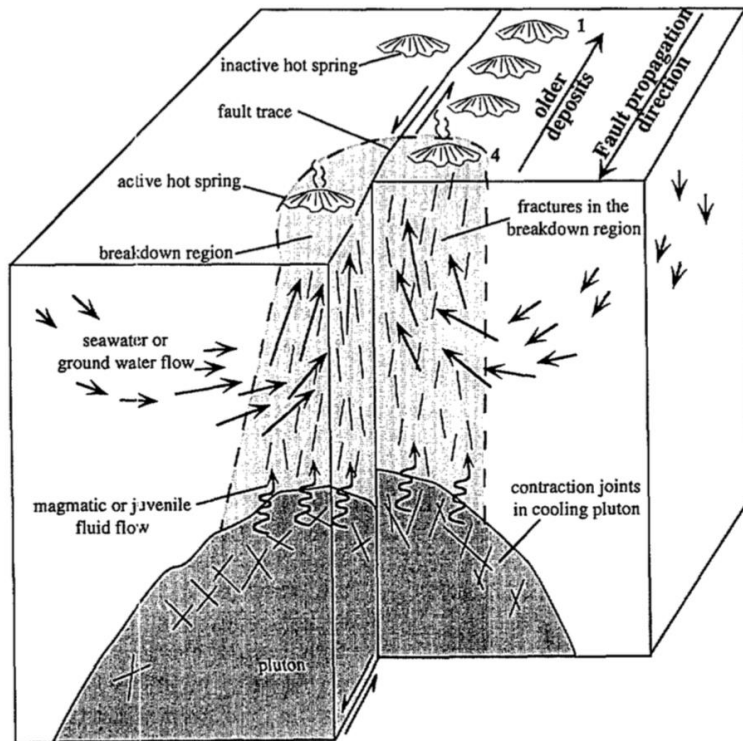


Hydrothermal circulations in Eastern Pyrénées : brittle and ductile faults both act as drains for upward circulations

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Faults and hydrothermal fluids : societal implications



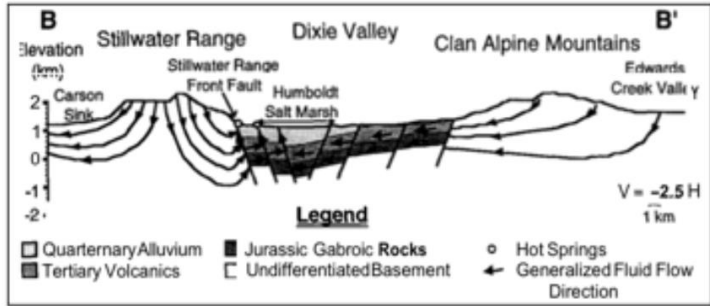
Curewitz & Karson, 1997



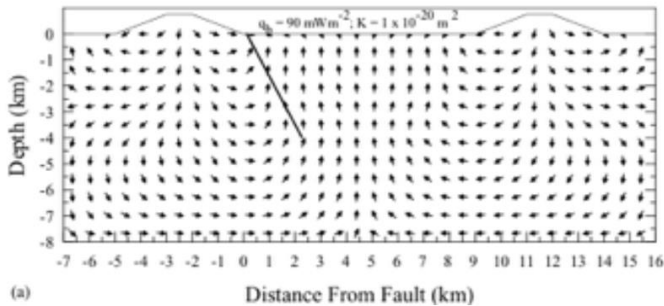
Gretar Ívarsson



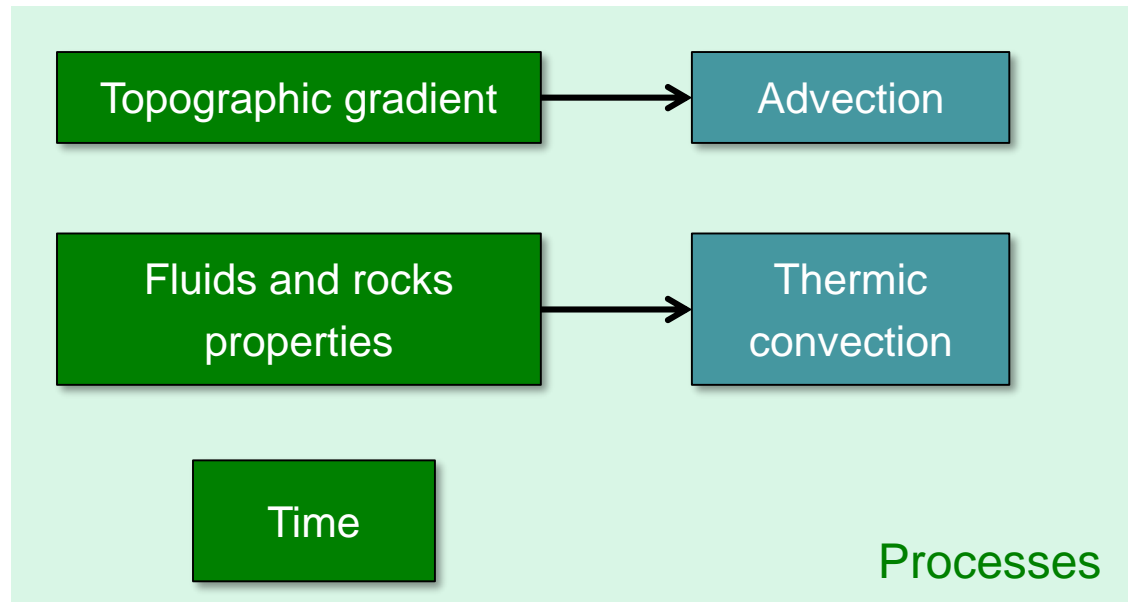
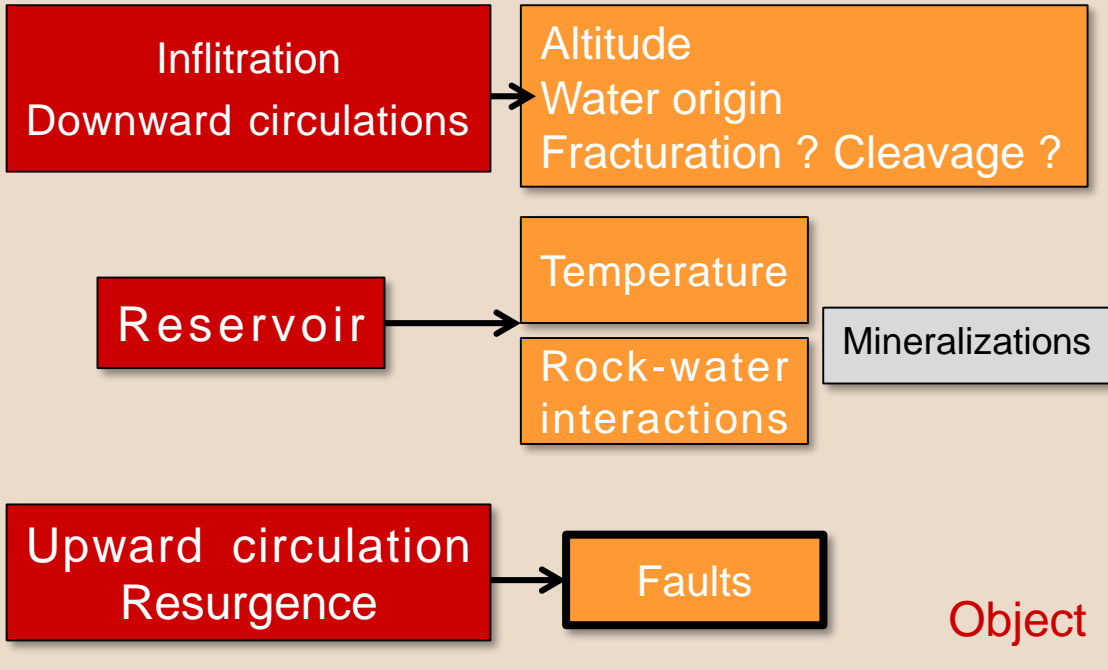
The continental hydrothermal system



