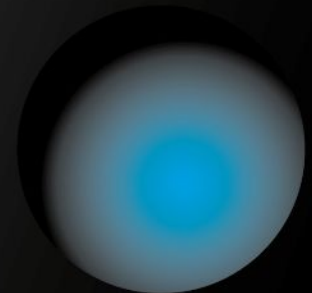


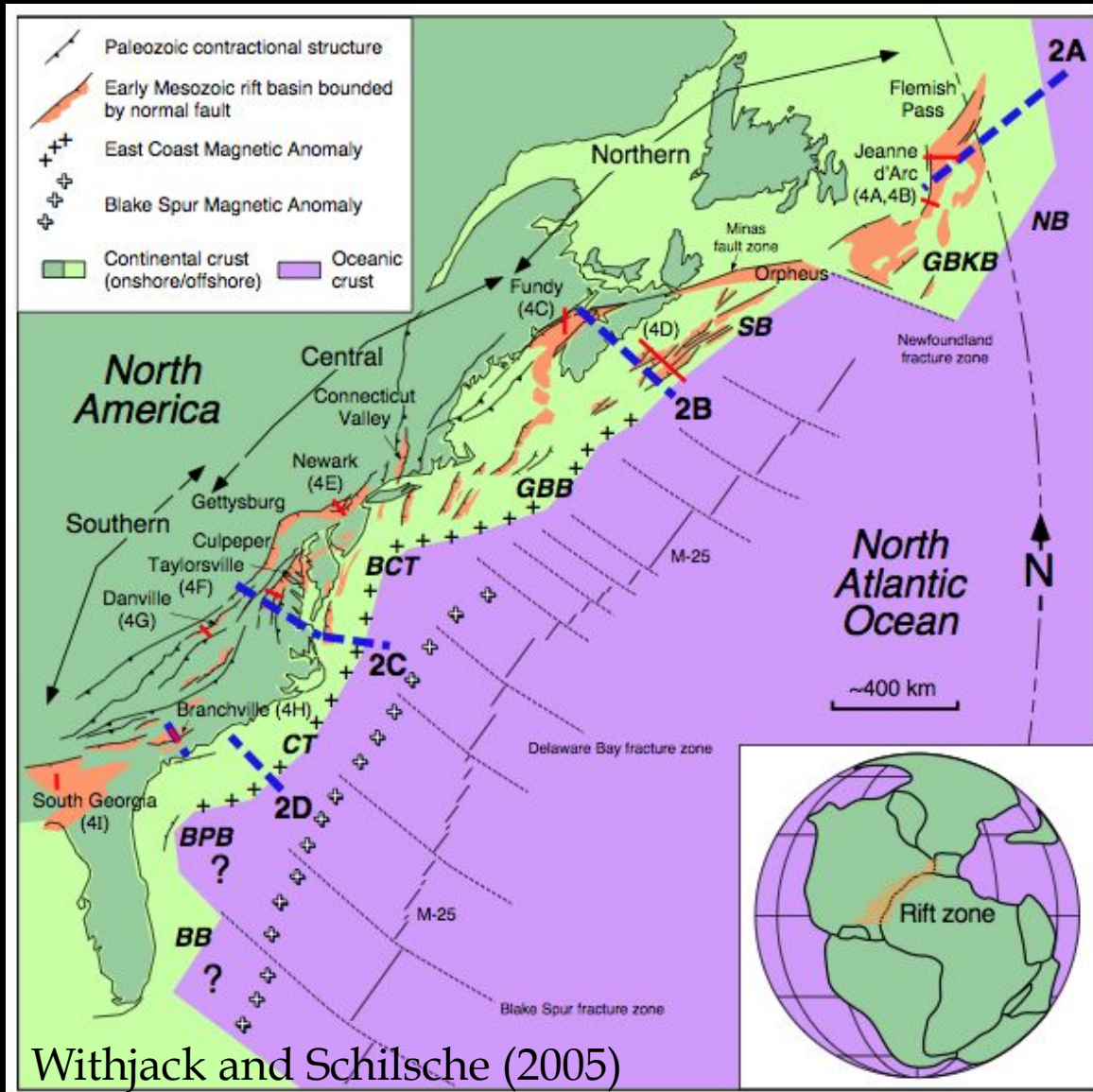


Influence of rheological layering on the formation of offset basins at inherited weak zones during continental rifting: effects of stiff and pliable layers

