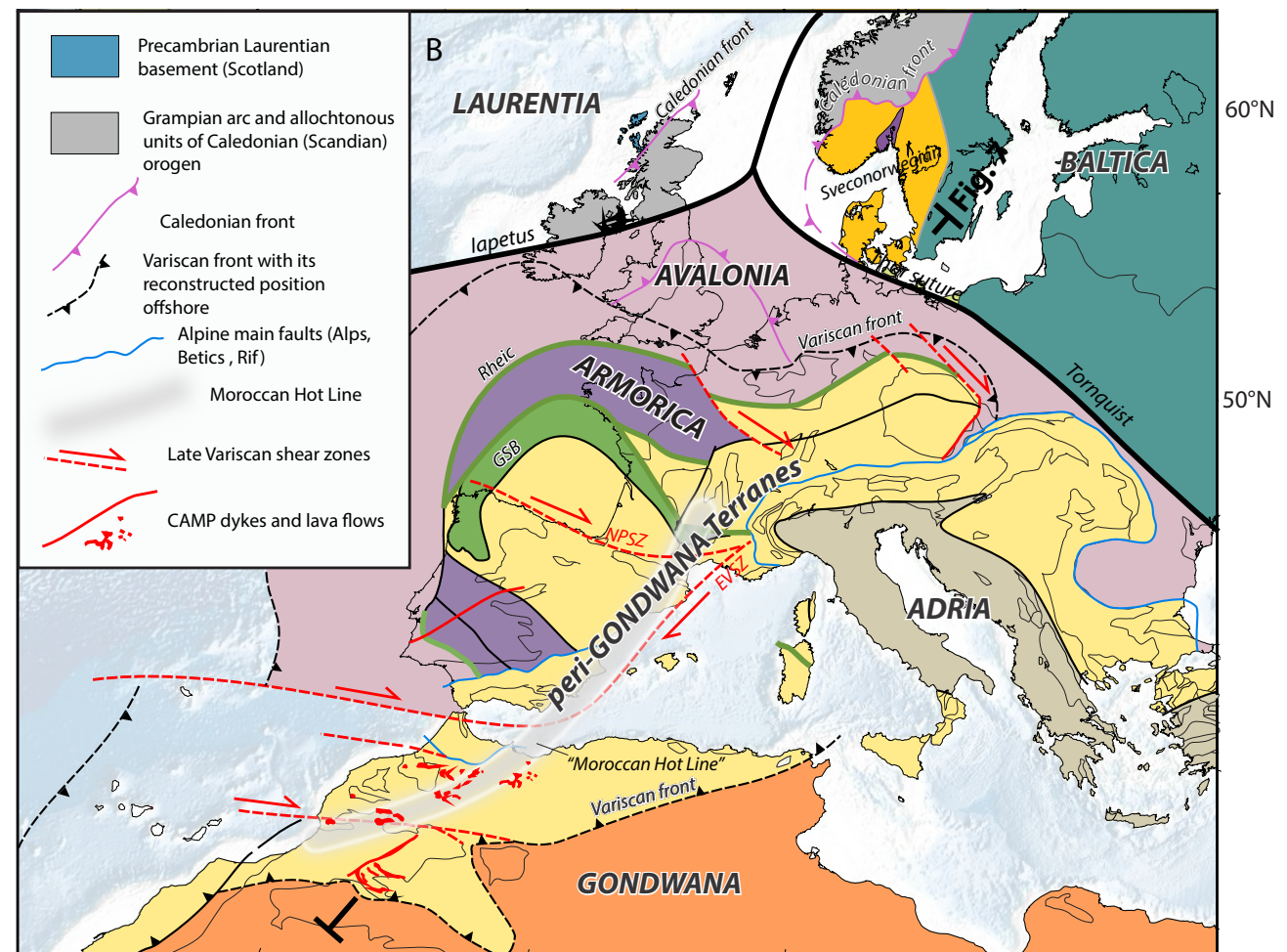


Cenozoic mountain building of Western Europe controlled by continental lithosphere evolution

Frédéric Mouthereau & Paul Angrand
GET-Univ. Toulouse - France

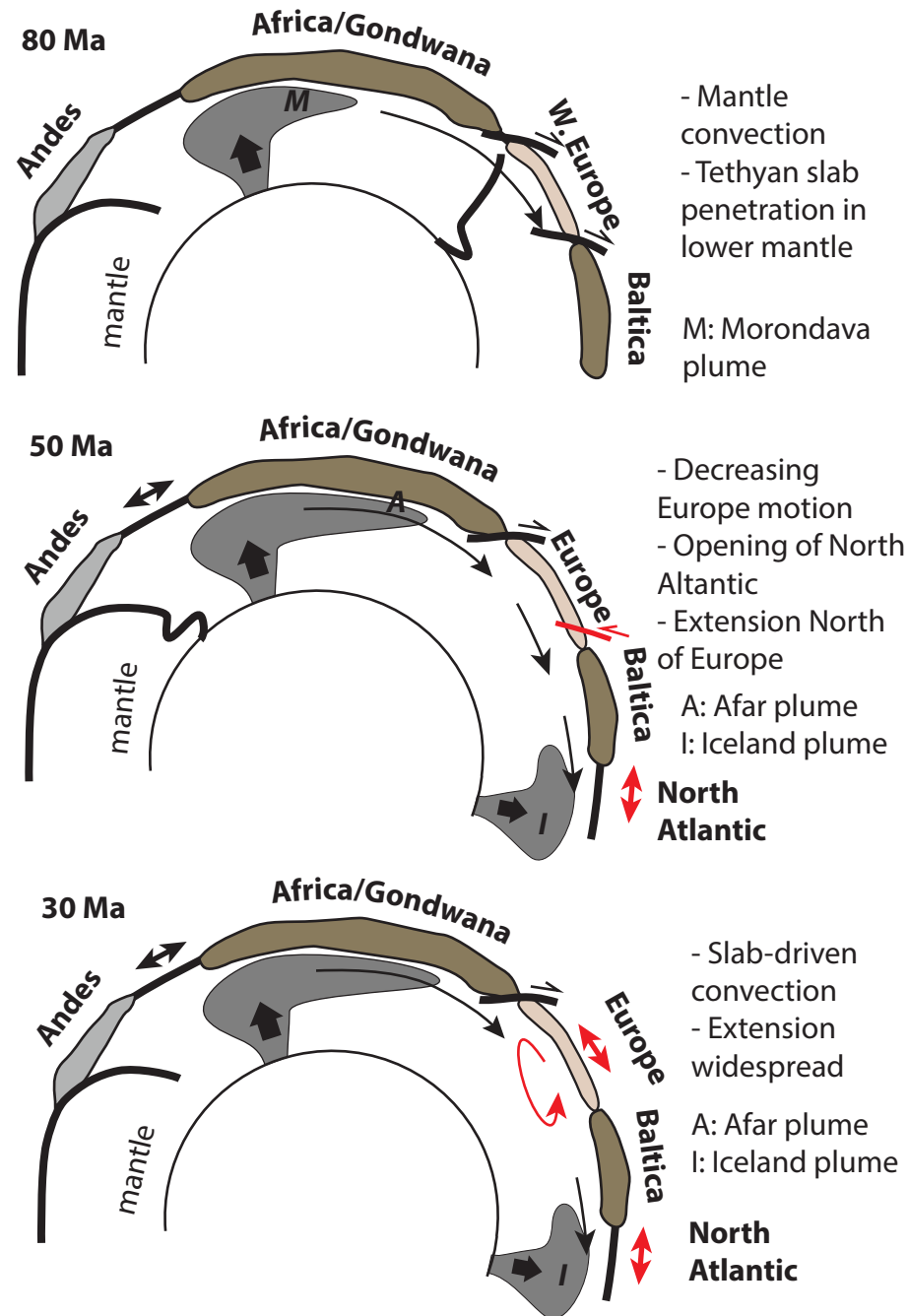


Mouthereau et al., 2021 “Cenozoic mountain building and topographic evolution in Western Europe: impact of billion years lithosphere evolution and plate tectonics” submitted

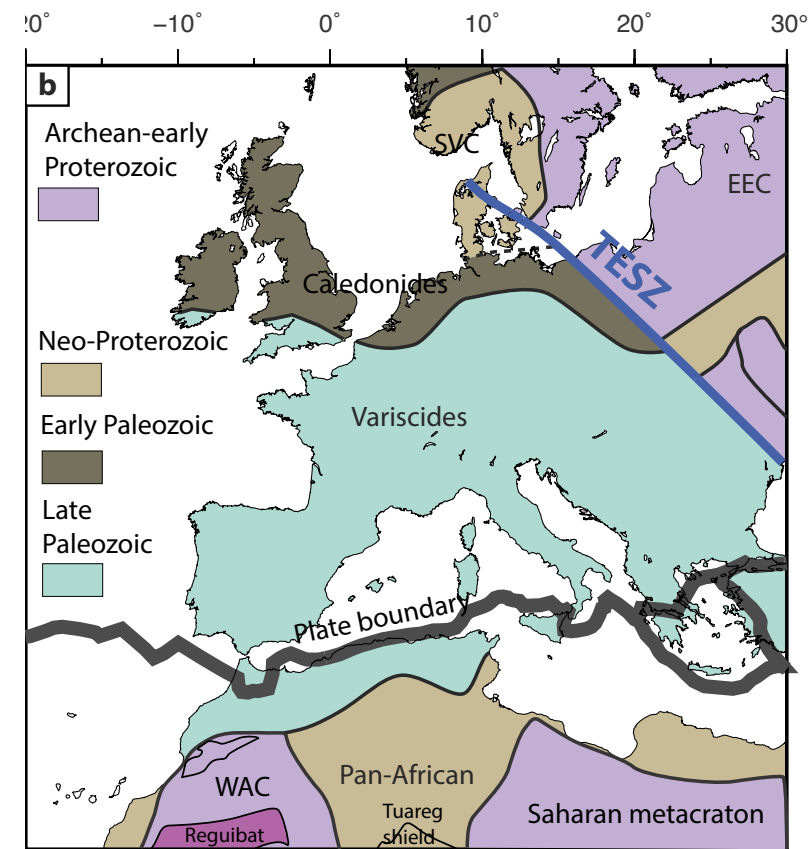


Orogenic evolution reflects mantle convection or inherited lithosphere properties ?