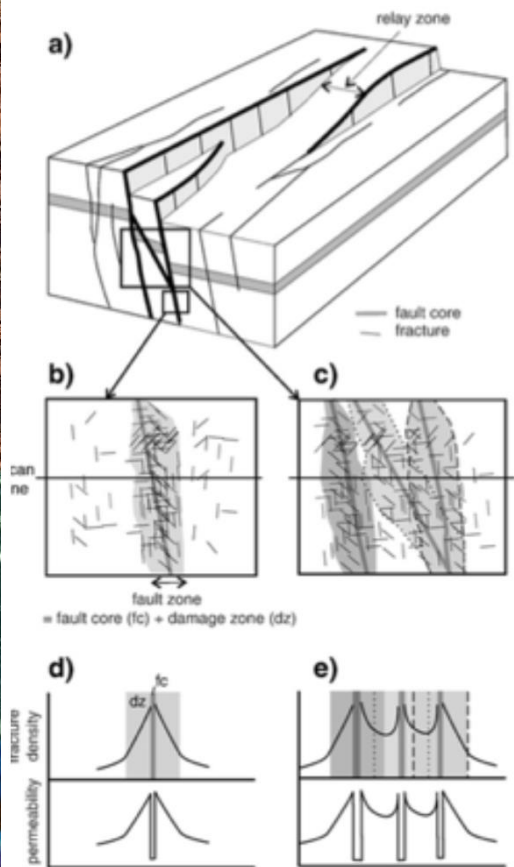
Forster, 1997



Mckenna & Blackwell, 2004

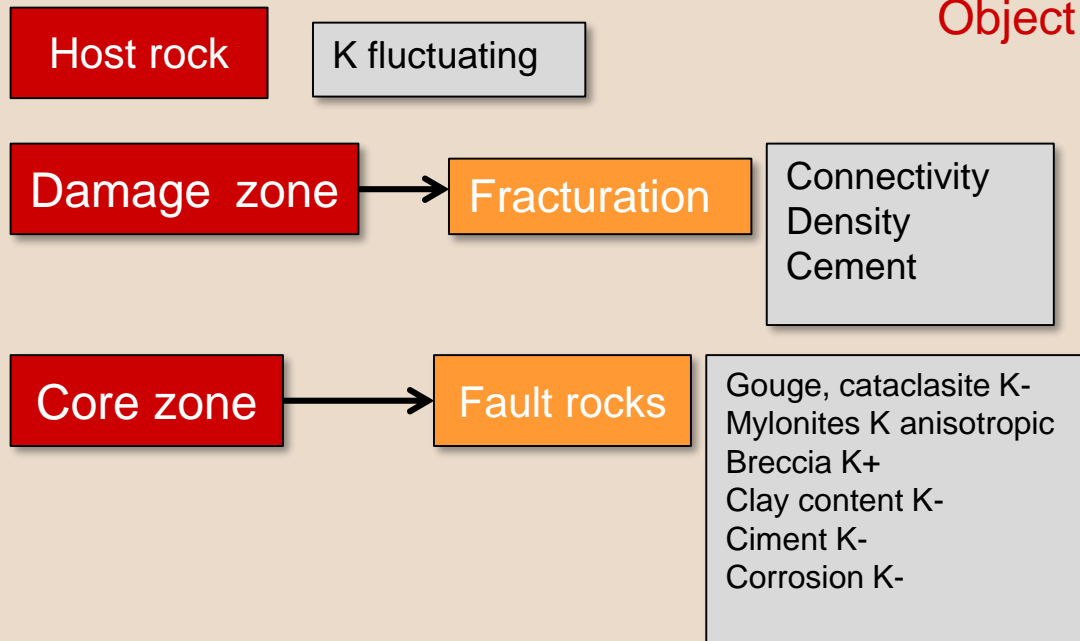


Drains in fault zone

