Avalonia, get bent!

PALEOMAGNETISM FROM SW IBERIA CONFIRMS THE GREATER CANTABRIAN OROCLINE

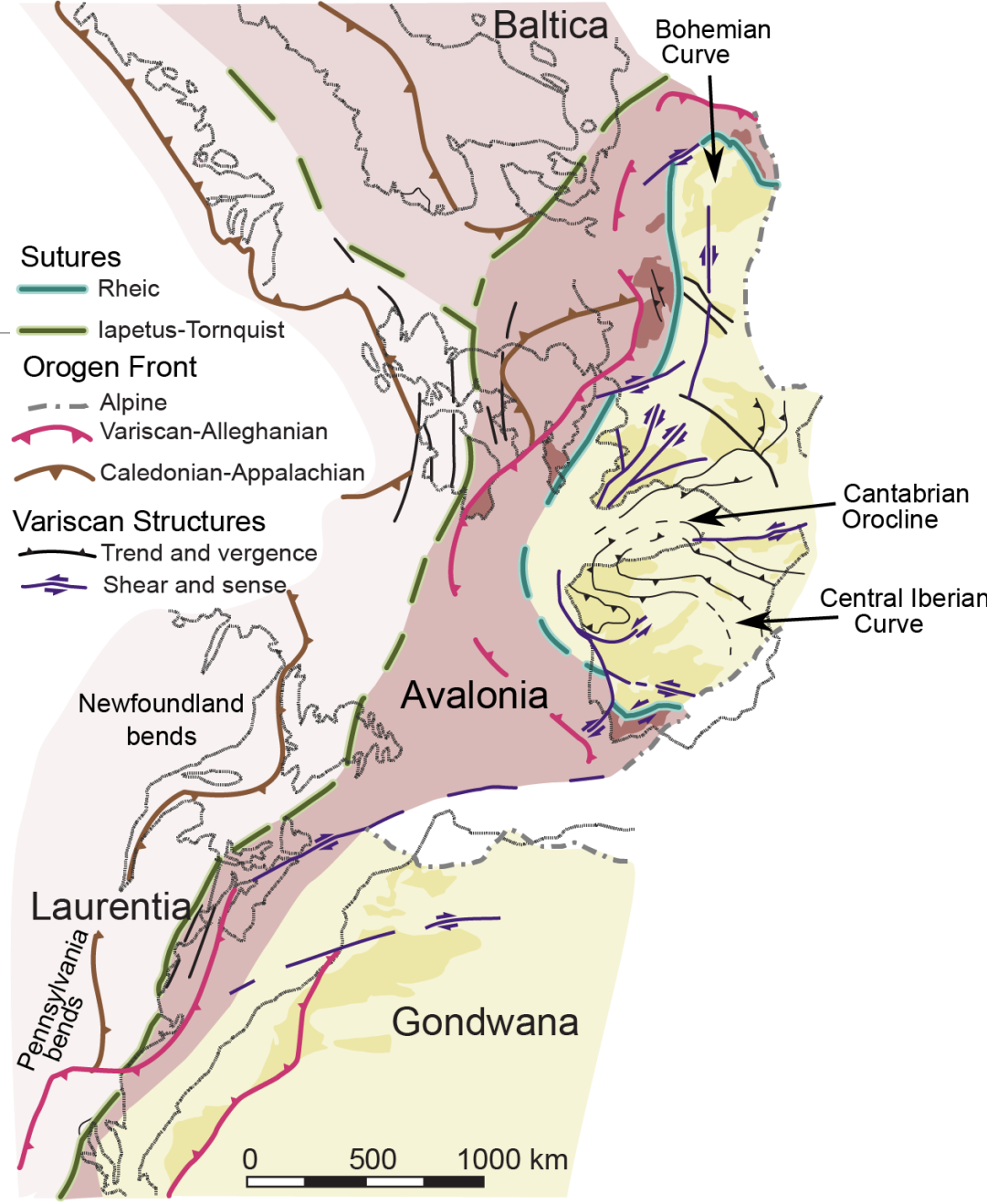
Introduction

Amalgamation of Pangea formed the Variscan Orogen

- Collision of Gondwana and Laurussia throughout the Carboniferous

Winding orogens, with multiple curves

- Most prominent structures are coupled Cantabrian Orocline and Central Iberian curve in Iberia