Pauline Chenin
&
Christopher Beaumont

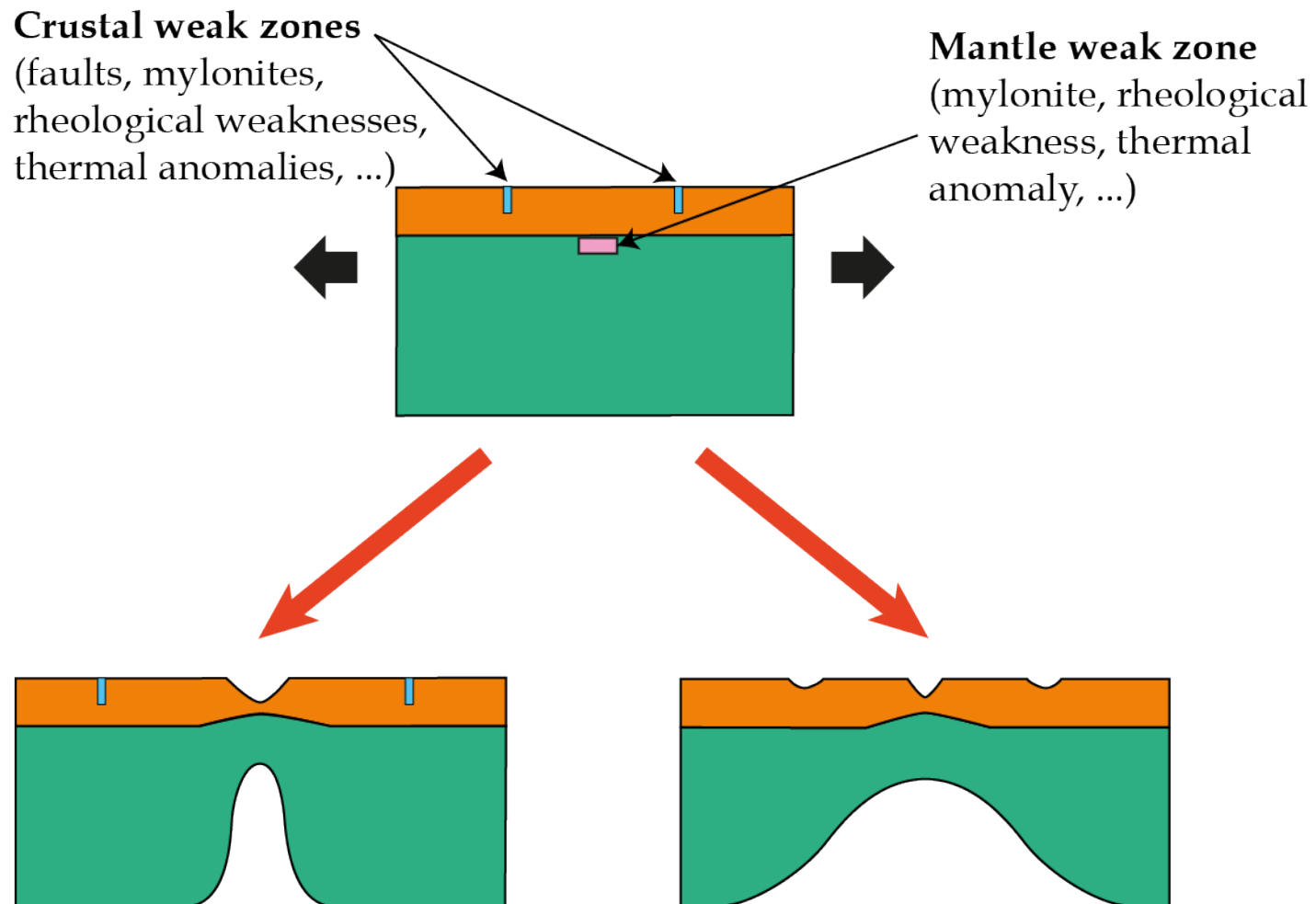


Offset Rift Basins

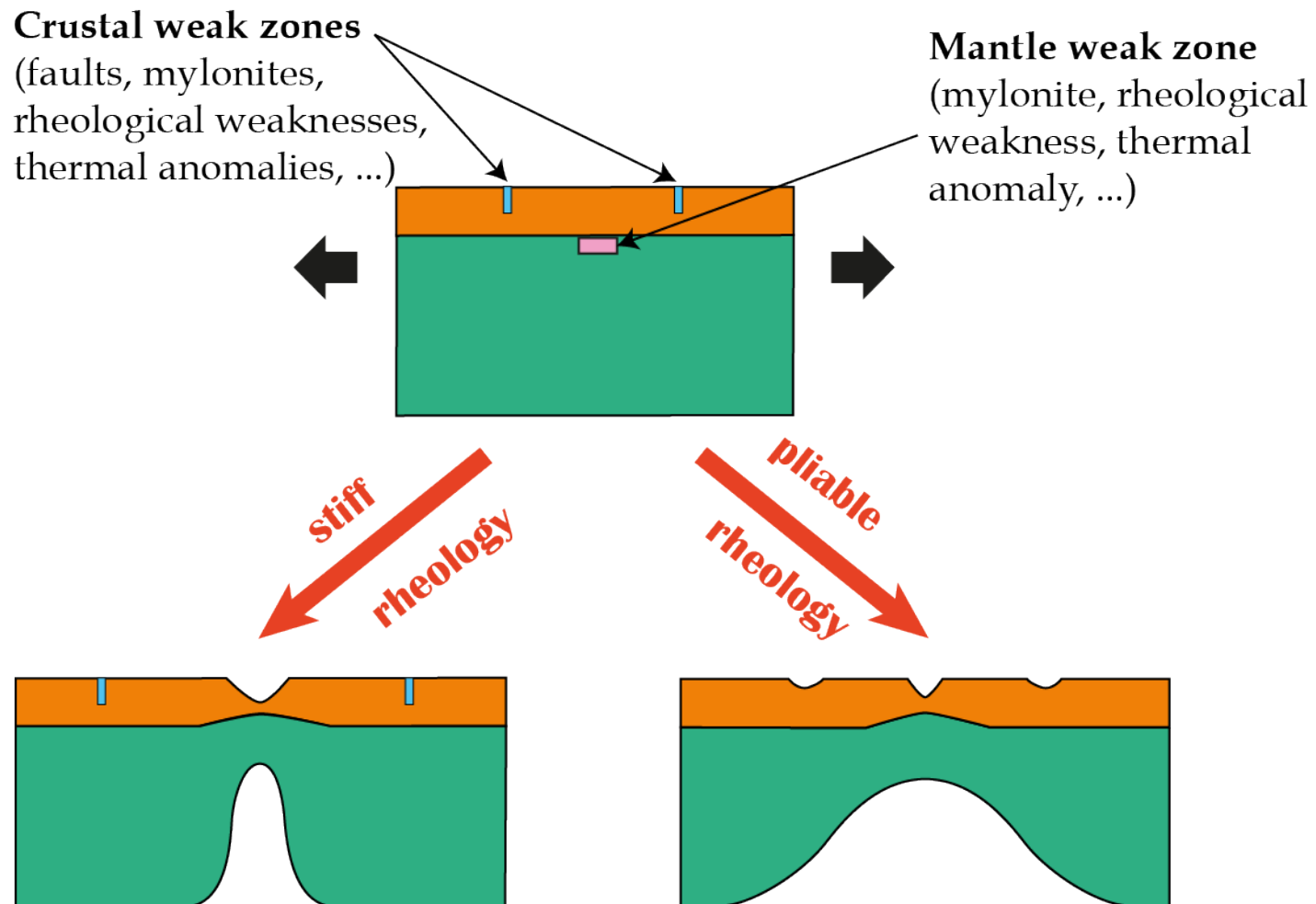


- Ubiquitous features of some continental rifted margins
 - Often develop at previous fold and thrust belts/sutures
- influence of inheritance

Why Offset Basins do not exist at every margins ?



Hypothesis: rheological control



2D thermo-mechanical code: Sopale nested

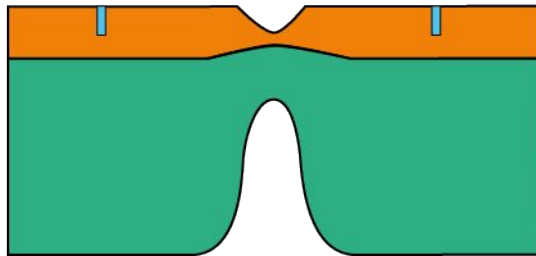
(Fullsack 1995, Beaumont et al. 2009)

Coulomb fracture criterion: $J_2' = P \sin \phi_{\text{eff}} + C \cos \phi_{\text{eff}}$

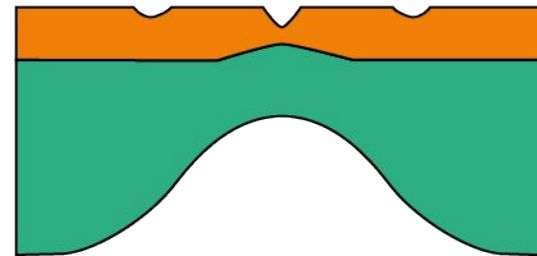
Power law creep: $\eta = A^{-1/n} \left(\dot{I}_2' \right)^{\frac{1-n}{2n}} \exp \left(\frac{Q + PV^*}{n R T} \right)$
viscosity

→ scaling factor f : $\eta_s = f \eta$
scaled viscosity

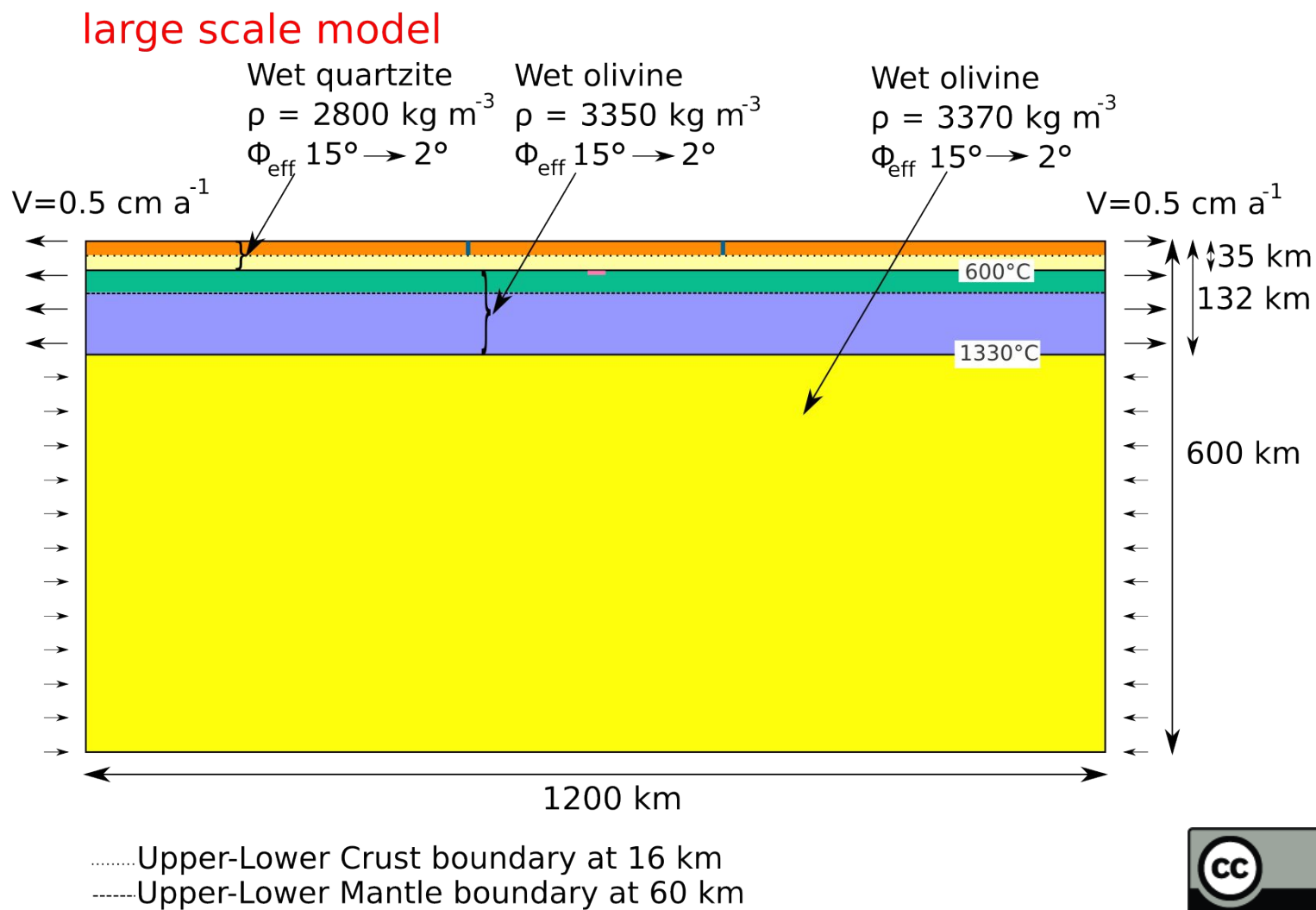
$f \sim 100 \leftrightarrow$ Stiff (plastic)



$f \sim 1 \leftrightarrow$ Pliable (ductile)