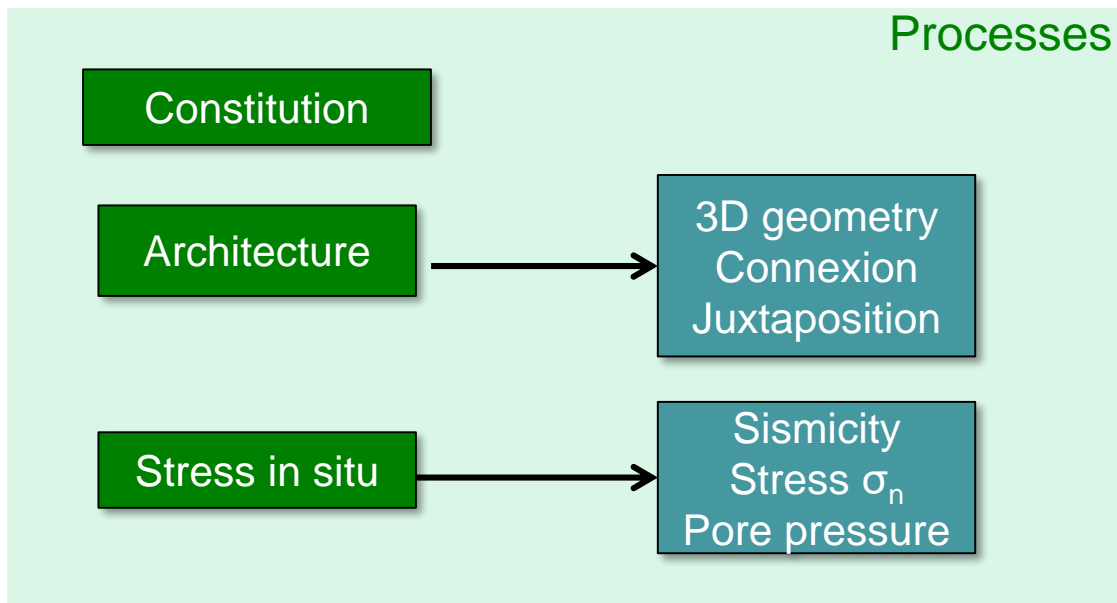


Bense et al, 2013

Object

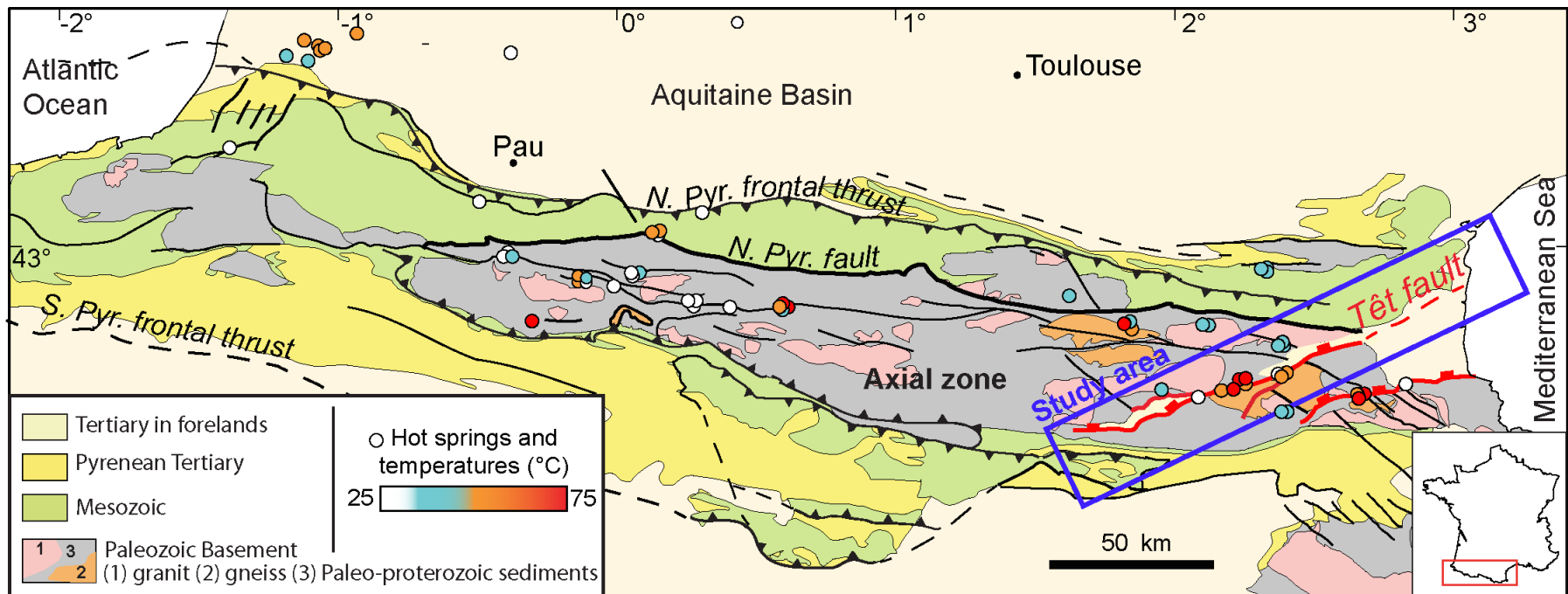
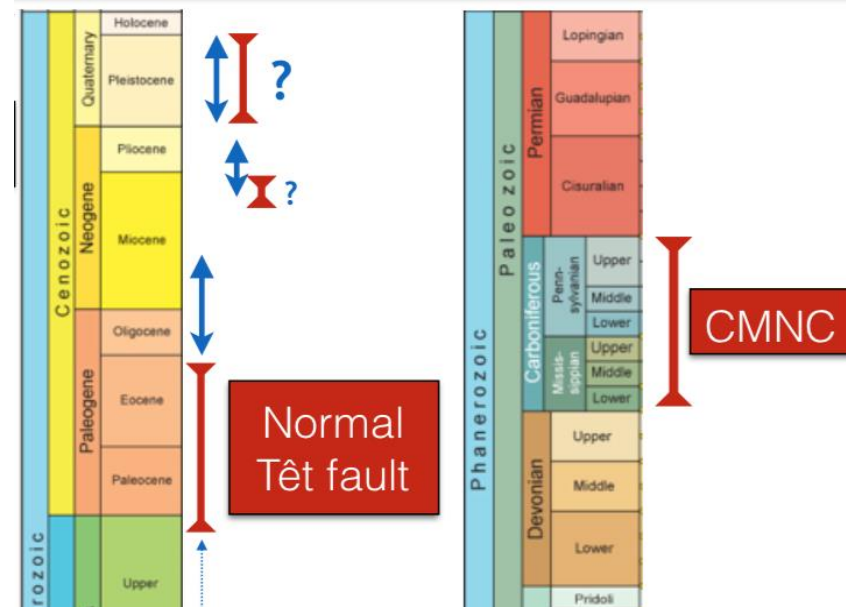


