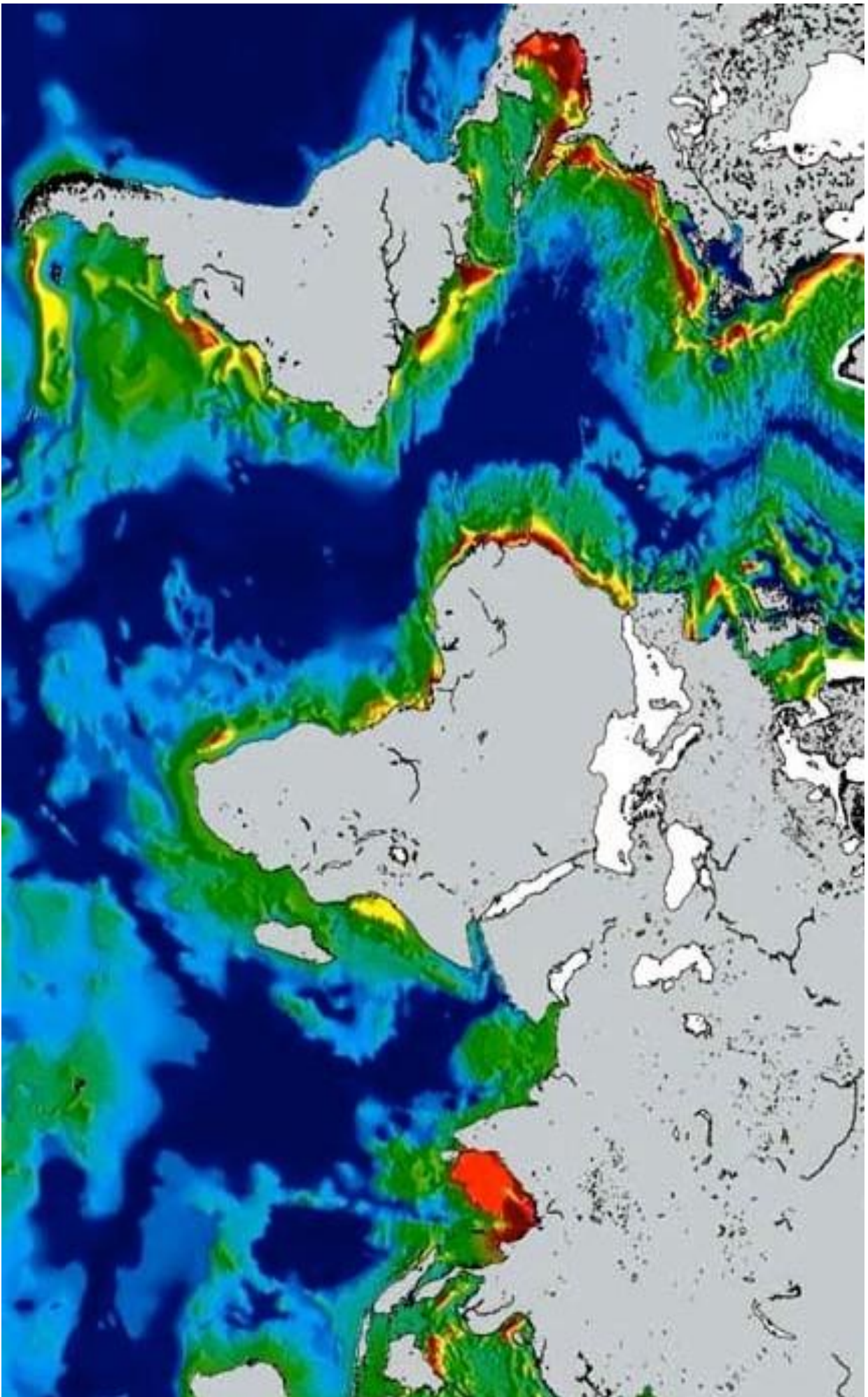
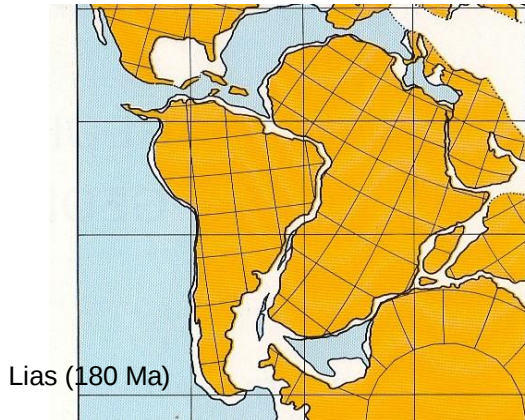


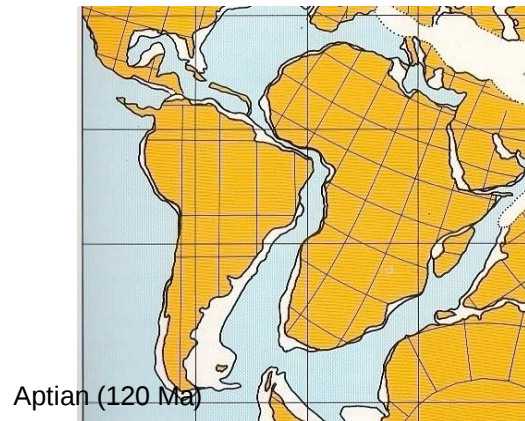
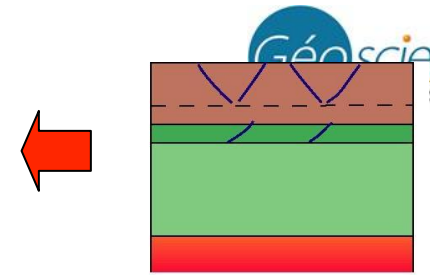
2.1.2. Passive margins



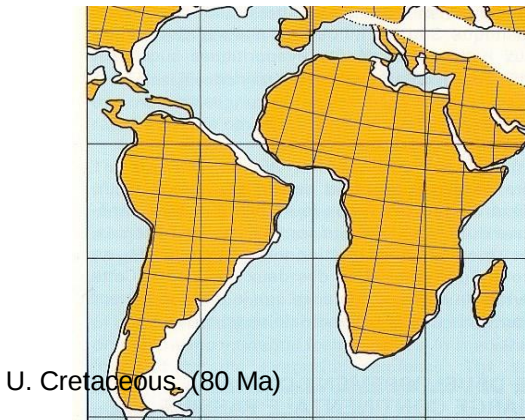
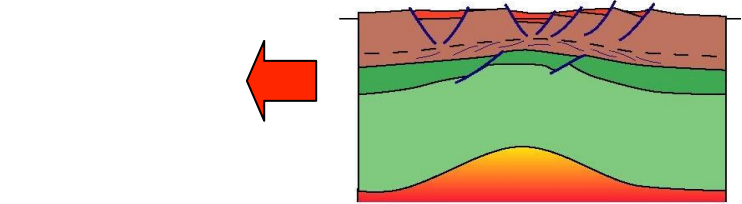
From rift to passive margin



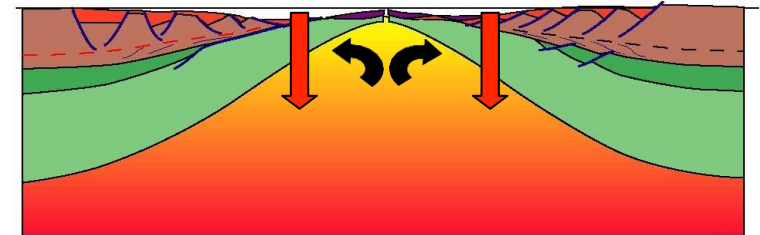
Stage « rift »



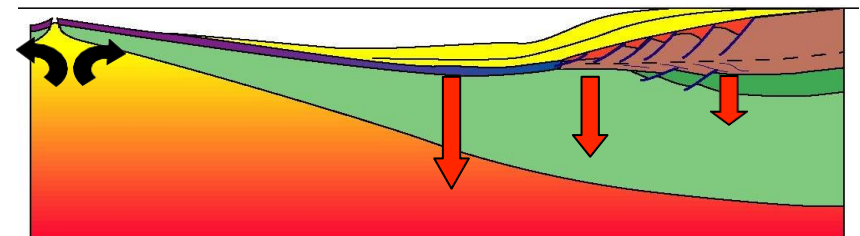
Stage « break-up »



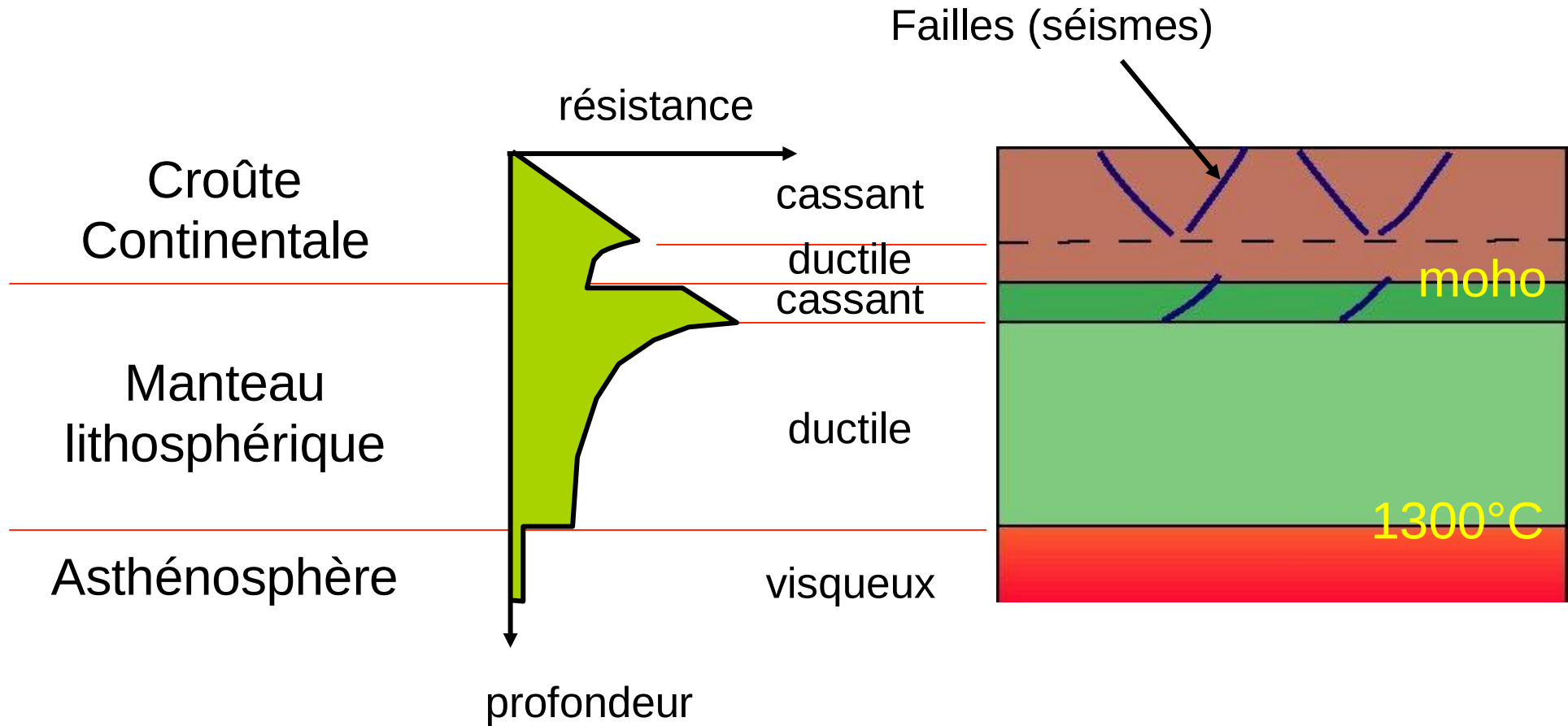
Stage
« young margin »



Stage
« mature margin »



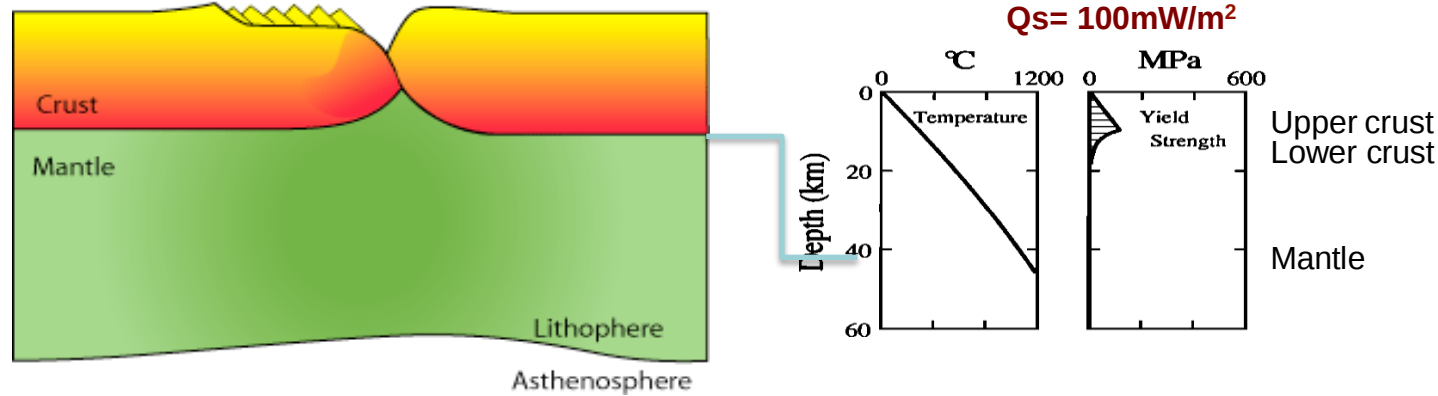
From rift to passive margin : lithosphere deformation