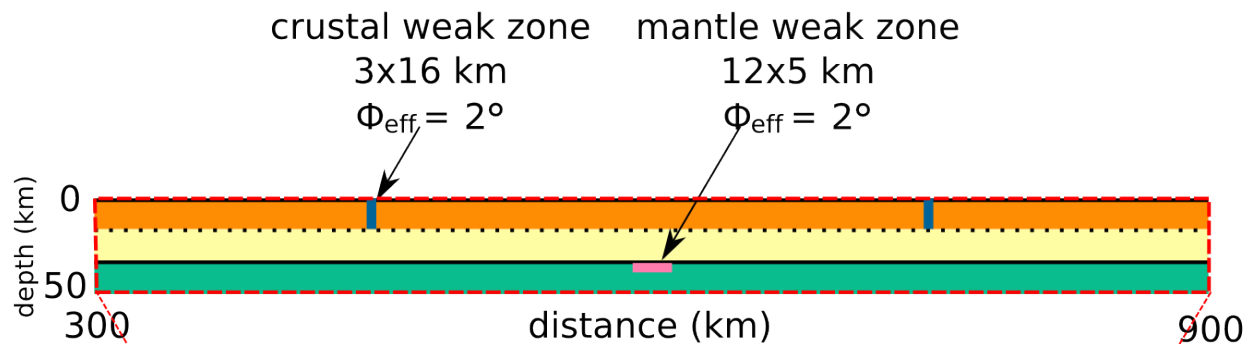


Model design

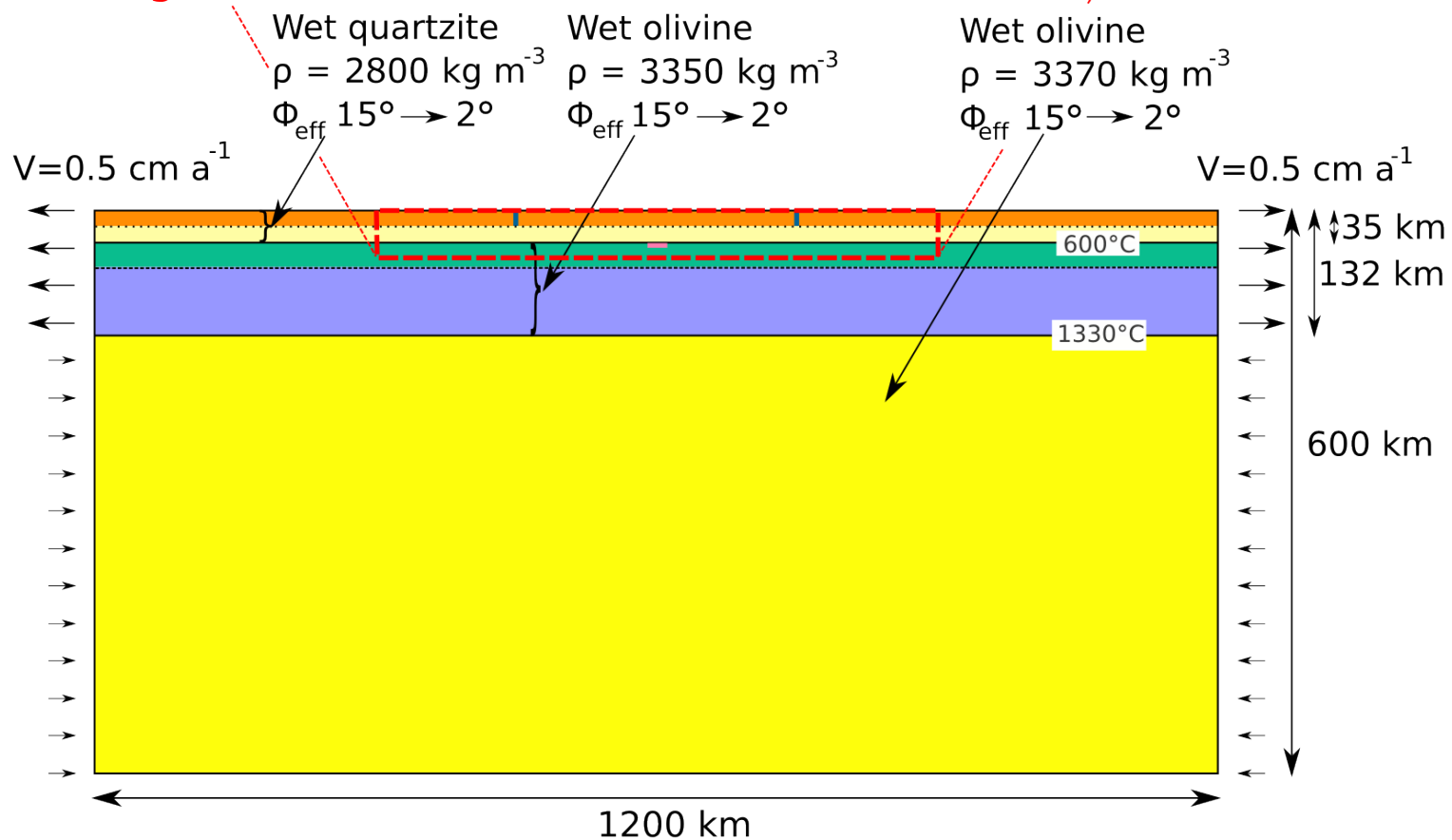


Model design

small scale model



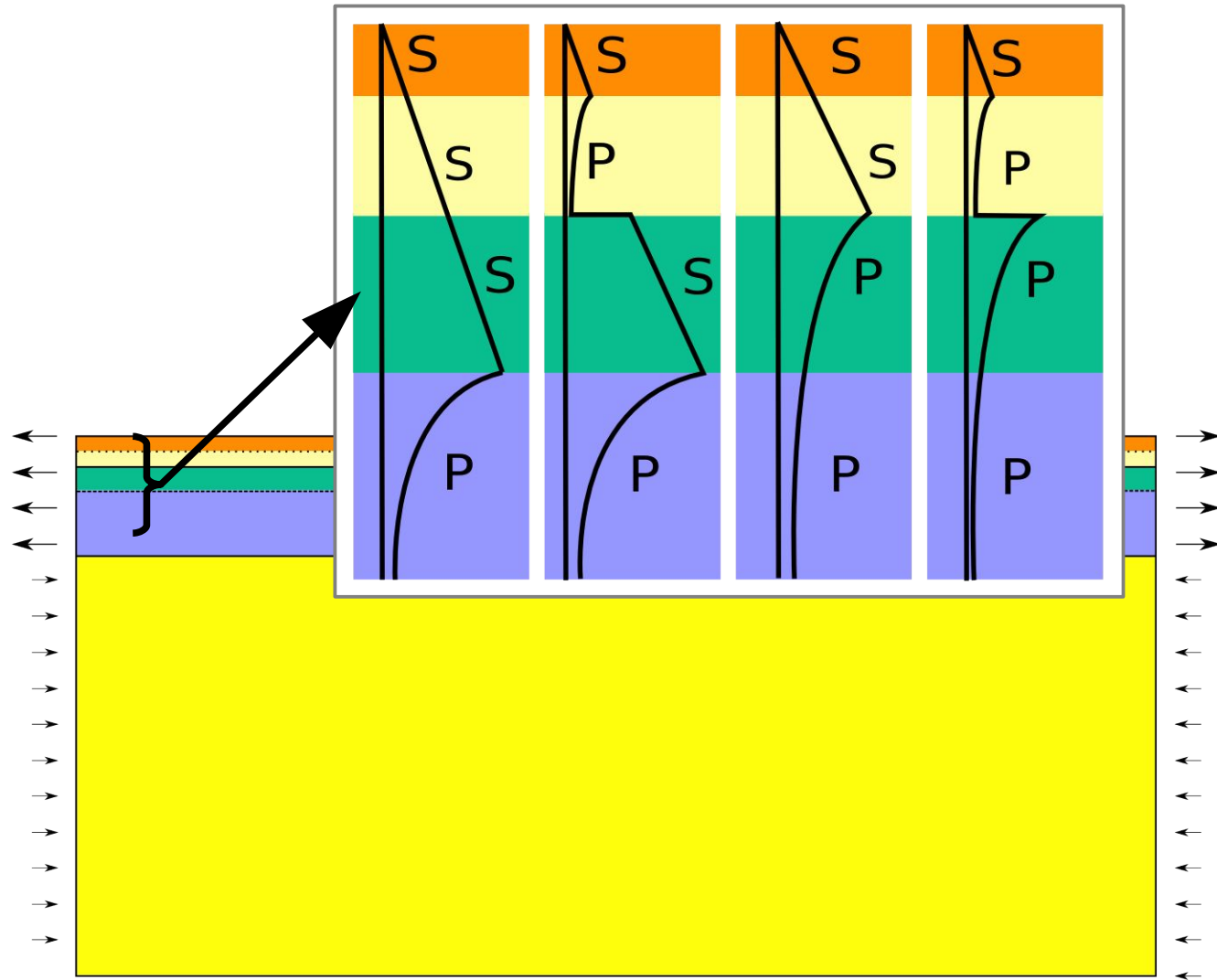
large scale model



.....Upper-Lower Crust boundary at 16 km
Upper-Lower Mantle boundary at 60 km

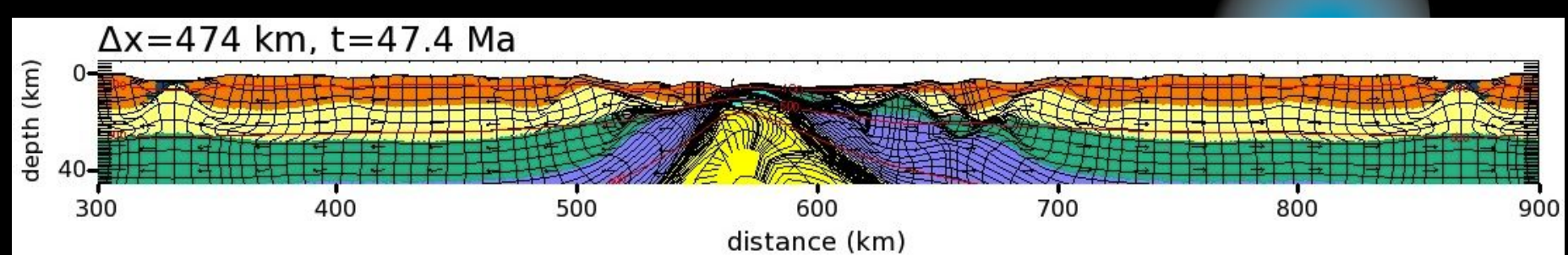
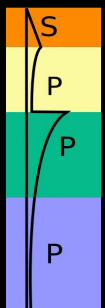
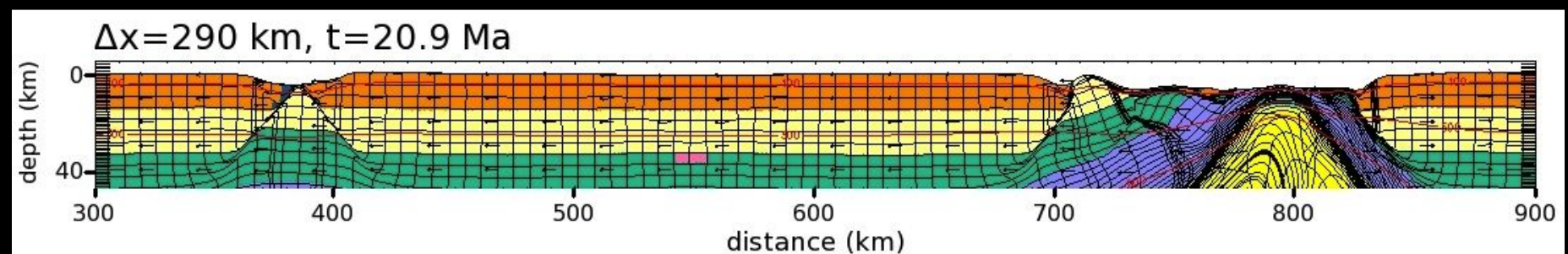
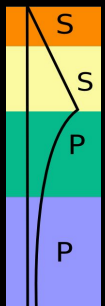
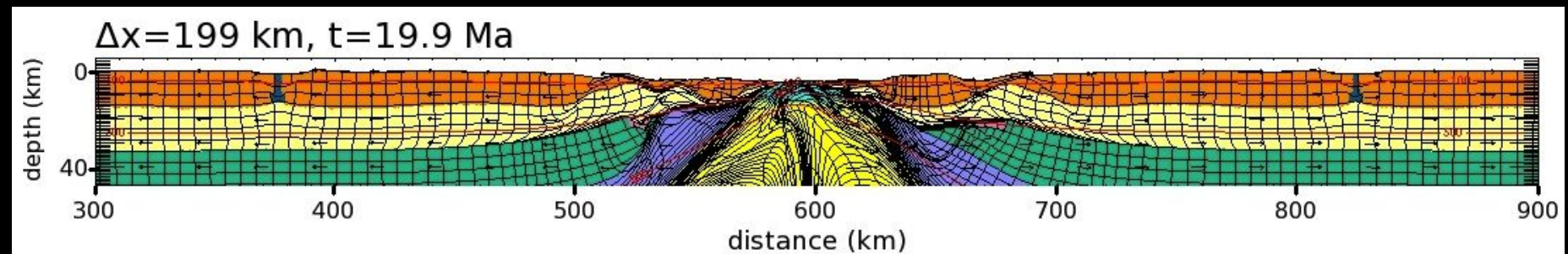
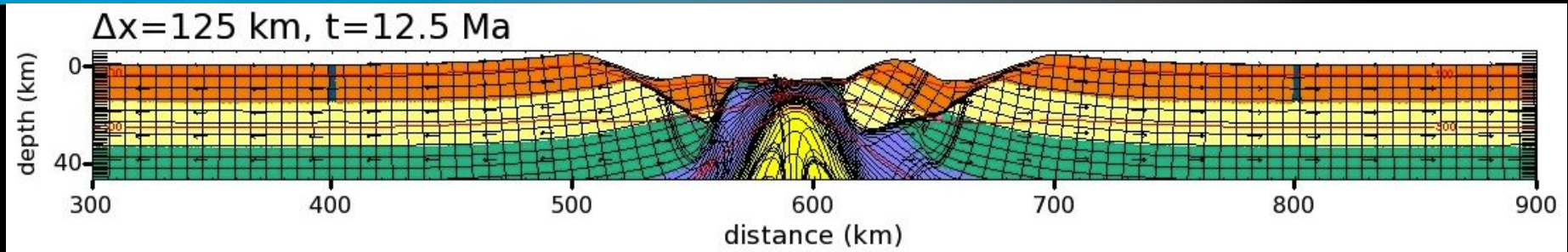
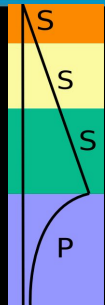
Model design

