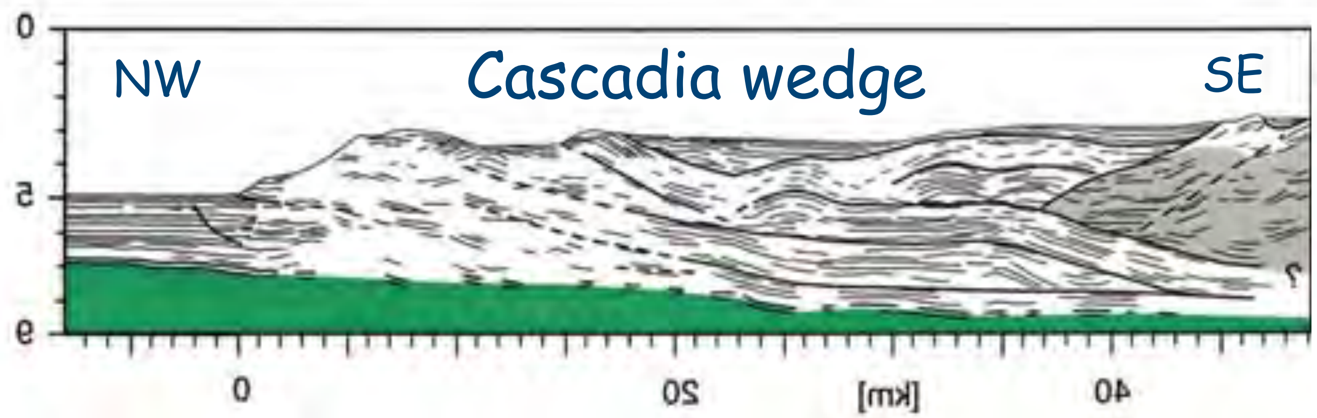
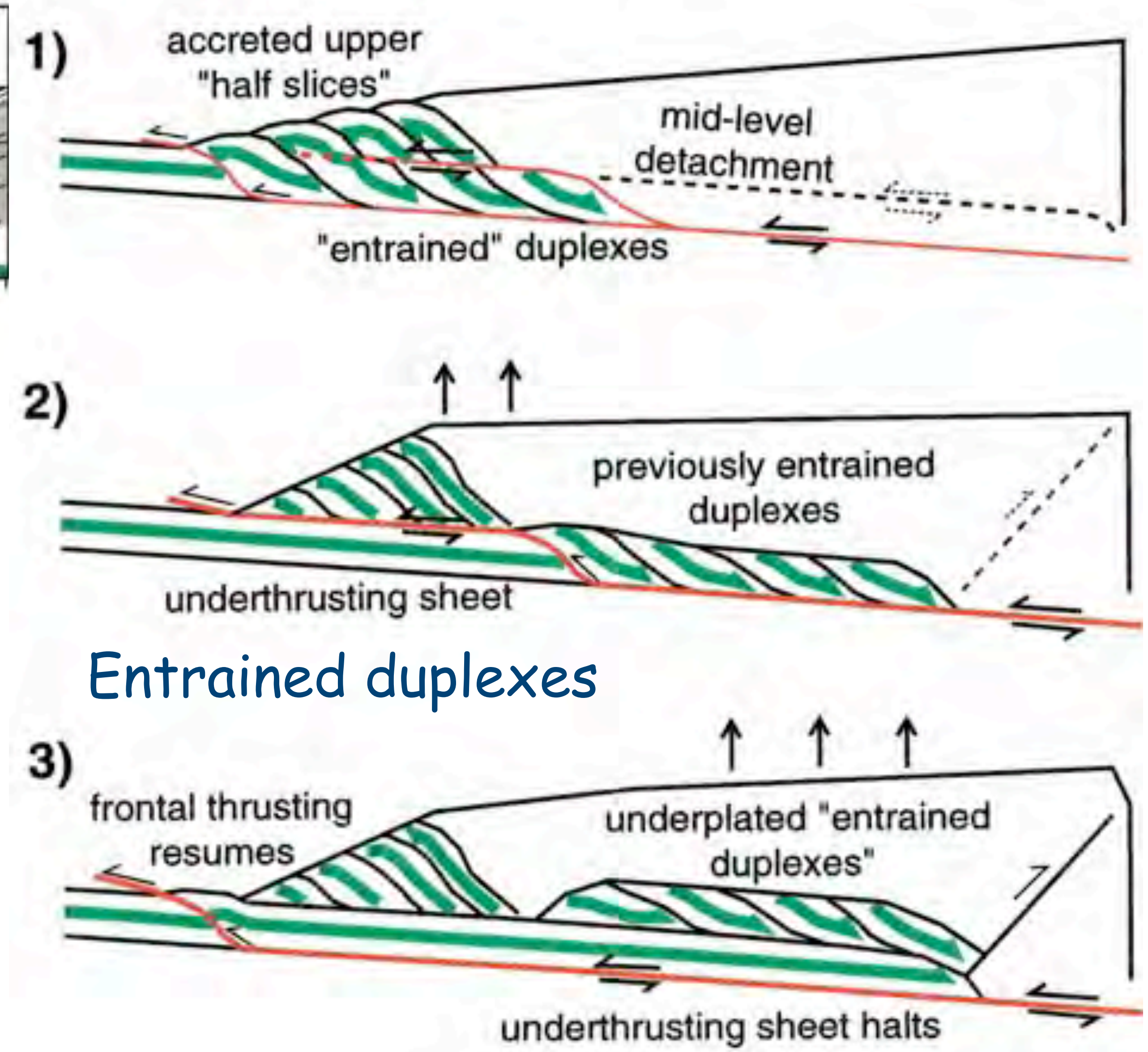
11-
Kollision zonen

Akkretion

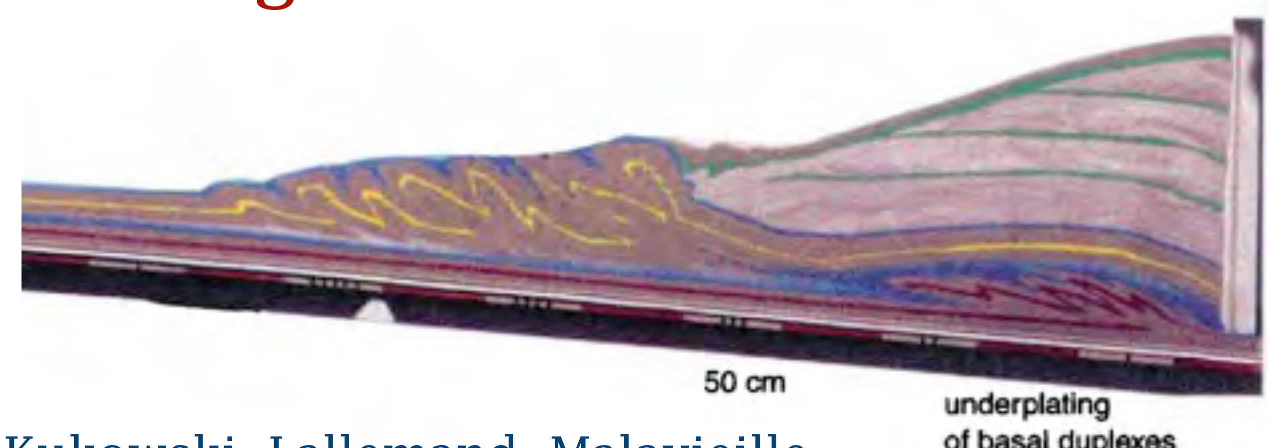
Mechanisms of accretion



Gutscher, M.A., Kukowski, N., Malavieille, J., and Lallemand, S., 1998, JGR



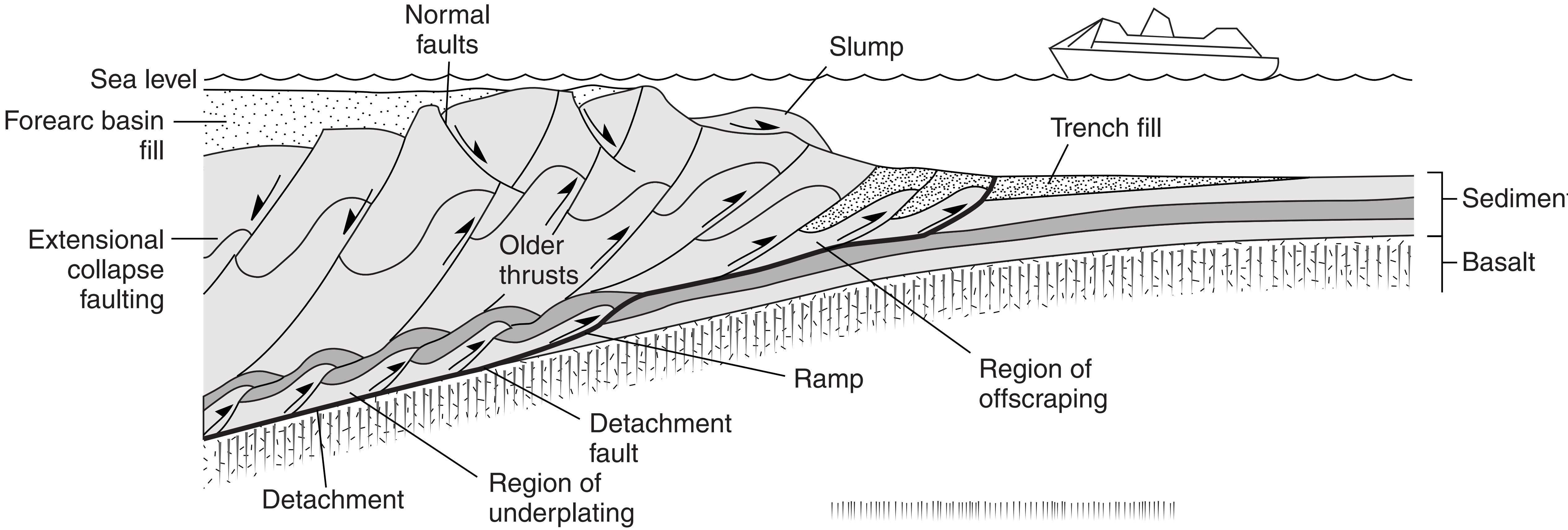
Changes in detachment levels



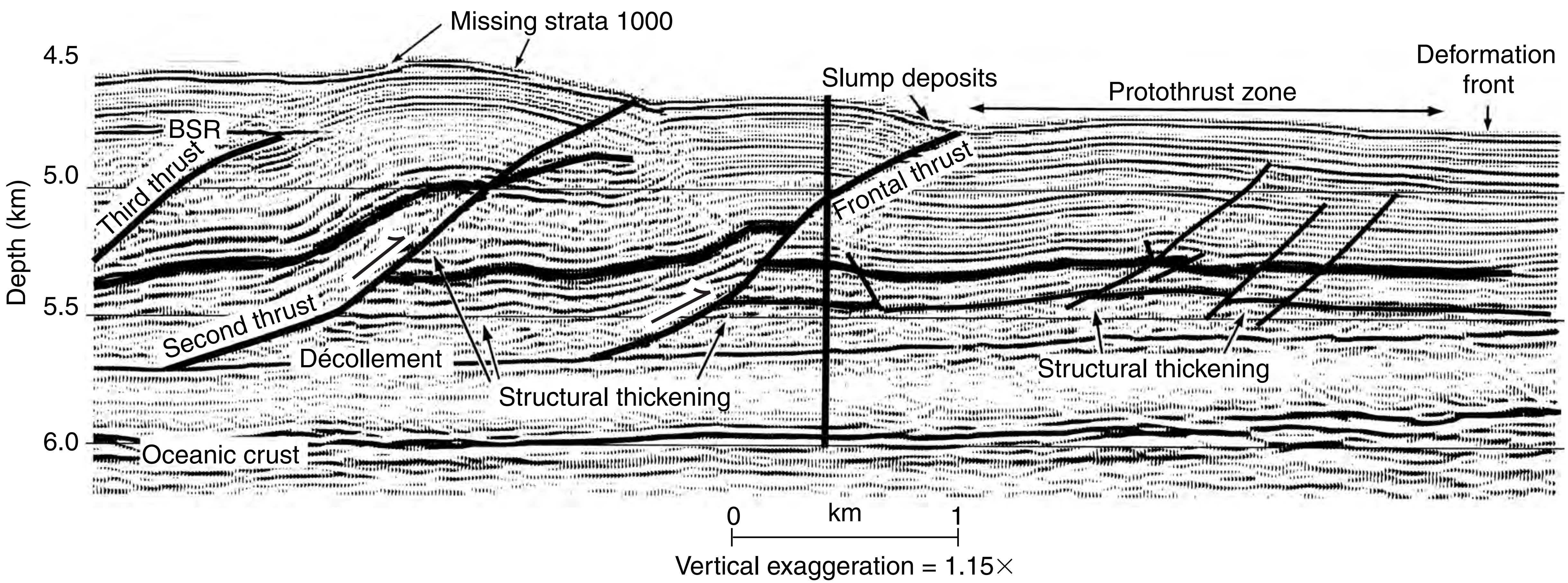
Kukowski, Lallemand, Malavieille, Gutscher & Reston, 2002, Marine Geology

Underplating + Frontal accretion

- Strain partitioning
- Two different growth processes acting simultaneously

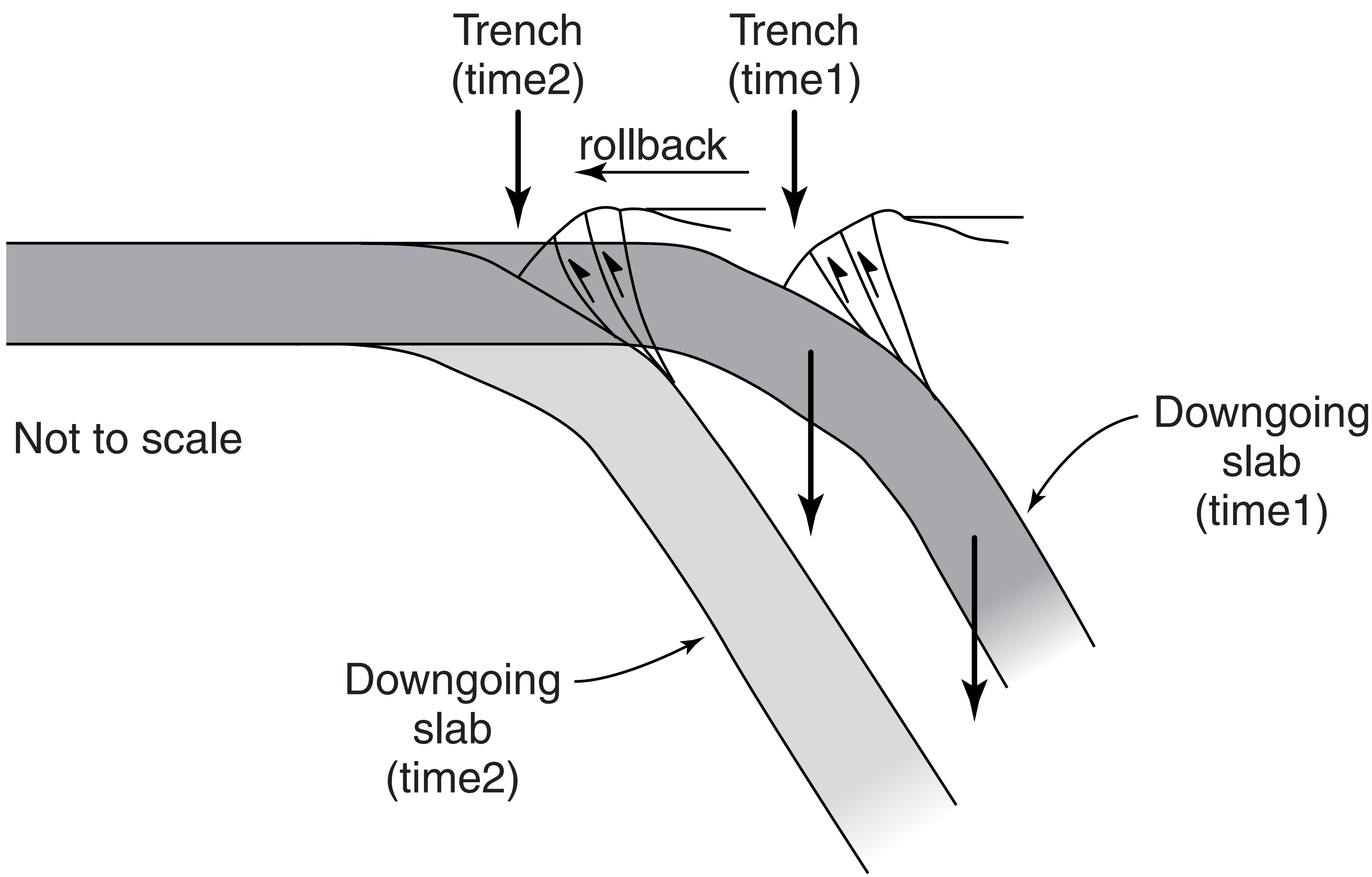


Schematic detail of an accretionary prism, showing different regimes of deformation.



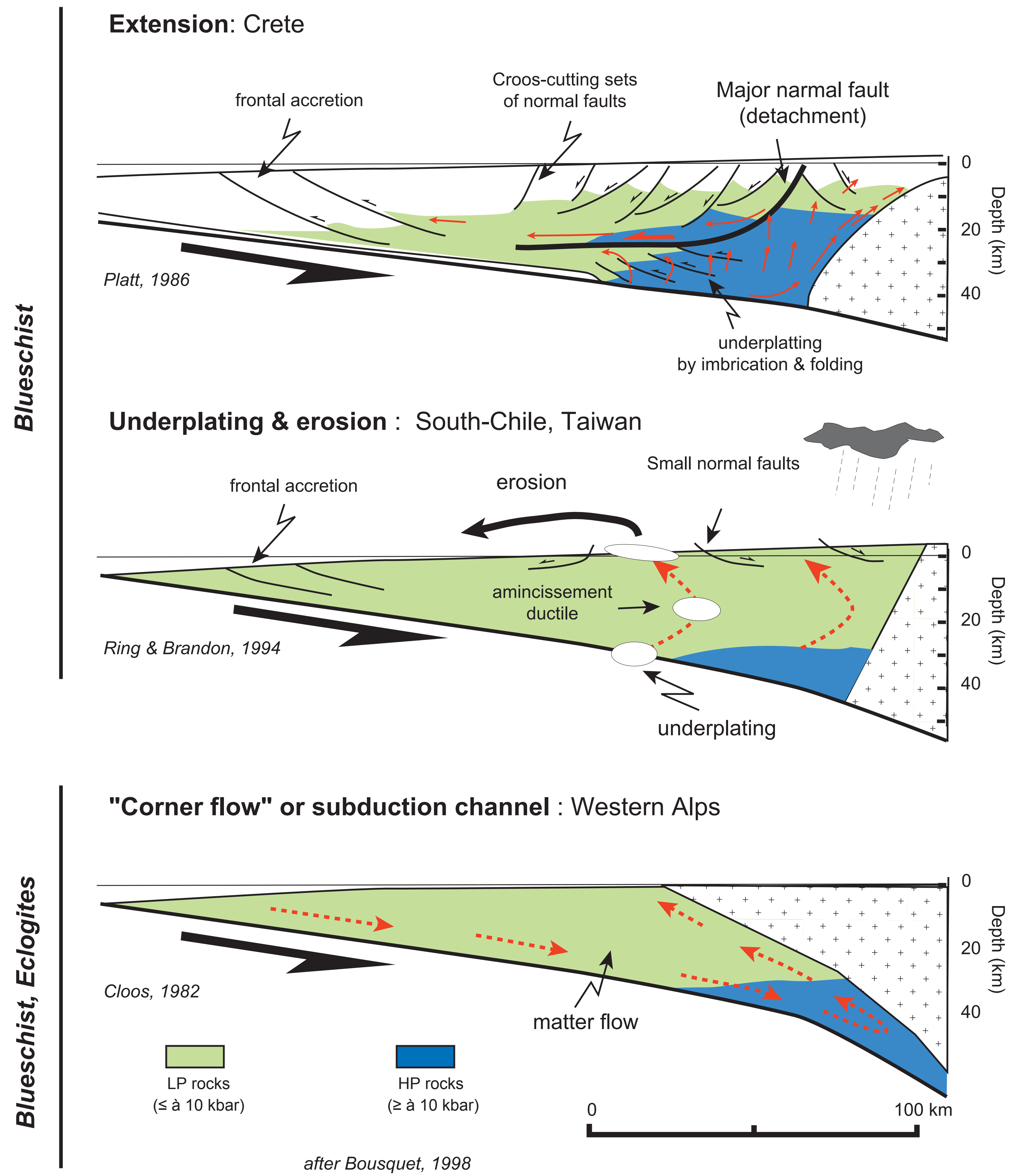
Interpreted seismic-reflection profile of the toe edge of an accretionary prism forming in the Nankai trough off Japan. Several faults can be imaged.

