Champ de déformation du socle paléozoïque des Pyrénées

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Encadrement

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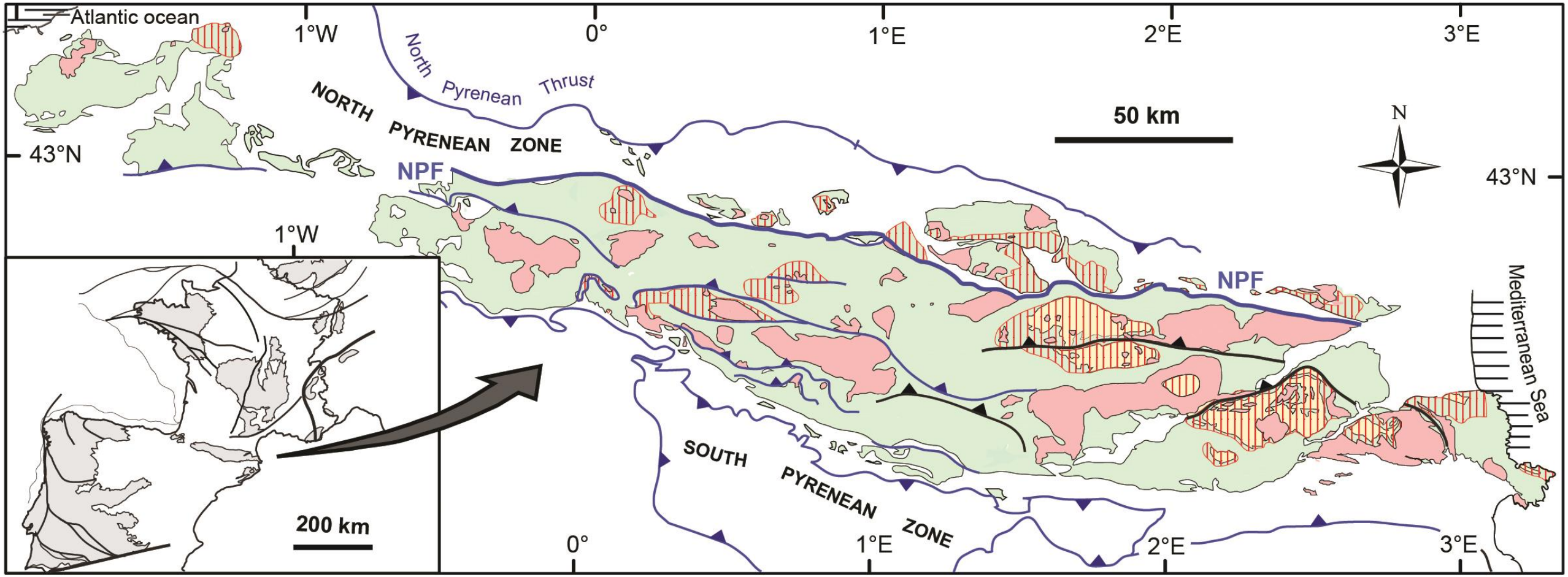
Charles Gumiaux **Benjamin Le Bayon**

Le socle paléozoïque des Pyrénées



Que reflète le **contraste structural** entre Infrastructure et Superstructure ?

Quel contexte **tectonique** et **géodynamique** ?
Quelle **position** pour les Pyrénées dans la chaîne varisque ?

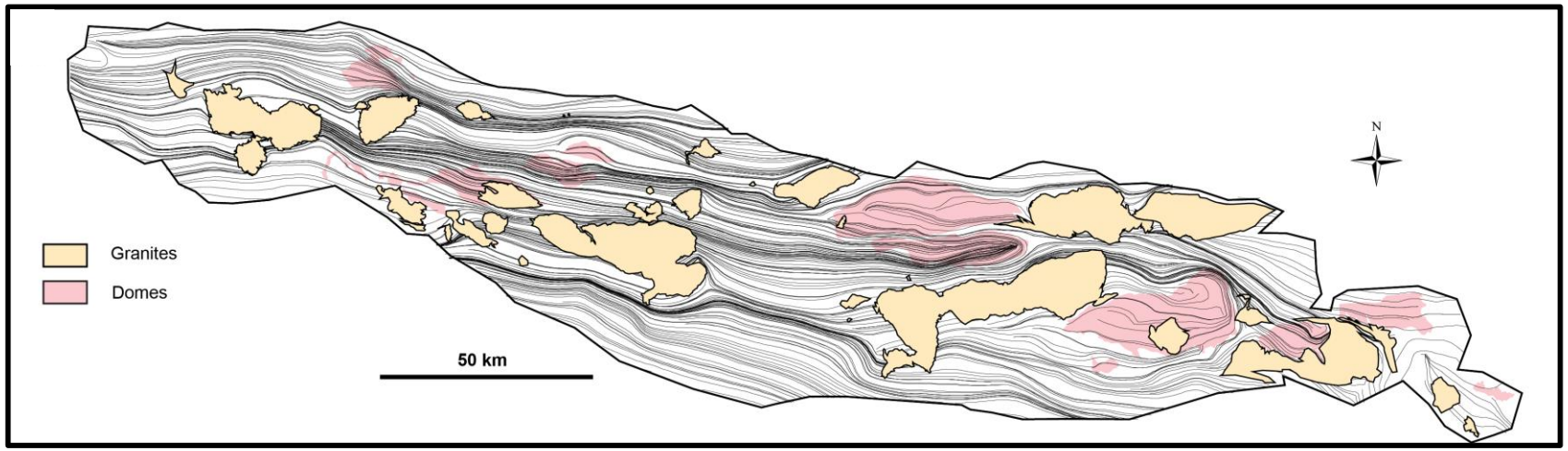
Impact des **déformations alpines** ?

Principaux résultats

- Nouvelles données structurales (6 mois de terrain)
- Base de données structurale harmonisée

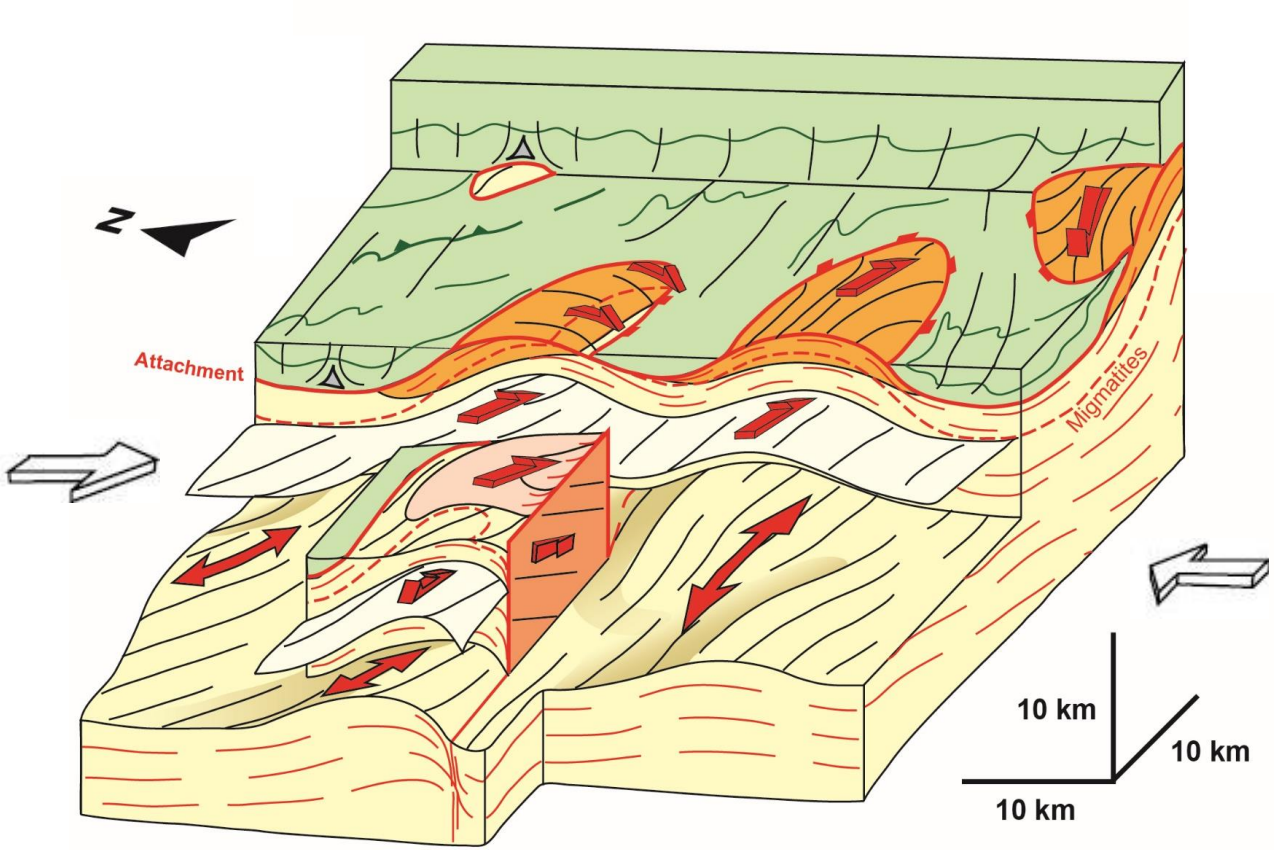
- Champ de déformation

- Analyse quantitative (géostatistiques)

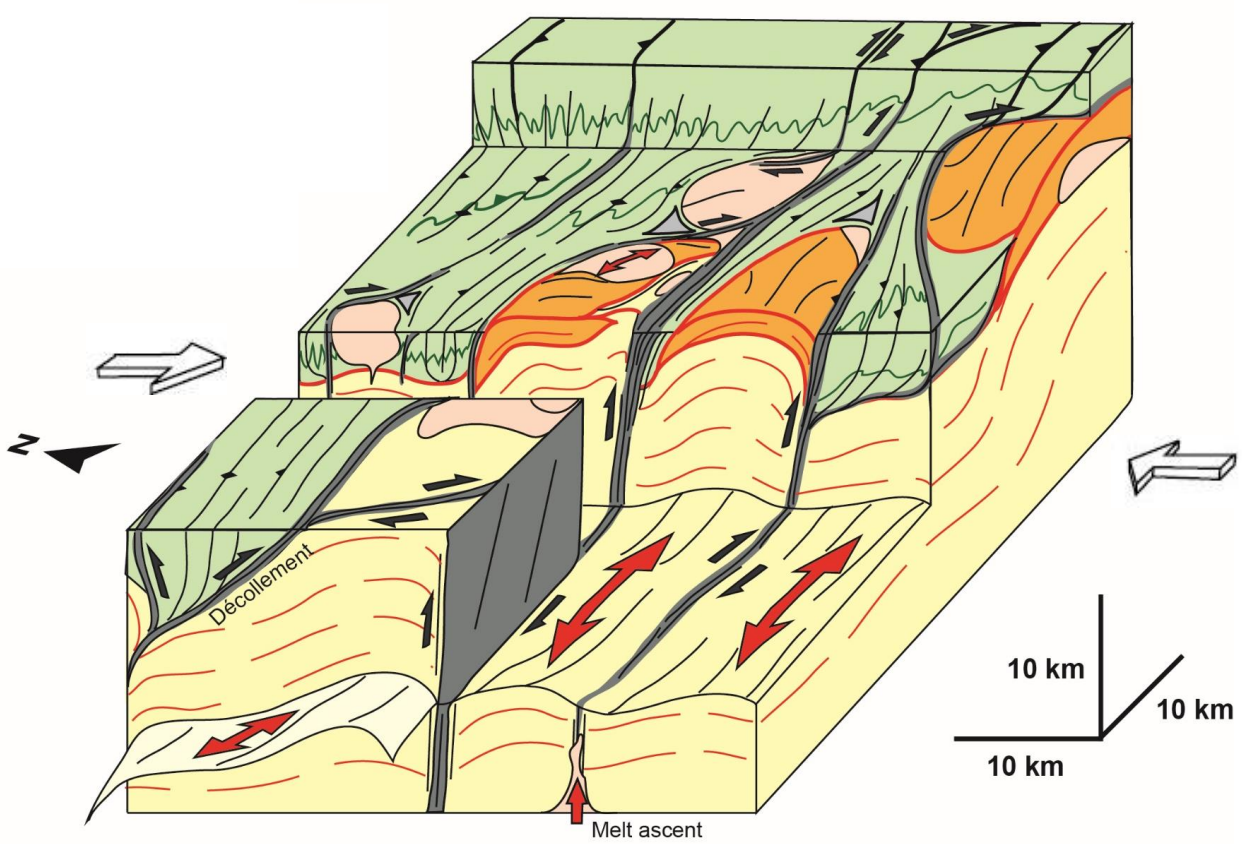


Modèle tectonique

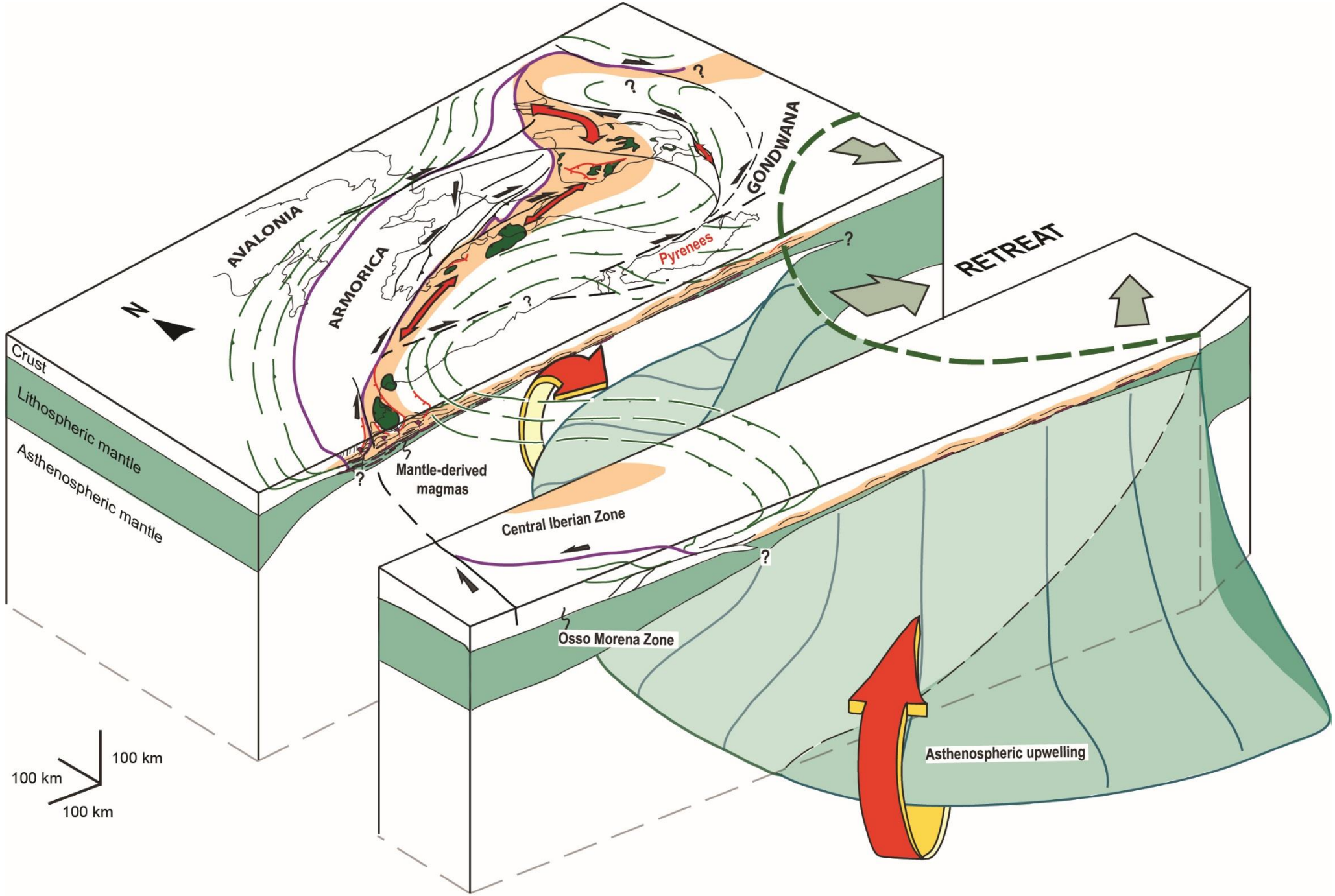
Initiation de la transpression (310 Ma)



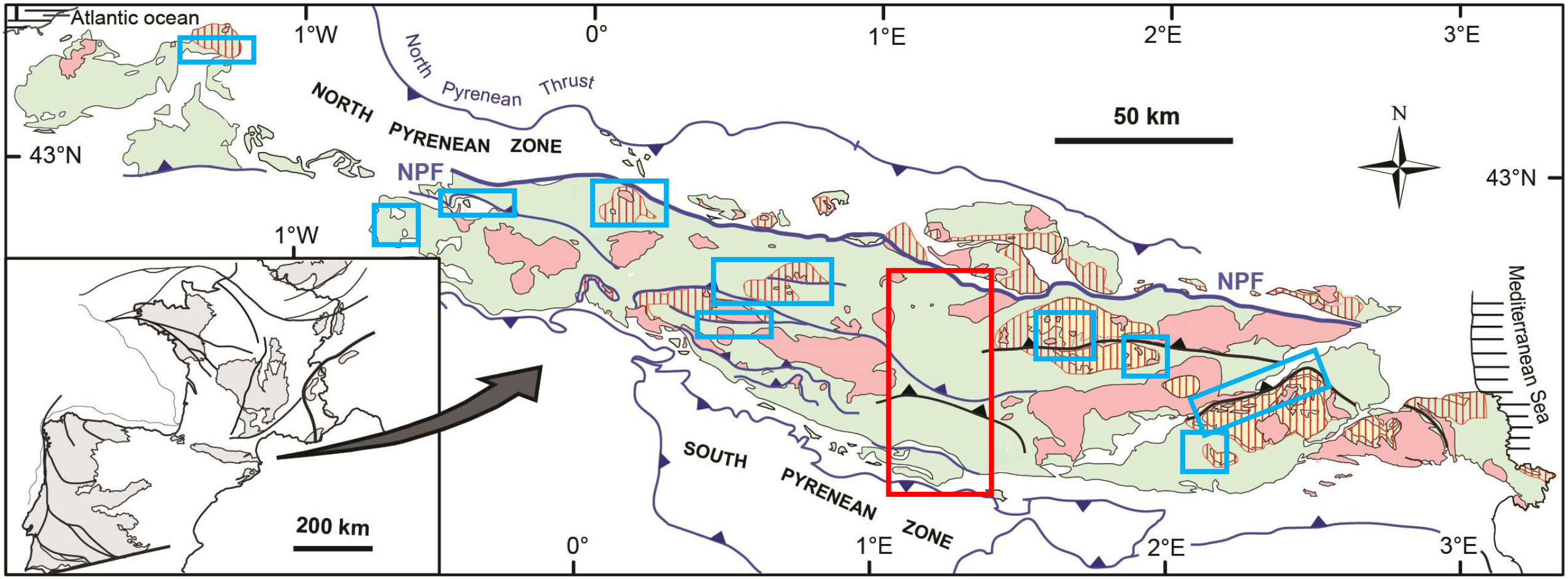
Paroxysme de la transpression (300-290 Ma)



REFROIDISSEMENT DE LA CROÛTE

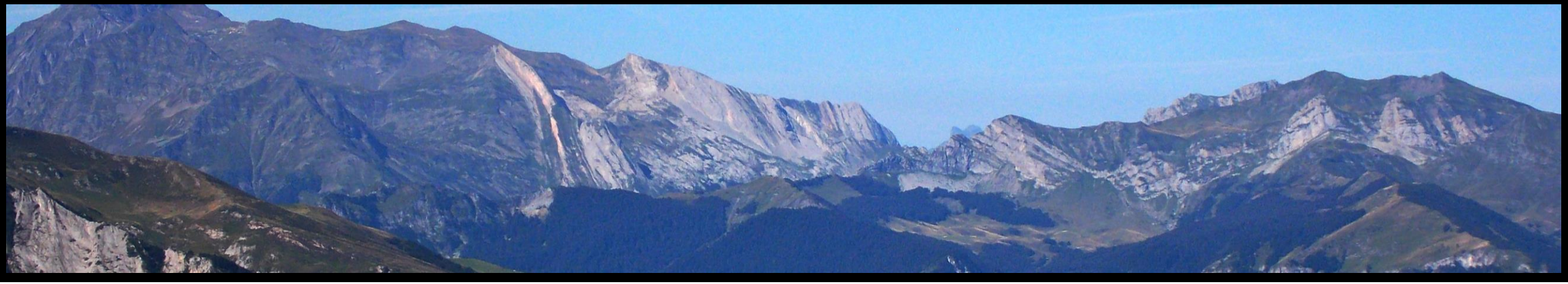

AVALONIA
ARMORICA
GONDWANA
Pyrenees
RETREAT
N
Crust
Lithospheric mantle
Asthenospheric mantle
Mantle-derived magmas
Central Iberian Zone
Osso Morena Zone
Asthenospheric upwelling
100 km
100 km
100 km

Les Pyrénées Centrales



Une géologie particulièrement simple: absence de dôme et plutons → Signal de 1er ordre

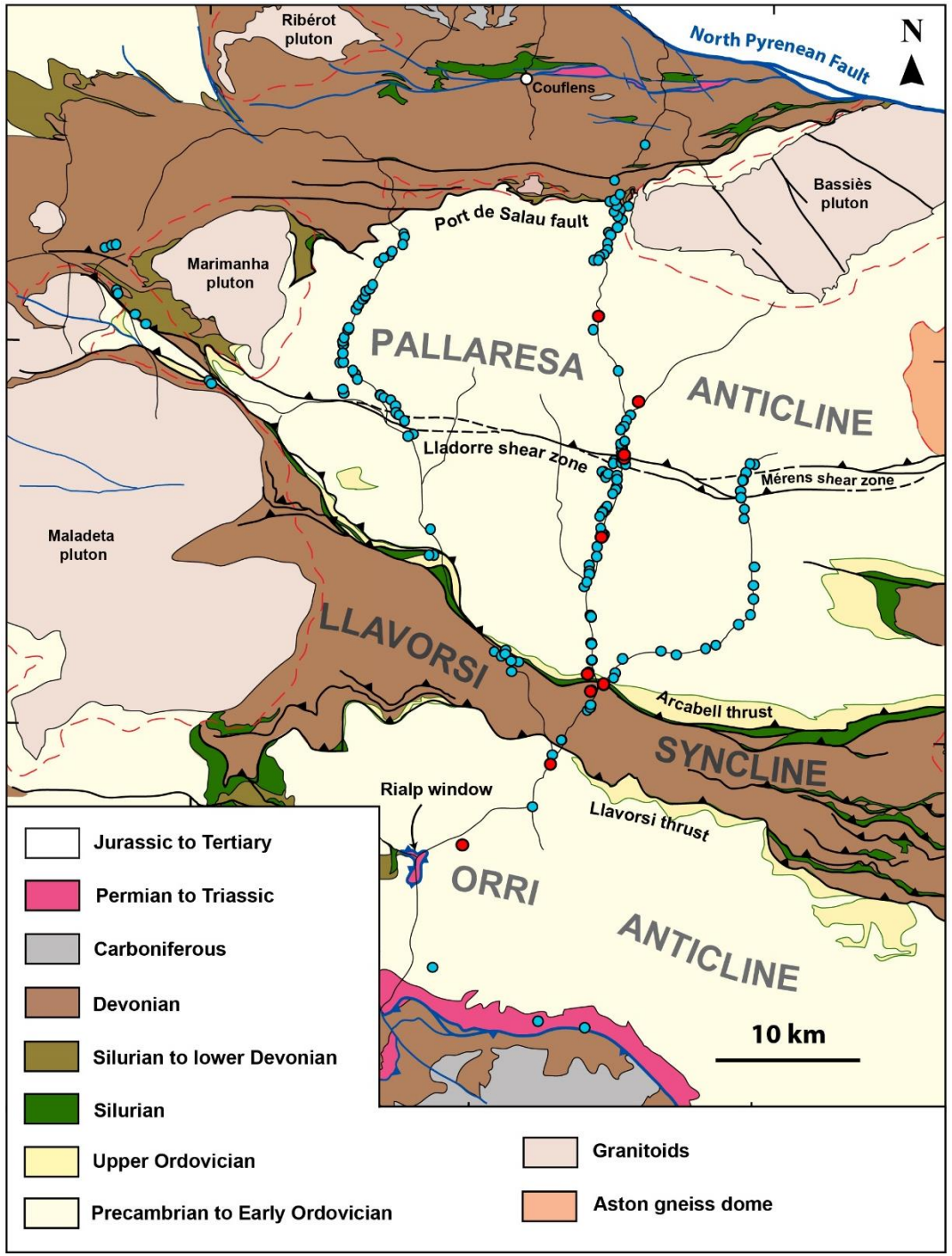
Lieu parfait pour discuter du rôle de l'héritage dans une chaîne de montagne



Long-to-short term structural inheritance in orogens:

