

Comparison of the crust and upper mantle structure of the Alboran and Algerian domains (Western Mediterranean): Tectonic significance



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CSIC



ICTJA

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What?

- HP/LT Metamorphic rocks
- Back-arc basins
- Volcanism

- Orogenic

Valencia Trough

Early Miocene-Middle Miocene
Calc-alkaline (Martí et al. 1992)

Alboran Basin

Si-K-rich (Upper
Miocene-Lower Pliocene)
(Duggen et al. 2004)

- Anorogenic

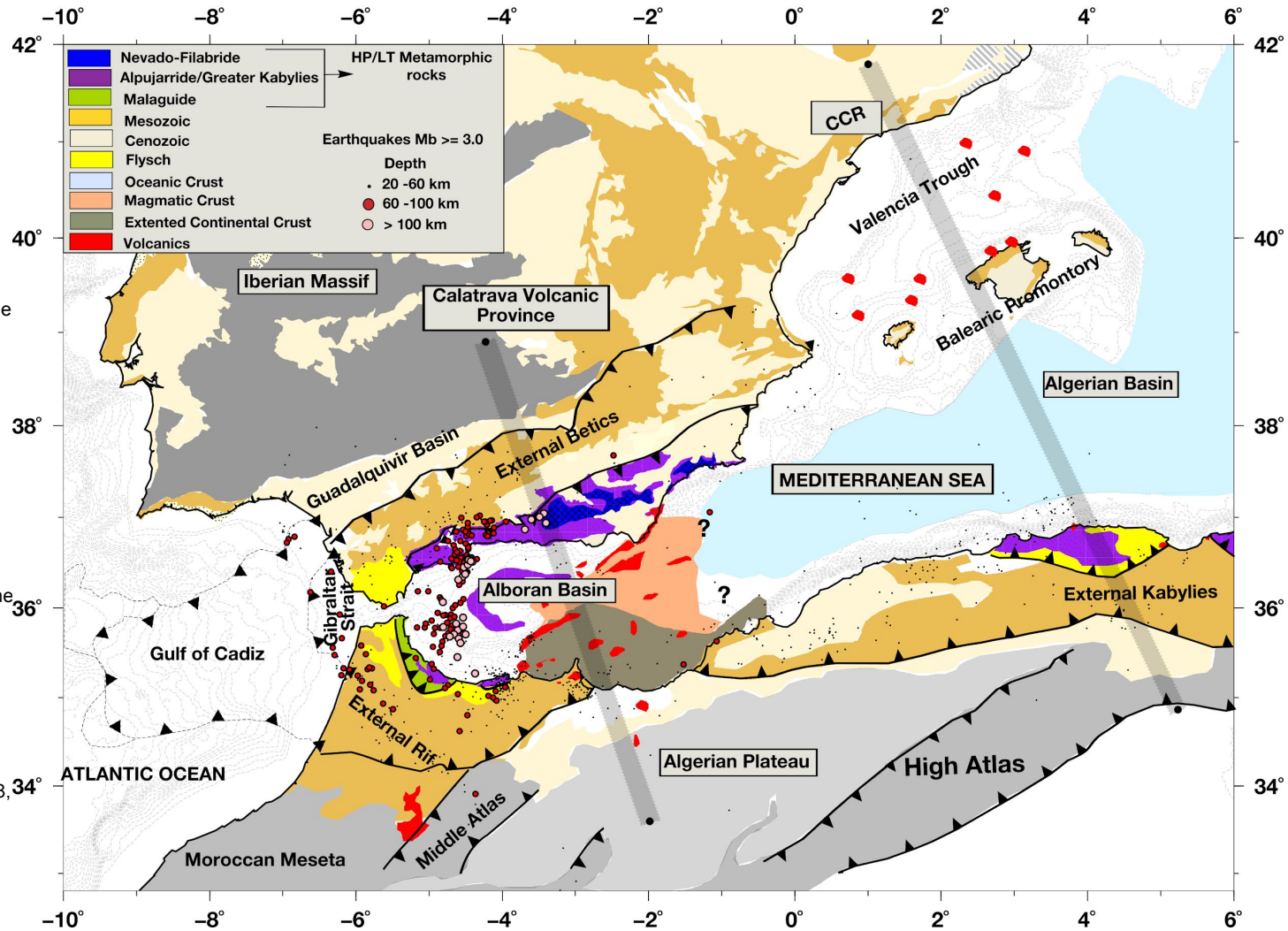
Valencia Trough

Middle Miocene- recent
Alkaline

Alboran Basin

Si-poor, Na-rich Upper-Miocene
- Pleistocene

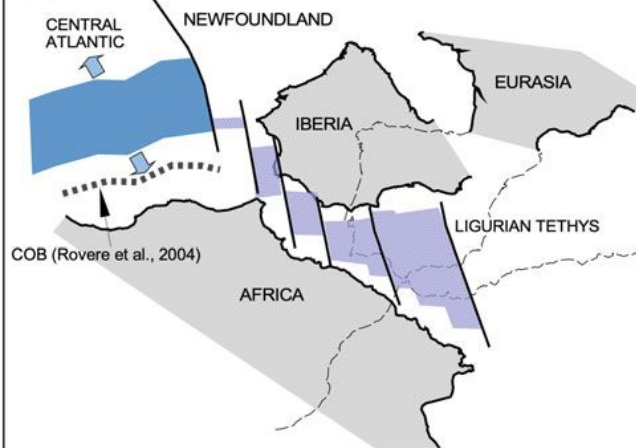
Vergés & Fernàndez, 2012, Pena et al. 2018, 2019,
Firozen de Lamotte et al. 2011, Martí et al.
1992, Duggen et al. 2004, 2005, 2008



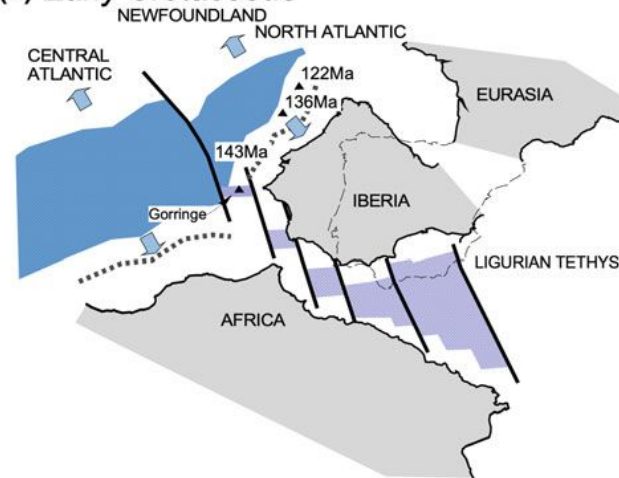
What?

Trans-tensive and **highly extended** continental segments transition to **oceanic lithosphere** to the east.