S = Stiff
P = Pliable

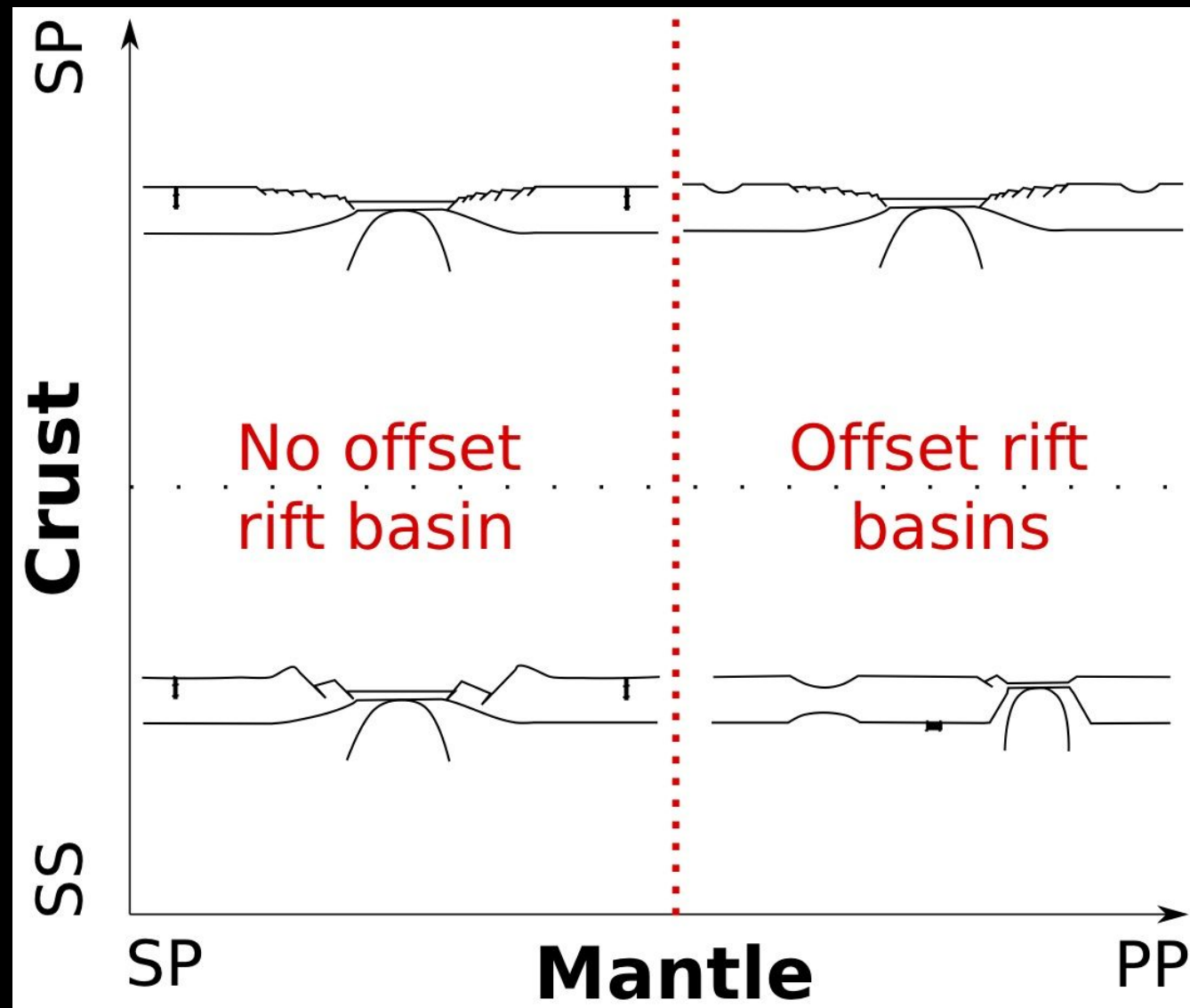


Results: rifting stage

S = Stiff
P = Pliable



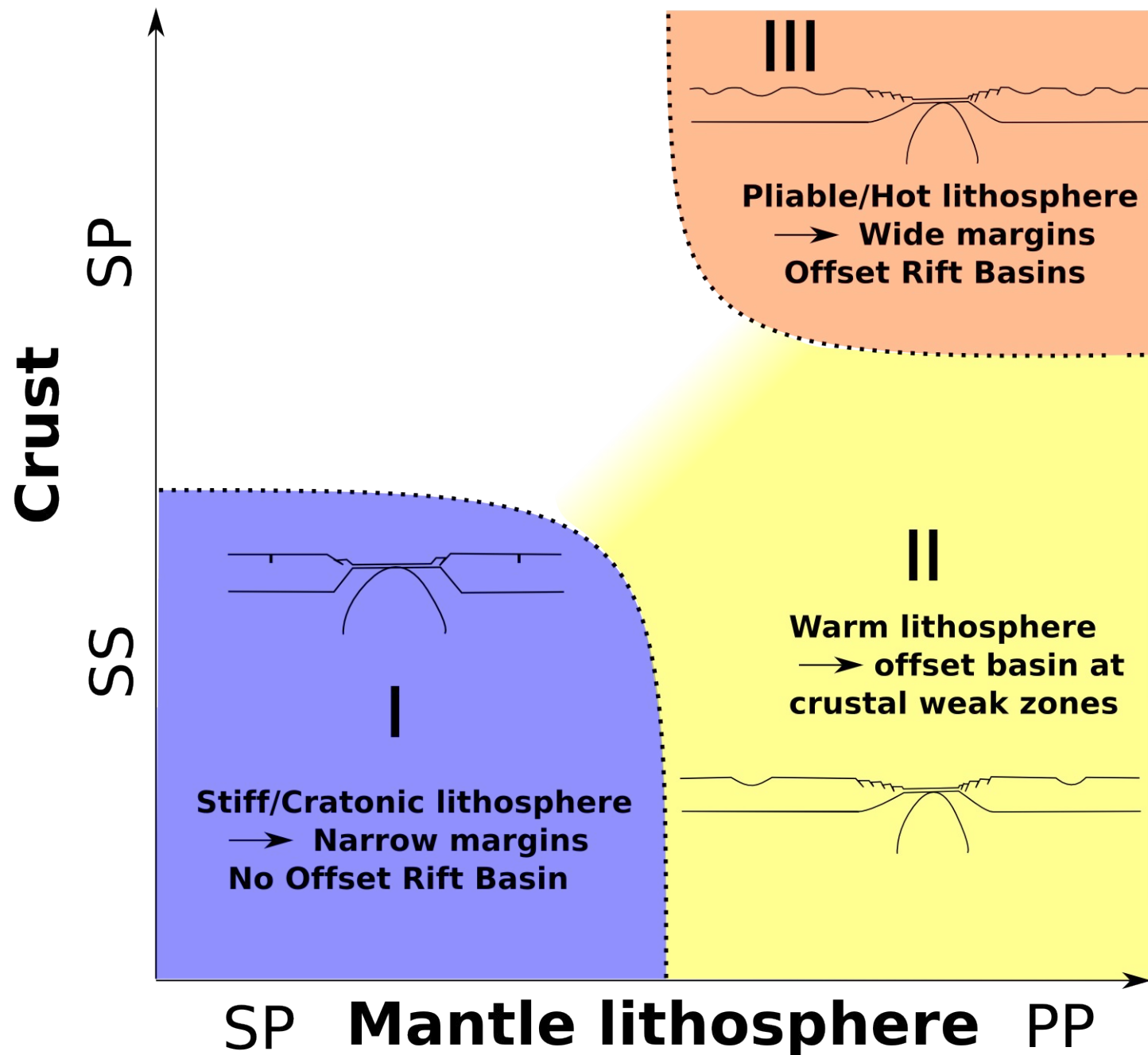
Results summary



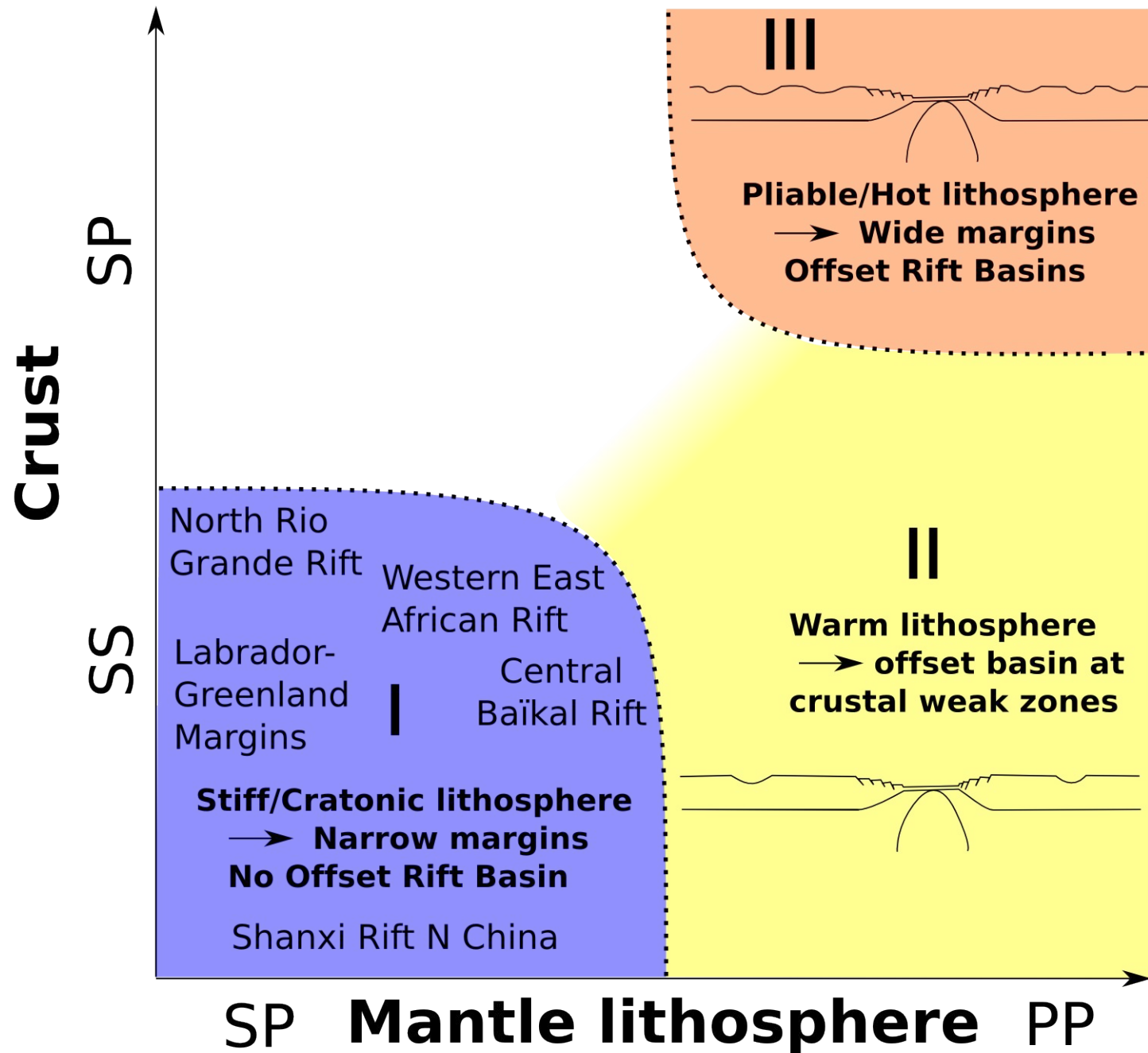
Stiff upper mantle
→ Early localization at the mantle weak zone, thus no offset basin