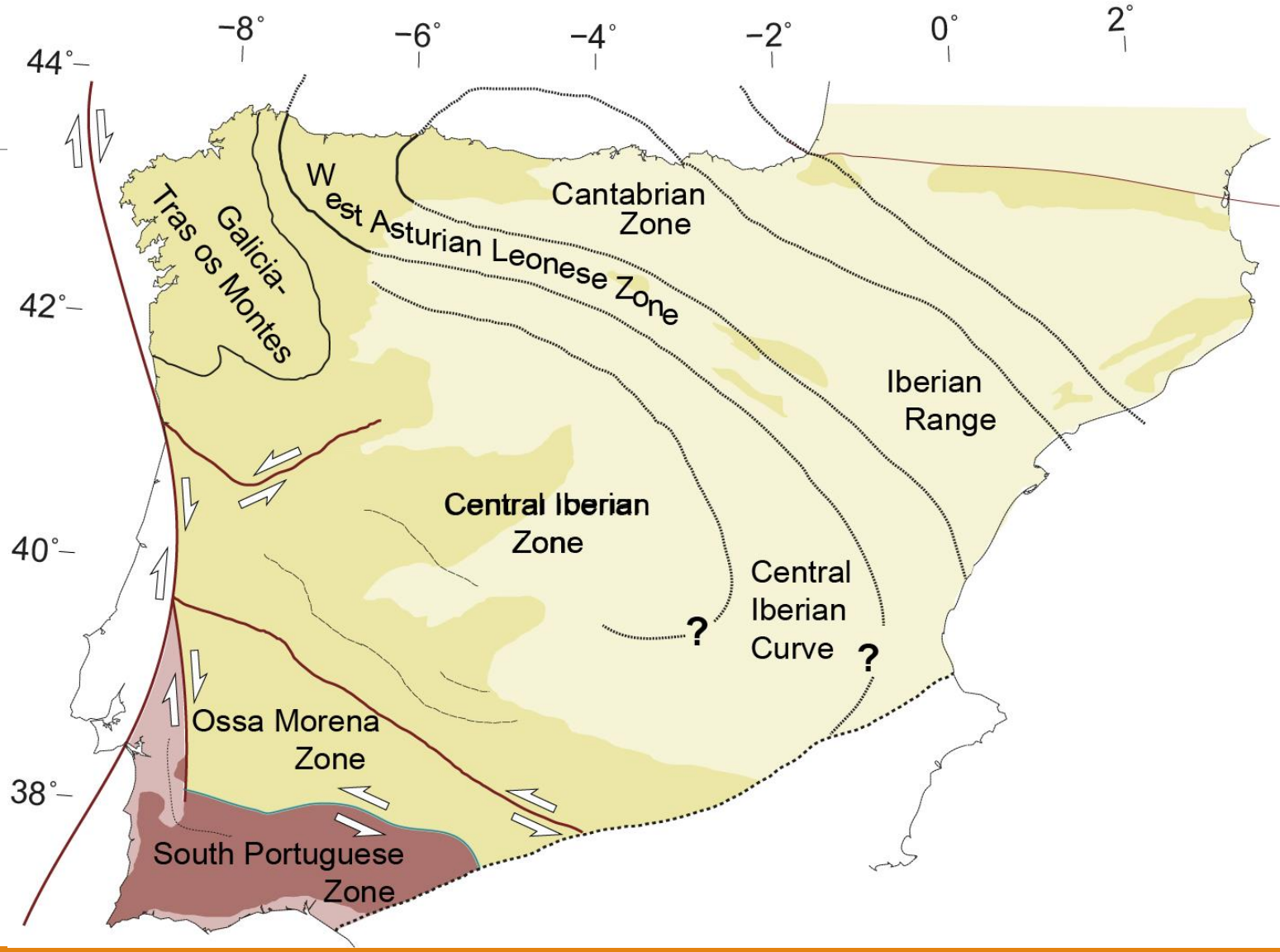
Iberia

Cantabrian Orocline (CO)

- Formed between ca 310-295 Ma
- Imply CCW rotations in south limb

Central Iberian Curve (CIC)

- No kinematic constrains
  - Lack of constrains – contradictory hypothesis
- Implies CW rotations in south limb



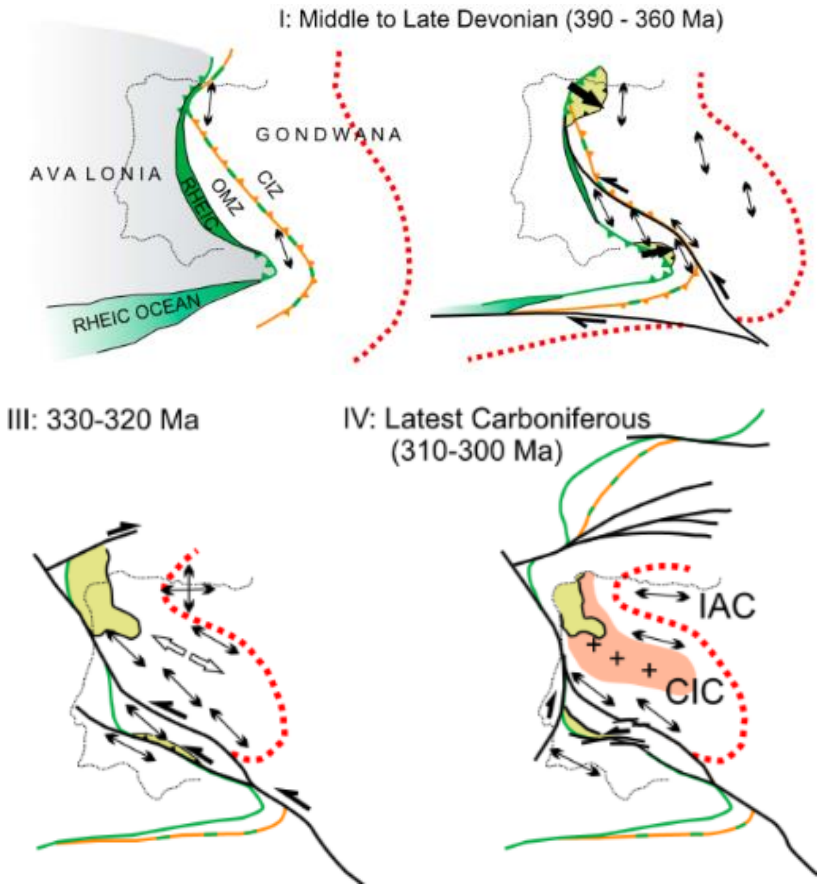
Competing Models

Indenting block model

- South Portuguese Zone is an indenting promontory, which bends CO and CIC at the time of collision
- Later tightening in later stages of deformation

“Stress-change” model

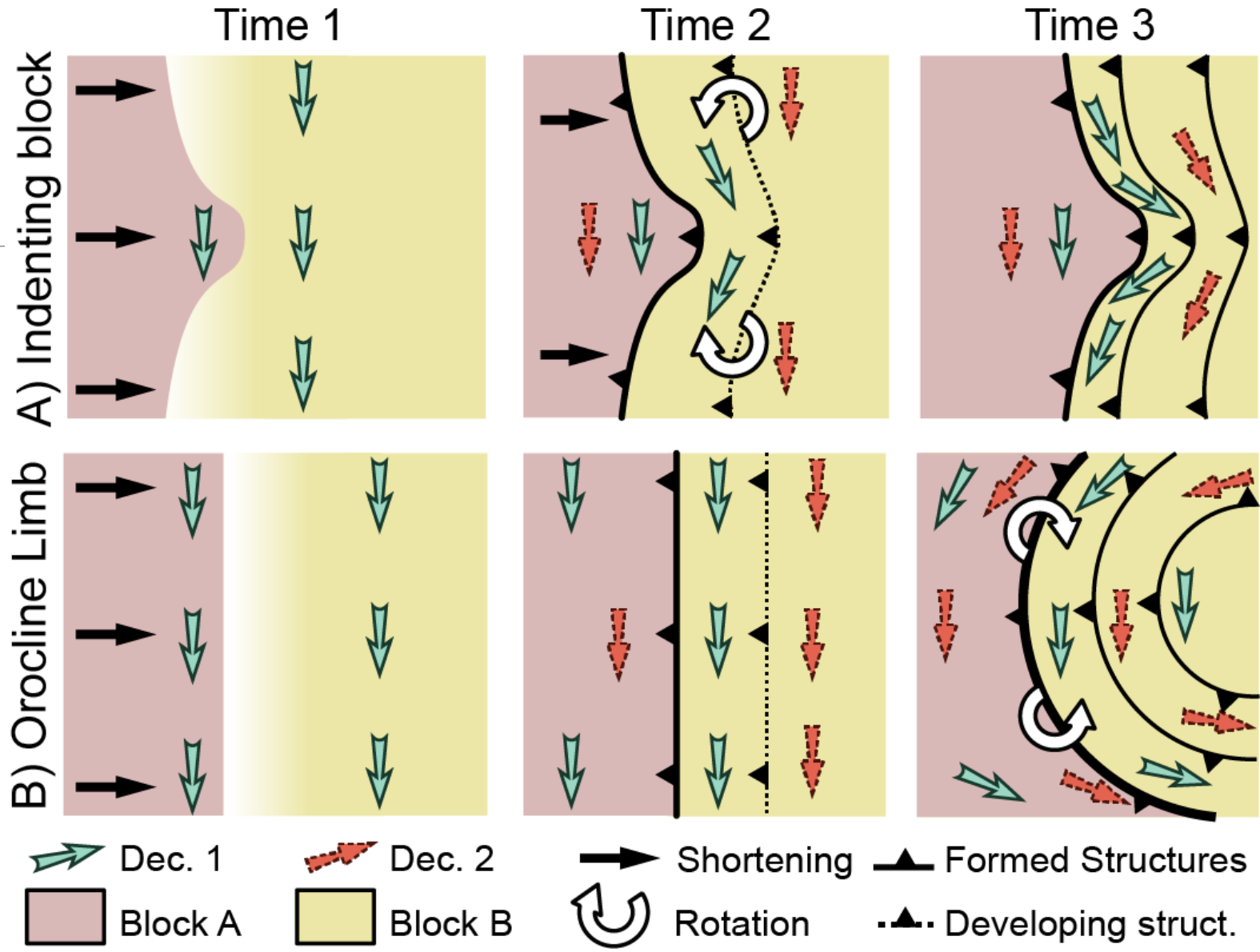
- A late Carboniferous 90º change in the stress field in relation to the collision, causes the full bending of the CO
- Expands the CO to affect both Avalonia and Gondwana, in a “Greater Cantabrian orocline”