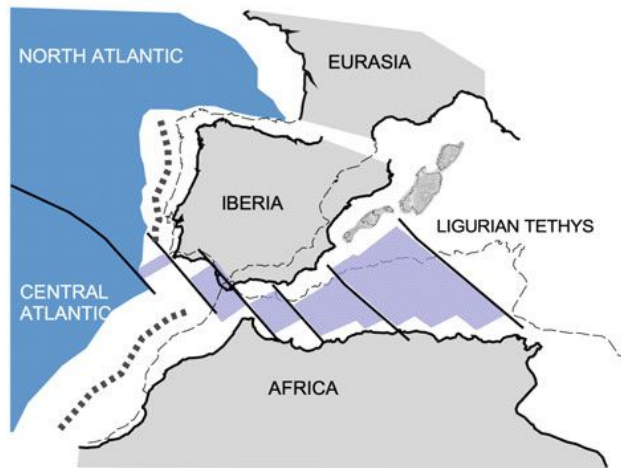
(c) *Late Jurassic*



(d) *Early Cretaceous*



(e) *Late Cretaceous*

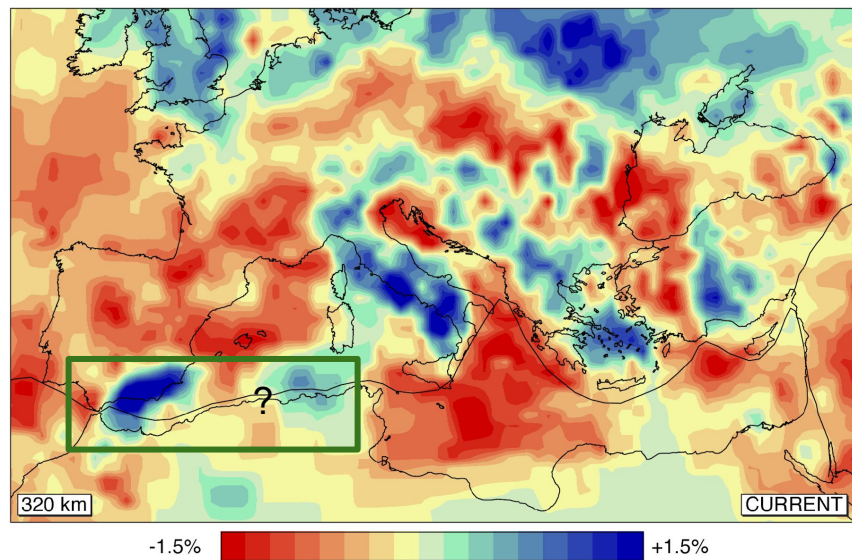


Stampfli & Borel 2002; Schettino & Turco 2011; Nirrengarten et al. 2018; Vergés et al. 2019

What?

Alboran Slab

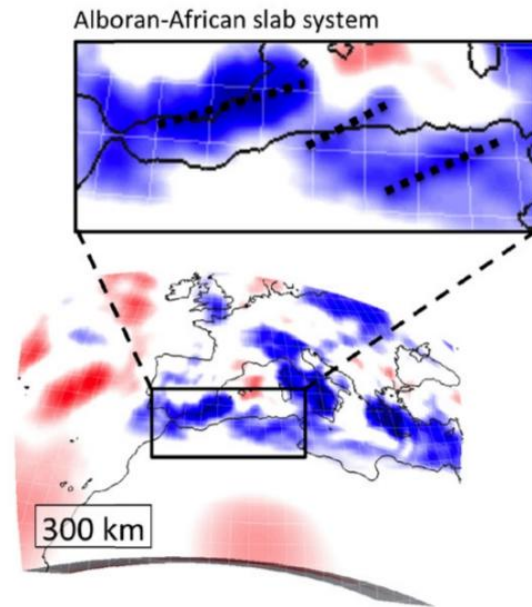
Travel time inversion



Villaseñor, Spakman and Engdahl, 2003

Algerian Slab

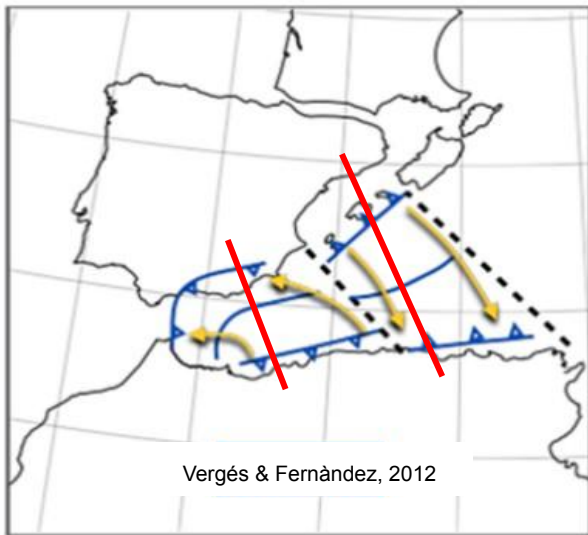
Full waveform inversion



Fichtner and Villaseñor, 2015

Why?

