

Late-Paleozoic extension in the "Bassin de Lodève", The Pyrenean belt near Montpellier and the opening of the "Golfe du Lion" - Languedoc, South of France



© 2016 S. Dominguez

Organized by **Stephane Dominguez** and **Jacques Malavieille**
Géosciences Montpellier, University of Montpellier

Forewords

During the field trip, 3 main topics will be addressed through the observation of typical tectonic structures:

1- The Late-Paleozoic extension in the "Bassin de Lodève"



Triassic (-250 Ma) conglomerates covering unconformably the Permian sediments of the Lodève Basin



Basaltic neck formed during late Quaternary volcanism activity

- The Lodève Permian Basin :

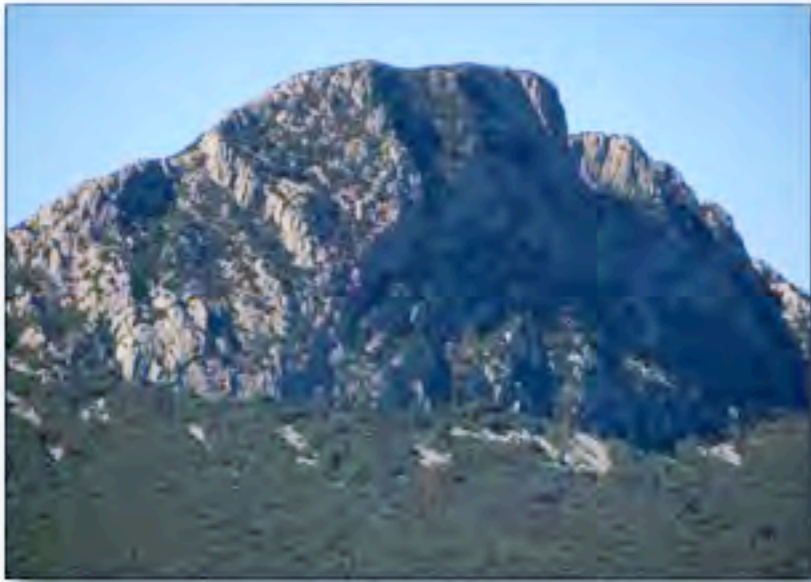
At the end of the Variscan orogeny, a widespread extension thinned the European continental crust forming spectacular basins filled with continental sediments deposited in a hot climatic environment. Fossil prints of Permian pre-mammalian reptilians are well preserved in the muddy sediments of the basin.

- The Quaternary volcanism :

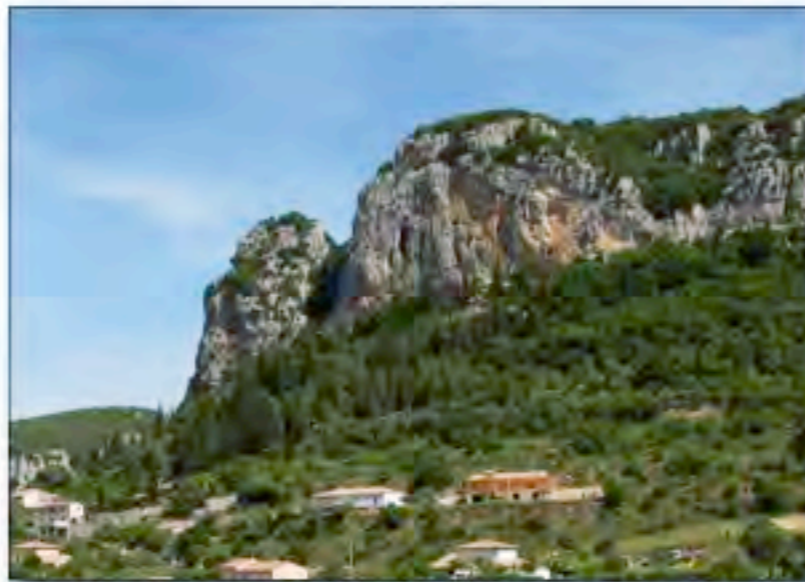
The recent volcanic activity of the "chainon de l'Escandorgue" (-2.5 to -1 Ma) is followed by a regional uplift and river incision that marks the last tectonic and morphologic evolution of the "Bassin de Lodeve" region.

