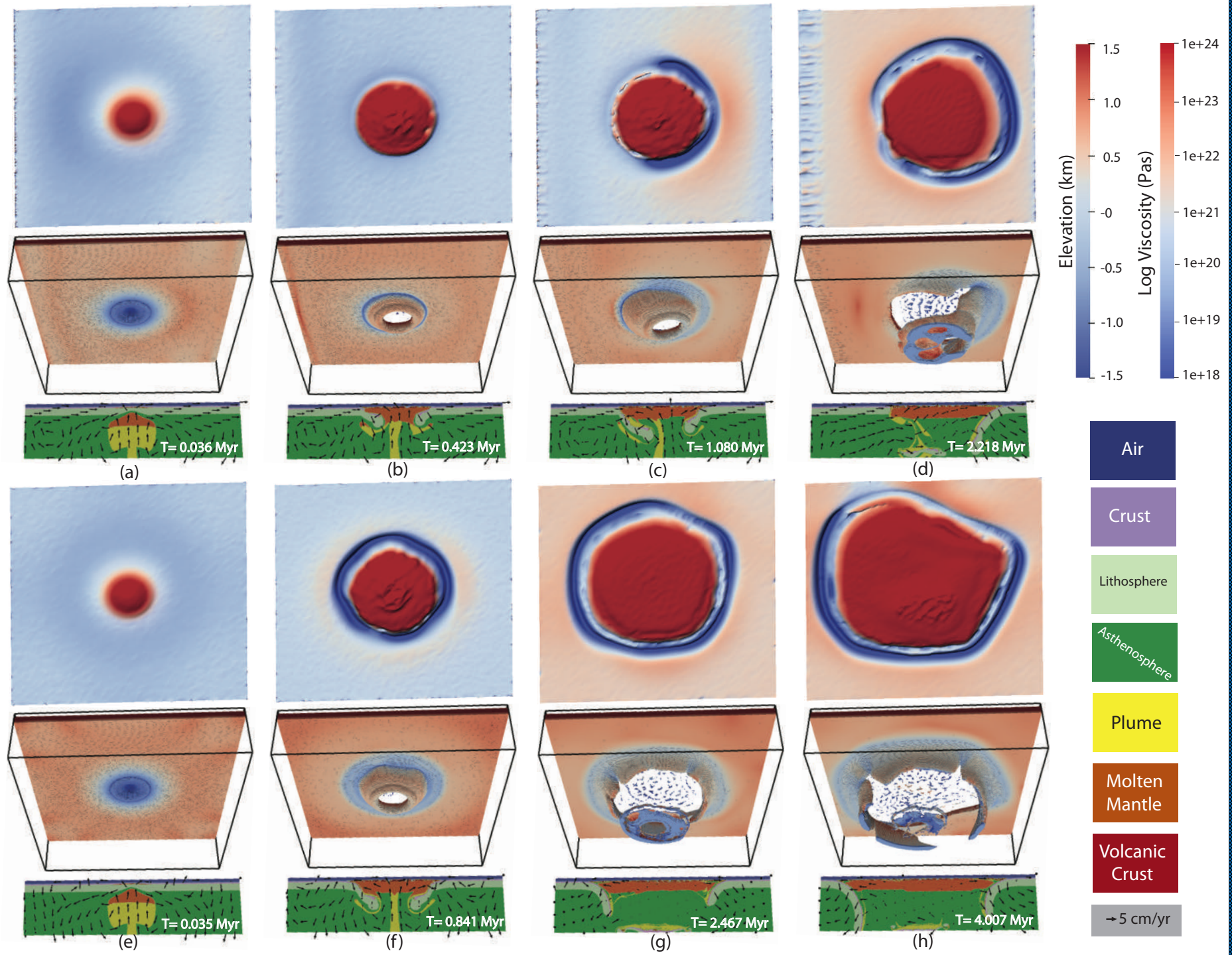
Elevation (km)