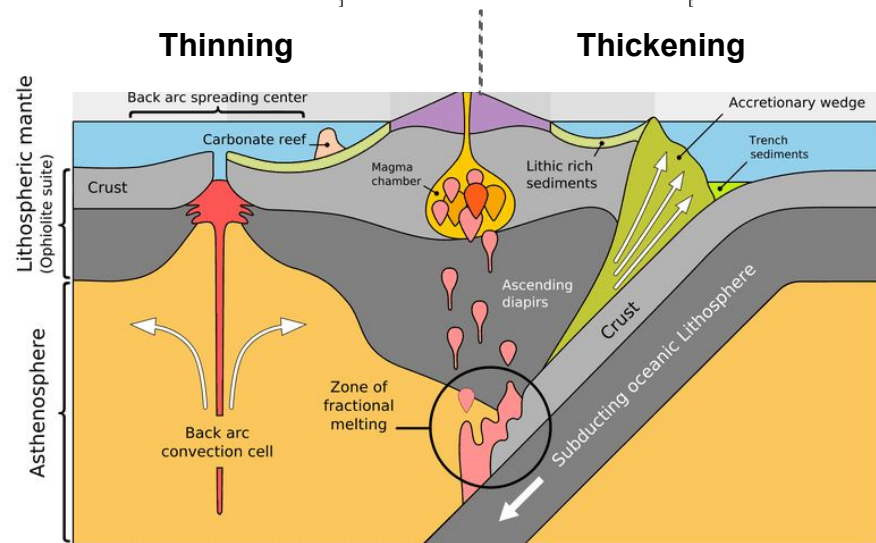
Typical subduction



Anorogenic Volcanism

Orogenic Volcanism

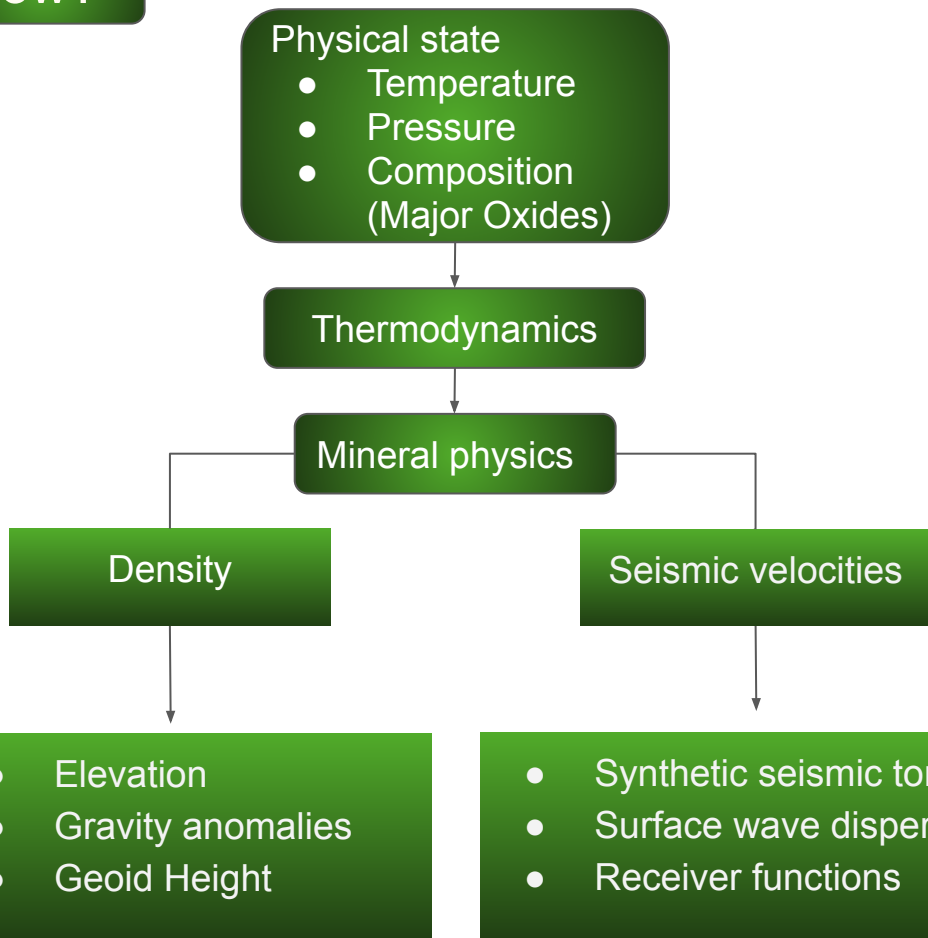
HP/LT rocks



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Can the opposite polarity subduction model explain the present day crust and upper mantle structure in the Alboran and Algerian basin?

How?



LitMod2D_2.0

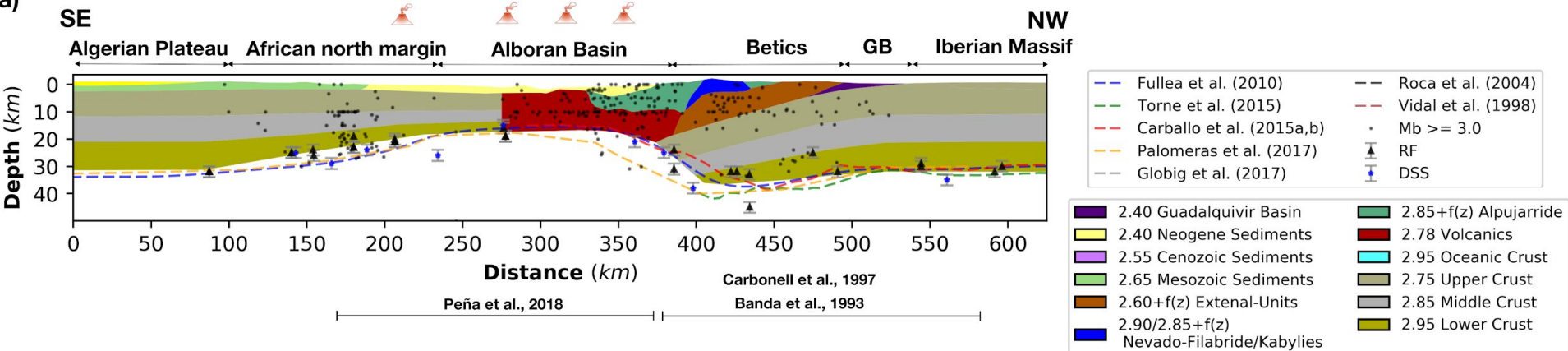


- Improved from LitMod2D_1.0 (Afonso et al., 2008)
- Depleted mid oceanic ridge basalt mantle (DMM, *Workman and Hart, 2015*) in the sublithospheric mantle
- Anomalies in sublithospheric mantle
 - Thermal
 - Compositional
 - Seismic velocities
- Anelastic attenuation parameters from recent laboratory measurements

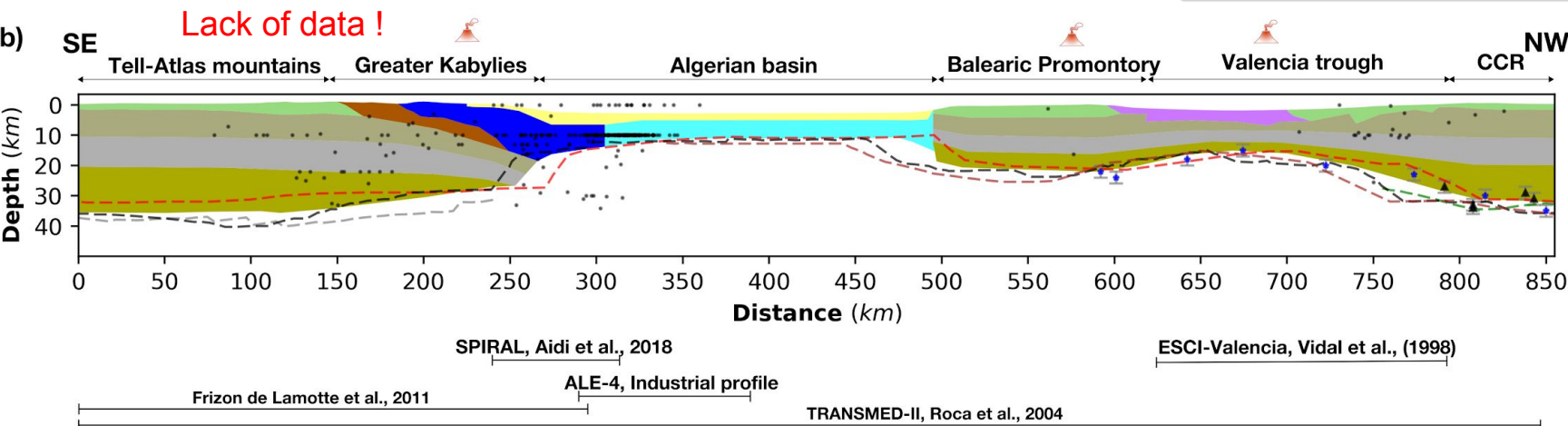
Kumar et al. 2020

Crustal scale model

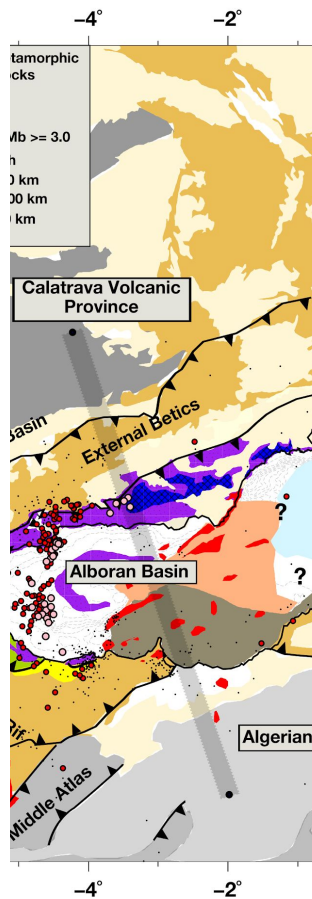
a)



b)