État initial

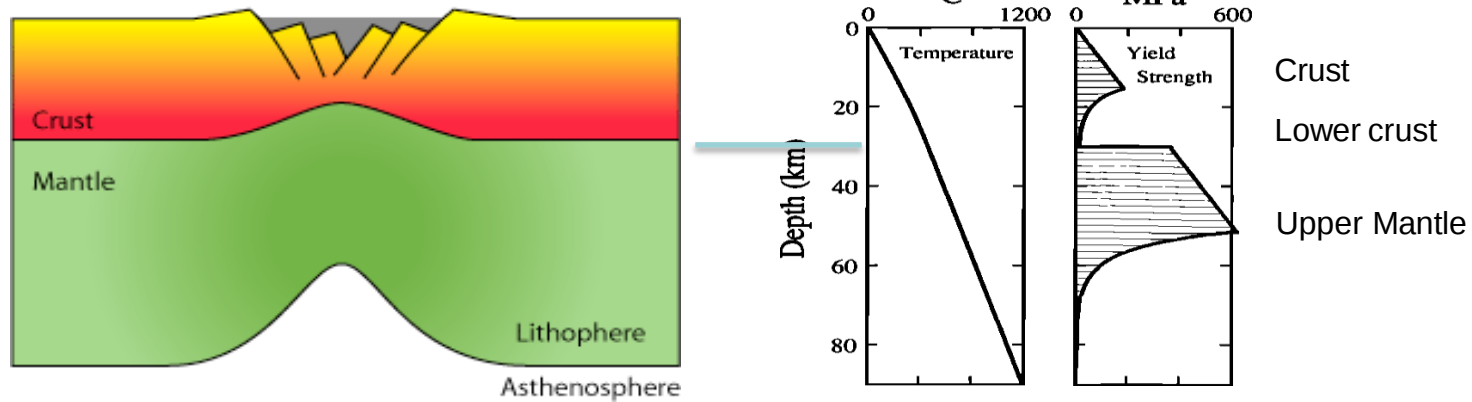
(Lithosphere rheology : initial conditions)

Core Complex Mode



« crème brûlée »

Narrow Rift Mode

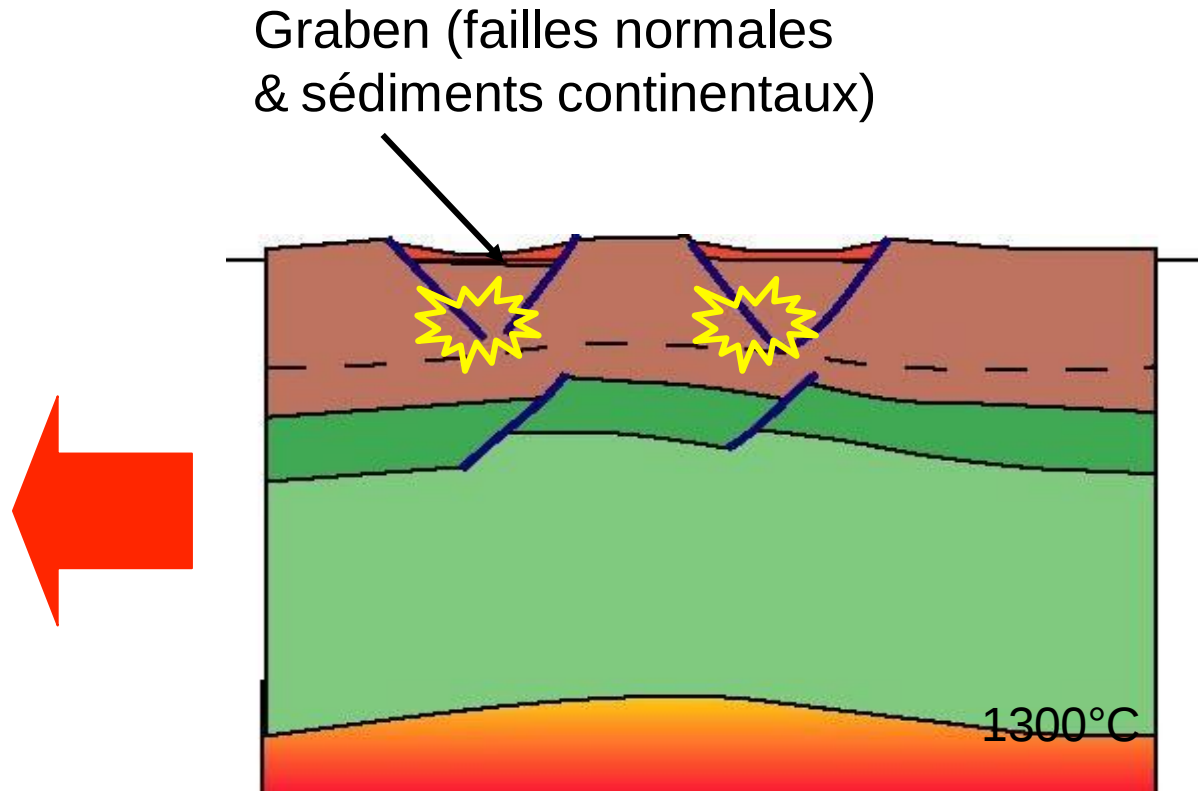


« Jelly sandwich »