2- The Pyrenean belt in the Languedoc (Eocene)

3- The opening of the "Golfe du Lion" during the Oligo-Miocene



Overtuned Jurassic limestones of the Pic St Loup thrusting Eocene syntectonic series



Uplifted and faulted Mesozoic along the Cevennes left lateral strike slip Fault



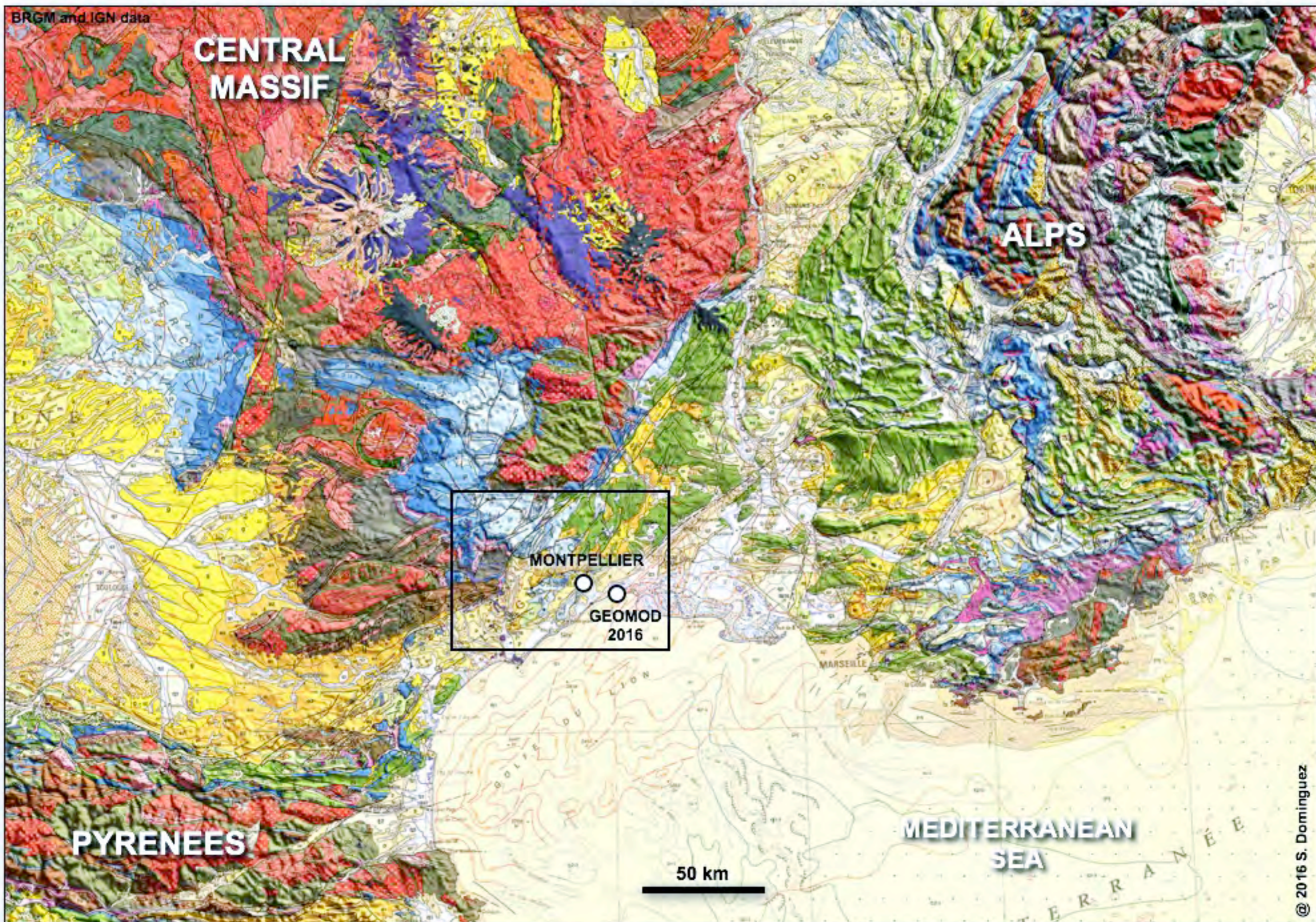
Normal fault plane, cutting Cretaceous limestones, induced by the Oligocene extensional tectonics

- The «Pic St Loup» : This emblematic mountain marks the northernmost front of the Pyrenean belt in Languedoc. The faulted and folded massive Jurassic limestones overthrust the Tertiary continental and lacustrine syntectonic deposits of the Saint Martin de Londres basin.