Alboran



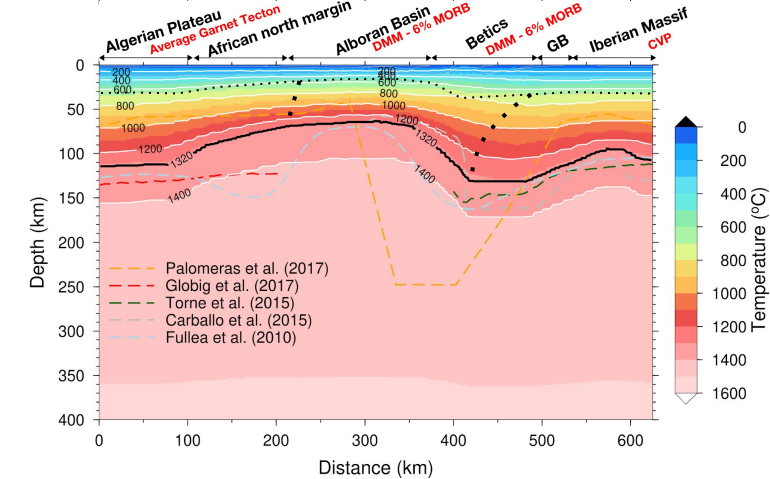
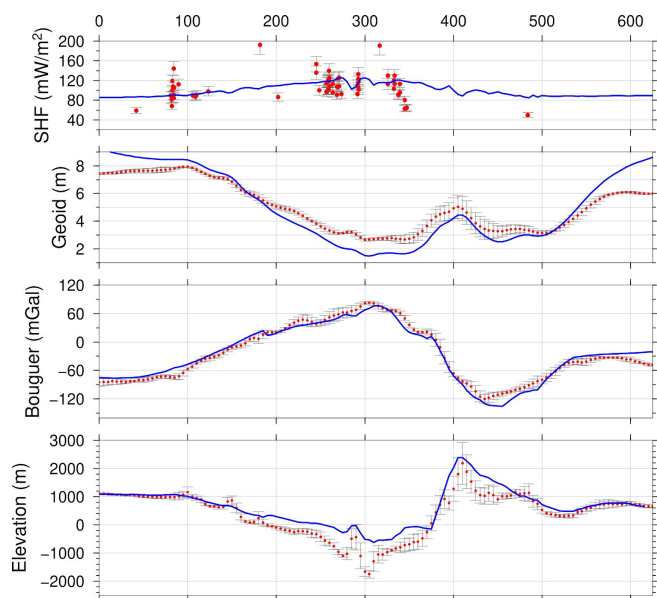
SE

SHF

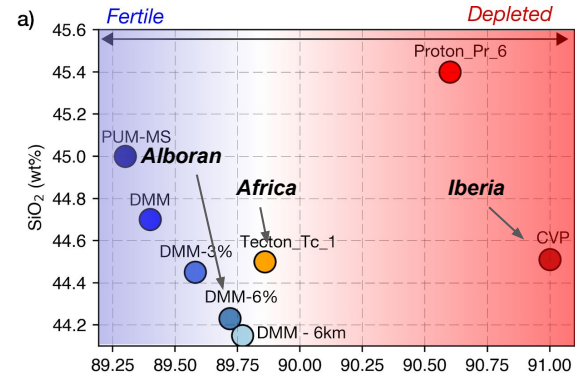
Geoid

Bouguer

Elevation

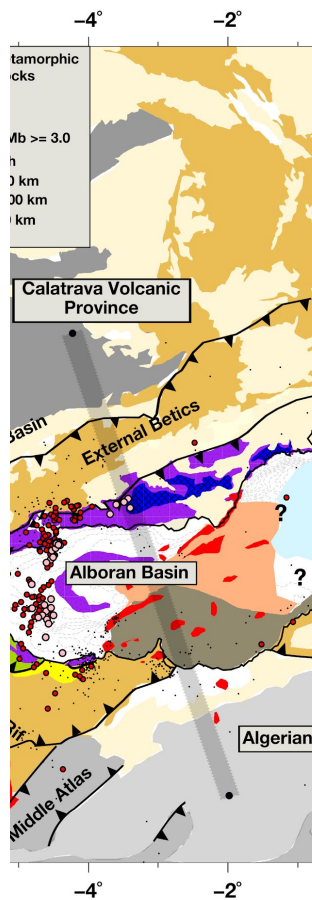


NW



Mass deficit beneath Betics.
Slab?

Alboran



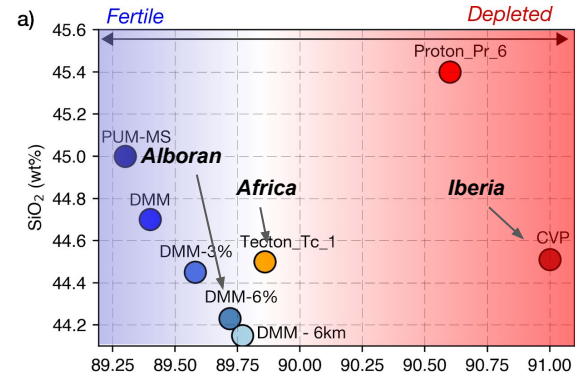
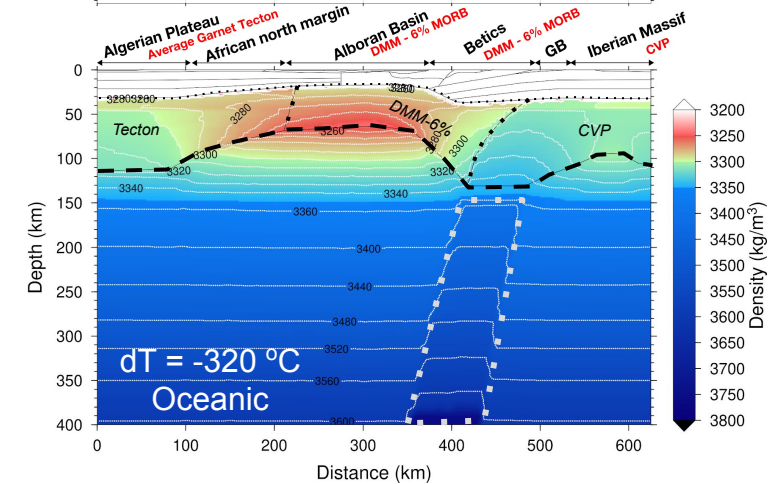
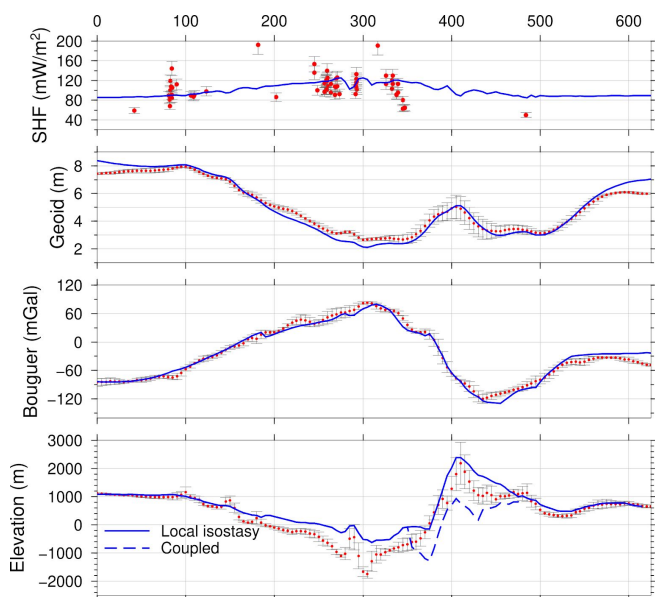
SE