Burov & Watts 2006

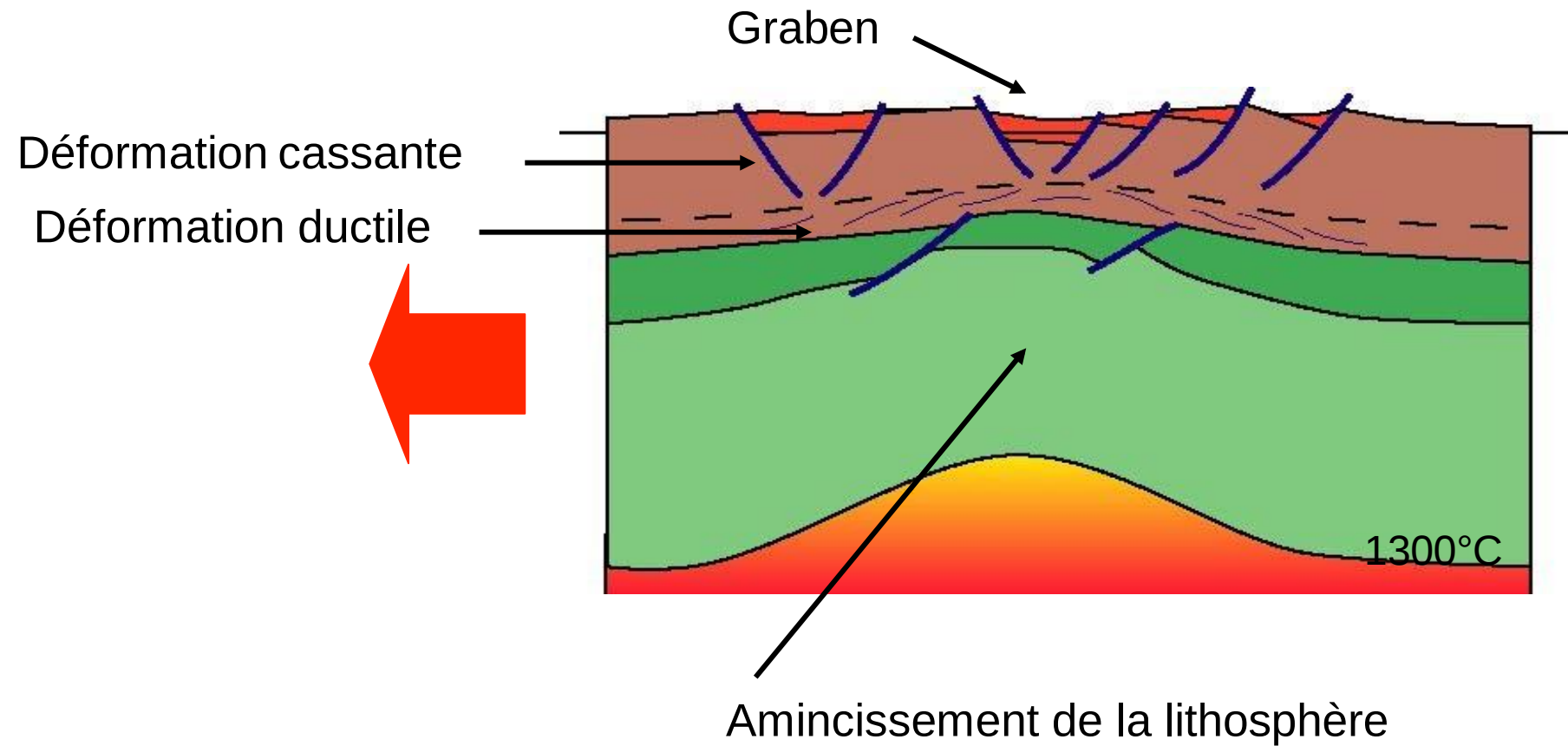
Buck, 1991

From rift to passive margin : lithosphere deformation



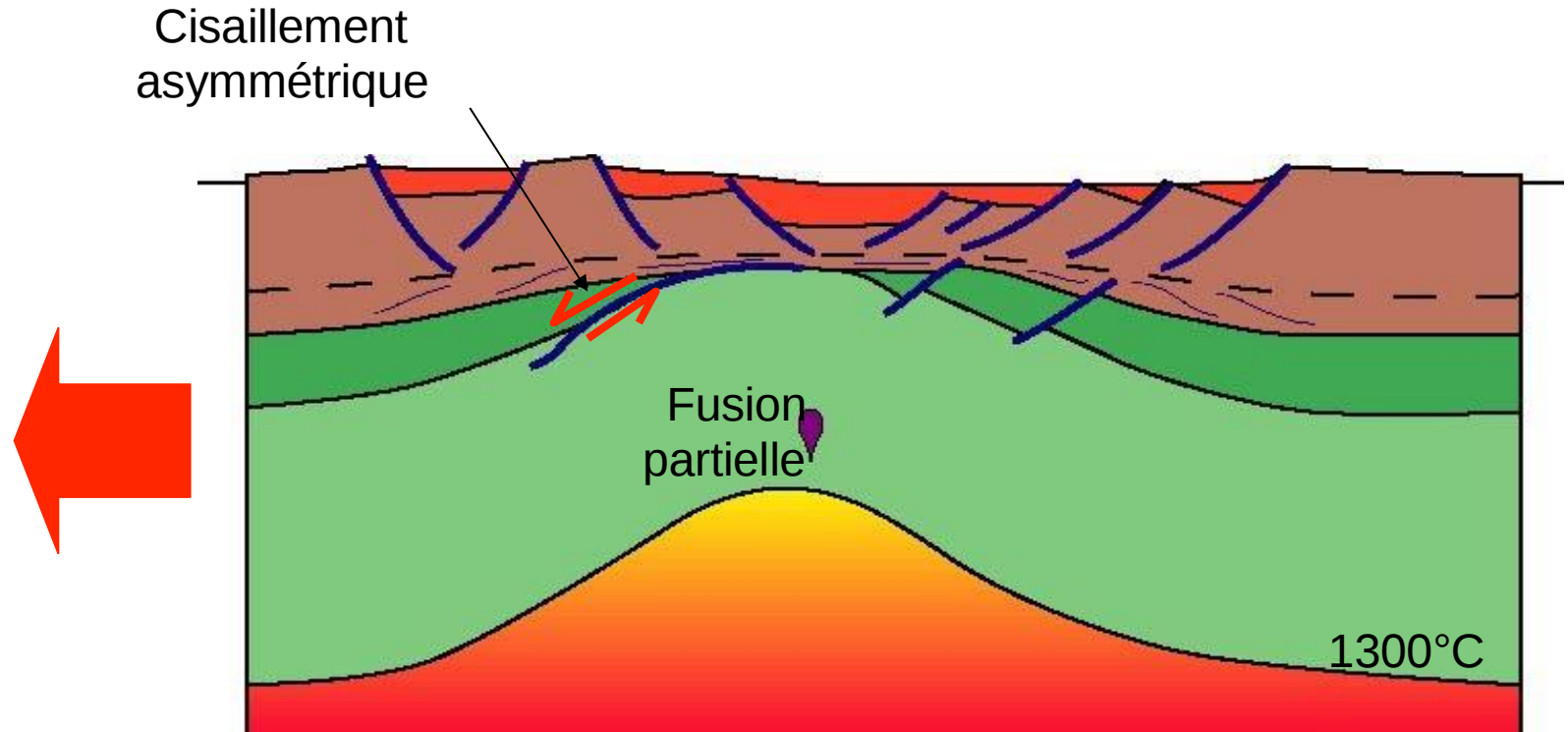
Stade rift précoce

From rift to passive margin : lithosphere deformation



Stade rift

From rift to passive margin : lithosphere deformation



Amincissement
lithosphérique

Remontée des
isothermes &
Asthénosphère

réchauffement

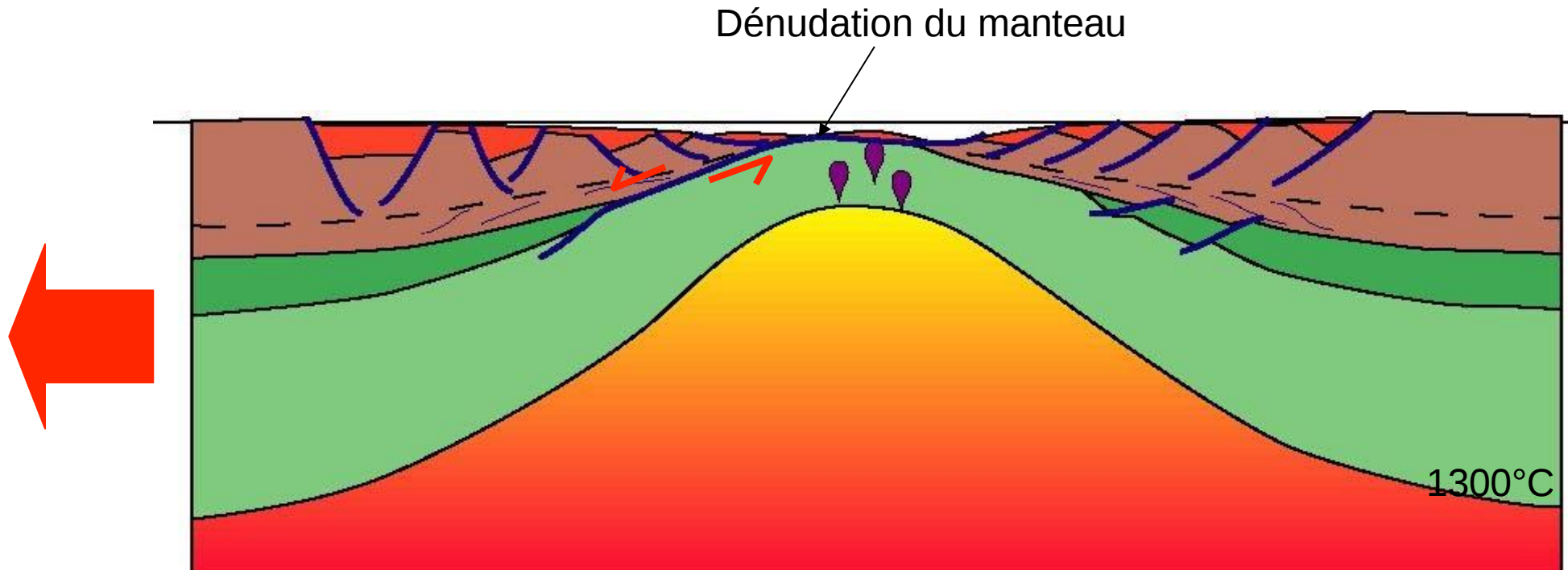
Diminution
de densité

Fusion partielle
(limitée)

Soulèvement

Stade rift mature

From rift to passive margin : lithosphere deformation



Faïlle de
Détachement
asymétrique



Élimination
de la croûte



Dénudation
du manteau

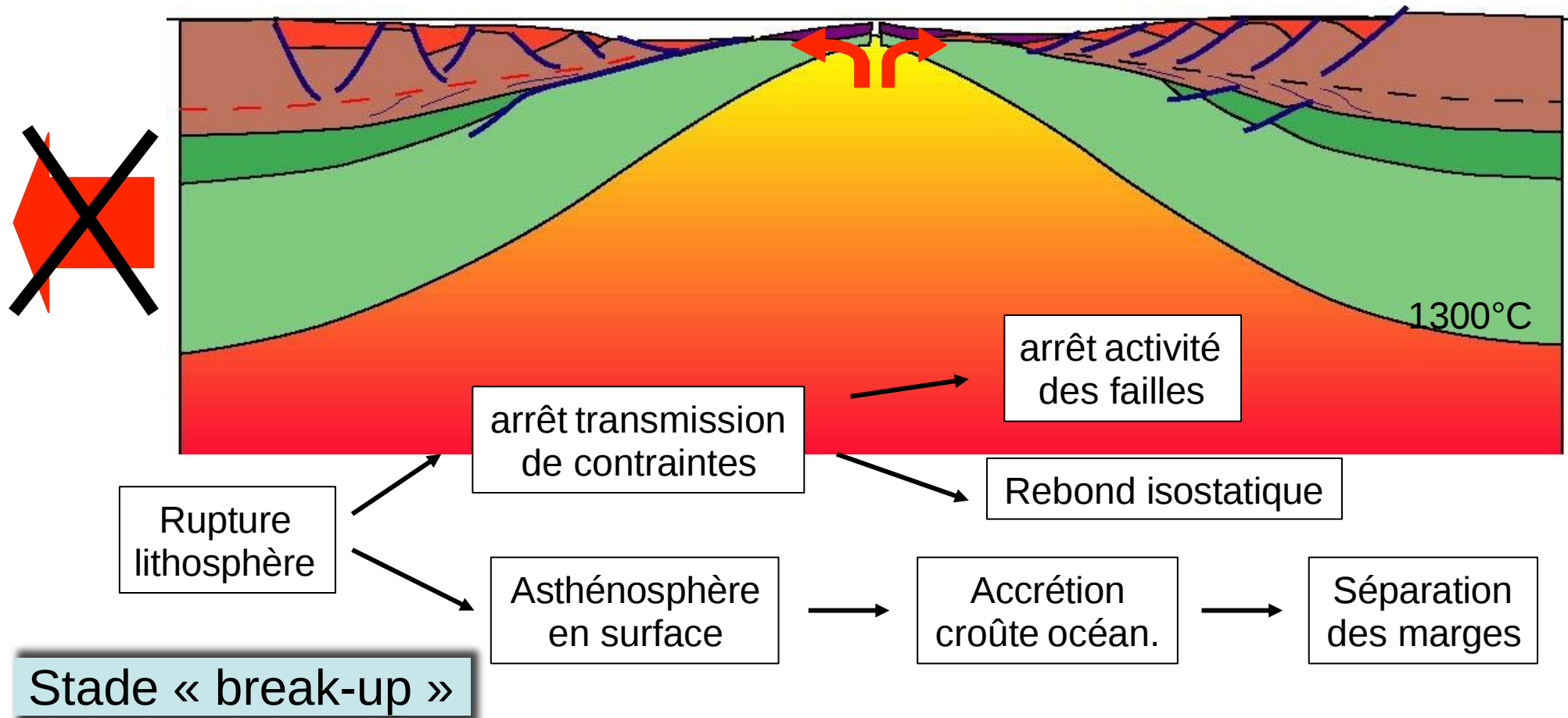


Altération
marine

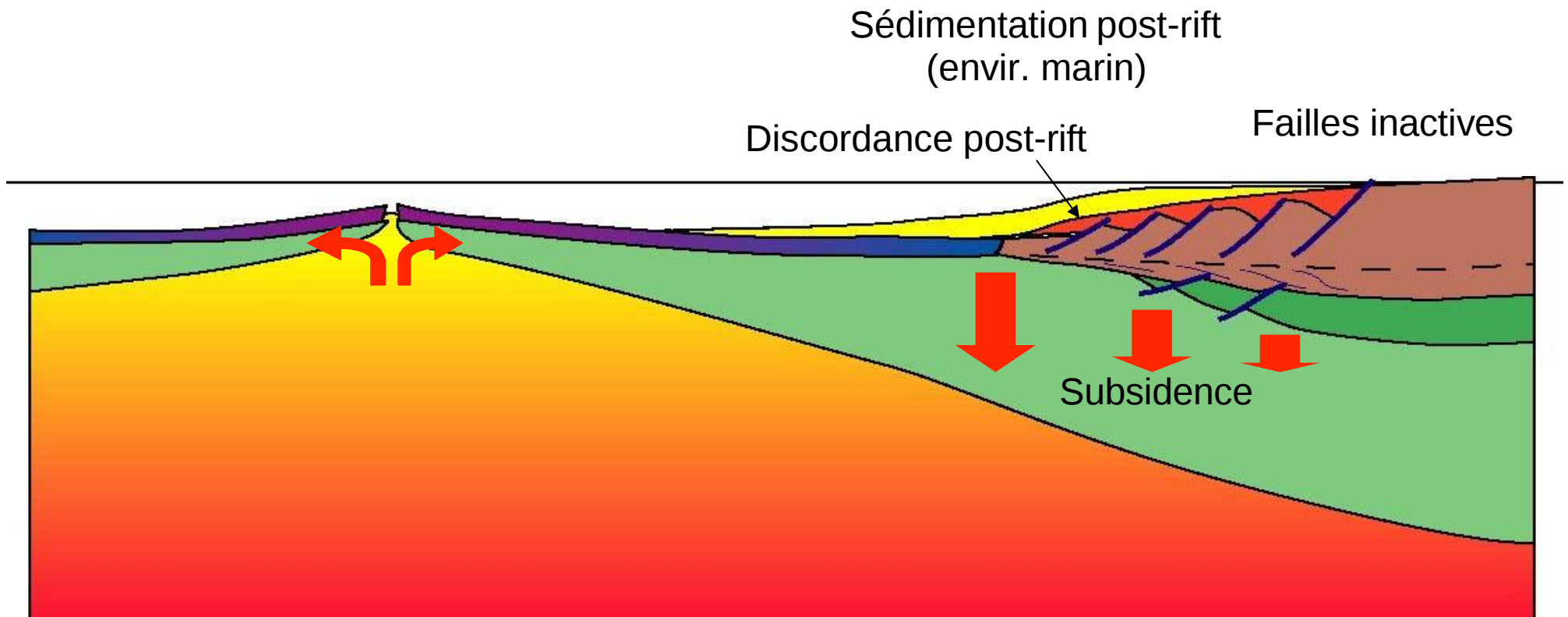
Stade dénudation manteau

From rift to passive margin : lithosphere deformation

Asthénosphère en surface
=> accrétion croûte océanique



From rift to passive margin : lithosphere deformation



Stade
marge jeune

Refroidissement
de la lithosphère



Densification



Subsidence
thermique

Refroidissement
= f(amincissement)

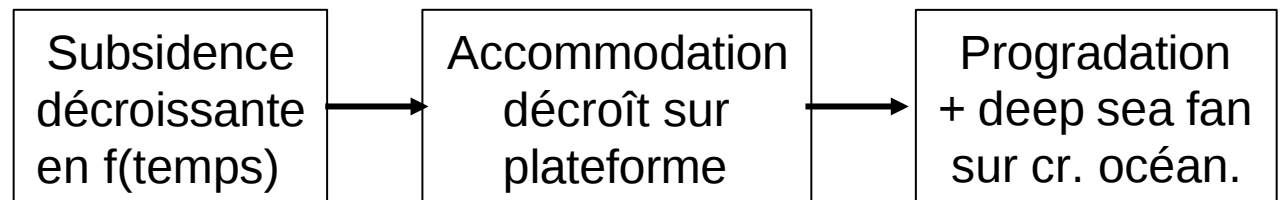
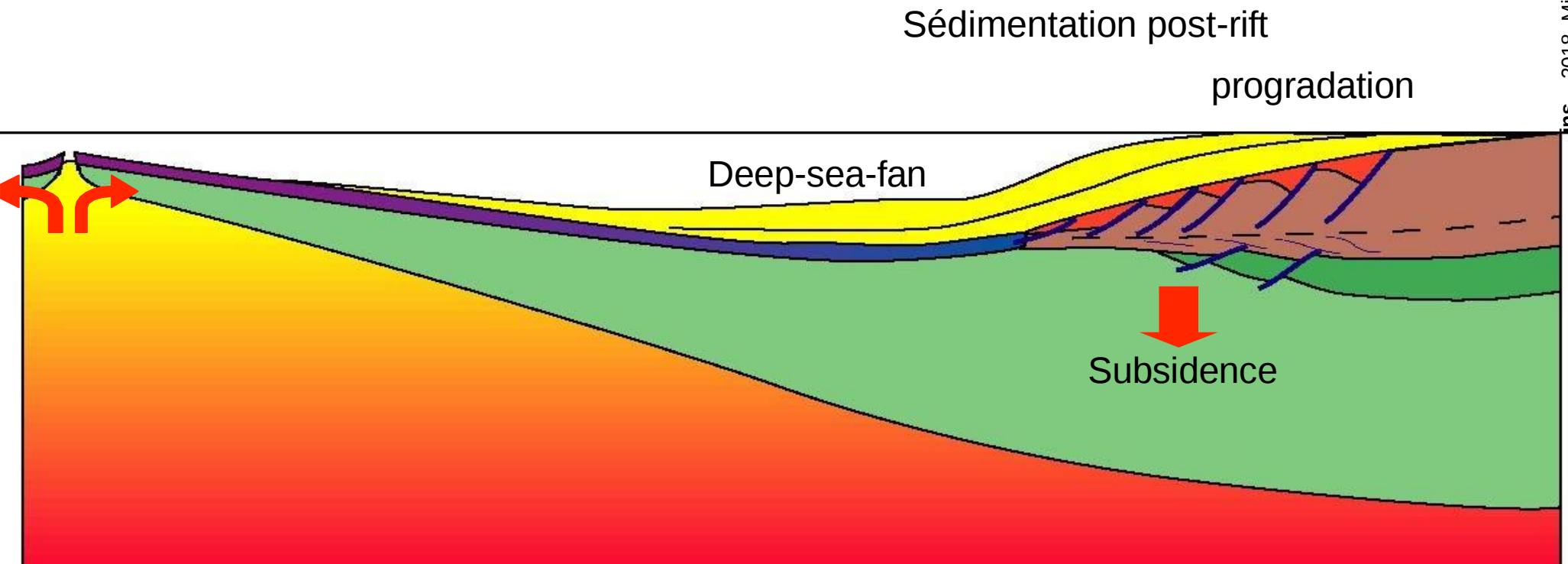


