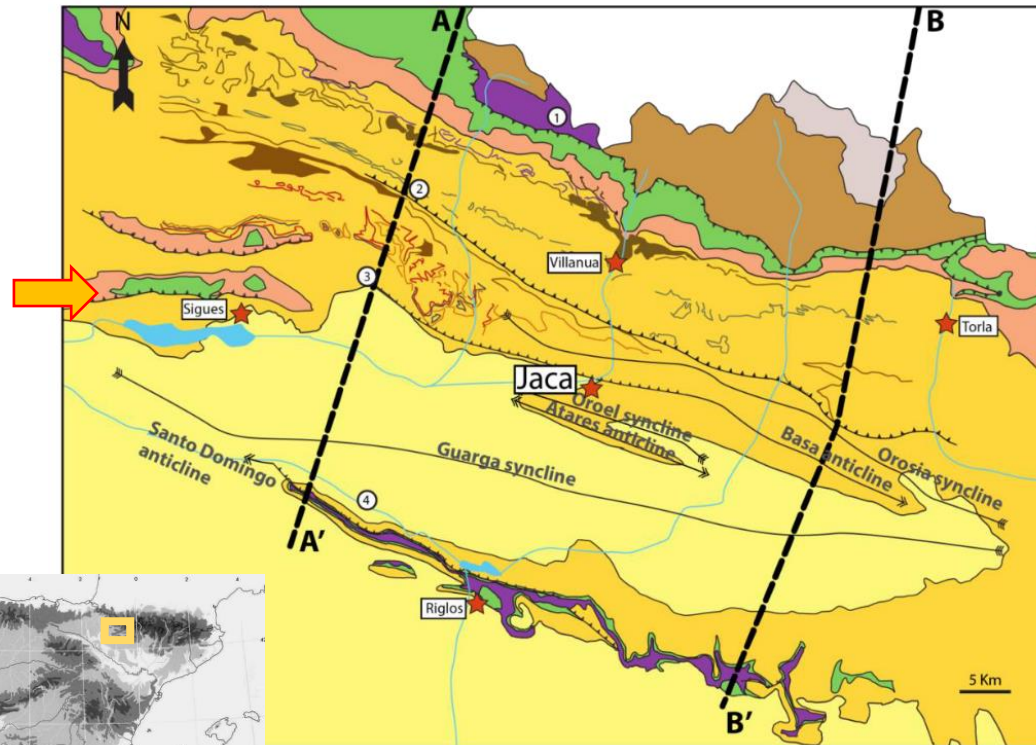


REVERSE FAULT PROPAGATION IN SHALES AND ASSOCIATED DECAMETRIC DEFORMATION GRADIENTS

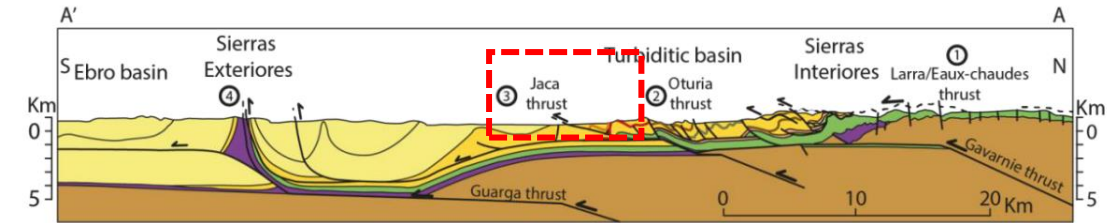
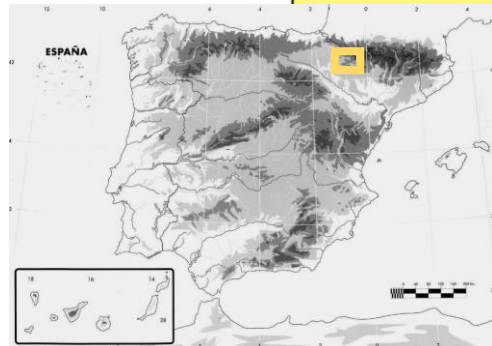
Francho Gracia Puzo (1,2), Charles Aubourg (1), Antonio Casas-Sainz (2)

¹Université de Pau et Pays de l'Adour, Laboratoire des Fluides Complexes et Leurs Reservoirs, Geosciences, France (fgpuzo@univ-pau.fr)

²Geotransfer Research Group (IUCA), Universidad de Zaragoza, Spain,



From Crognier, 2016.