Pliable upper mantle
→ Protracted extension and formation of offset rift basins

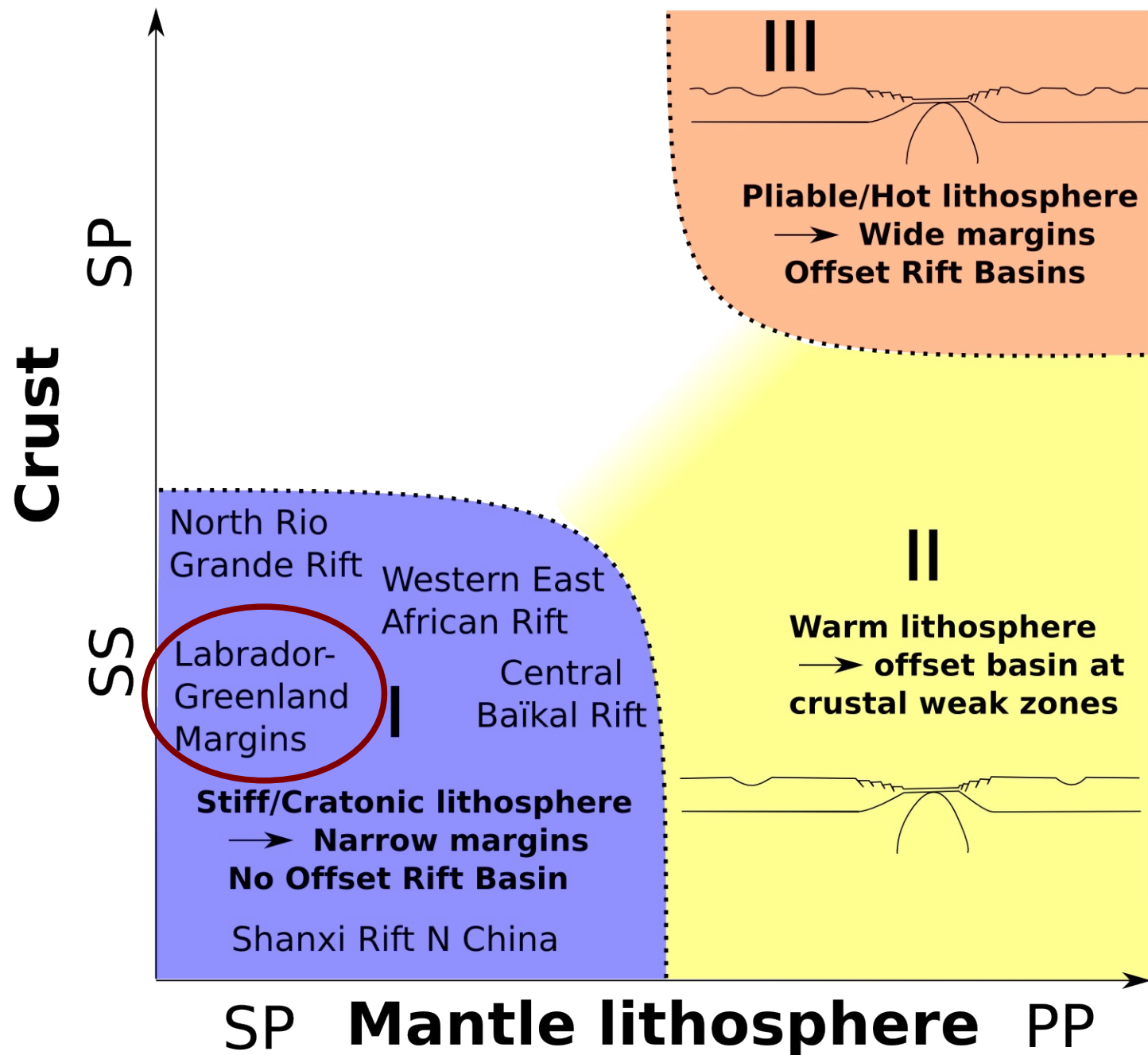
Tectonic Styles Diagram

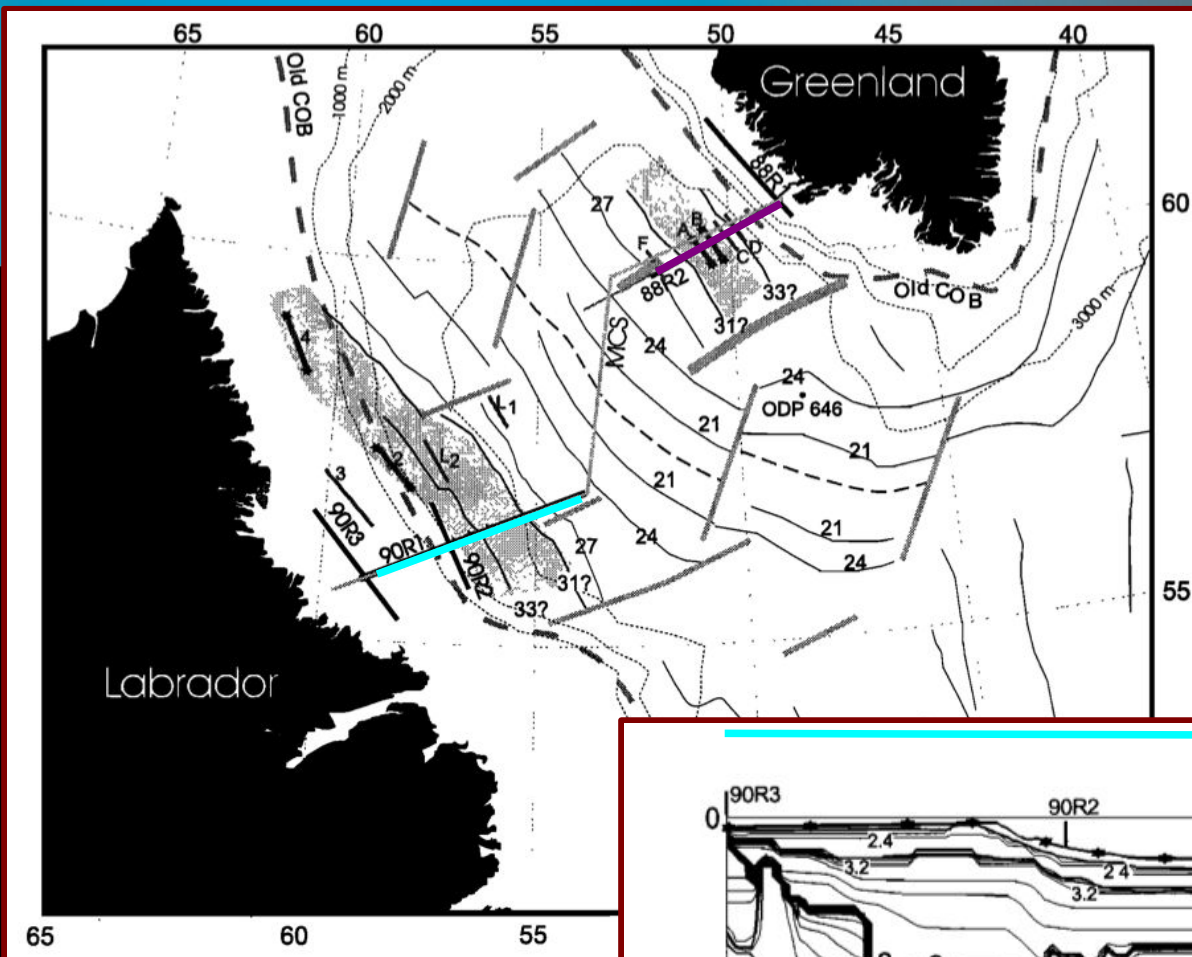


Tectonic Styles Diagram

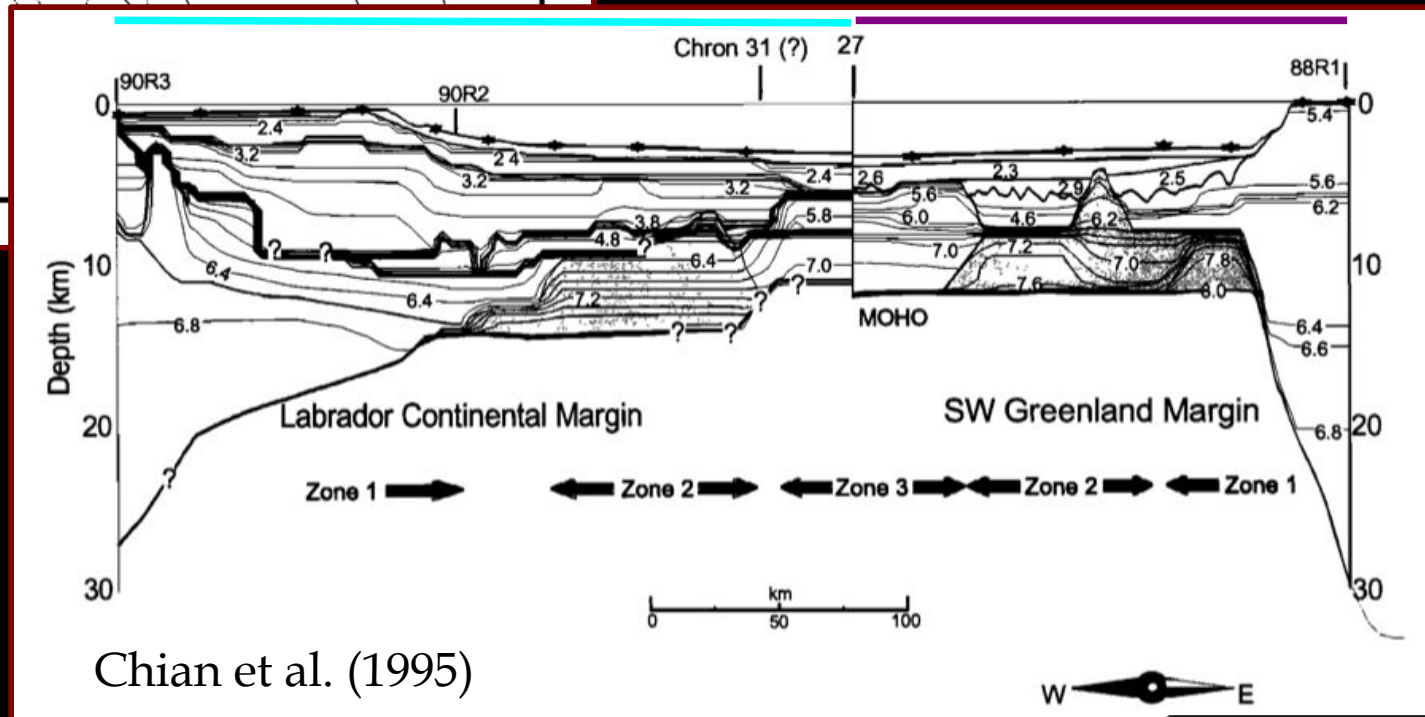