Baes et al., under review

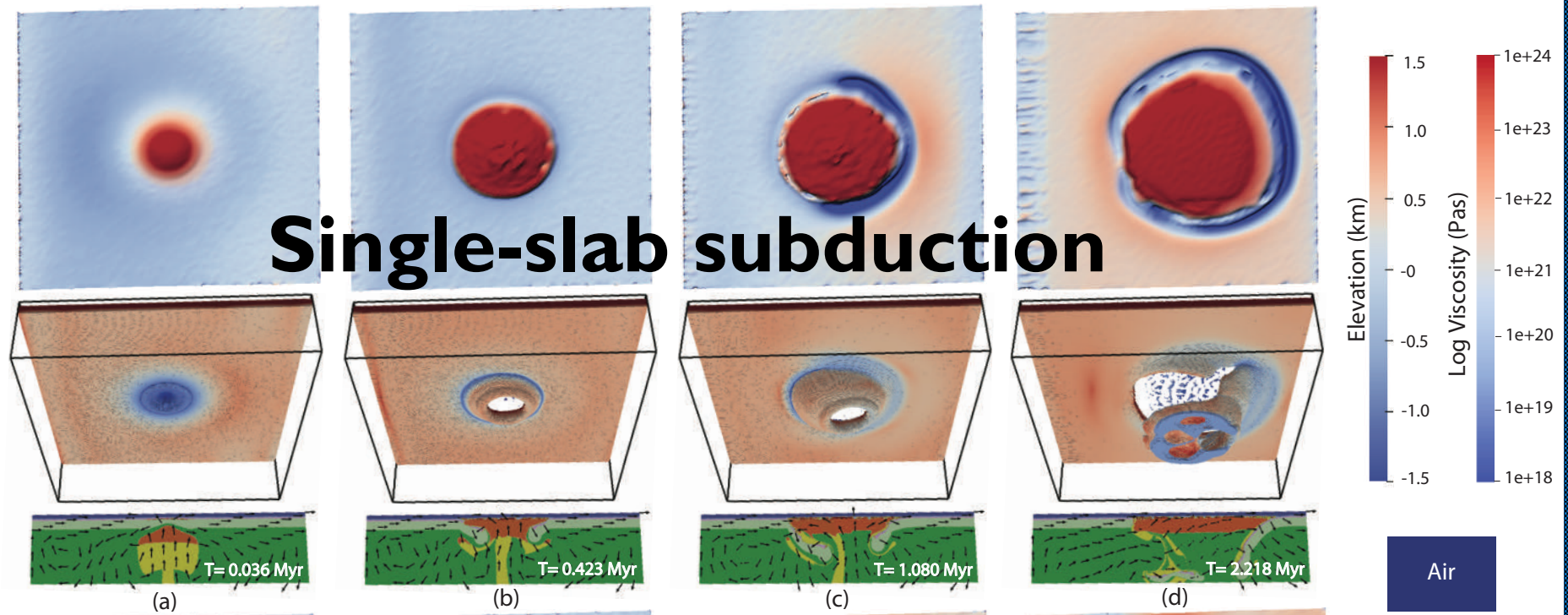
Moving plate

Stationary plate



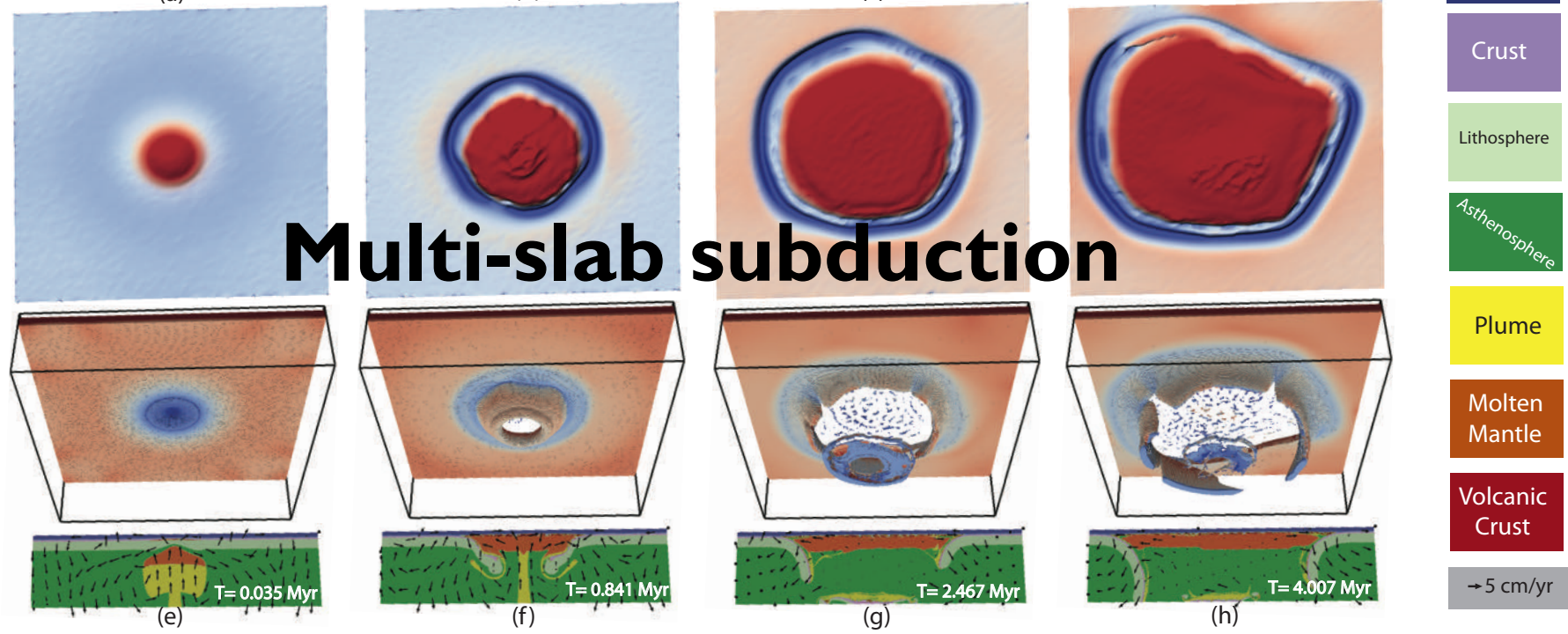