From Teixell et al. 1996

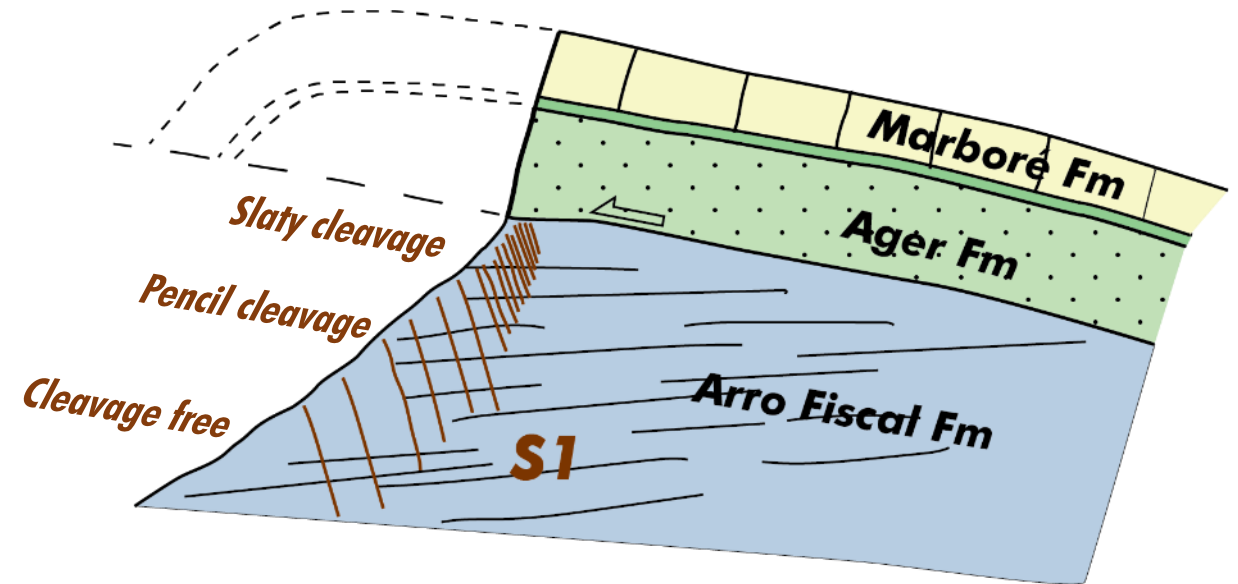
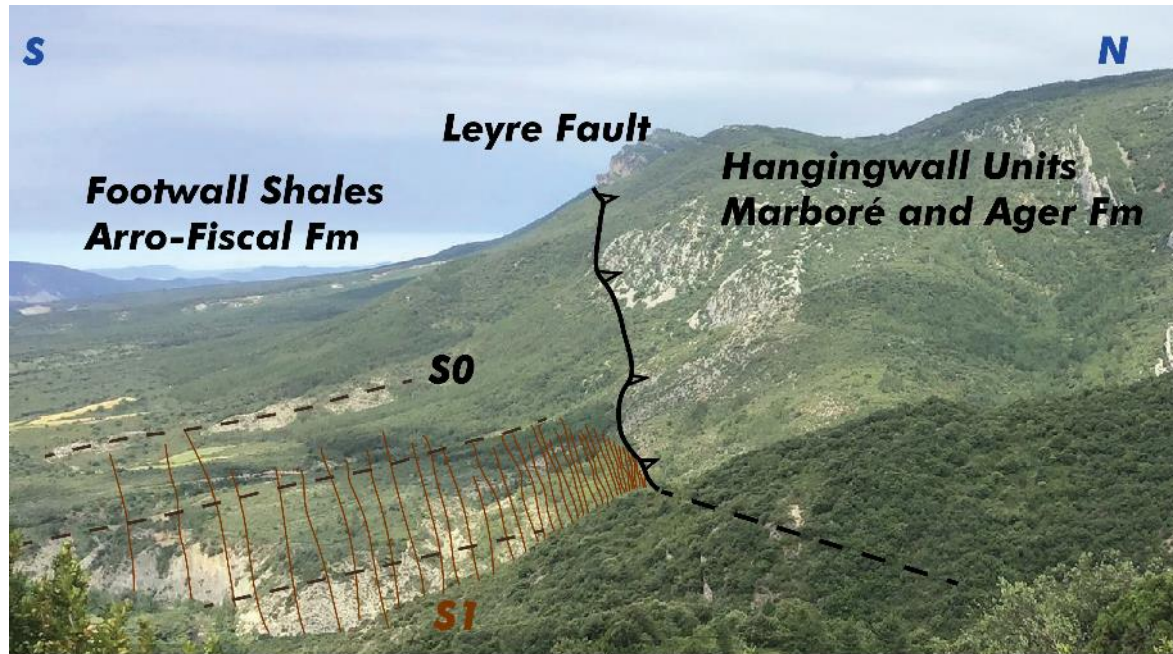
South Pyrenean fold-and-thrust belt