SHF

Geoid

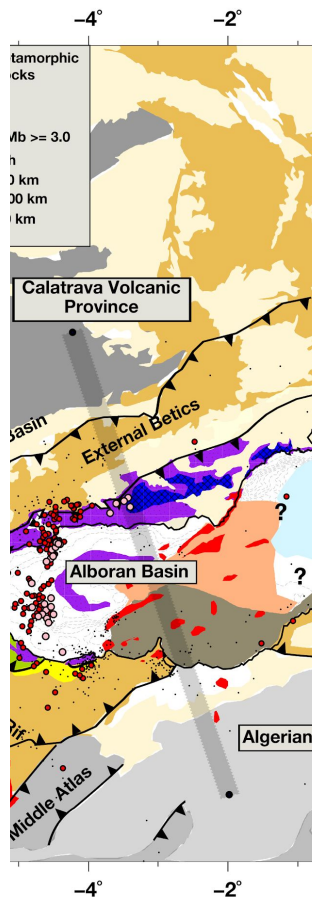
Bouguer

Elevation



Oceanic slab still not enough.

Alboran



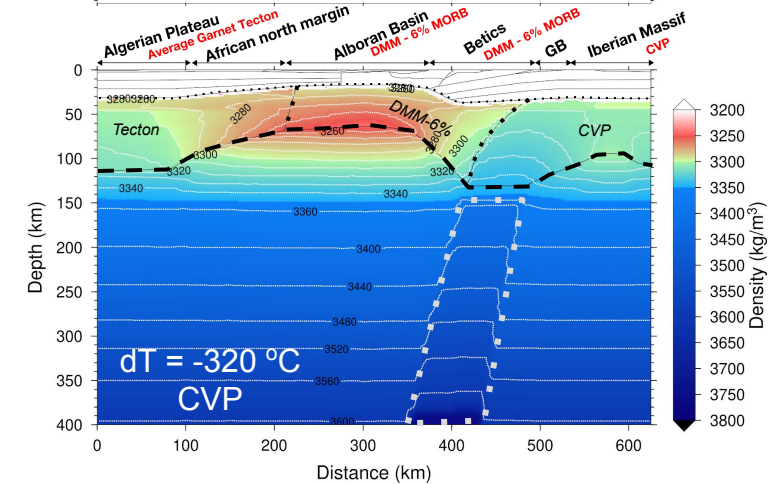
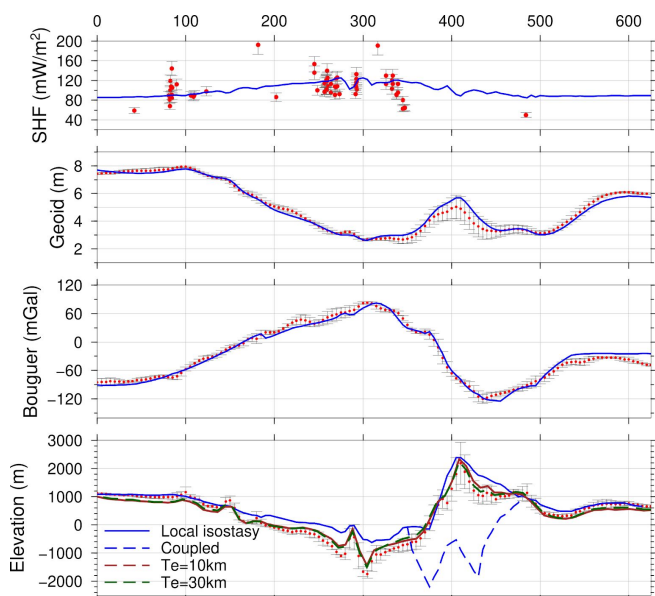
SE

SHF

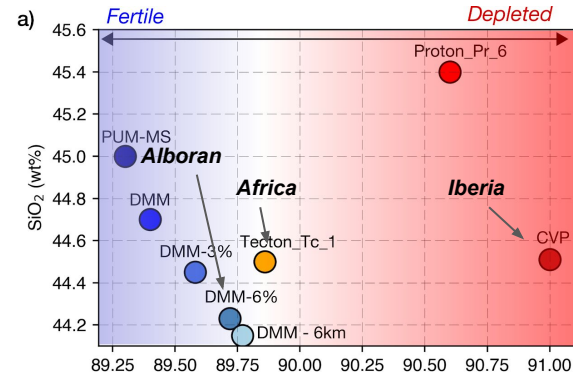
Geoid

Bouguer

Elevation

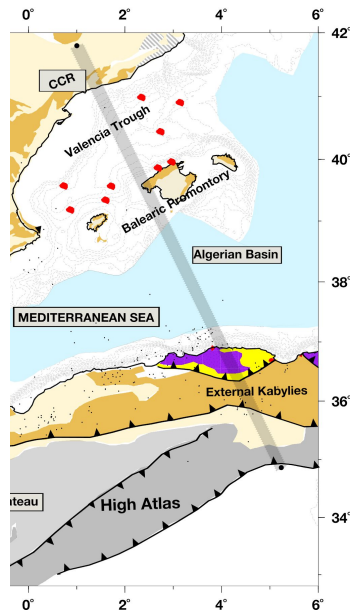


NW



Slab with same composition as Iberian lithosphere.