Nature of SPZ

Way to test each model is a paleomagnetic study in SW Iberia

- A rigid Avalonian promontory will not have undergone rotations
- If it is part of the orocline limb, rotations will be coeval and of the same magnitude as remainder of Iberia

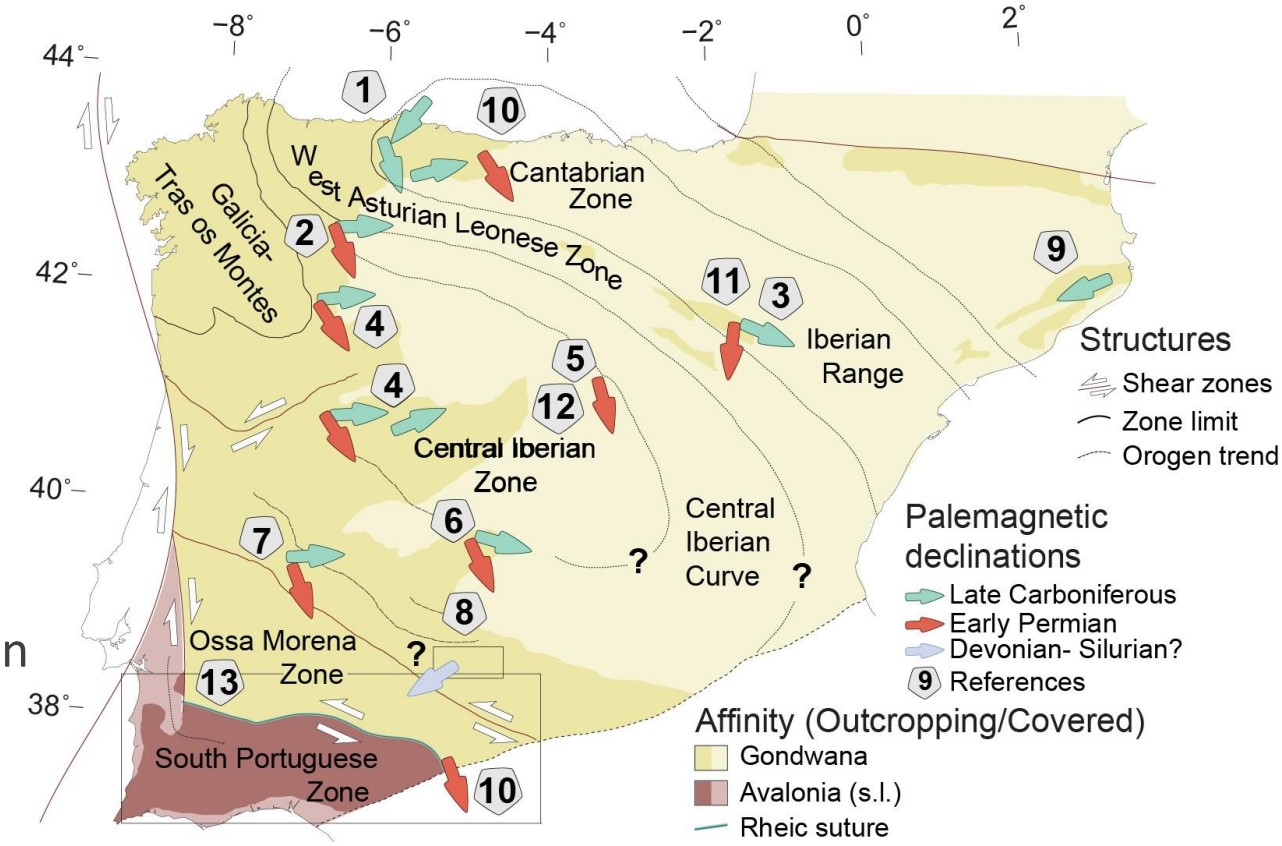


Paleomagnetism: How and why?

Paleomagnetism is a snapshot of the Earth's magnetic field

- It is independent of orogen structure
- Under normal circumstances will always point to the pole
- Rotations are recorded as discrepancies between observed directions, and pole-pointing directions

In the case of Iberia, the reference "pole-pointing" direction is the early Permian direction (in red).