Moving plate

Single-slab subduction

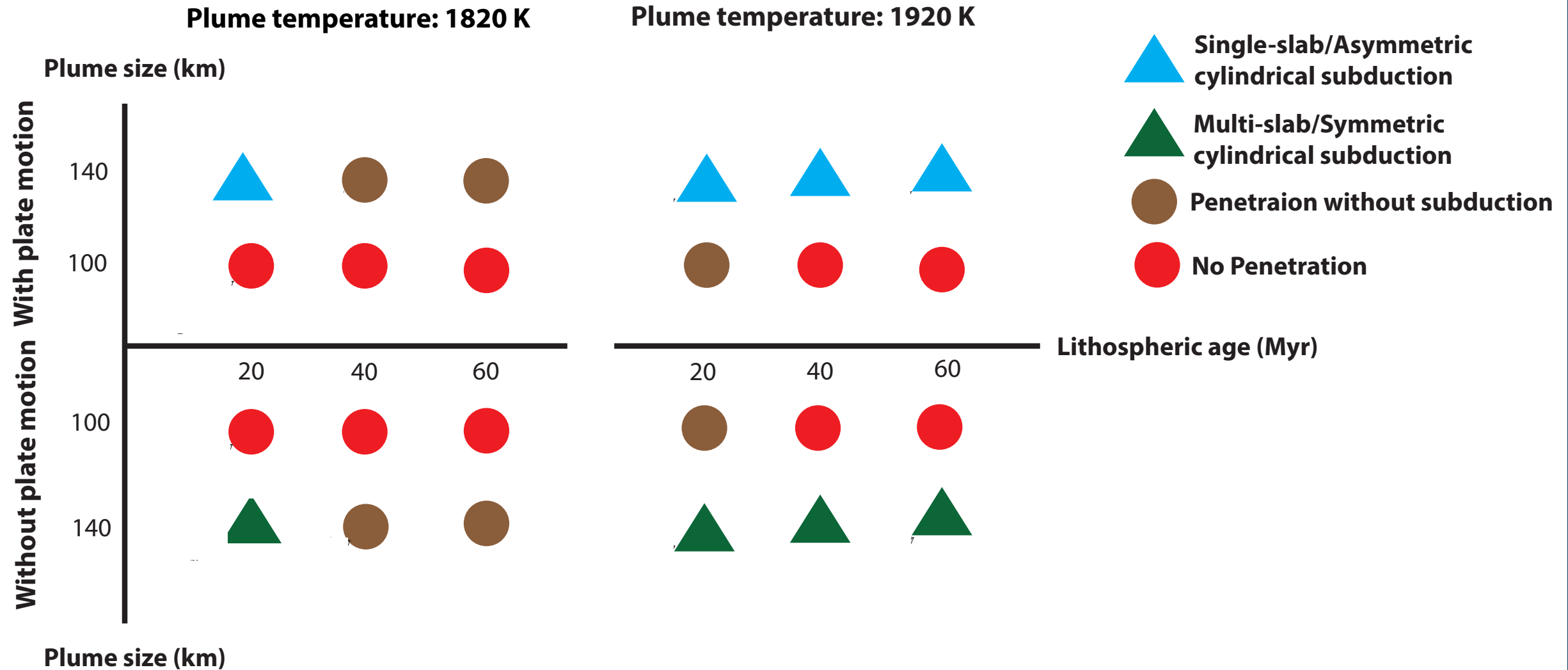


Stationary plate

Multi-slab subduction

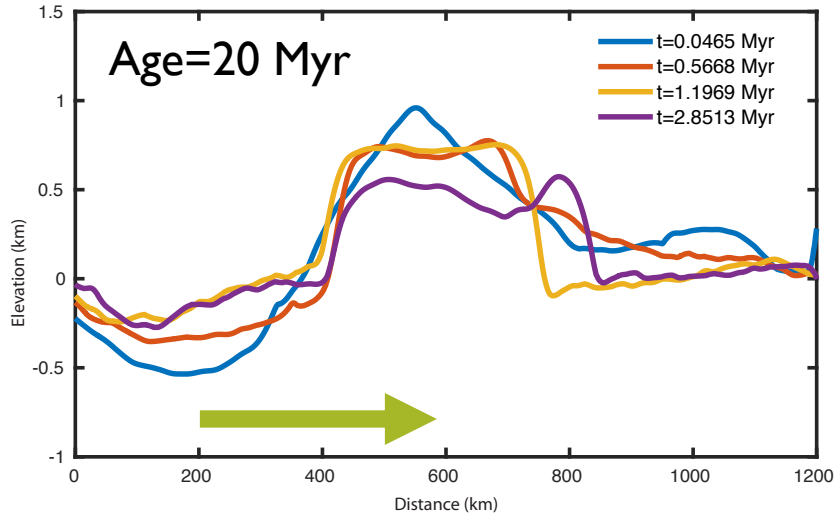