Variscan to Alpine evolution of the Pyrenean Axial Zone

B. Cochelin, B. Lemirre, Y. Denèle, M. de St Blanquat, A. Lahfid, S. Duchêne

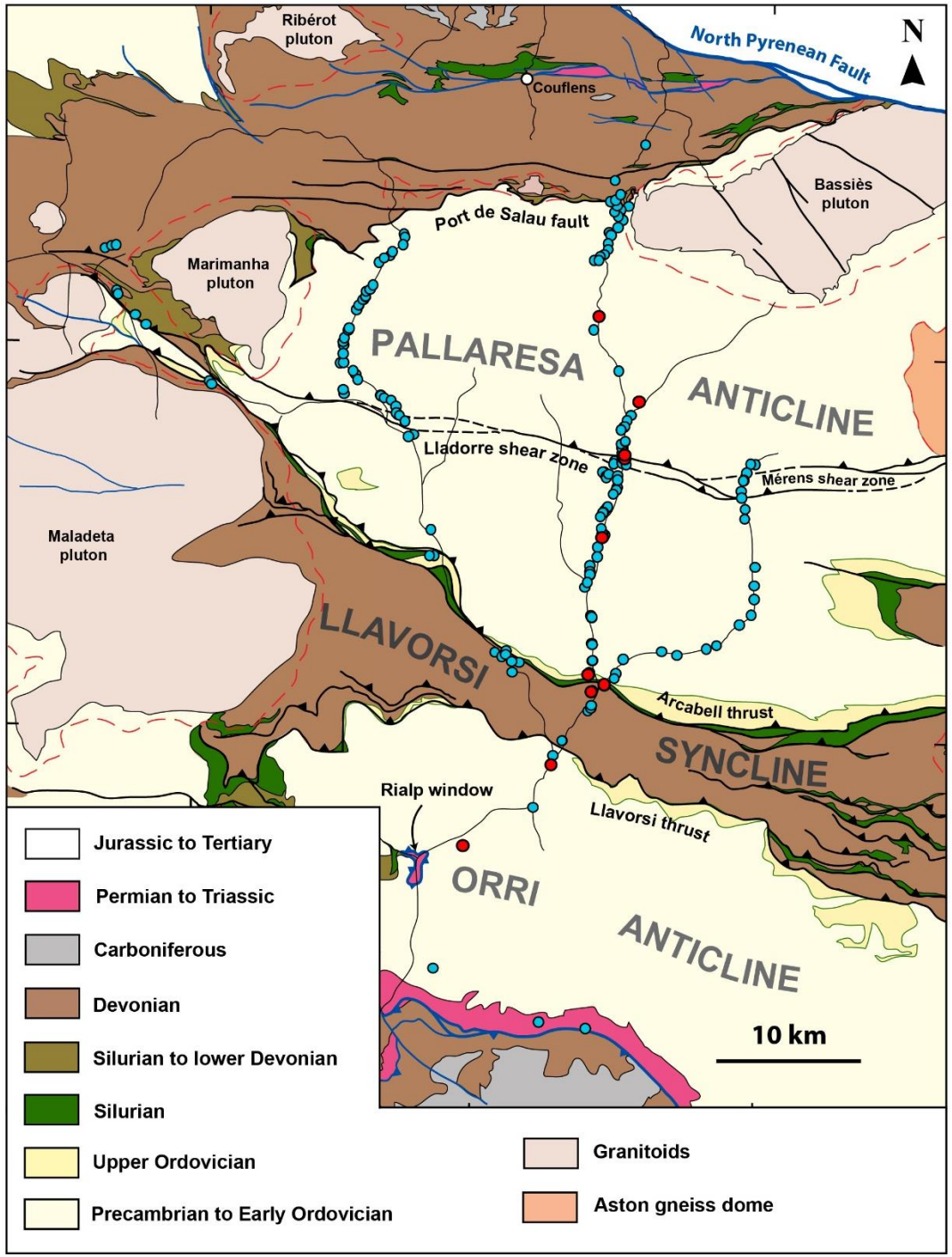


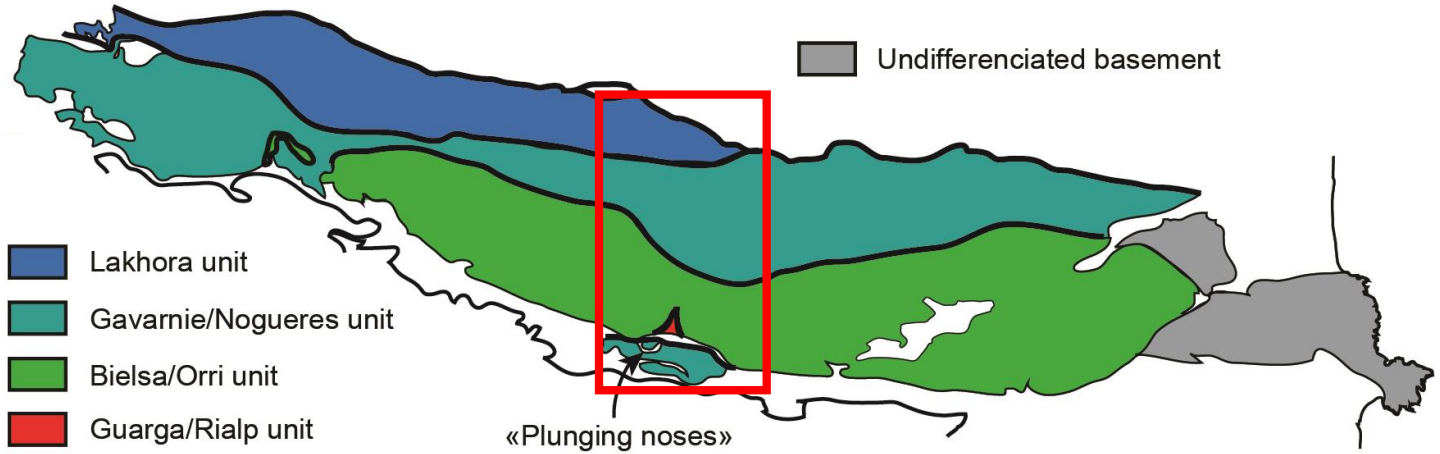
La zone d'étude

Succession de synclinaux et anticlinaux

De nombreuses failles et zones de cisaillement régionales

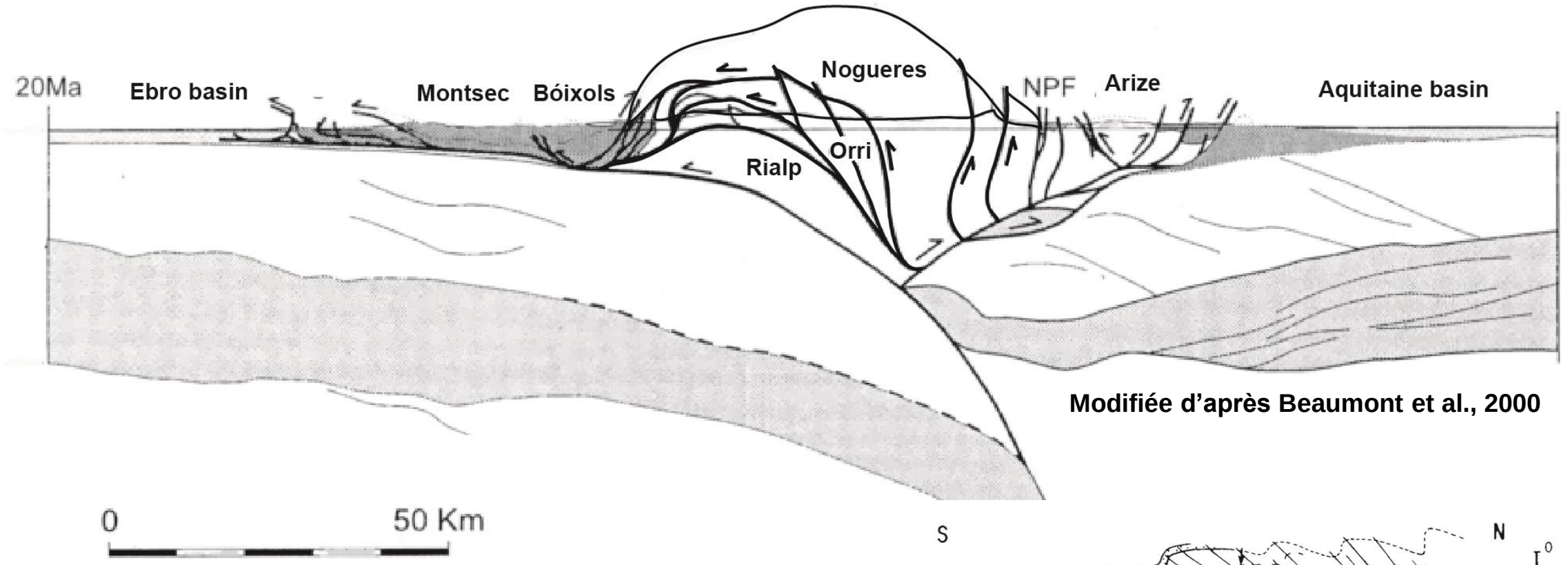
Varisques? Crétacées? Pyrénéennes? Un peu des trois?





D’un point de vue pyrénéen… Quatre unités tectoniques

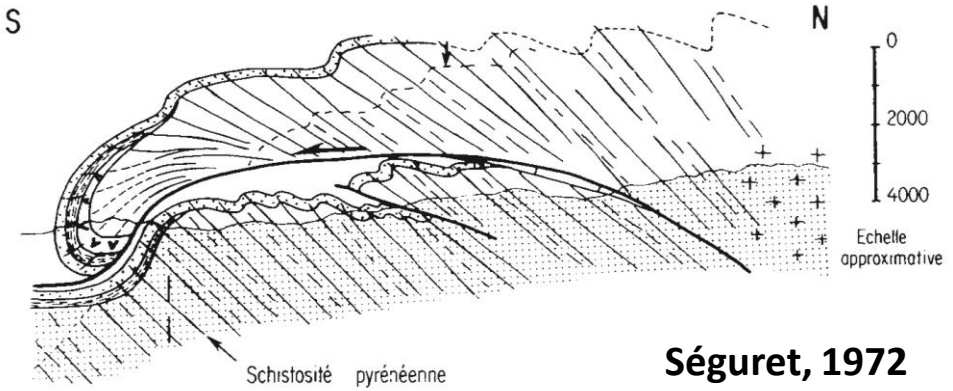
La chaîne pyrénéenne



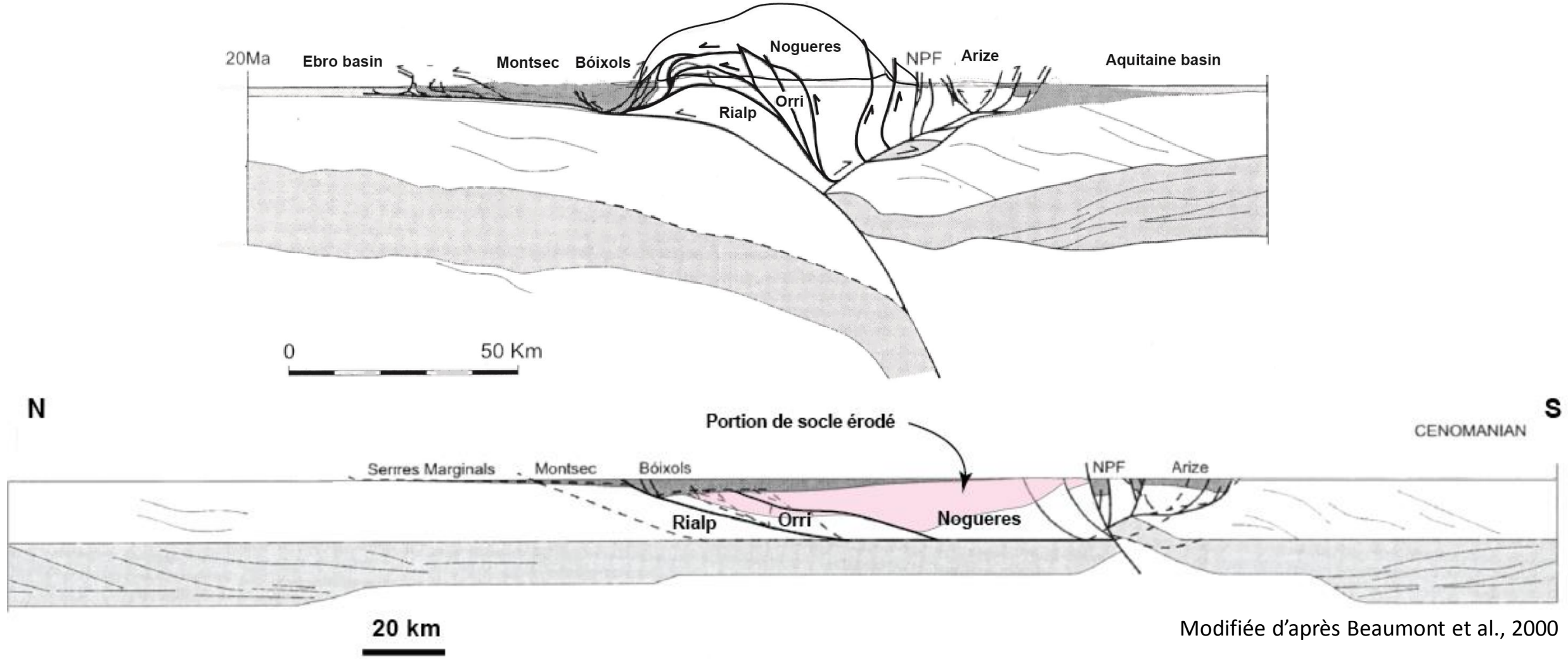
Modifiée d'après Beaumont et al., 2000

Empilement de nappes crustales

Formation de « Têtes plongeantes » allochtones



Séguret, 1972



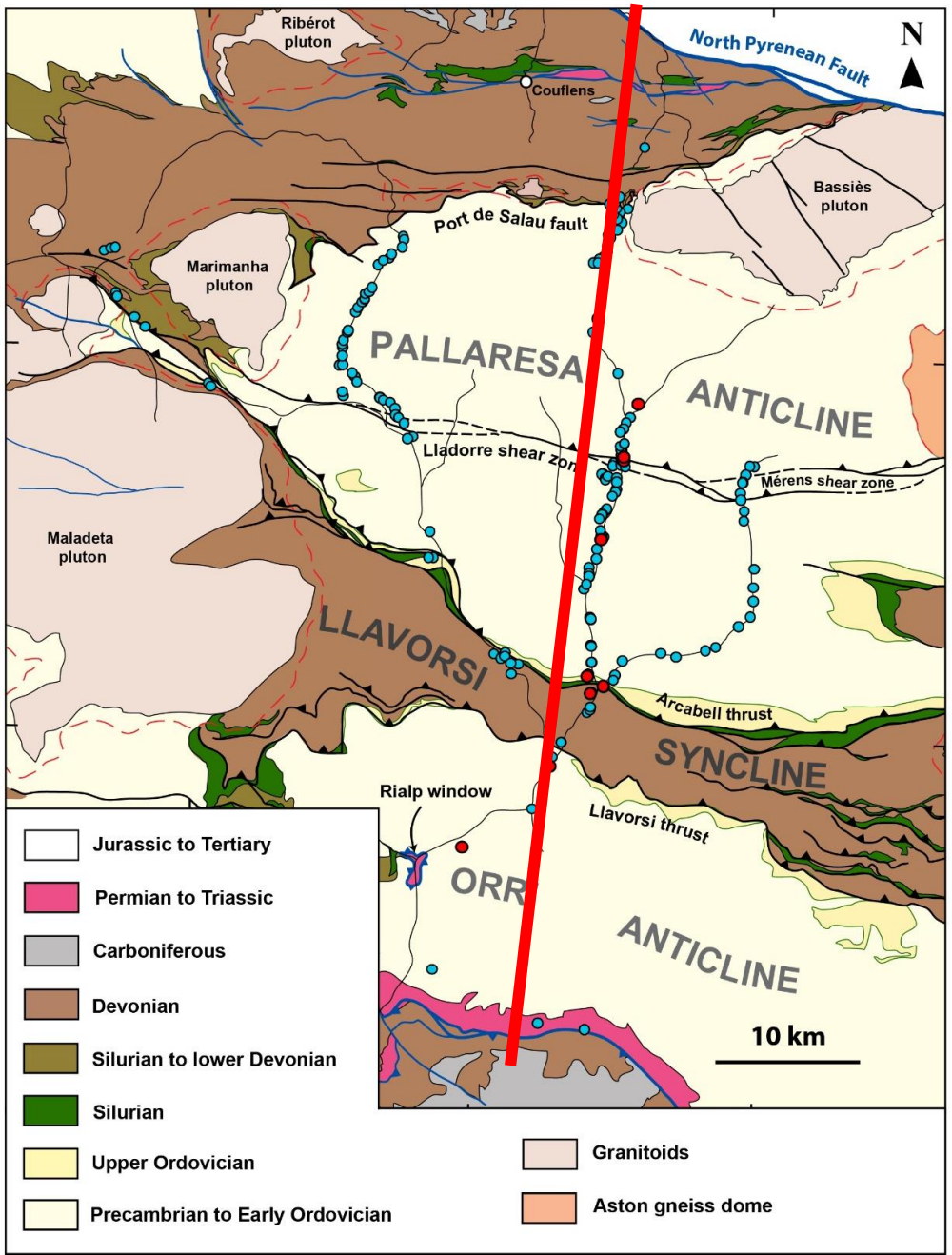
Modifiée d'après Beaumont et al., 2000

Implications:

- Discontinuités nettes dans le socle
- Rotation de blocs
- Déformation interne intense (unité de Nogueres)
- Un accès à la croûte moyenne-inférieure?

Etude structurale

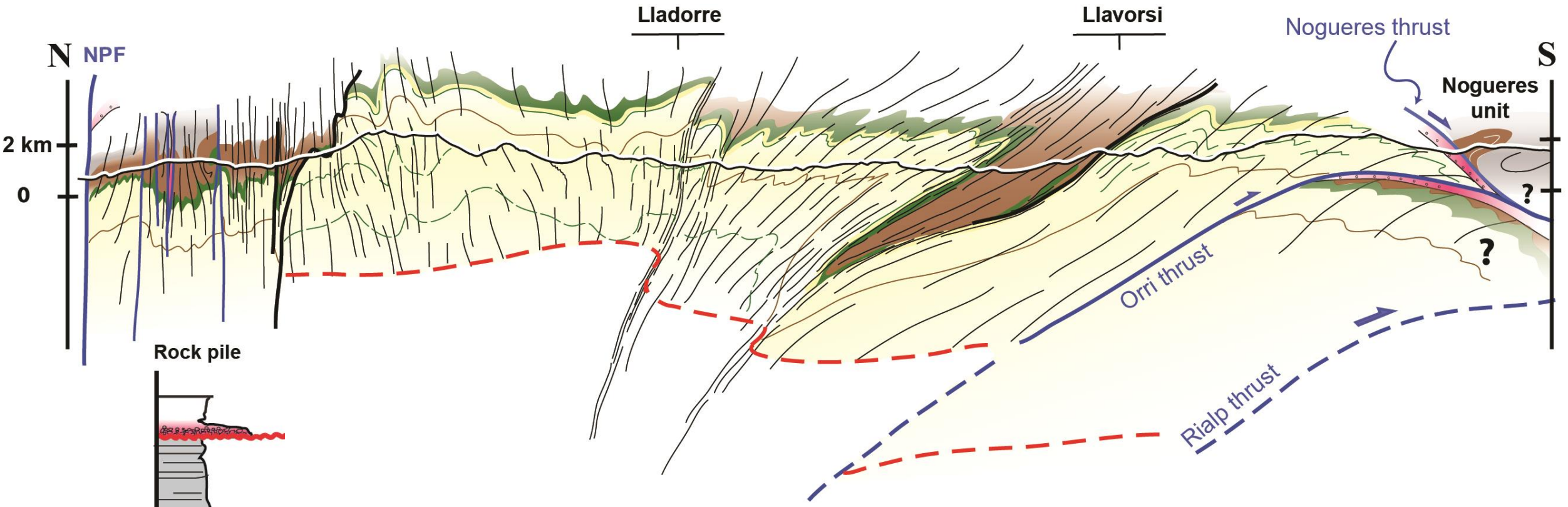
Etude structurale

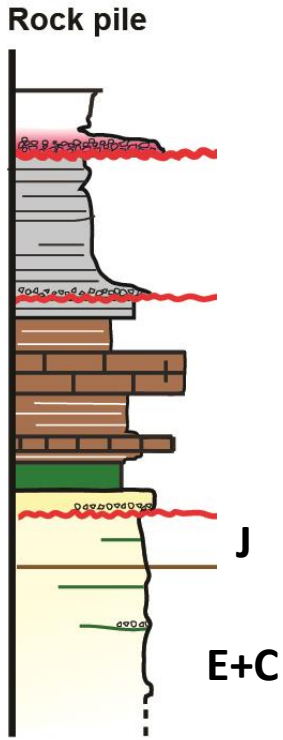


Une coupe construite à partir de nouvelles observations

- Relation S0/S1
- Critères de polarité
- Estimation qualitative de l'intensité de la déformation
- Reconnaissance des faciès