The concept of rollback

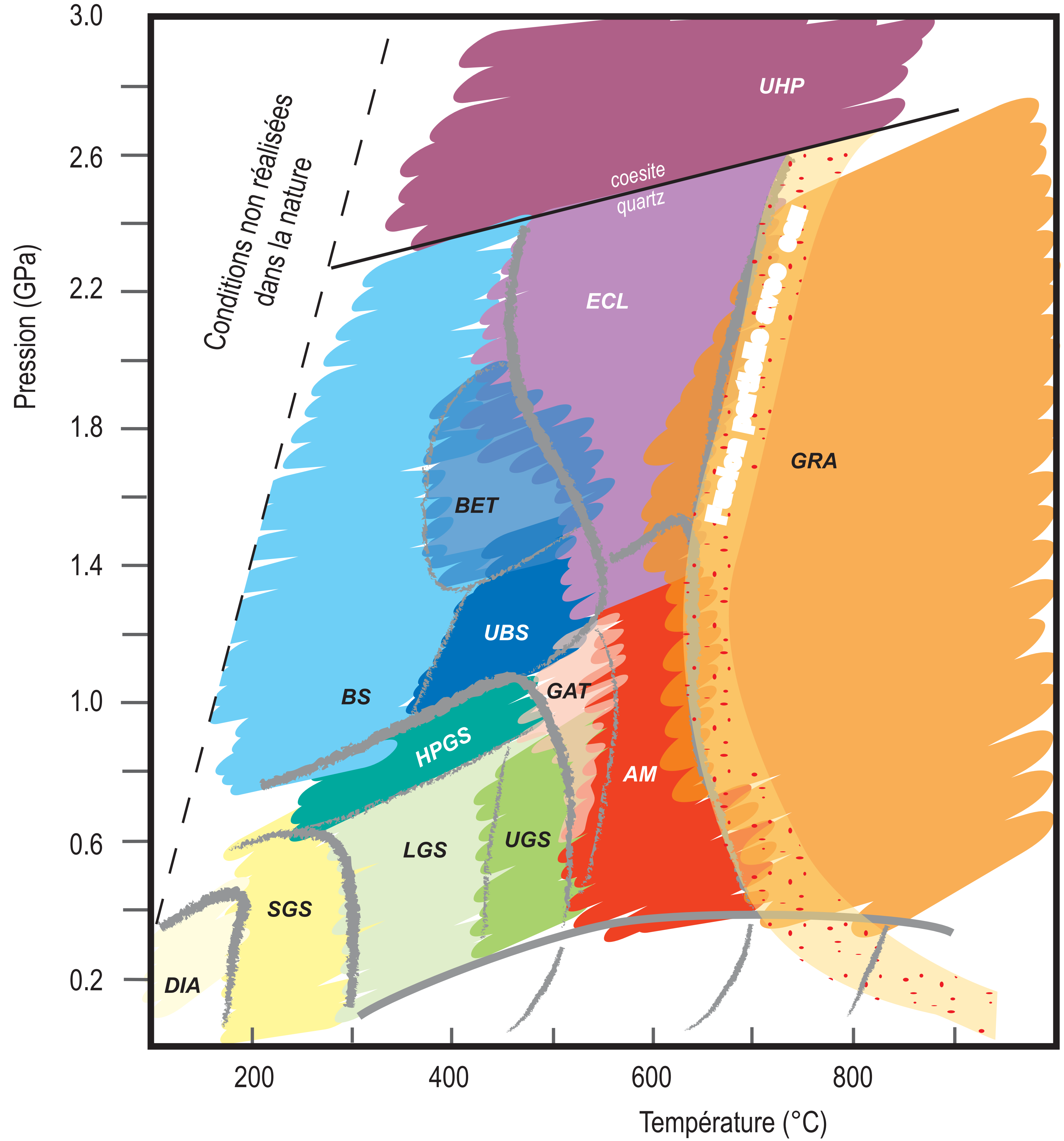


As a subducting slab sinks into the asthenosphere, the position of the trench relative to the a fixed point in the mantle migrates. This movement is called rollback