PISI: Effect of plate motion

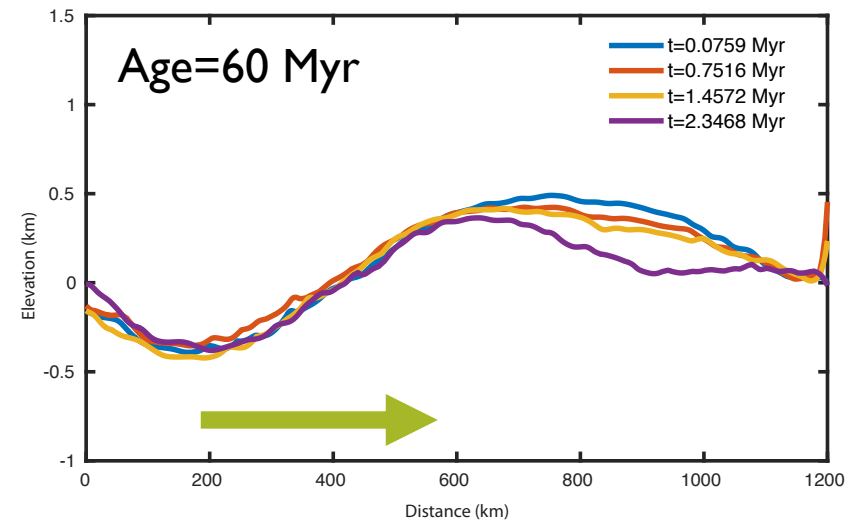


PISI: Effect of plate motion

With plate motion