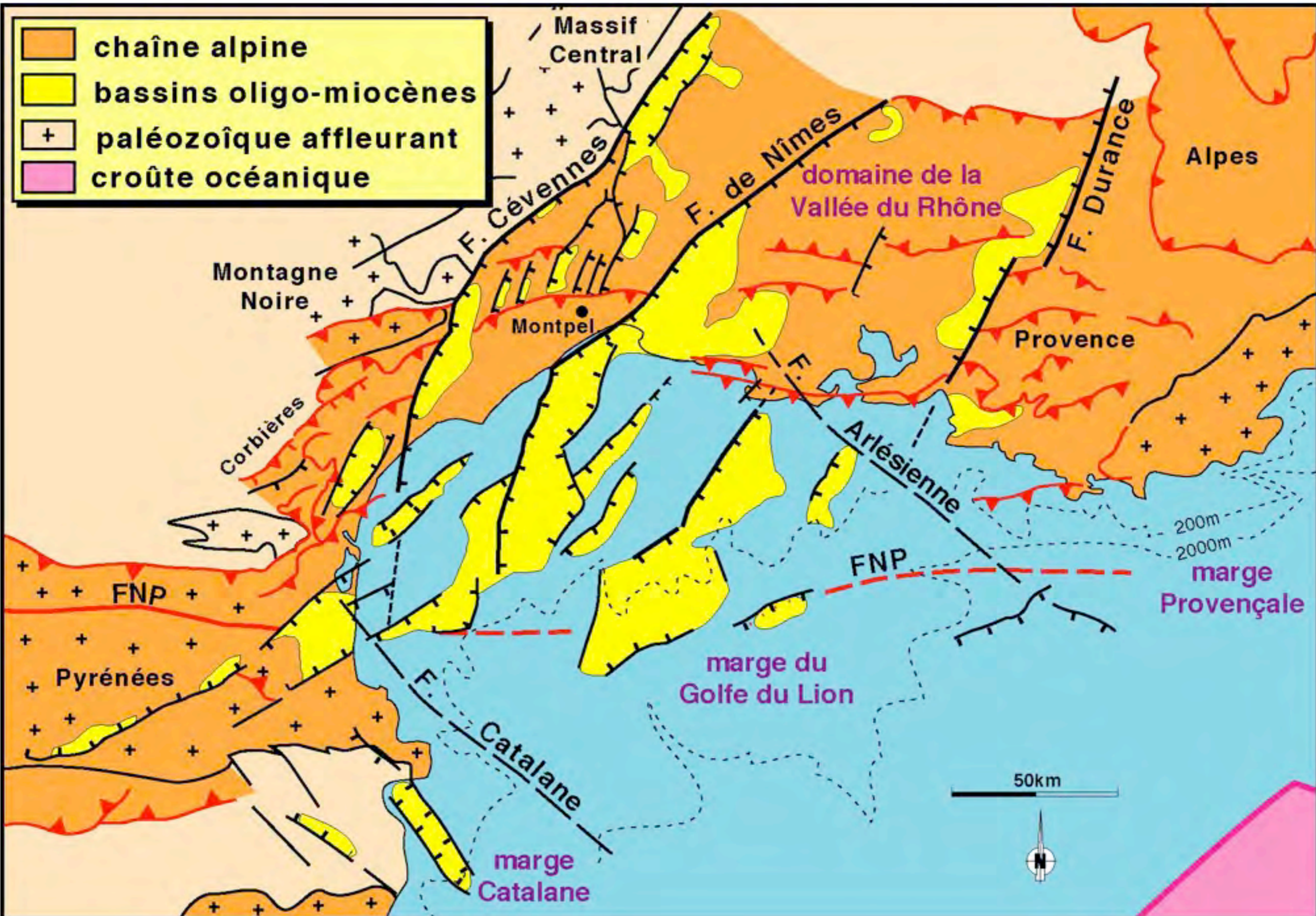
- The «Faille des Cevennes» : This major SW-NE oriented fault zone outlines the main topographic step that bounds the "grands Causses" plateau. Its complex history begins at the end of the Hercynian compressional tectonics. During the Tertiary, left lateral strike slip displacements accommodate the compressional Pyrenean tectonics.