Types of wedge & exhumation of HP rocks



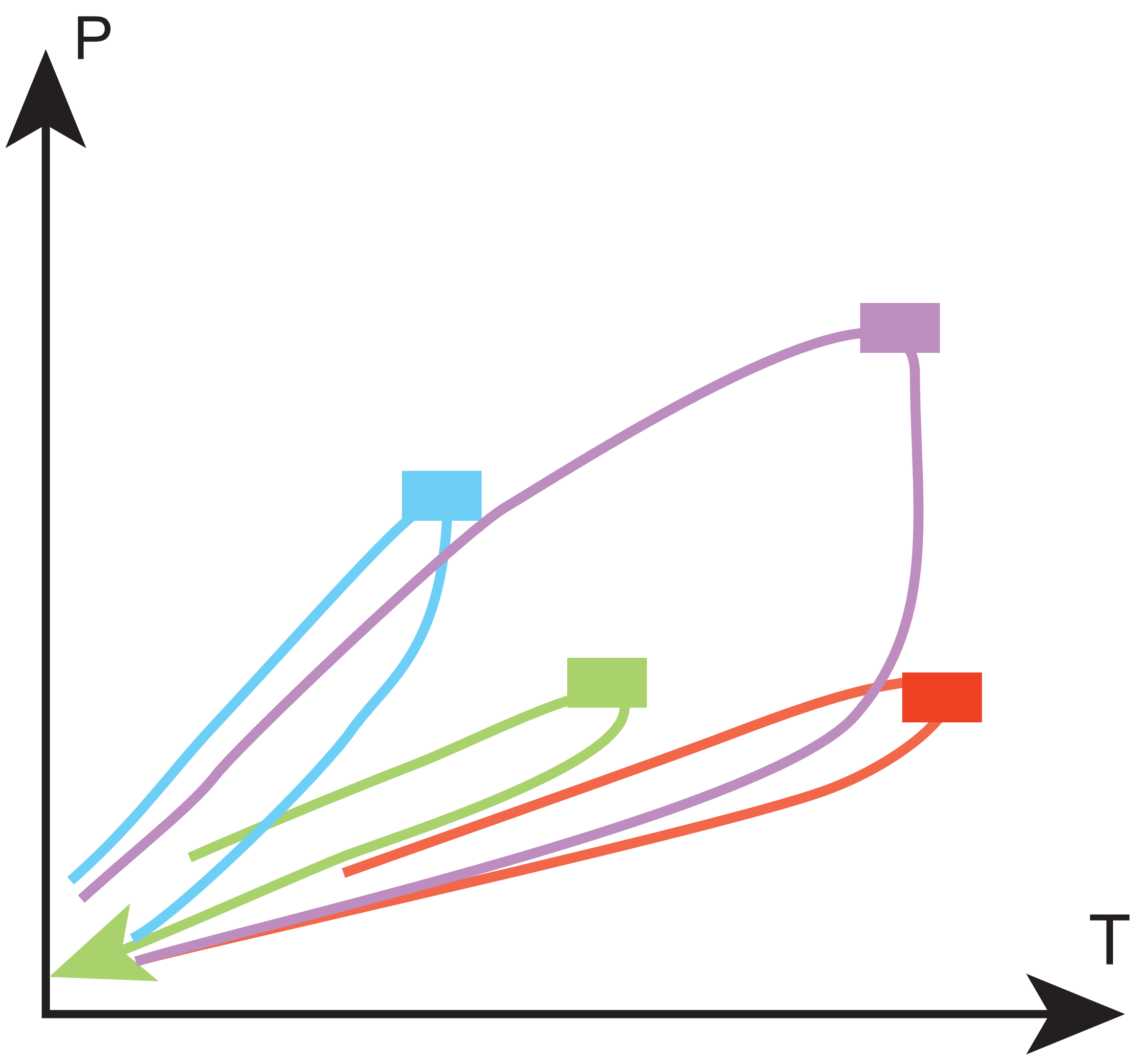
Metamorphic facies



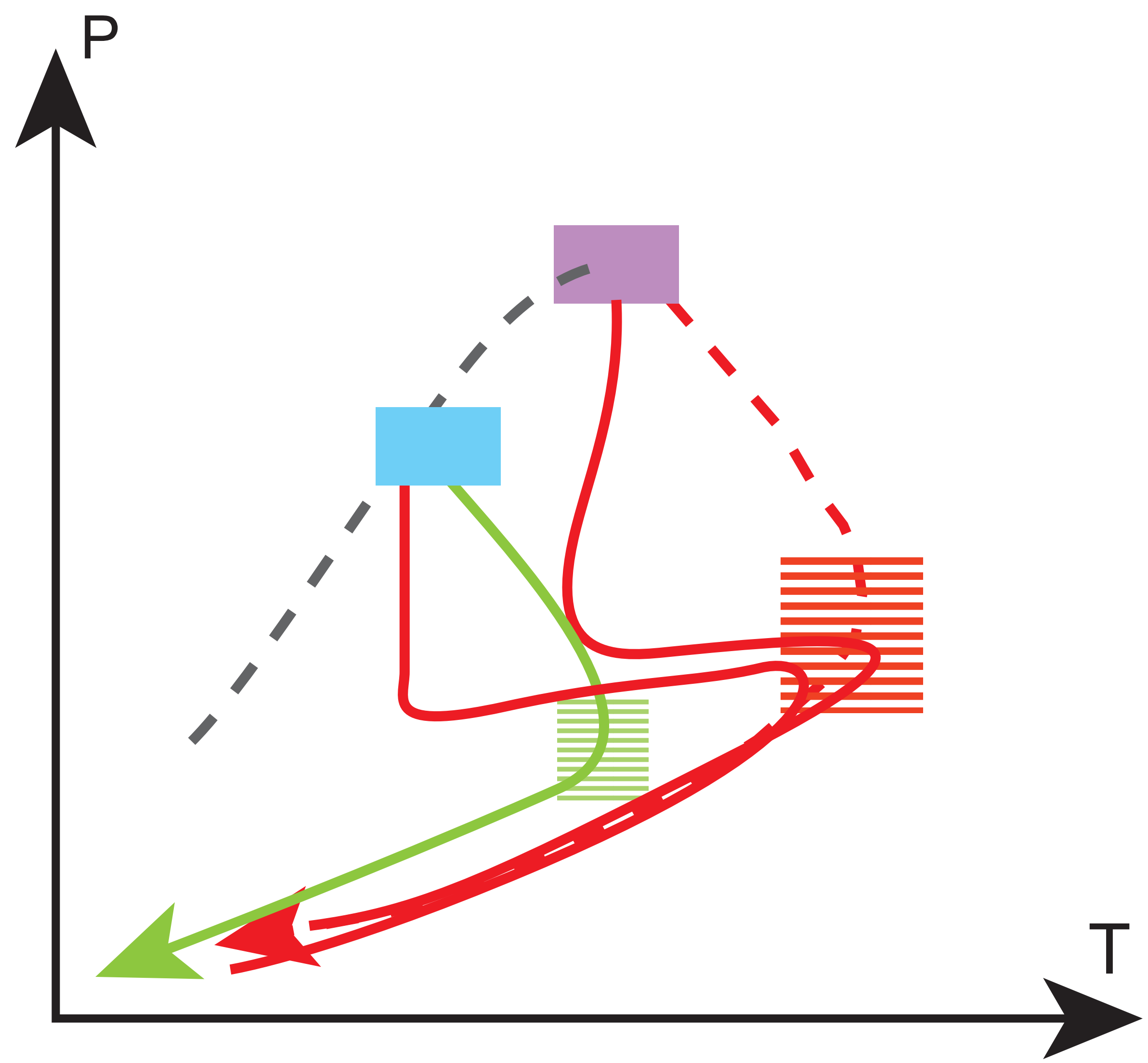
Different types of PT paths

Single metamorphic peak

always followed by cooling or isothermal retrograde events

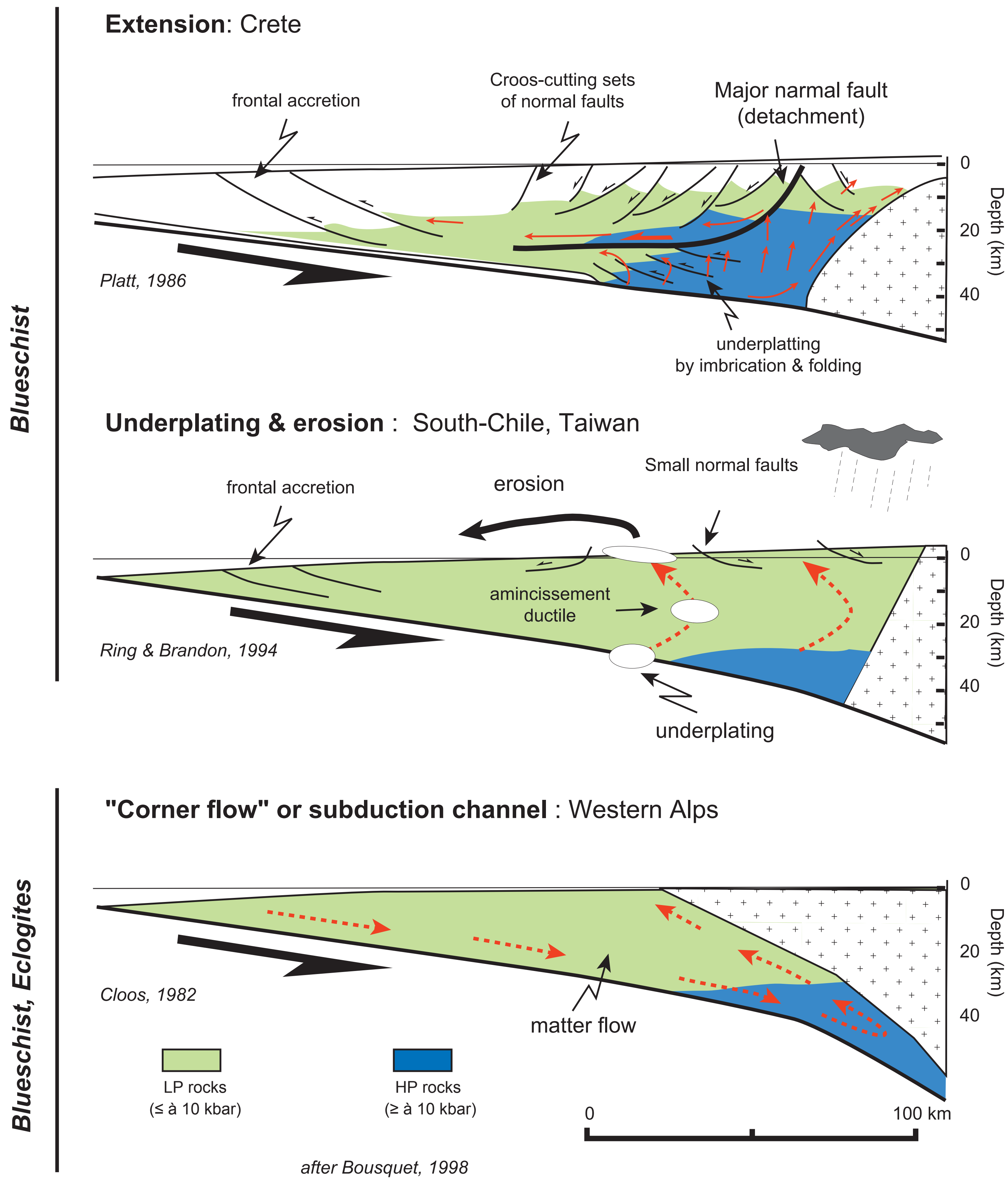


Metamorphic P-peak overprinted by a later thermal peak

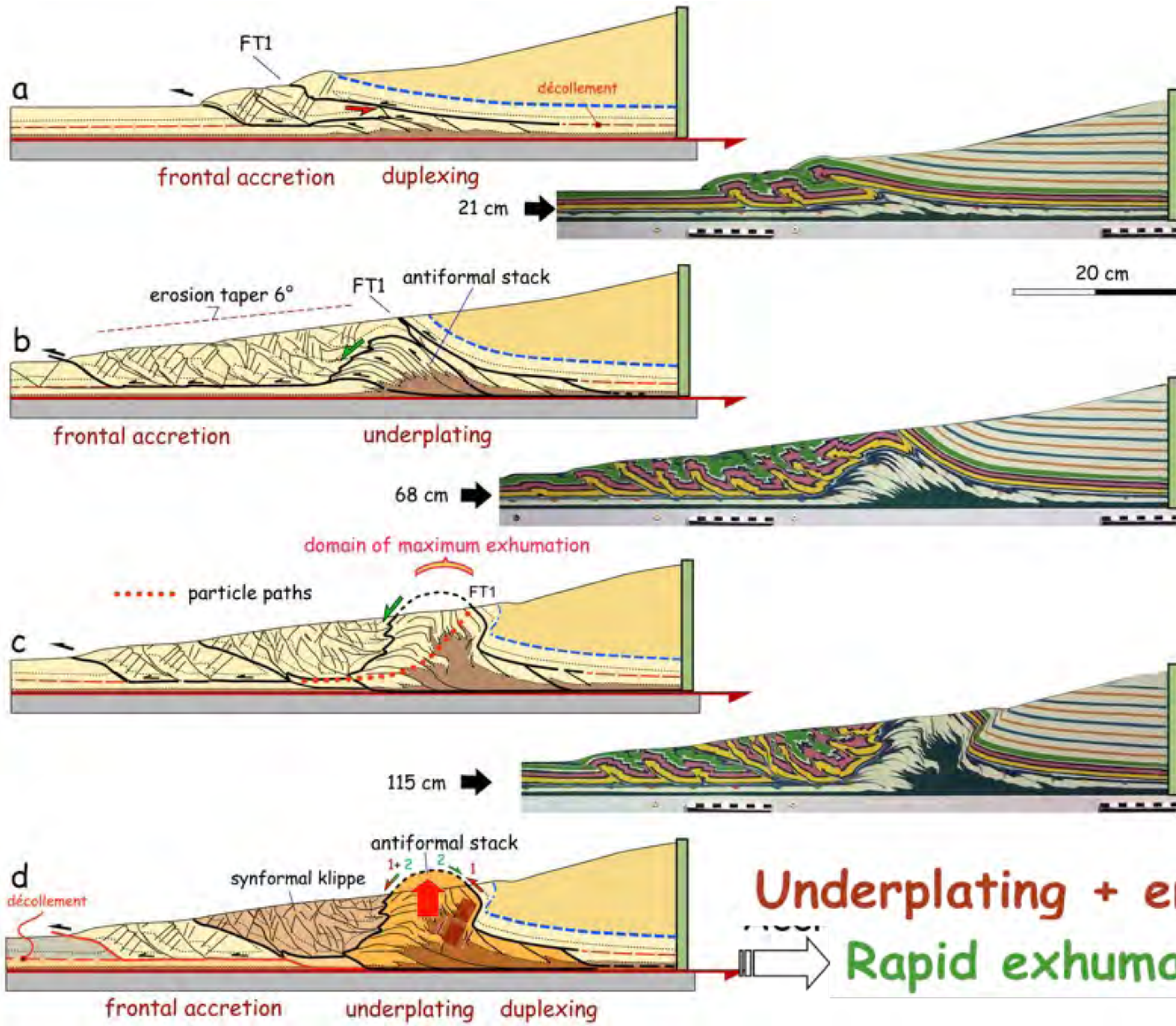


Oberhänsli et al., 2004

Types of wedge & exhumation of HP rocks



Accretion & erosion for the exhumation

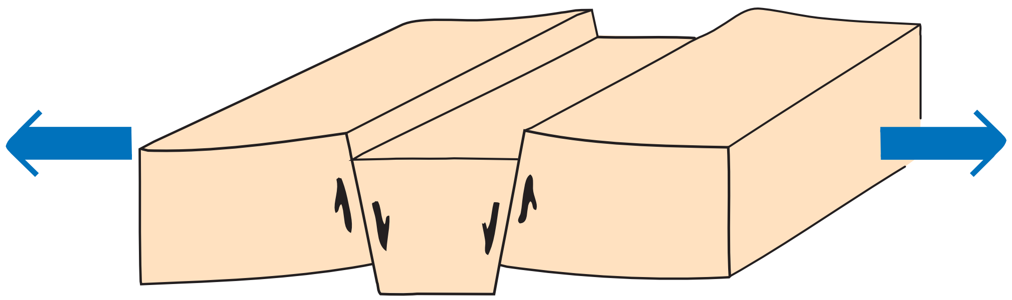


Underplating + erosion

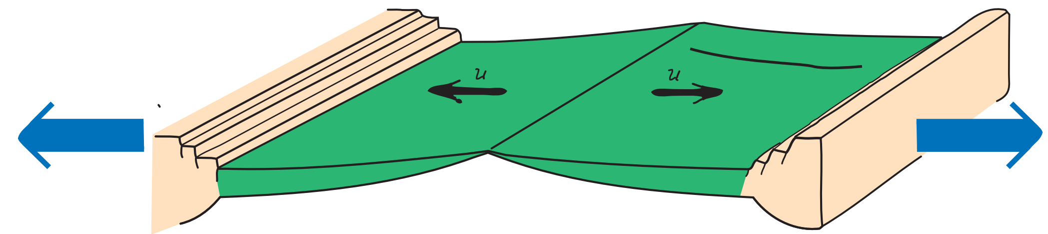
Rapid exhumation

Wilson cycle

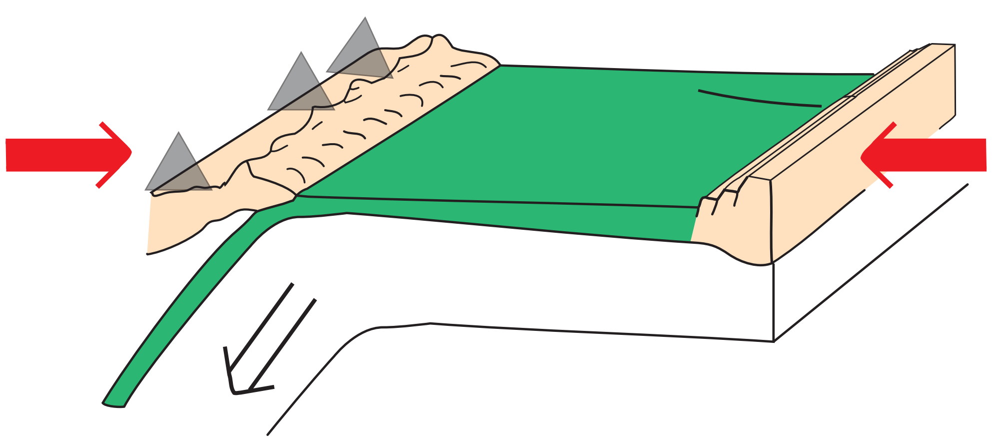
Rifting



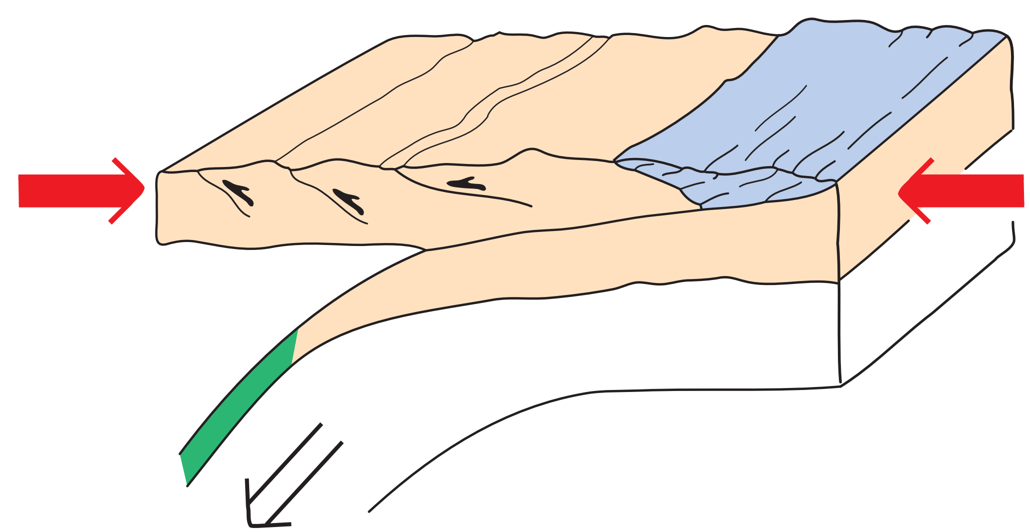
Ocean formation



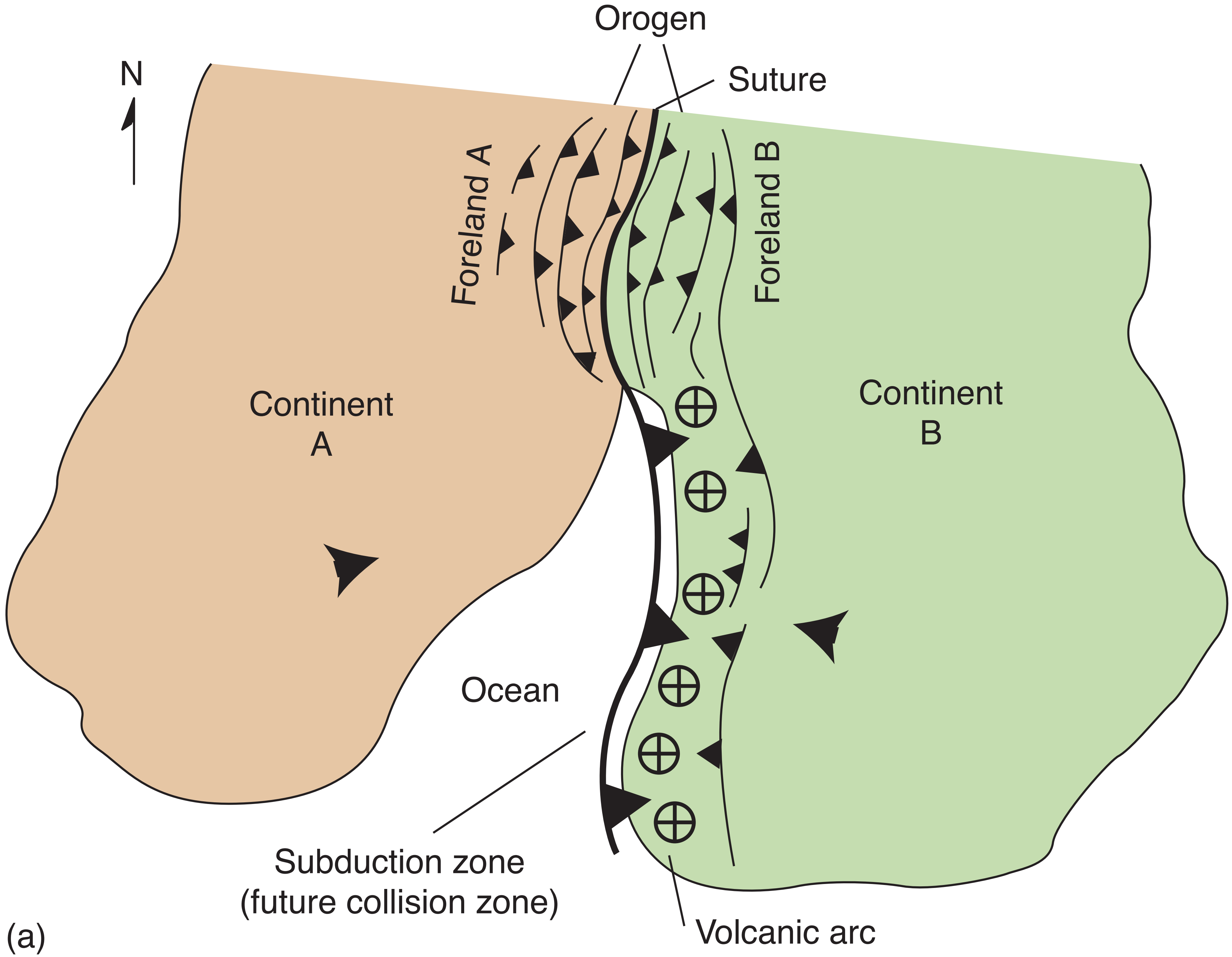
Subduction



Collision

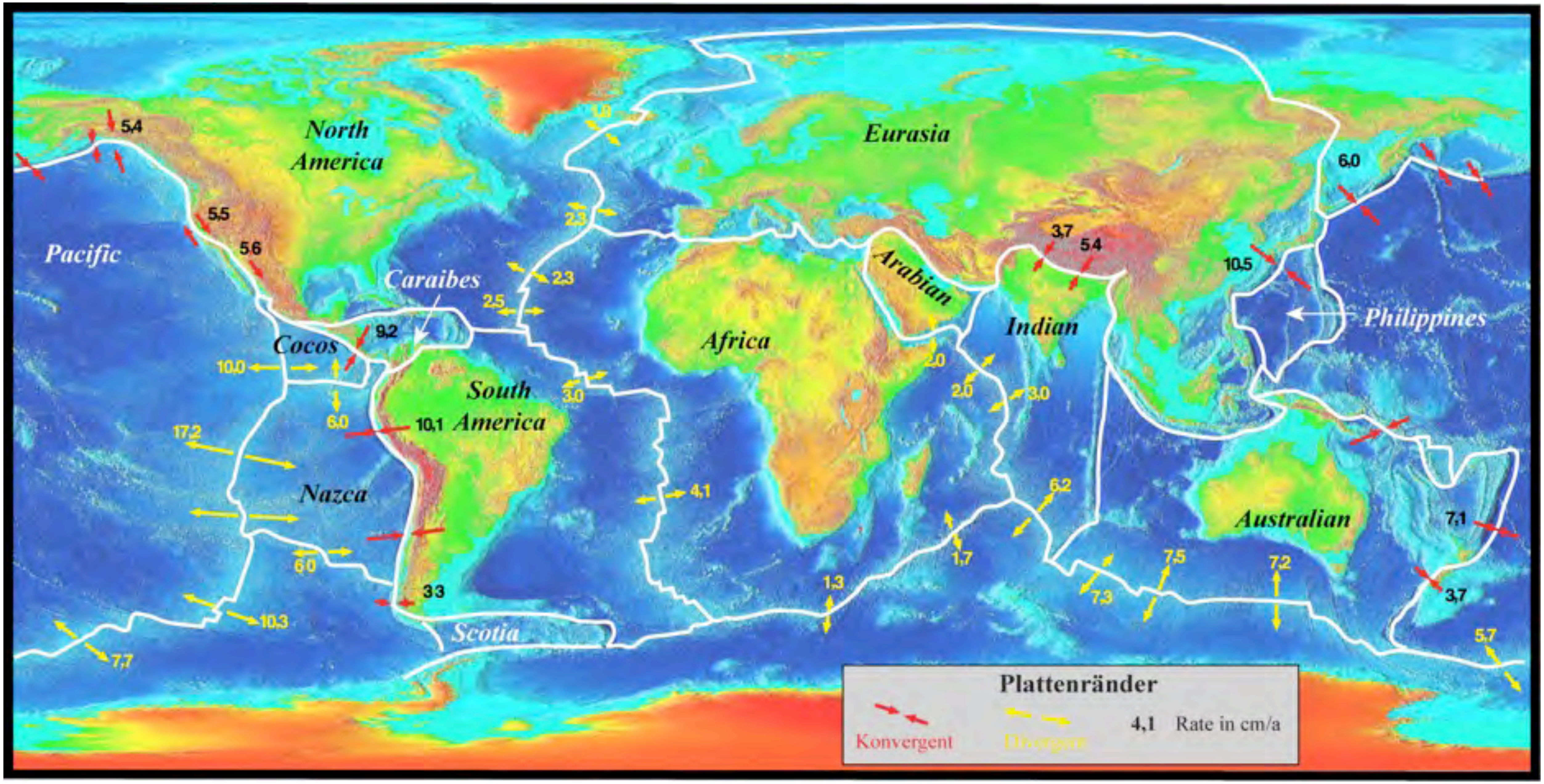


From subduction to collision

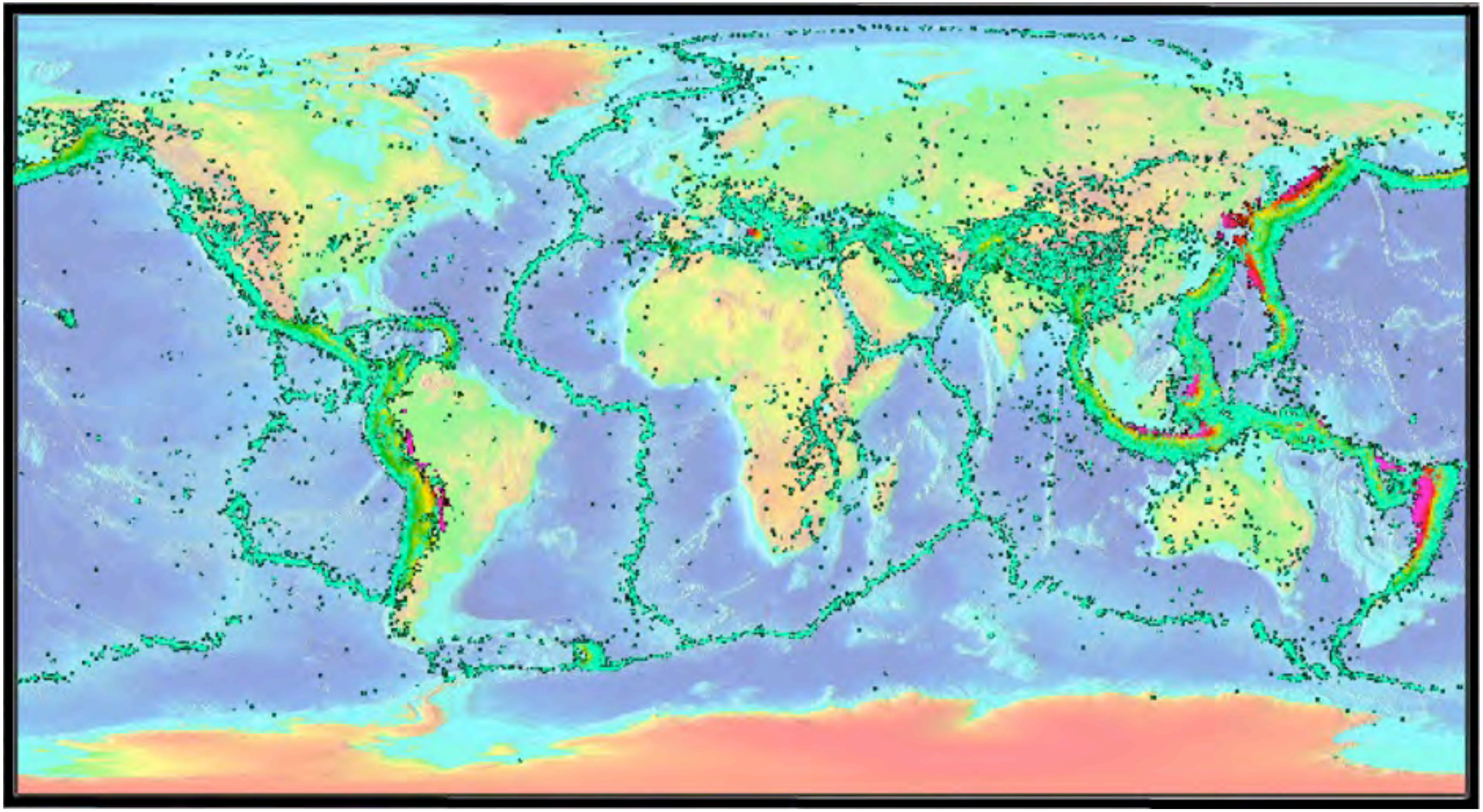


A map showing a zipper-like collision between two continents. Here,the ocean between the two continents is closing progressively from north to south. In the collision zone, the boundary between what had originally been two separate continents.