Jaca Piggyback basin - four main subunits

- Internal Sierras (Cretaceous and Paleocene)
- Turbiditic basin (Eocene)
- Molassic basin (Eocene to Miocene)
- External Sierras (Cretaceous to Miocene)

DEFORMATION IN SHALES: A METHODOLOGY

Faults are present in basins and orogens, and the damage they cause to rock is of interest in many disciplines of geology.



Leyre structure: cleavage is observed at hundreds of meters of extent (Boiron et al. 2020)

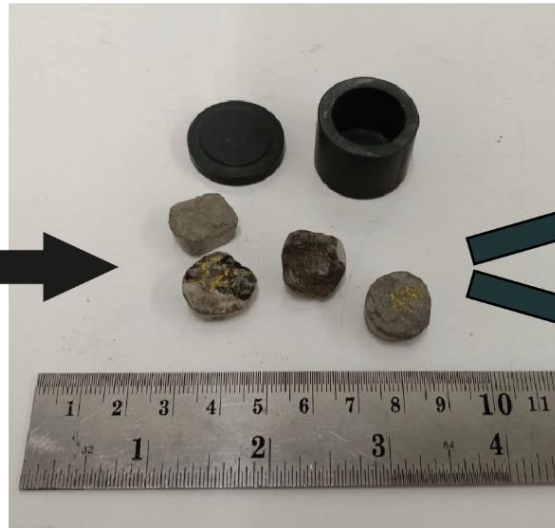
- How to make sure that a shaly formation is not deformed?
- How to describe and frame cleaved shale formations?

DEFORMATION IN SHALES: A METHODOLOGY

Collecting samples in **poorly consolidated** rocks (Gracia Puzo et al. 2021)



Non-destructive < 2min measure



Magnetic fabric scalar data

P, degree of anisotropy

T, shape parameter



Peak burial temperature $\sim 180^{\circ}\text{C}$ \rightarrow illite dominant clay (Boiron et al. 2020)