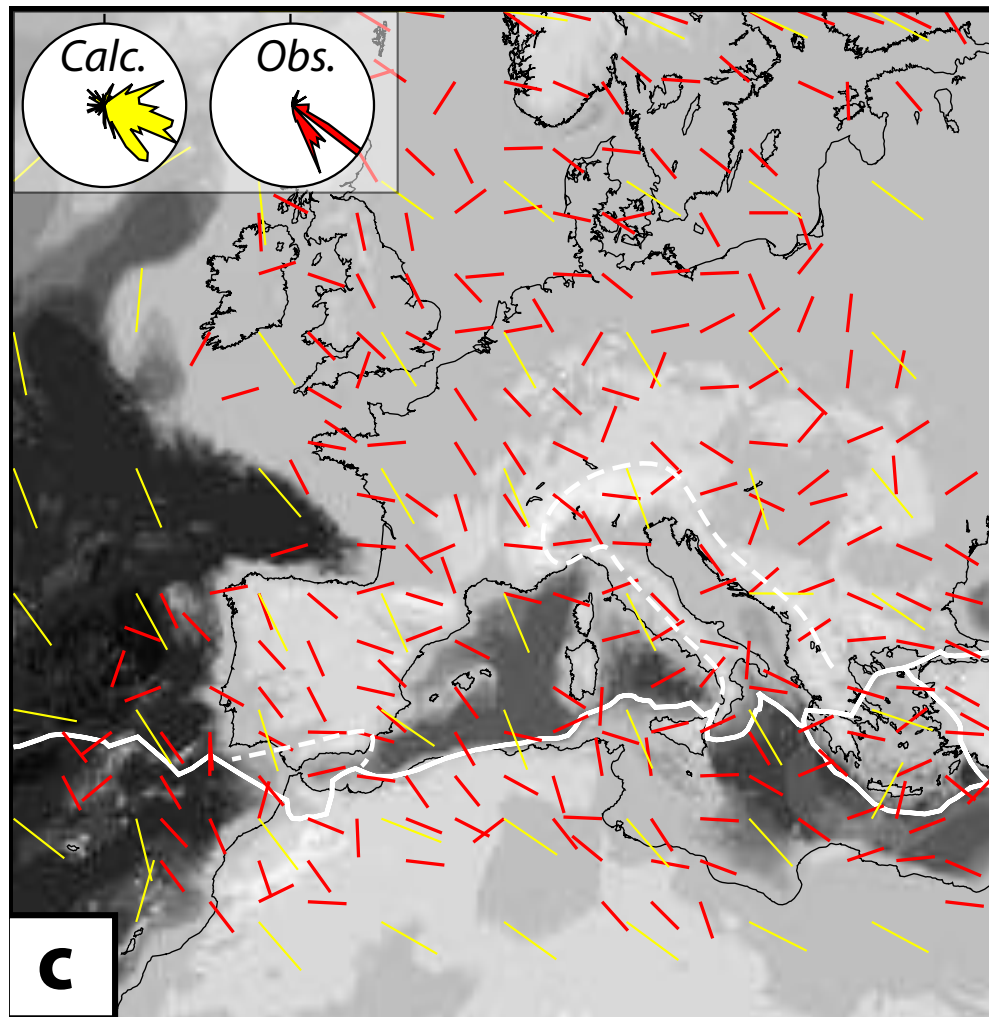
whole-mantle drivers



Lithosphere-scale processes



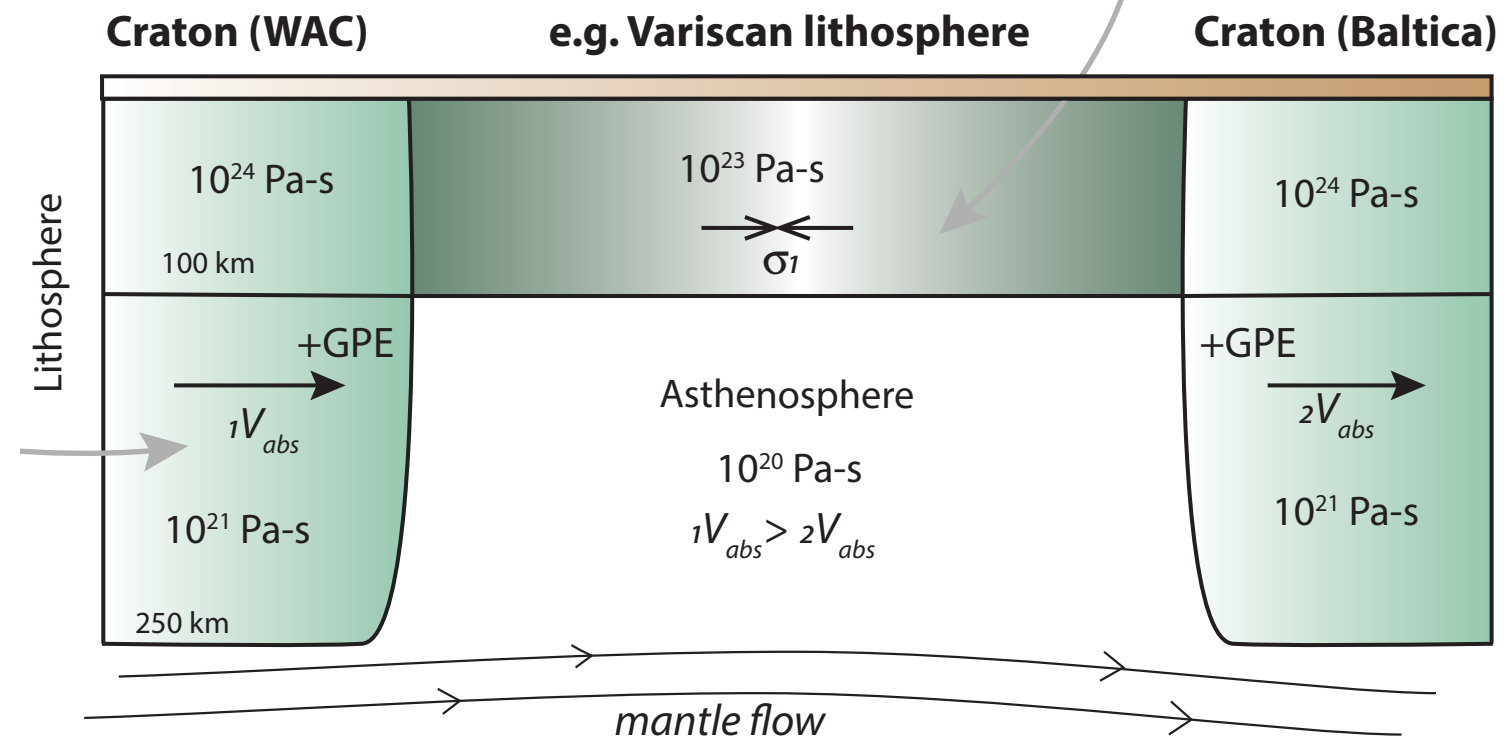
Orogenic evolution reflects mantle convection or inherited lithosphere properties ?