Algerian

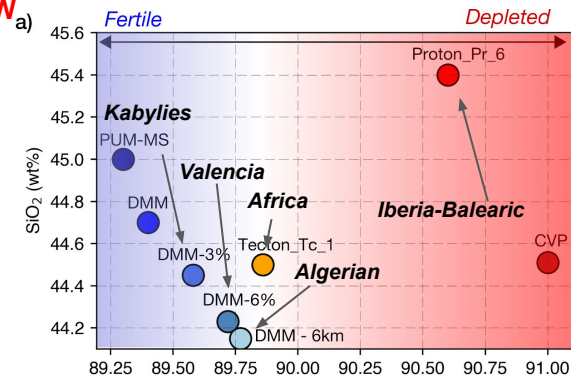
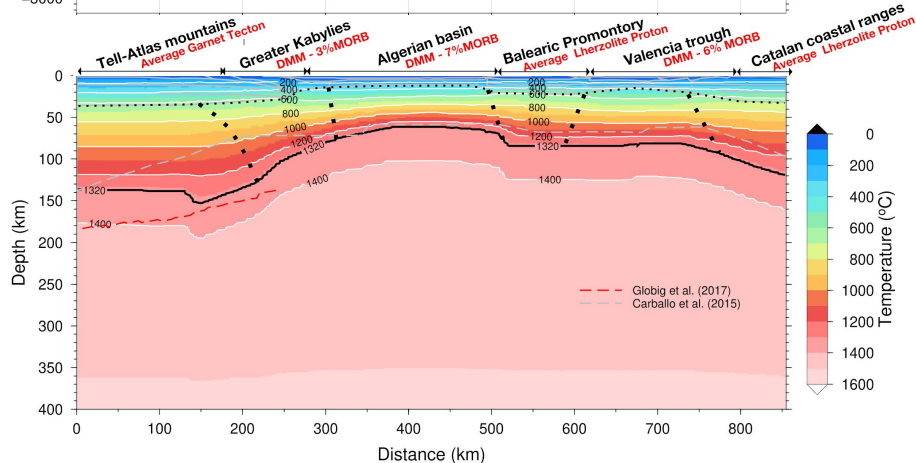
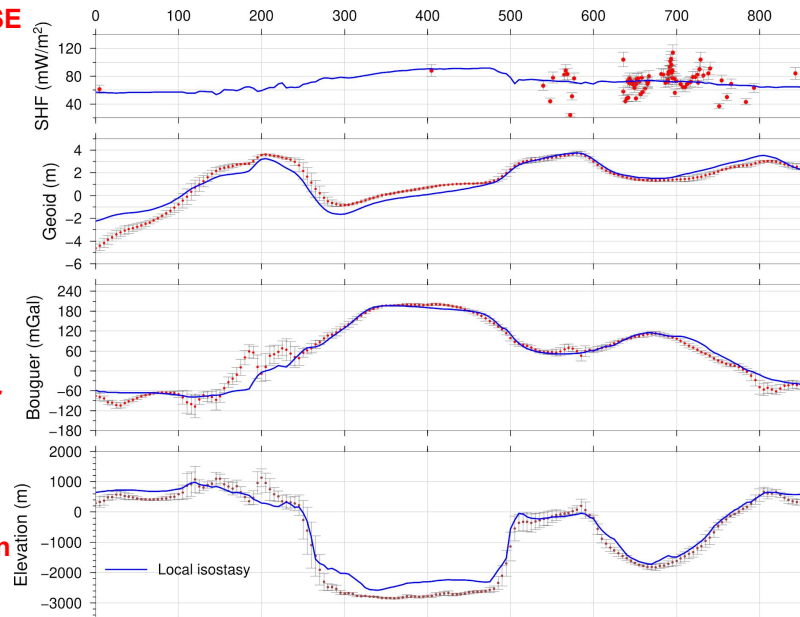


SHF

Geoid

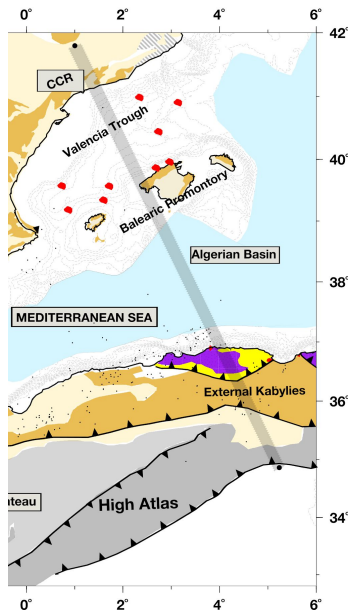
Bouguer

Elevation



Mass deficit beneath Kabylies.

Algerian

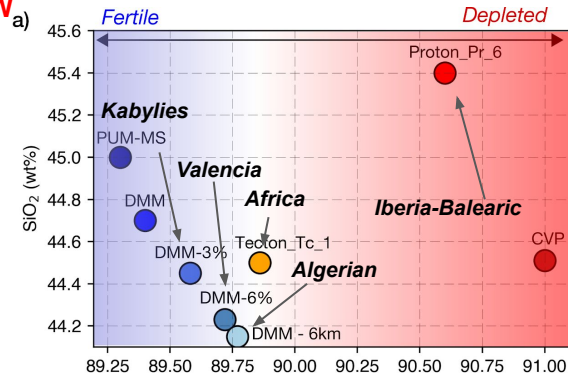
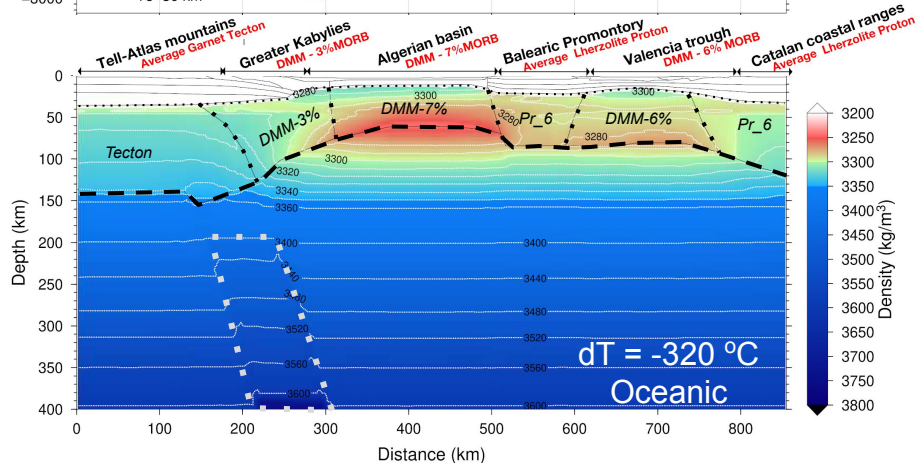
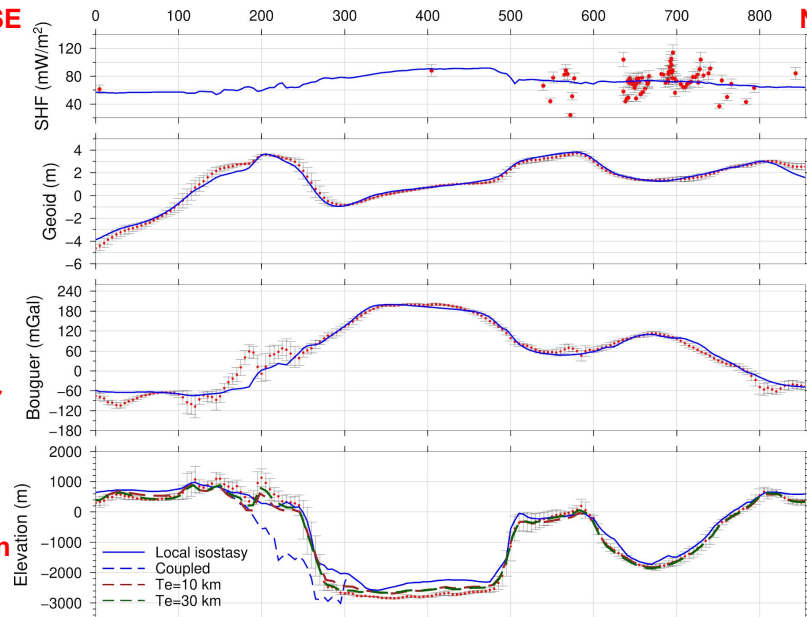