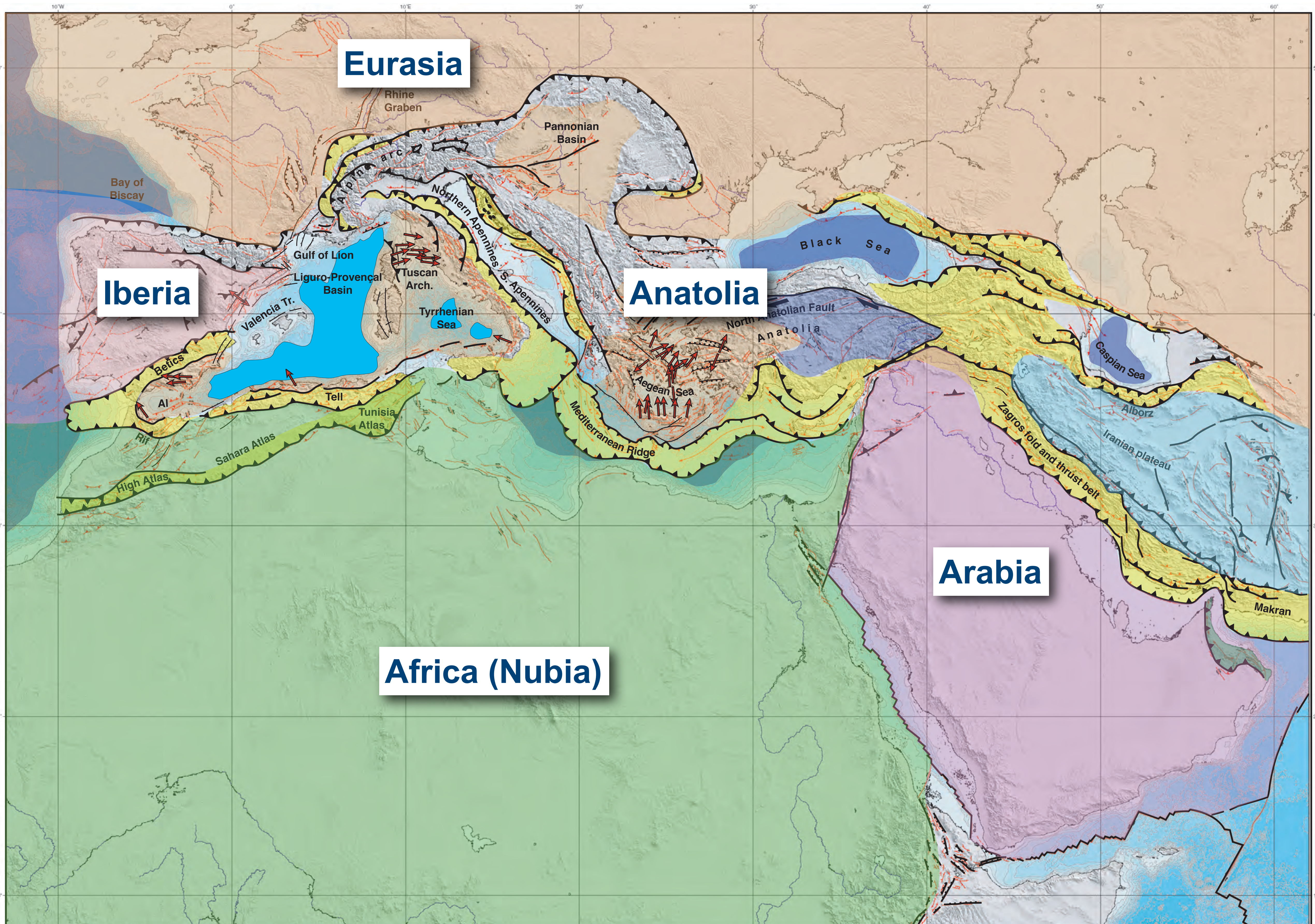
Konvergente Plattenräder



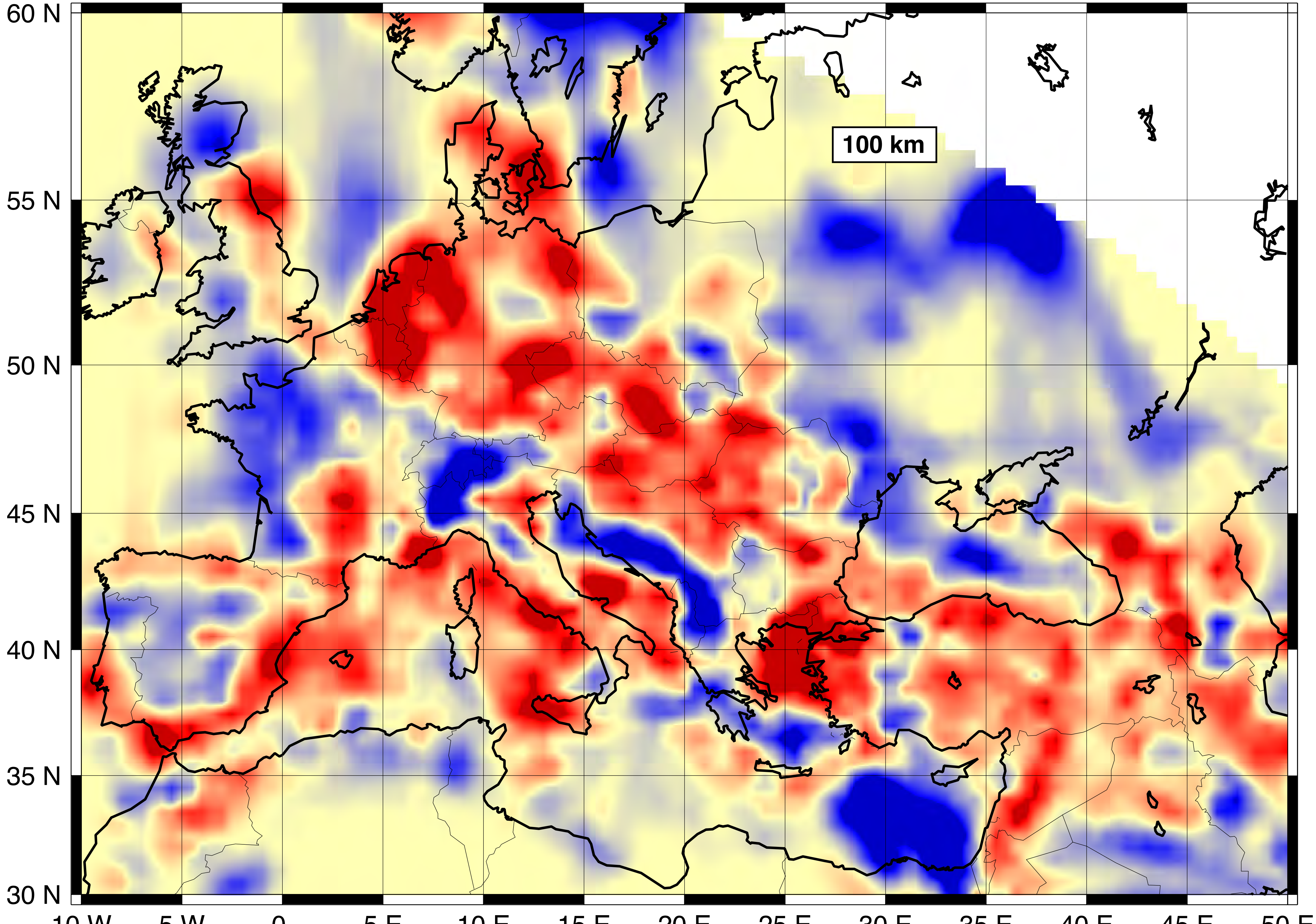
Earthquakes



Deep structure of the Mediterranean area

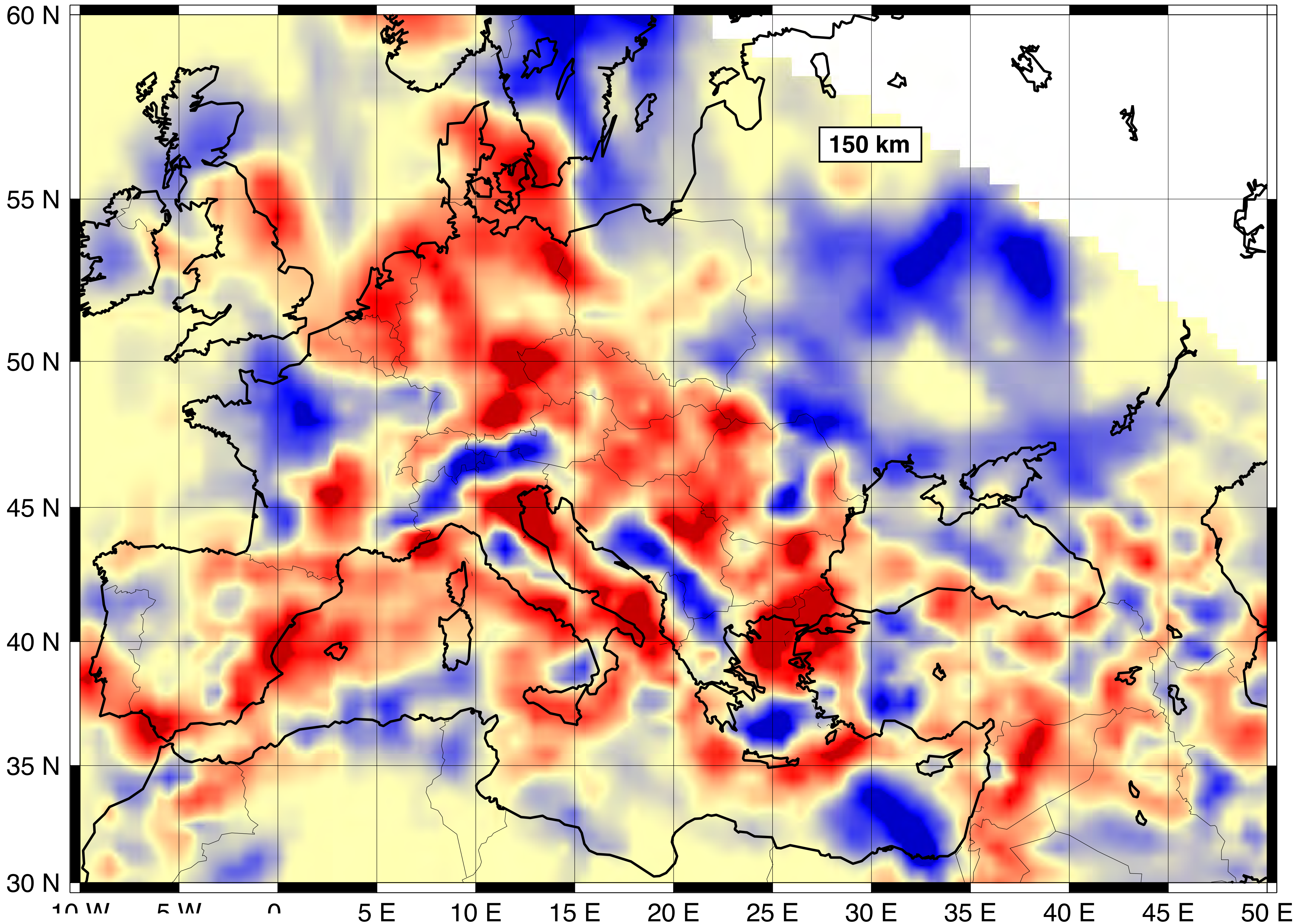


Deep structure of the Mediterranean area



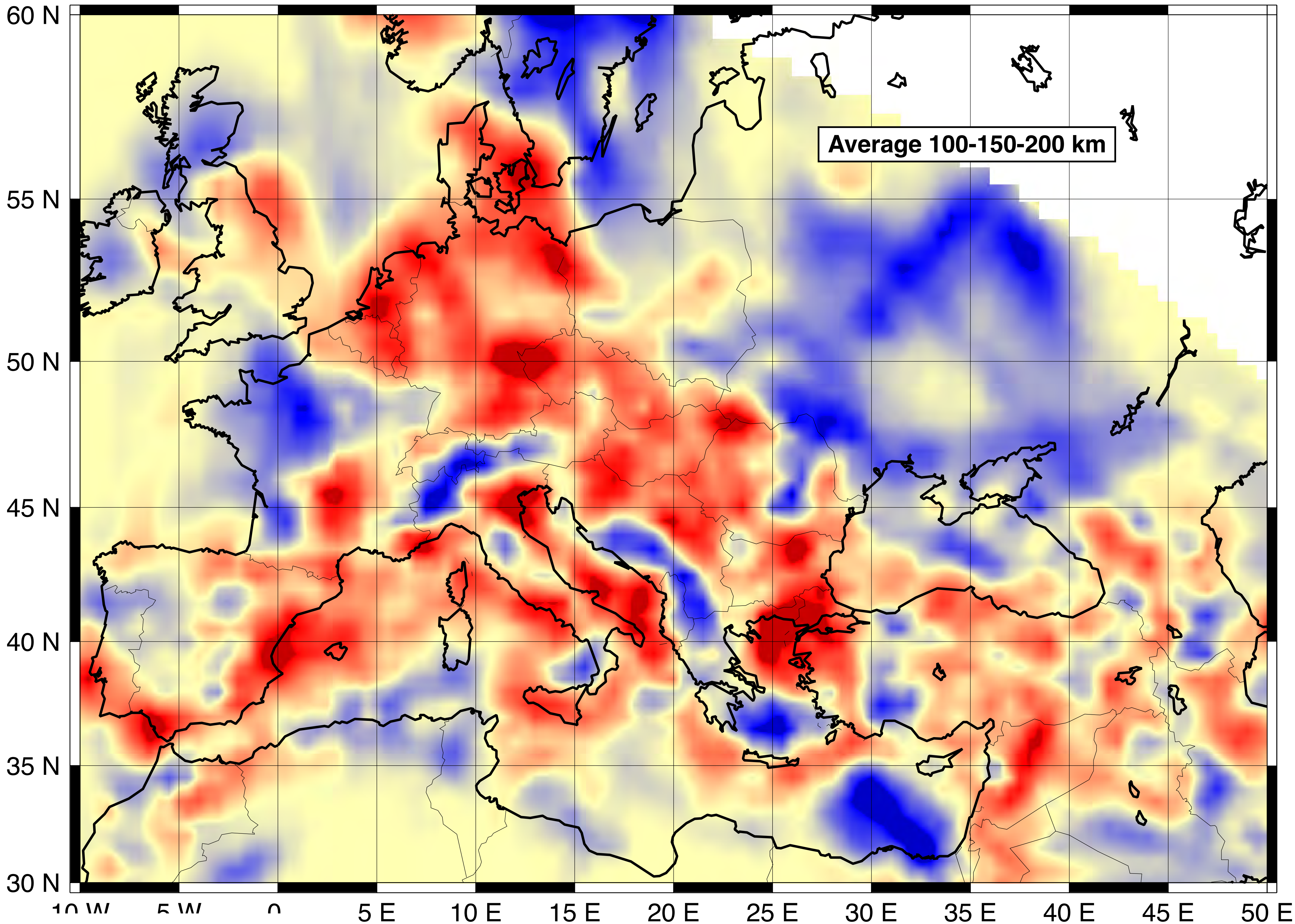
Piromallo et al.

Deep structure of the Mediterranean area



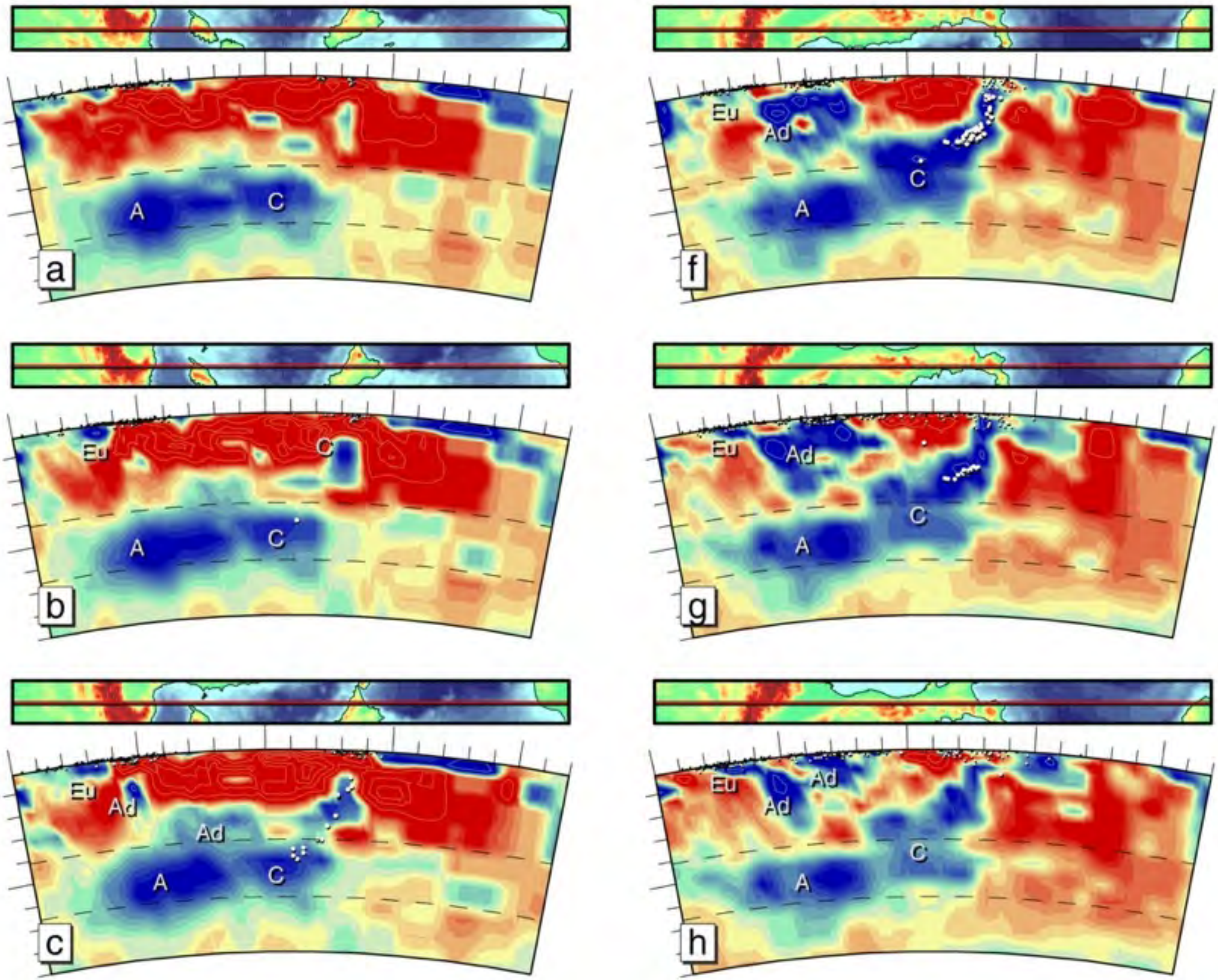
Piromallo et al.

Deep structure of the Mediterranean area

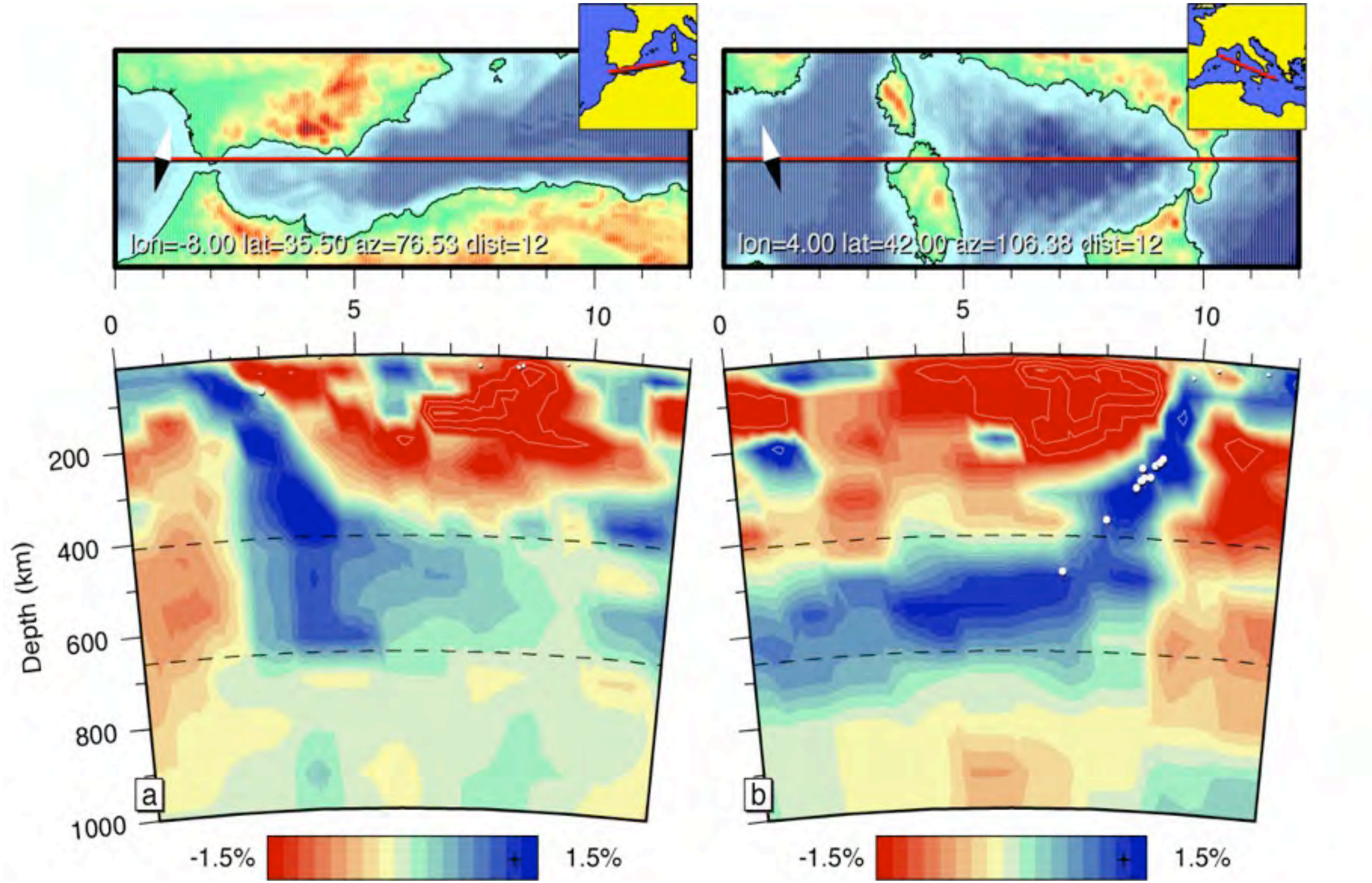


Piromallo et al.

Deep structure of the Mediterranean area

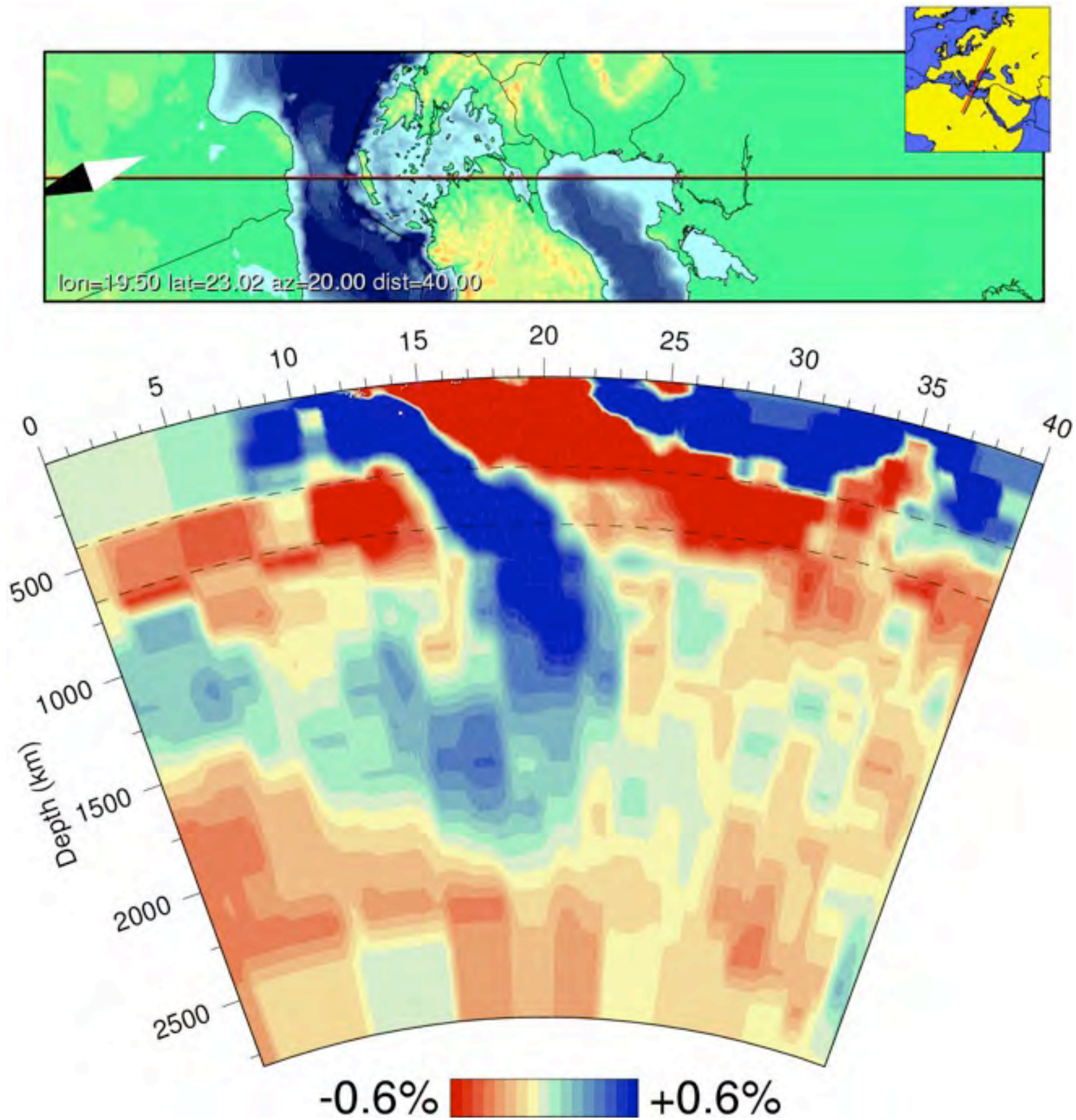


Deep structure of the Mediterranean area



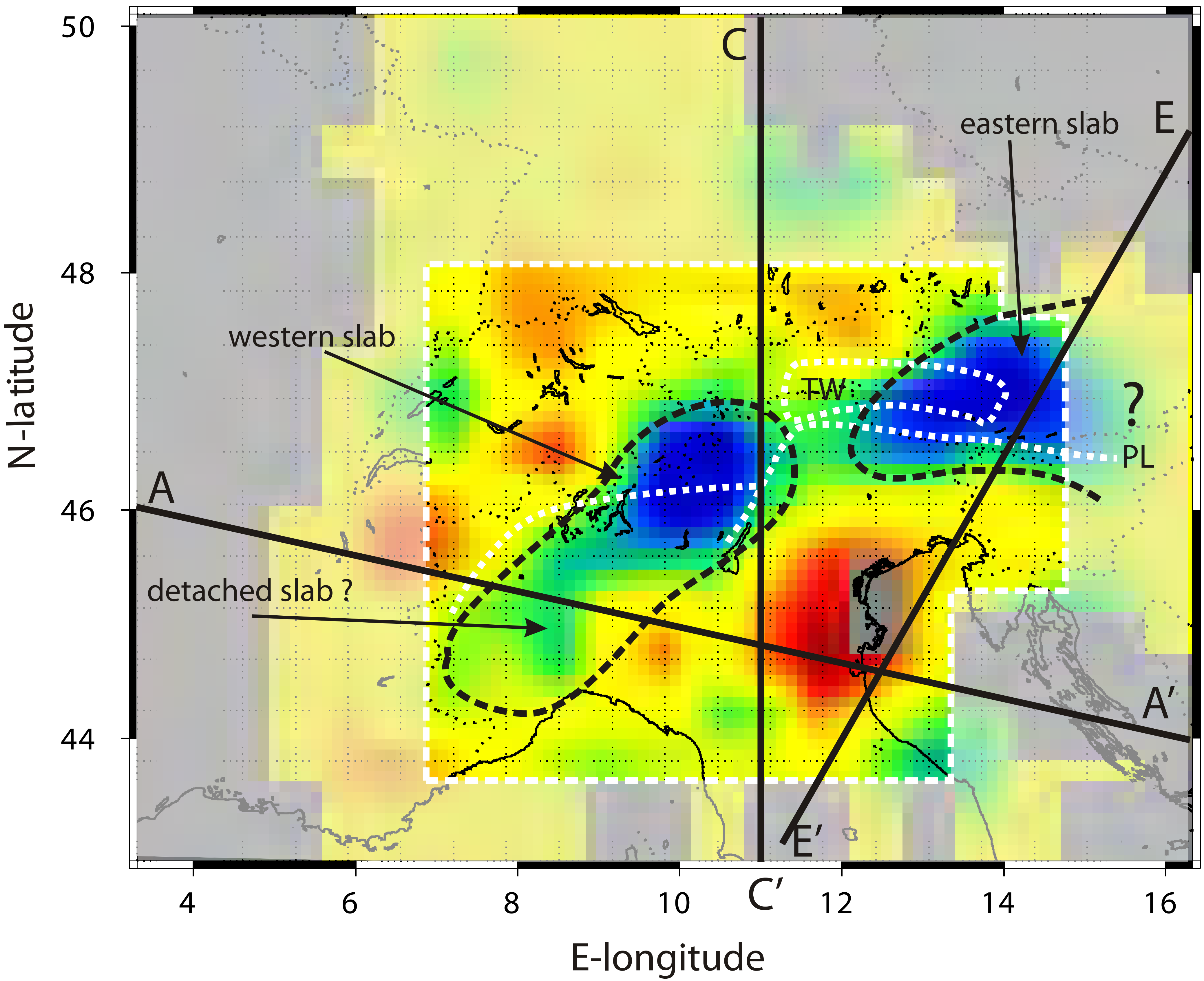
Spakman & Wortel, 2004

Deep structure of the Mediterranean area

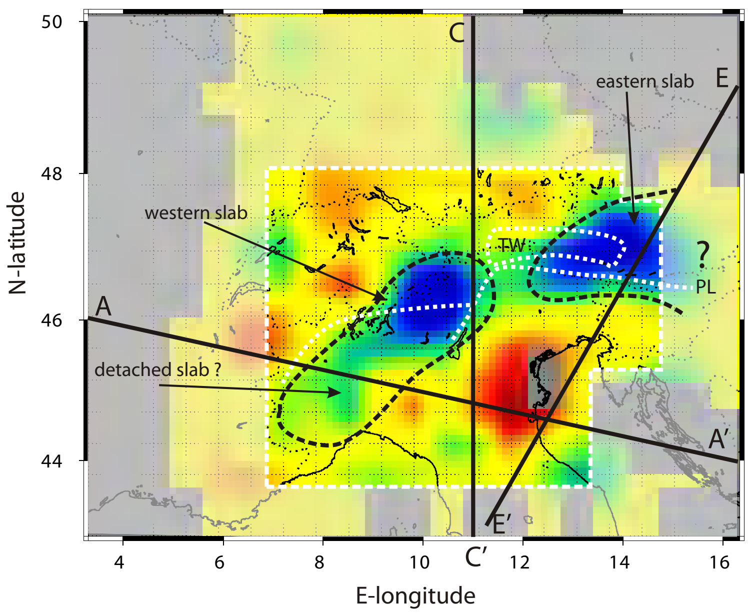


Spakman...