Etude structurale

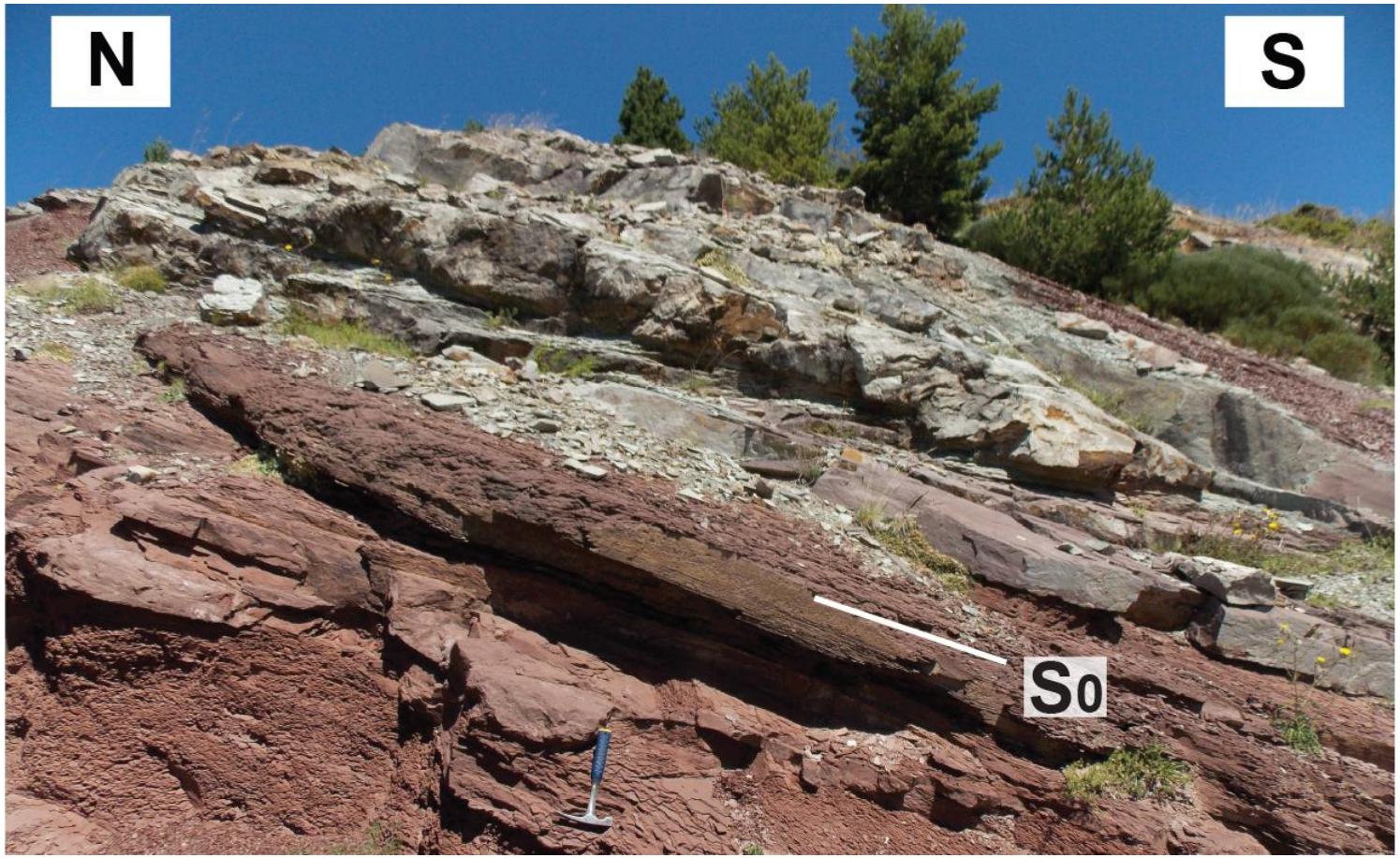




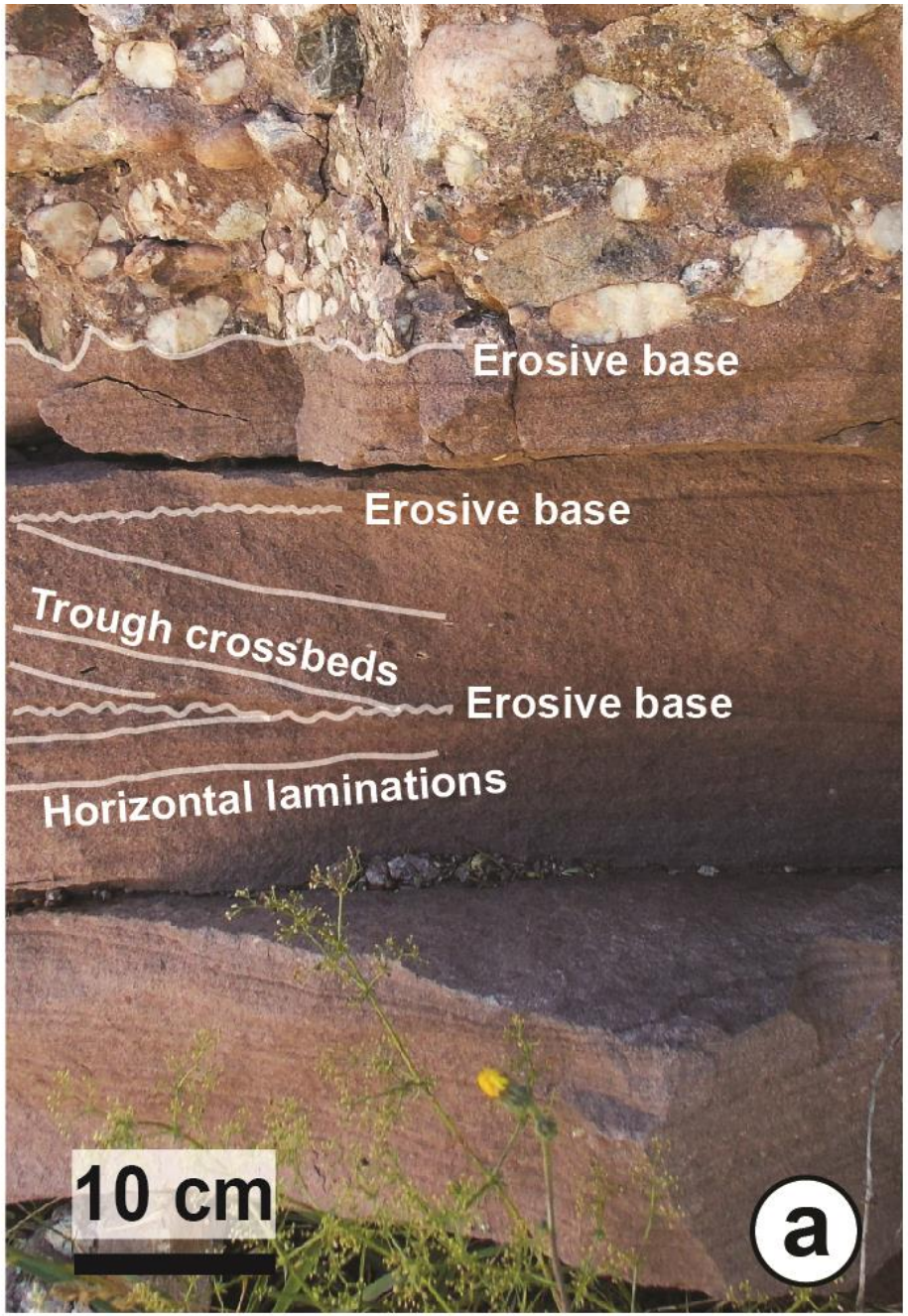
Plissement polyharmonique

Repères stratigraphiques relativement plats

Age des structures

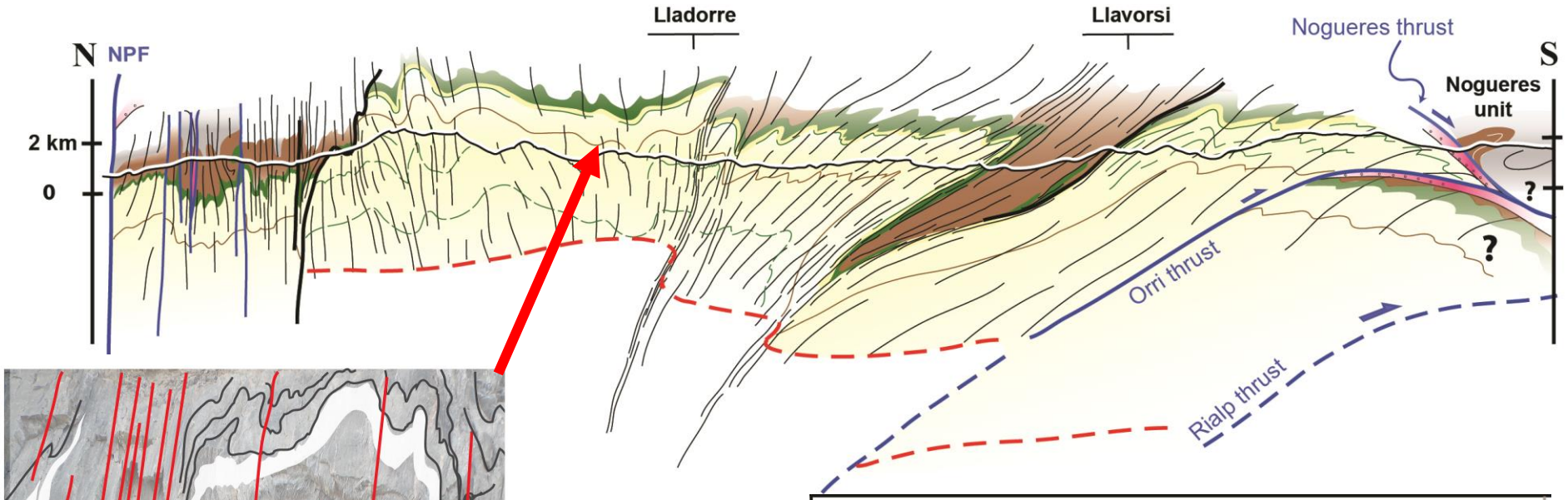


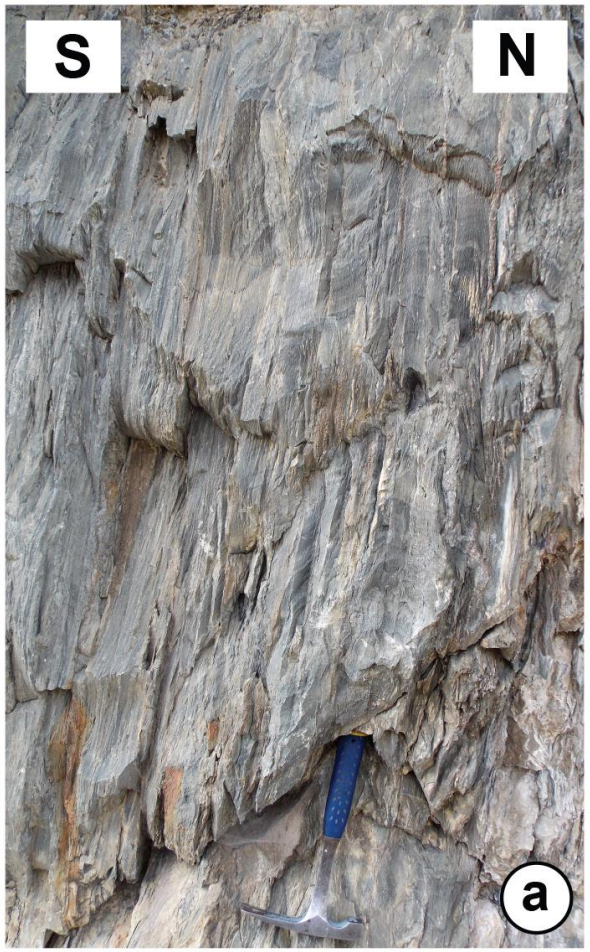
Trias (Port del Canto, Rubio)

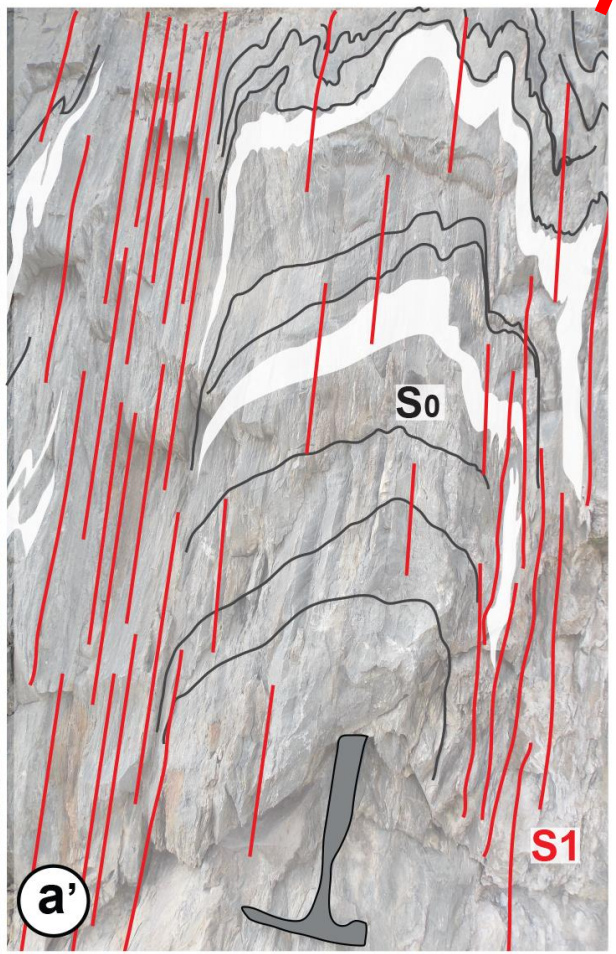


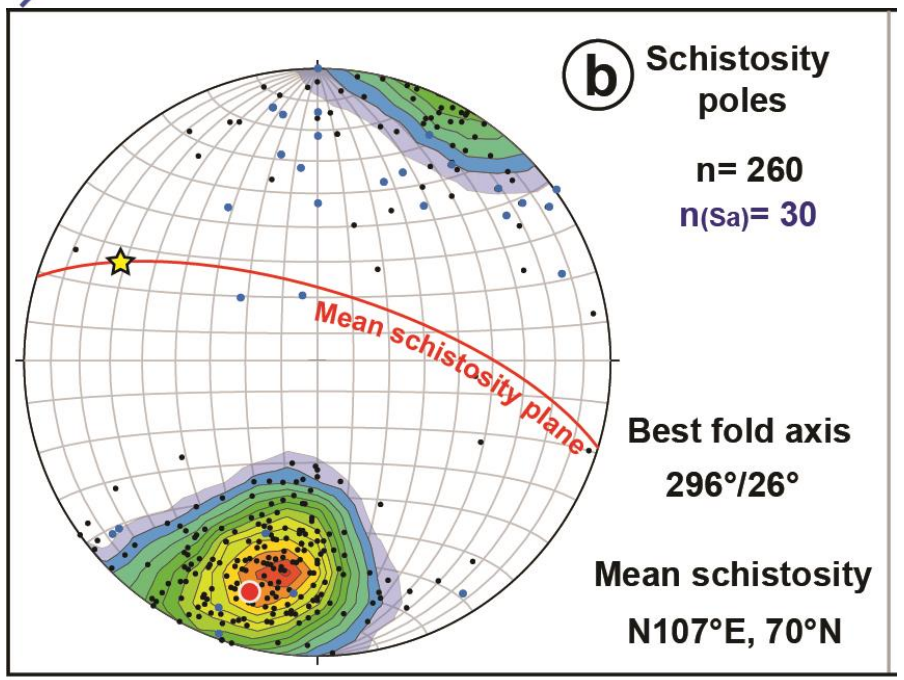
Permien (Port del Canto, Rubio)

Etude structurale

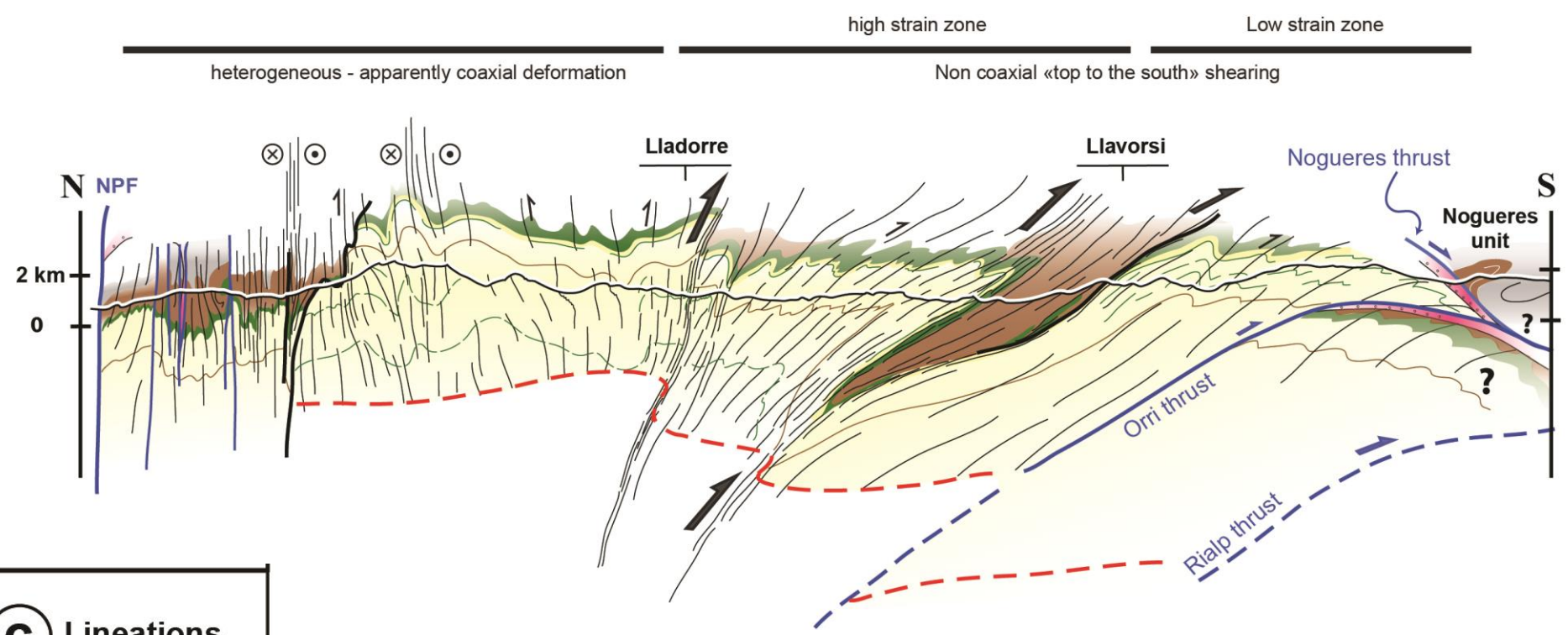


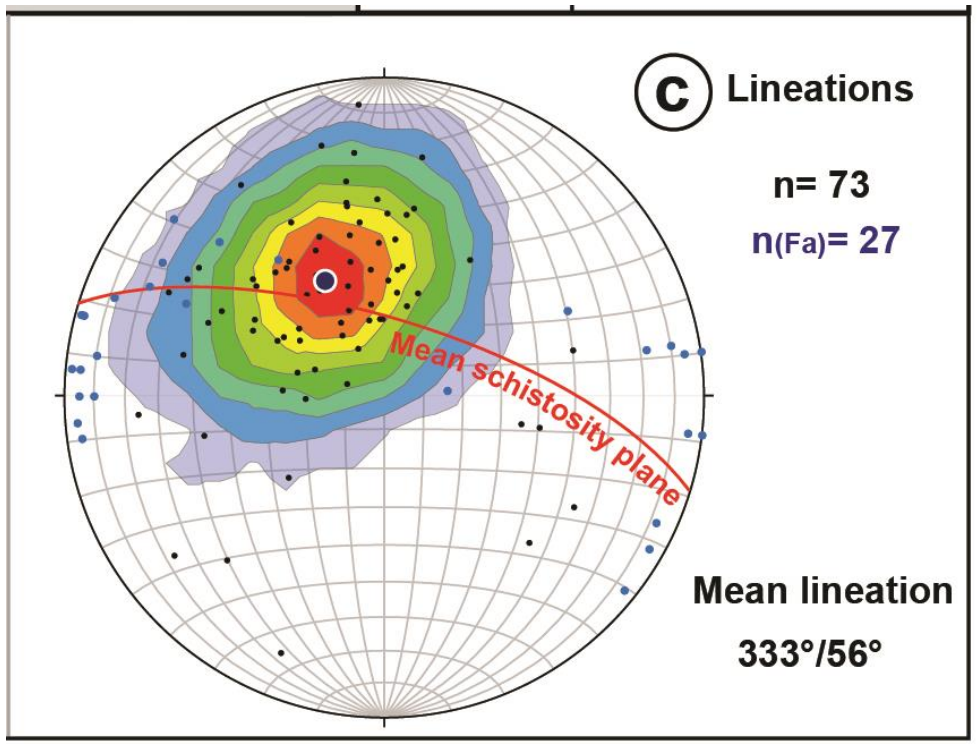






Etude structurale

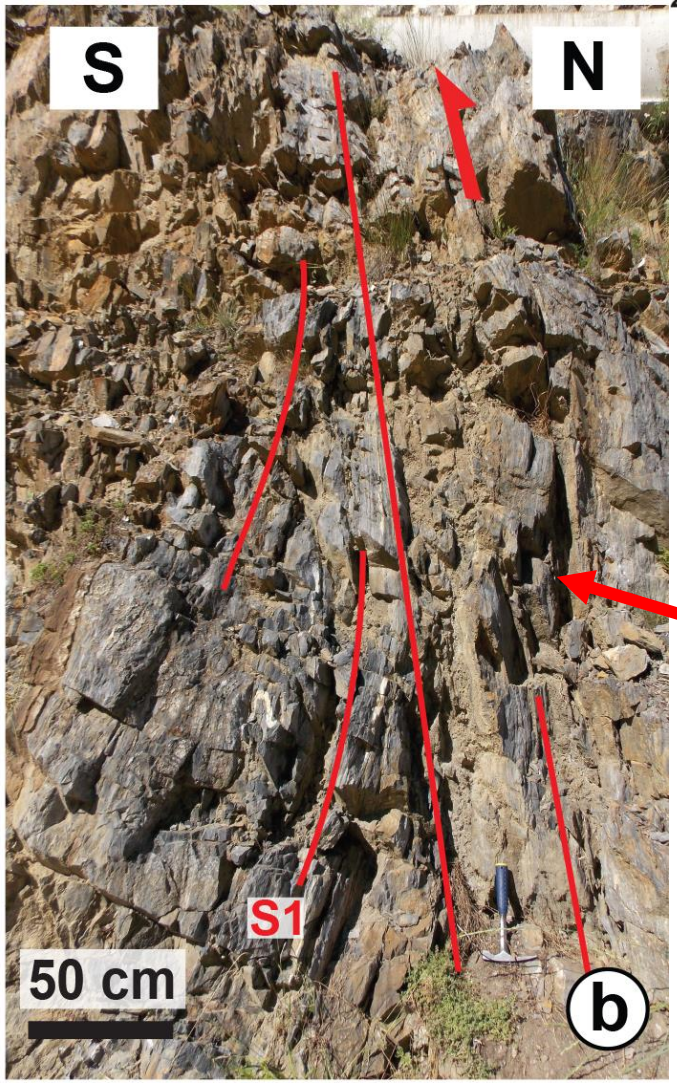


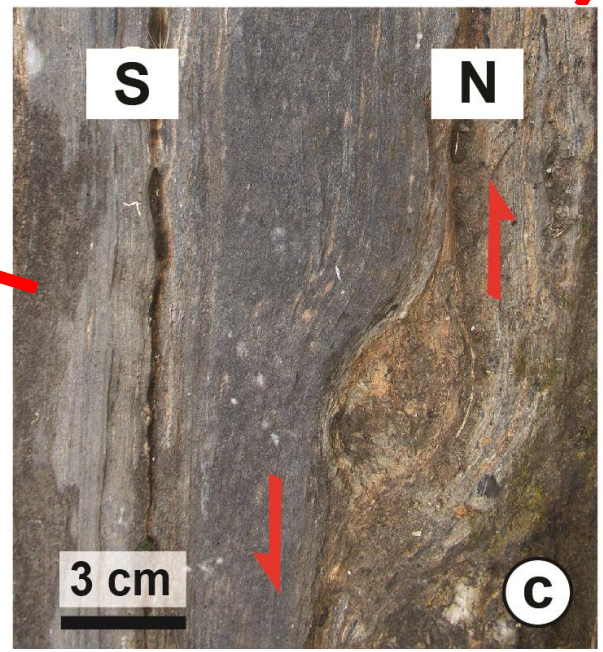


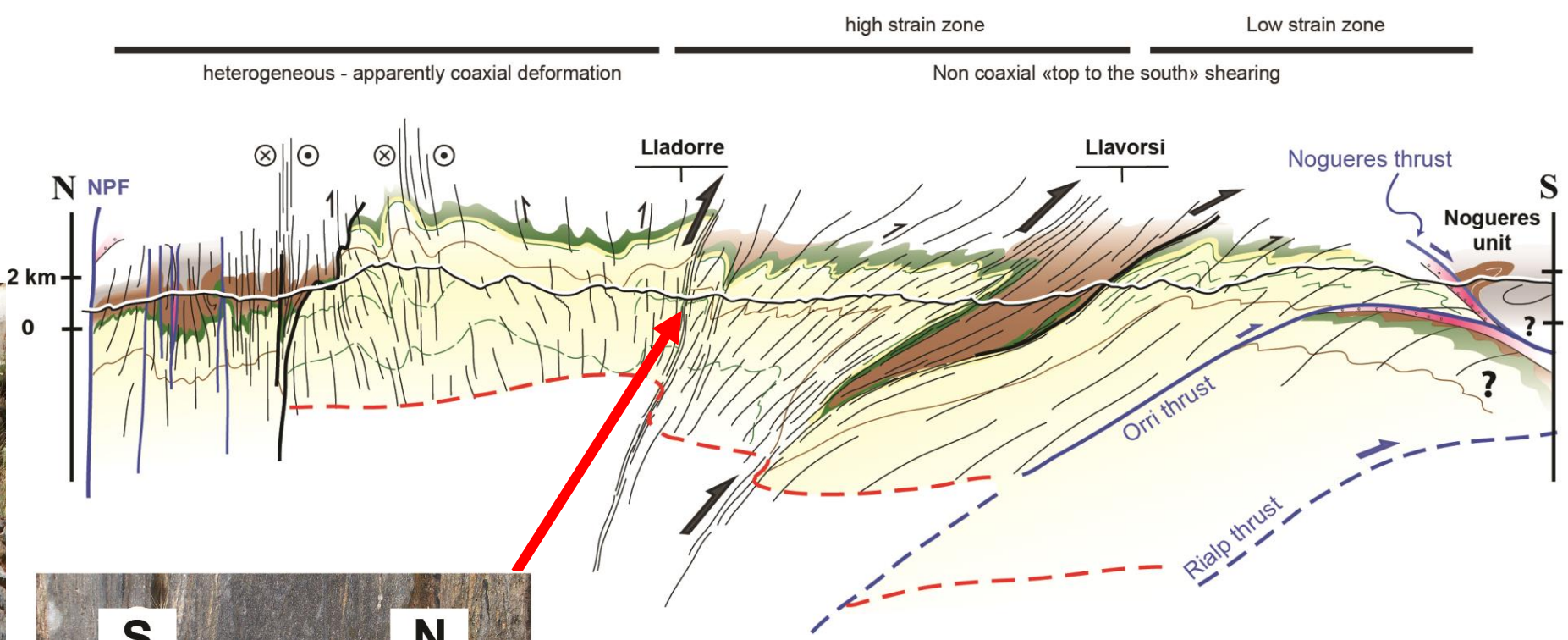
Etirement vertical (down-dip)

Mouvement verticaux (shear zones)