Subsidence
différentielle



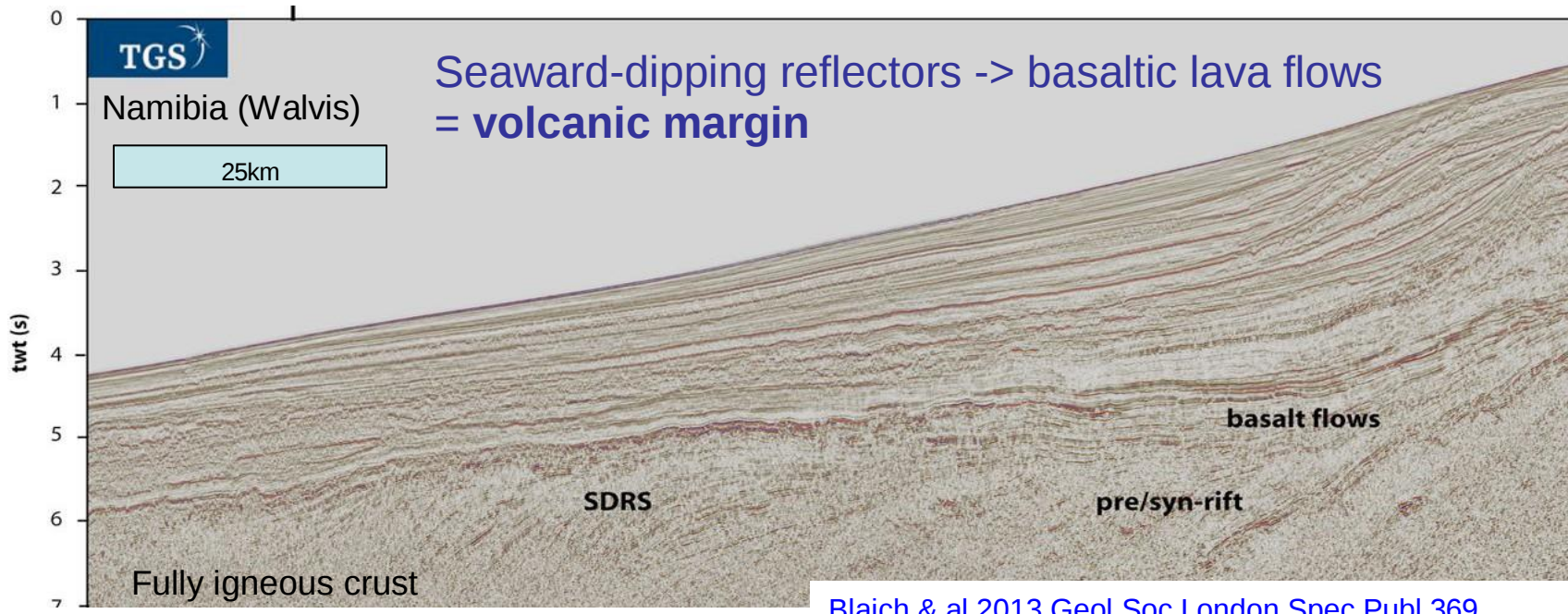
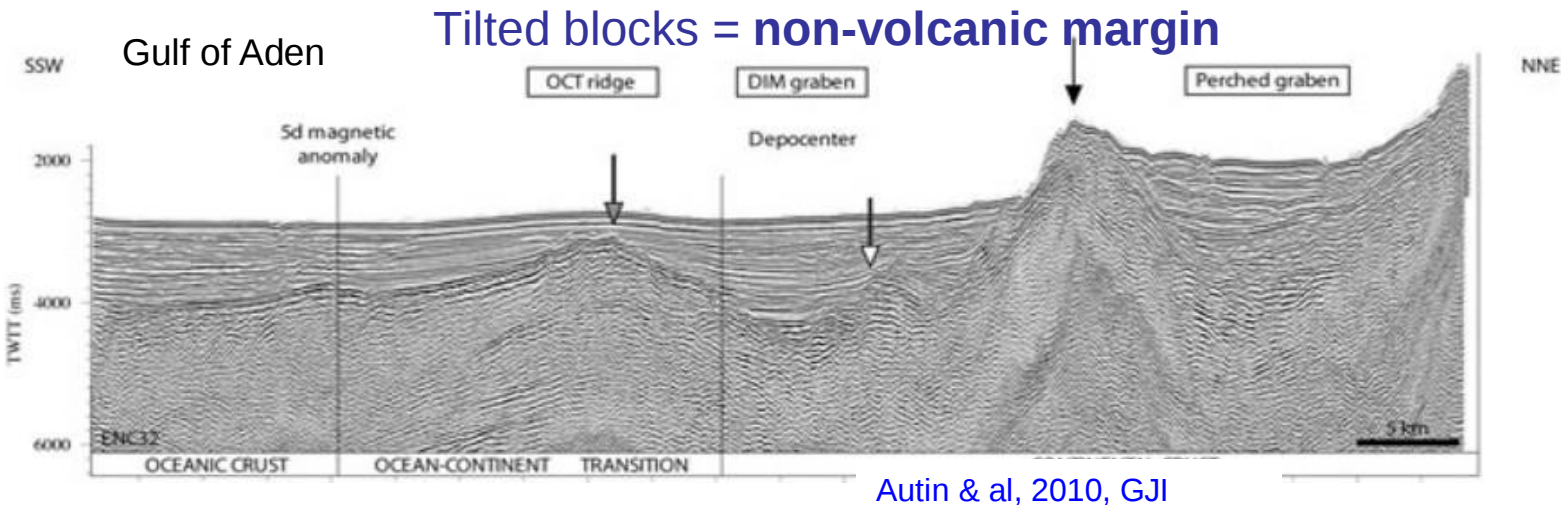
Basculement
de la marge

From rift to passive margin : lithosphere deformation

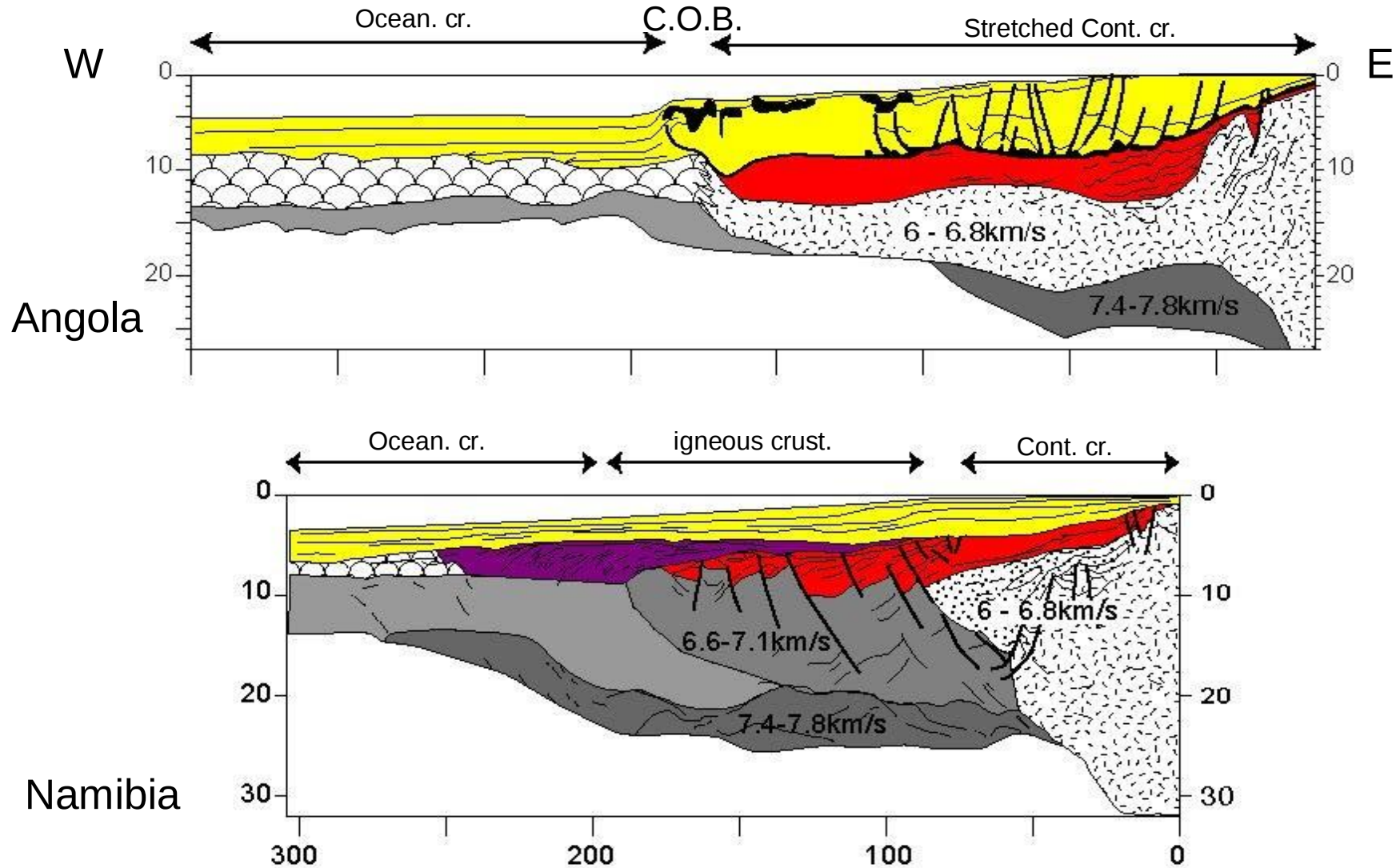


Stade marge mature

Basement structure => 2 types of continental margins

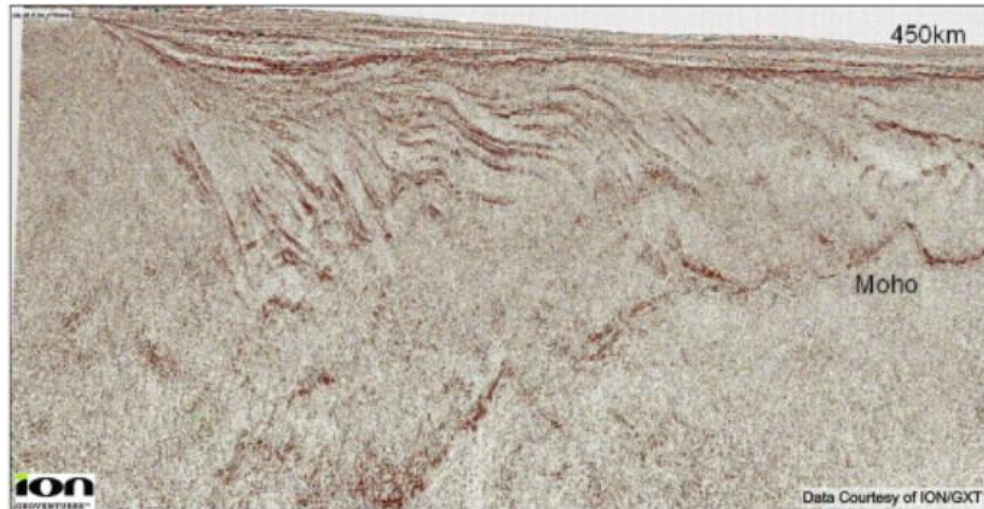


Basement structure => 2 types of continental margins Non-volcanic vs Volcanic margins