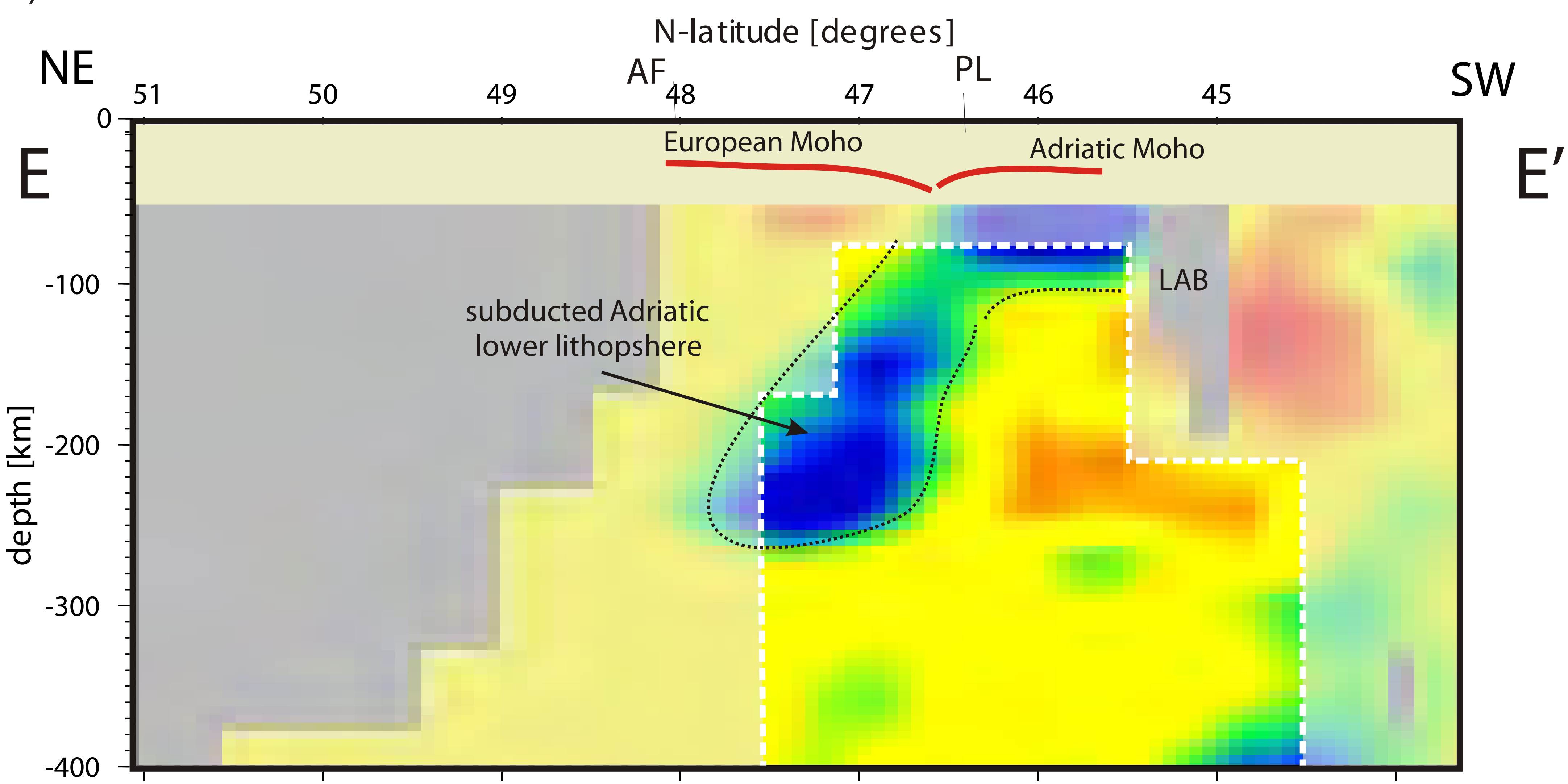
Deep structure of the Alpine area



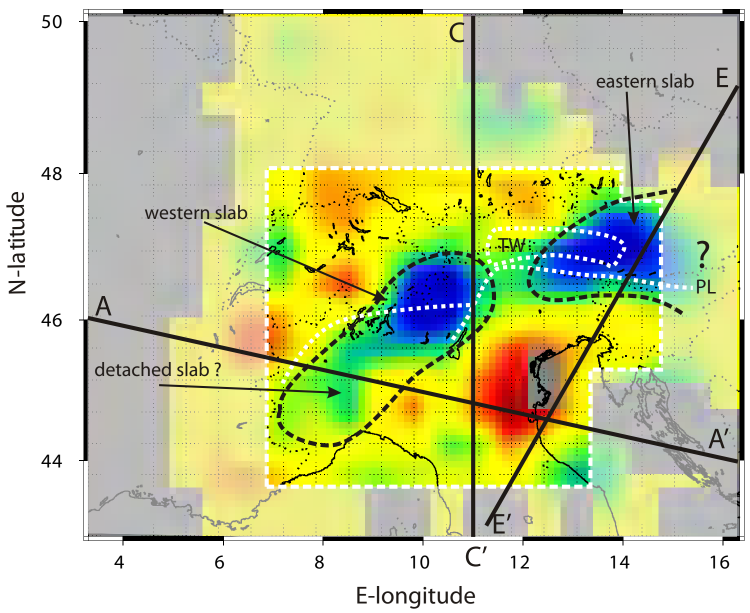
Deep structure of the Alpine area: East

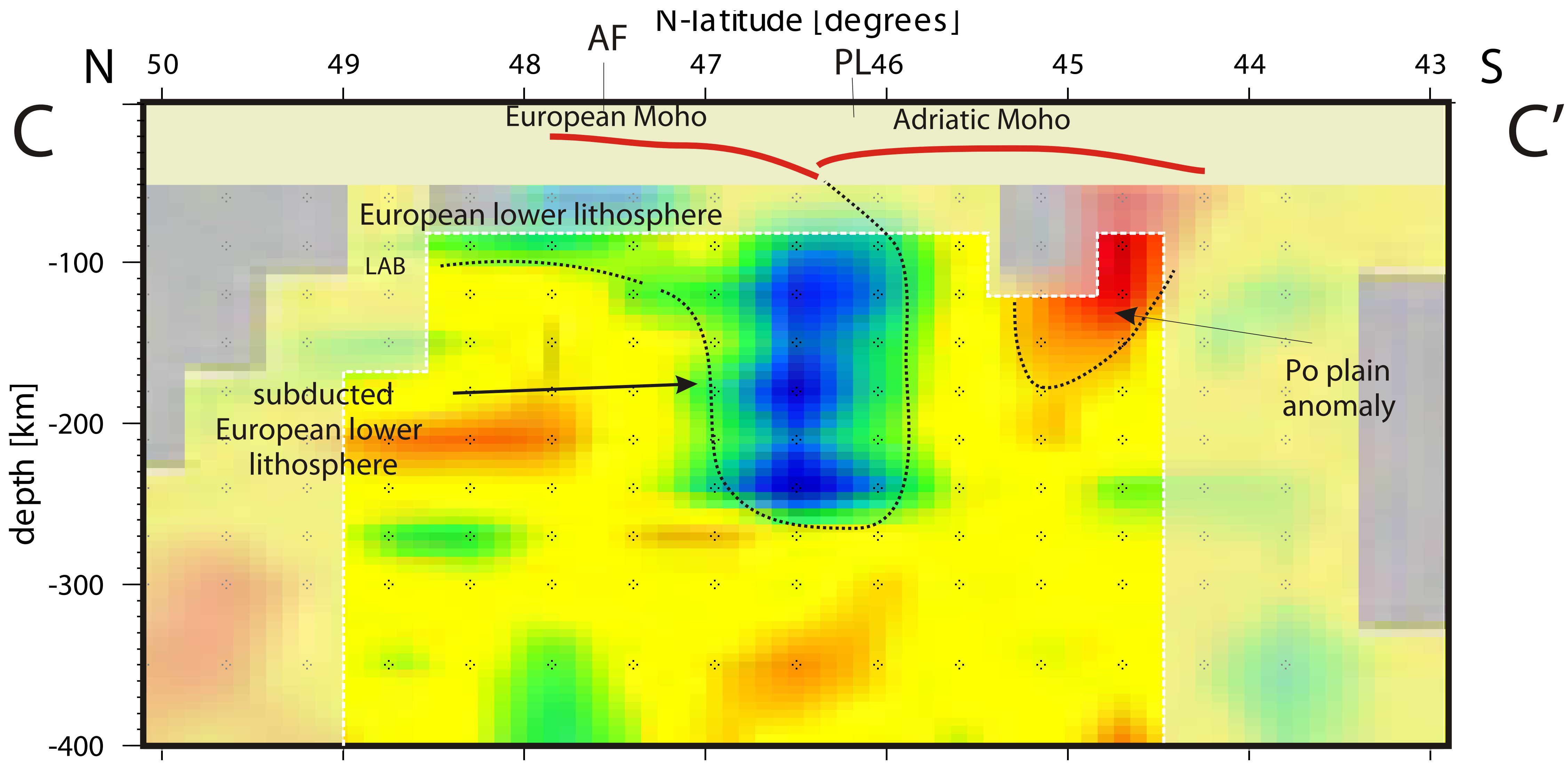


f) Profile EE'

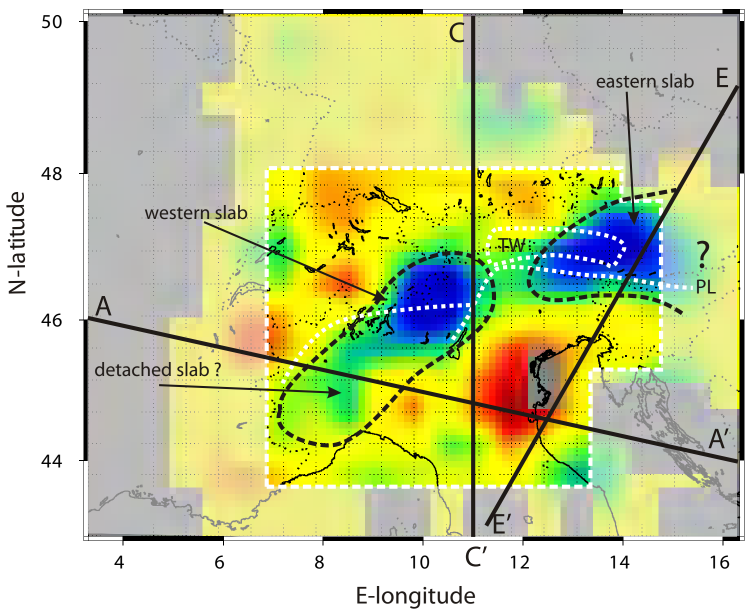


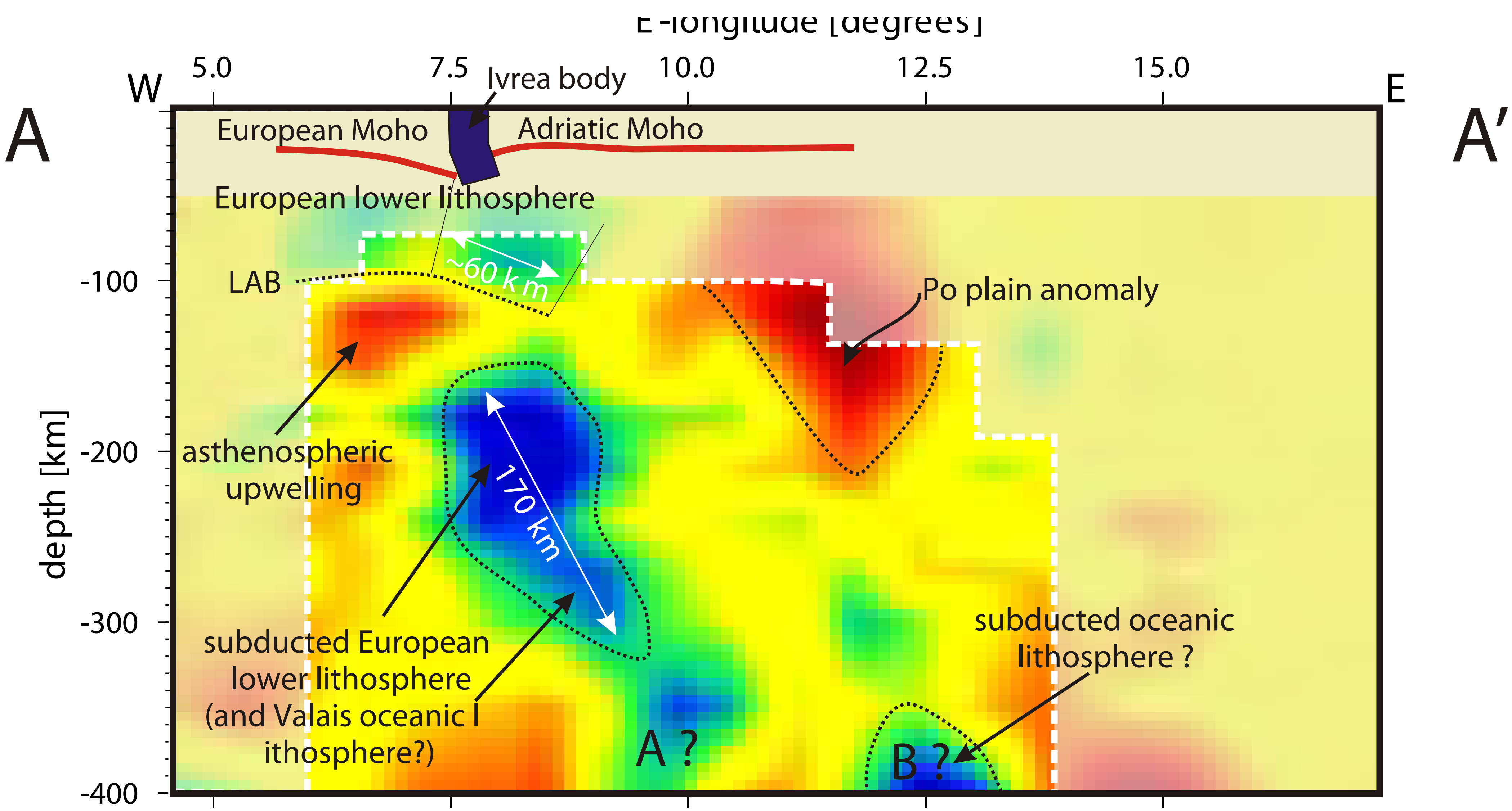
Deep structure of the Alpine area: Center



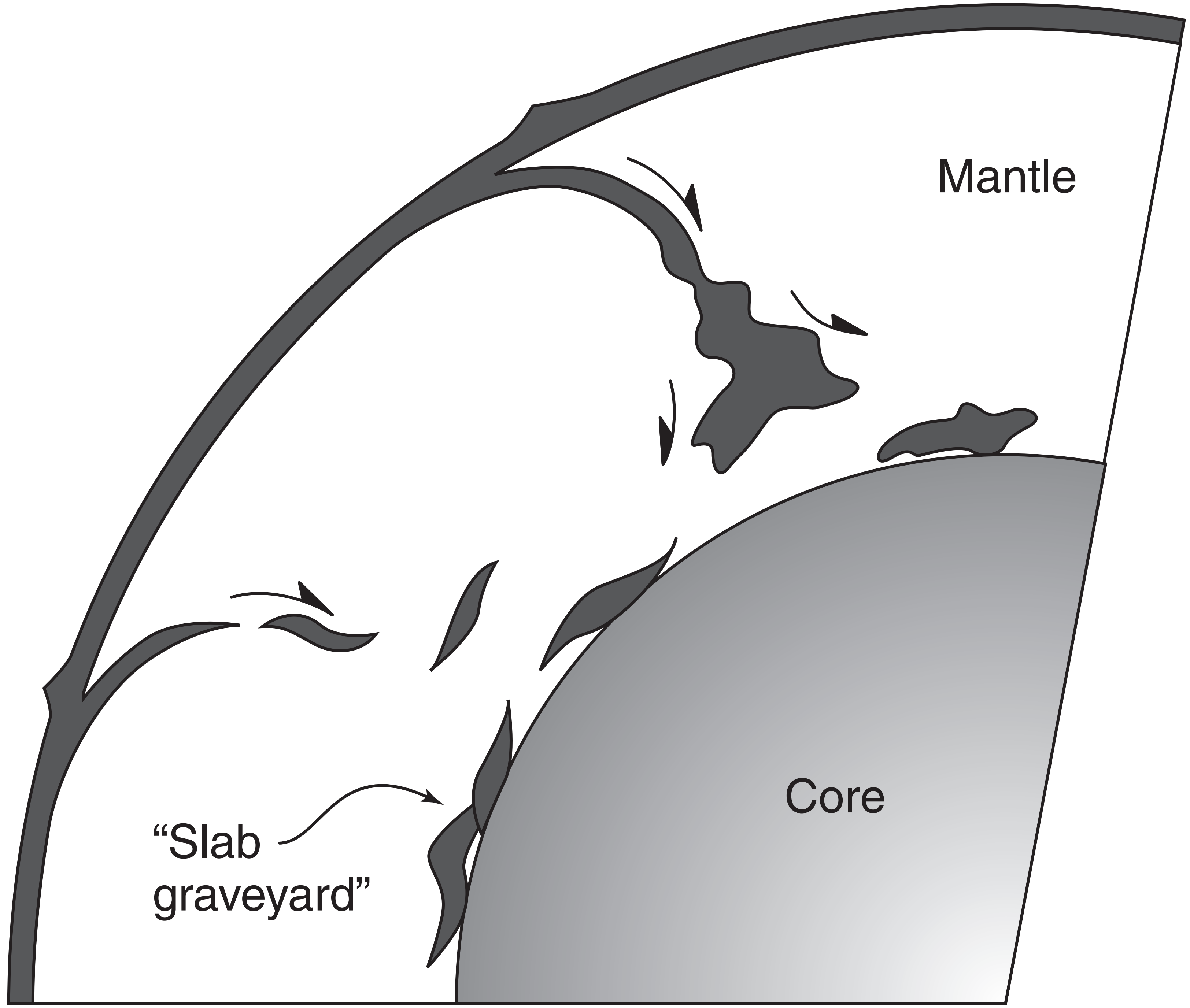


Deep structure of the Alpine area: West



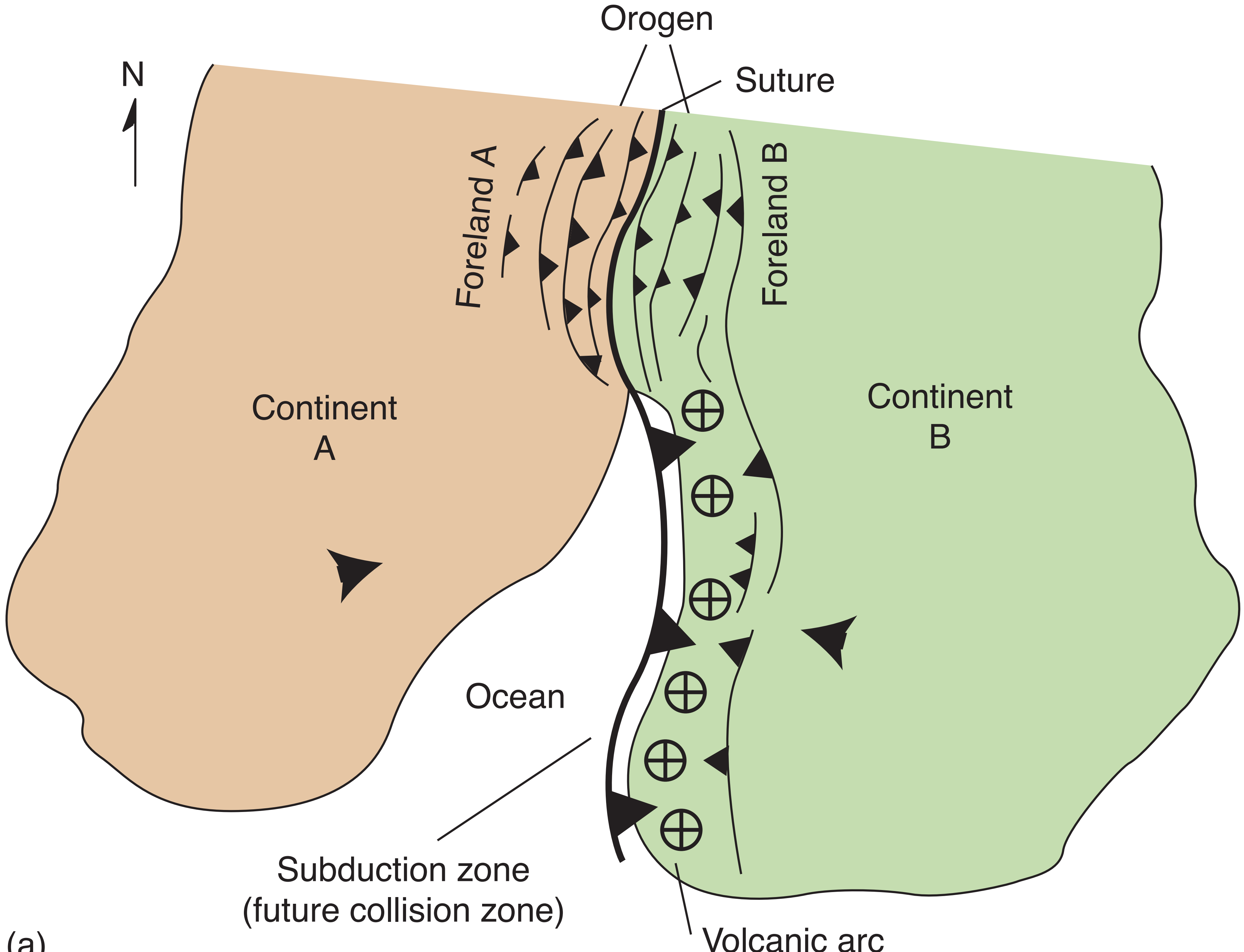


Slab & break-off



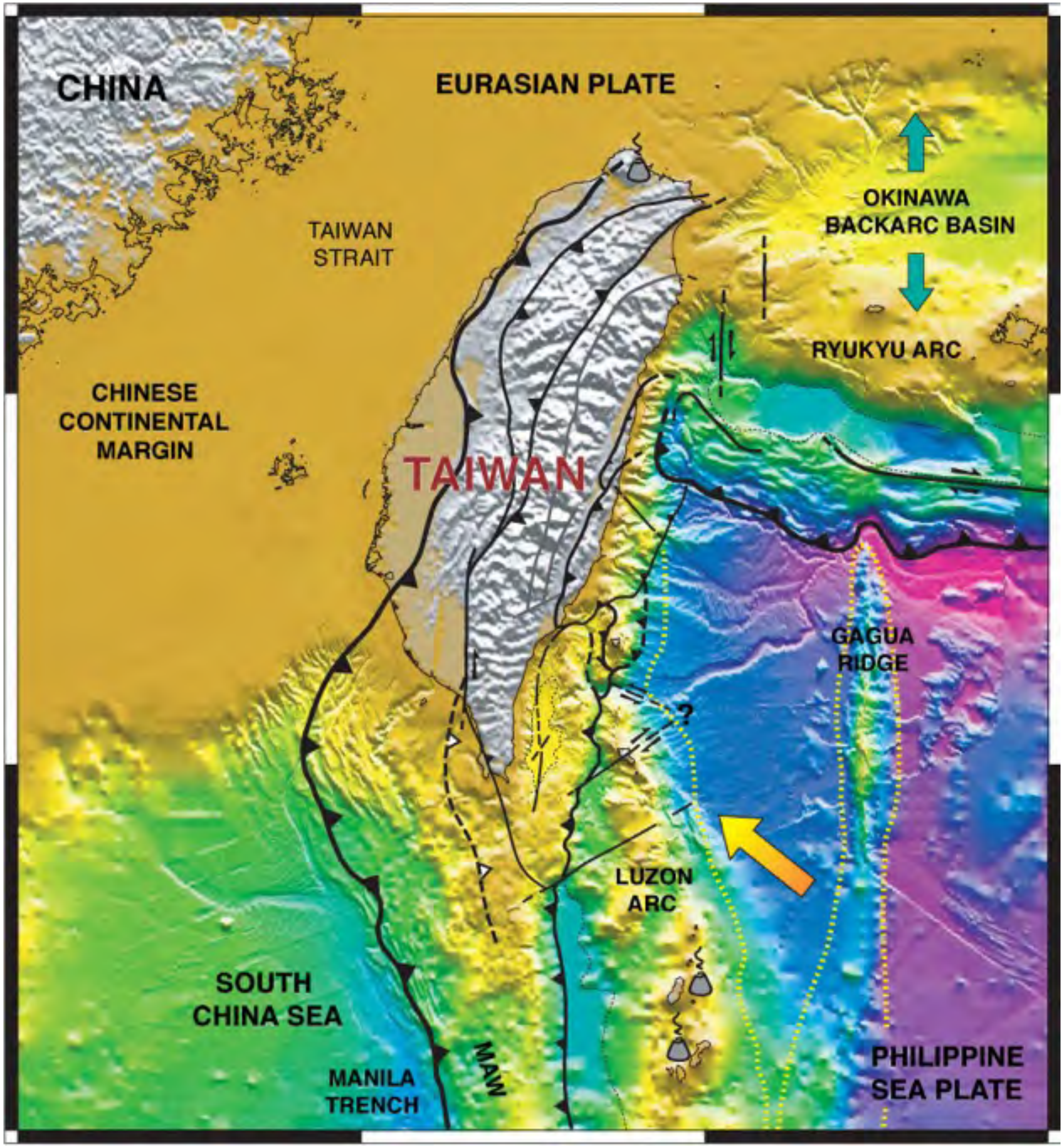
Schematic cross section of the Earth illustrating the concept of a slab