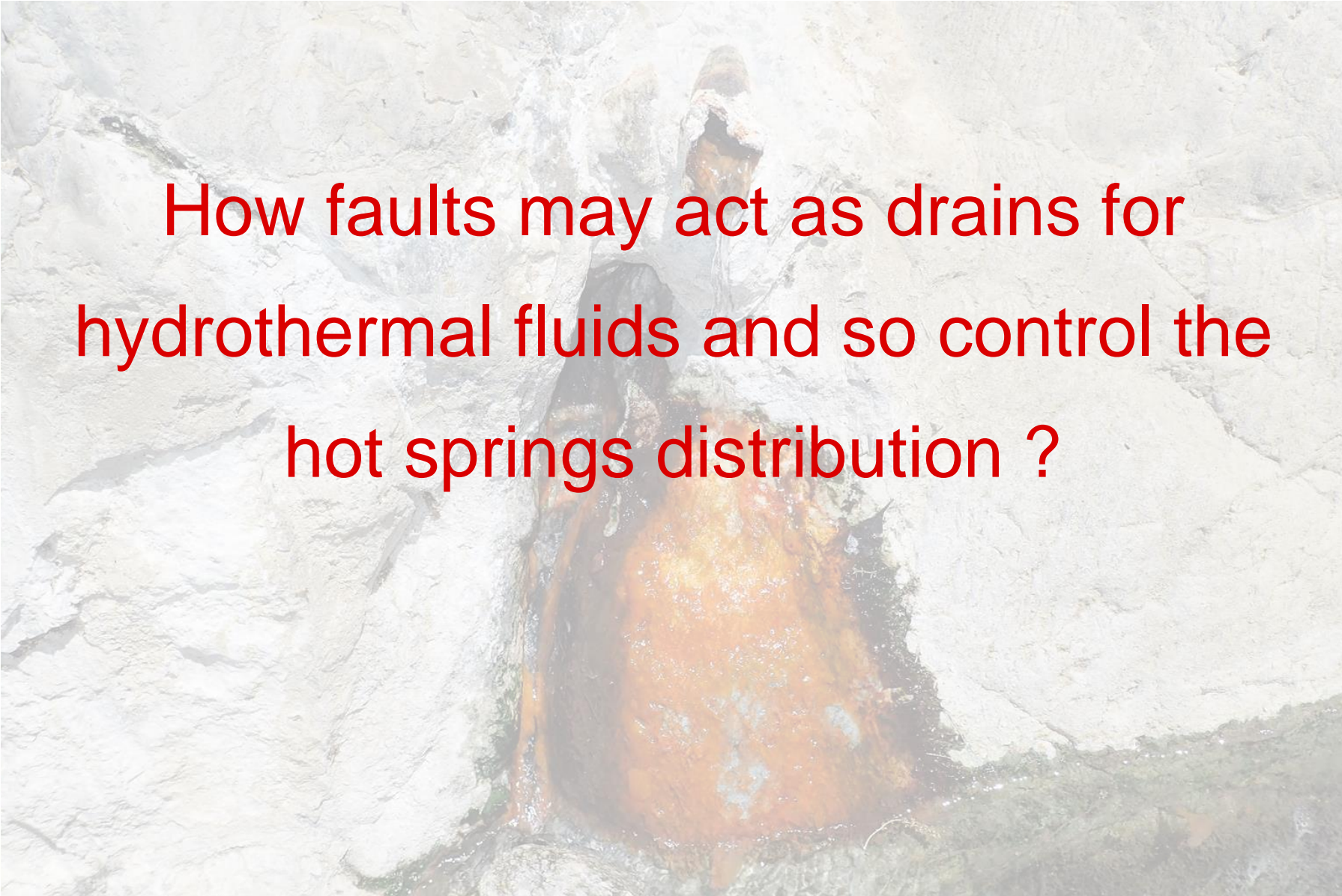
Processes



Hot springs in Eastern Pyrénées

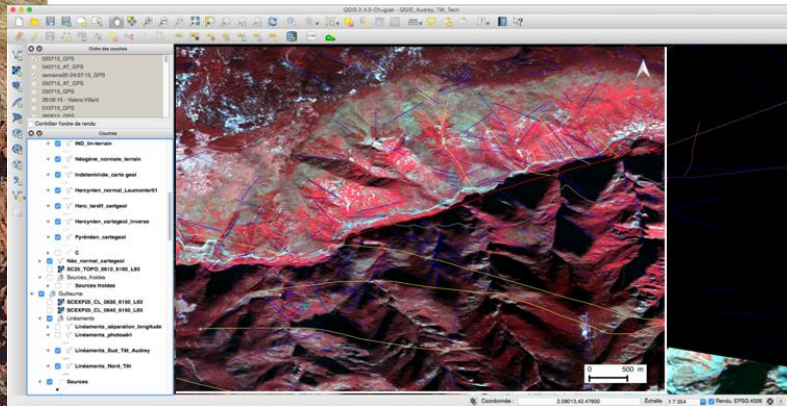
- Rocks properties – Juxtaposition
- Relief
- Seismicity





How faults may act as drains for hydrothermal fluids and so control the hot springs distribution ?

GIS mapping



Datas

- Geological map
- Topographic map
- DEM
- Aerial pictures
- SPOT pictures

Mapped objects

- Hot springs
- Faults trace
- Lineations

Field work

- Faults and joints measurements
- Alteration sampling
- Hot water chemical and physical properties



500 outcrops

Min 30 joint / outcrops

Min 1 outcrop / km²



Inclinometer smartphone application

Numerical modelling COMSOL

Heat transfert in a porous media

k_{medium} (W/m/K) thermal conductivity

ρ_{fluid} (kg/m³) density f(T)

ρ_{medium} (kg/m³)

Cp_{medium} (J/kg/K) heat capacity

Normal thermic gradient f(p)

Lateral boundaries : thermal insulation

Model base : heat flow

Surface temperature

Darcy Law

ρ_{fluid} (kg/m³) density f(T)

μ_{fluid} (Pa.s) viscosity f(T)