Current stress patterns in W Europe explained by coupled convection and variable lithosphere properties

e.g. Ghosh et al., JGR, 2013

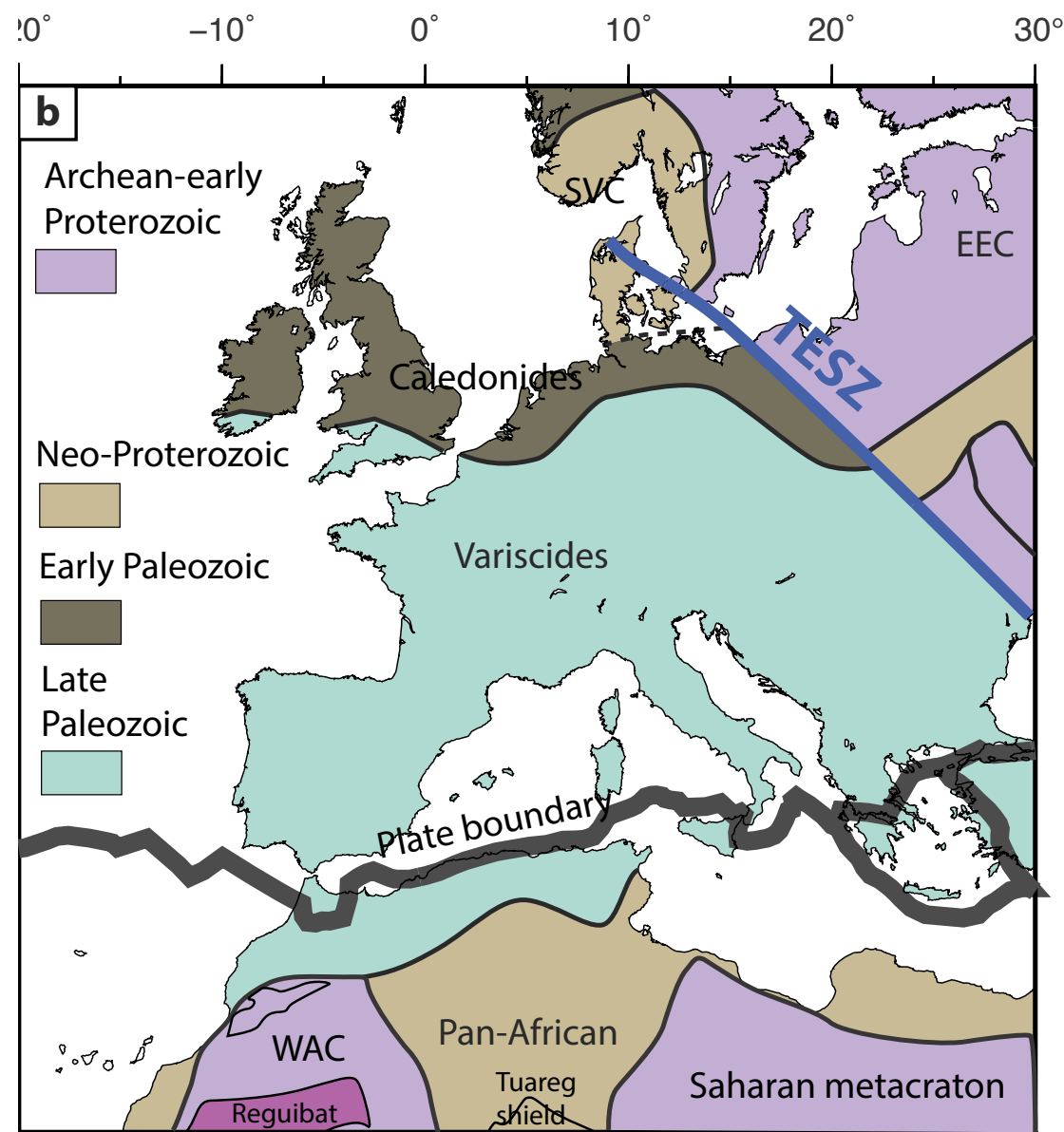
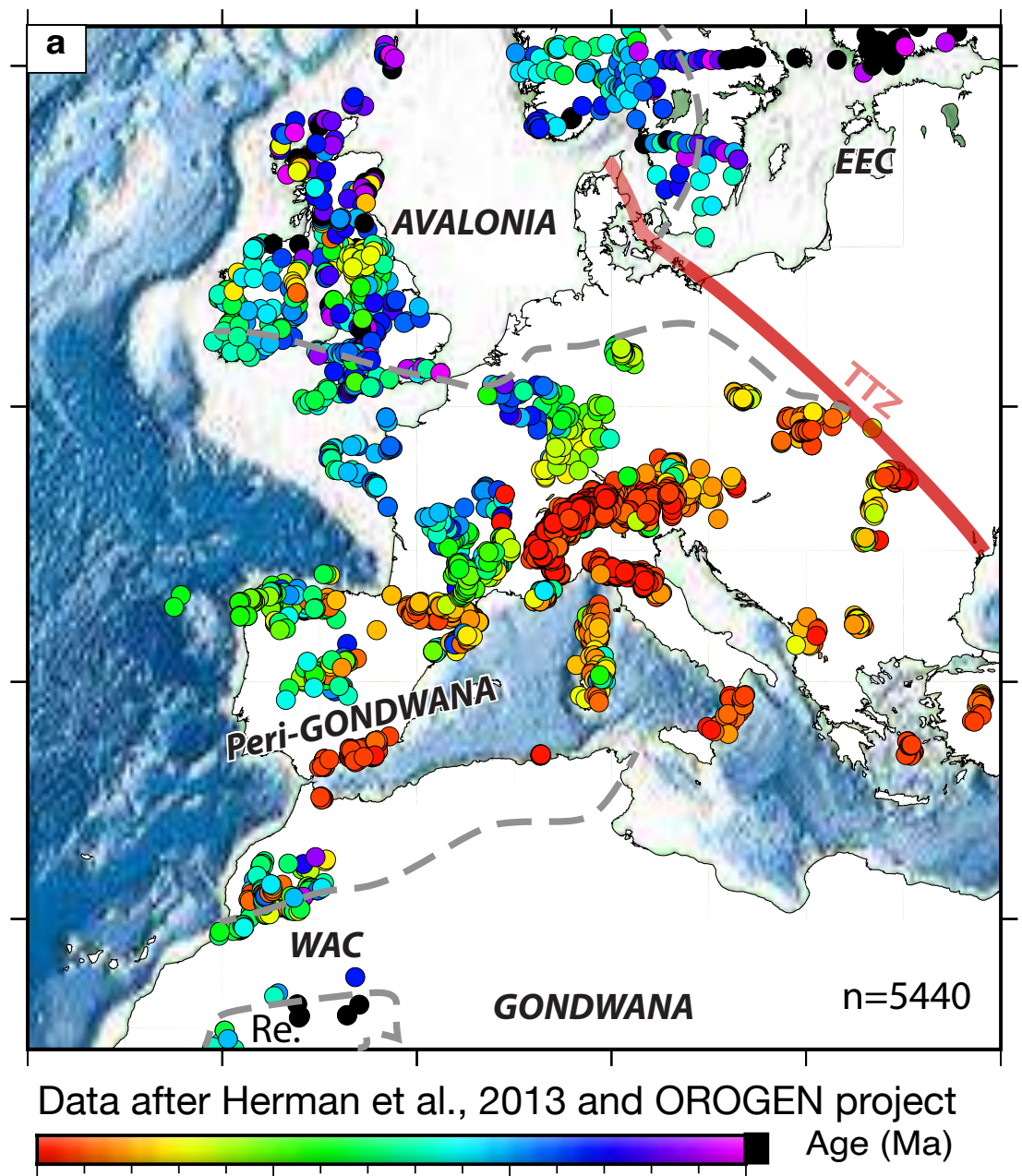
C) Coupled lithosphere-mantle convection model