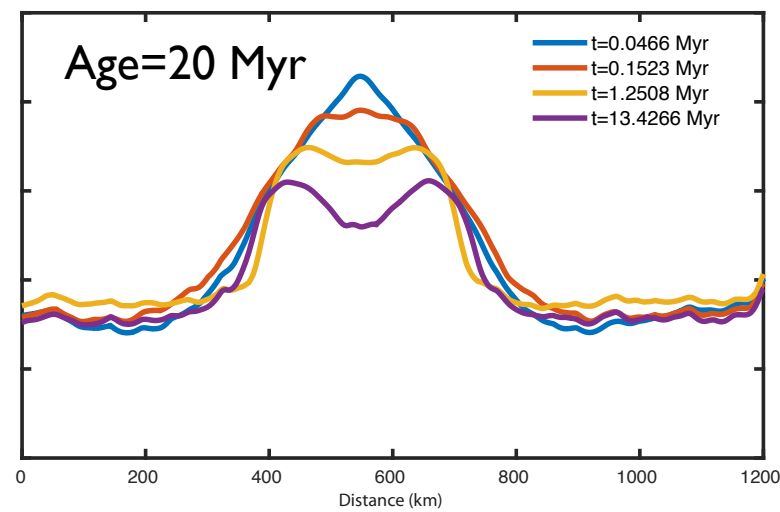


(a)

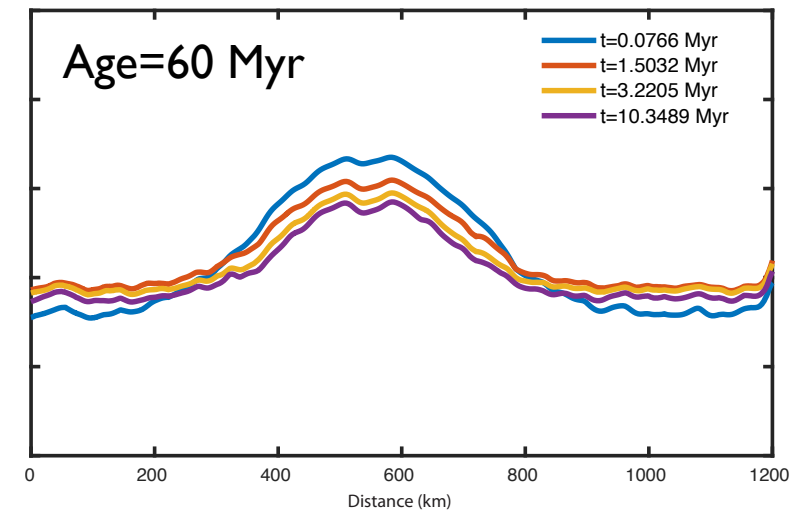


(c)

Without plate motion

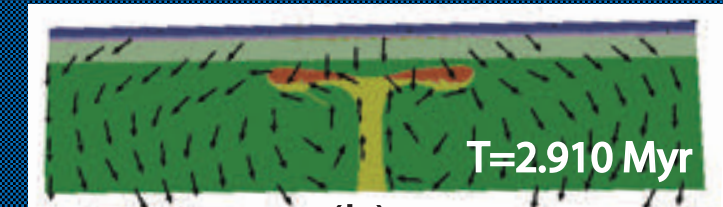


(b)