From subduction to collision

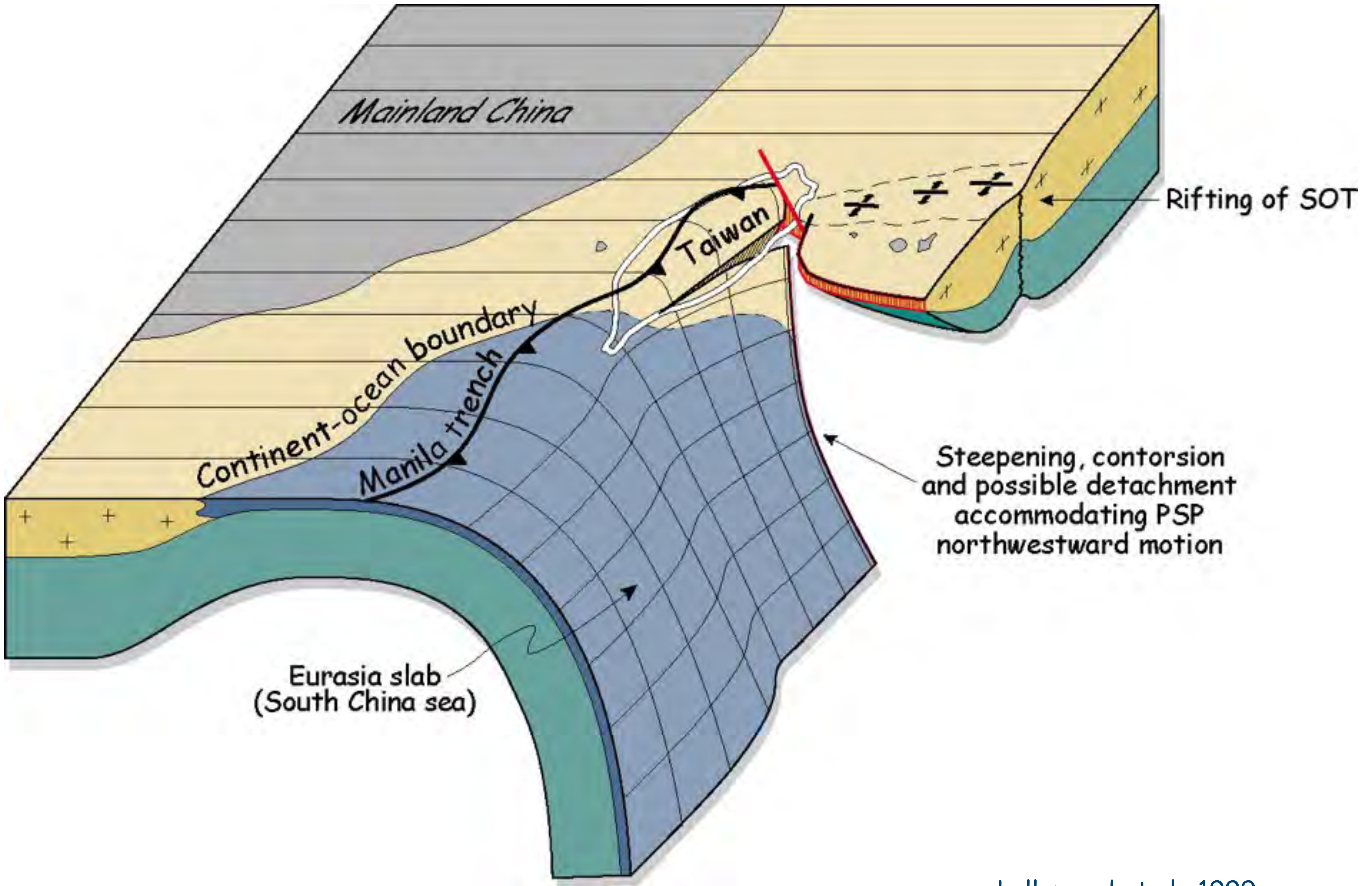


A map showing a zipper-like collision between two continents. Here,the ocean between the two continents is closing progressively from north to south. In the collision zone, the boundary between what had originally been two separate continents.

From subduction to collision: Taiwan



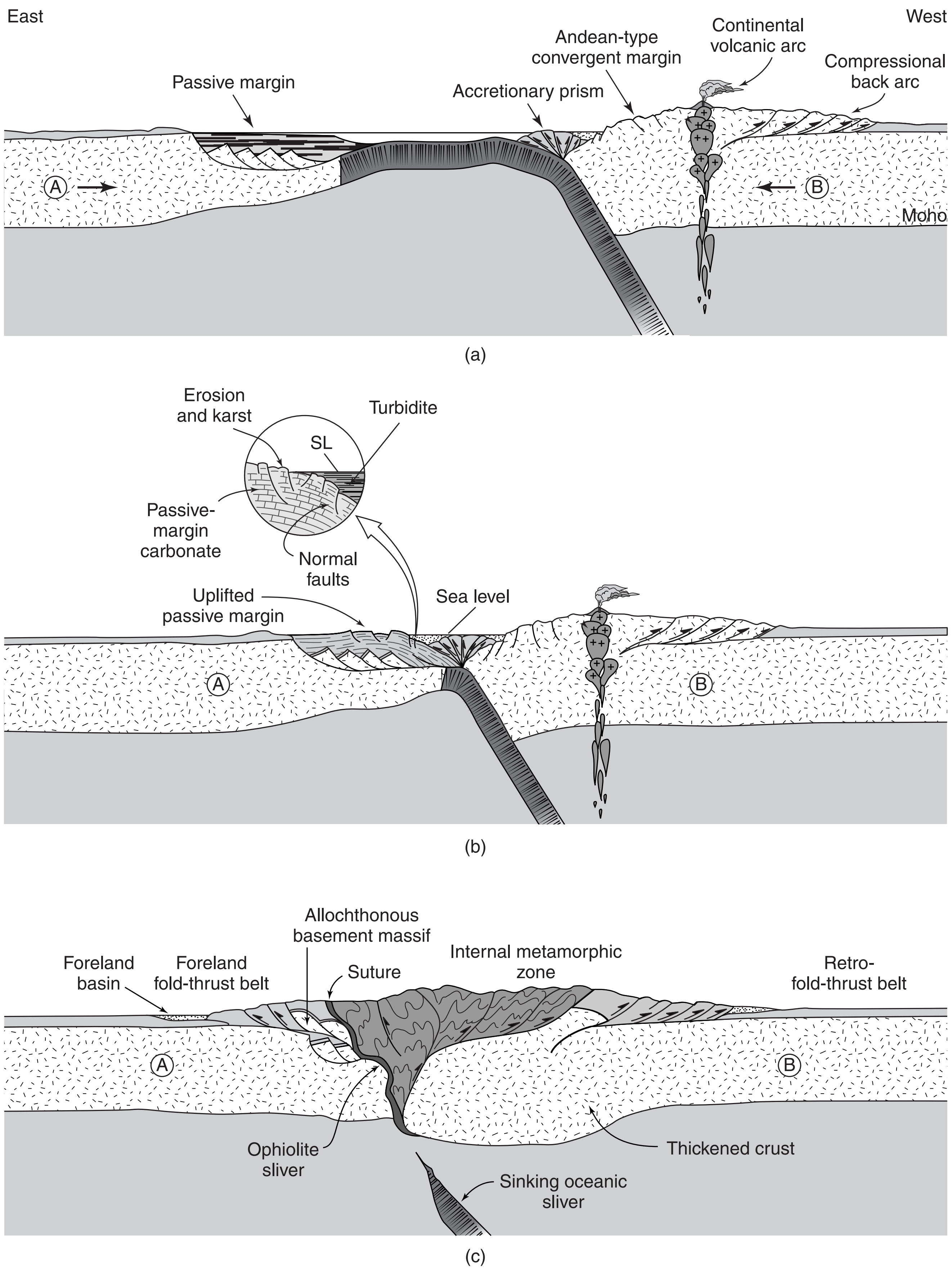
From subduction to collision: Taiwan



Lallemand et al., 1999

From subduction to collision

Stages in an idealized subduction–collision transition



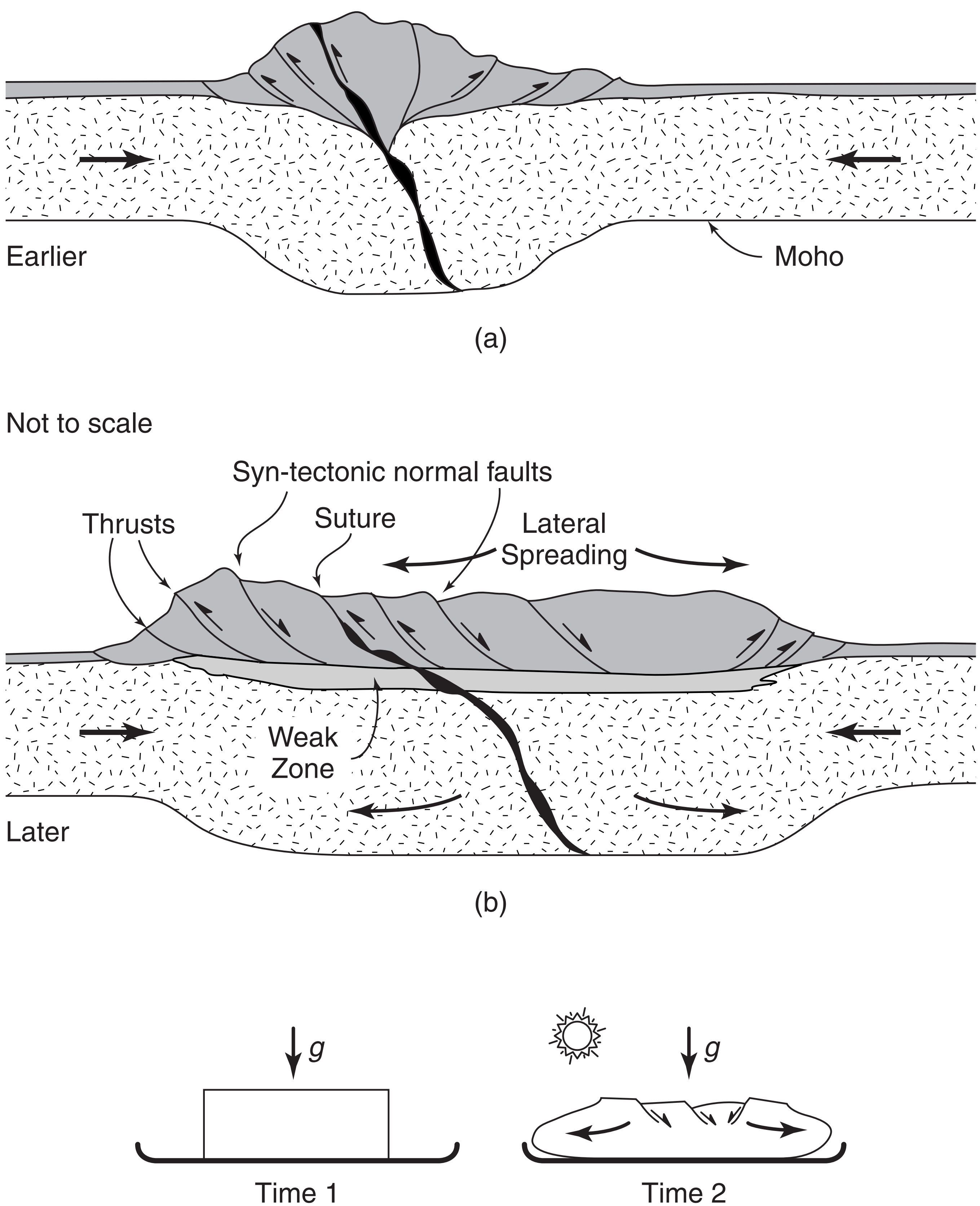
(a) Precollision configuration. Continent A has a passive-margin basin on its east coast, while Continent B has a convergent margin on its west coast. There is a **subduction** of the ocean

(b) During the **continental subduction**, the passive margin is uplifted, and an unconformity (locally, with karst) develops. Turbidites derived from Continent B soon bury this unconformity (see inset). Normal faults break up the strata of the passive-margin basin, due to stretching. But soon, thrusts begin to develop, transporting the deeper parts of the basin over the shallower parts.

(c) In a **collision orogen**, the subducting slab has broken off, a suture has formed, and metamorphic rocks are uplifted and exhumed in the interior of the orogen.

Collision and post-orogenic processes

The concept of orogenic collapse



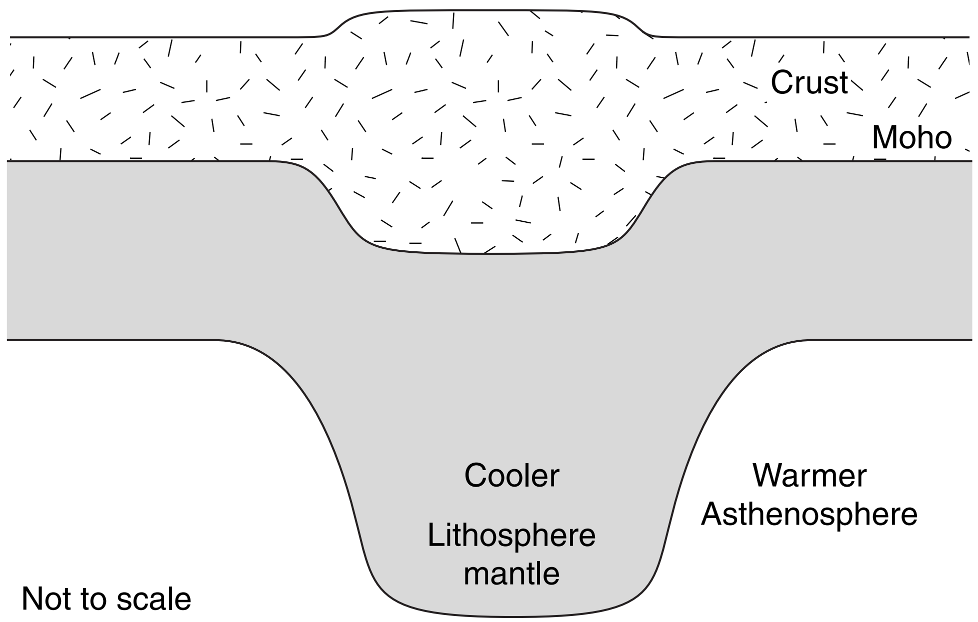
(a) A schematic cross section shows that during an
early stage in a collision, the crust thickens by thrusting.

(b) Later, as collapse occurs, extensional faults develop in the upper crust, while plastic flow occurs at depth. This process may contribute to development of a broad plateau.

(c) The soft-cheese analogy for extensional collapse. A block of cold cheese can maintain its thickness. If the cheese warms up in the sun, it loses strength and spreads laterally. The rind of the cheese ruptures, and small faults develop

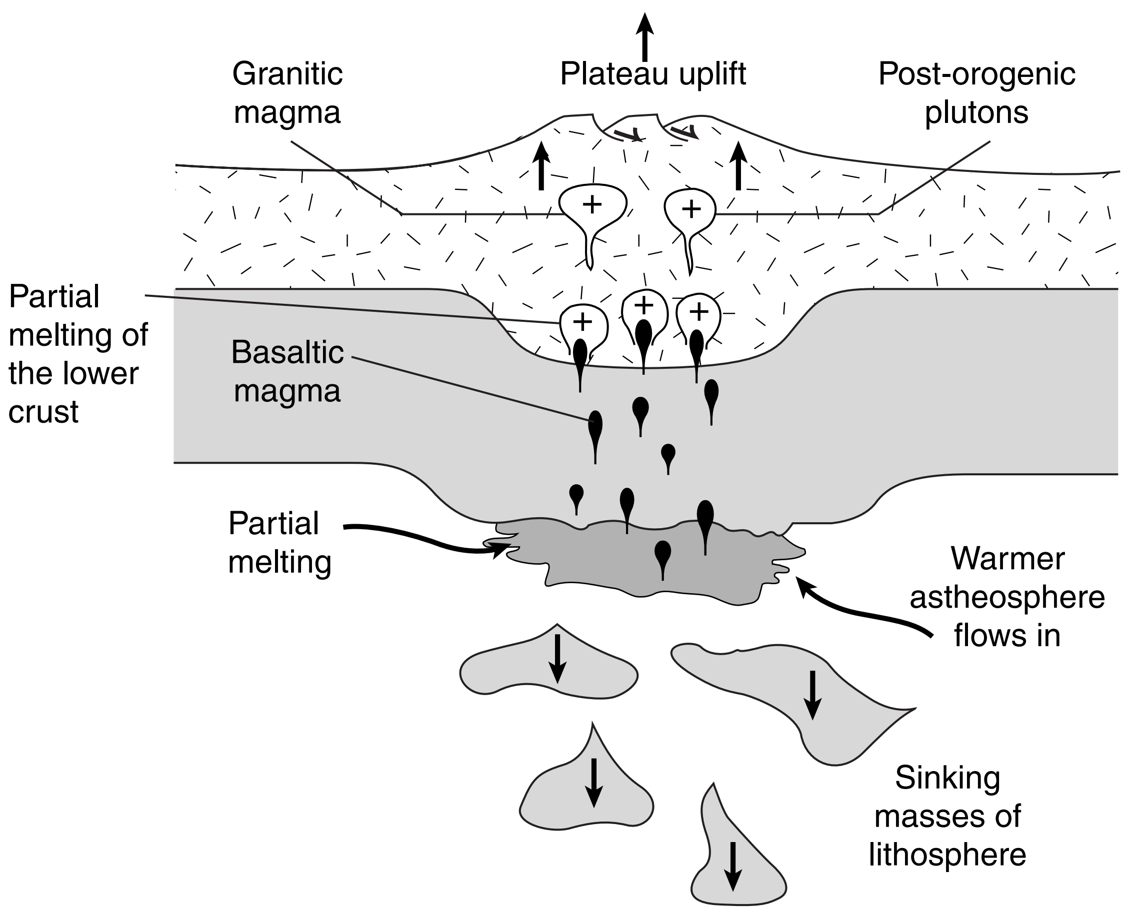
Collision and post-orogenic processes

Post-orogenic plutons and delamination



(a)

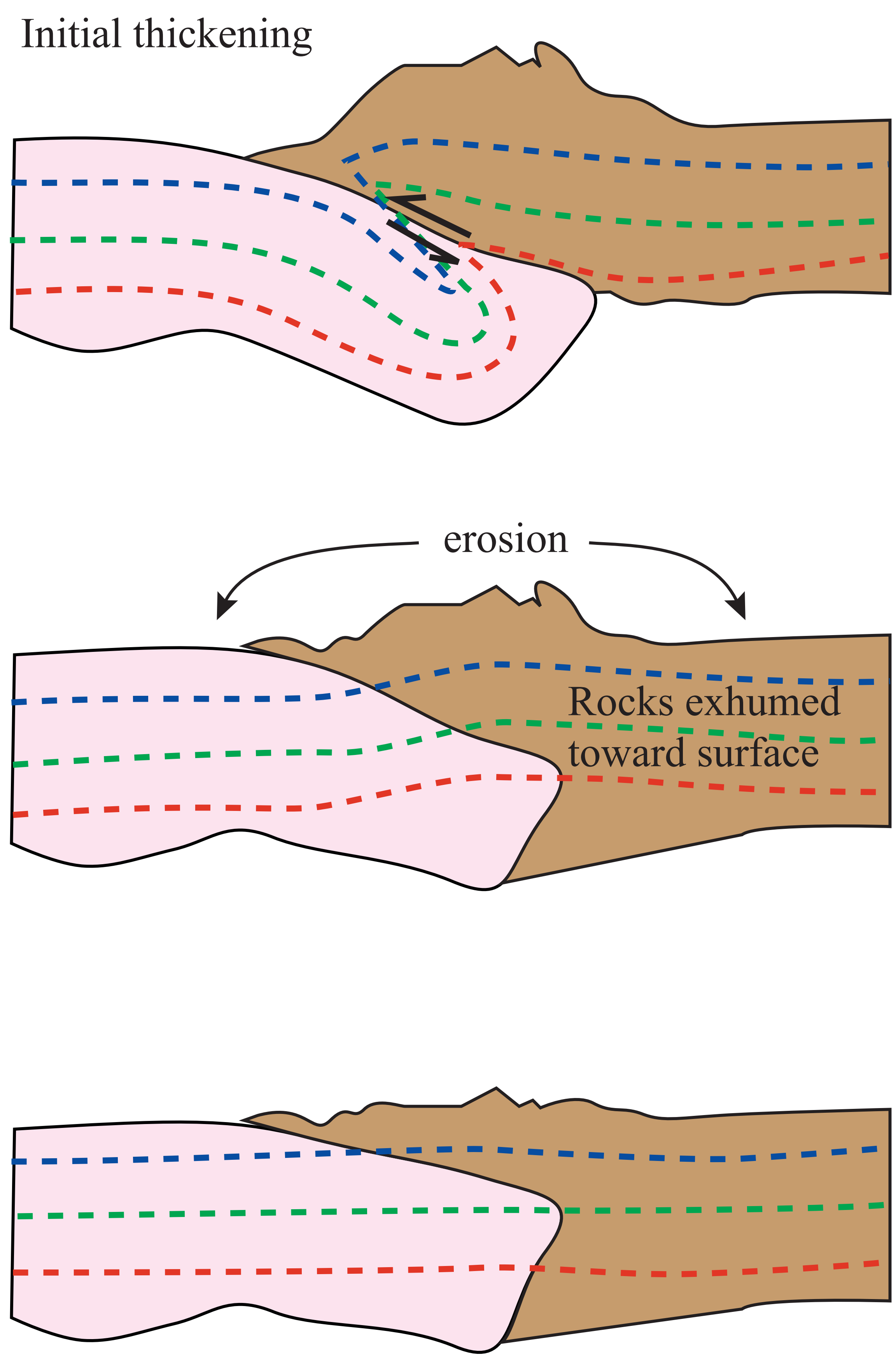
(a) Thickening of lithosphere forms a keel-shaped mass of cool lithosphere to protrude down into the asthenosphere.