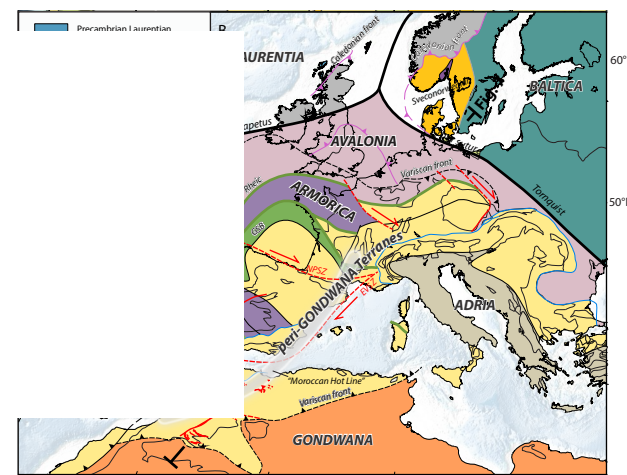
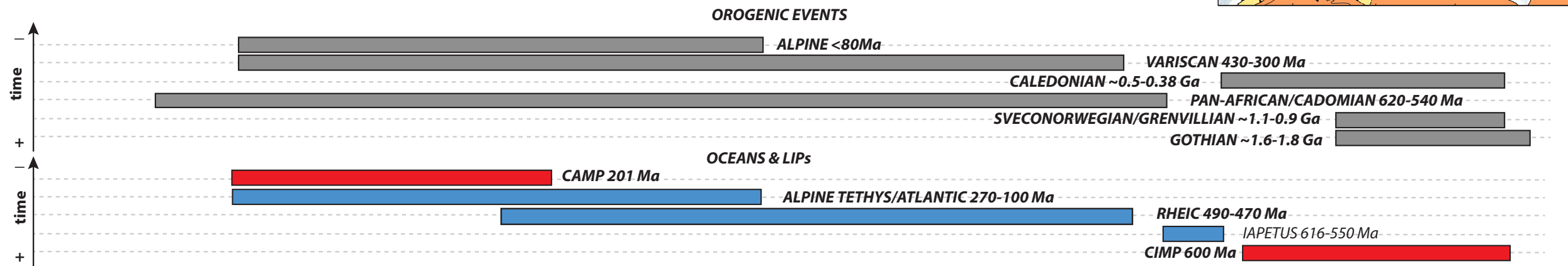
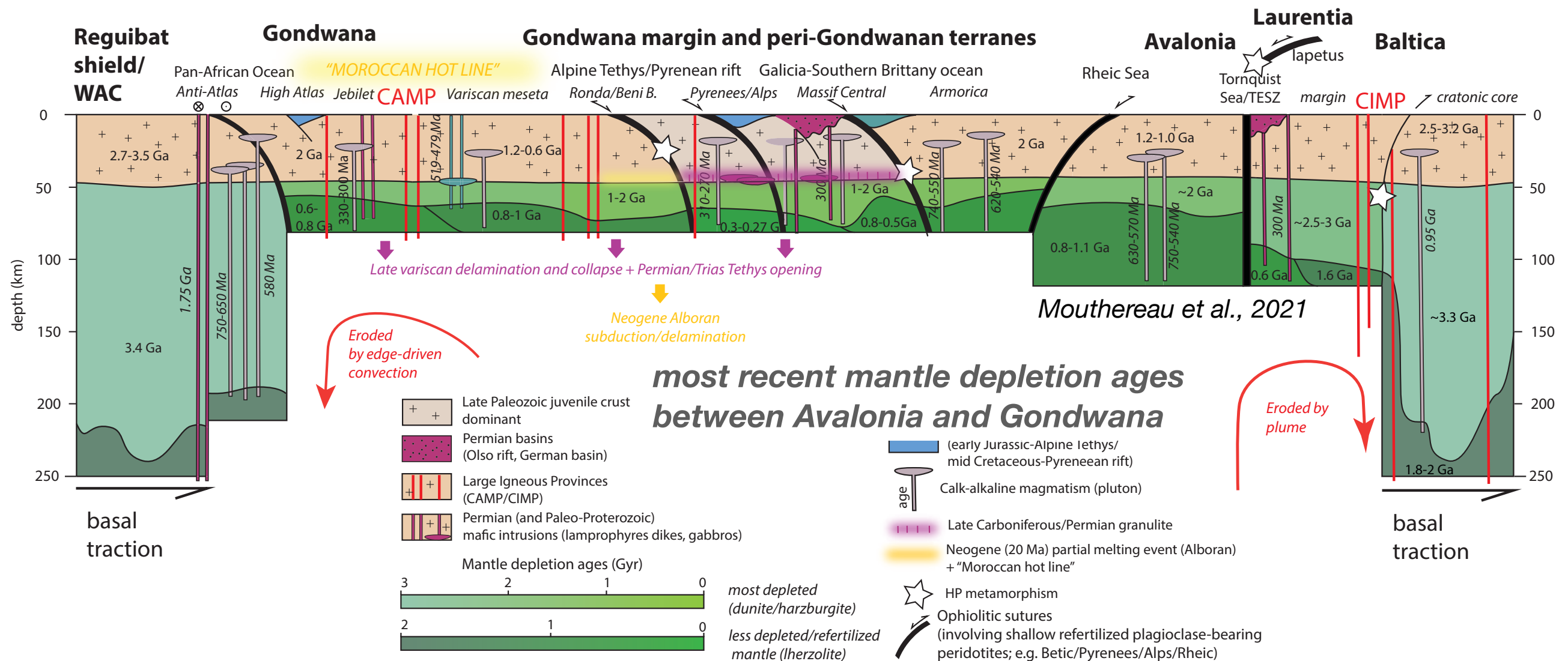
Orogenic evolution reflects mantle convection or inherited lithosphere properties ?

Apparent correlation between Cenozoic upper crustal exhumation (proxy for topography) and long-term tectono-magmatic evolution

How did it work in time and space ?



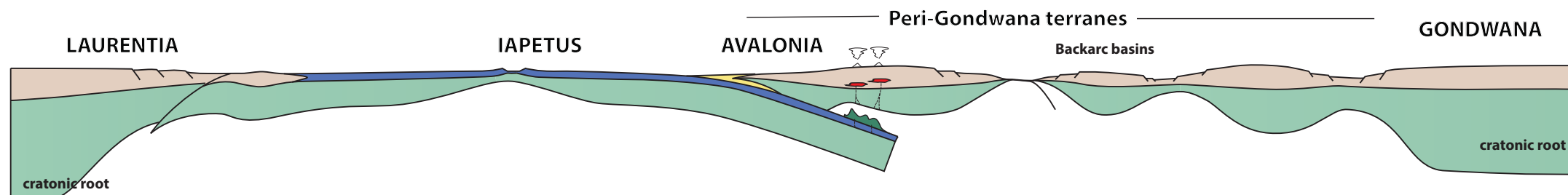
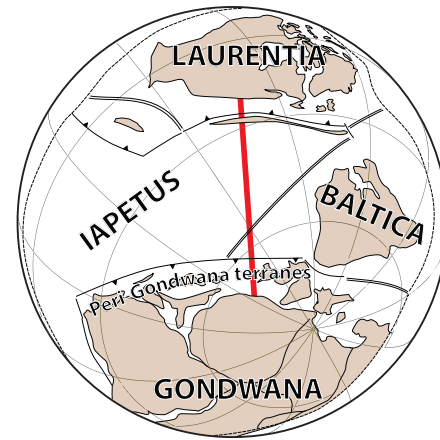
Lithospheric mantle properties result from depletion events driven by plume, subduction and rifting events over 1.8 Gyr



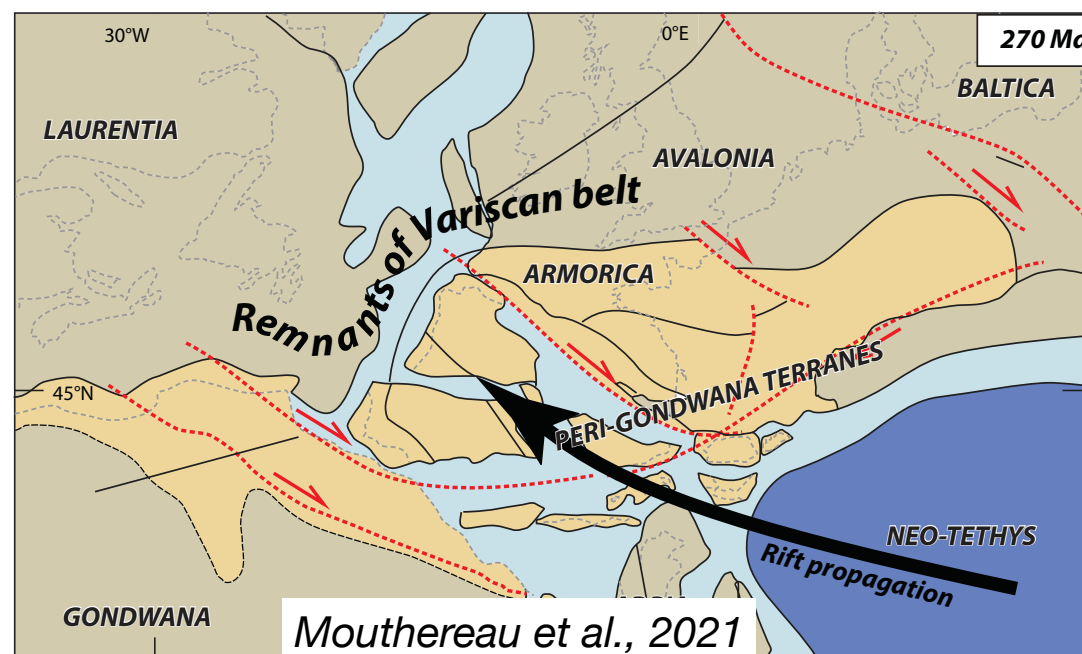
Examples of main thermal, metasomatic and thinning events

600-500 Ma

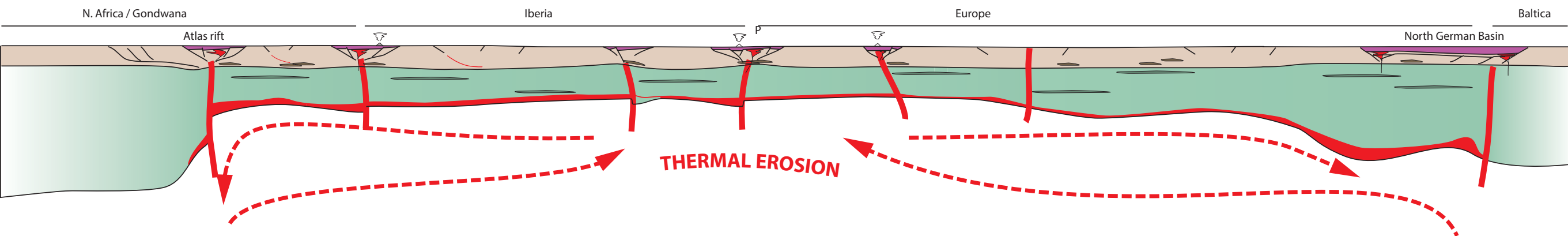
Metasomatism : backarc extension and subduction of Iapetus