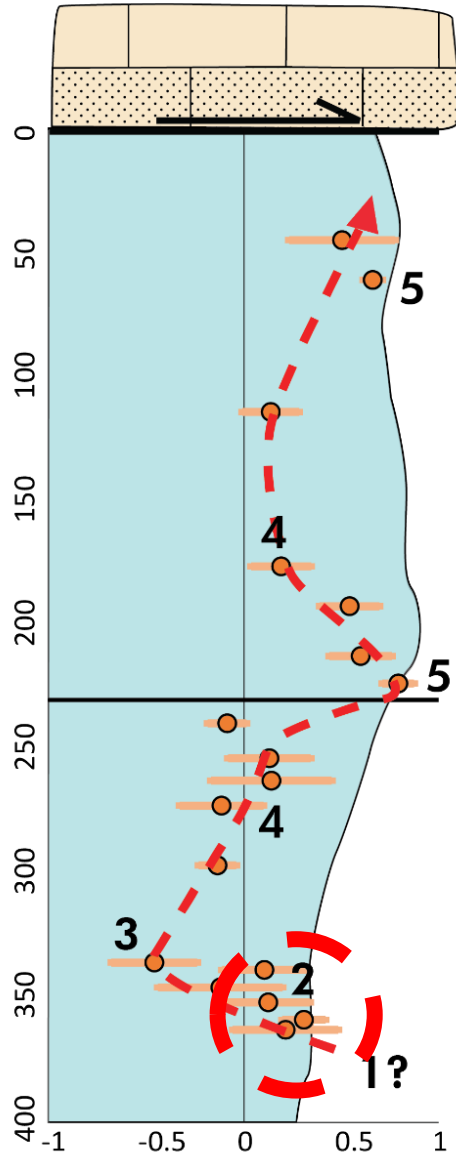
Strain gauge of illite –rich shales

$$\varepsilon = 1 - \sqrt{\frac{\bar{K}_1 - \bar{K}_3}{3(\bar{K}_1 - 1)}}$$

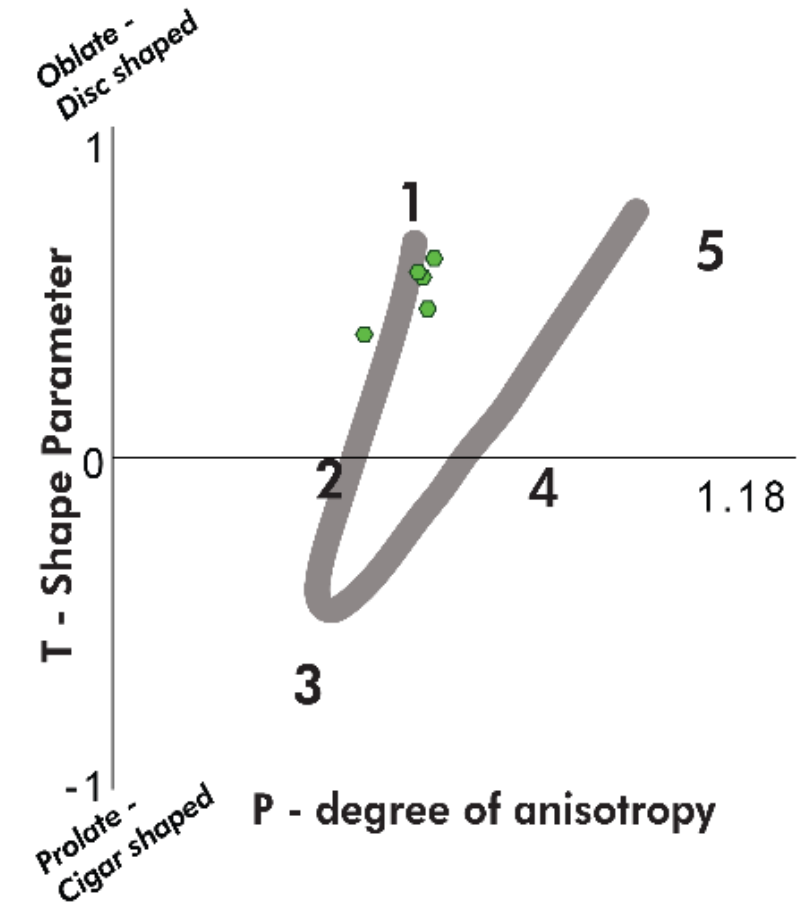
$$\varepsilon = 1 - \sqrt{\frac{\bar{K}_1 - \bar{K}_2}{3(\bar{K}_1 - 1)}}$$