Etude structurale



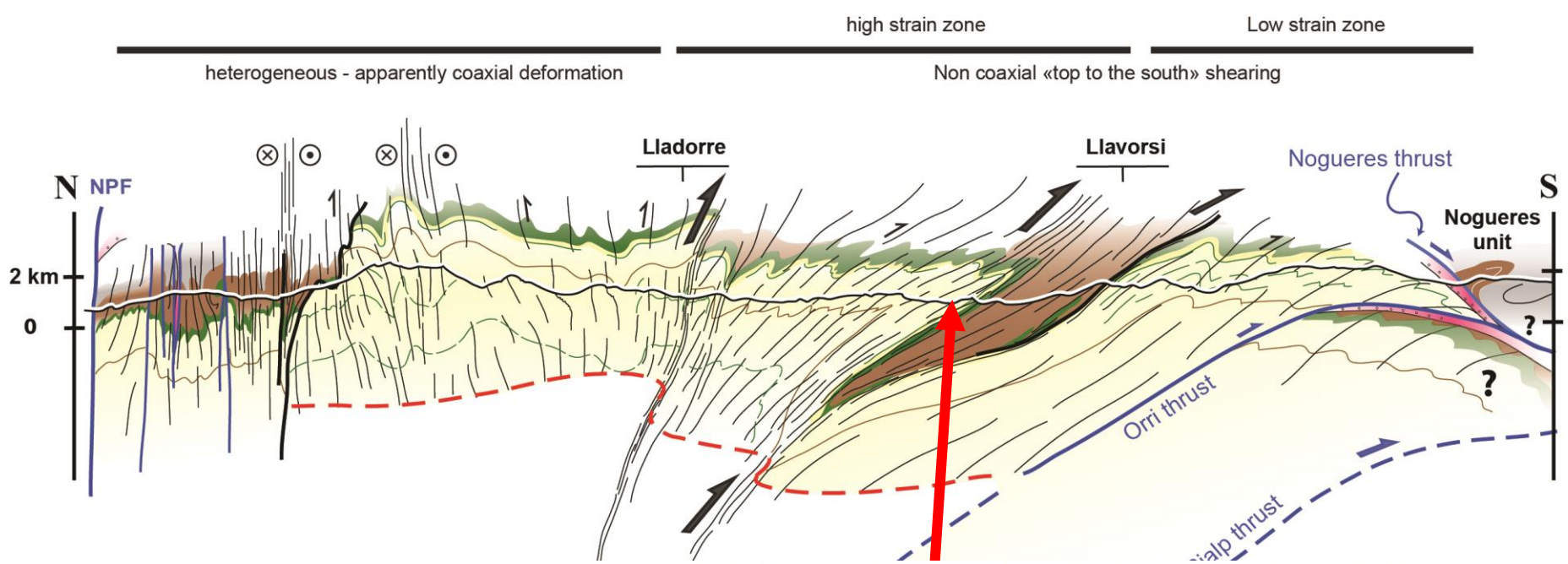




Plutôt coaxiale au nord

Non-coaxiale à partir de Lladorre (« north-side up »)

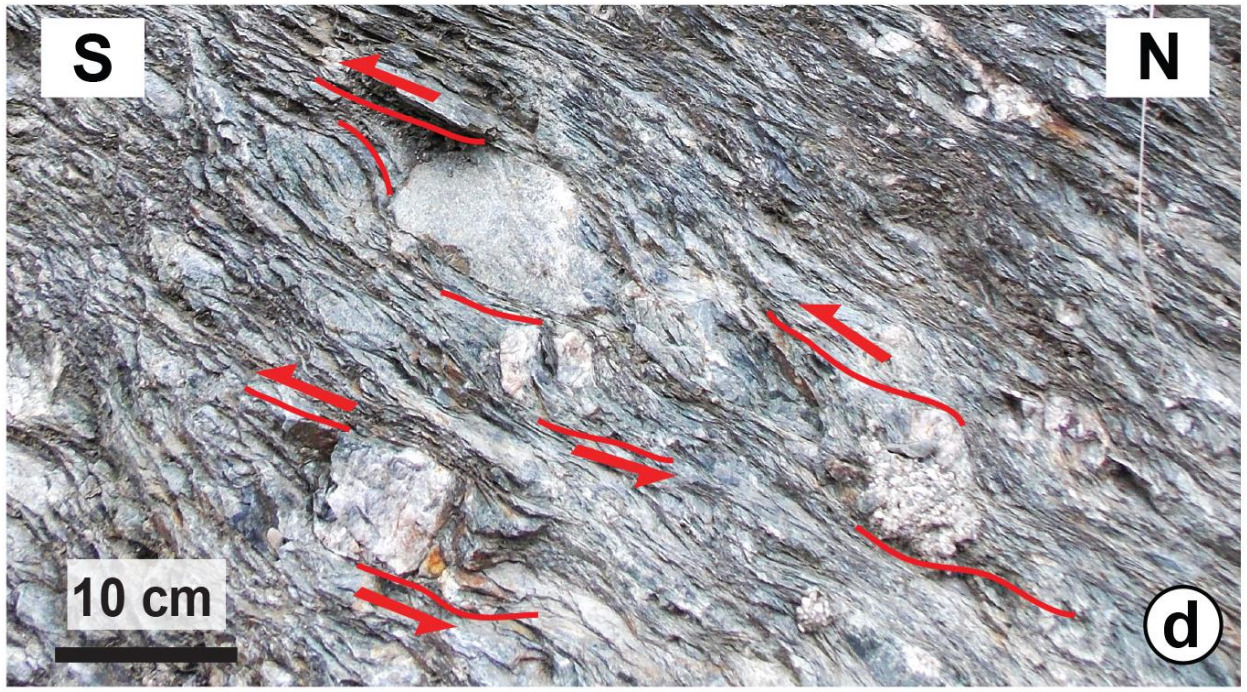
Etude structurale



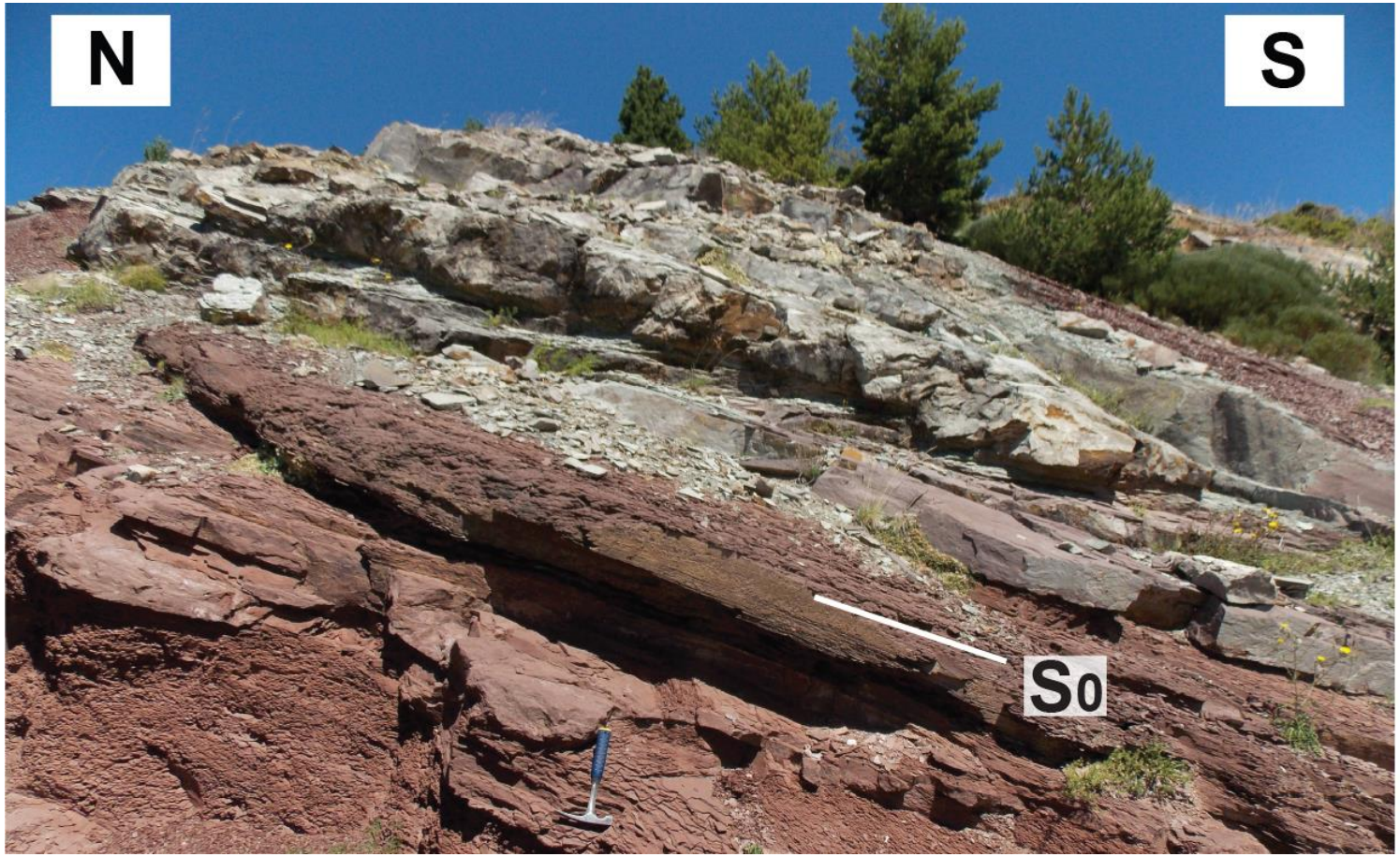
Domaine sud:

Cinématiques “top sud”

Pas de déformation pénétrative alpine?



Déformation pyrénéenne



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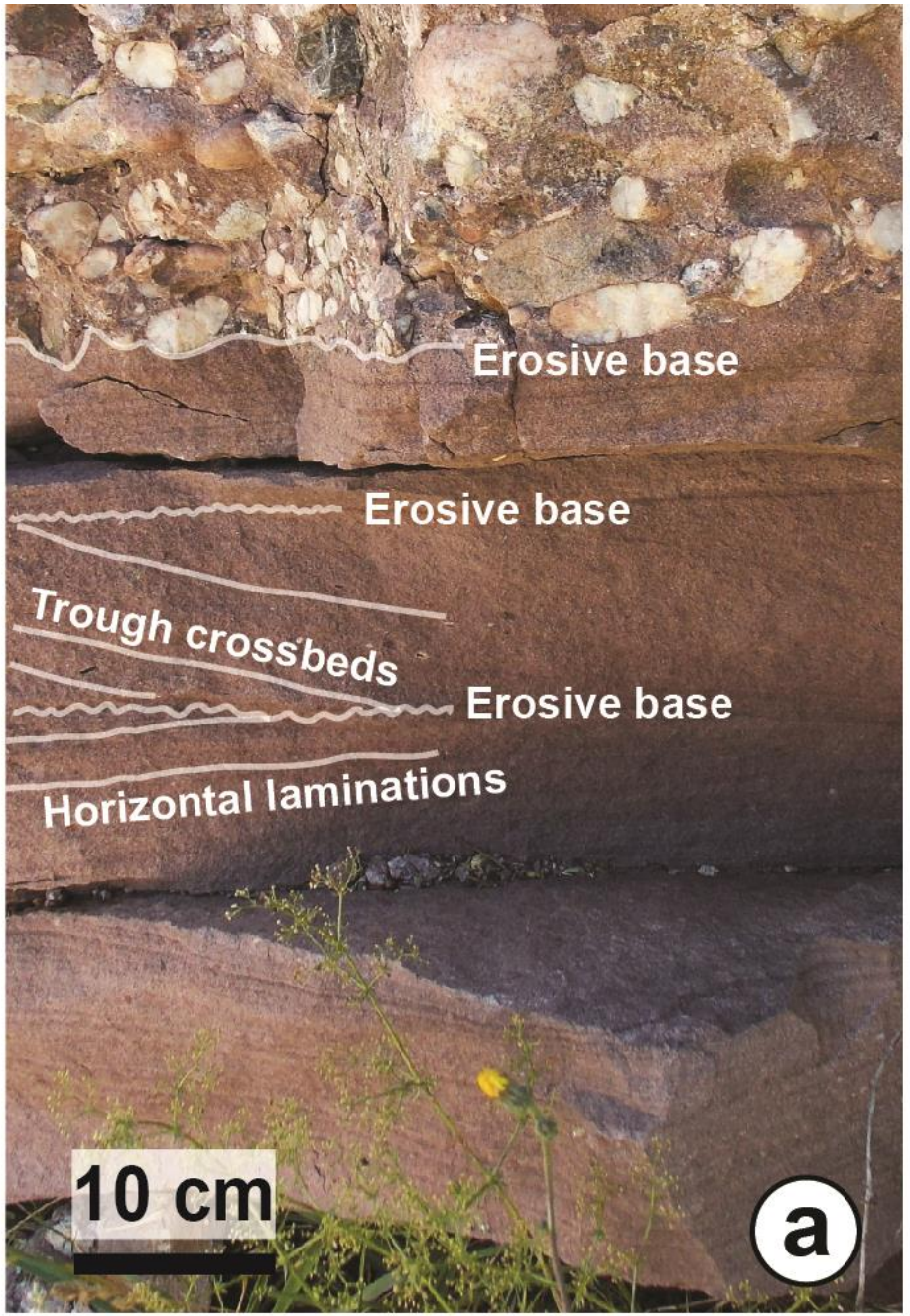
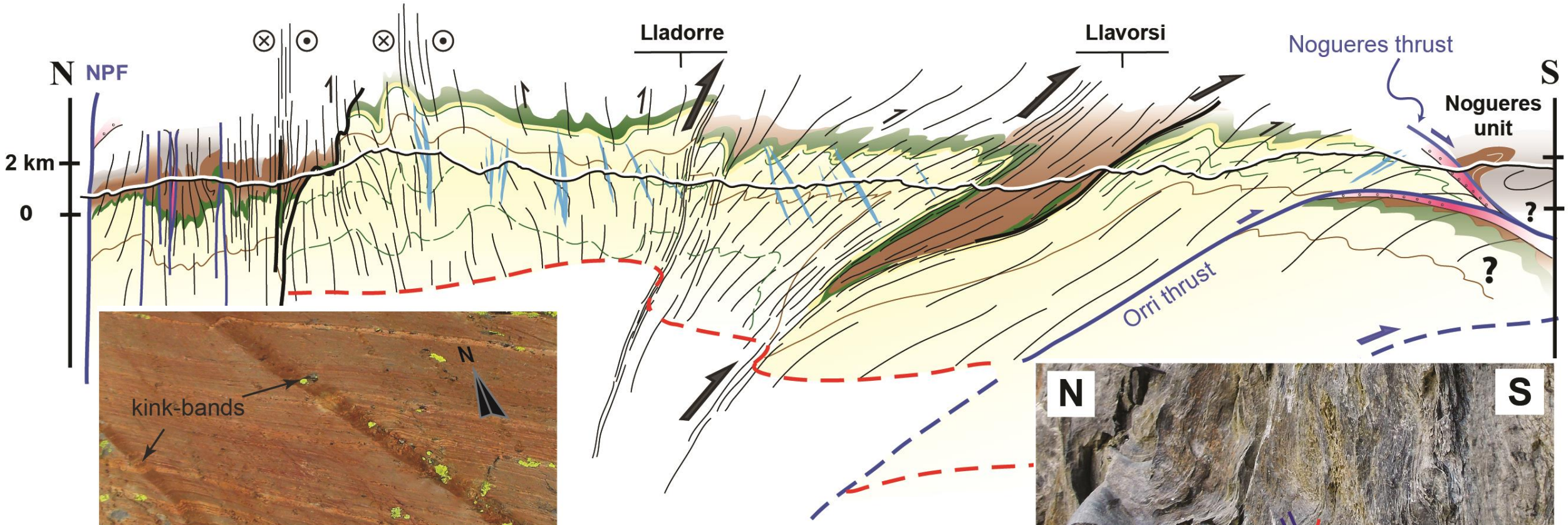
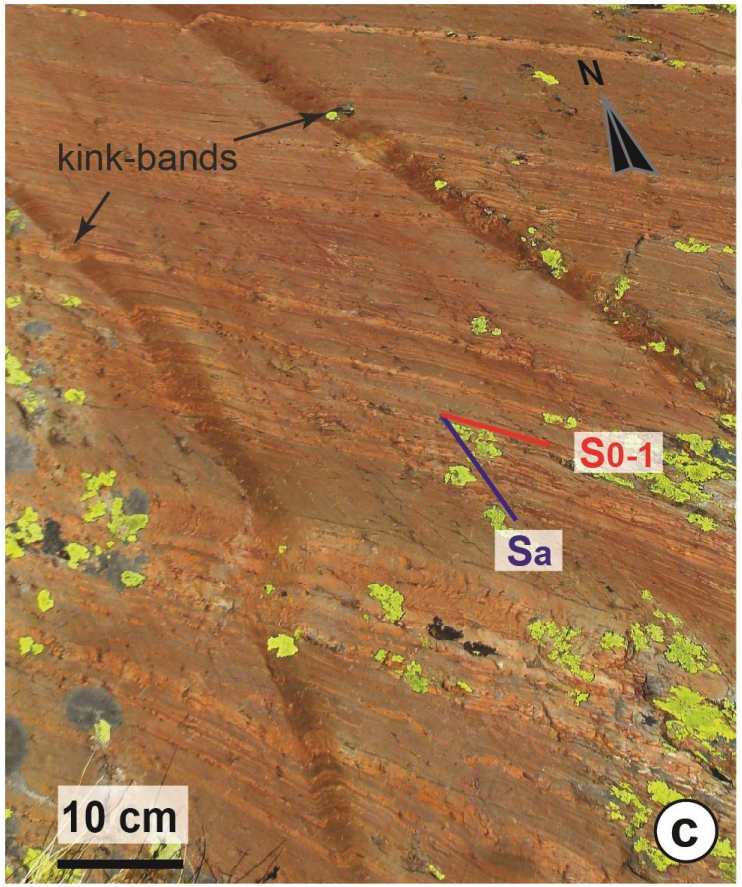


Permien (Port del Canto, Rubio)

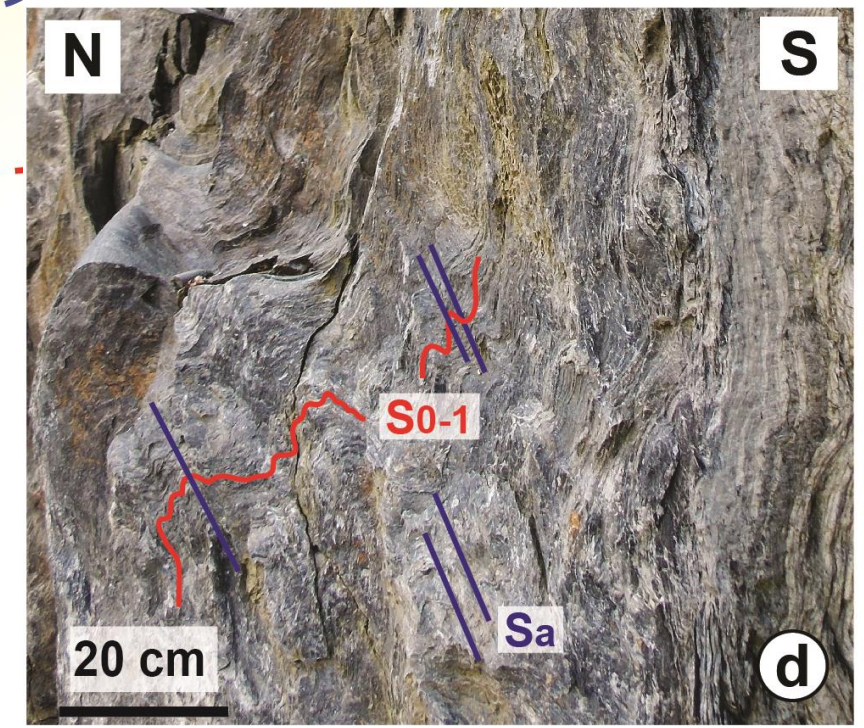
Pic de Gabedaille, Pyrénées Atlantiques





Couloirs de déformation:

- Kink-bands
- Schistosité de crénulation
- Pas plus de 200m d'épaisseur



Etude pétrologique

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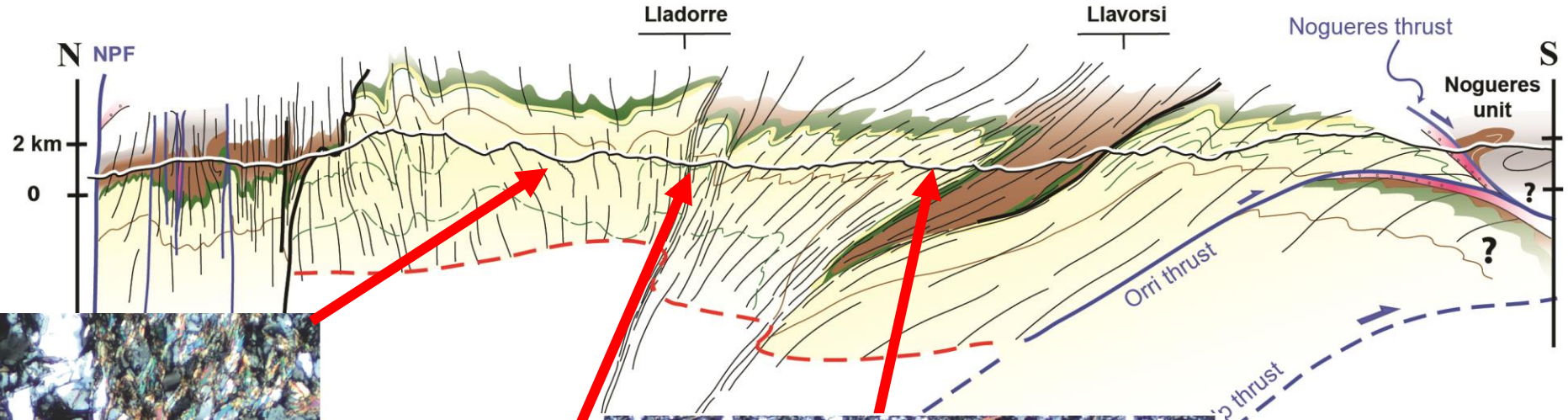
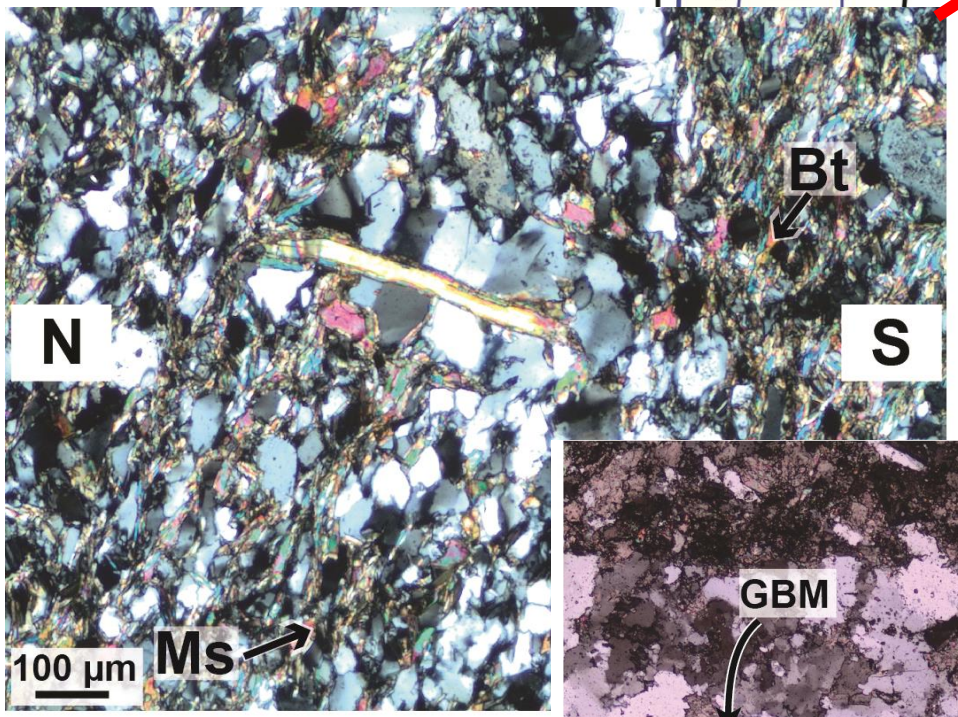
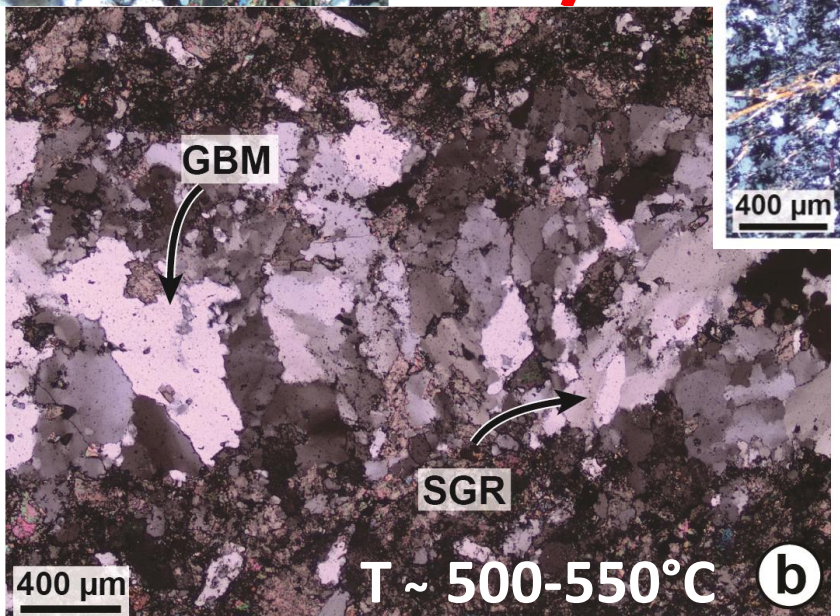
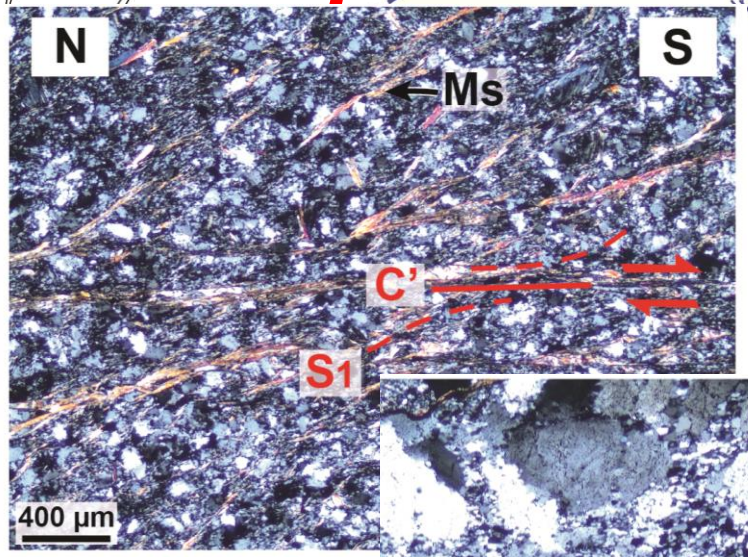