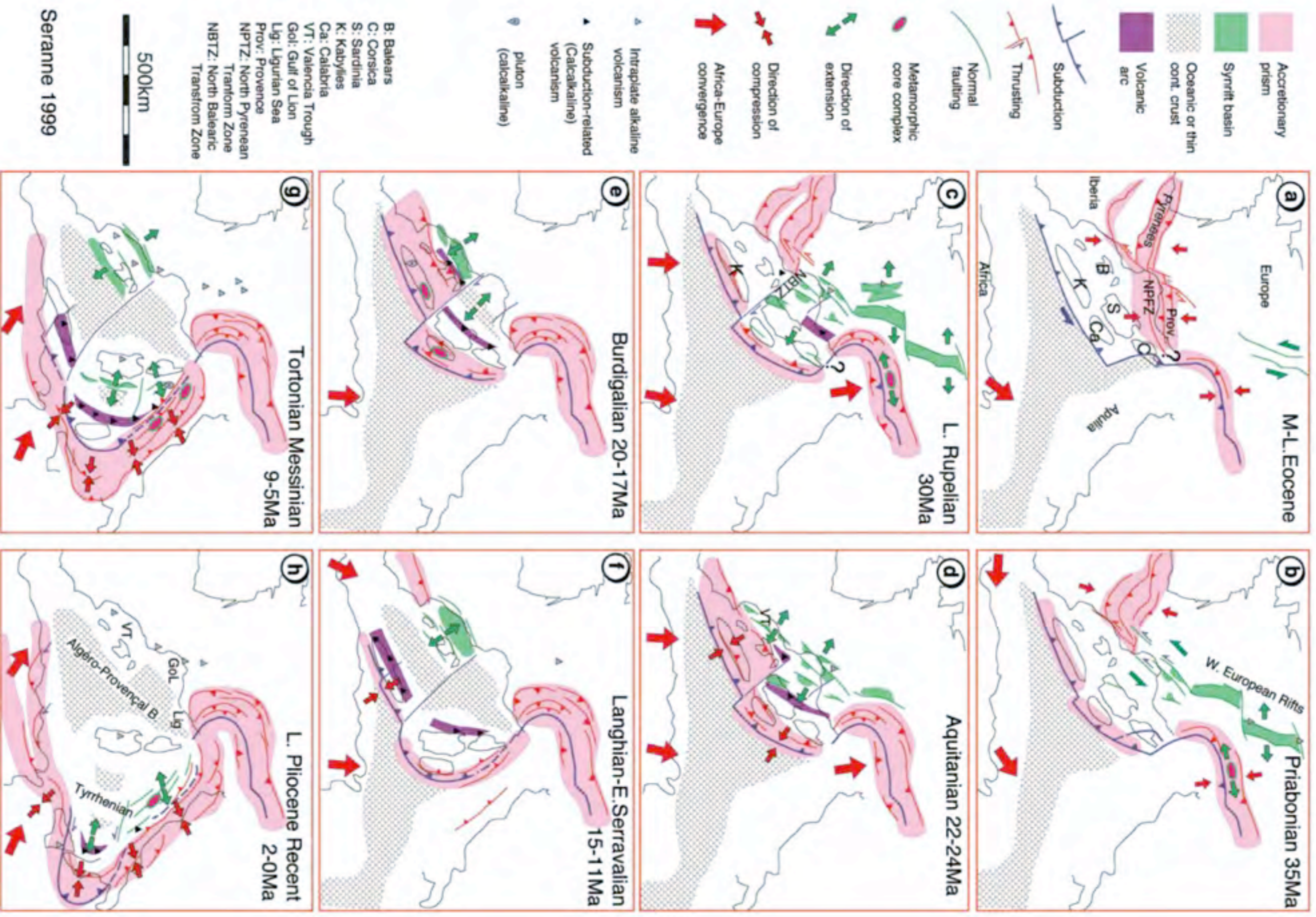
- The Oligocene-Miocene extensional basins : During Alpine tectonics, roll back of the main subduction zone that controls the growth of the Alps-Appennine system, induces the break-up and rotation of the Corsica Sardinia continental block. The subsequent rifting and sea floor spreading is responsible for the opening of the Golfe du Lion. This tectonic event rejuvenates the Faille des Cevennes as a normal fault. Oligo-Miocene continental basins bounded by SW-NE normal faults characterizes the extensional tectonics.