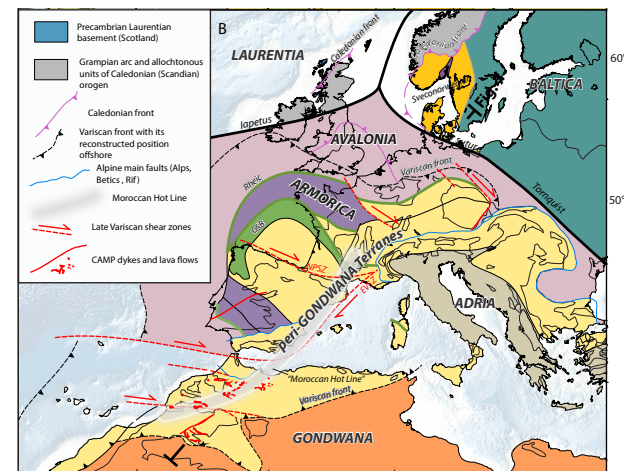
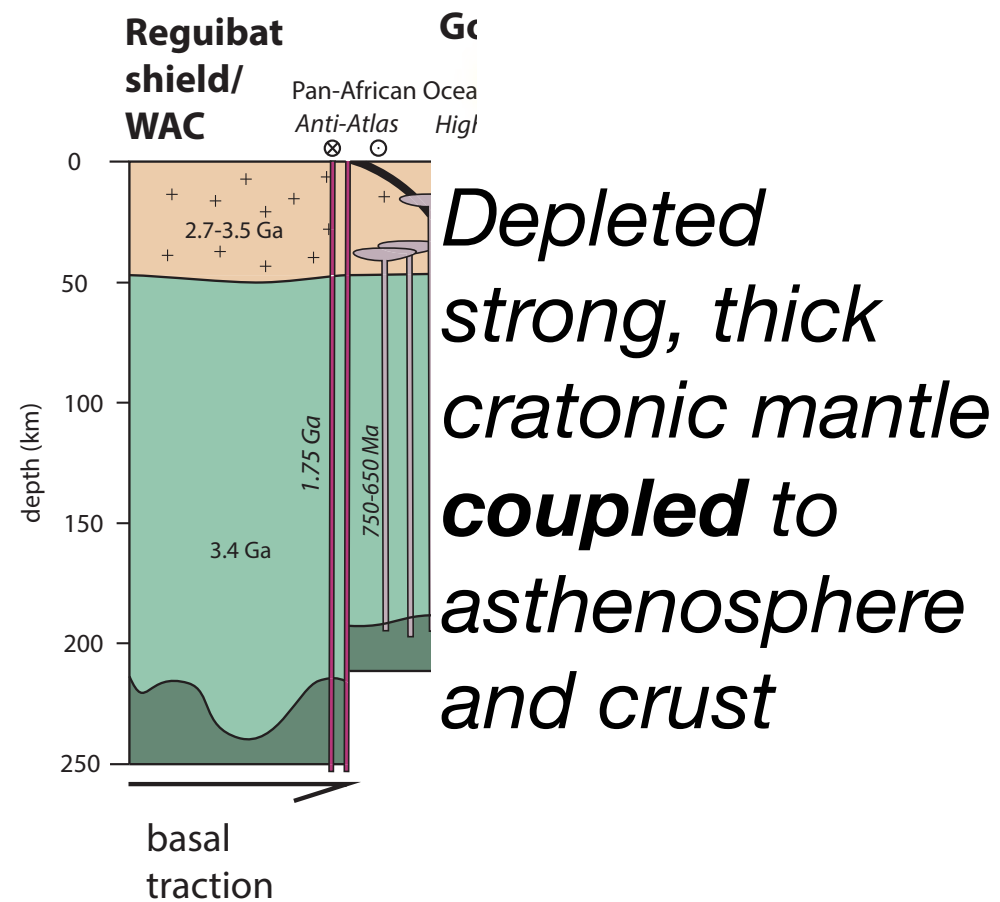
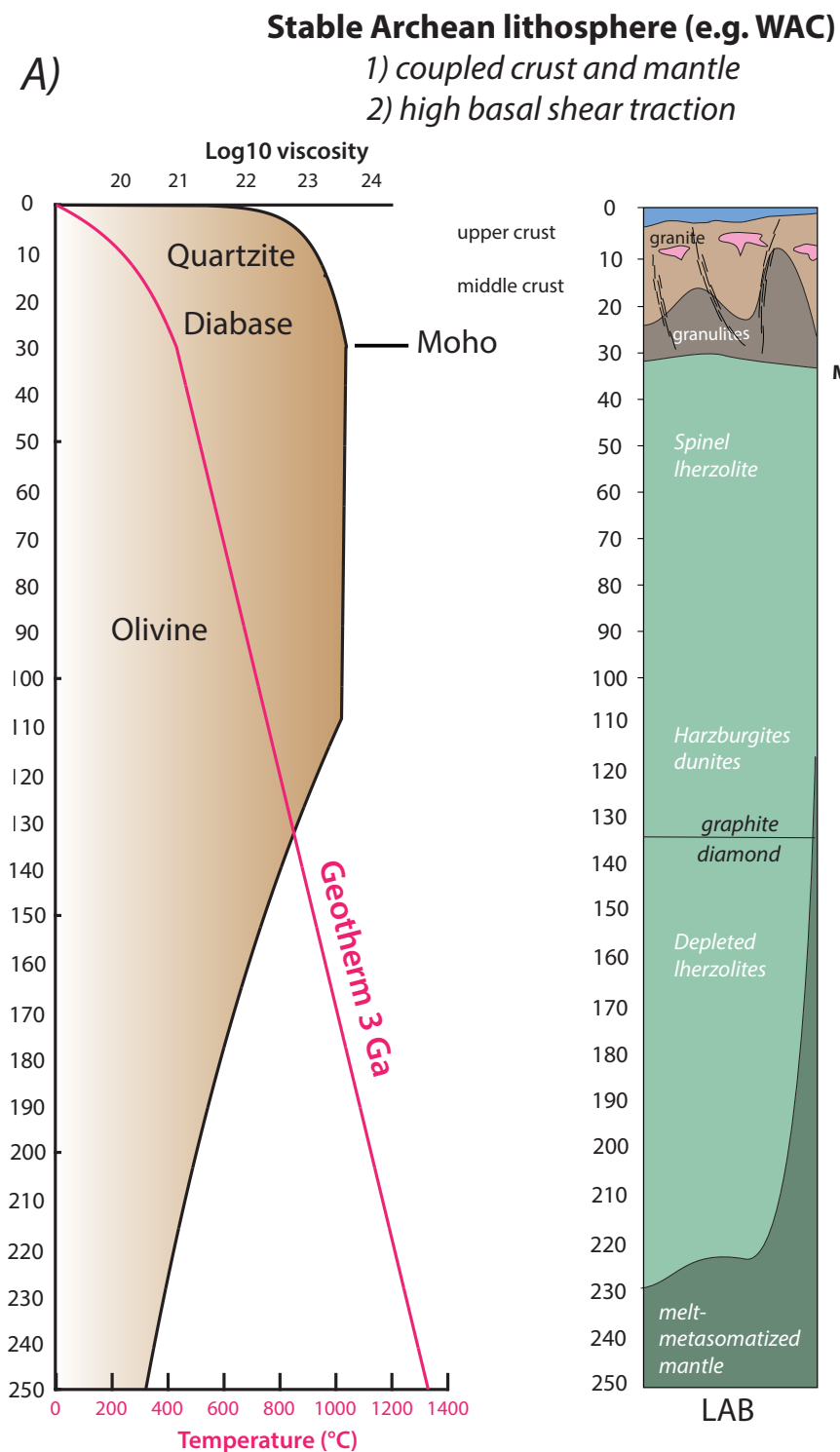
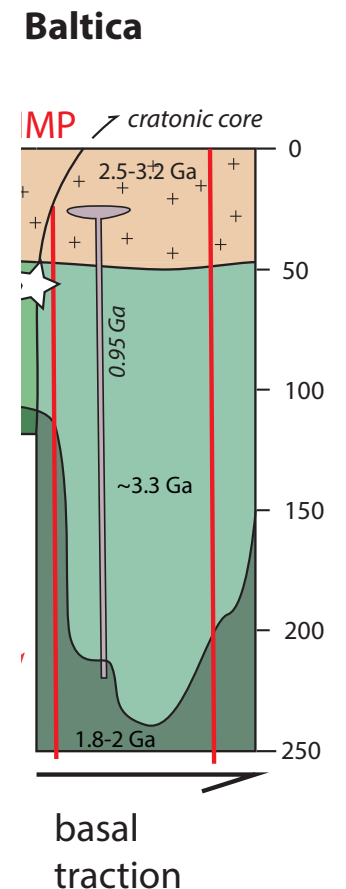
270 Ma