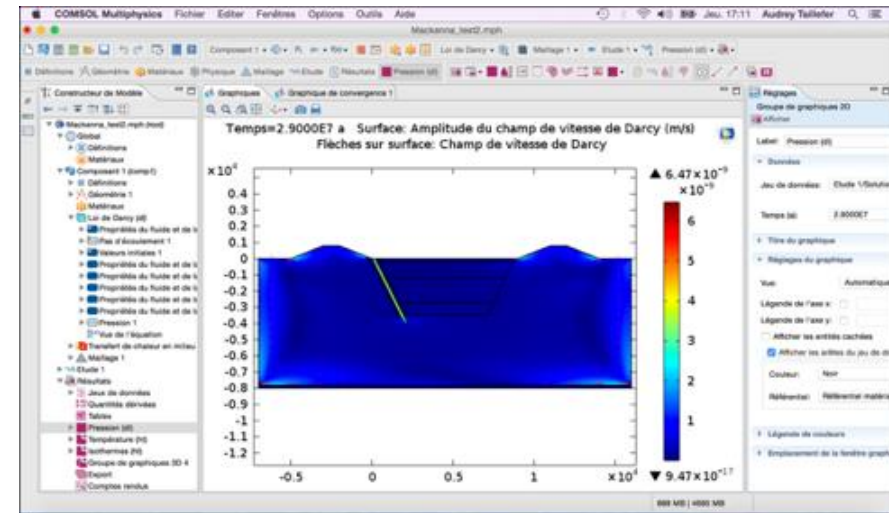
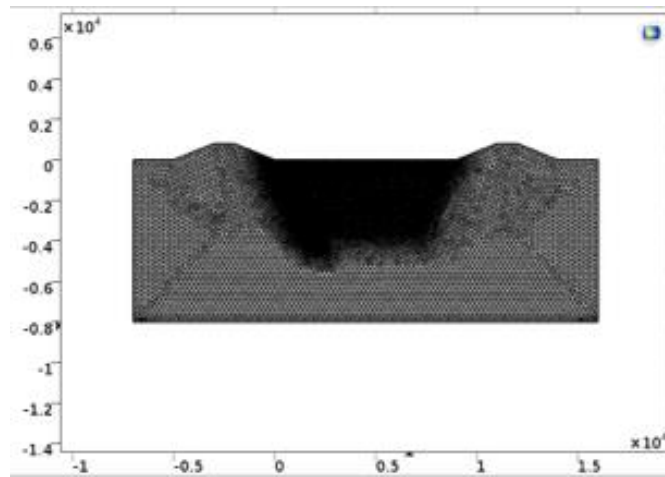
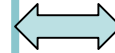
ϕ media porosity

K (m²) permeability (various)

No boundaries flow

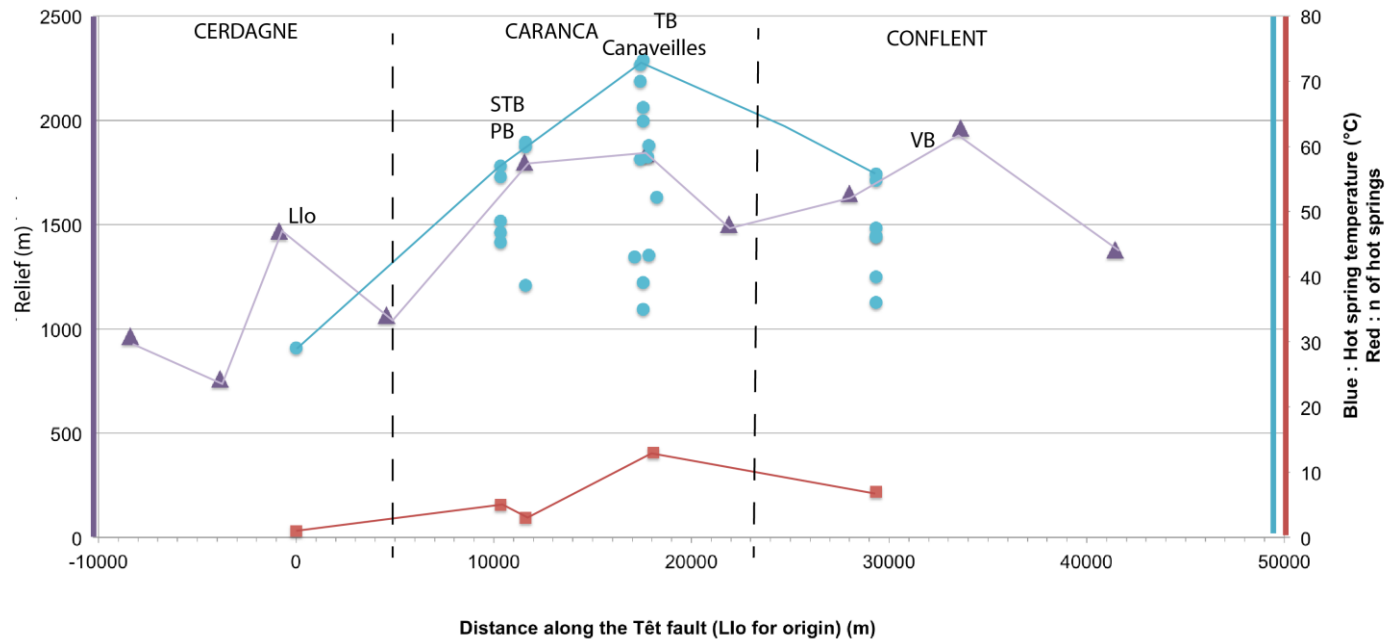
Pressure gradient f(p)