General geological Setting : South of France



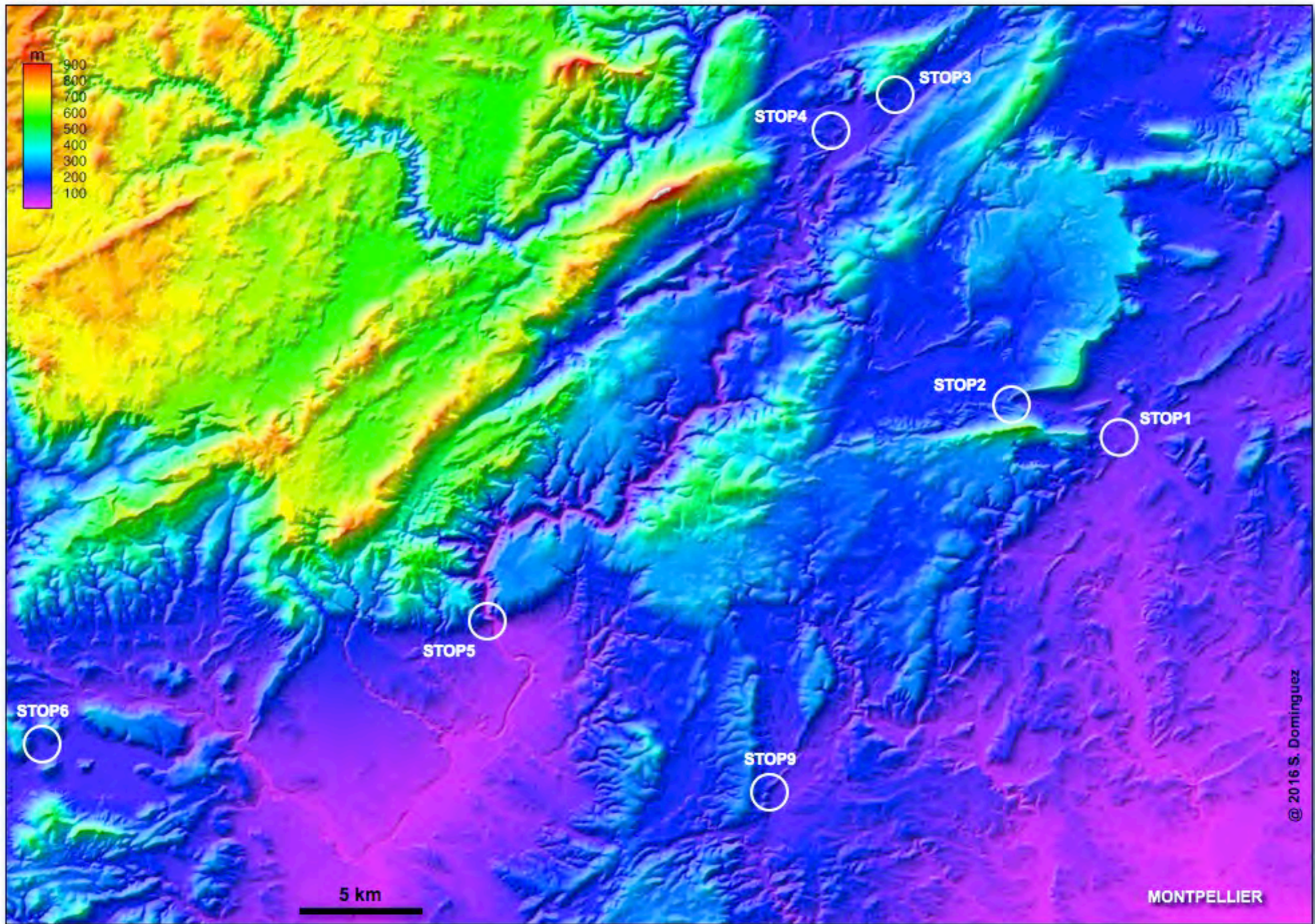
General geological Setting : Languedoc region