(b)

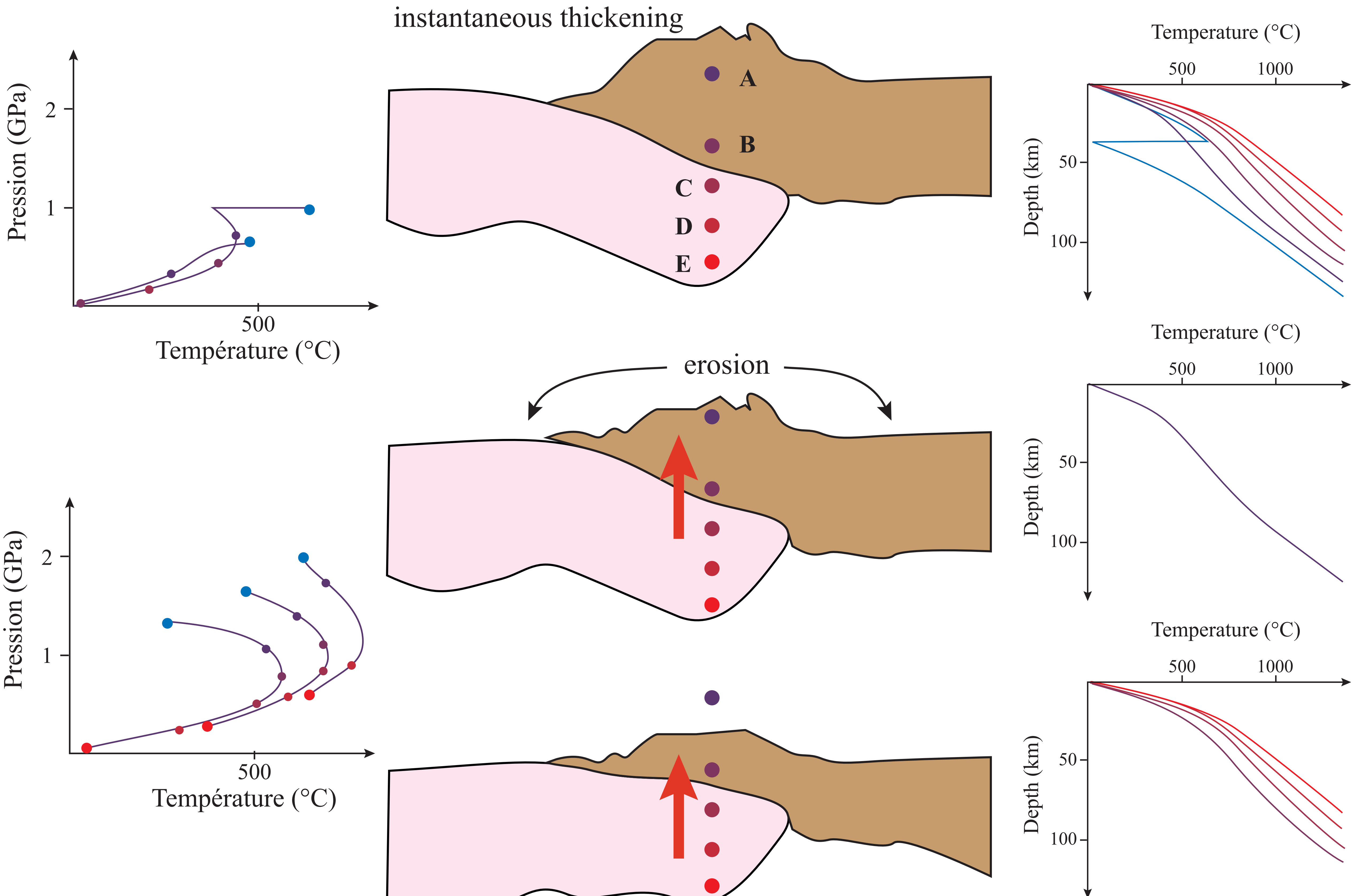
(b) The keel drops off and is replaced by warm asthenosphere, causing partial melting and formation of anorogenic (postorogenic) plutons. The surface of the crust may rise as a consequence

Collision: Thermal Models (1D)



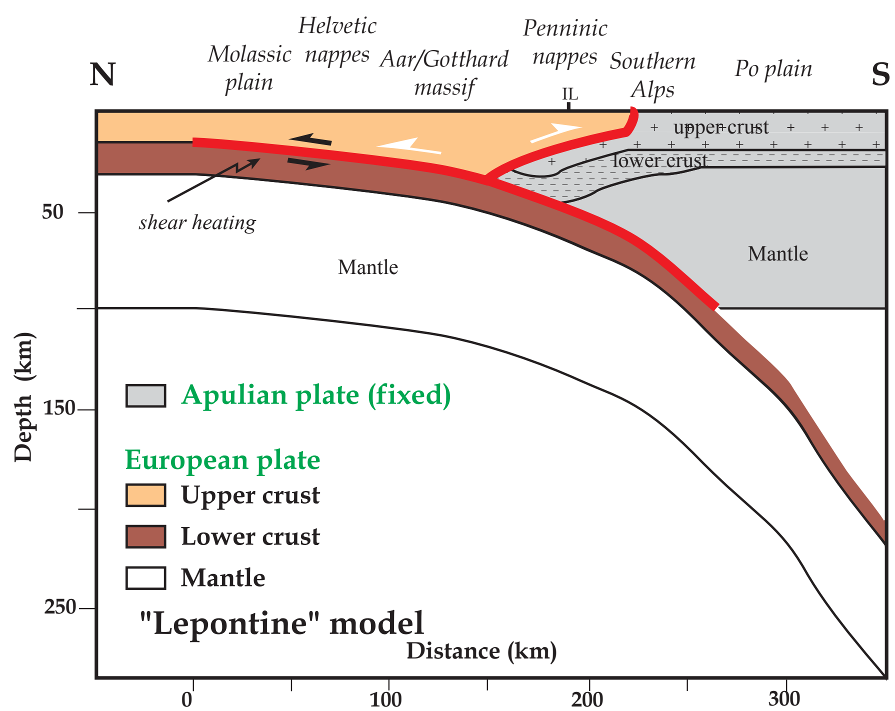
Thompson & England, 1984

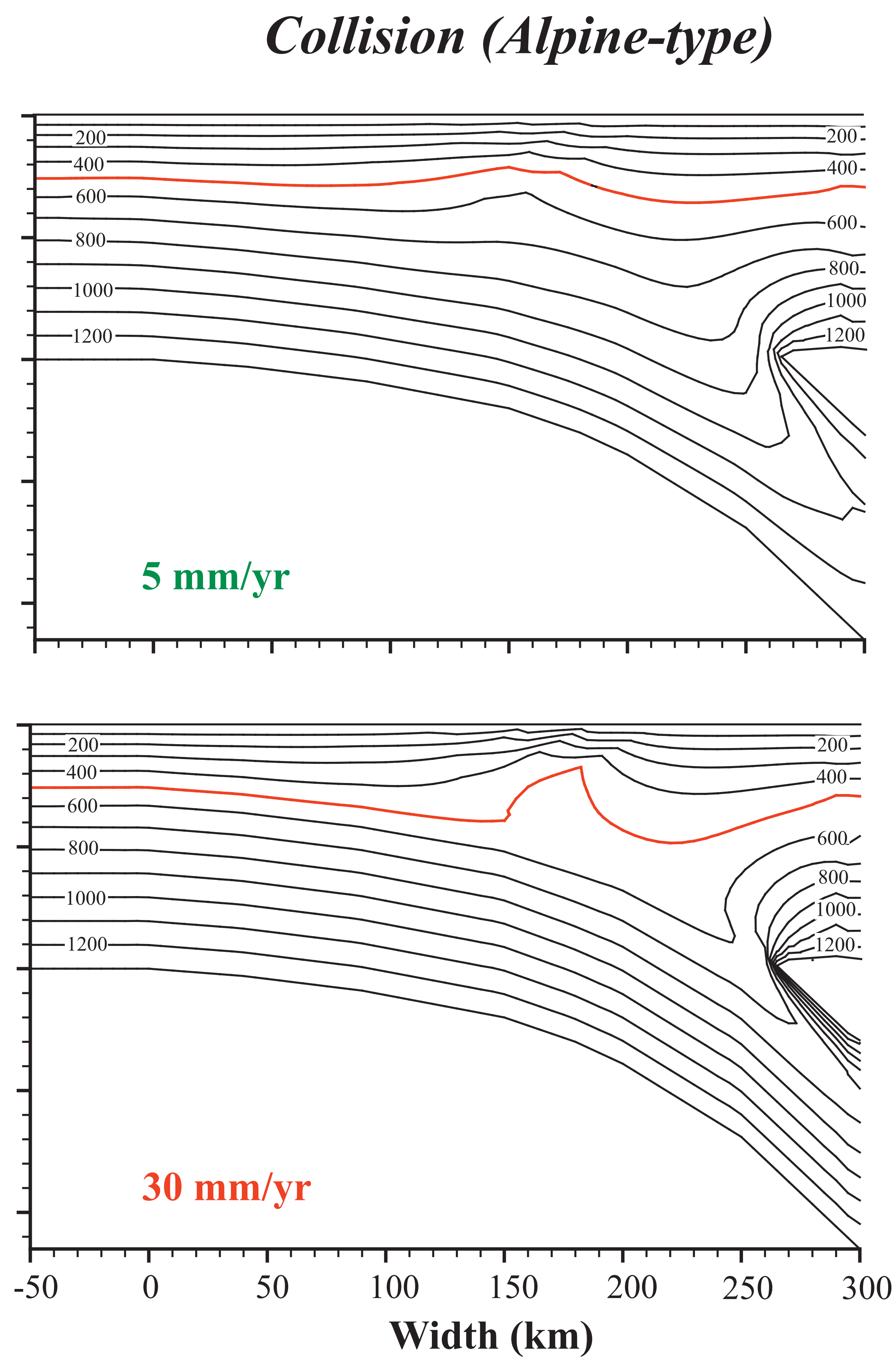
Collision: Thermal Models (1D)



Davy & Gillet, 1986

Collision: Thermal Models (2D)



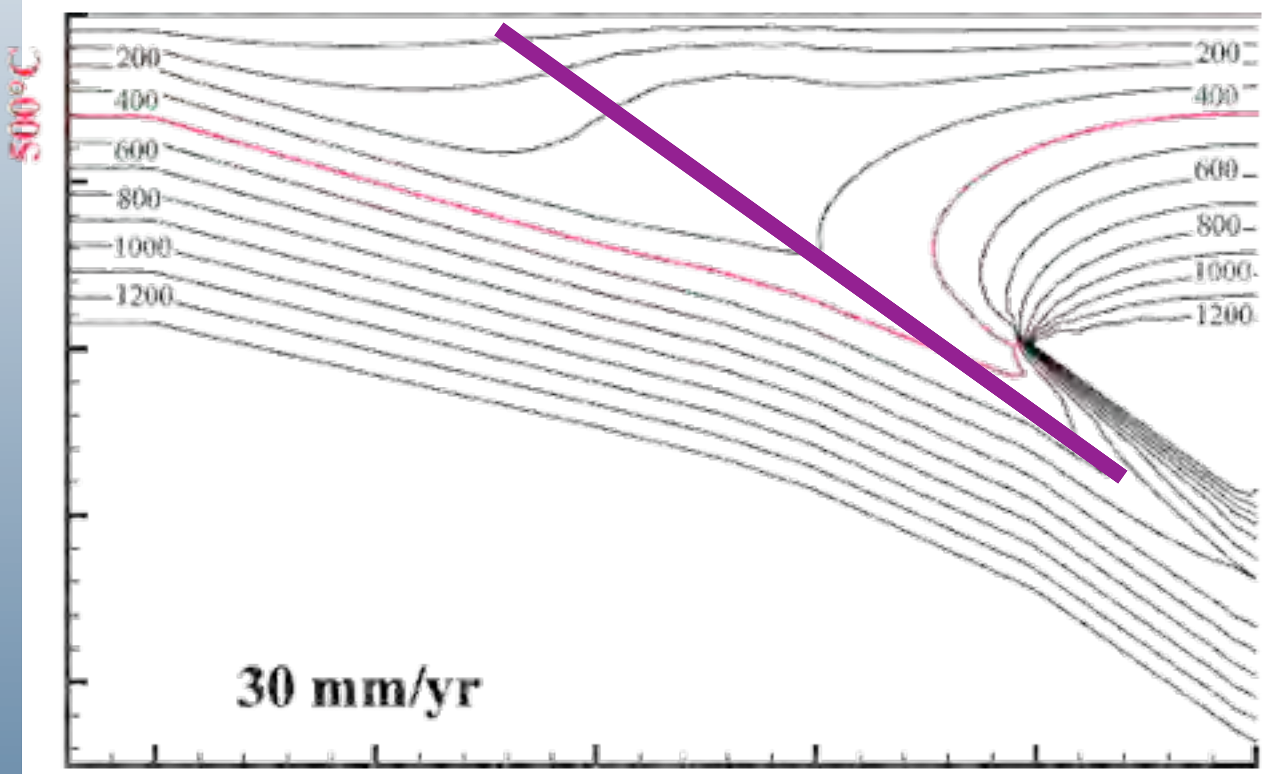


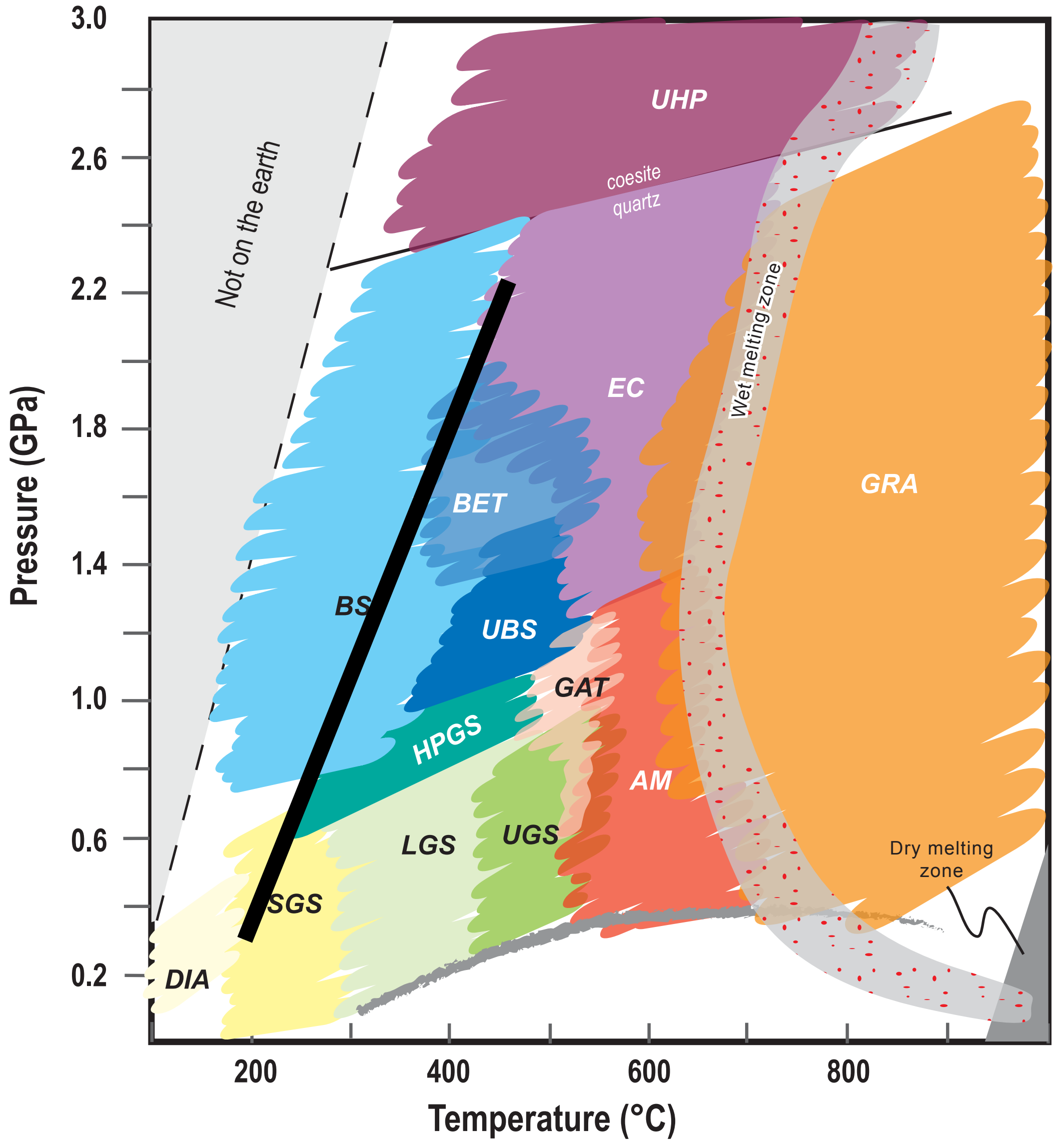
R. Bousquet 2009-2010

Thermal Models: Subduction *vs* collision

Subduction

Very "Cold" Gradient
HP-LT ~ 6°C/km





Bousquet et al., 1997

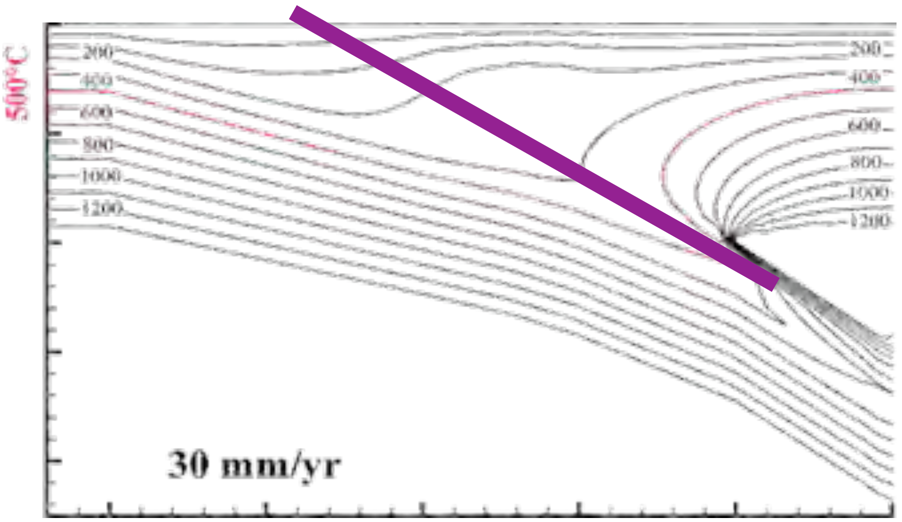
Thermal Models: Subduction *vs* collision