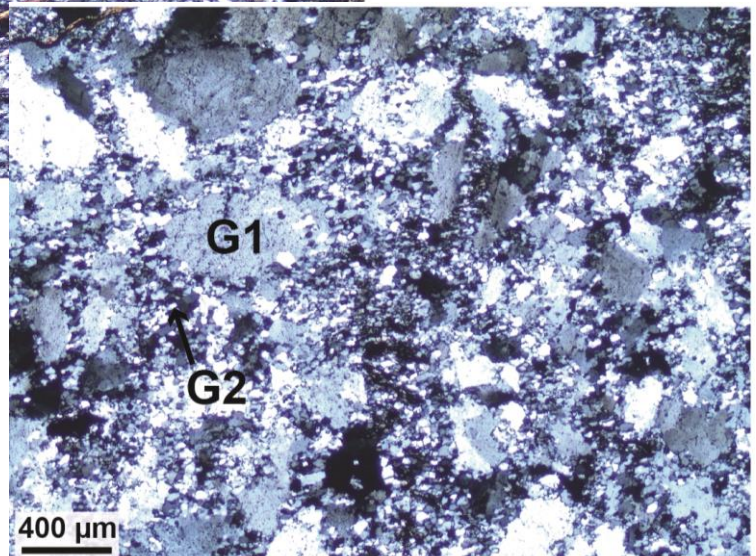


T ~ 500°C

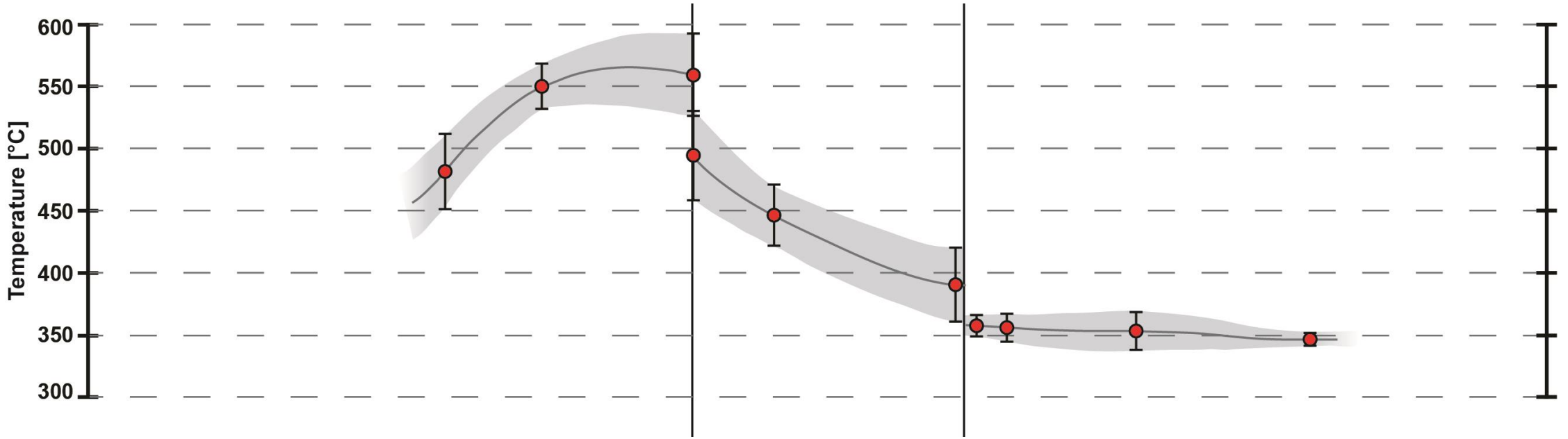




T ~ 400°C



Spectroscopie Raman



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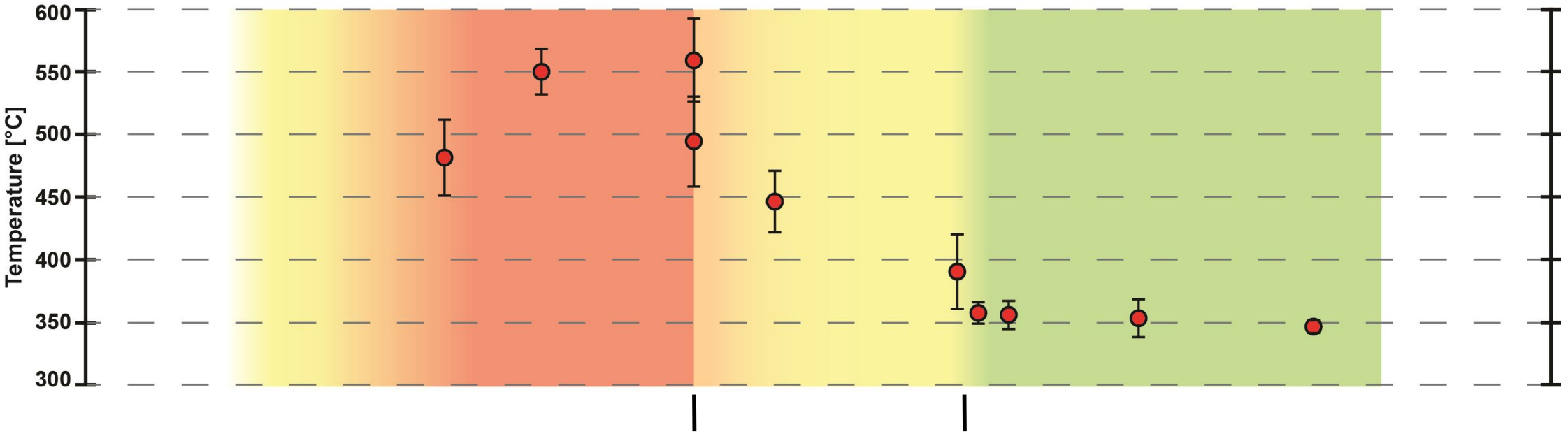
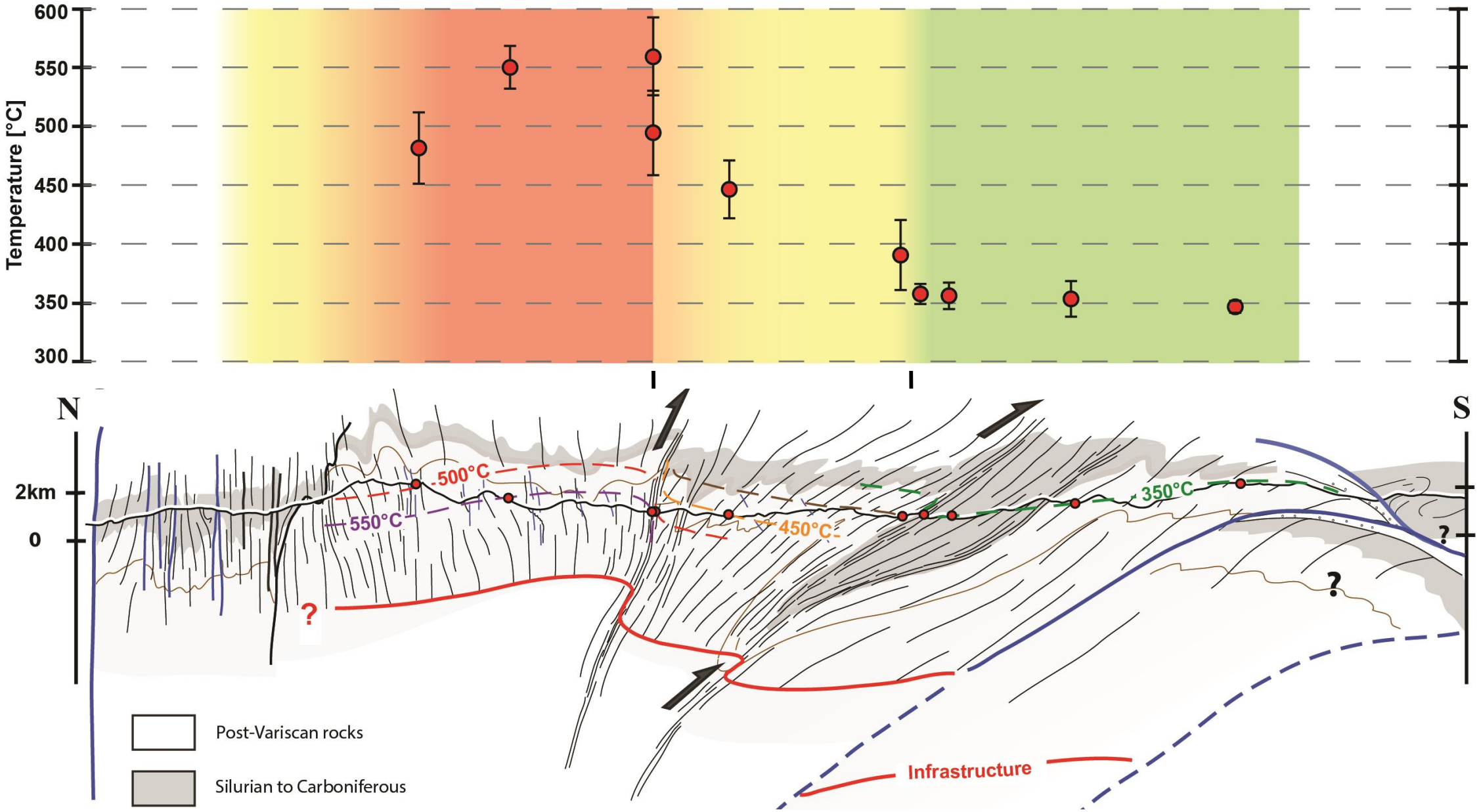


Minerals	Muscovite	Biotite + Muscovite	Muscovite	Muscovite + Chlorite
Quartz recrystallization		+ GBM	+ SGR + Bugling	+ Bugling
Qualitative temperatures		**~500-550°C**	**~400°C**	**< 400°C**

Spectroscopie Raman



Conclusions de l'étude pétro-structurale

Structures continues le long de la coupe

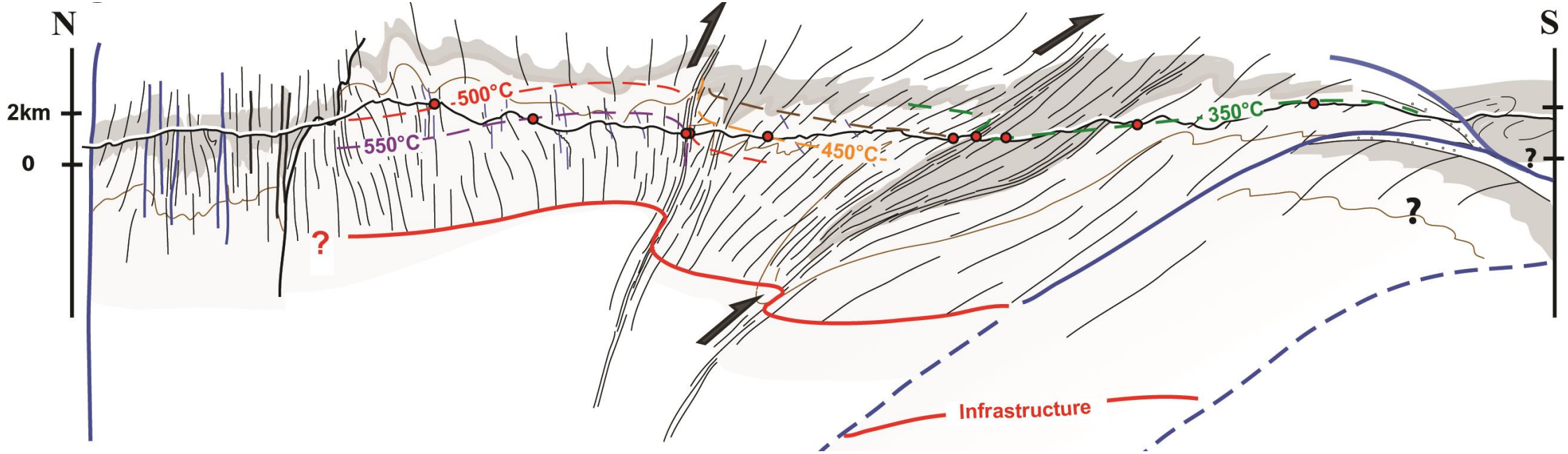
Entre déformation pénétrative et déformation localisée: même grade métamorphique

Même cinématique

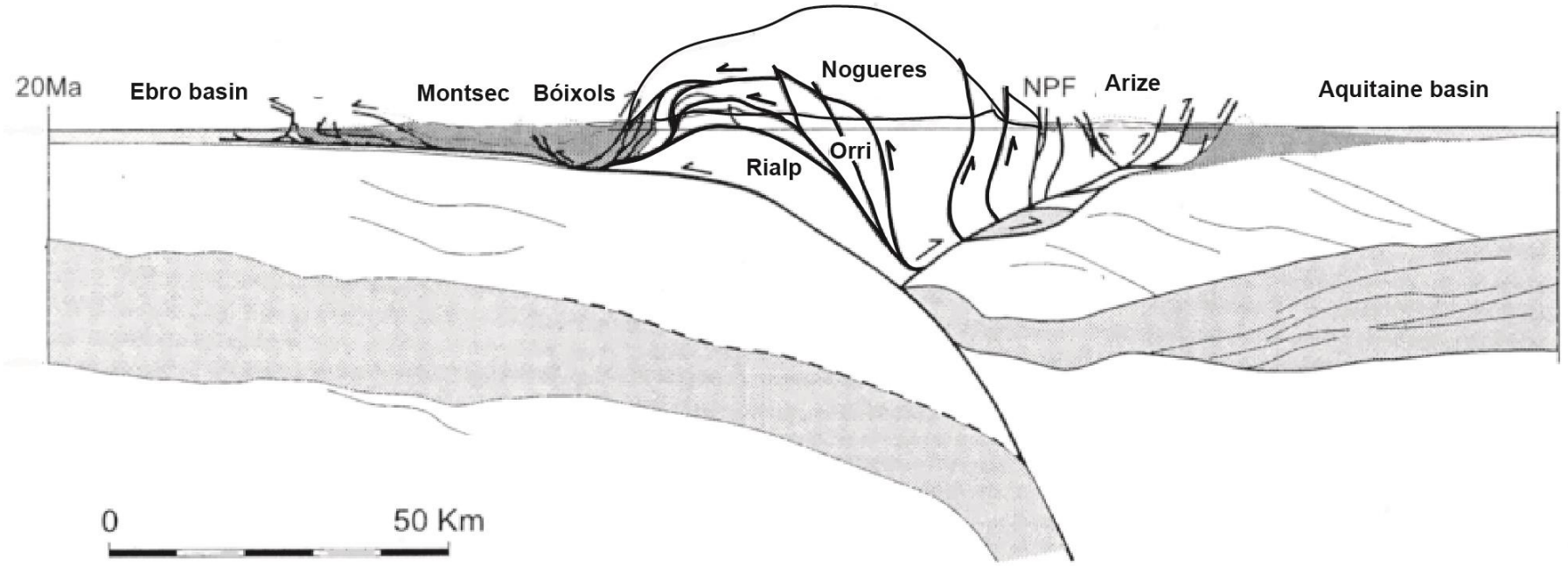
Sédiments permo-triasiques discordants et non-déformés

Varisques

Décalage des marqueurs: 1 à 2 km maximum

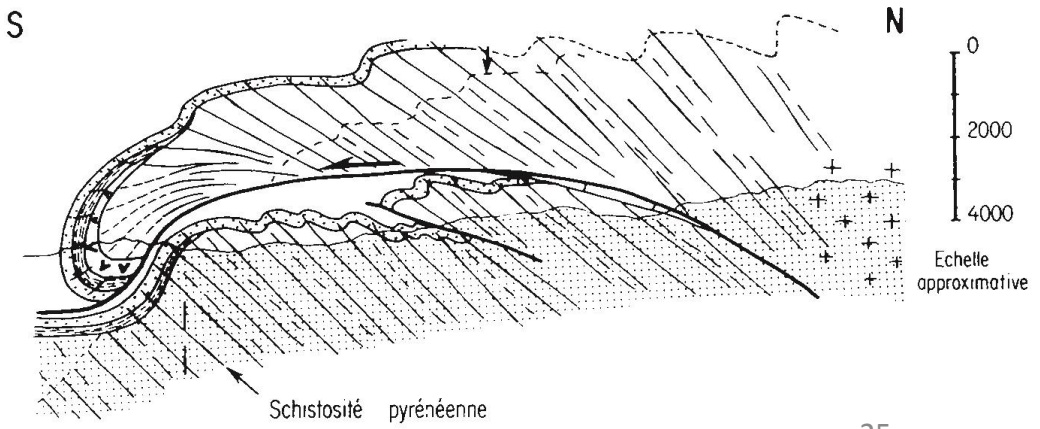


Conclusion

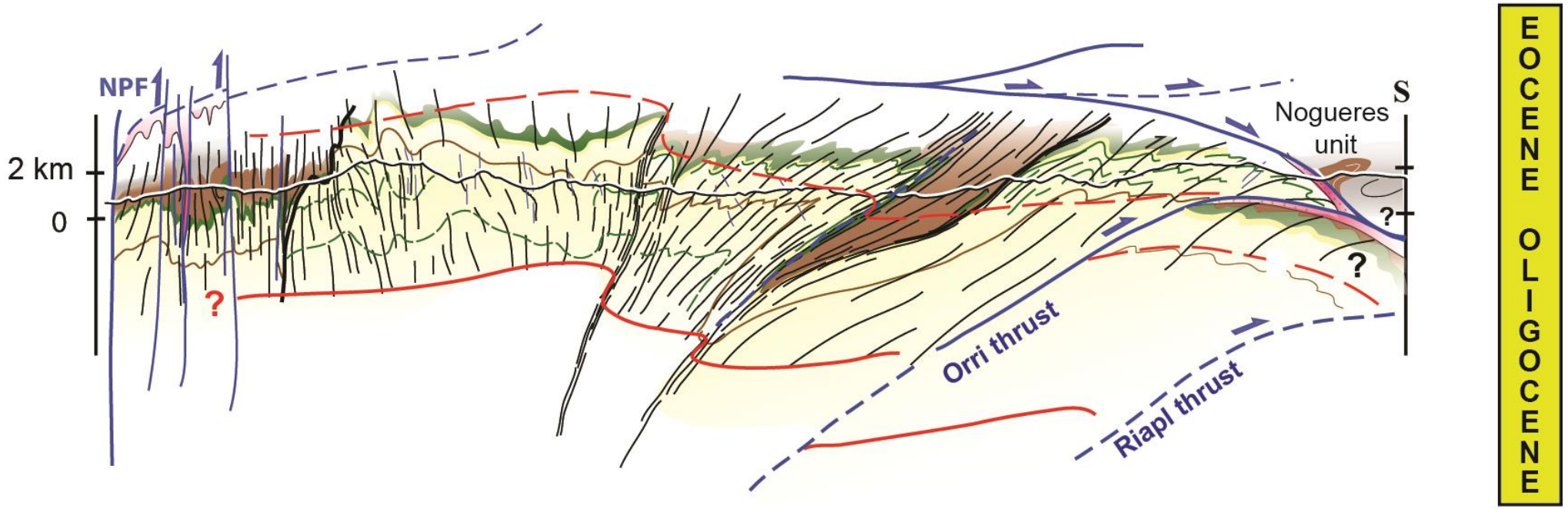


Dans les Pyrénées centrales de la Zone Axiale, pas d'évidence de:

- chevauchement alpin
- rotation de bloc entre unités tectoniques
- déformation interne importante



Modèle appliqué aux Pyrénées centrales: origine des unités allochtones

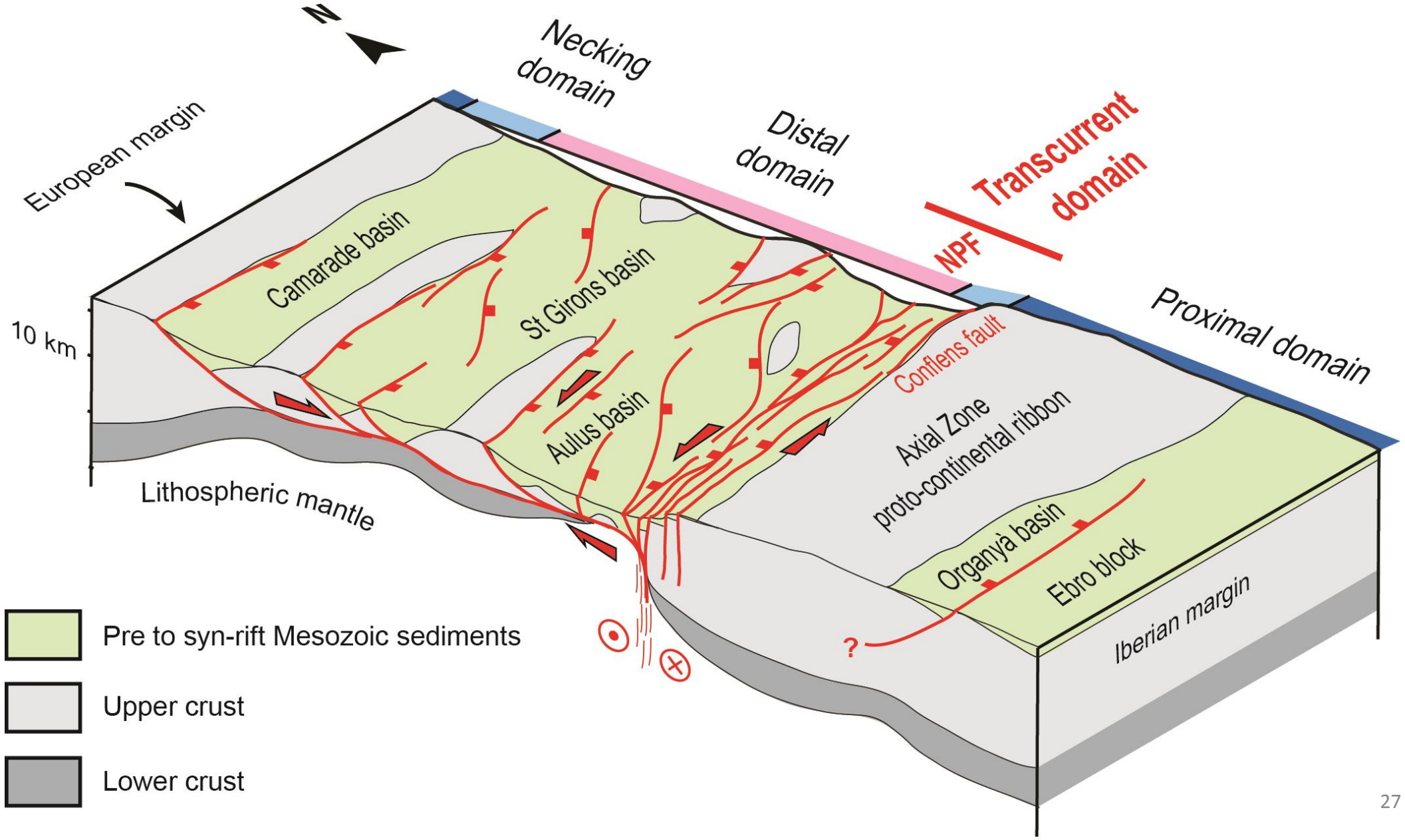


Unités allochtones = nappes de couverture

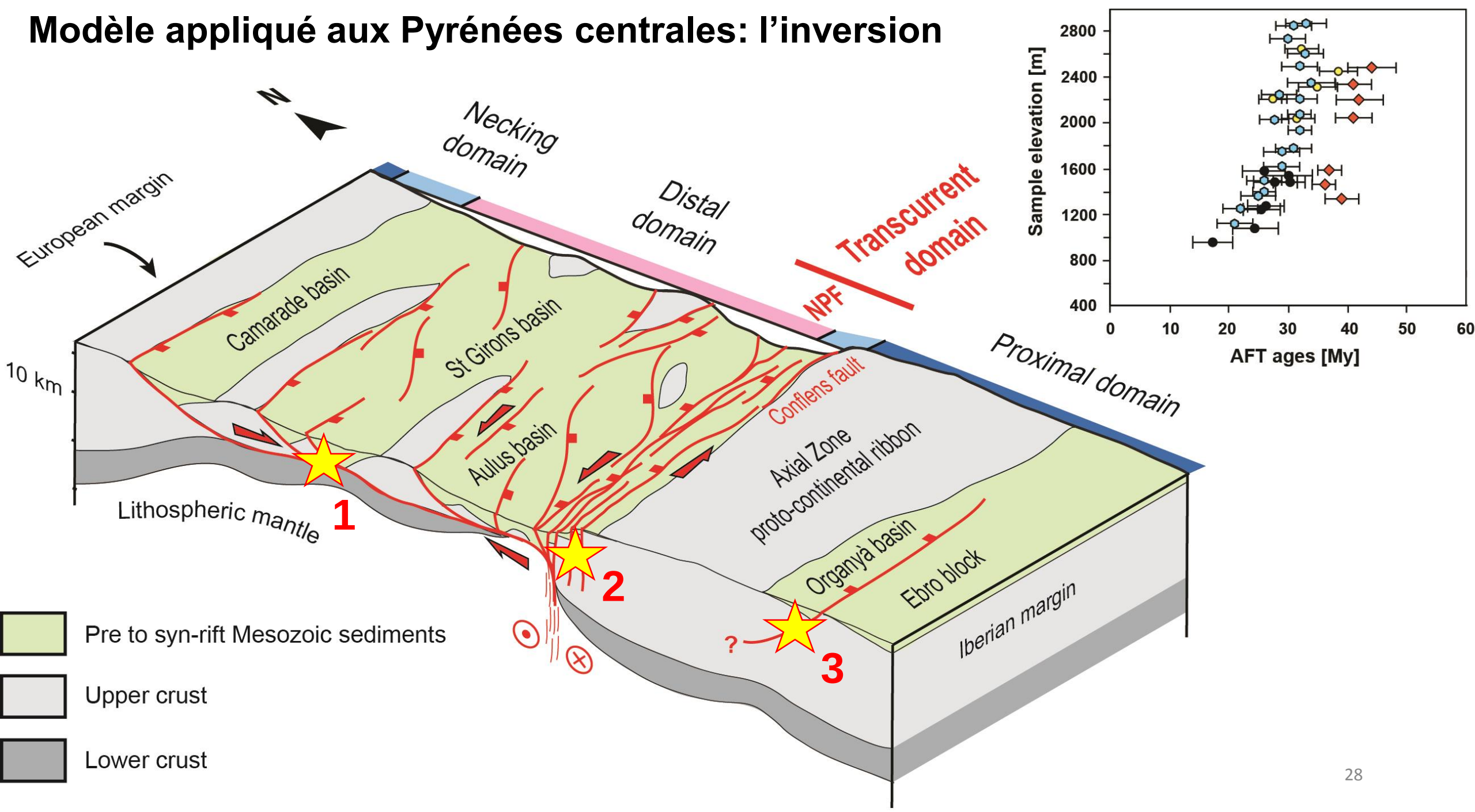
Localisation de la déformation aux bordures nord et sud de la Zone Axiale