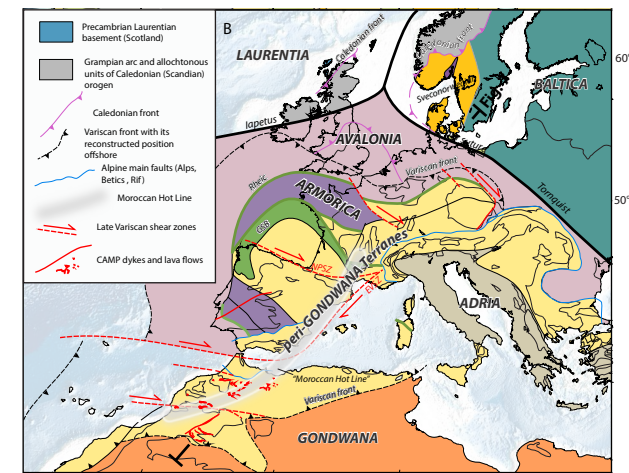
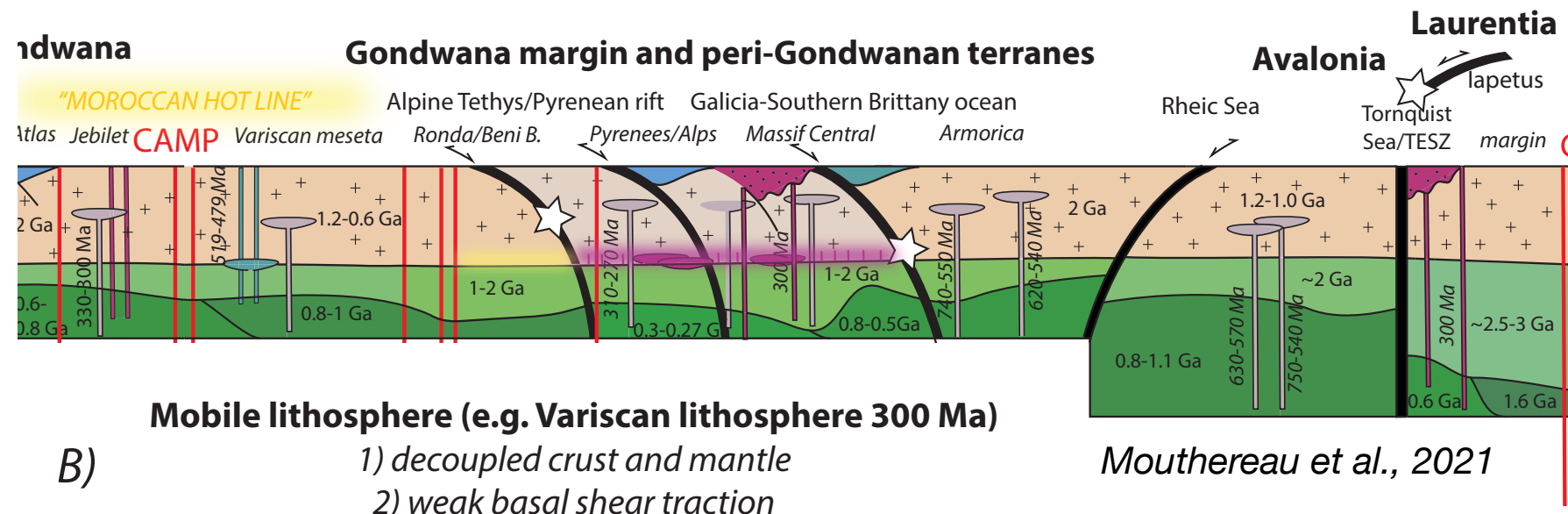
Metasomatism and thermal erosion: late-Variscan delamination and rifting



Implications for mantle-plate and crust-mantle coupling - CRATON

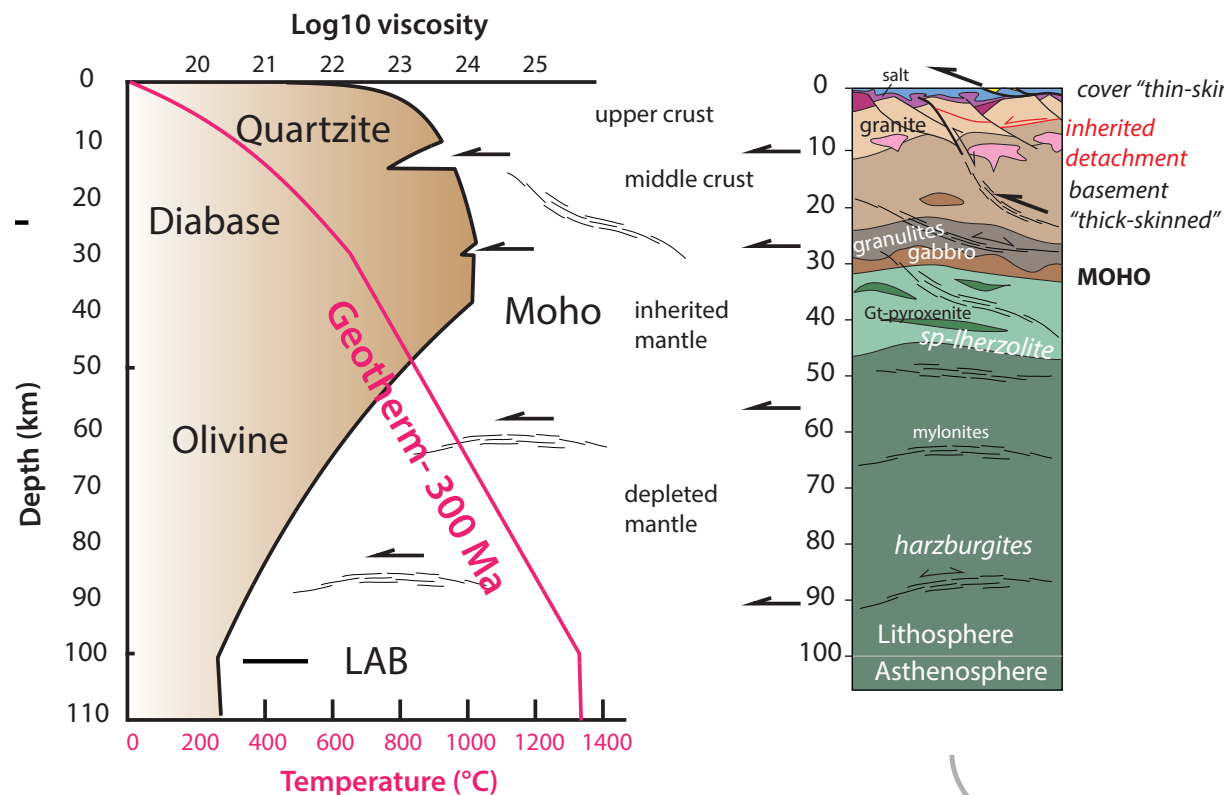


Implications for mantle-plate and crust-mantle coupling - PALEOZOIC EUROPE LITHOSPHERE



Mobile lithosphere (e.g. Variscan lithosphere 300 Ma)
 B) 1) decoupled crust and mantle
 2) weak basal shear traction