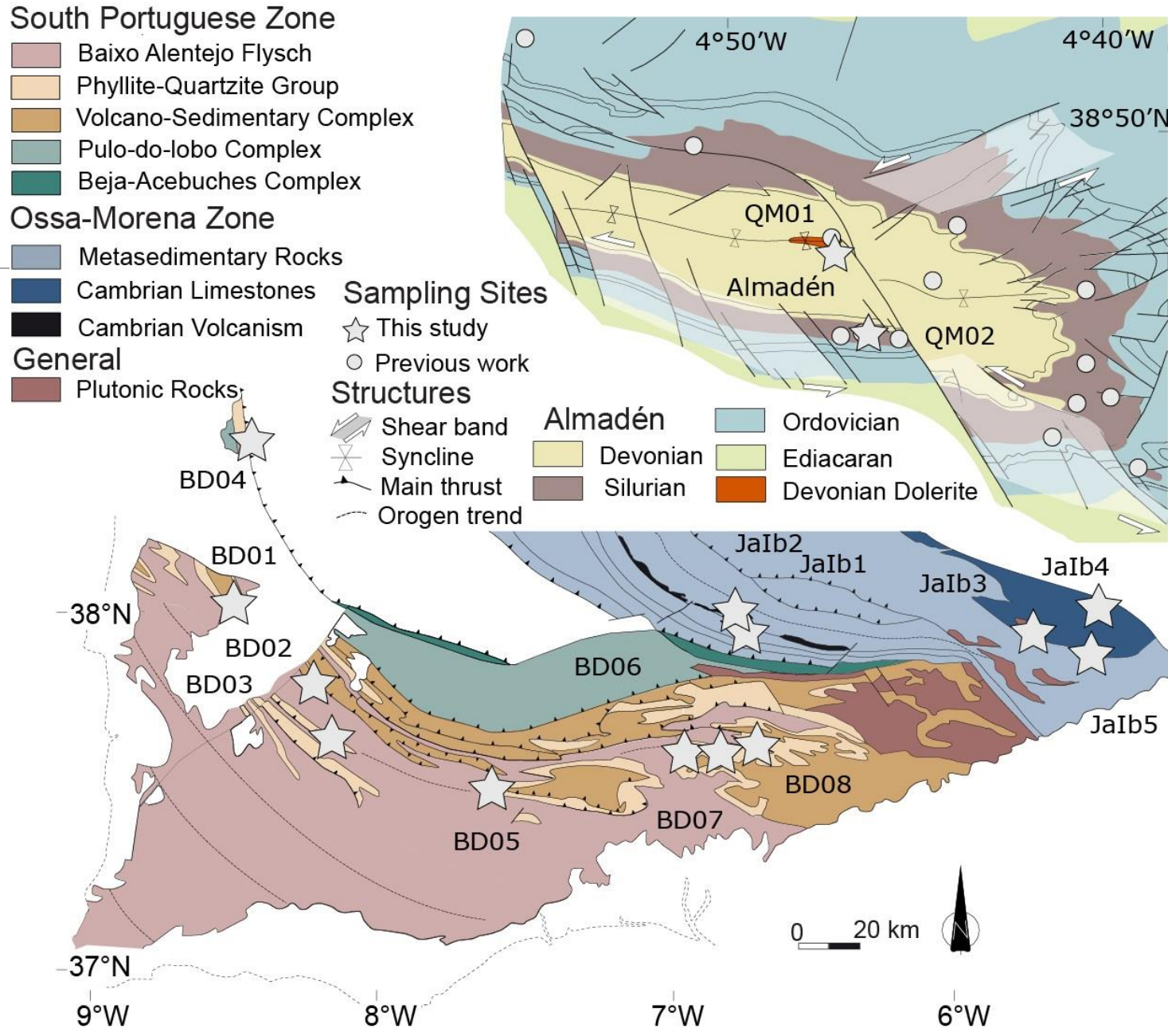
Sampling

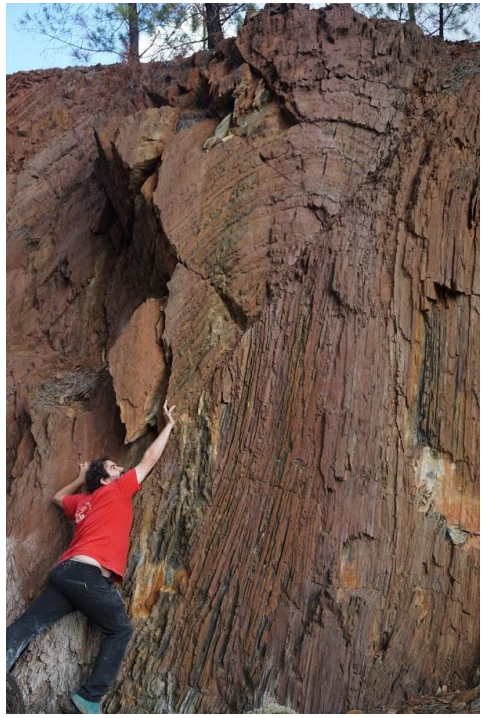
15 Sites

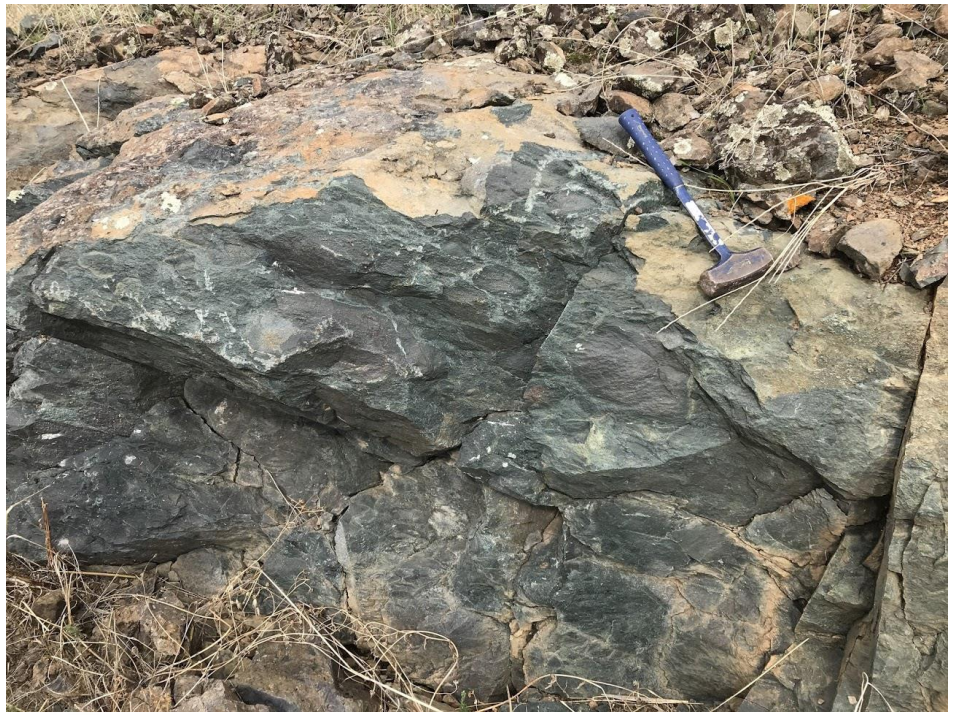
- 8 South Portuguese Zone
- 5 Ossa-Morena Zone
- 2 Central Iberian Zone
  - Almadén Syncline