→ Une configuration héritée de la phase de rifting

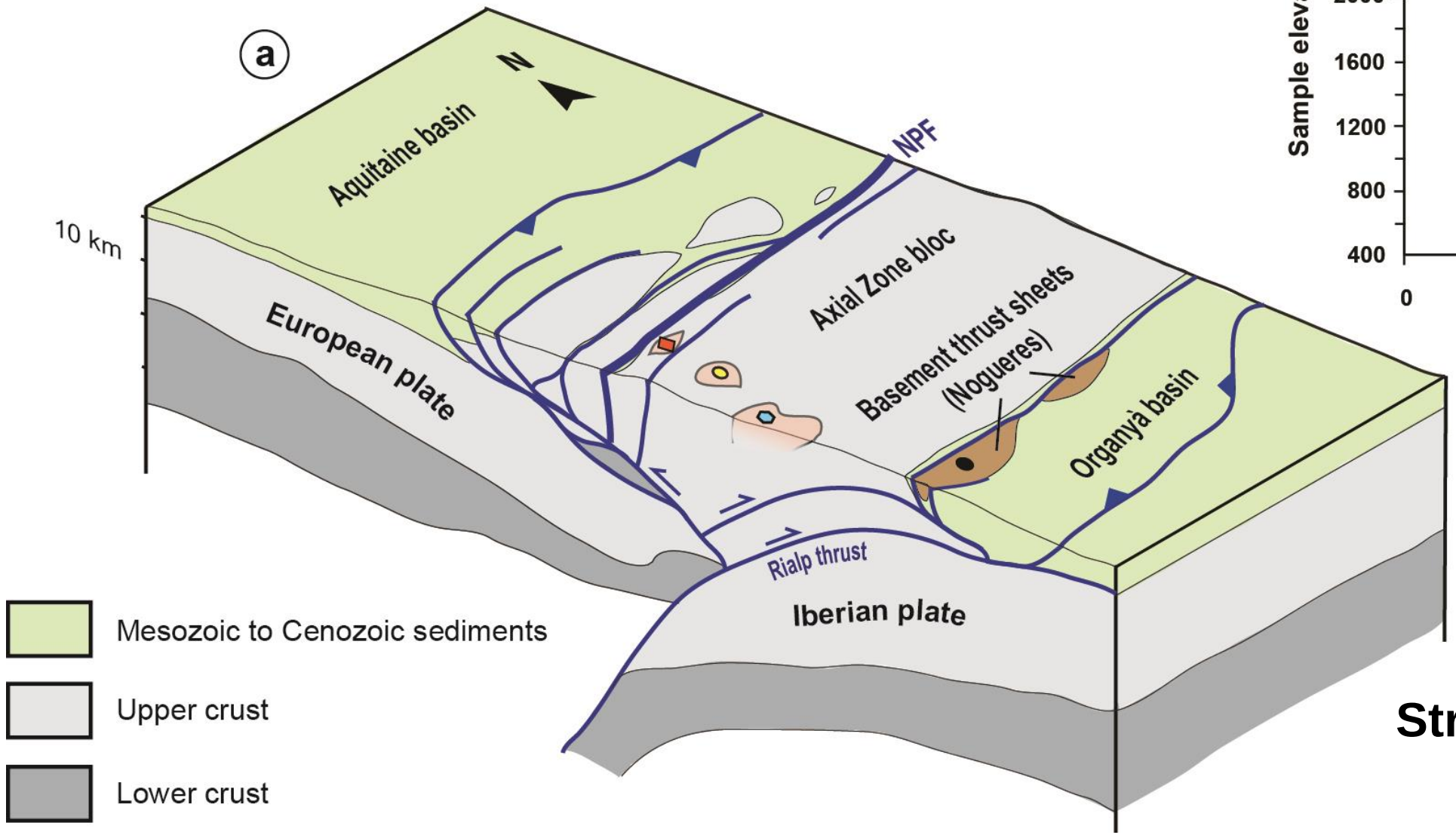
Modèle appliqué aux Pyrénées centrales: architecture des marges

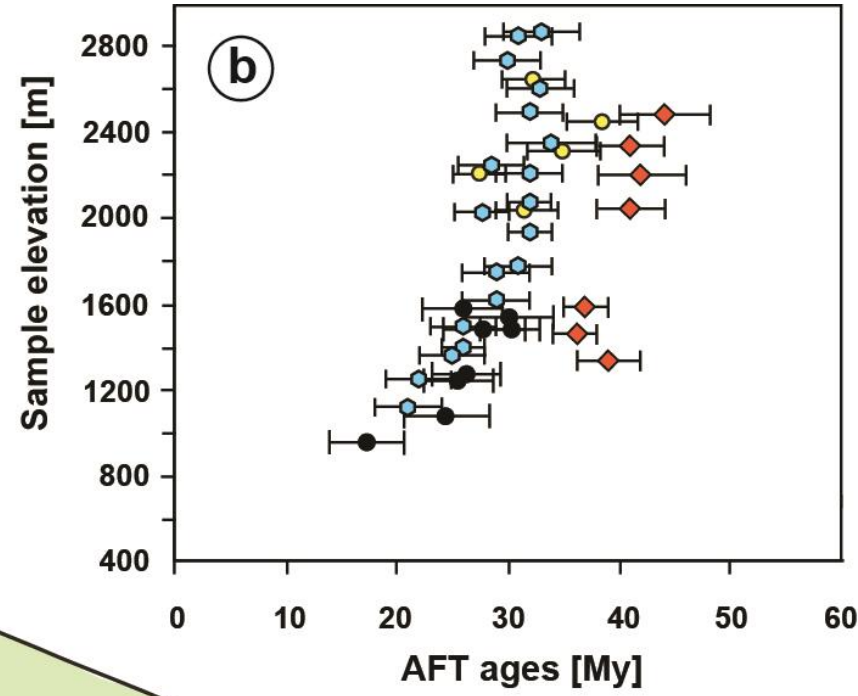


Modèle appliqué aux Pyrénées centrales: l'inversion

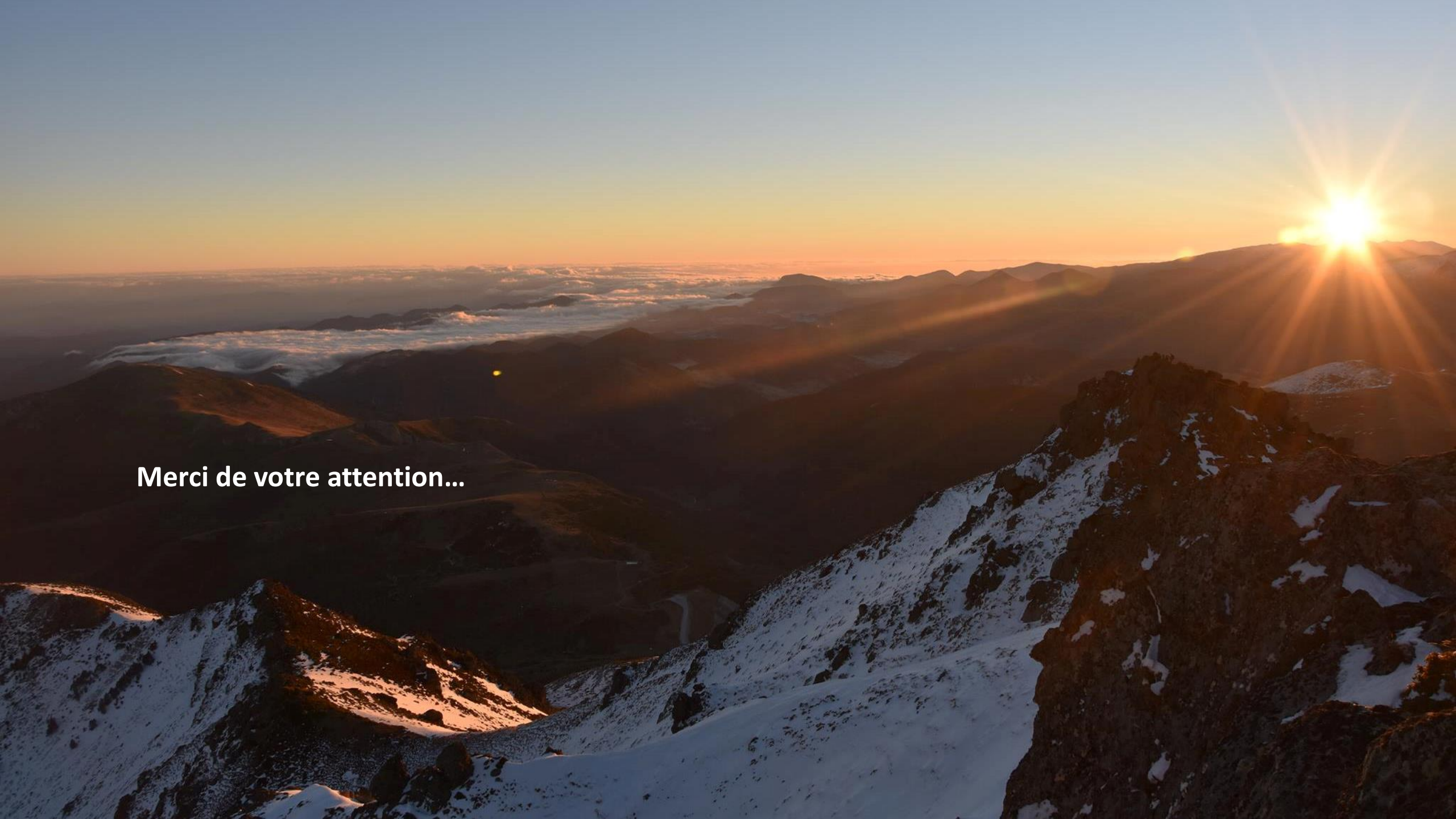


Modèle appliqué aux Pyrénées centrales:

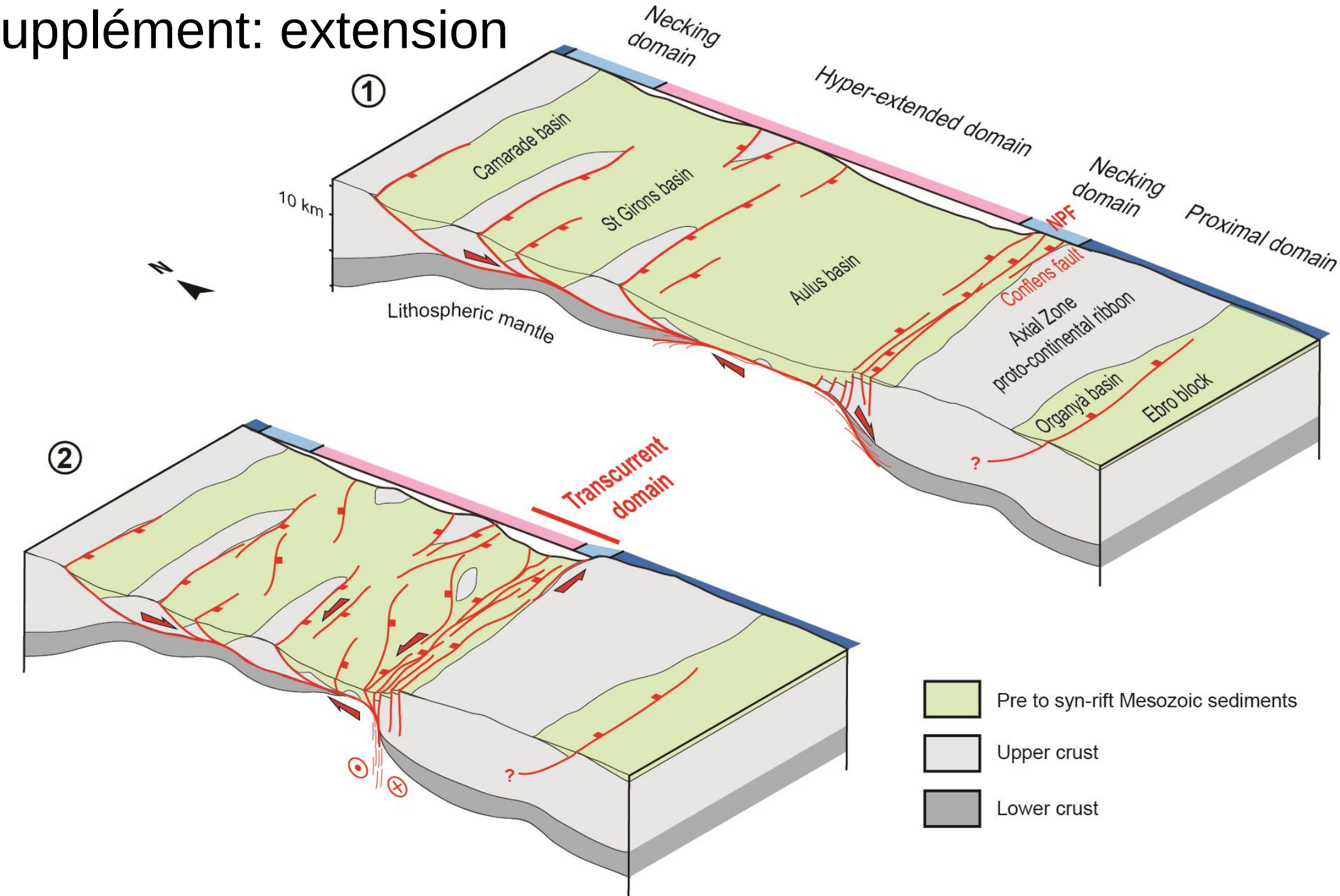


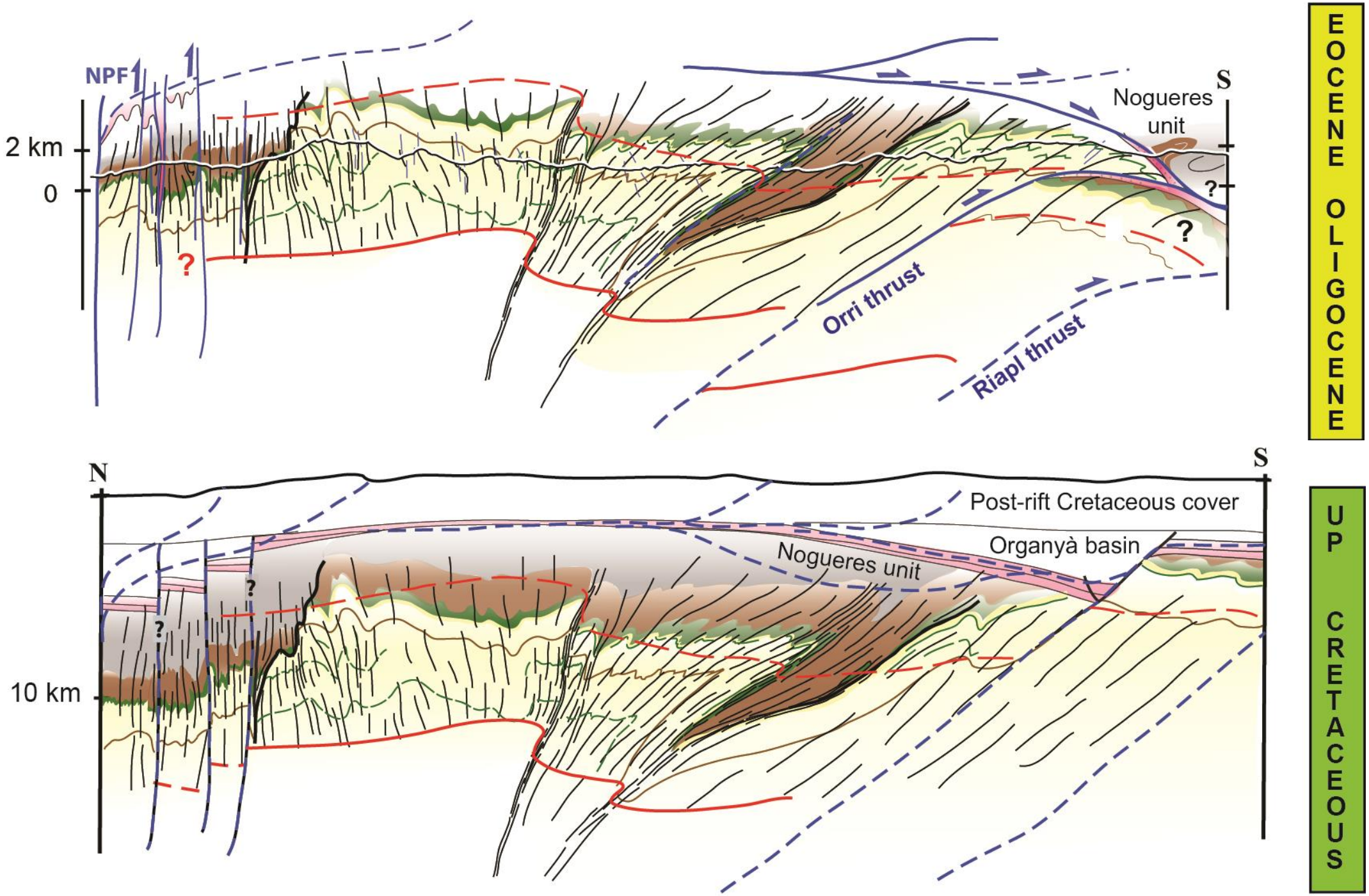


Structure en Pop-up

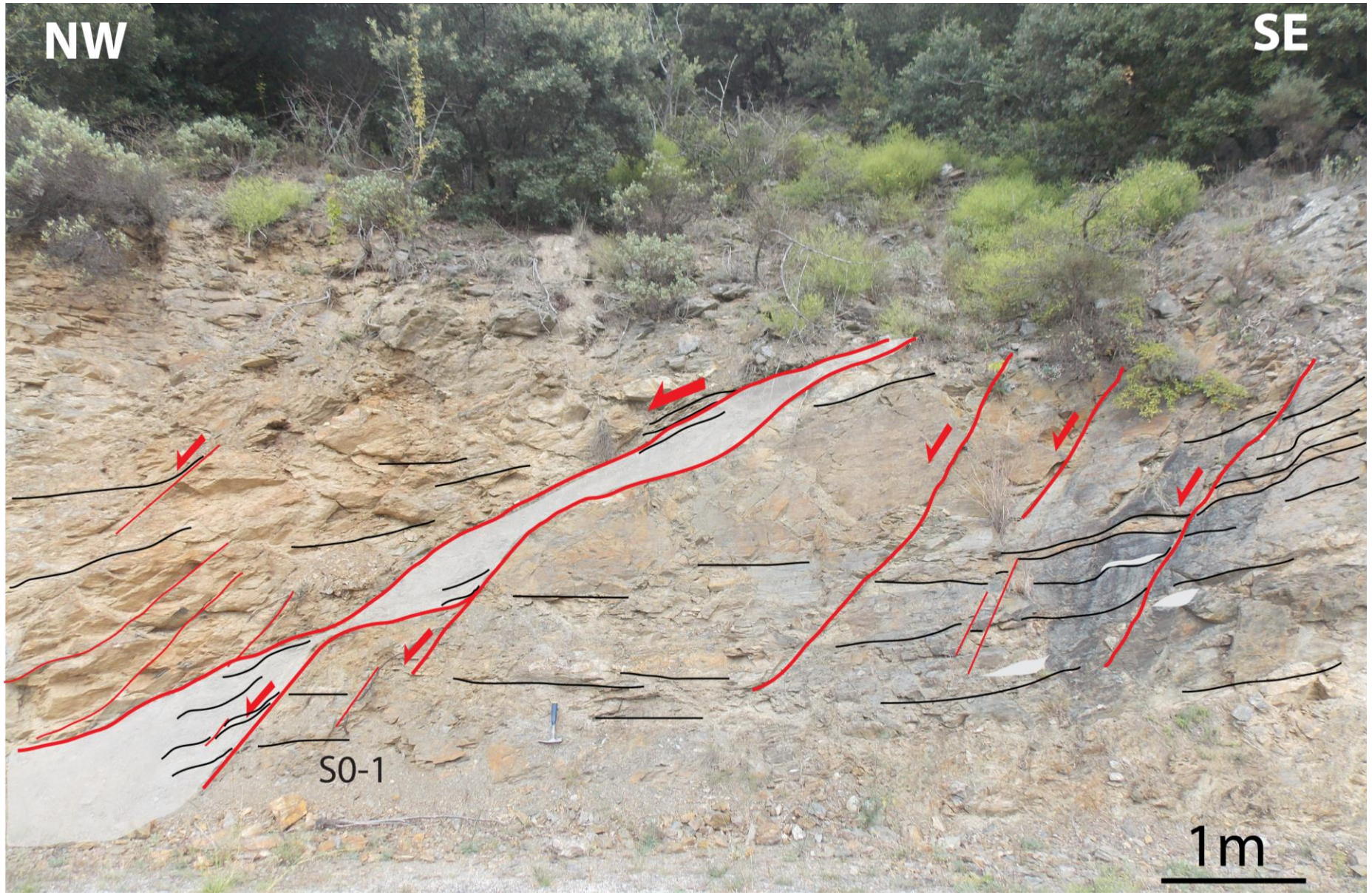

Merci de votre attention…

En supplément: extension

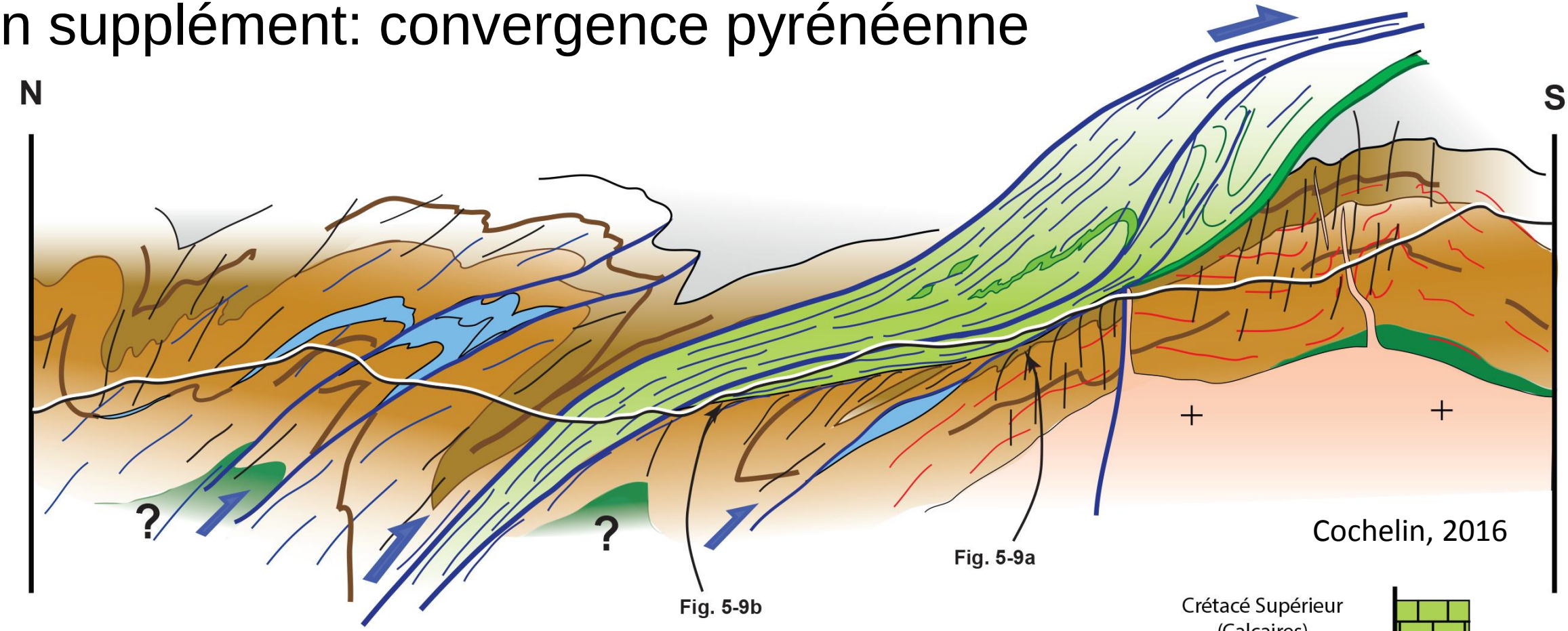



NPF
2 km
0
?
Nogueres unit
S
?
?
Orri thrust
Riapl thrust
EOCENE OLIGOCENE
N
S
10 km
?
?
Post-rift Cretaceous cover
Organyà basin
Nogueres unit
UP CRETACEOUS