Mouthereau et al., 2021

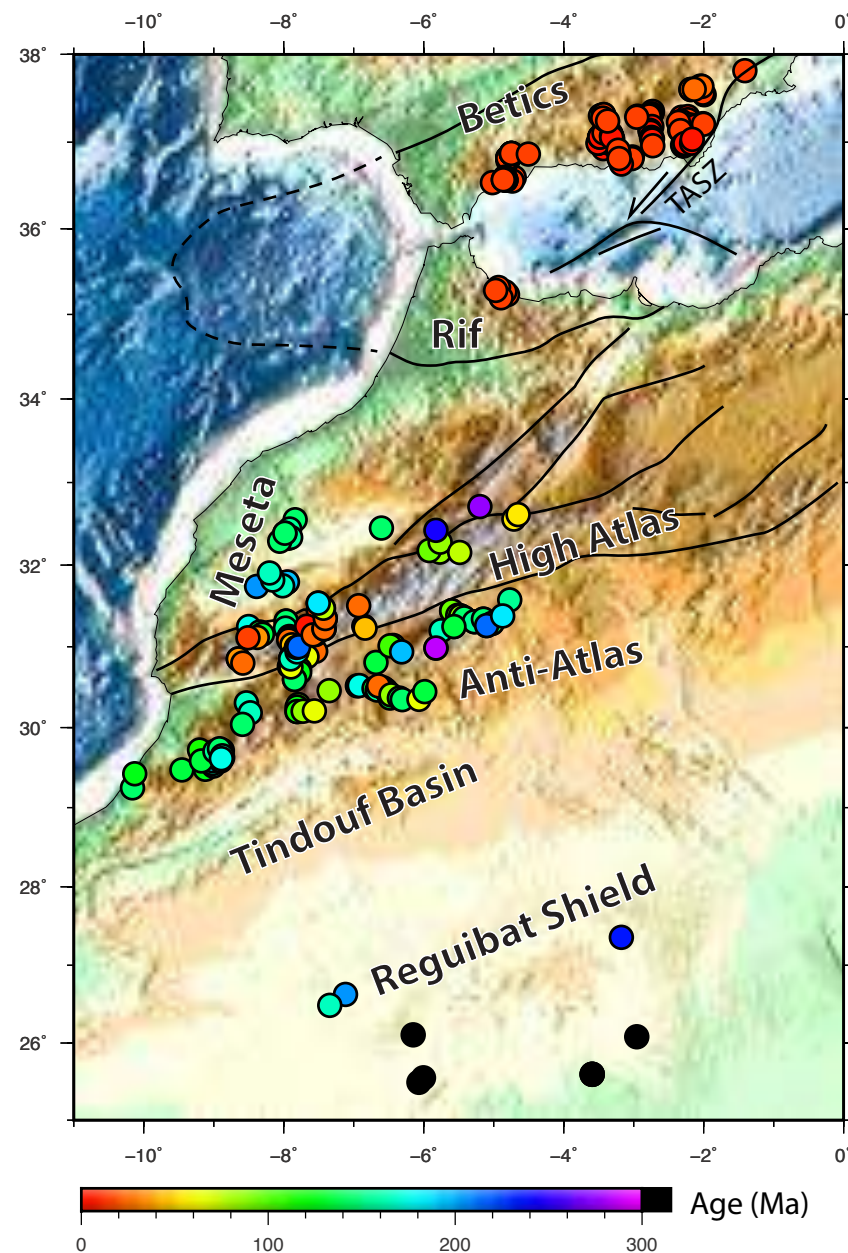
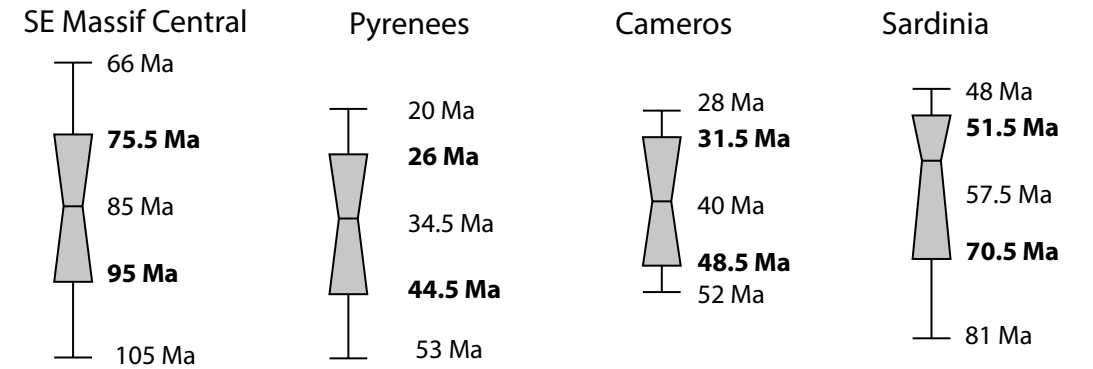
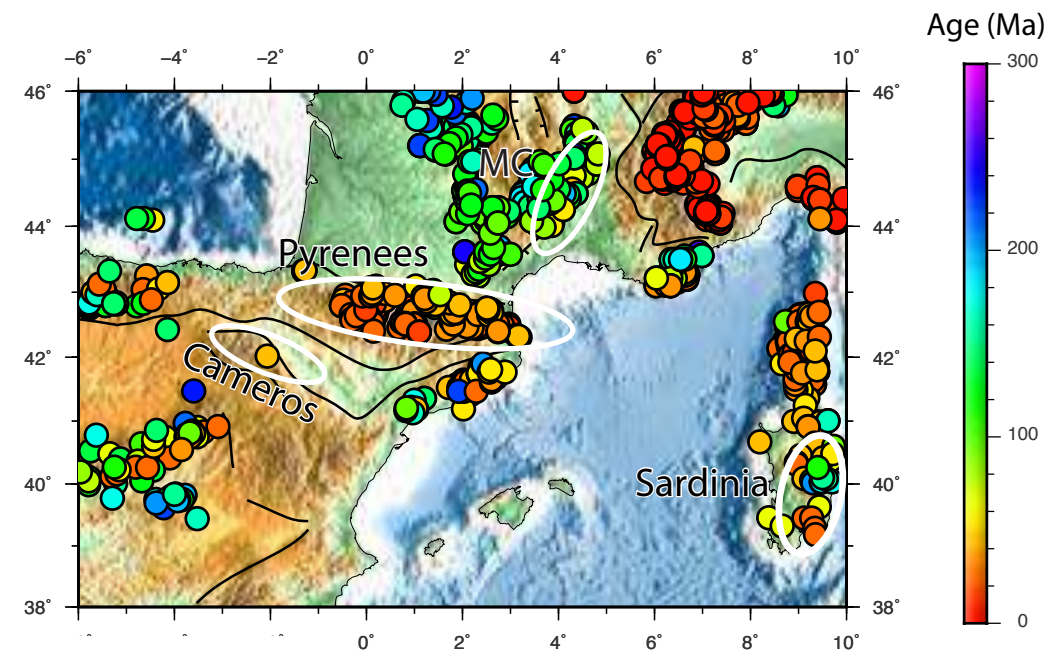


*Less depleted
weak, thin
phanerozoic mantle
decoupled from
asthenosphere
and crust*