SHF

Geoid

Bouguer

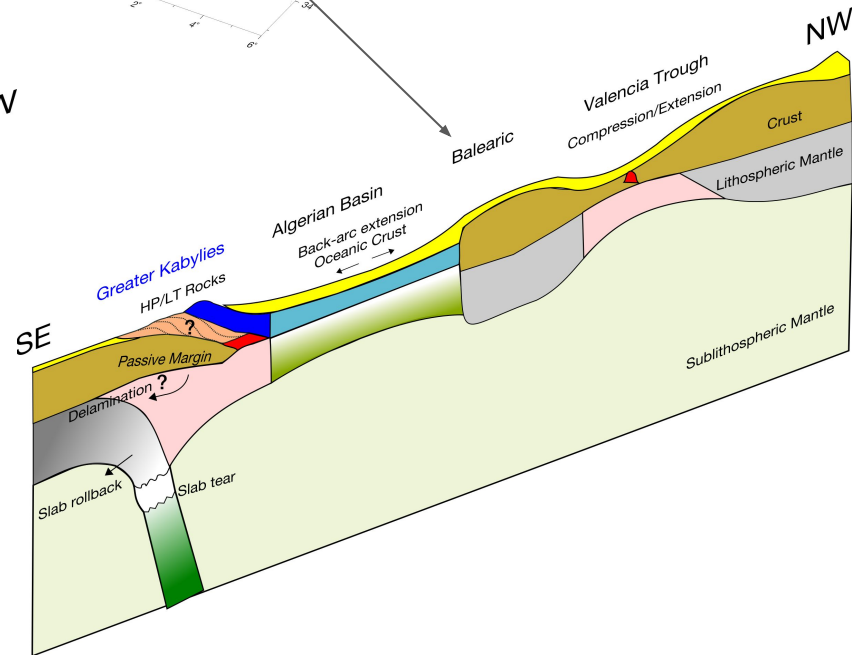
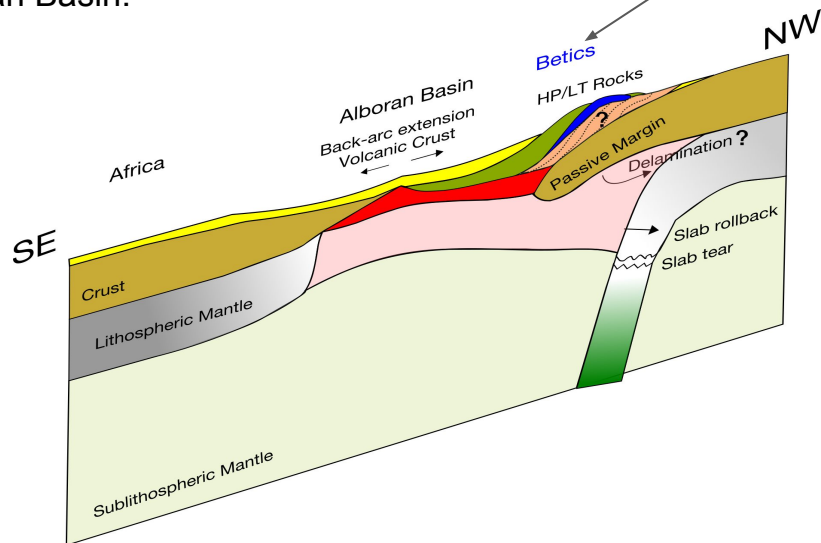
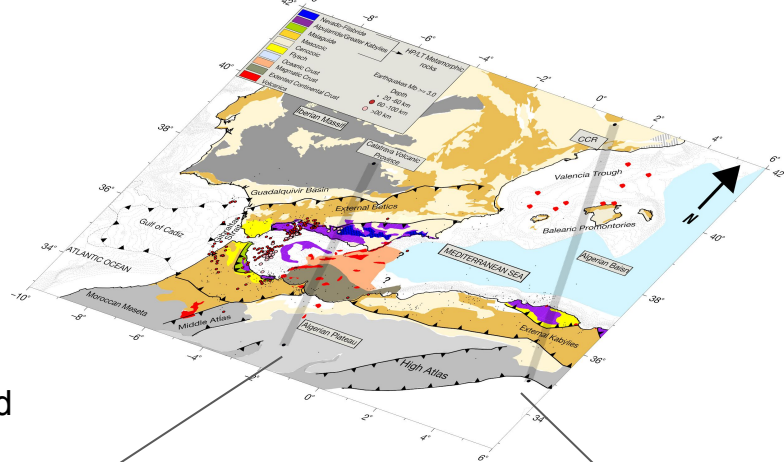
Elevation



Slab with oceanic lithosphere composition fits better.