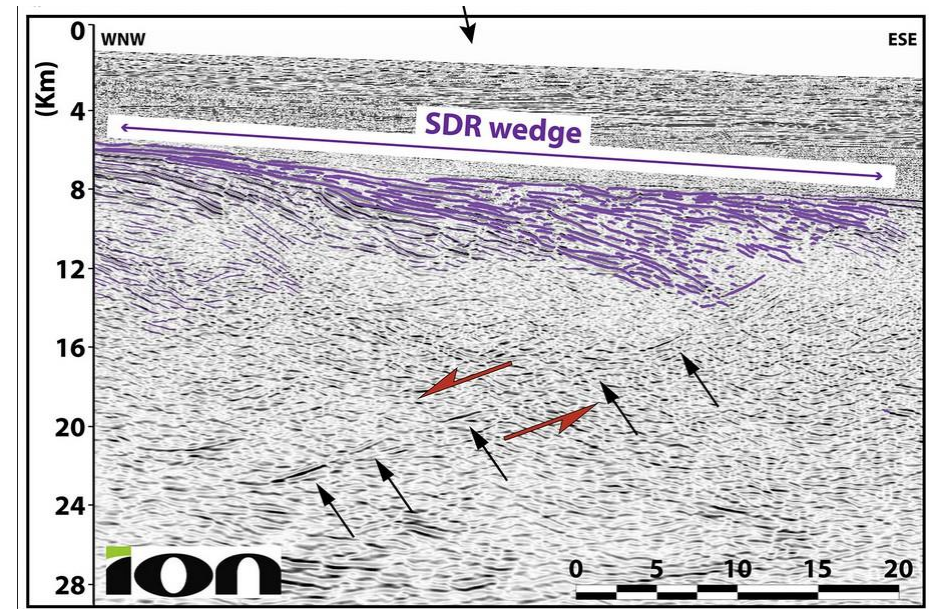


Conceptual model of SDR formation

Pelotas Basin, S. Brazil-Uruguay

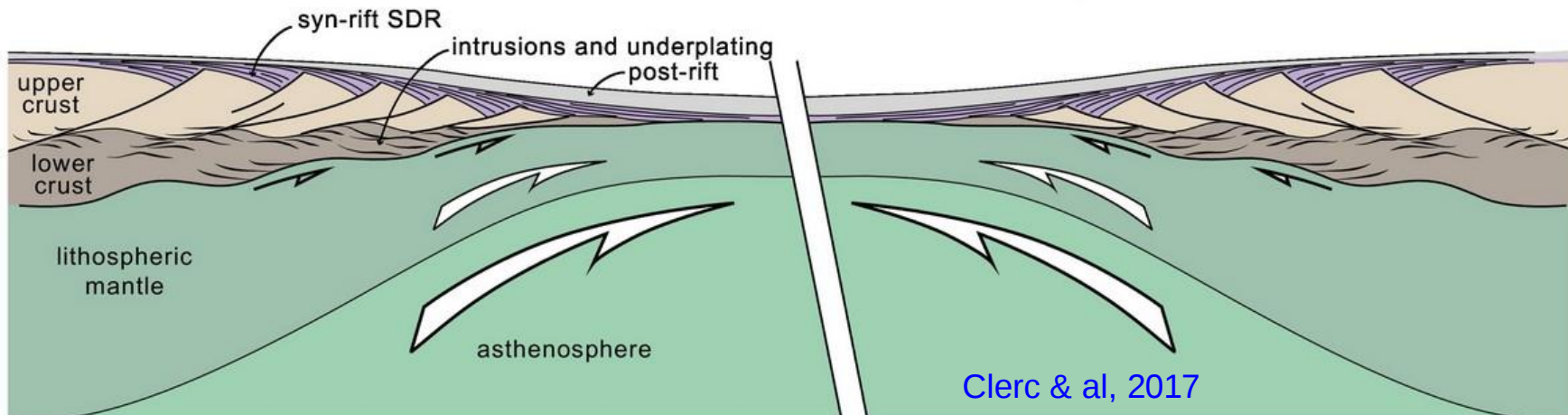


Stica & al, 2014, M&P G



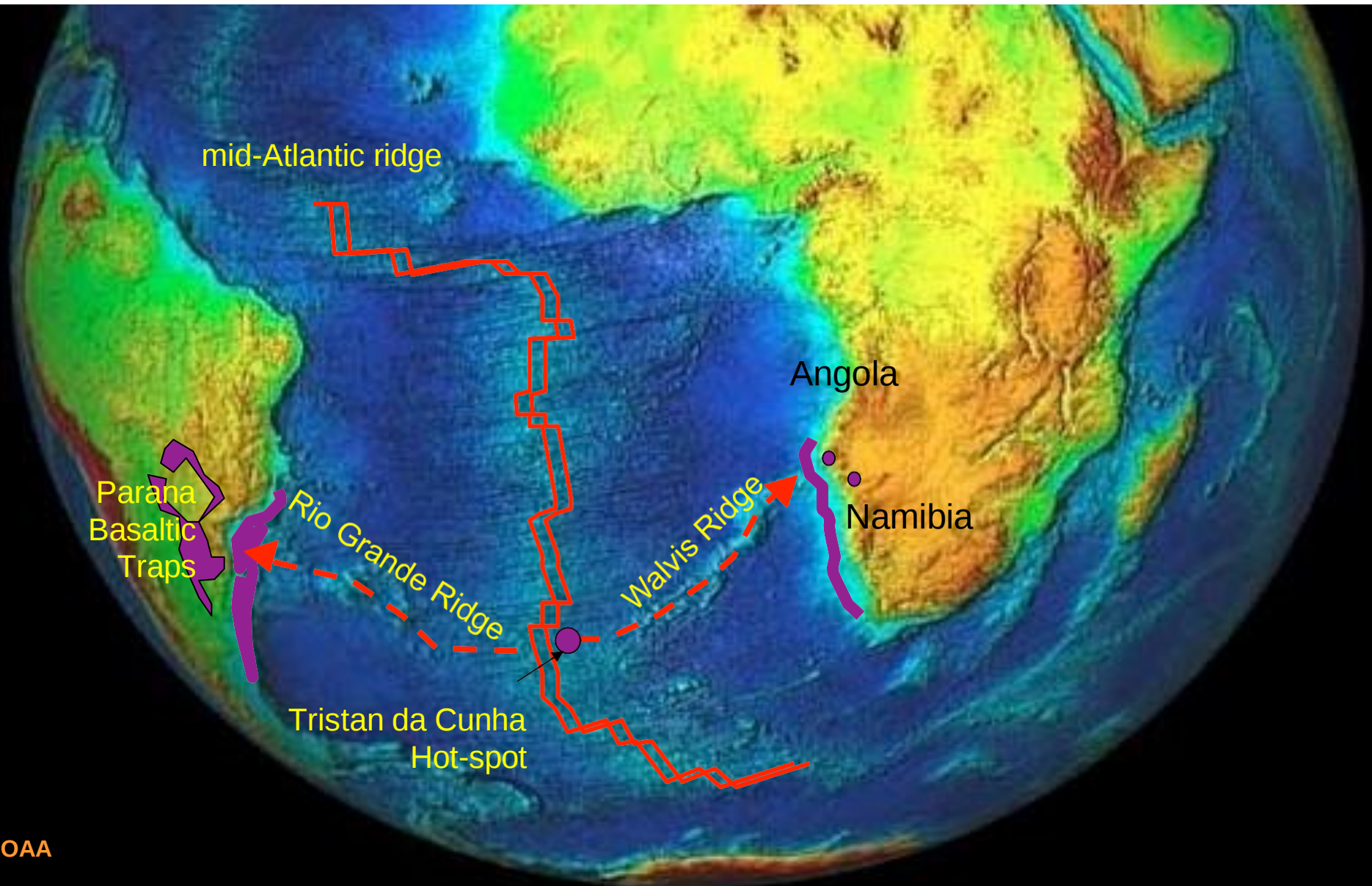
Clerc & al, 2017

Seaward dipping reflectors / landward dipping normal faults = shearing in lithospheric mantle



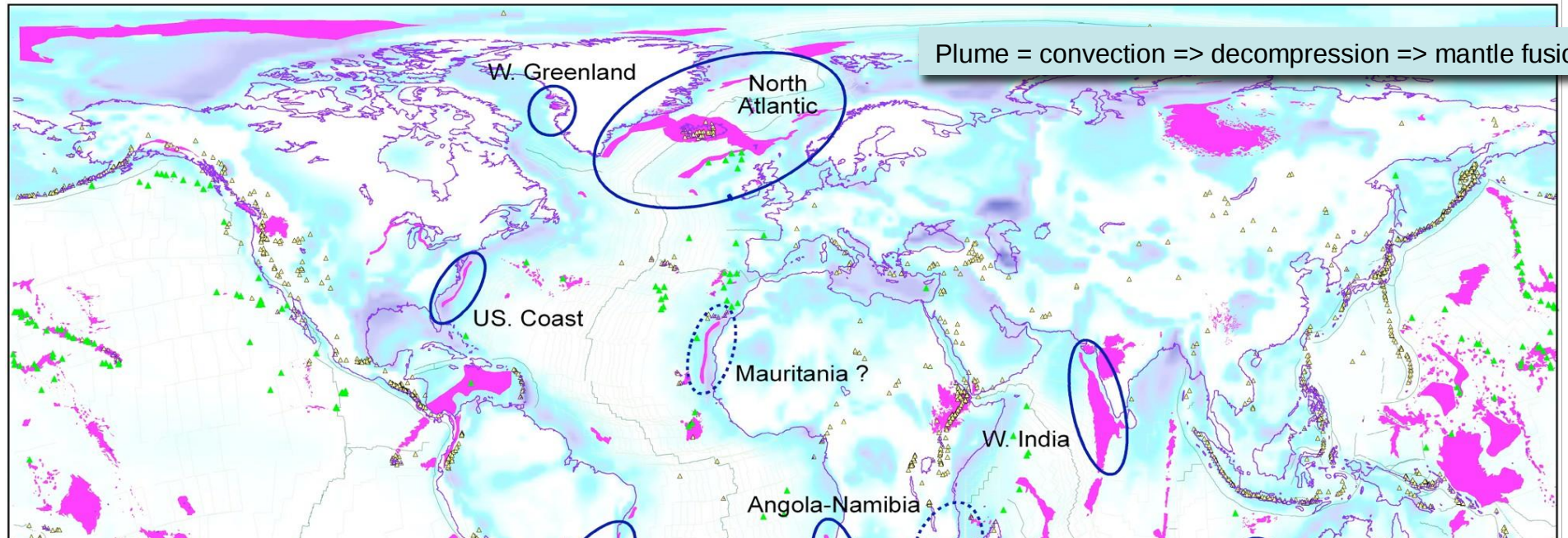
Clerc & al, 2017

South Atlantic conjugate margins / Hot-spot / Traps



Volcanic margins and Large Igneous Provinces

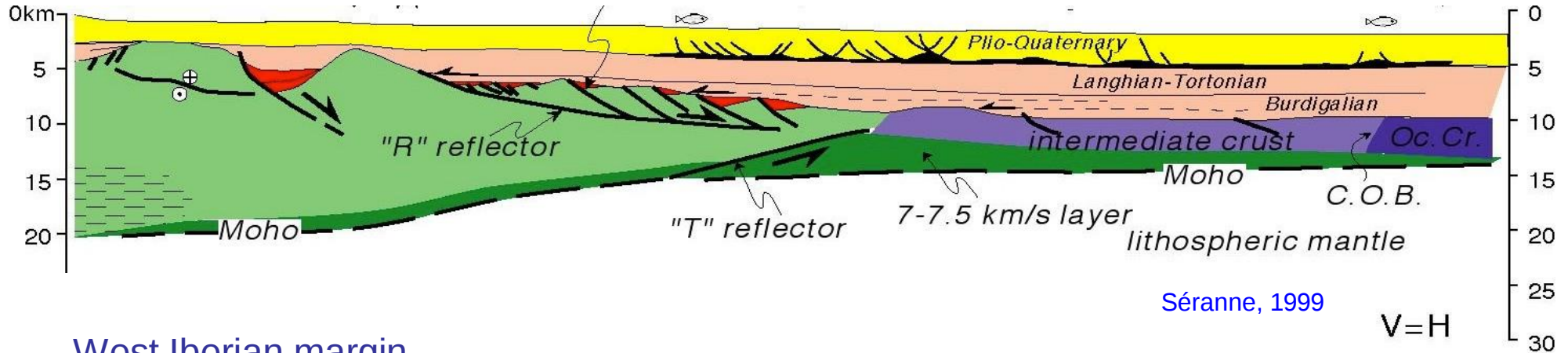
World sedimentary basins, Large Igneous Provinces and distribution of volcanic rifted margins



LIP's: basalt plateaus = traps
associated with volcanic margins
(e.g. Atlantic volcanic M.)

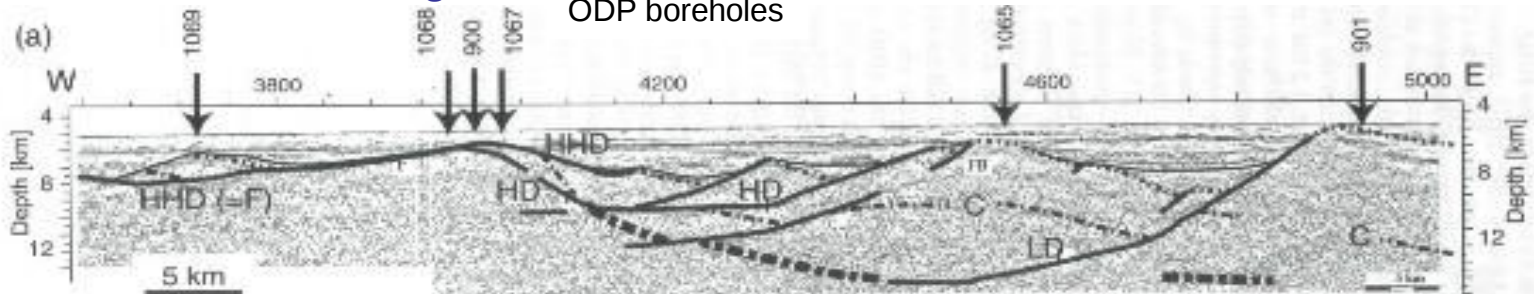
Non-volcanic margin : Stretched lithosphere