(d)

Without plate motion



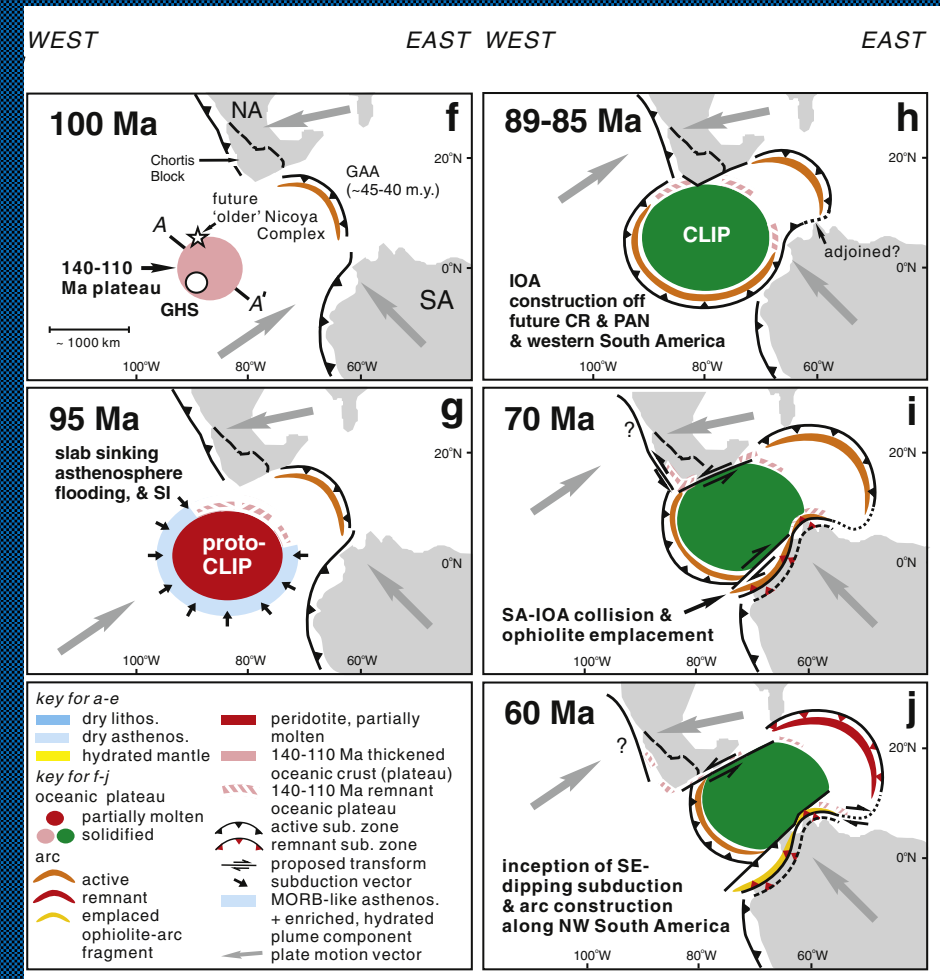
With plate motion



Baes et al., under review

PISI in Caribbean

Single-slab Caribbean subduction could have formed due to the arrival of a sufficiently buoyant plume below a young but subductable lithosphere (20 Myr in our experiments). The eastward motion of Farallon plate could have resulted in breaking off the slab from east side and continuation of subduction in the west.



Summary

- plate motion may notably affect the geometry and dynamics of plume-lithosphere interaction by promoting asymmetry of resulting subduction.
- Lithospheric strength and plume buoyancy are key parameters in penetration of plume and subduction initiation and that the plate speed has no effect.
- Surface topography evolution indicates that due to the plate motion, the size of a newly formed plateau increases in the direction of plate movement.
- Plate motion may have played a key role in formation of the single-slab subduction zone in southern and western margins of the Caribbean Plate at ~100 Ma.