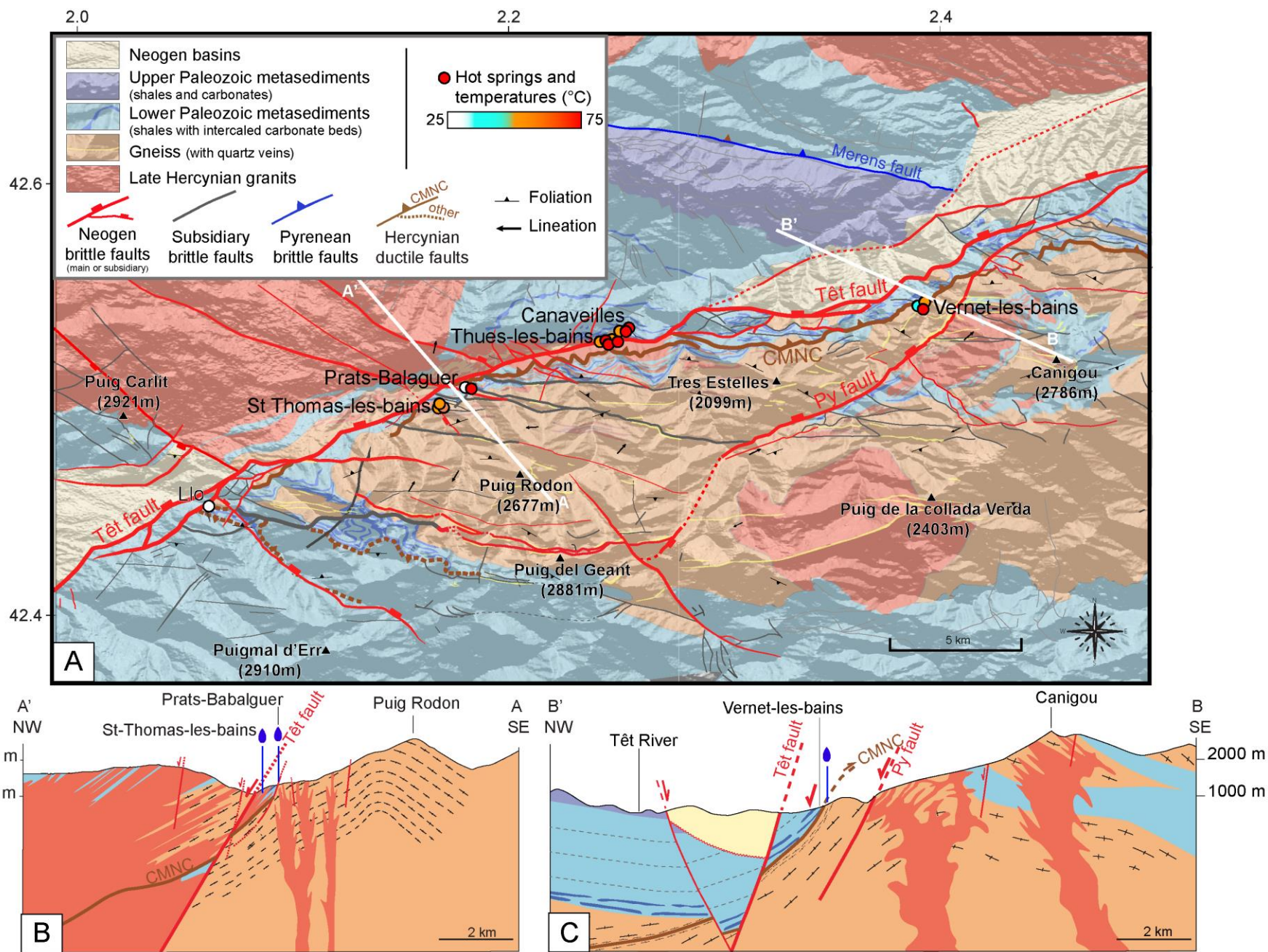
Surface pressure f(altitude)



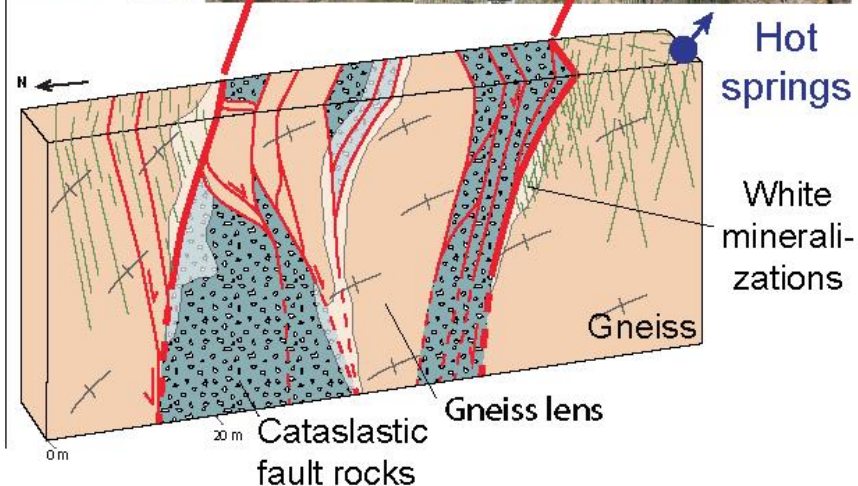
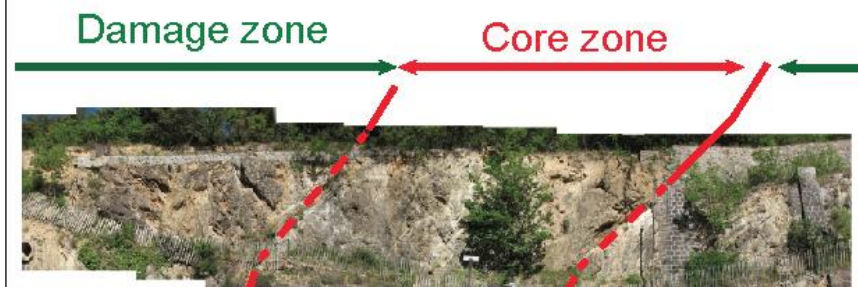
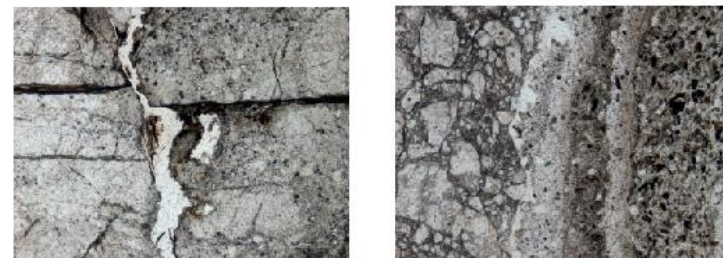
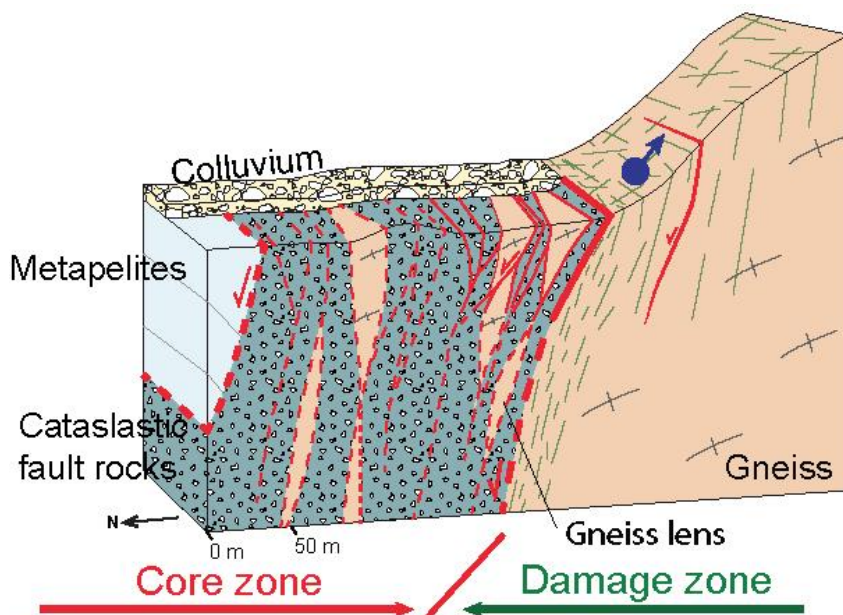