Gulf of Lion margin

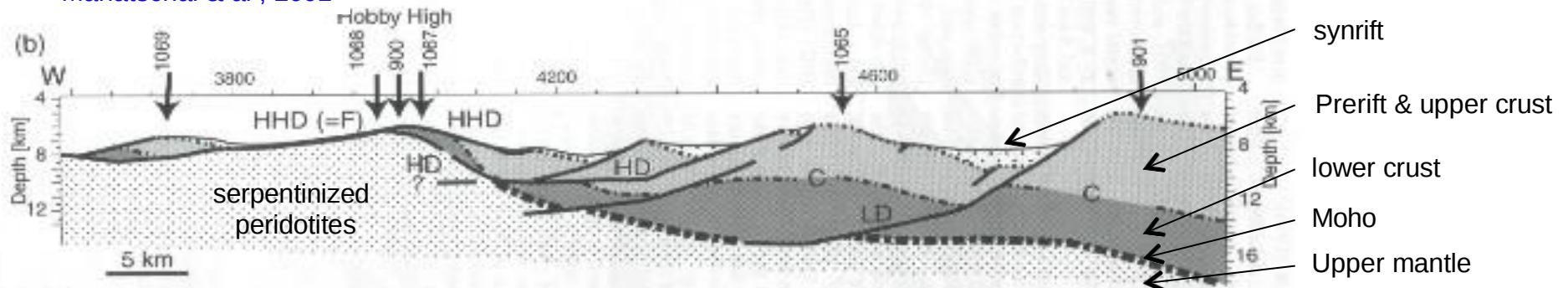


West Iberian margin

ODP boreholes



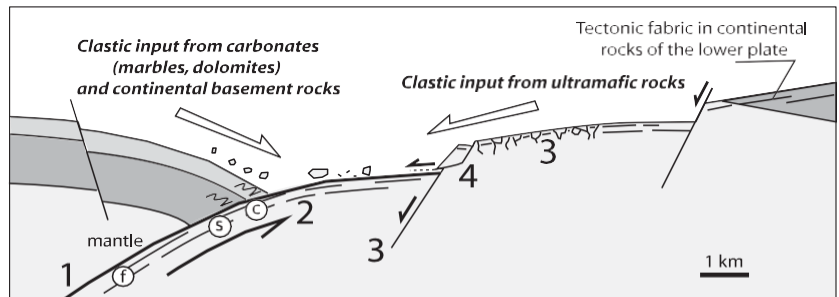
Manatschal & al , 2001



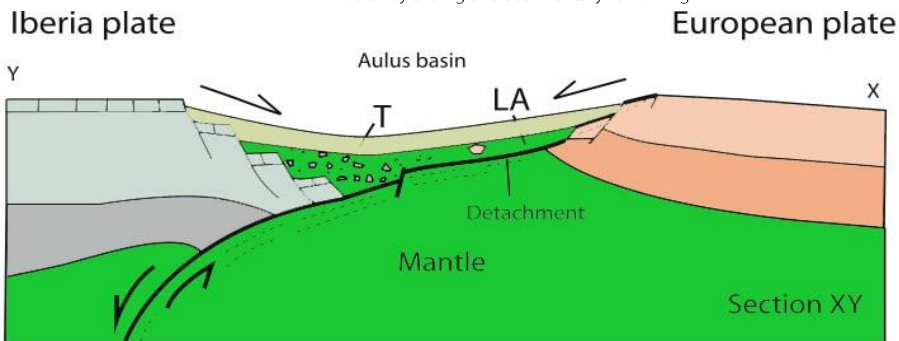
Stretched lithosphere & mantle denudation

Fossil Non-volcanic Margins inverted and exposed in orogens

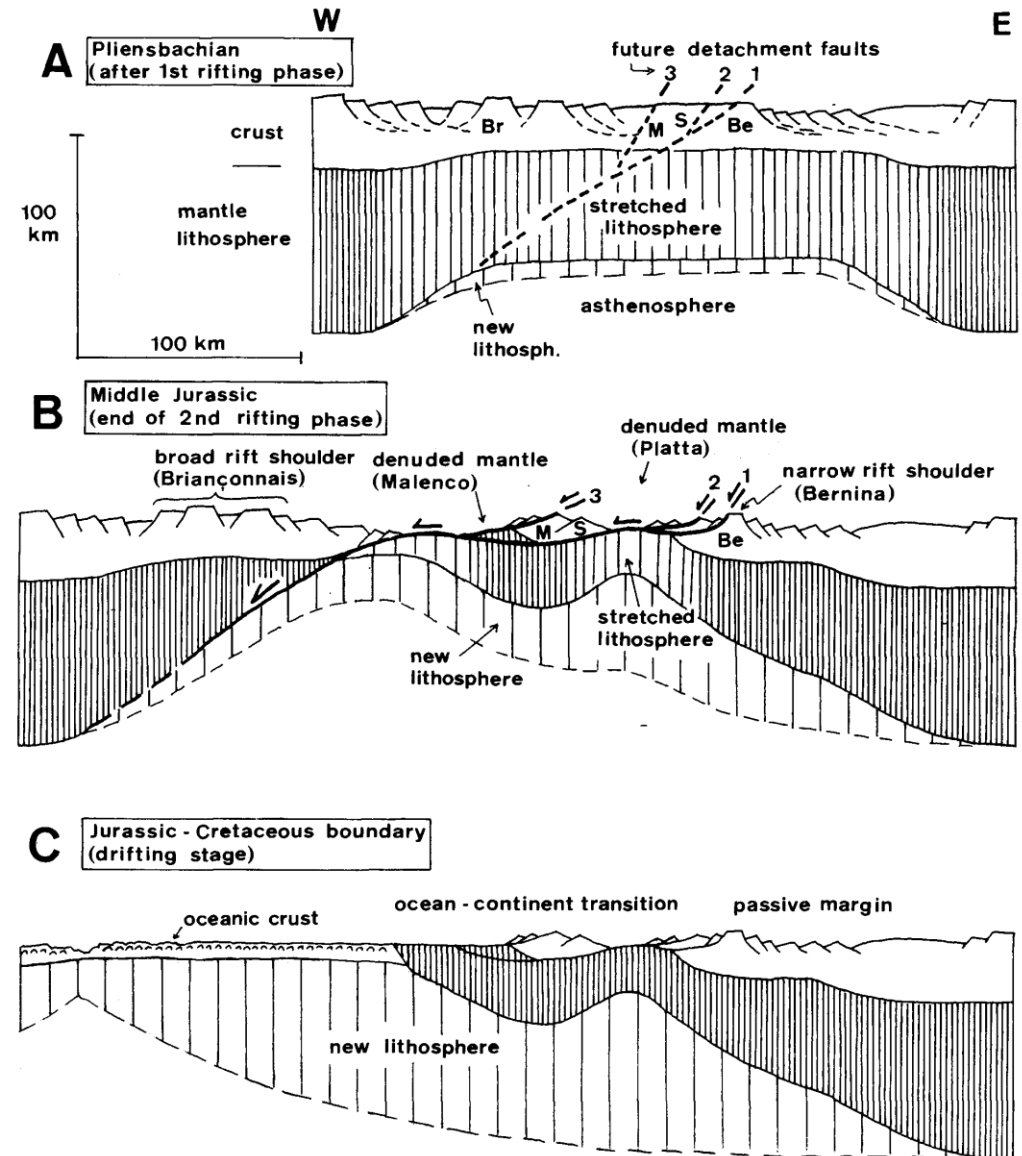
Ex: Albian Pyrenean basin



- 1: Detachment inducing foliation (f) in mantle rocks
- 2: LT shear zones (s), cataclasites (c) and exhumation to seafloor
- 3: Late normal faulting, submarine alteration, and sedimentary reworking of tectonic breccias
- 4: Gravity sliding and sedimentary reworking



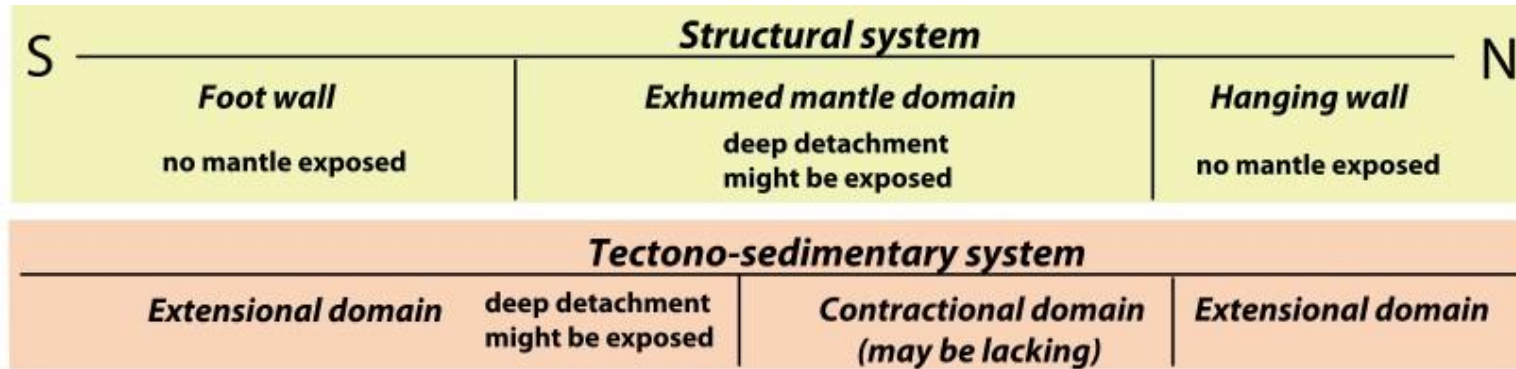
Lagabrielle & Bodinier 2008



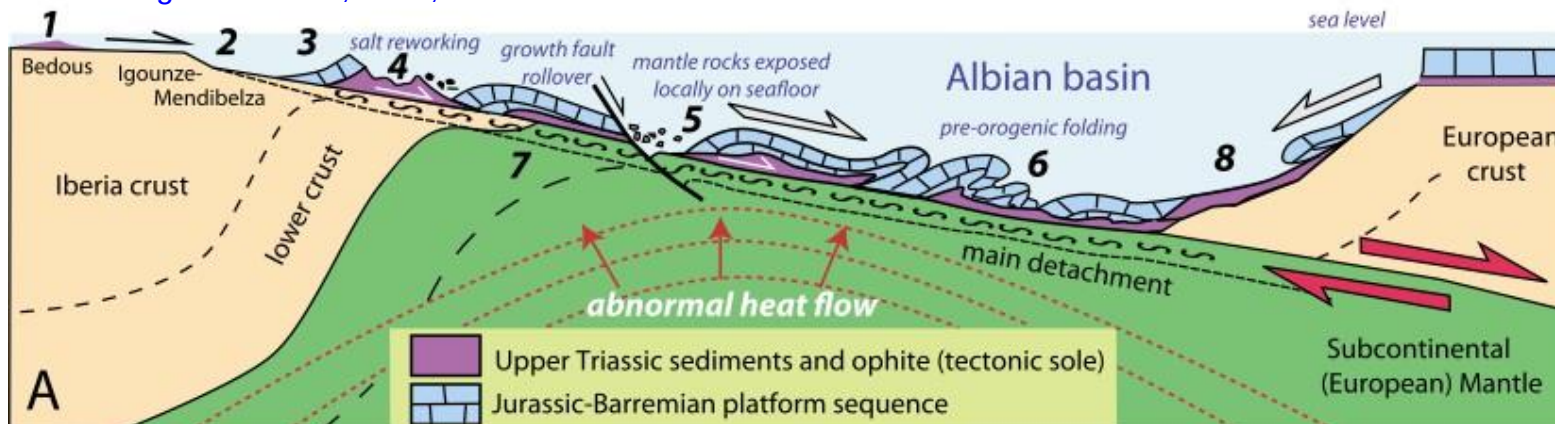
Ex: Tethyan margin

Froitzheim & Manatschal, 1996

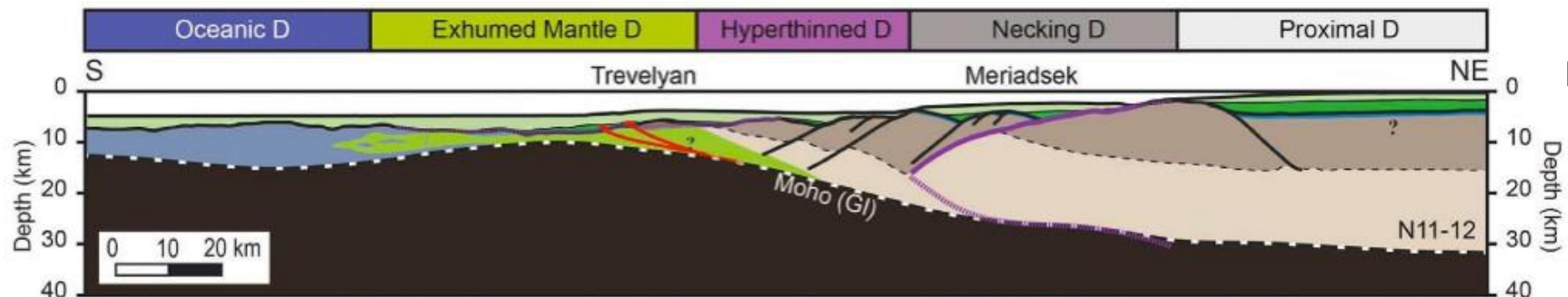
Stretched lithosphere & mantle denudation



Lagabrielle & al, 2013, Tectonics



Pyrenees

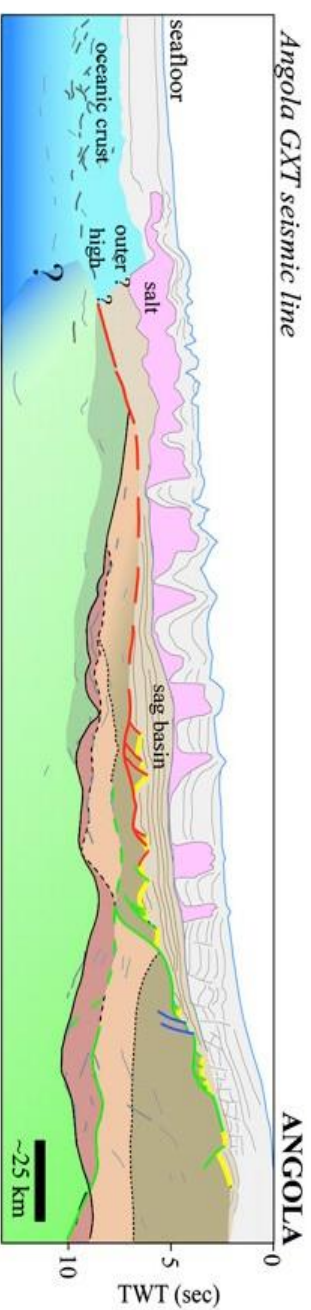
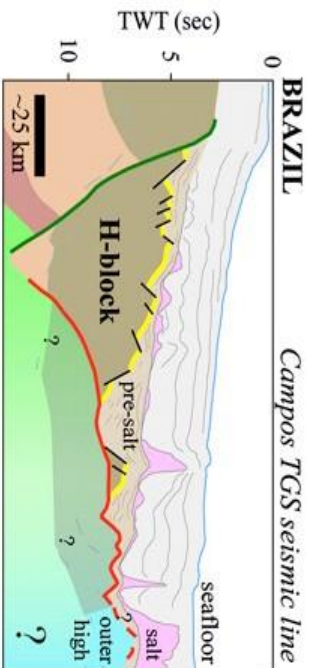