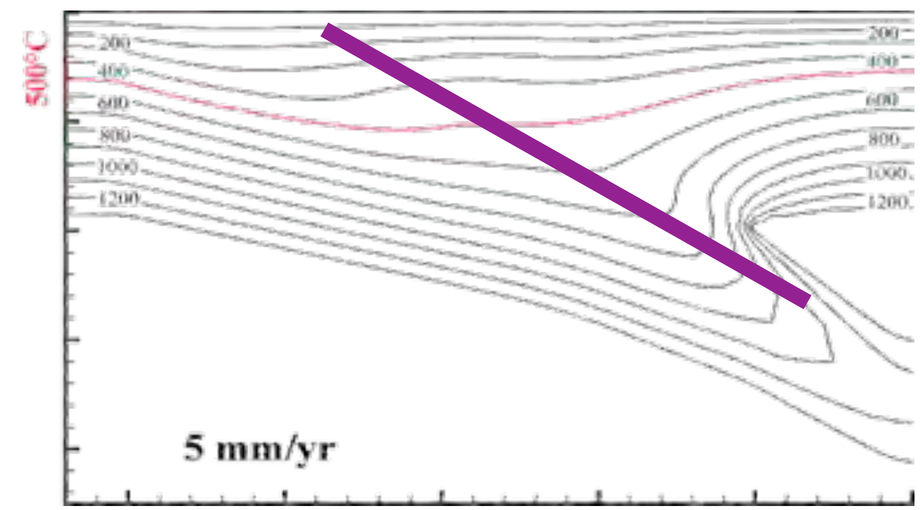
Fast subduction

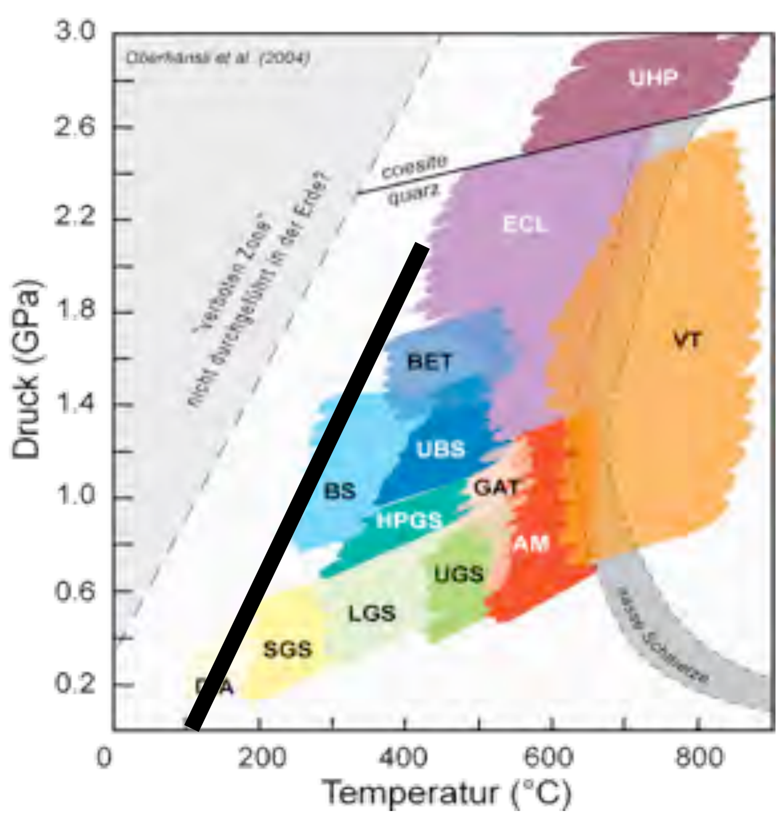
Very "Cold" Gradient HP-LT ~ 6°C/km

Slow subduction

"Cold" Gradient HP-LT ~ 15°C/km

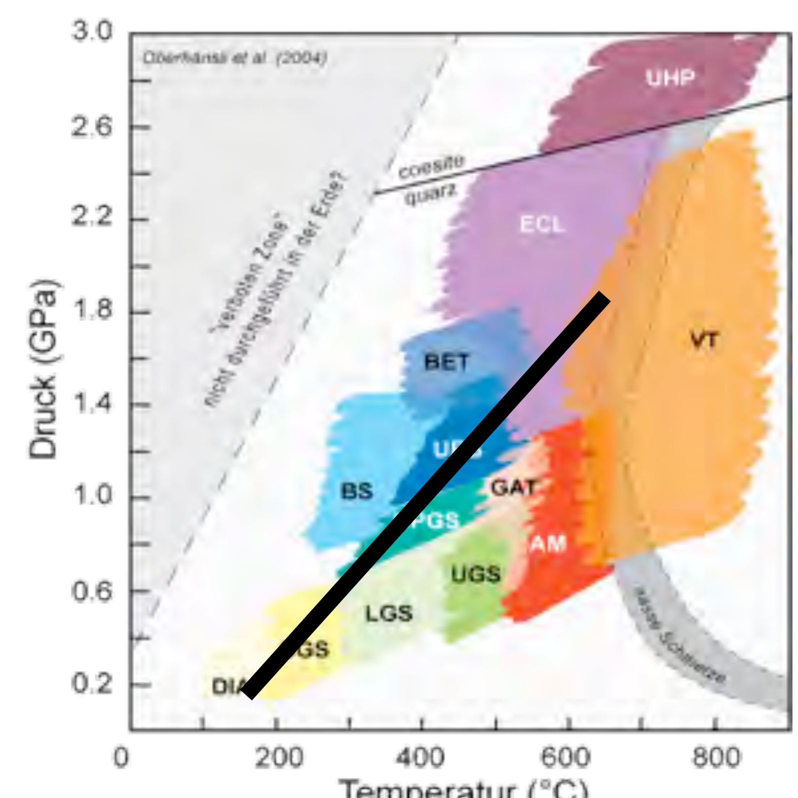






Eclogite

Blueschist

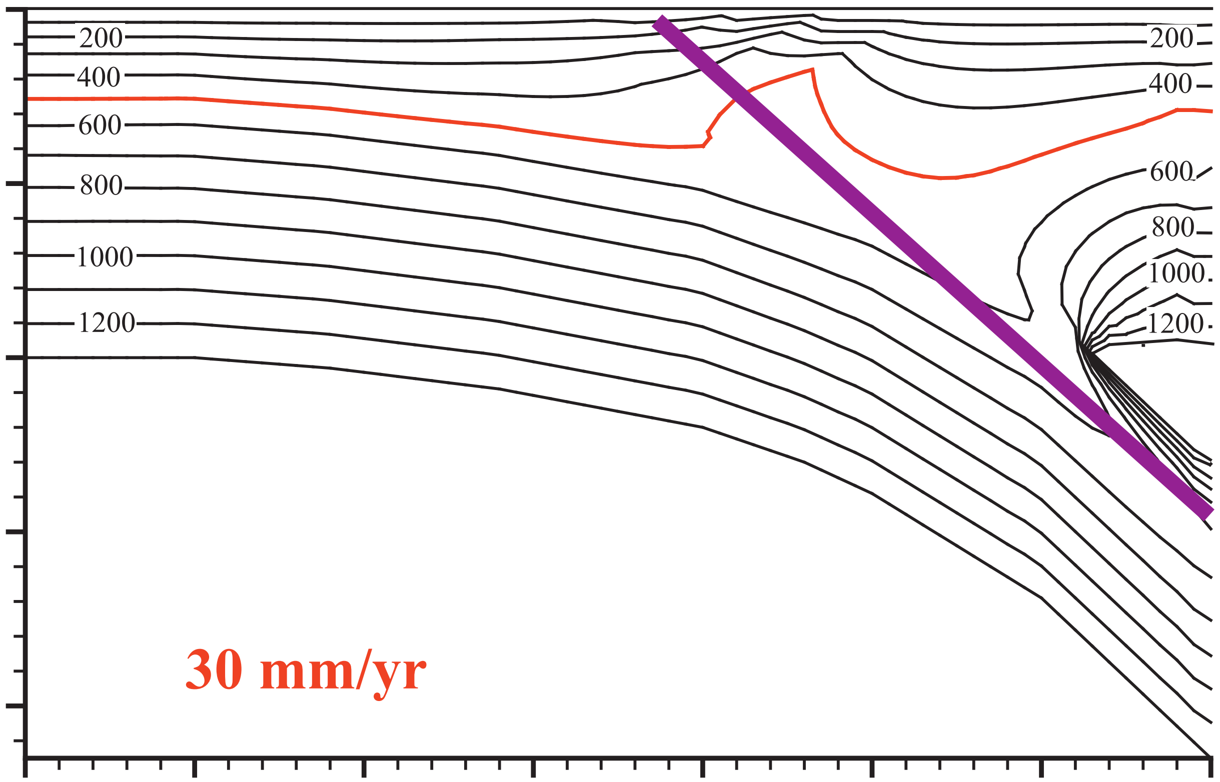


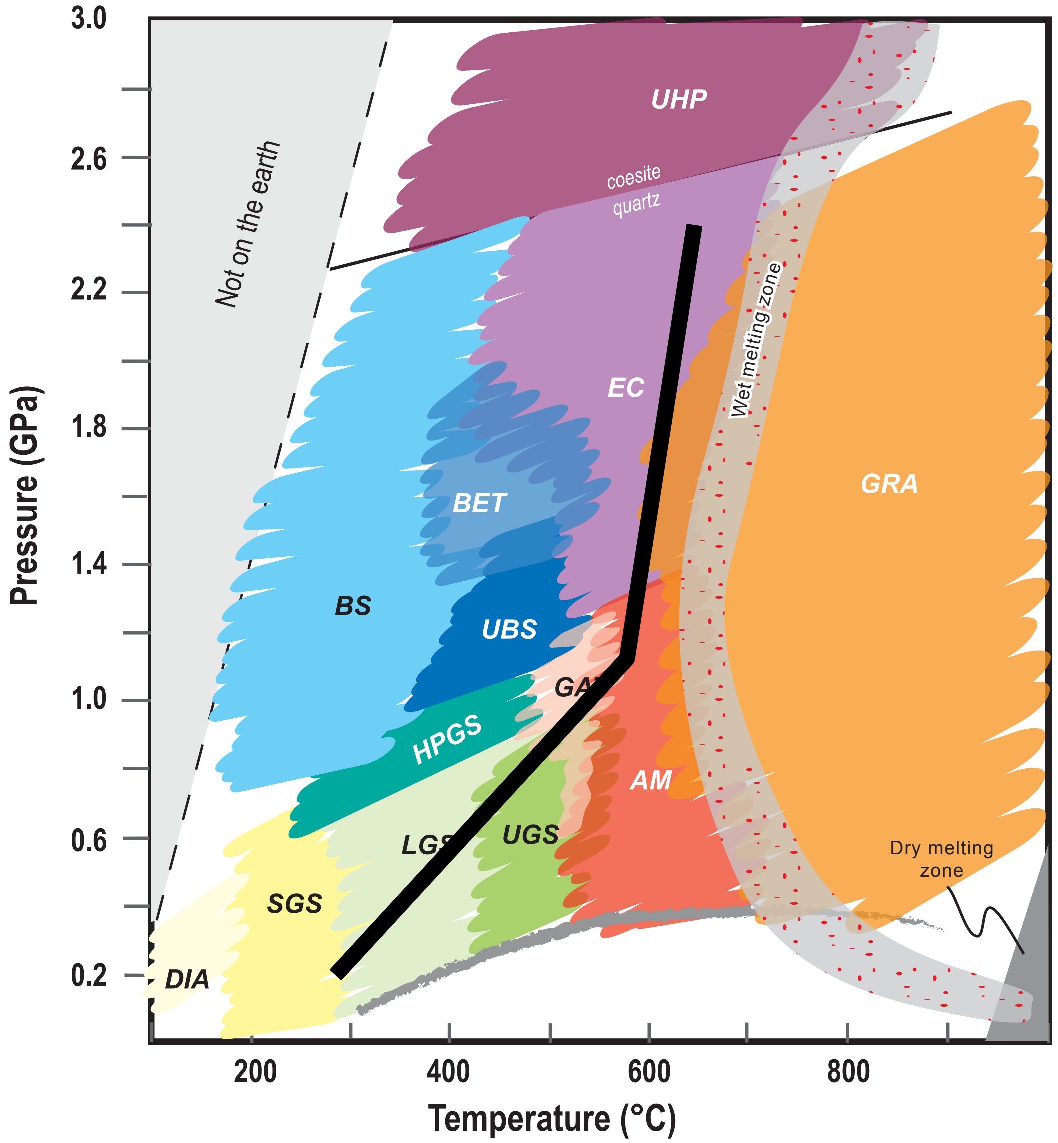
Bousquet et al., 1997

Thermal Models: Subduction *vs* collision

Continental Subduction

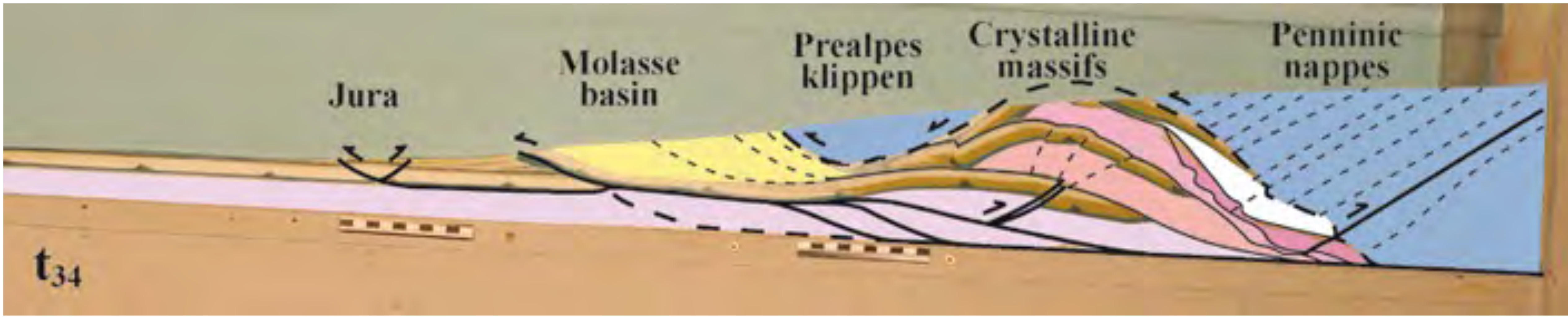
"Middle" Gradient
HP-MT ~ 15°C/km



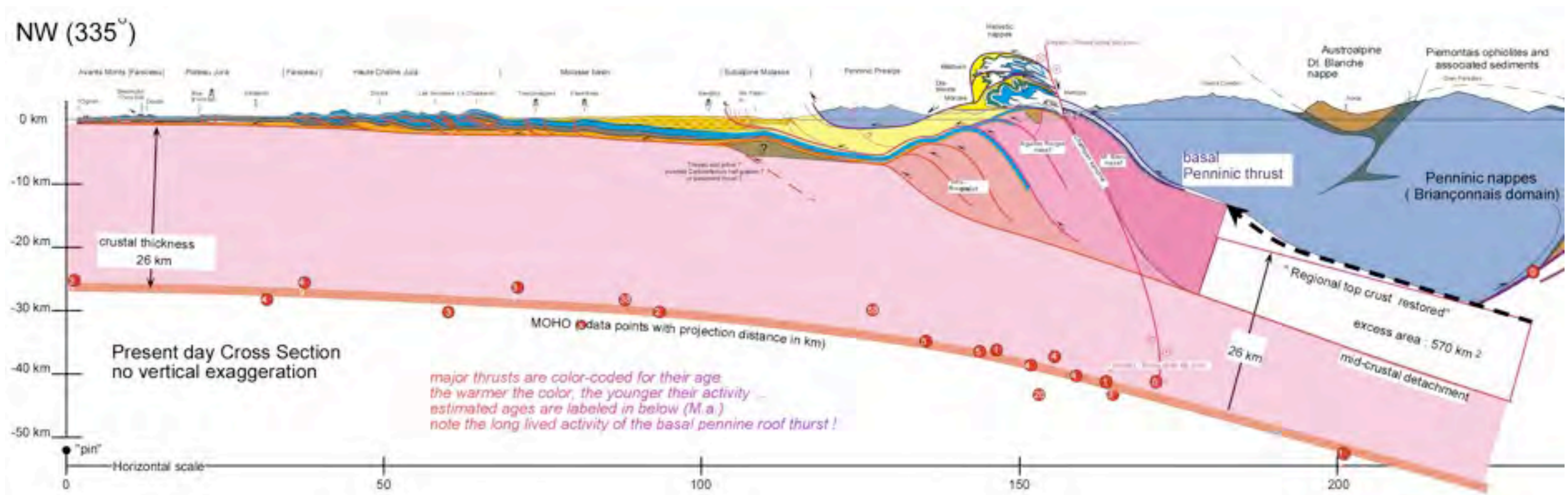


Bousquet et al., 1997

Example of continental accretion: the Alps

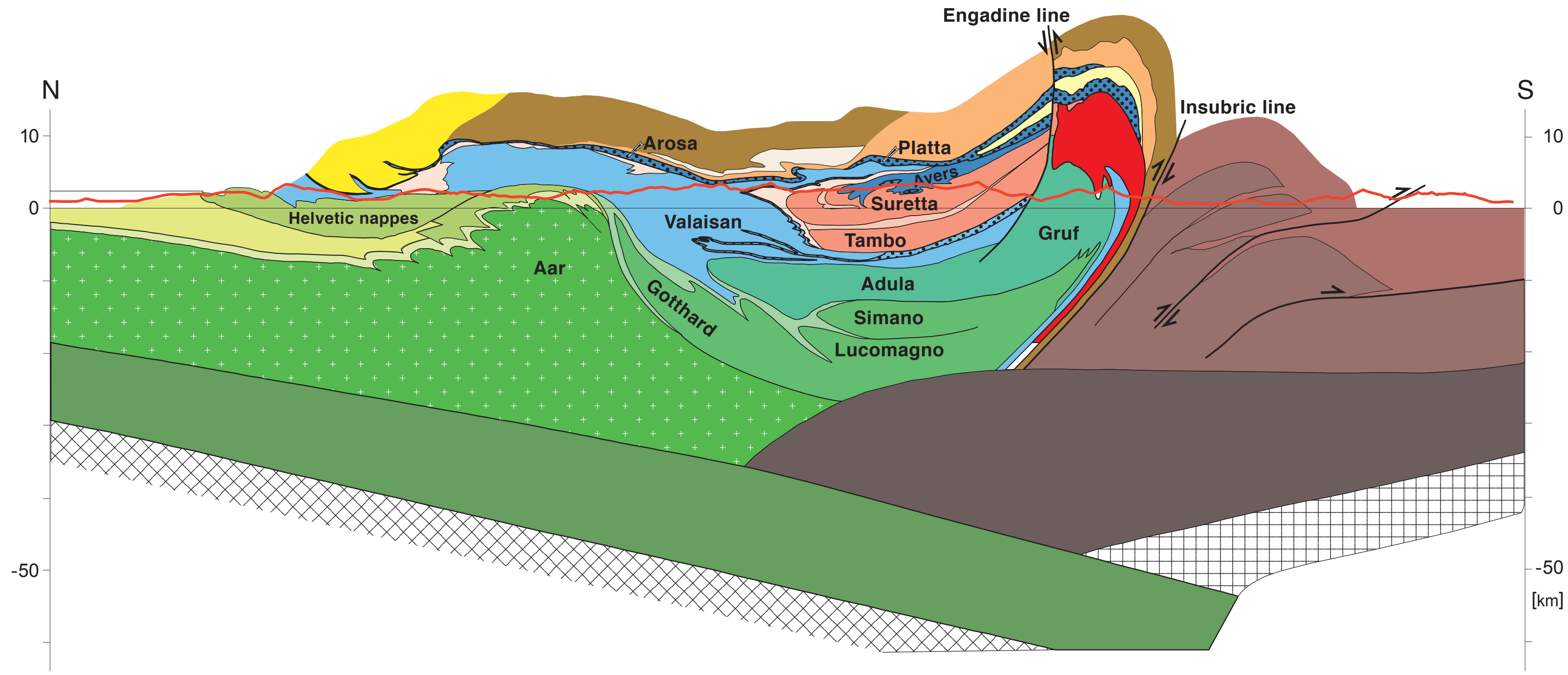


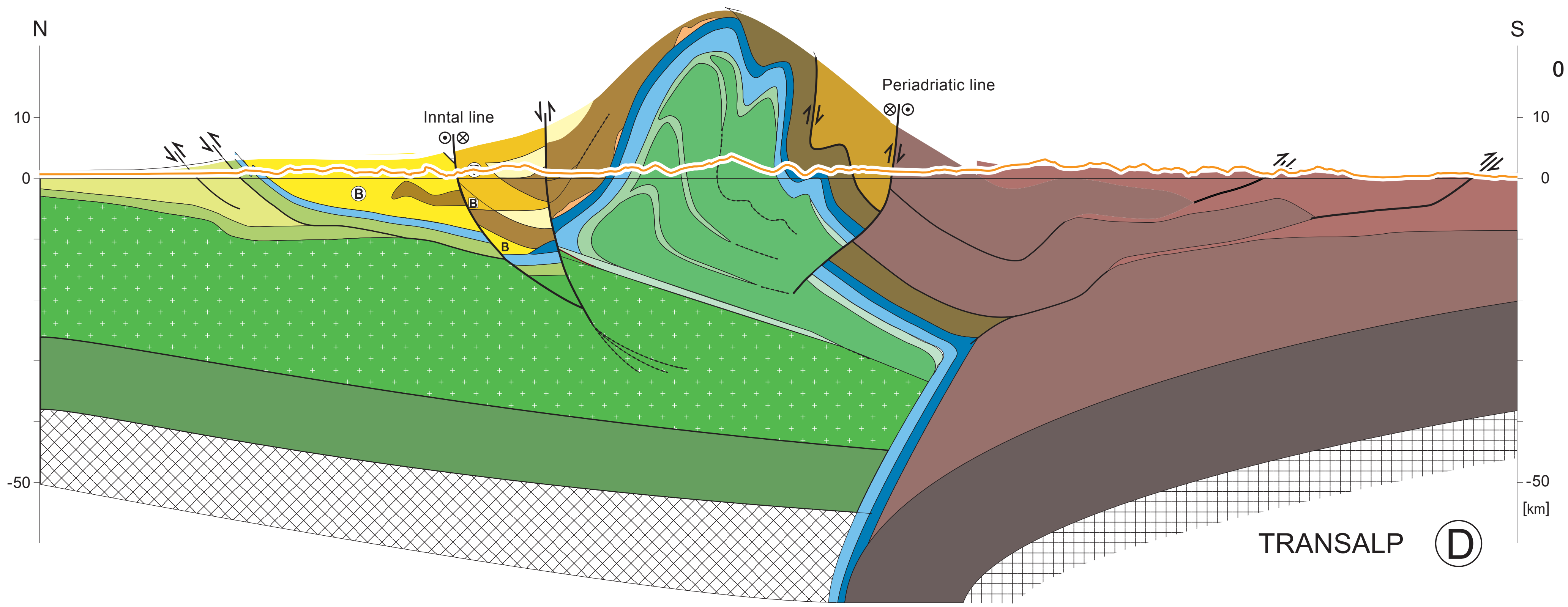
Bonnet et al., 2006



Example of continental accretion: the Alps

Profiles





Schmid et al., 2004

Suduction-collision in the Alps