Humbert et al. 2014

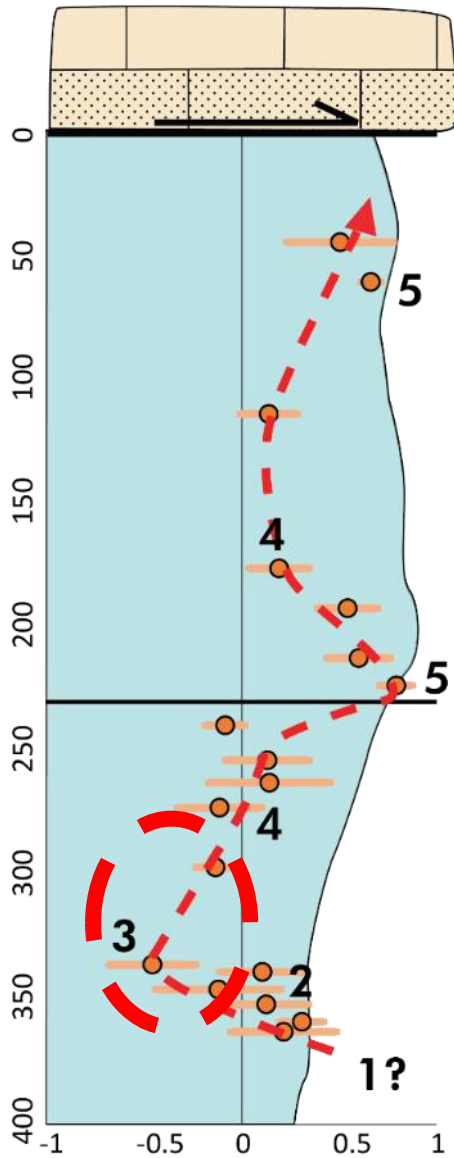
T parameter ESCALAR



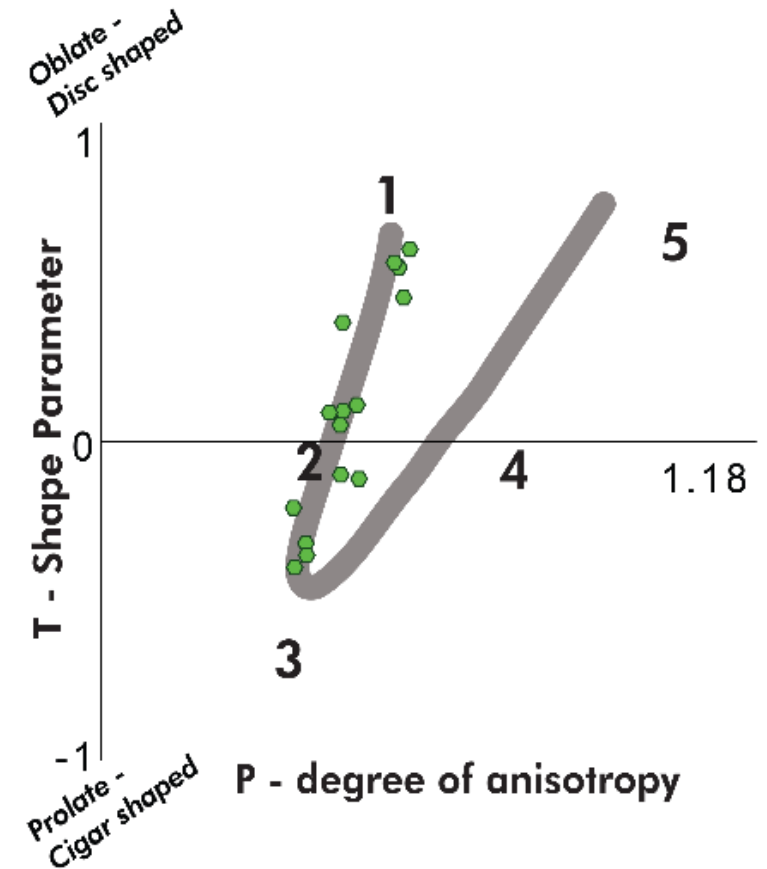
No cleavage domain: S0 fabric