429 Samples (standard cylindrical cores)

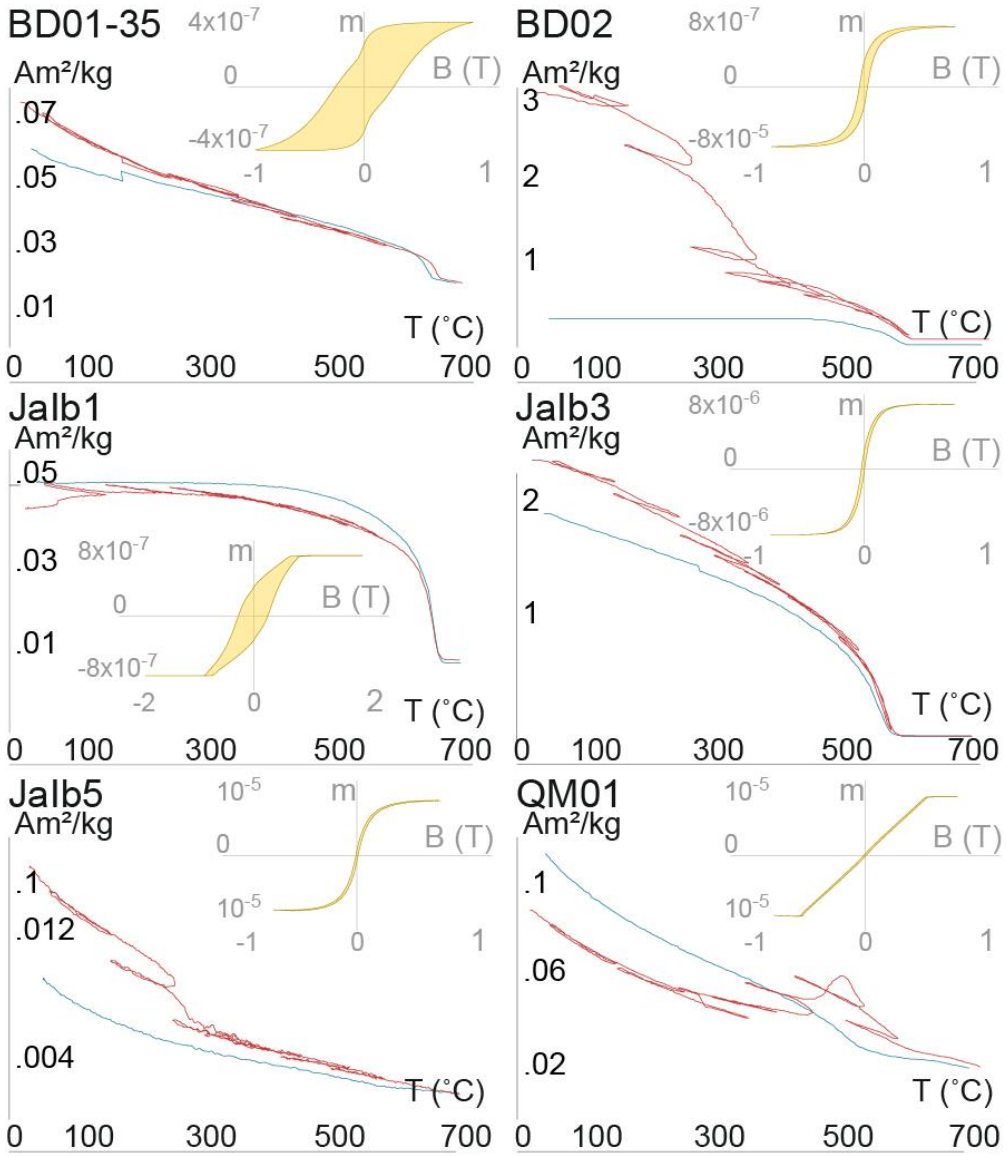
- 223 Basic lavas and acidic tuffs (BD series)
- 144 Cambrian lithologies (JaIb series)
- 90 Devonian dolerite + Silurian Tuff and lavas (QM Series)