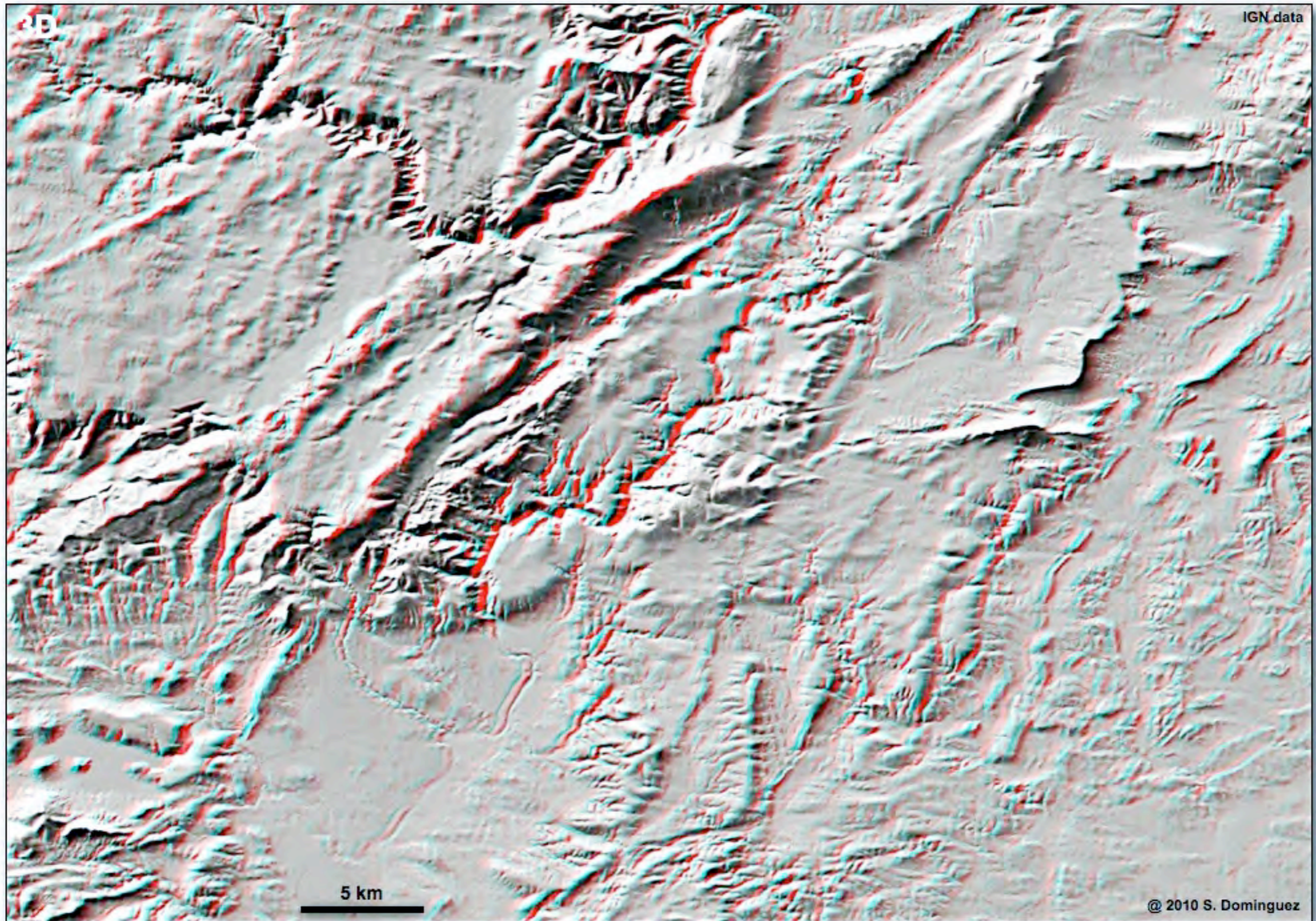
General topographic map of the Field Trip area and main Stops