Bay of Biscay

Tugend & al, 2014, Tectonics

Stretching model for the S. Atlantic conjugate margins

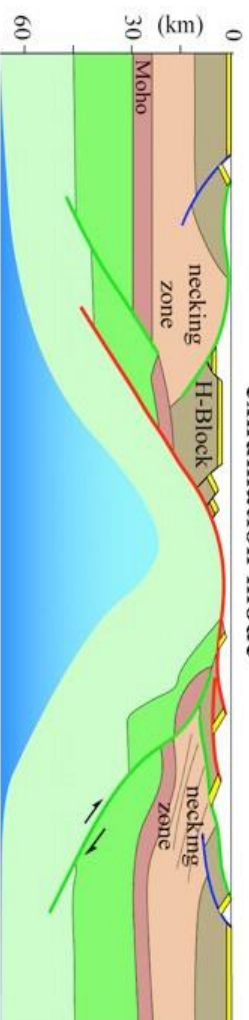
e



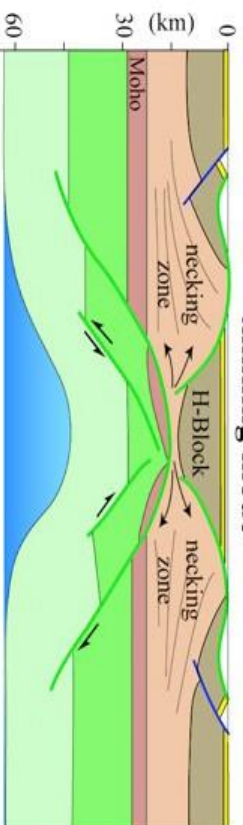
ocean → continent → ocean

Unternehr & al 2010 (Petroleum Geoscience)

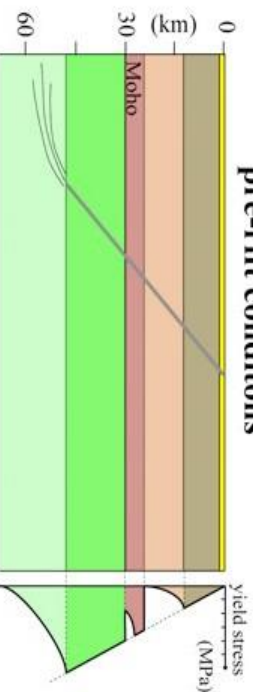
exhumation mode



thinning mode



pre-rift conditions



time-evolution →

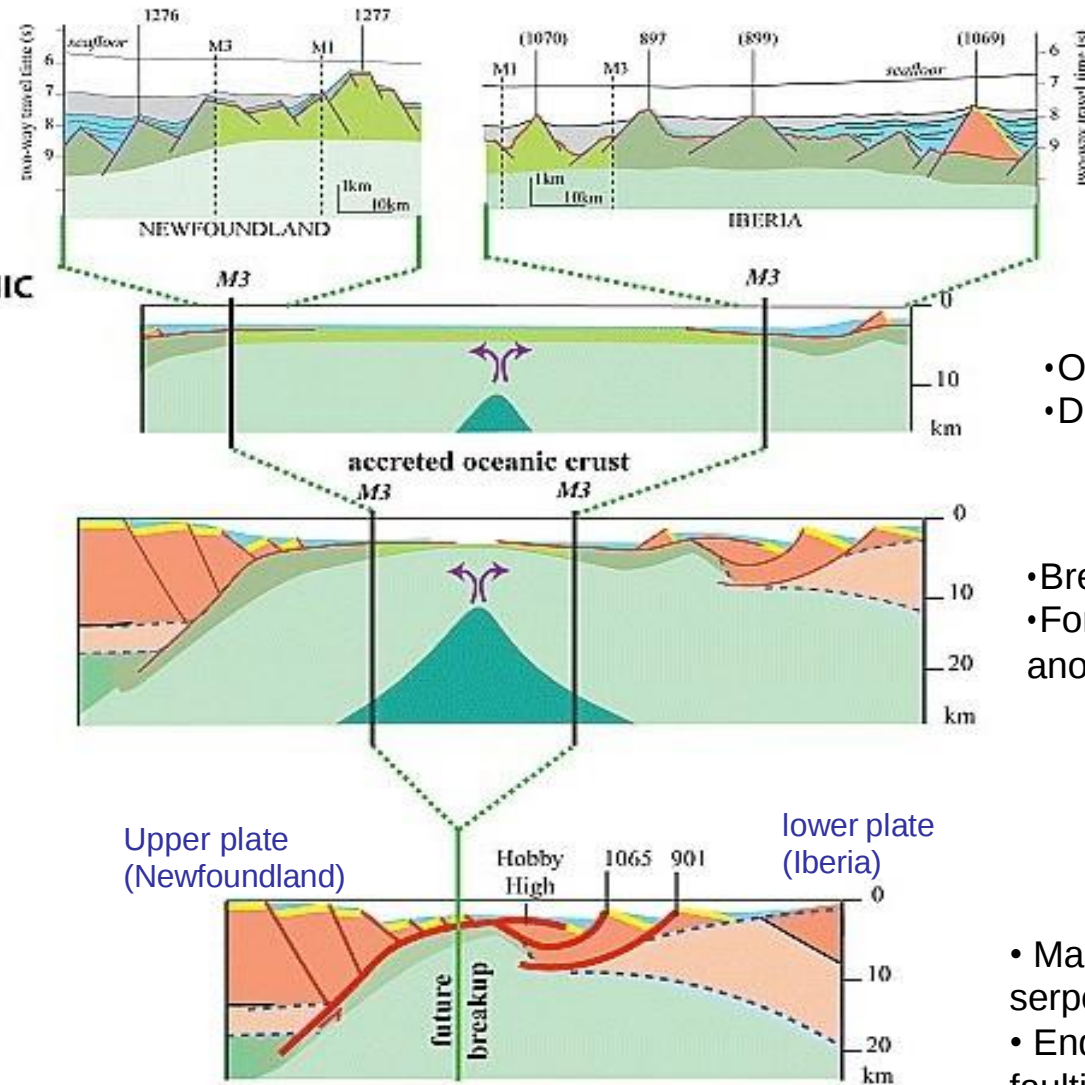
stretching structures
thinning structures
exhumation structures

post-rift sediments
oceanic crust
salt
pre-salt (sag phase) sediments
pre-rift sediments
upper crust
(qtz-fsp rich) middle/lower crust
mafic lower crust
inherited subcontinental mantle
infiltrated subcontinental mantle
highly deformed/infiltrated/intruded mantle
asthenospheric mantle

deformation modes → mantle → continent

Continent-Ocean Boundary

North-Atlantic break-up and conjugate margins



• Conjugate margins

• Oc. crust accretion
• Drifting

• Break-up: 1st accretion
• Formation of 1st magnetic anomalies,

• Mantle exhumation & serpentinitisation
• End of rifting (no more faulting)

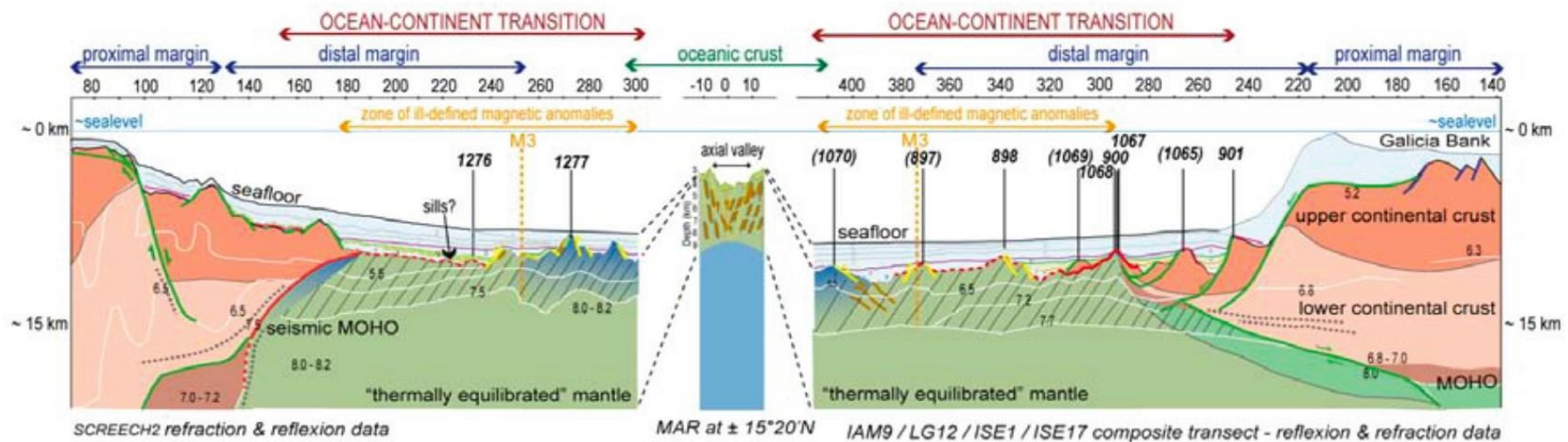
Time

Duration $\pm$ 20Ma

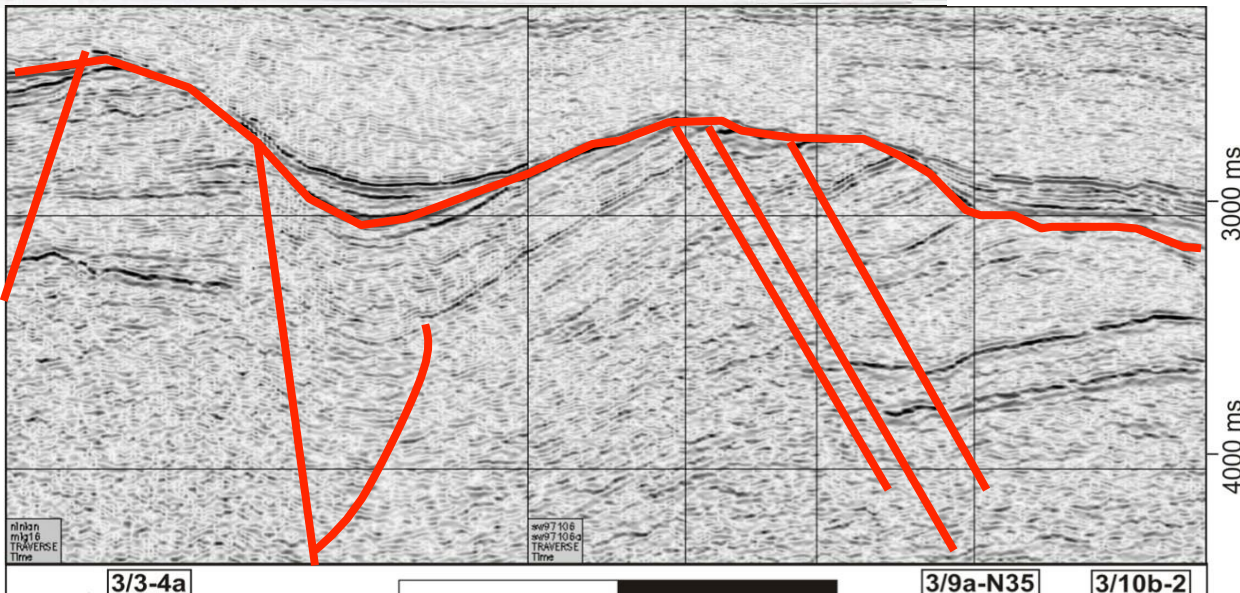
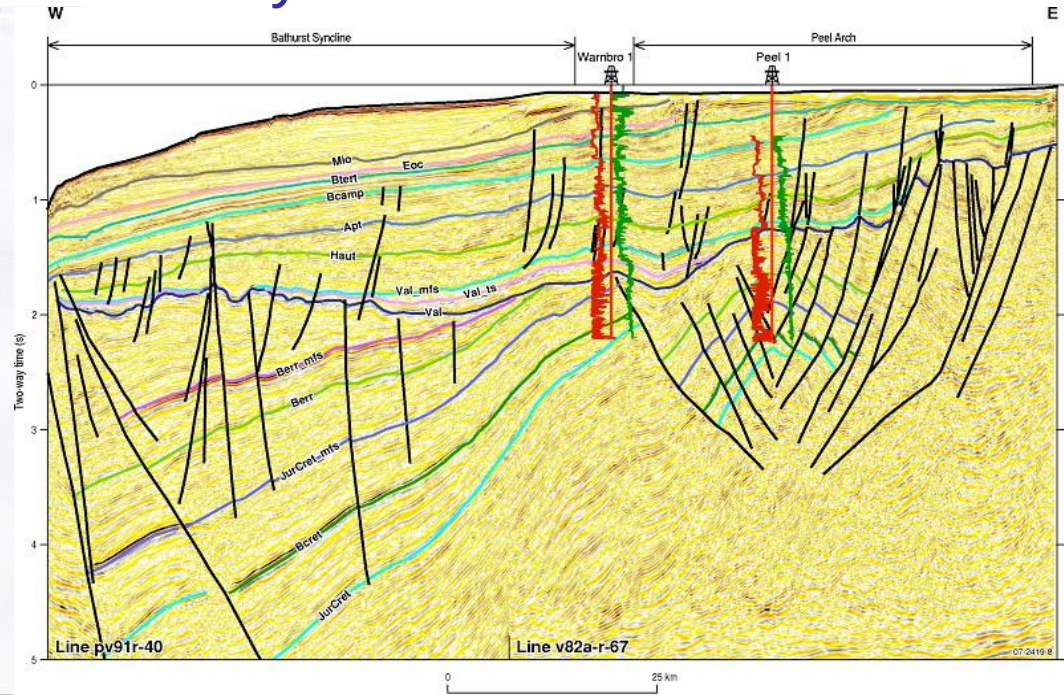
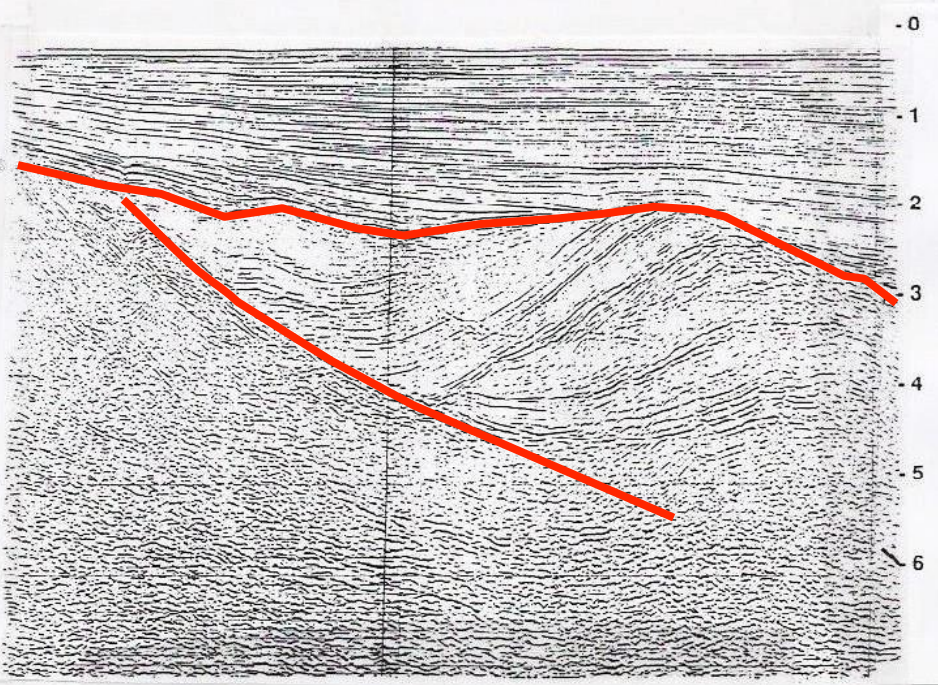