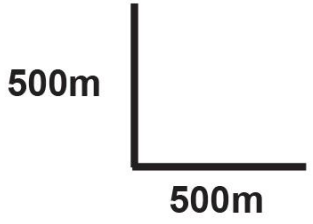
Exemple de faille normale post-varisque: flanc nord-Canigou (hanging-wall de la faille de la Têt)

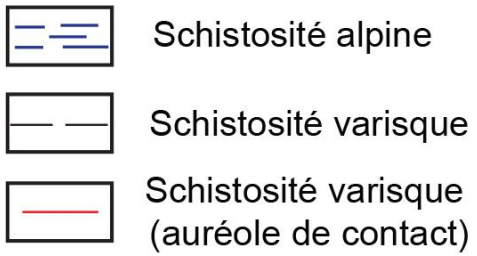


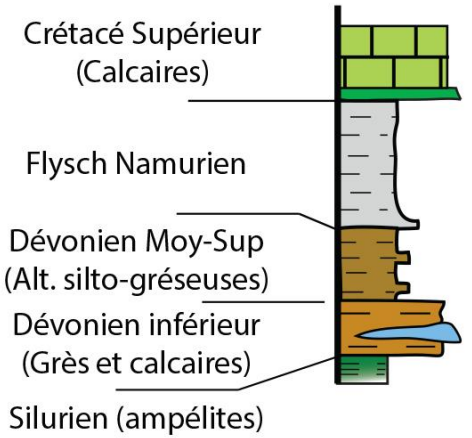
En supplément: convergence pyrénéenne

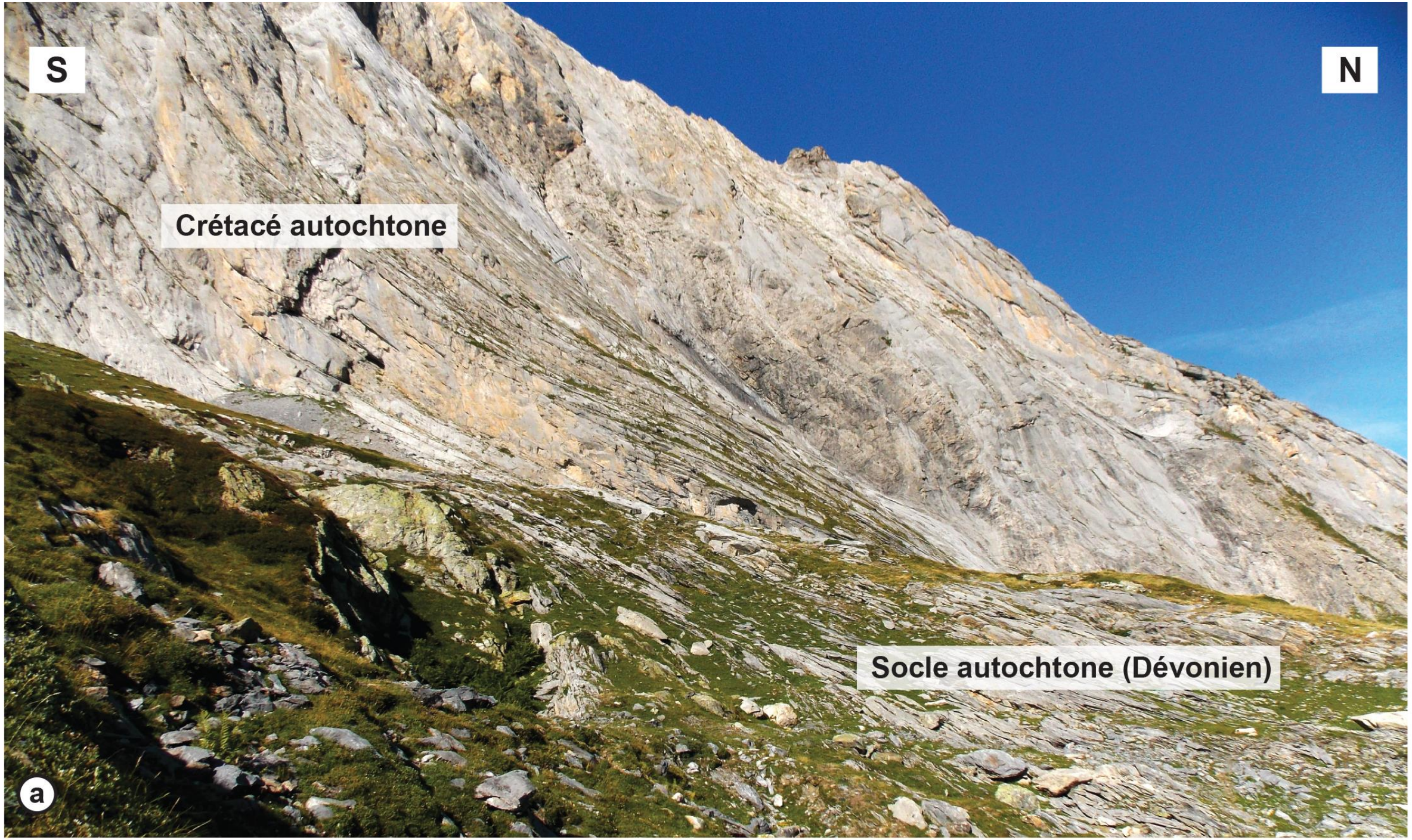


Cochelin, 2016

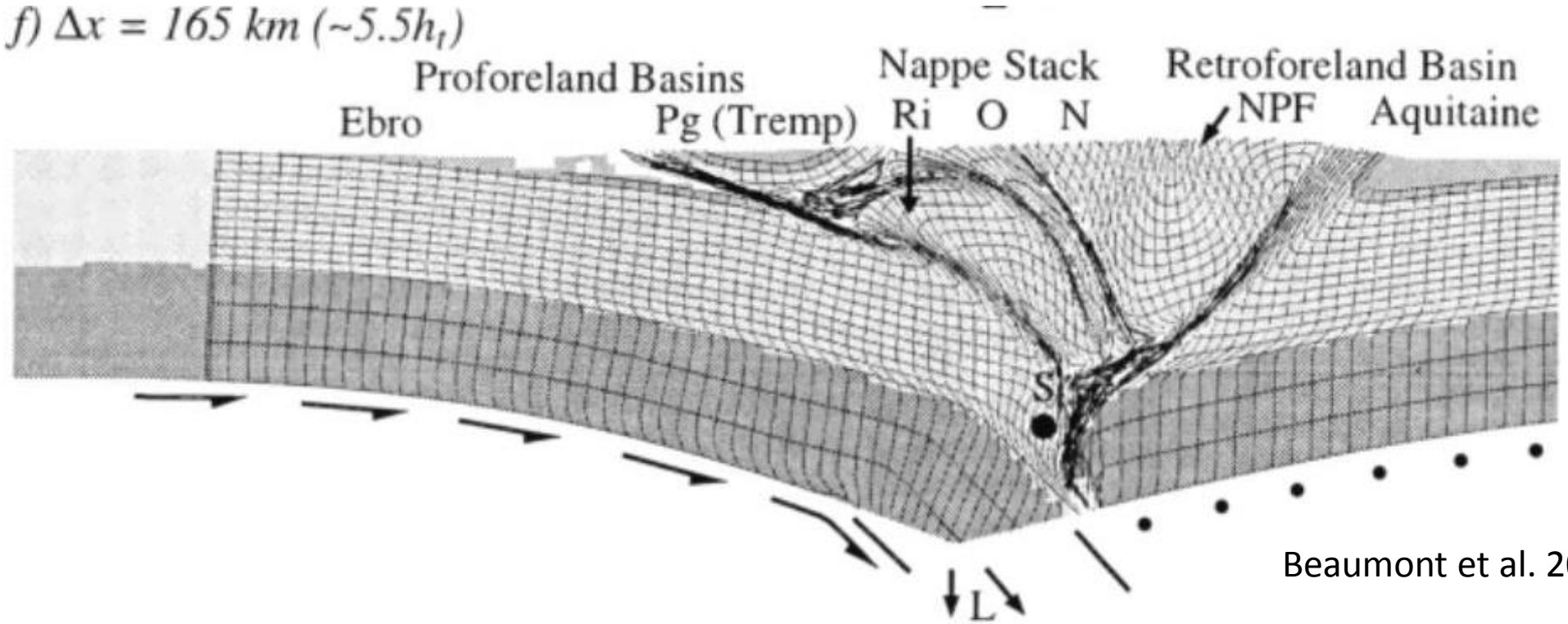






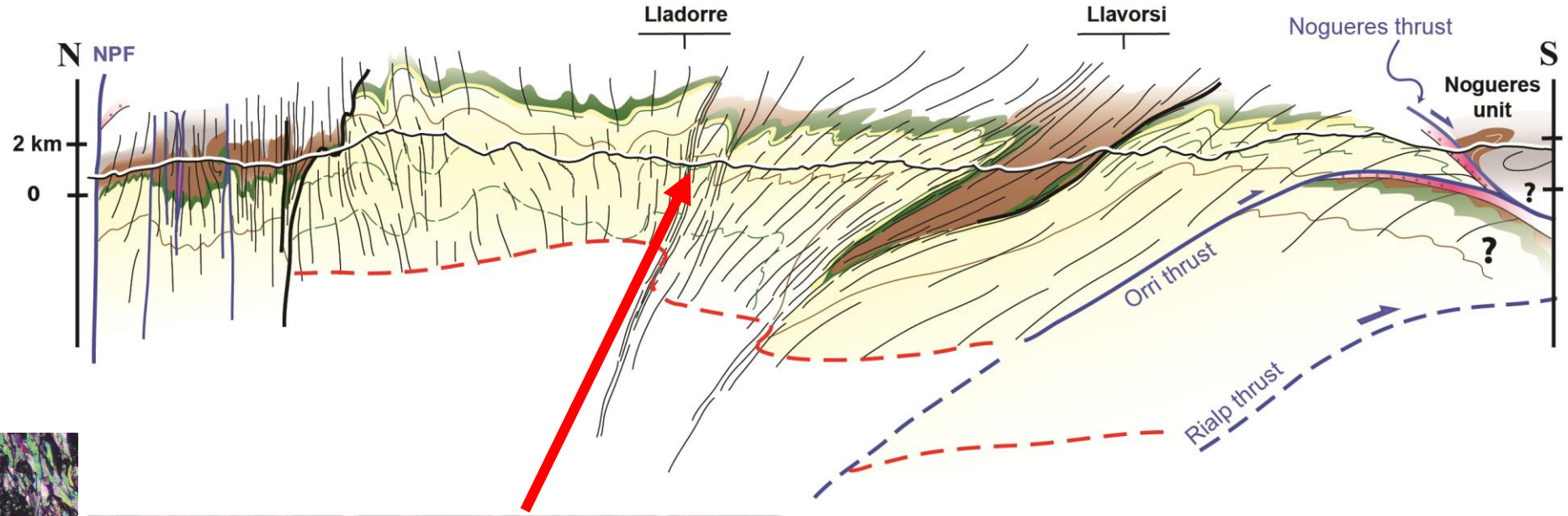

S
N
Crétacé autochtone
Socle autochtone (Dévonien)
a

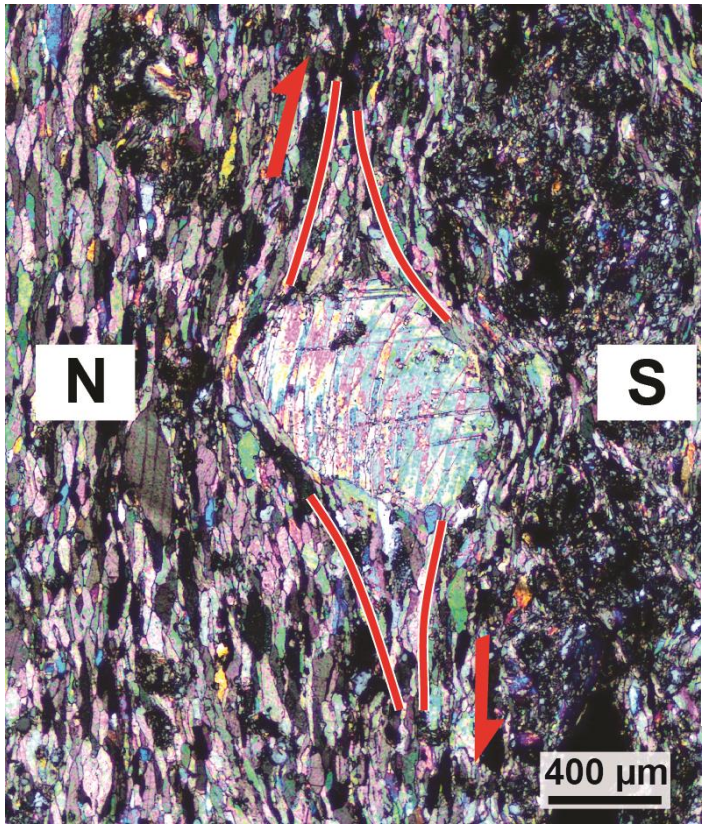
En supplément: convergence pyrénéenne

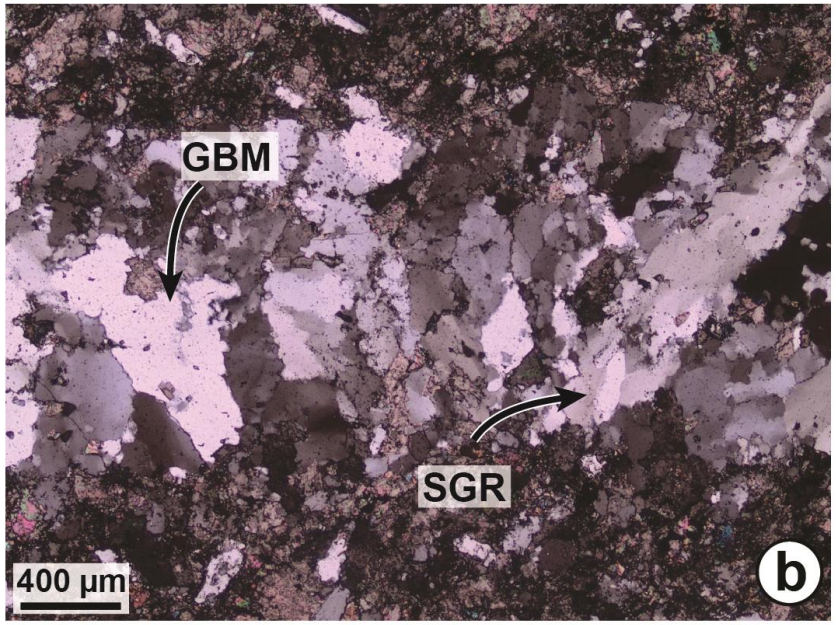


Beaumont et al. 2000

Etude pétrologique





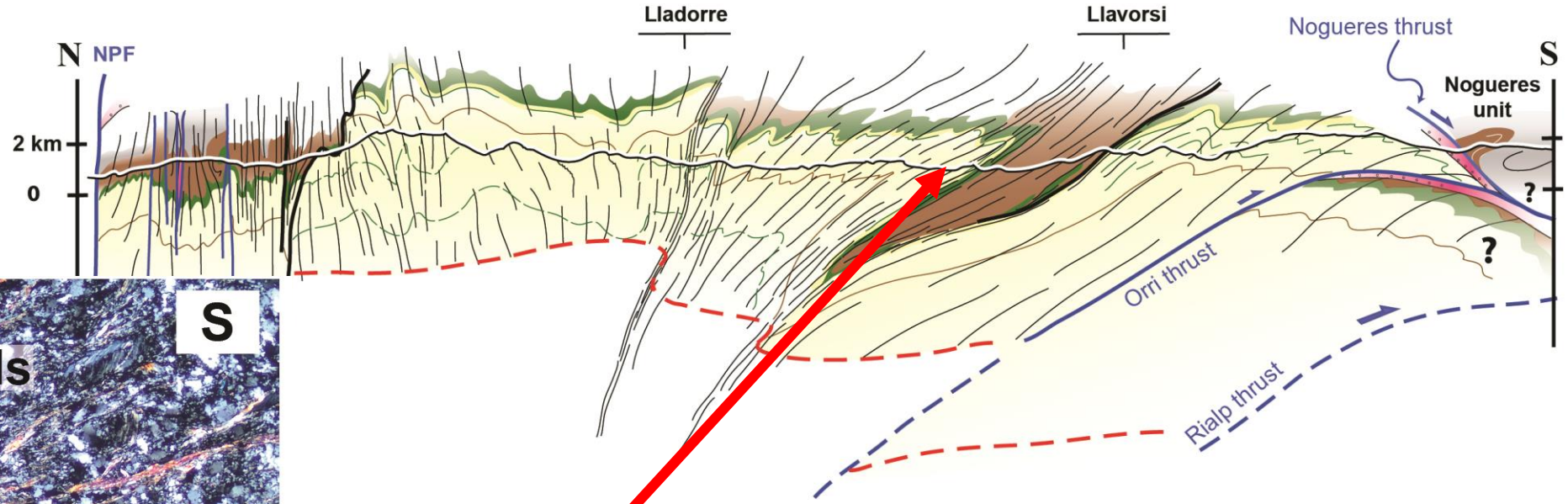


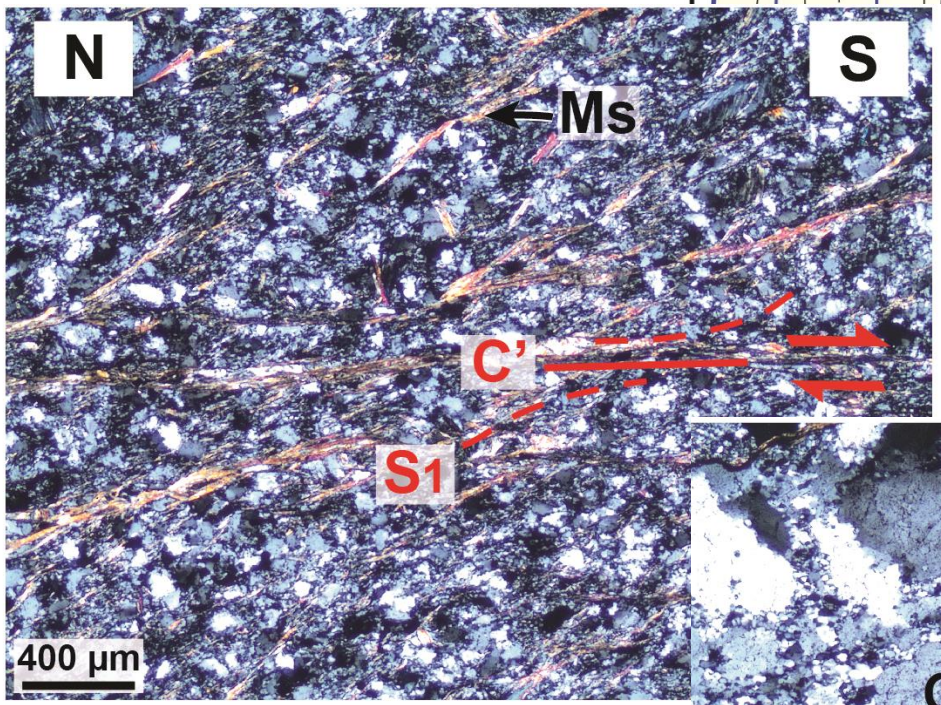
Migration de joint de grains

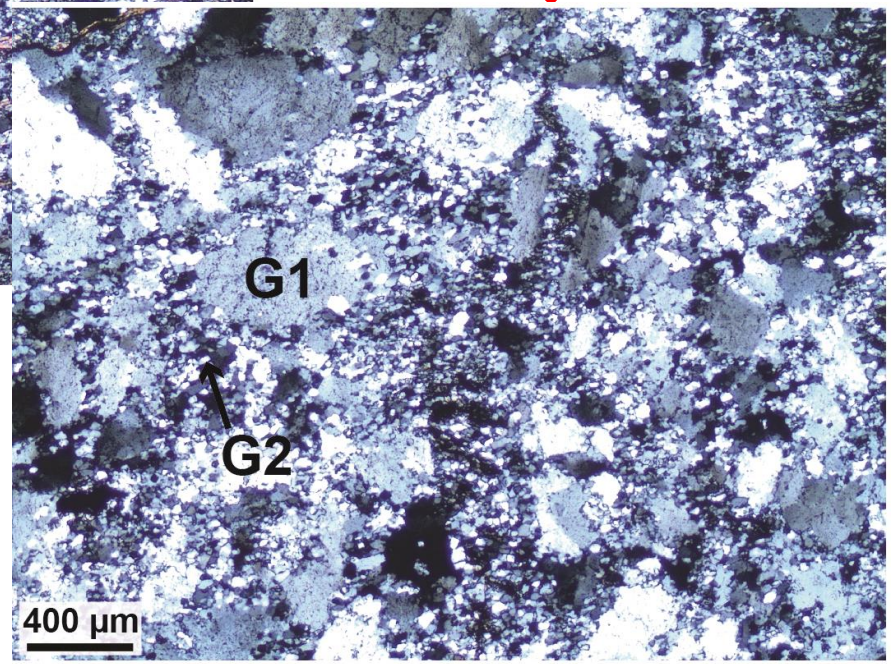
Rotation de sous-grains

→ **T ~ 500-550°C**

Etude pétrologique





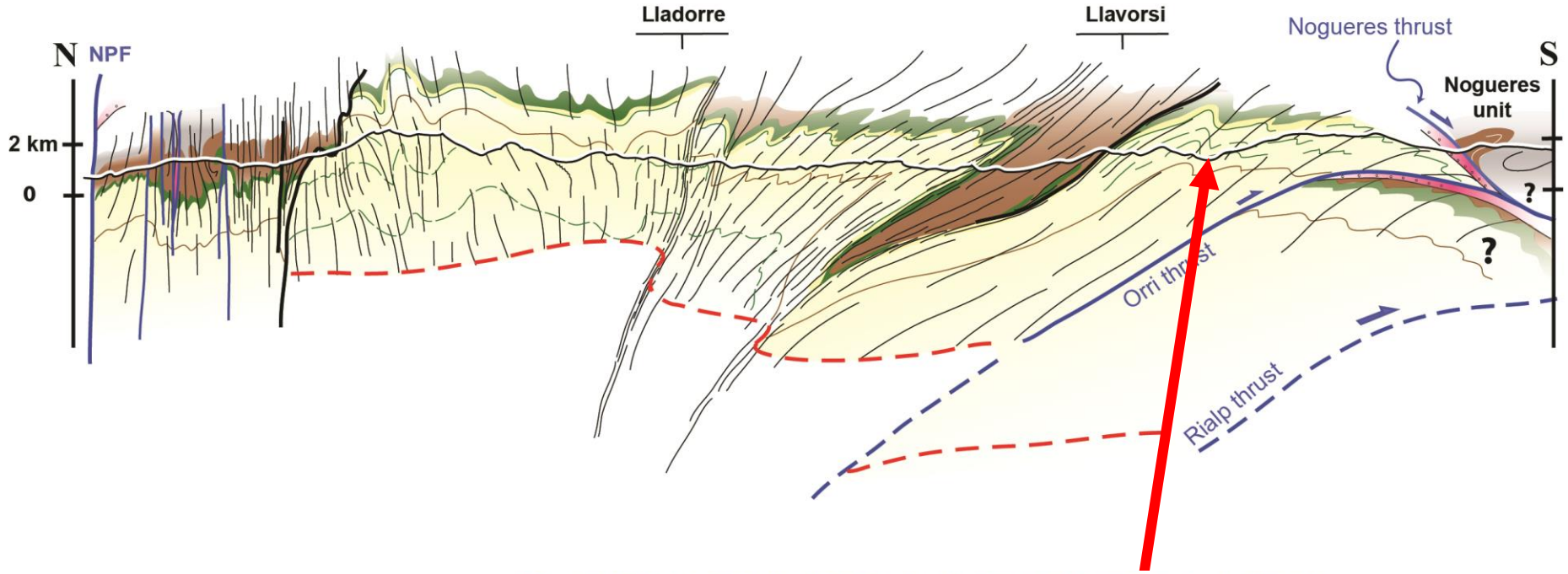


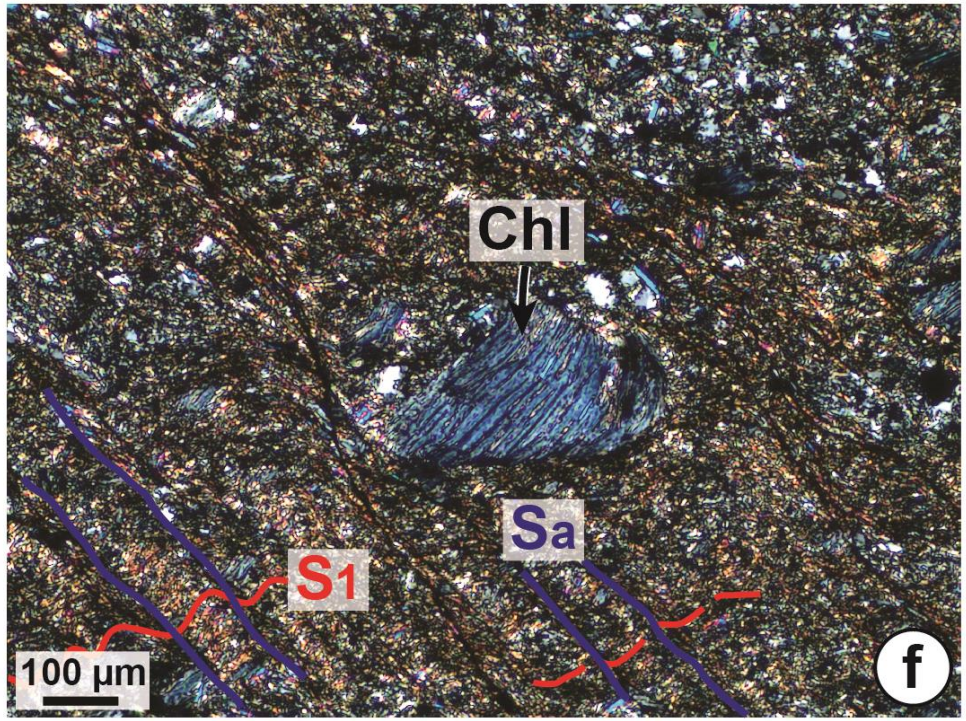
Recristallisation du quartz (20-50 µm)
Rotation de sous-grains
&
Bugling