IGN data

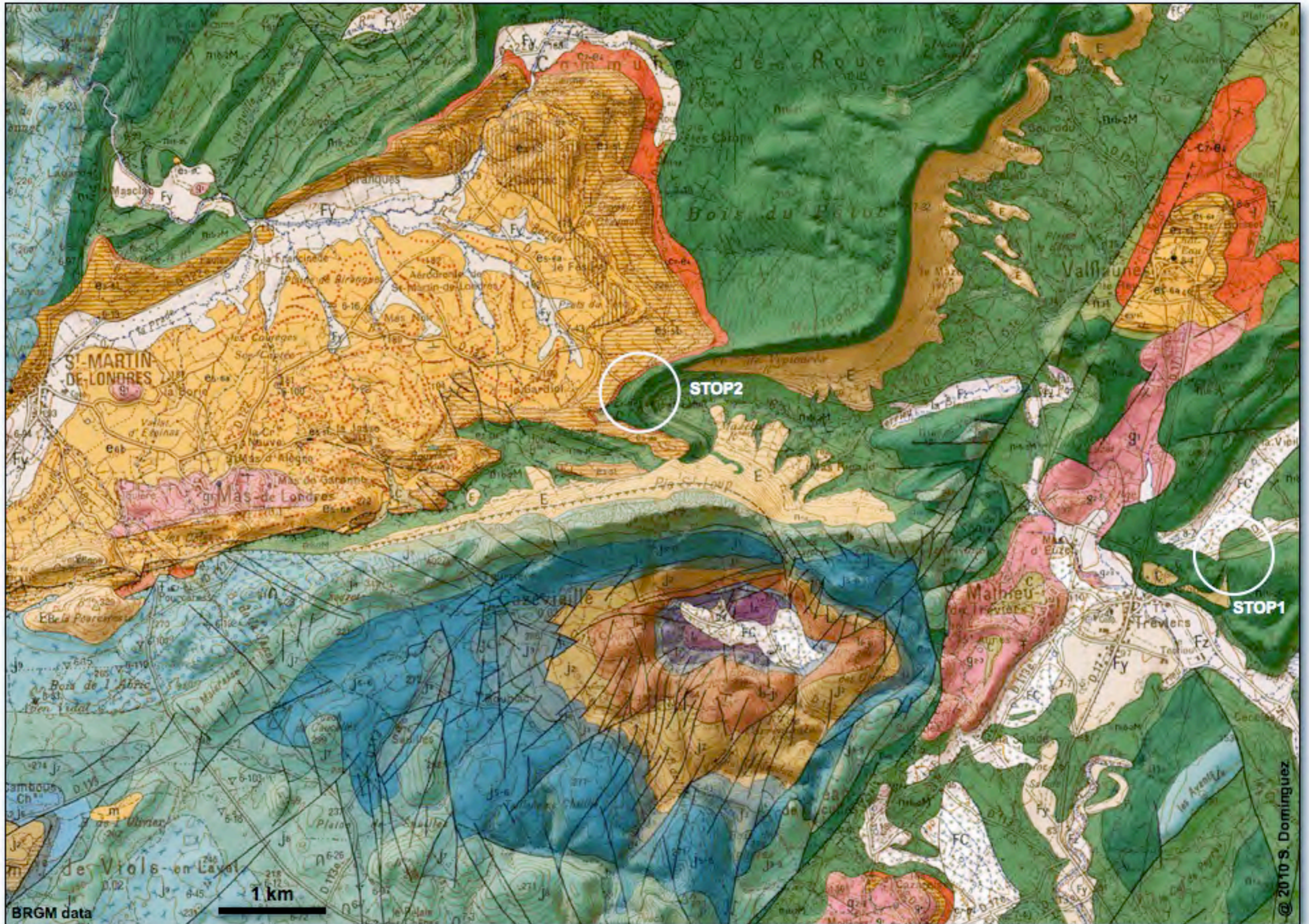


@ 2016 S. Dominguez

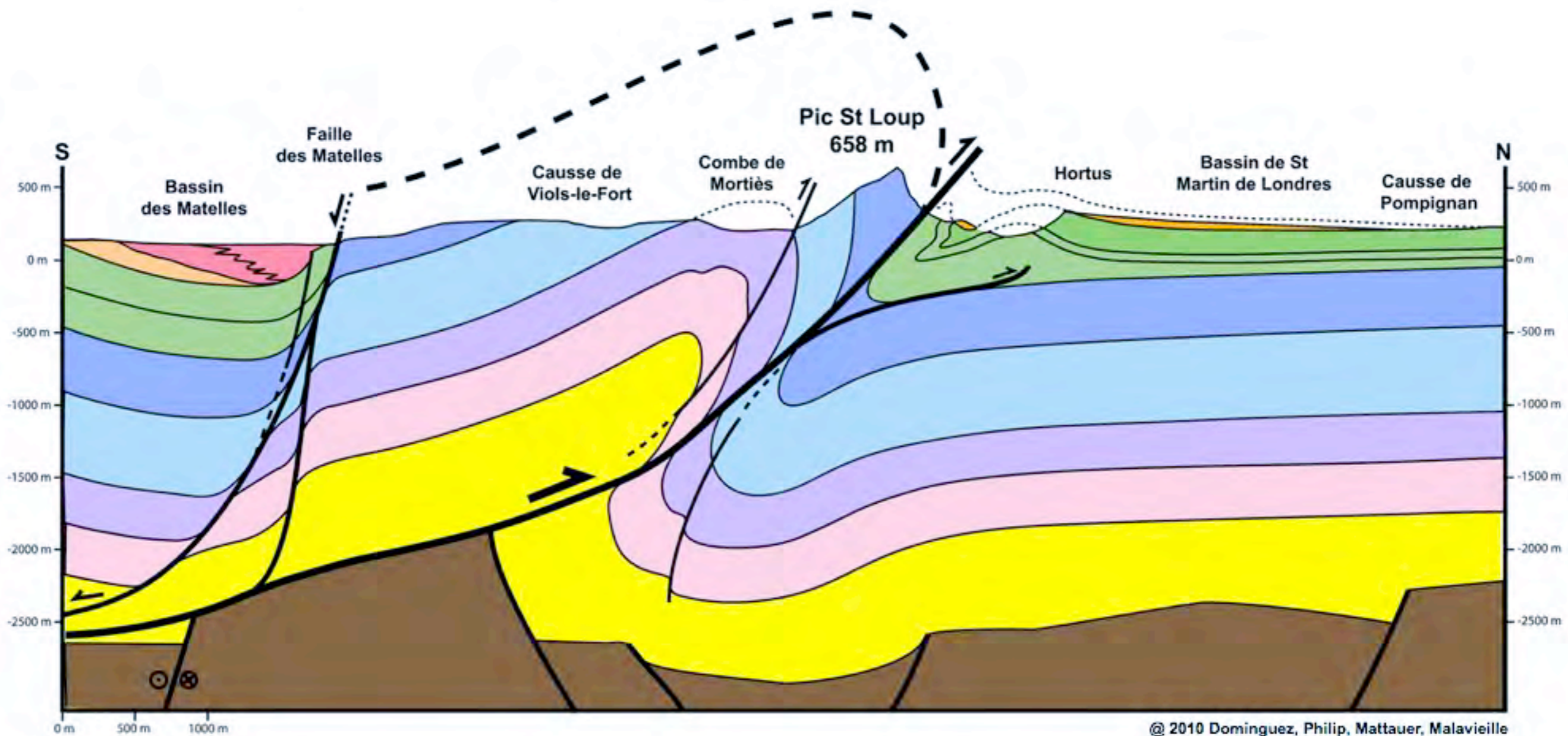
General topographic map of the Field Trip area (Anaglyph)