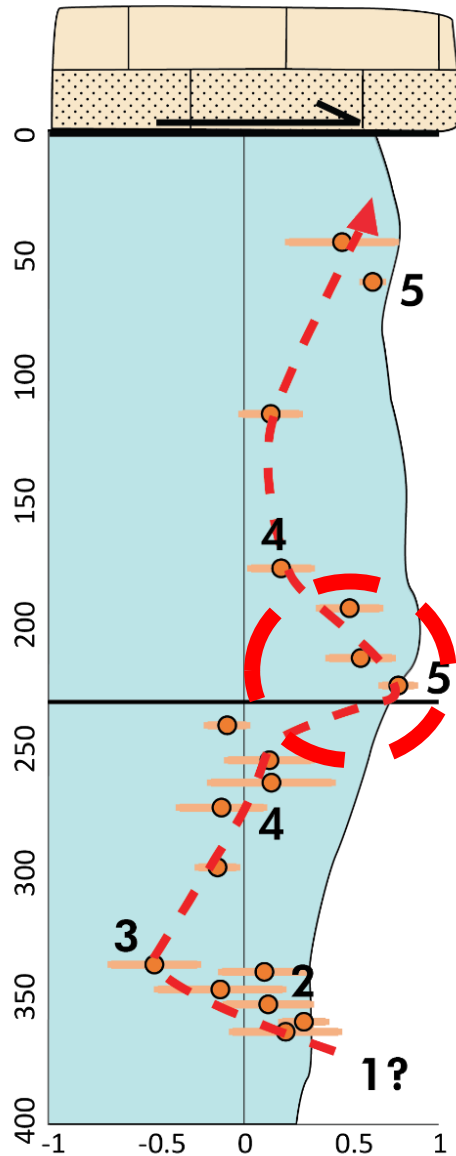
T parameter ESCALAR



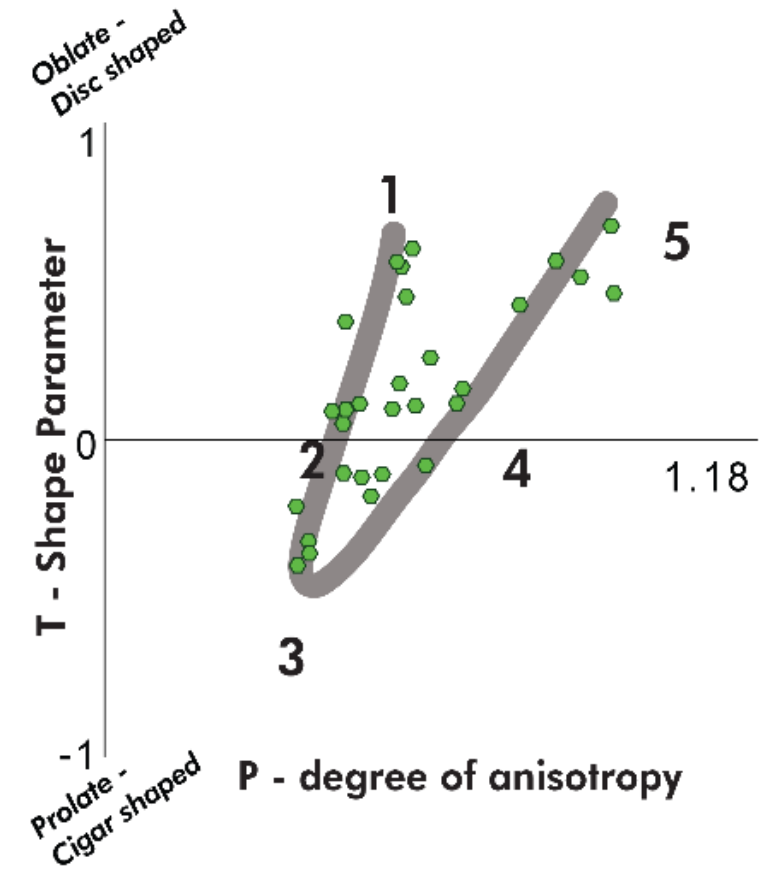
Pencil cleavage domain: S0 and S1 fabric coexist