$T (^{\circ} C) \Leftrightarrow$ Hot spring nb \Leftrightarrow Relief

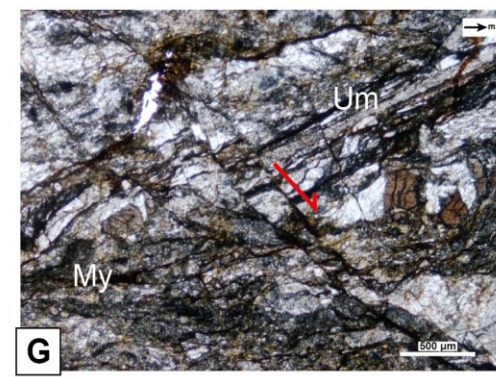
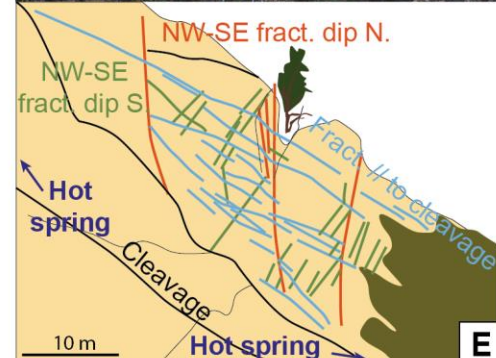
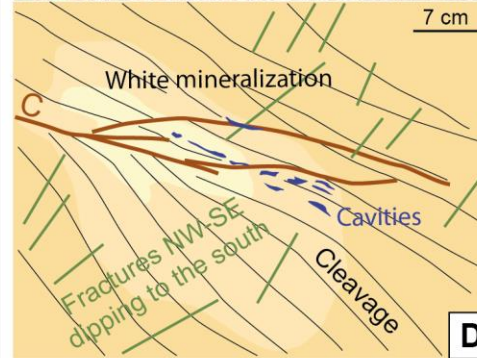
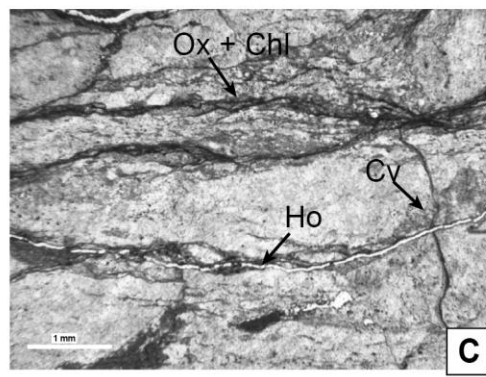
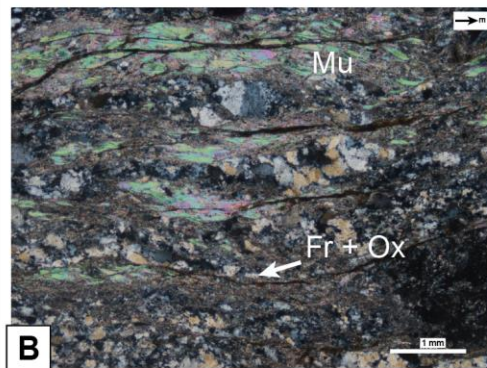