Break-up

- Lithospheric rupture
- End of extensional faults activity
- Onset of oceanic accretion
- First oceanic crust magnetic anomaly
- Two distinct continental margins



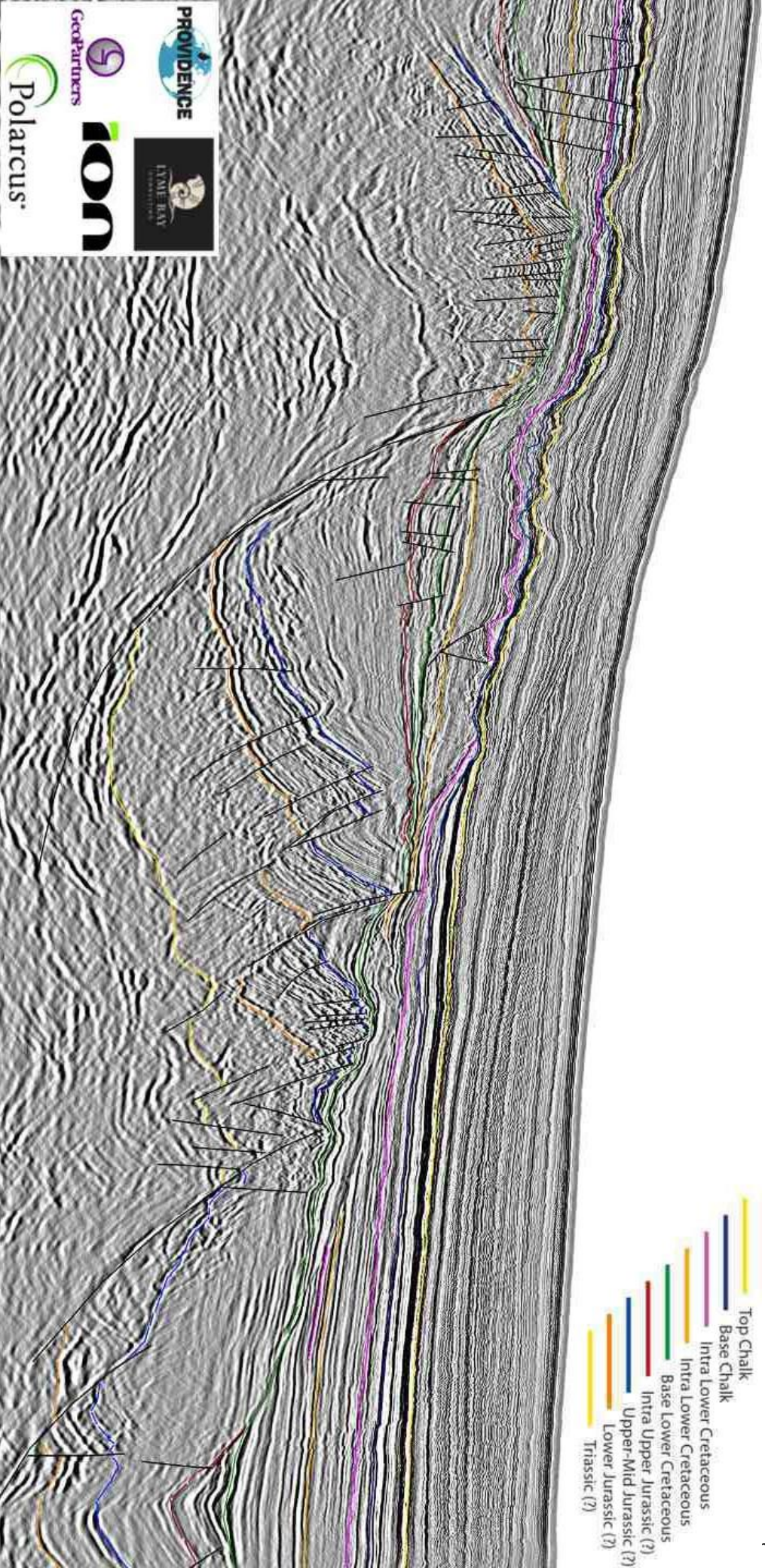
Break-up unconformity



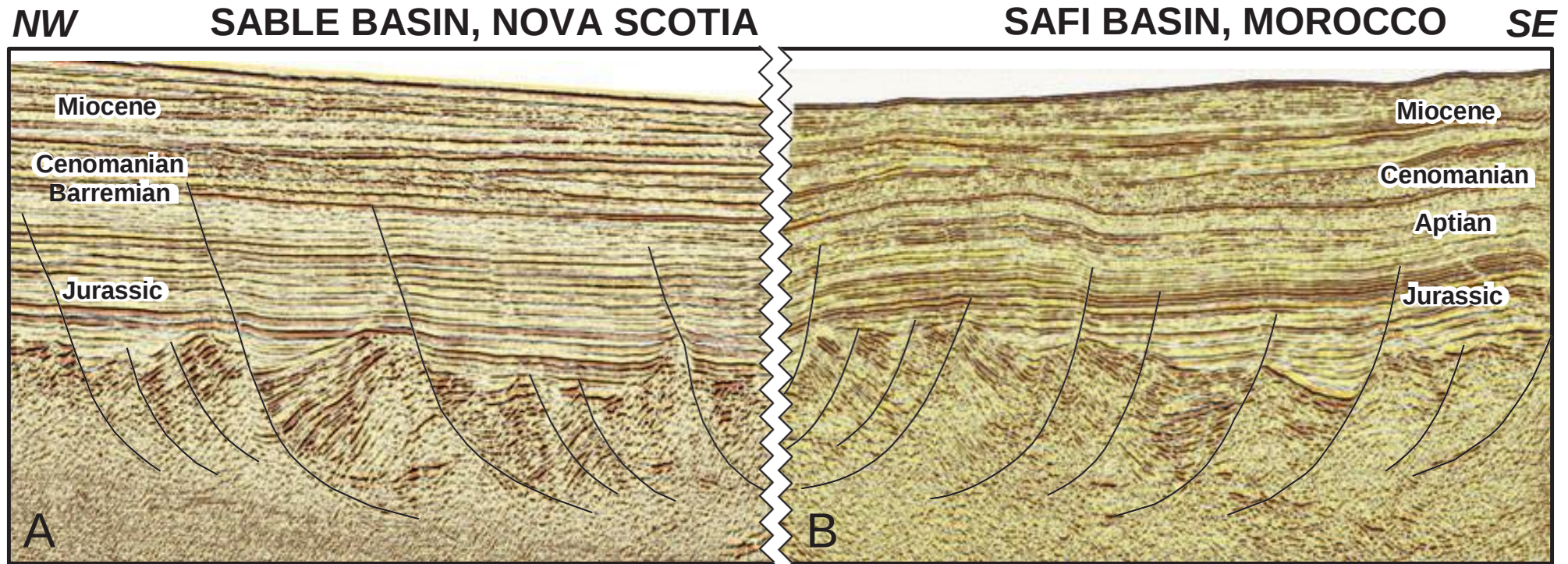
<http://www.ga.gov.au/scientific-topics/energy/province-sedimentary-basin-geology/petroleum/offshore-southwest-australia/perth-basin/blaming-sub-basin>

Break-up unconformity :
signature of stress release

Break-up unconformity



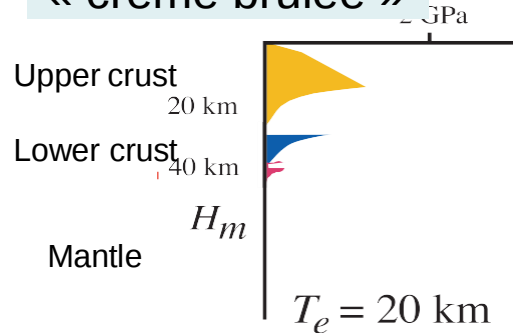
Break-up unconformity on conjugate margins



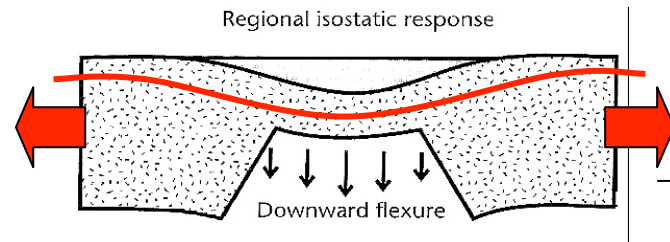
Break-up = isostatic flexure of rift basins

Lithosph. rheology

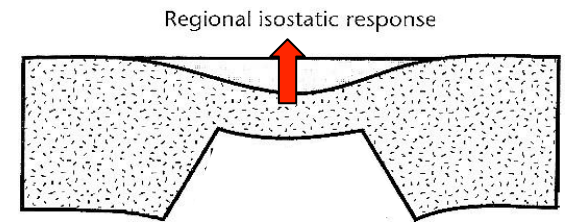
« crème brûlée »



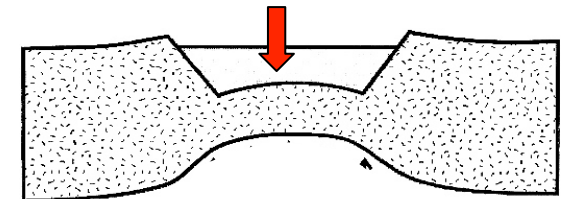
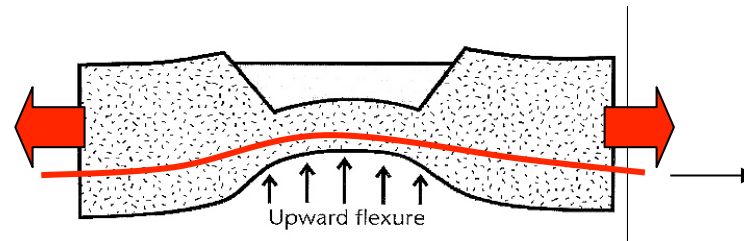
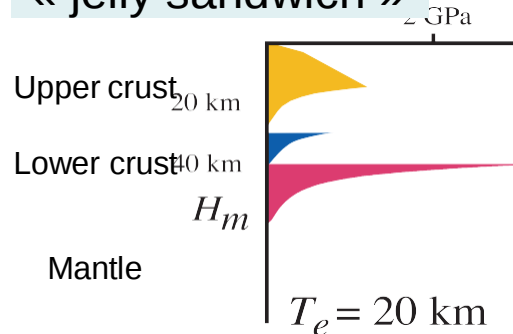
Rifting stage



End of rifting



« jelly sandwich »



Burov & Watts 2006

Cloetingh

lithosphere structure => depth of necking => isostatic flexural response
=> vertical movement => erosion