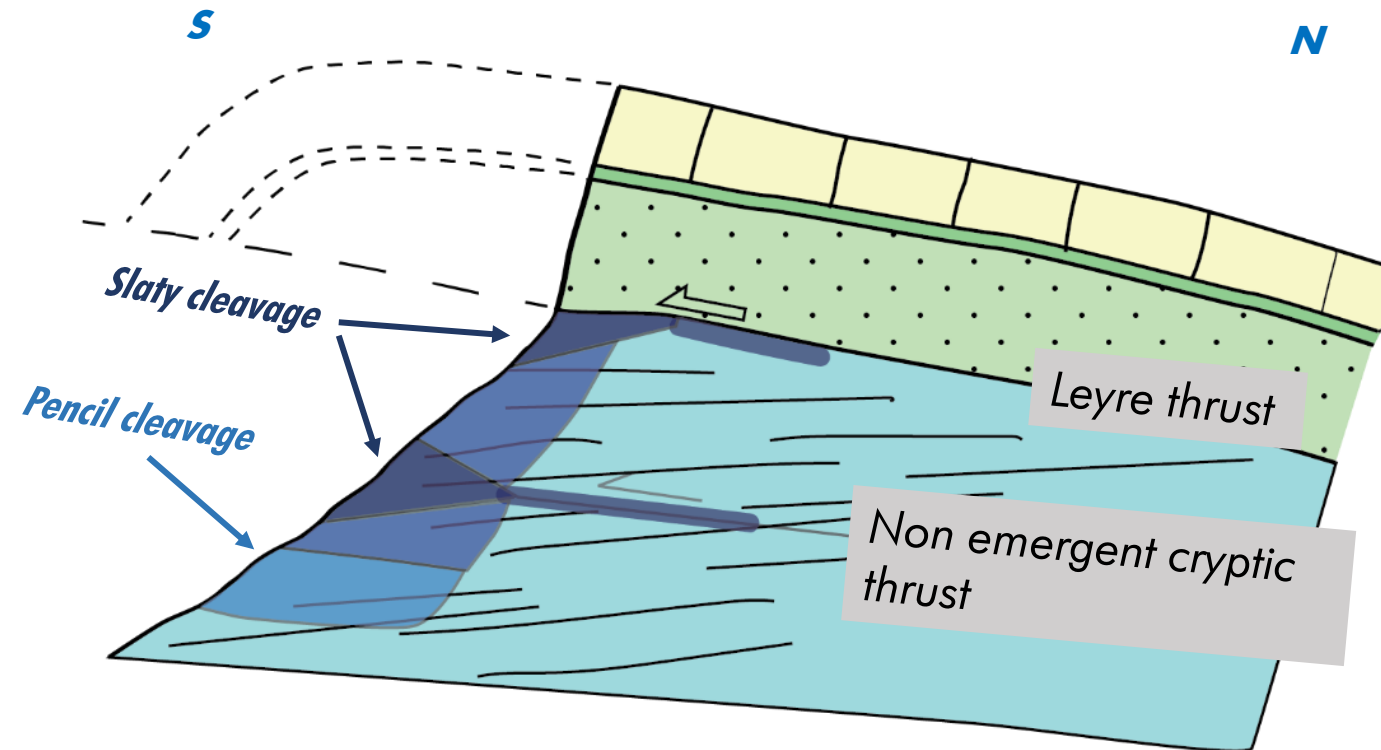
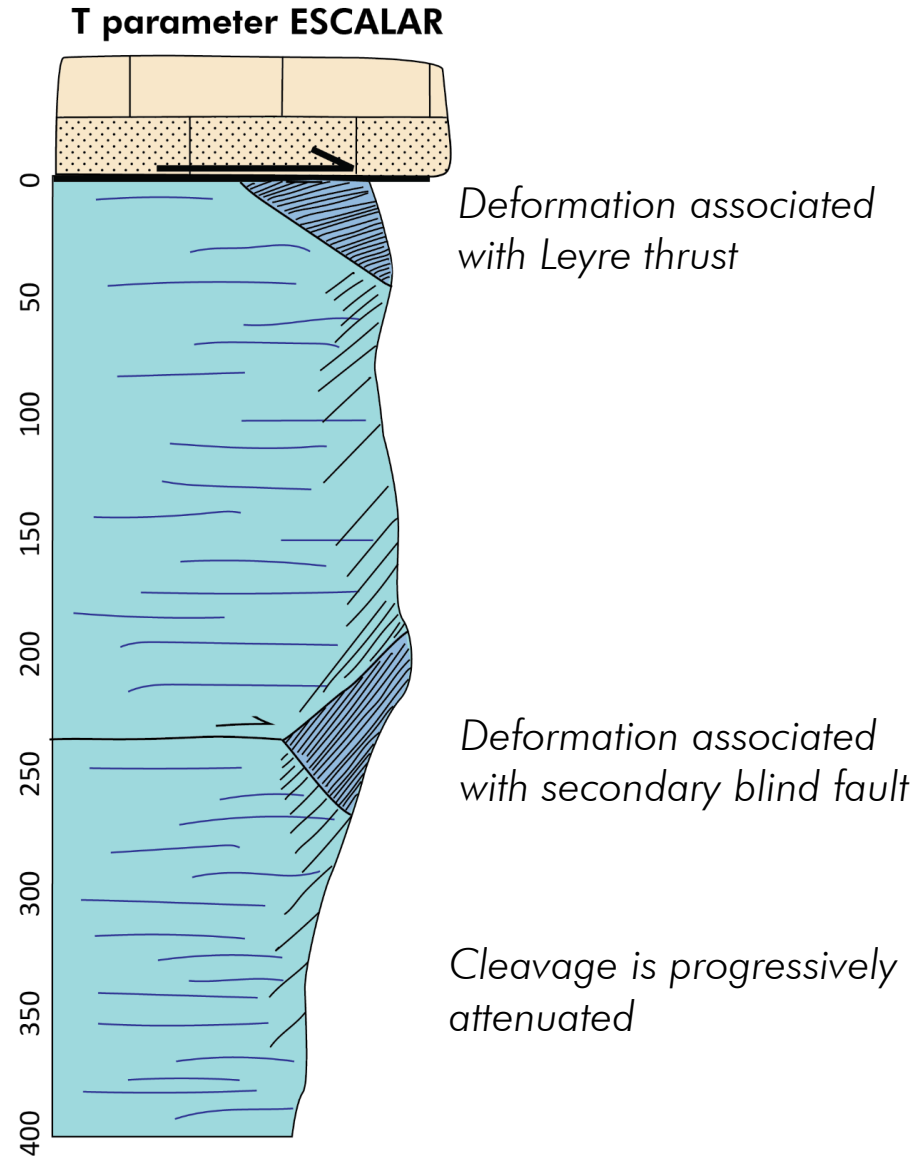


T parameter ESCALAR



Slaty cleavage domain: S1 fabric dominates





Take home message:

- Under the condition of similar mineralogical conditions: **rigid rotation of illite**, this sampling technique makes it possible to explore large areas and to know the state of deformation of the shales.