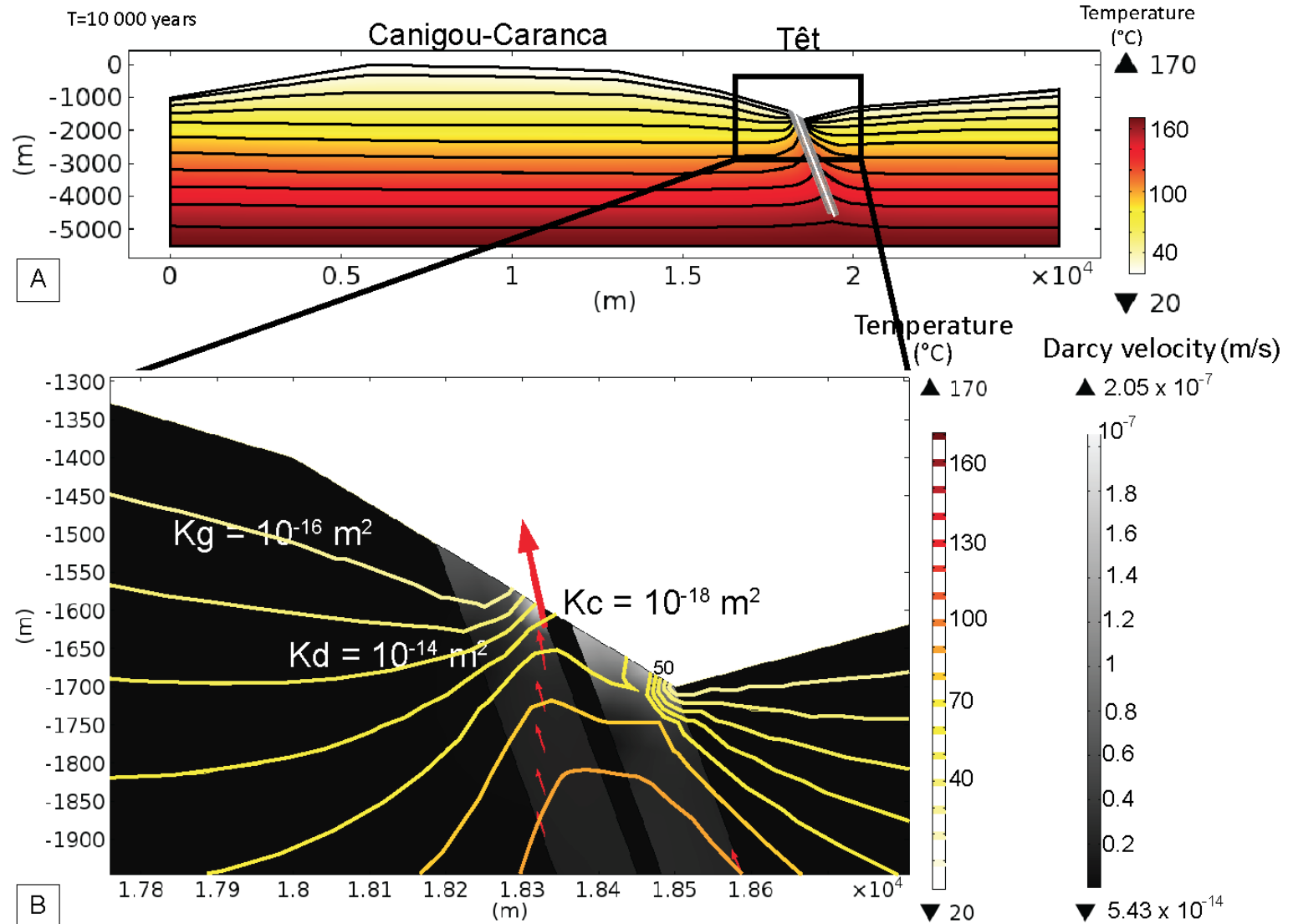
Brittle faults

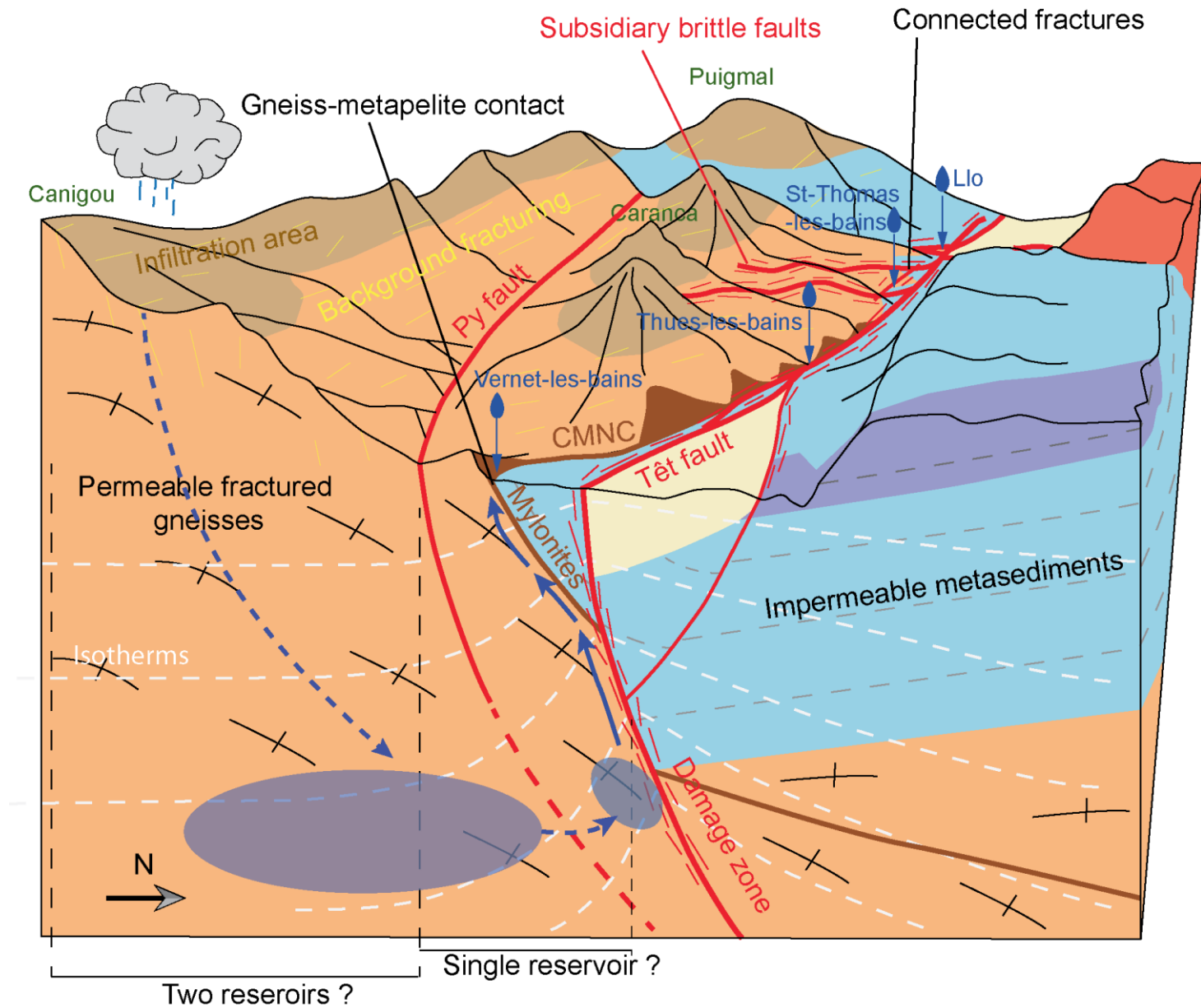


Ductile faults



Thermicity





Brittle and ductile fault both act as drains for hydrothermal fluids.



- Segmentation
- Footwall
- Gneiss / metasediments
- CZ : cataclasite
- DZ intersection : fractures
- Mylonitic dissolution cavities

Thank for your attention !