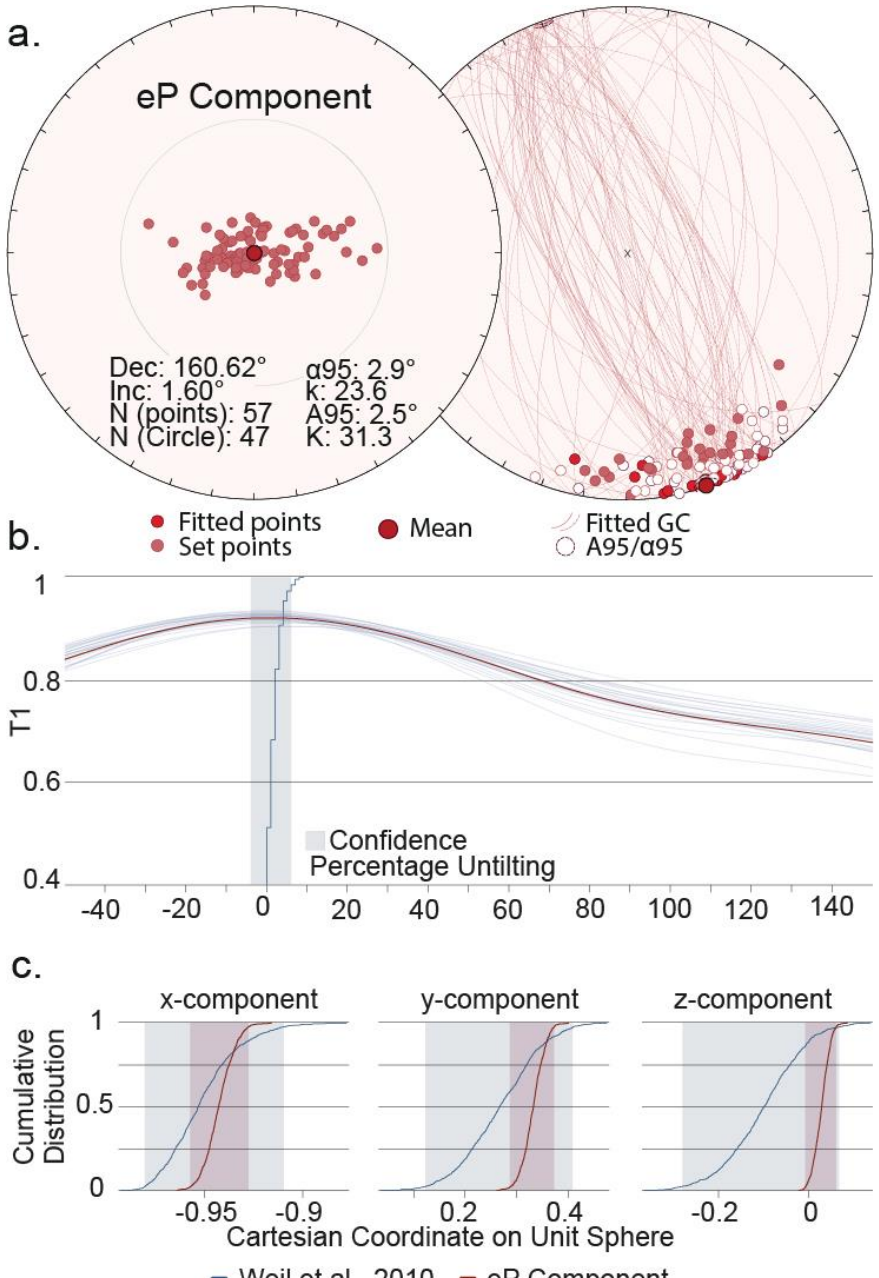


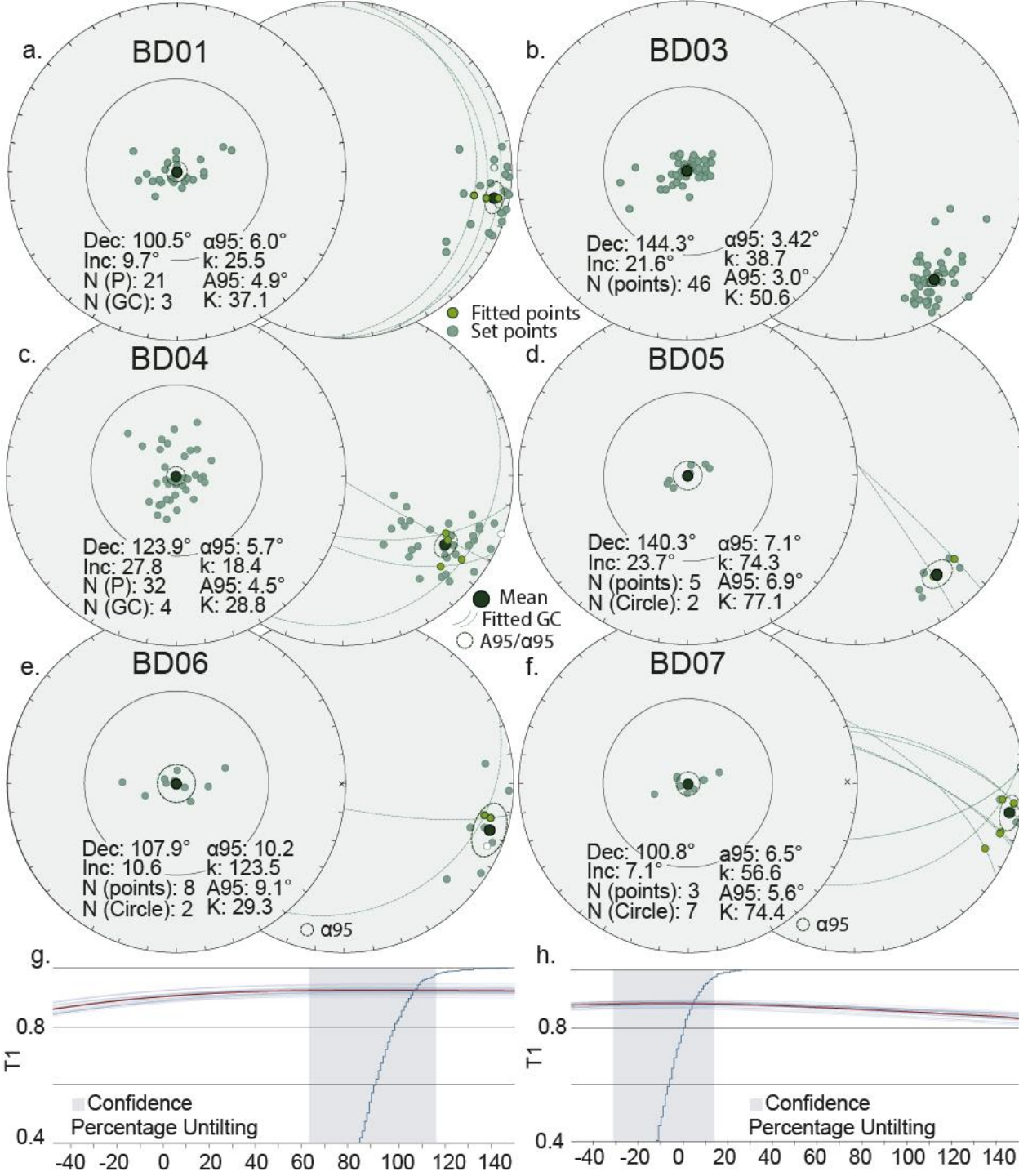


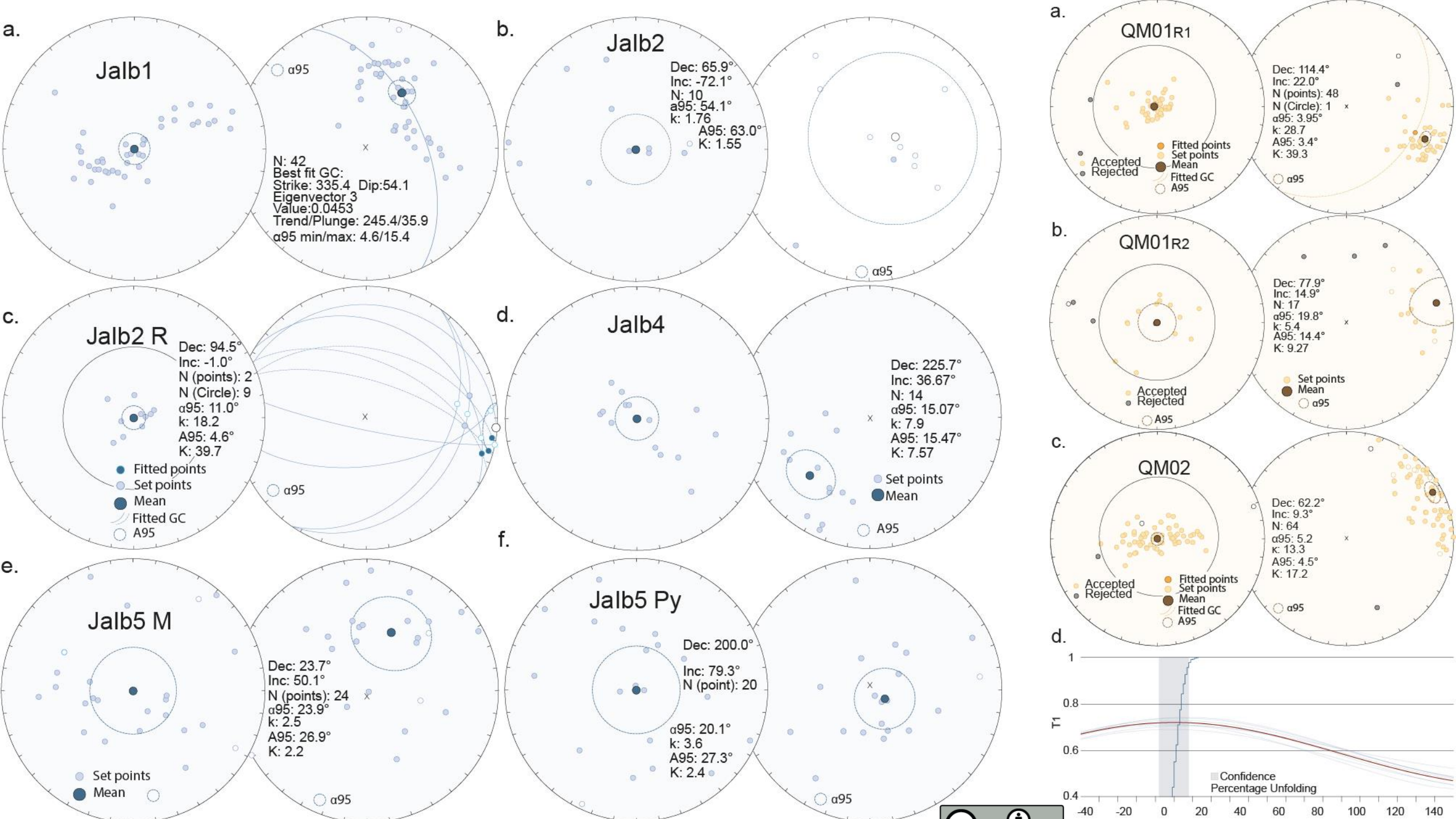
Results



Paleomagnetic Directions





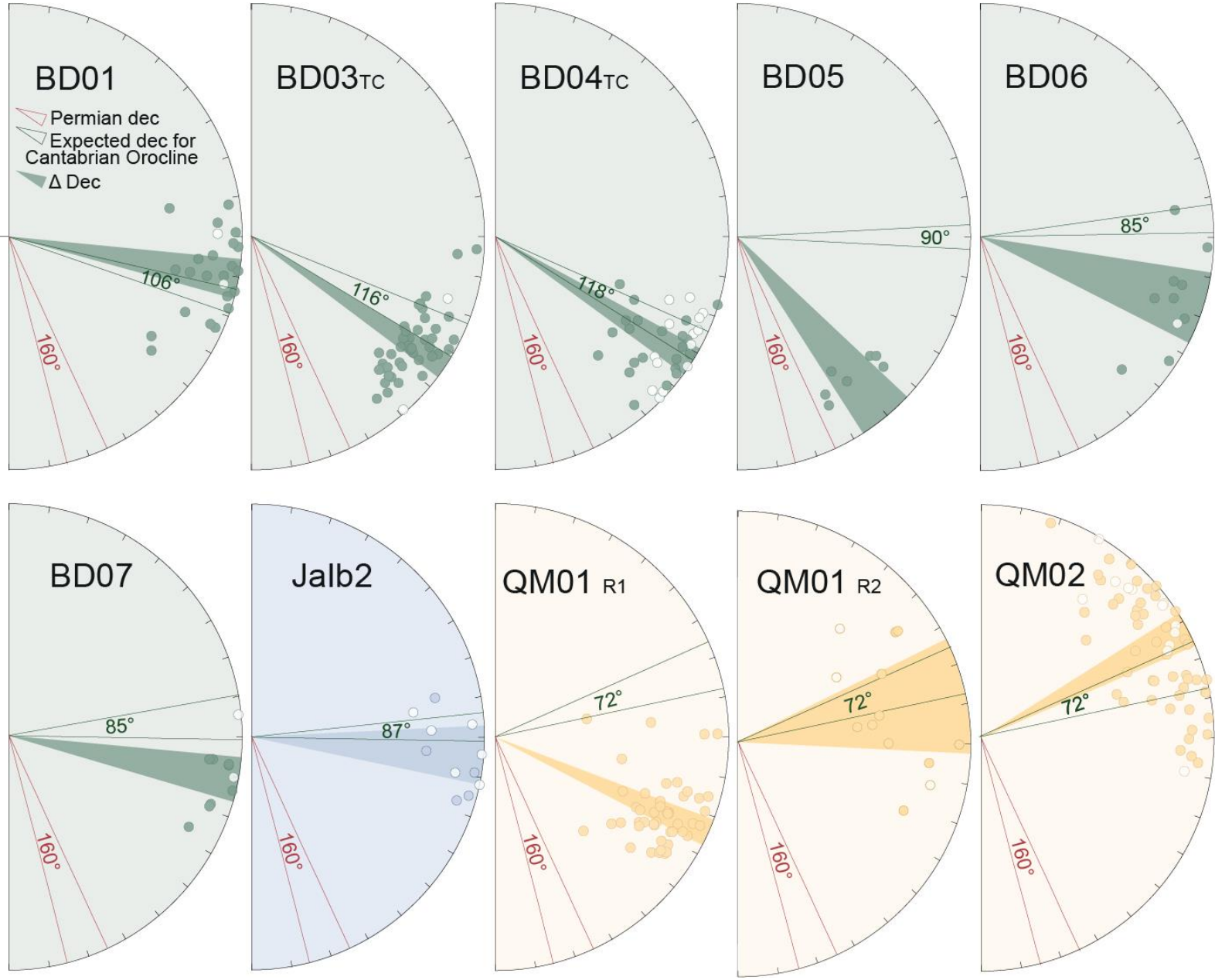

a.
Jalb1
α95
N: 42
Best fit GC:
Strike: 335.4 Dip:54.1
Eigenvector 3
Value:0.0453
Trend/Plunge: 245.4/35.9
α95 min/max: 4.6/15.4
b.
Jalb2
Dec: 65.9°
Inc: -72.1°
N: 10
a95: 54.1°
k: 1.76
A95: 63.0°
K: 1.55
α95
c.
Jalb2 R
Dec: 94.5°
Inc: -1.0°
N (points): 2
N (Circle): 9
α95: 11.0°
k: 18.2
A95: 4.6°
K: 39.7
Fitted points
Set points
Mean
Fitted GC
A95
α95
d.
Jalb4
Dec: 225.7°
Inc: 36.67°
N: 14
α95: 15.07°
k: 7.9
A95: 15.47°
K: 7.57
Set points
Mean
A95
e.
Jalb5 M
Dec: 23.7°
Inc: 50.1°
N (points): 24
α95: 23.9°
k: 2.5
A95: 26.9°
K: 2.2
Set points
Mean
α95
f.
Jalb5 Py
Dec: 200.0°
Inc: 79.3°