Tectonic Styles Diagram



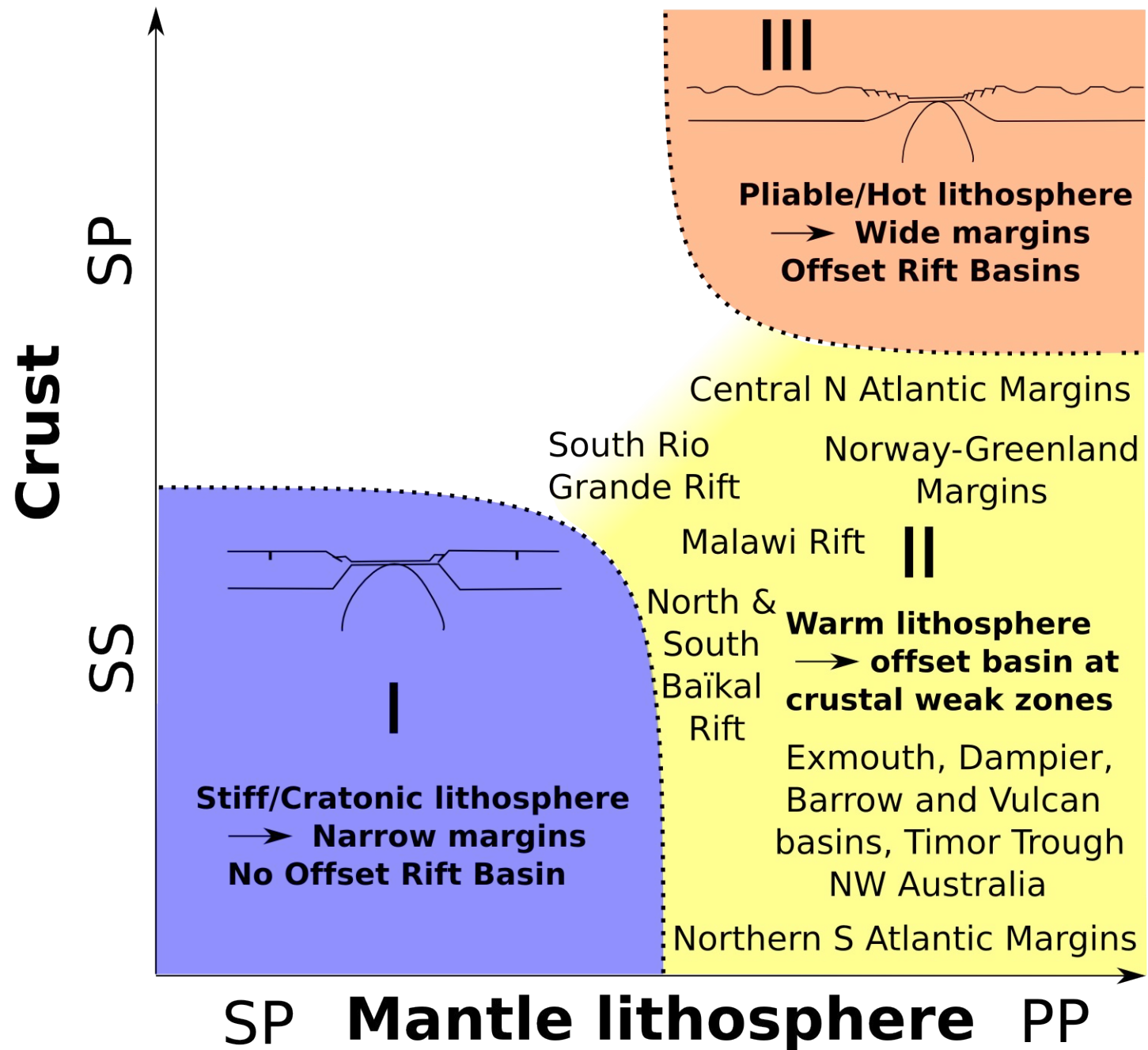


Labrador - Greenland margins

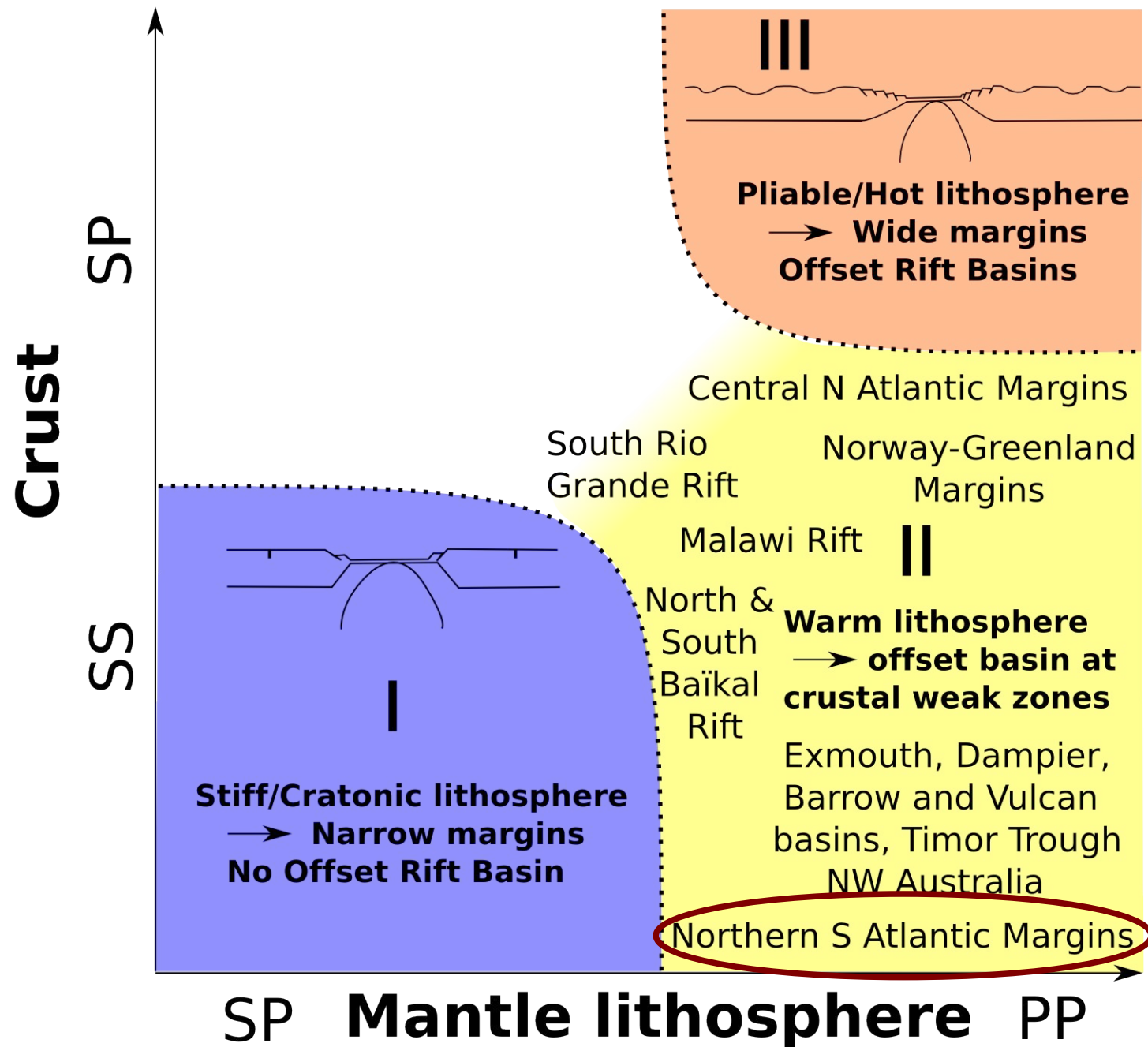


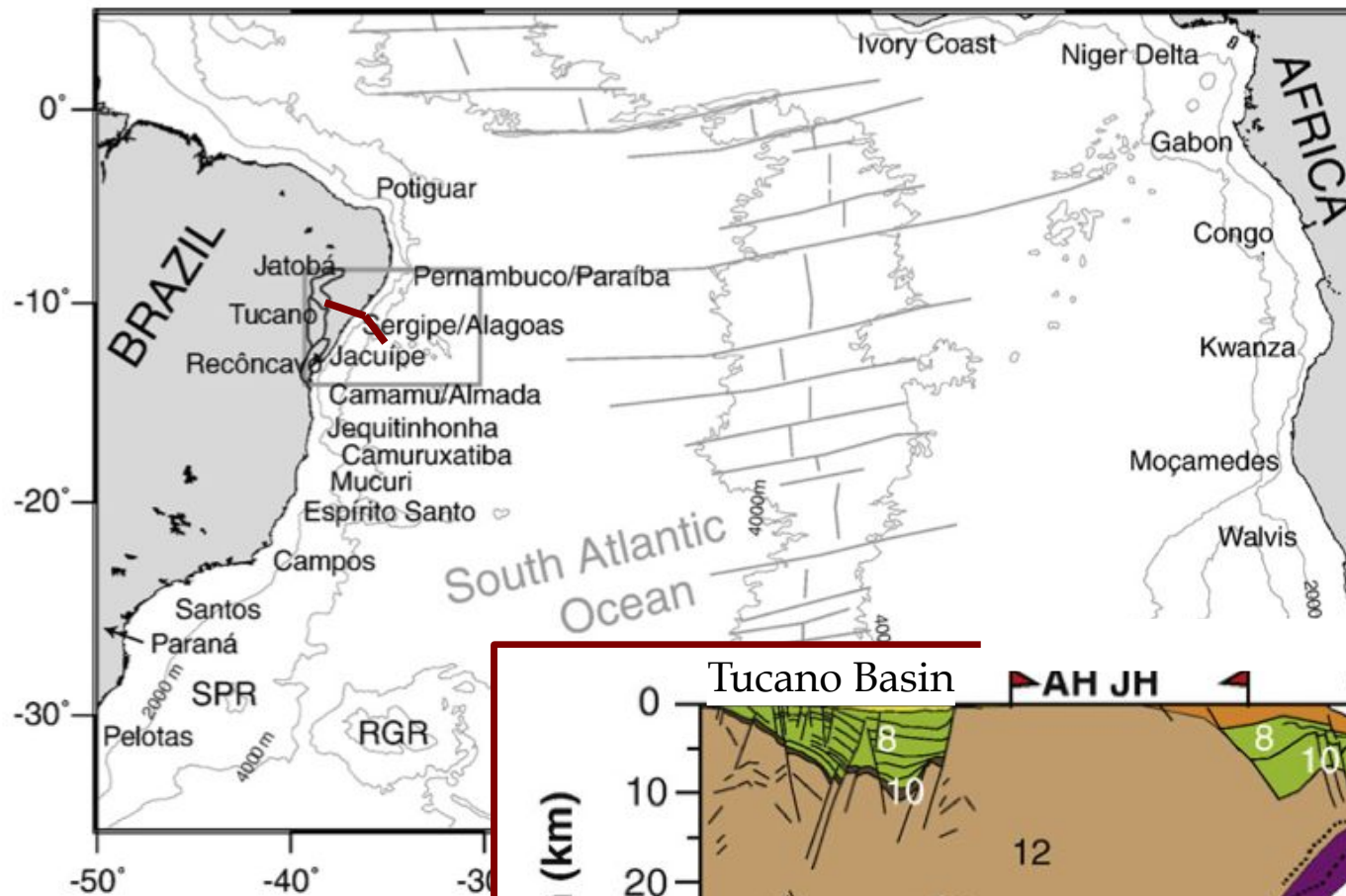
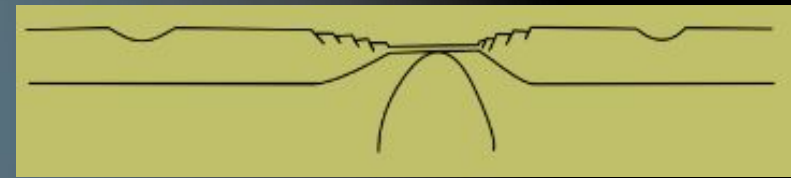
Chian et al. (1995)