Muscovite

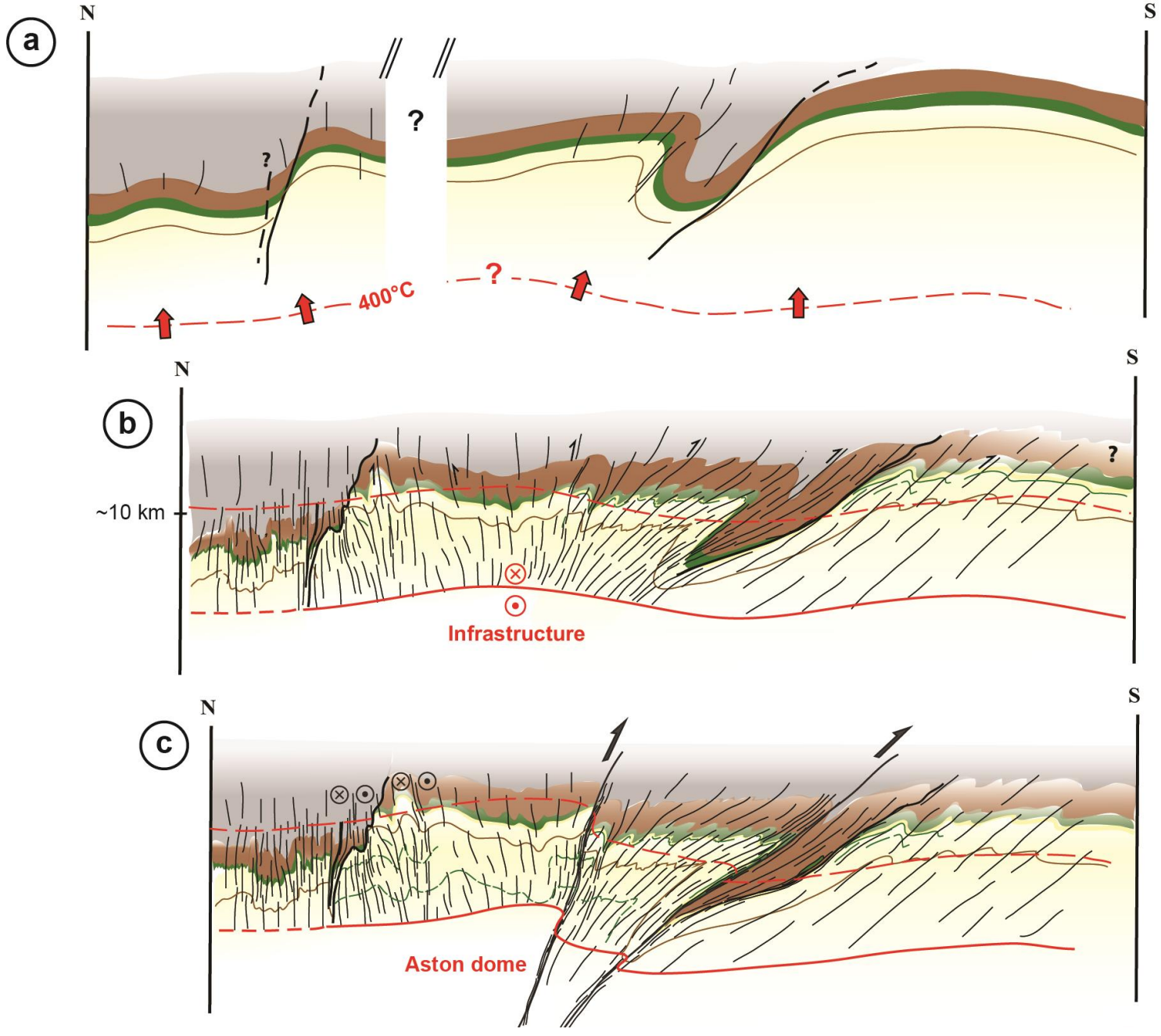
→ **T ~ 400°C**

Etude pétrologique

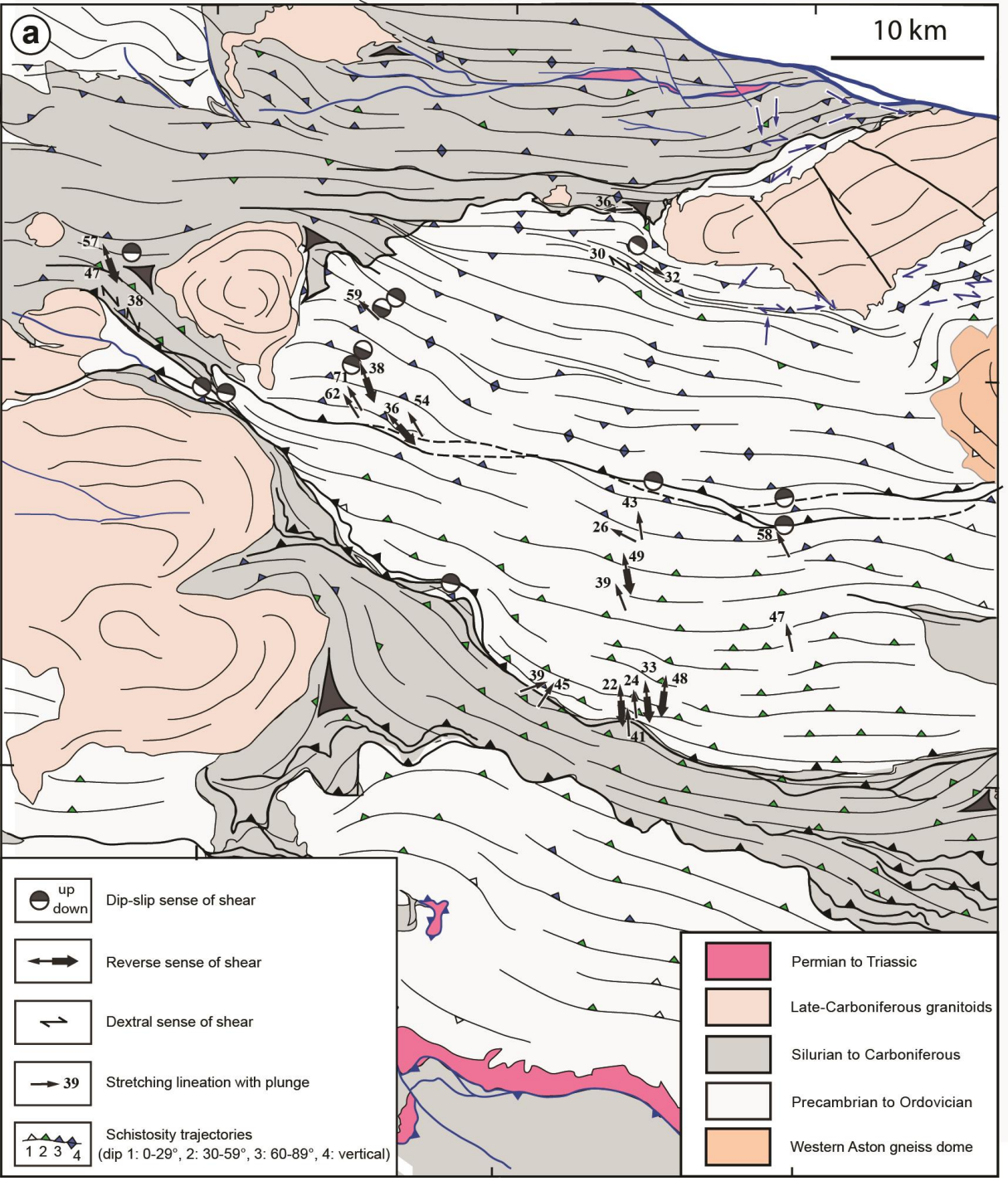


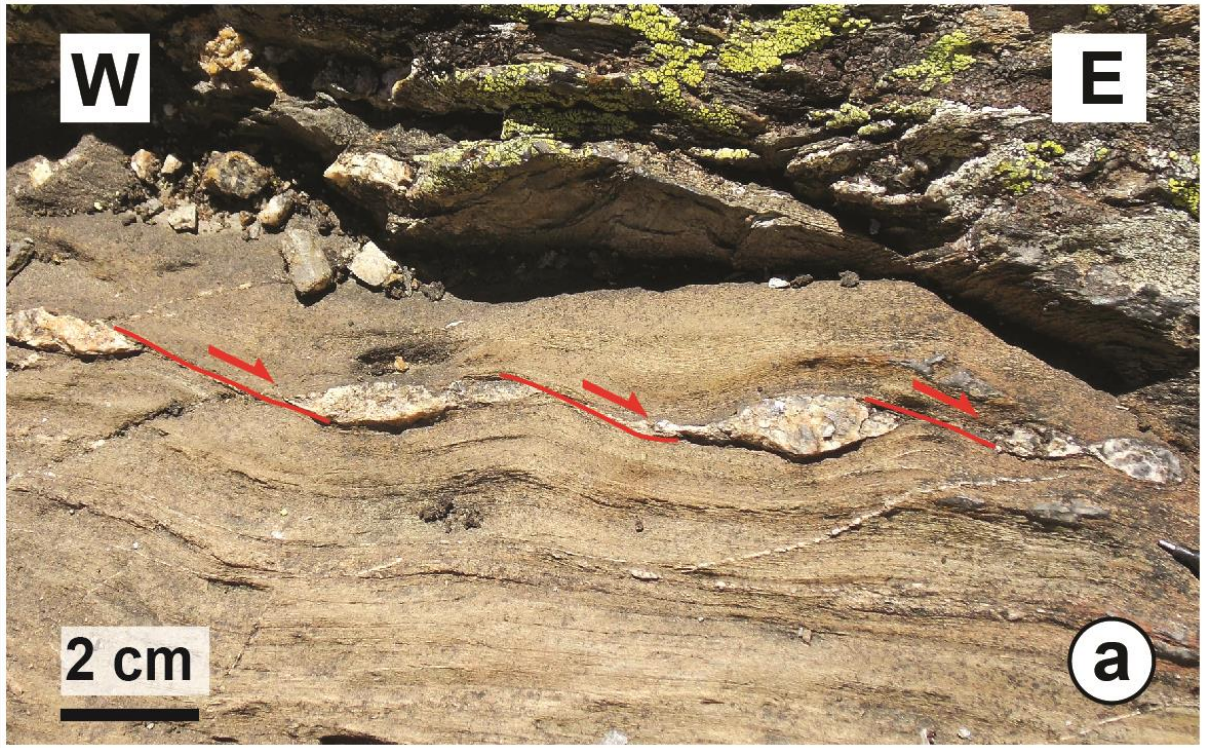


En supplément: le varisque



En supplément: le varisque





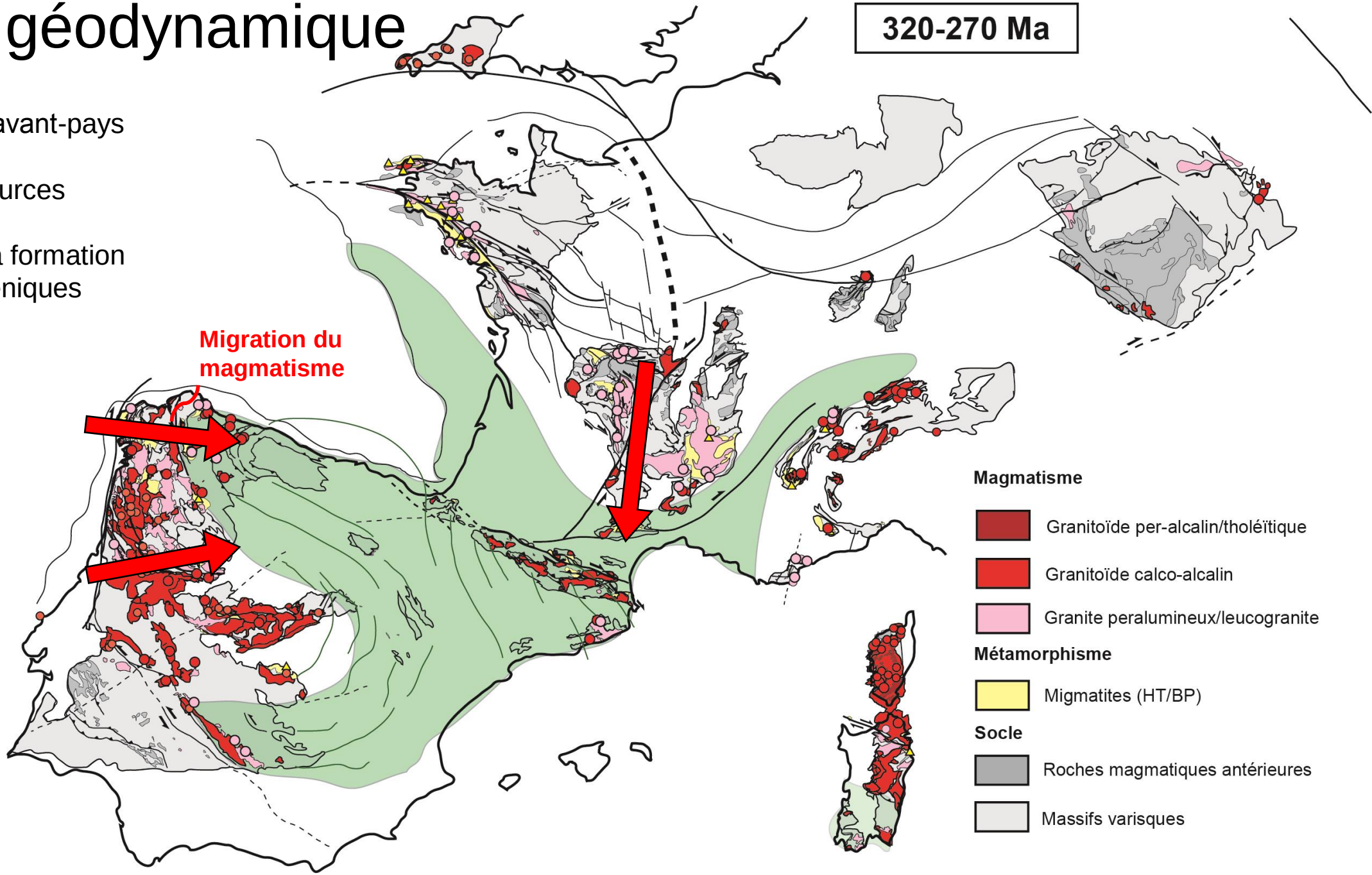
Cinématiques dextres autour des plutons

Contexte géodynamique

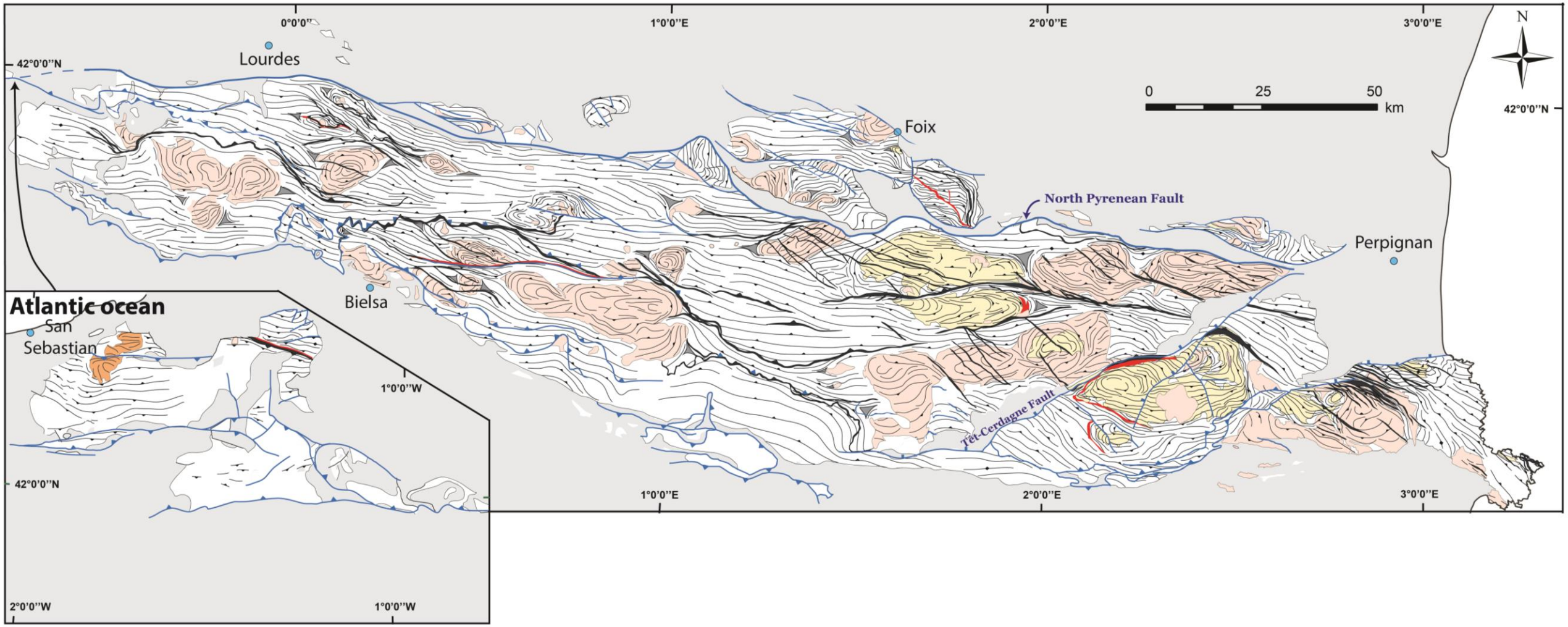
Propagation vers l'avant-pays

Modification des sources

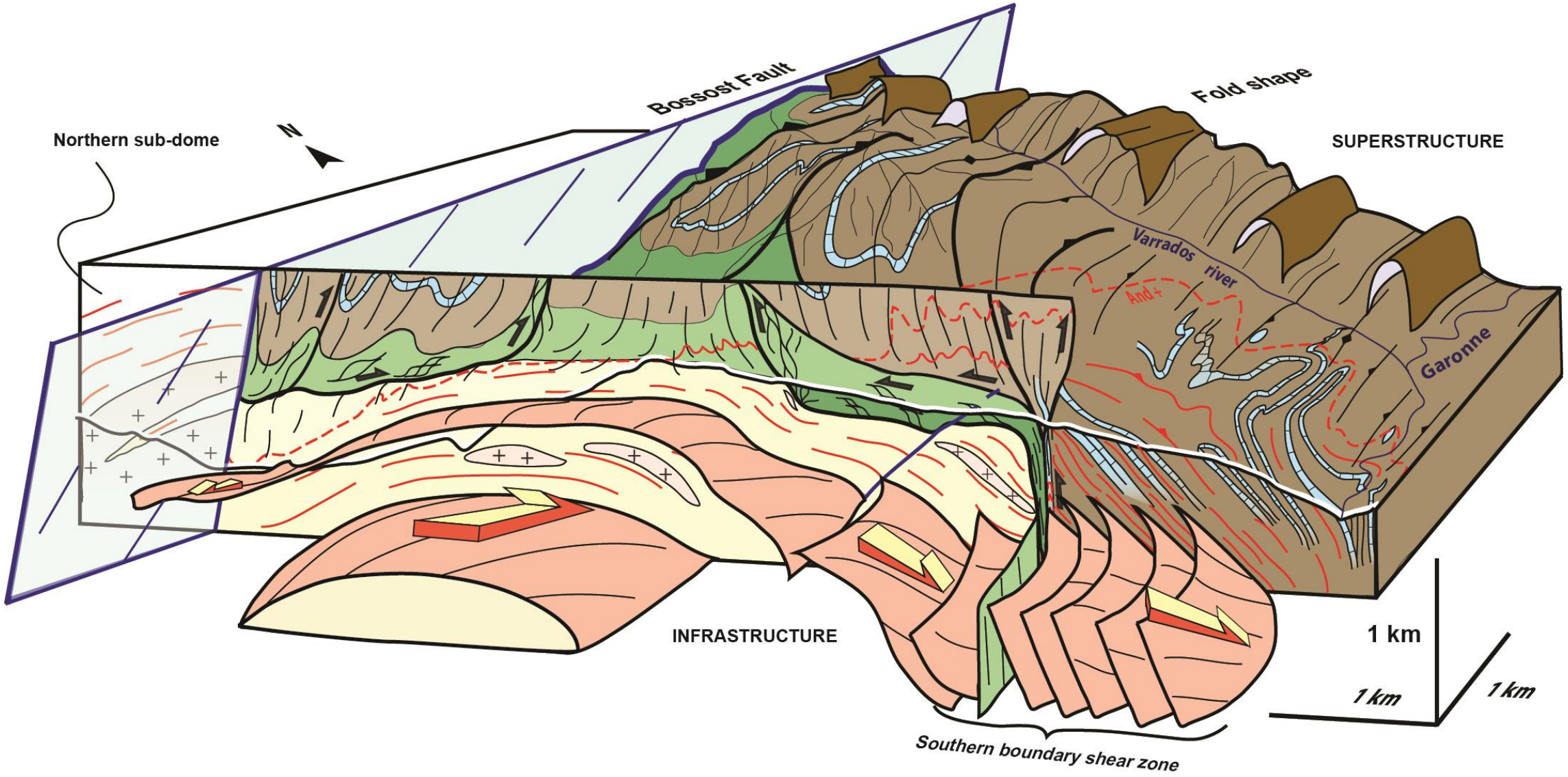
Contemporain de la formation des syntaxes orogéniques



En supplément: le varisque



En supplément: le varisque



En supplément: le varisque