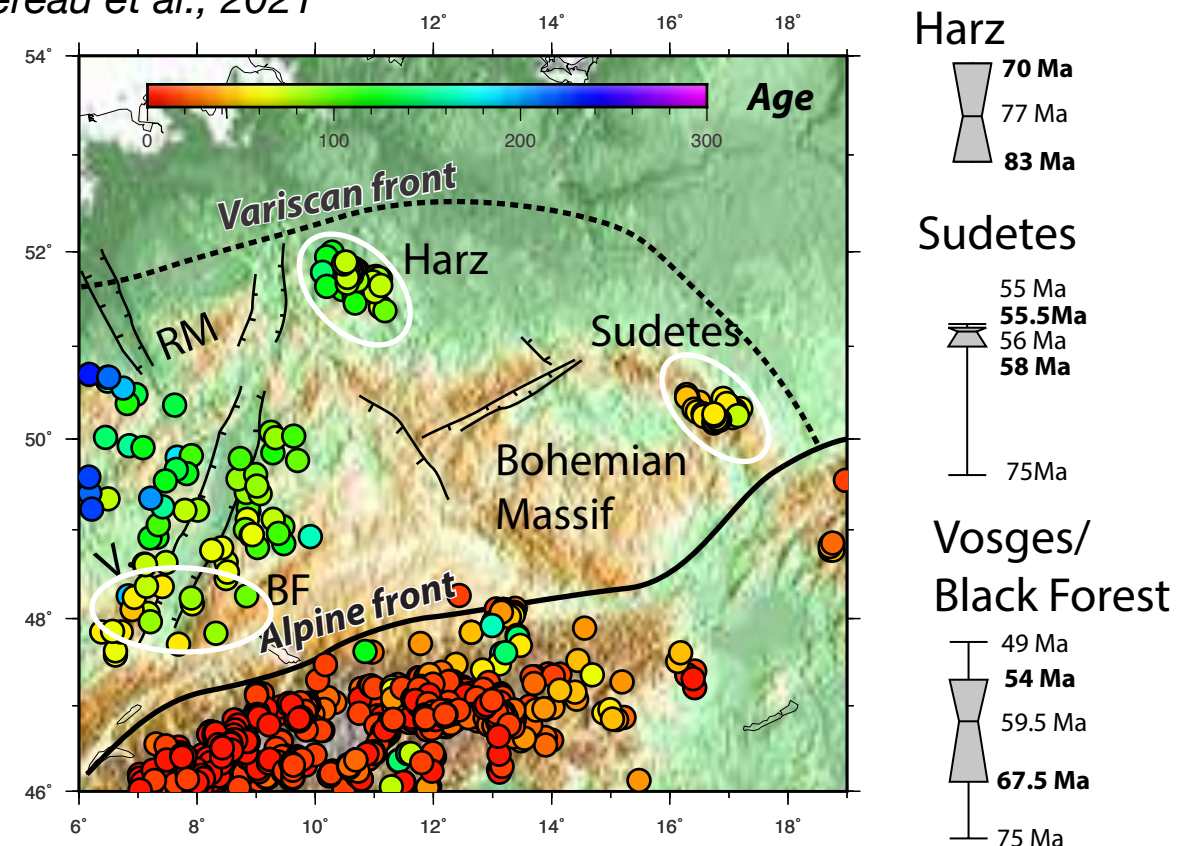
Resolving periods of fast exhumation -

Low-temperature data as proxy for uplift

Fast exhumation ages according to thermal modelling



Mouthereau et al., 2021

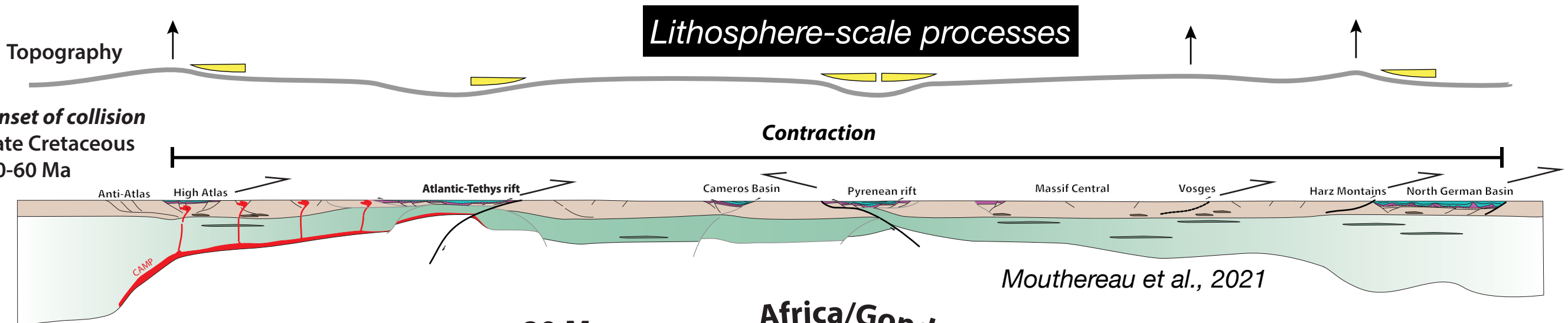


Topographic evolution of W Europe

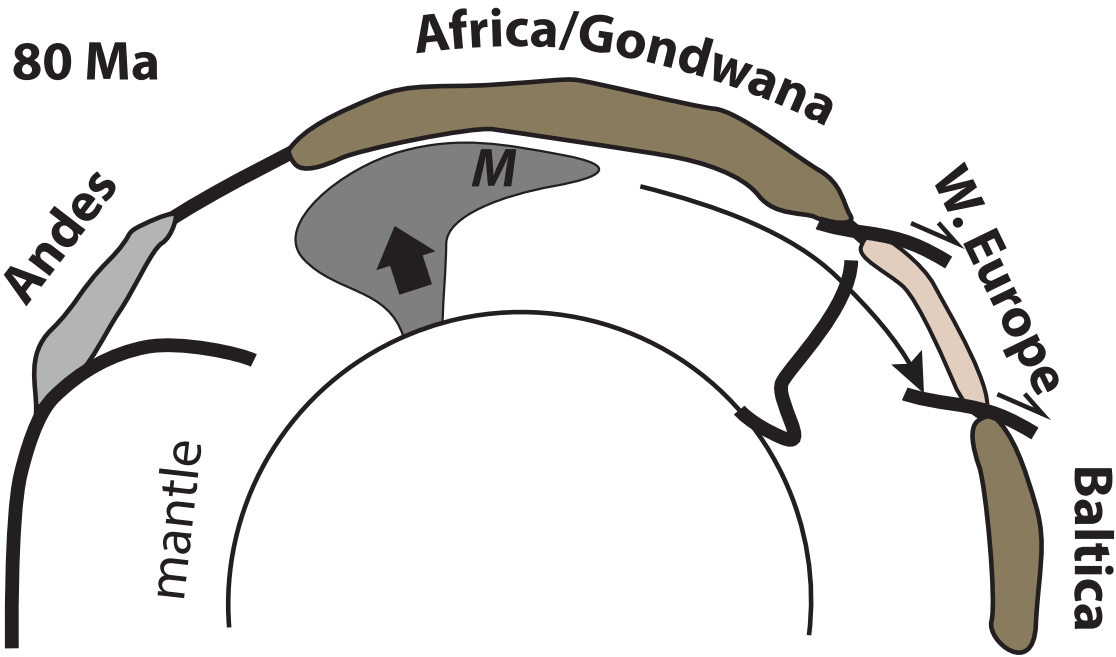
Onset of AF/EU convergence. All W-Europe is deformed but uplift recorded only in weakly extended domains (Atlas, North Germany)

Deep mantle convection is the far-field driver but inherited lithosphere properties controls topography

80 Ma



whole-mantle drivers



- Mantle convection
 - Tethyan slab penetration in lower mantle
- M: Morondava plume

Topographic evolution of W Europe

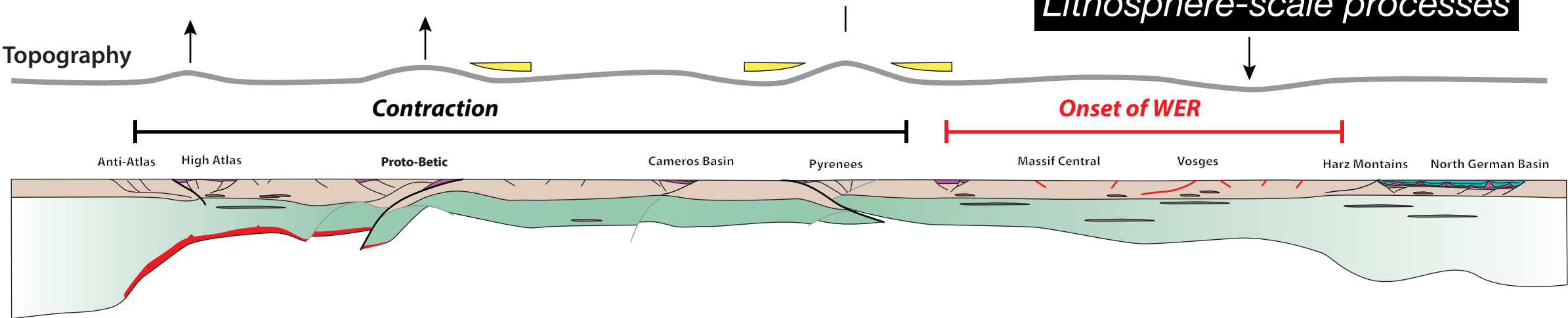
Onset of N Atlantic spreading/Icelandic plume and extension in West European Rift

50 Ma

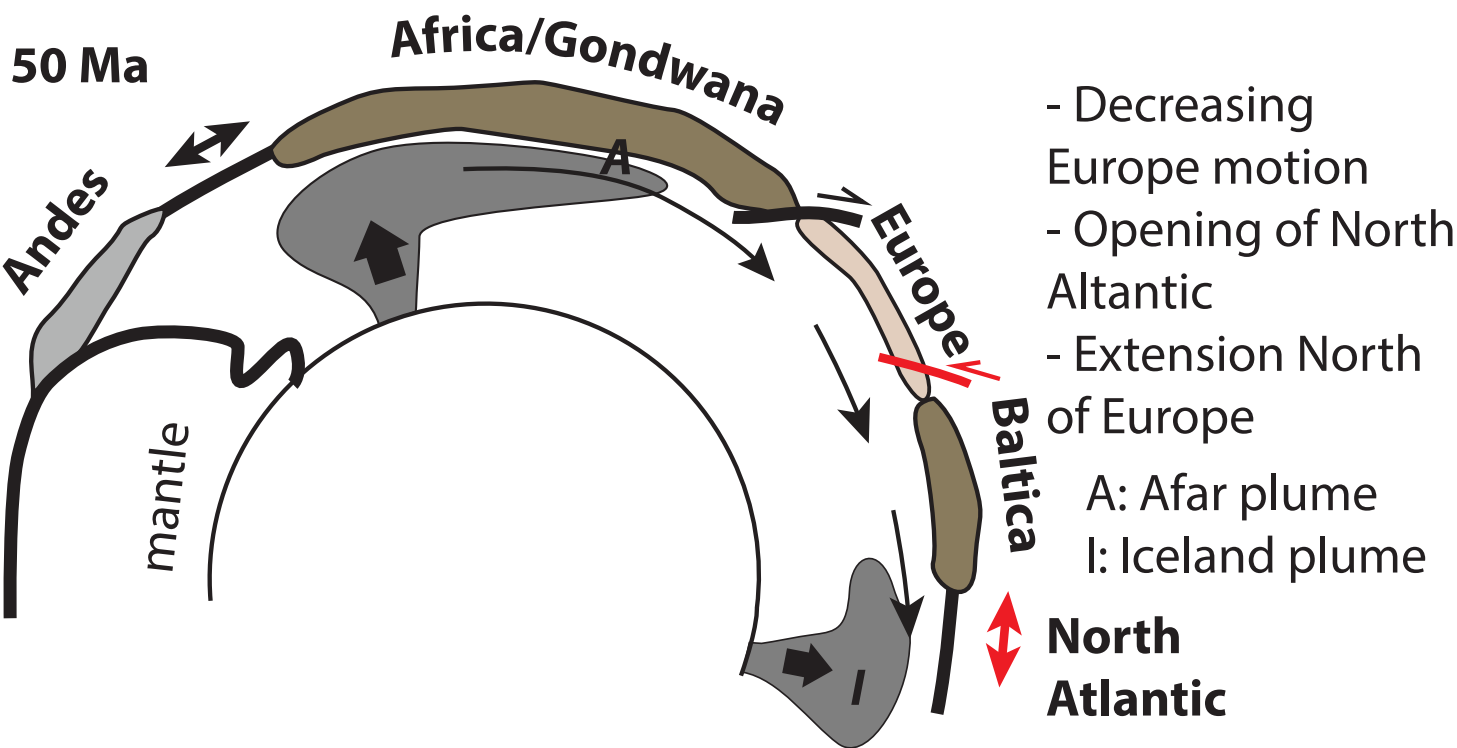
Uplift focuses in southern Europe as hyper-extended domains are sutured - Inheritance is the main driver of topography

Lithosphere-scale processes

*Growth of orogenic topography
Early Eocene
50 Ma*



whole-mantle drivers



Topographic evolution of W Europe

W-Mediterranean kinematic reorganisation, shortening and delamination in S-Iberia in the most thinned part, extension and magmatism in West European Rift

< 30 Ma

Small-scale convection controls changes of lithosphere properties (magmatism) which in turn controls uplift