Summary

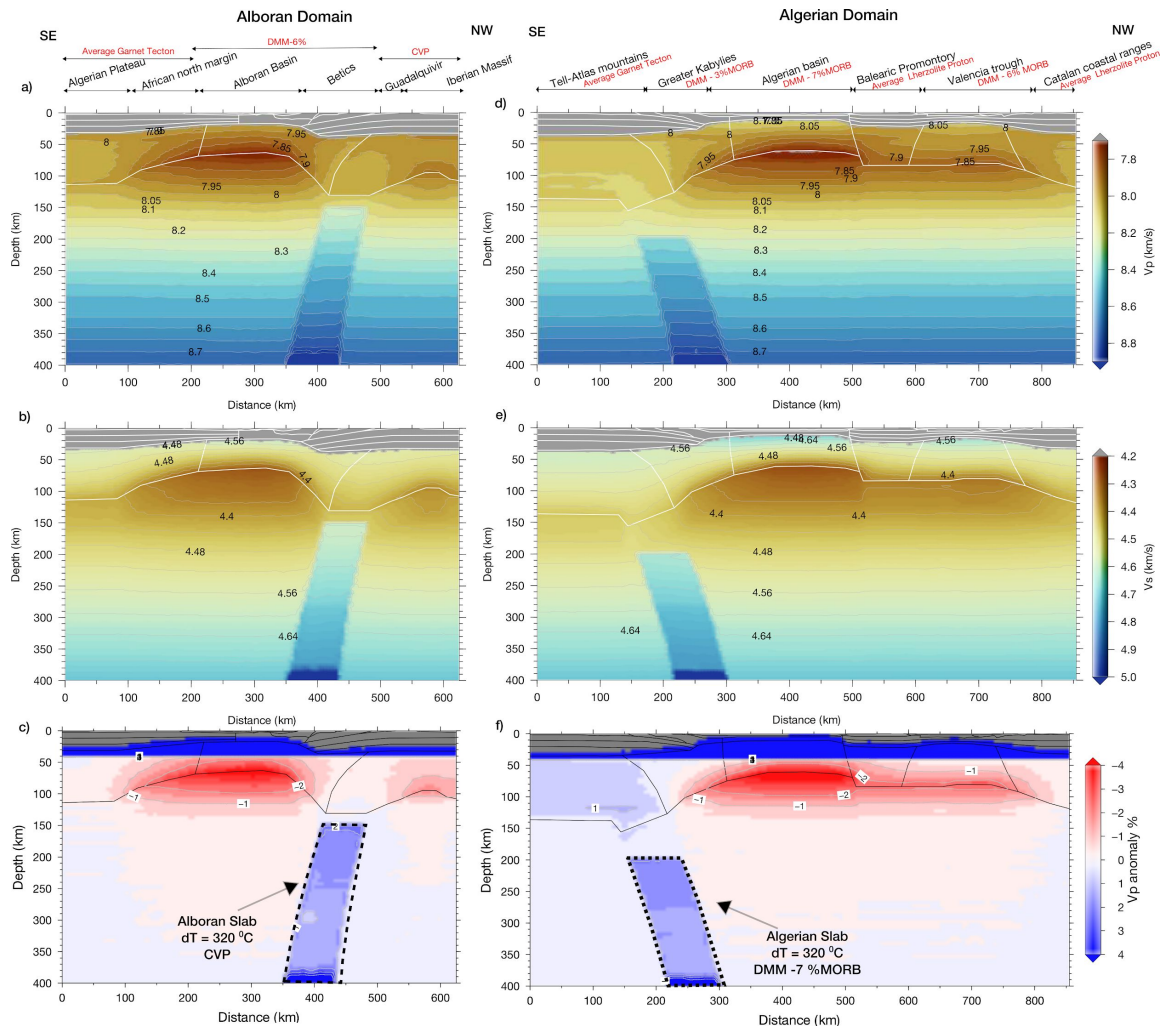
- Thick lithospheres on opposite sides.
- The Alboran slab is less fertile than the Algerian slab.
- Relatively fertile mantle beneath Alboran and Algerian Basin.



Schematic illustration, not to scale!

Supplementary slides

Seismic velocities



Lithospheric Mantle : Chemical composition

PUM - **P**rimitive **U**pper **M**antle

(McDonough & Sun 1995)

DMM - **D**epleted **M**id-oceanic-basalt **M**antle

(Workman & Hart 2005)

Tecton_Tc_1 - Average Garnet Tecton

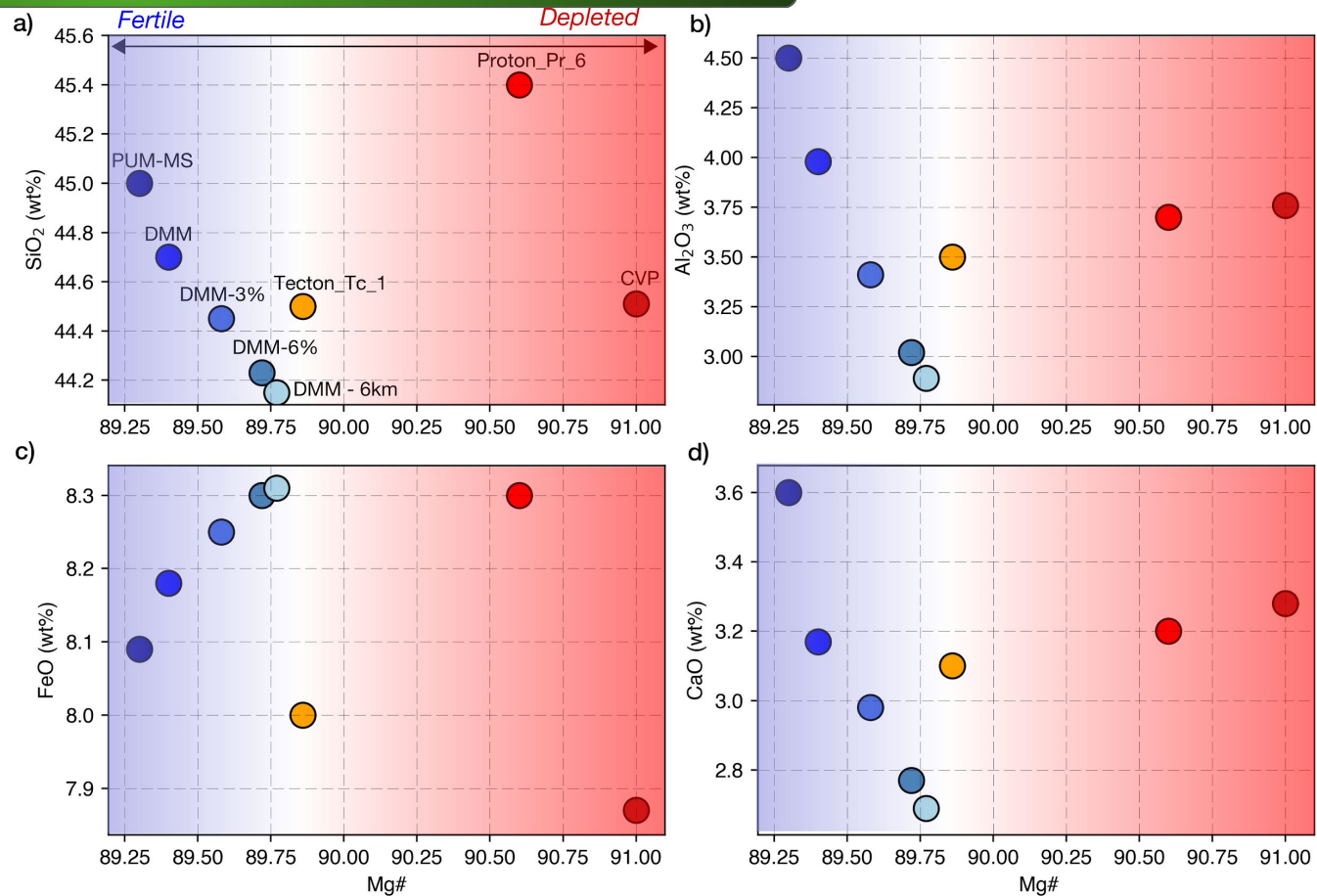
(Griffin et al, 2009)

Proton_Pr_6 - Average Proton Lherzolite

(Griffin et al, 2009)

CVP - **C**alatrava **V**olcanic **P**rovince

(Villaseca et al. 2010)



Melting