N (point): 20
α95: 20.1°
k: 3.6
A95: 27.3°
K: 2.4
α95
a.
QM01R1
Fitted points
Set points
Mean
Fitted GC
A95
Accepted
Rejected
Dec: 114.4°
Inc: 22.0°
N (points): 48
N (Circle): 1
α95: 3.95°
k: 28.7
A95: 3.4°
K: 39.3
α95
b.
QM01R2
Accepted
Rejected
A95
Dec: 77.9°
Inc: 14.9°
N: 17
α95: 19.8°
k: 5.4
A95: 14.4°
K: 9.27
Set points
Mean
α95
c.
QM02
Accepted
Rejected
Fitted points
Set points
Mean
Fitted GC
A95
Dec: 62.2°
Inc: 9.3°
N: 64
α95: 5.2
κ: 13.3
A95: 4.5°
K: 17.2
α95
d.
T1
1
0.8
0.6
0.4
Confidence
Percentage Unfolding
-40
-20
0
20
40
60
80
100
120
140

Orocline limb?

R component records late carboniferous CCW rotations in SW Iberia

- We compared the observed declinations with expected declinations using an Orocline test

- CCW rotations coeval and of same magnitude of CO

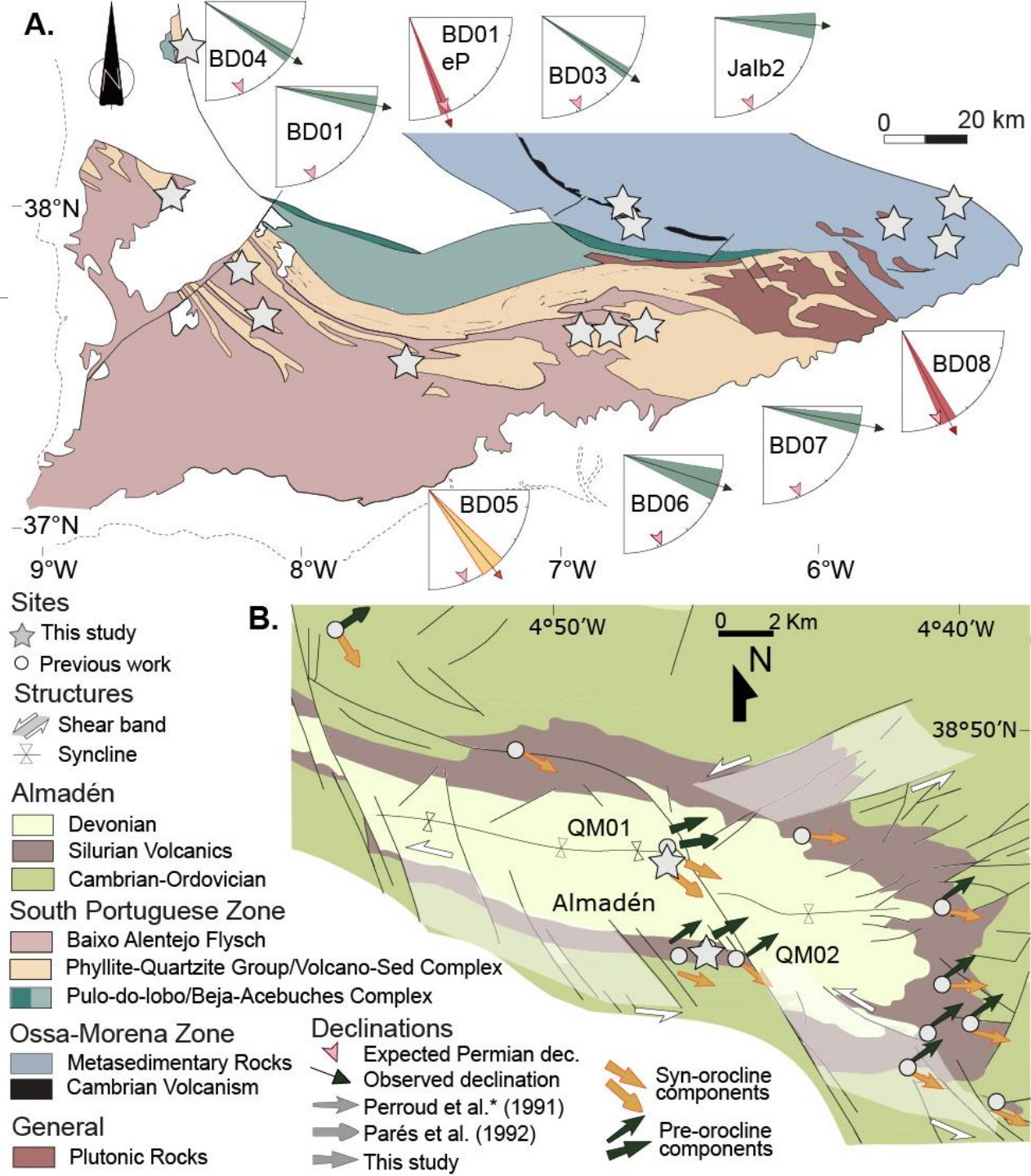


Kinematic Implications

CCW rotations in SW Iberia discard the “Rigid Indenter” hypothesis as the driving mechanism for the formation of the CO

Cantabrian Orocline extended into both Gondwana and Laurussia

No evidence of clockwise rotations in Central Iberia



Conclusions

Conclusions

Two re-magnetization events in SW-Iberia

- Late Carboniferous
- Early Permian

SW Iberia rotated 30º - 90º CCW during late carboniferous

- These rotations are coeval and of the same magnitude as the Cantabrian Orocline's south Limb
- Discards the Rigid indenter hypothesis for the formation of the Cantabrian Orocline.

We confirm the Greater Cantabrian Orocline hypothesis, formed through transcontinental orocline formation.

Central Iberian curve did not form coeval with Cantabrian Orocline