Tectonic Styles Diagram

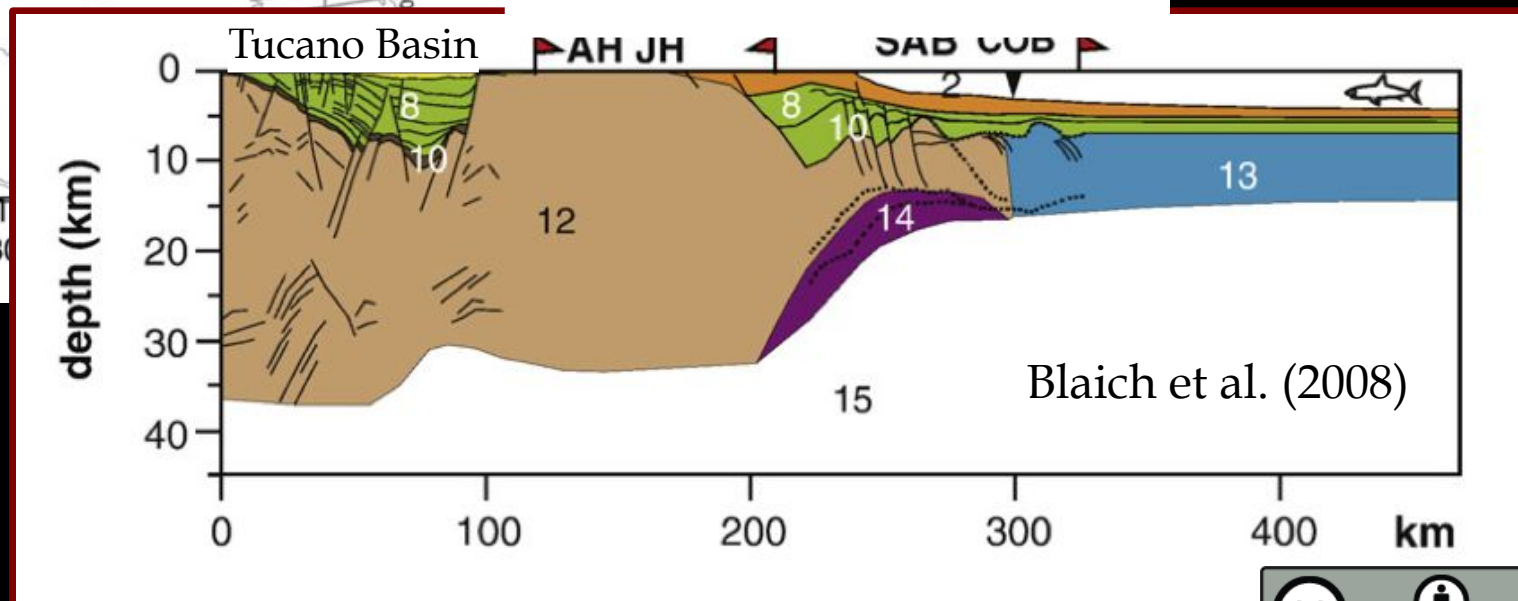


Tectonic Styles Diagram

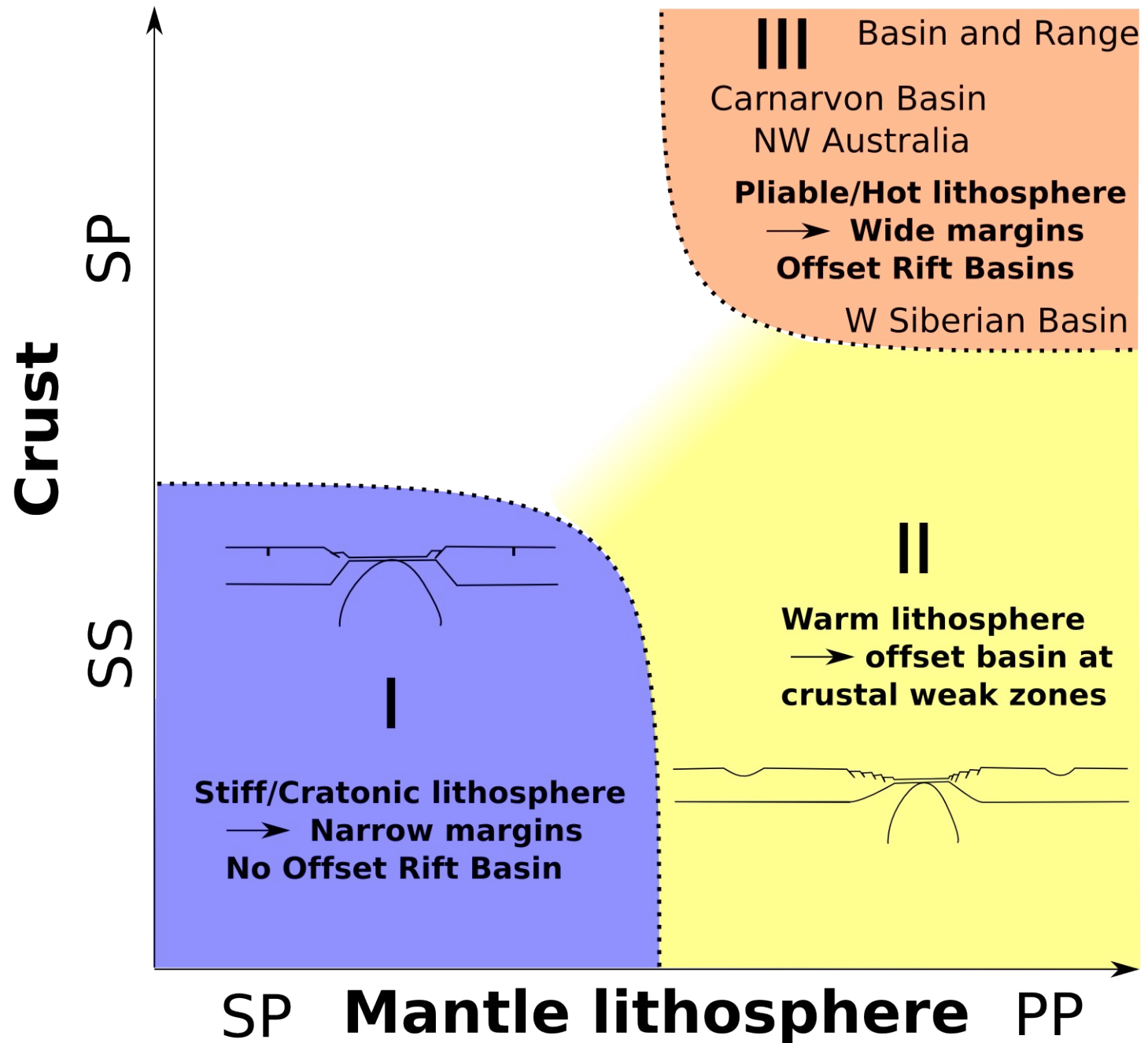




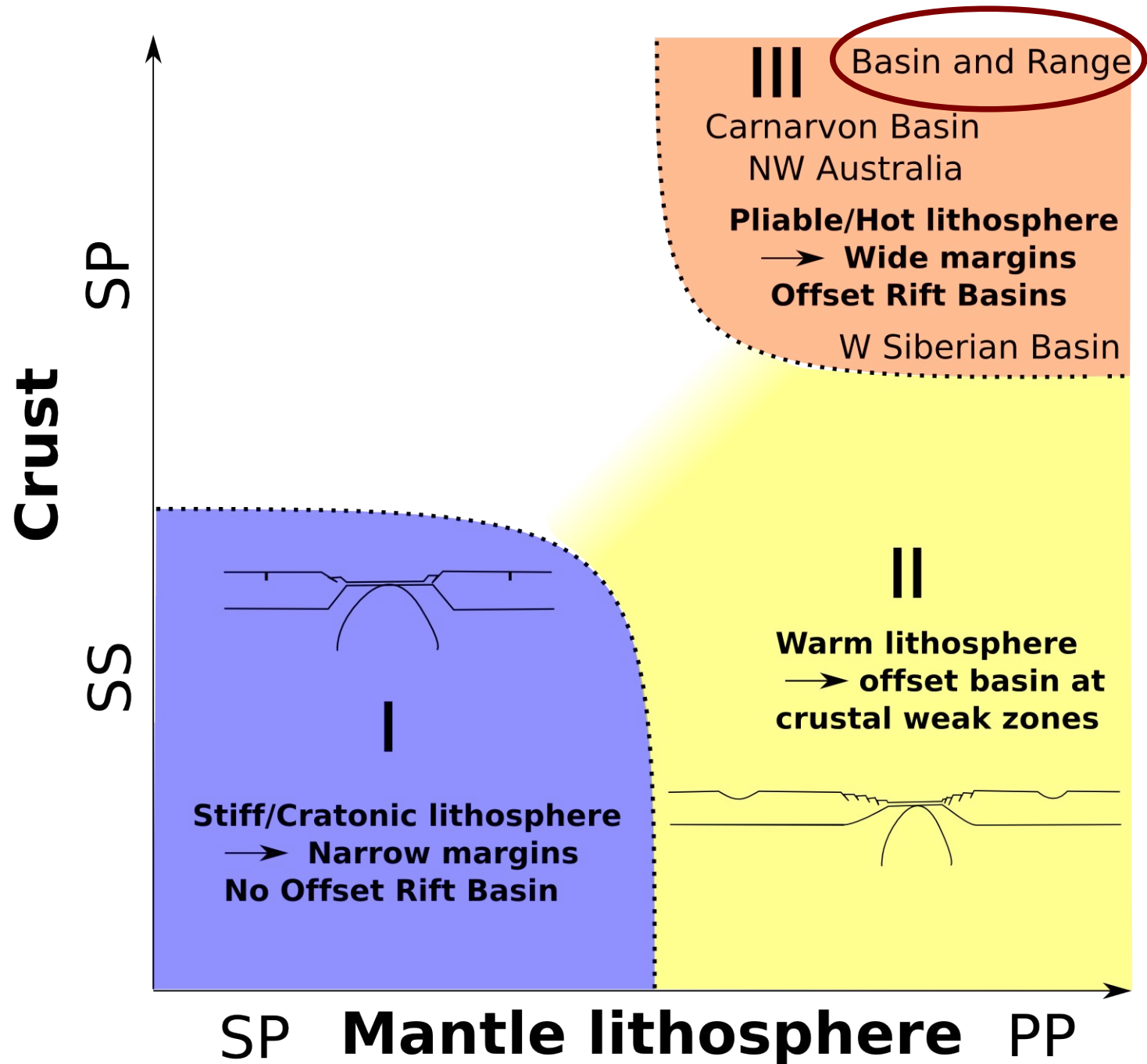
Jacuipe - Sergipe - Alagoas margins (Brazil)

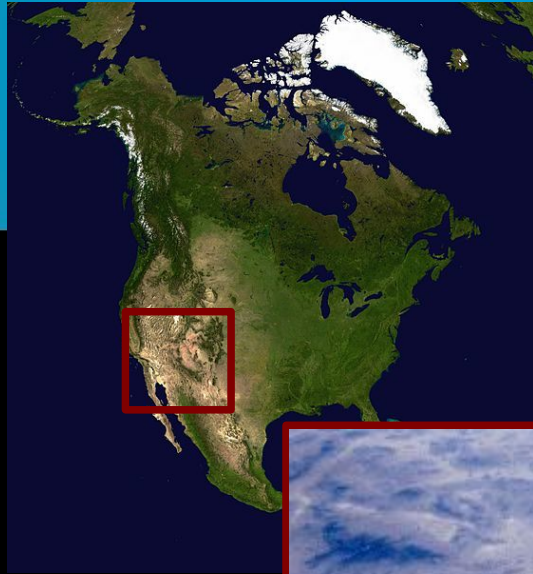


Tectonic Styles Diagram

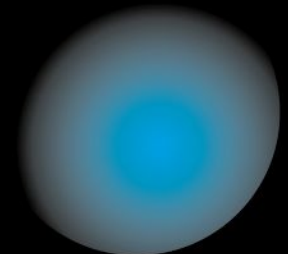
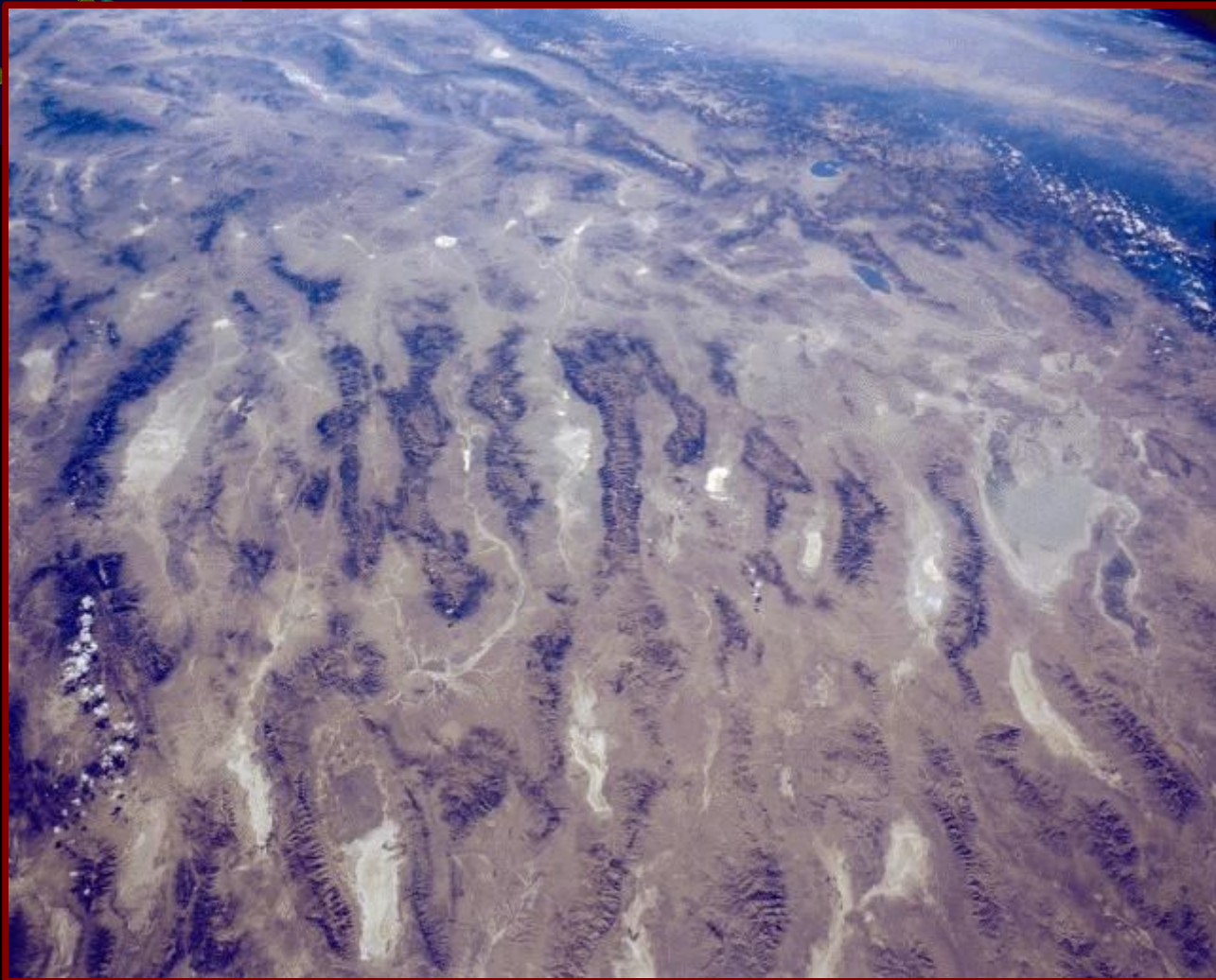


Tectonic Styles Diagram





Basin and Range Province



Summary & Conclusions

Offset Rift Basins formation at inherited weak zones depends on the **rheology of the layers containing the weaknesses**:

✧ **Stiff layer** \leftrightarrow Early localisation and **rapid necking** \rightarrow **no offset rift basin**

✧ **Pliable layer** \leftrightarrow Slow localisation and **protracted extension** \rightarrow **formation of basins at offset weak zones**

Further details in:

Chenin and Beaumont

Influence of offset weak zones on the development of rift
basins: activation and abandonment during continental
extension and breakup
(accepted in JGR)

<http://onlinelibrary.wiley.com/doi/10.1002/jgrb.50138/abstract>