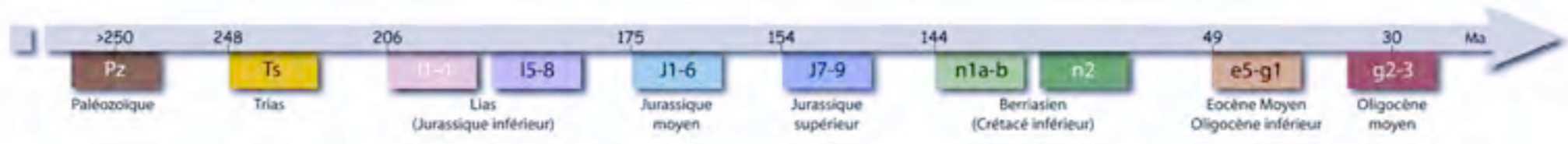
The Pic St Loup : An impressive structure of the Pyrenean foreland



The Pic St Loup : A section in the foreland of the Pyrenees

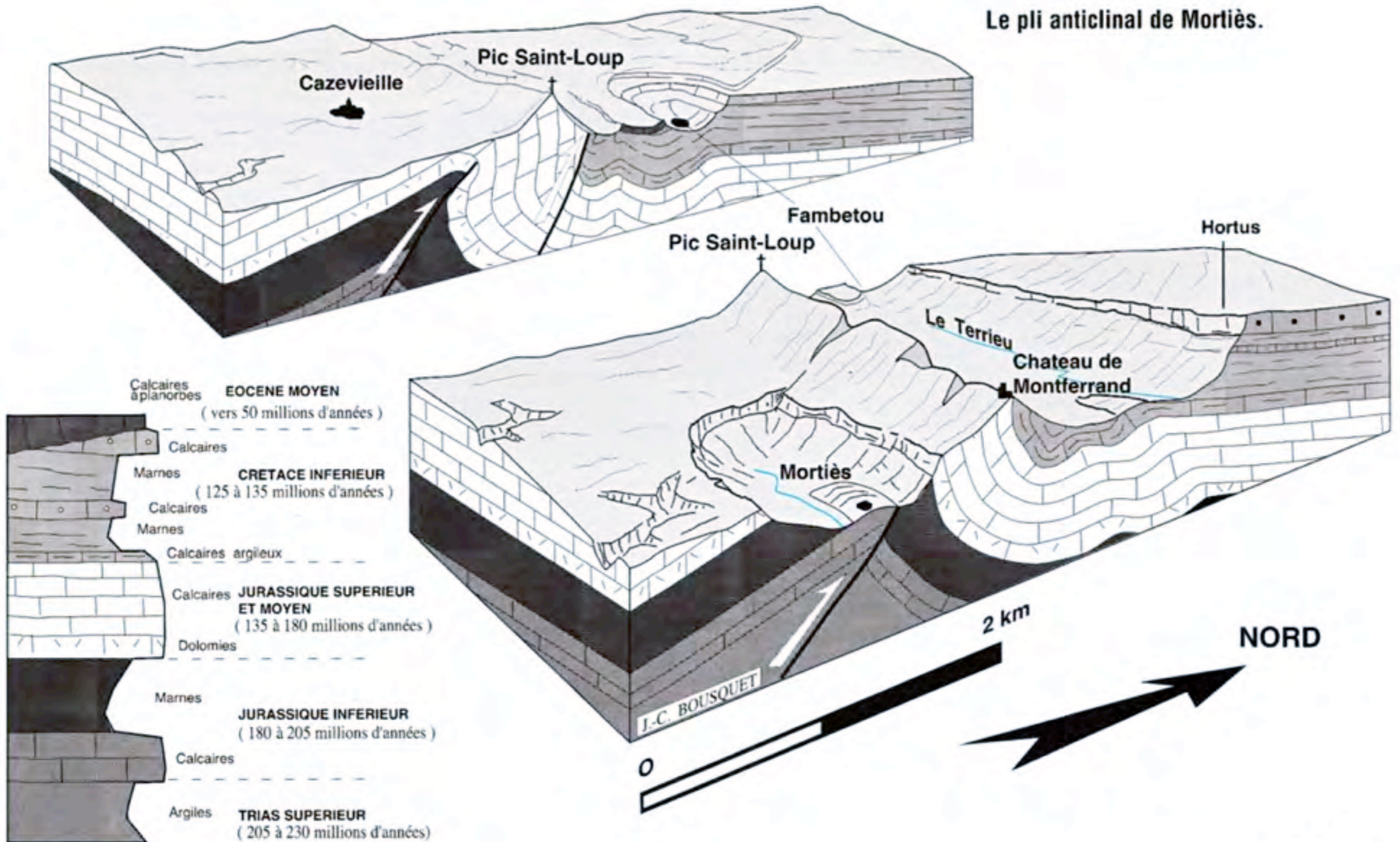


@ 2010 Dominguez, Philip, Mattauer, Malavieille

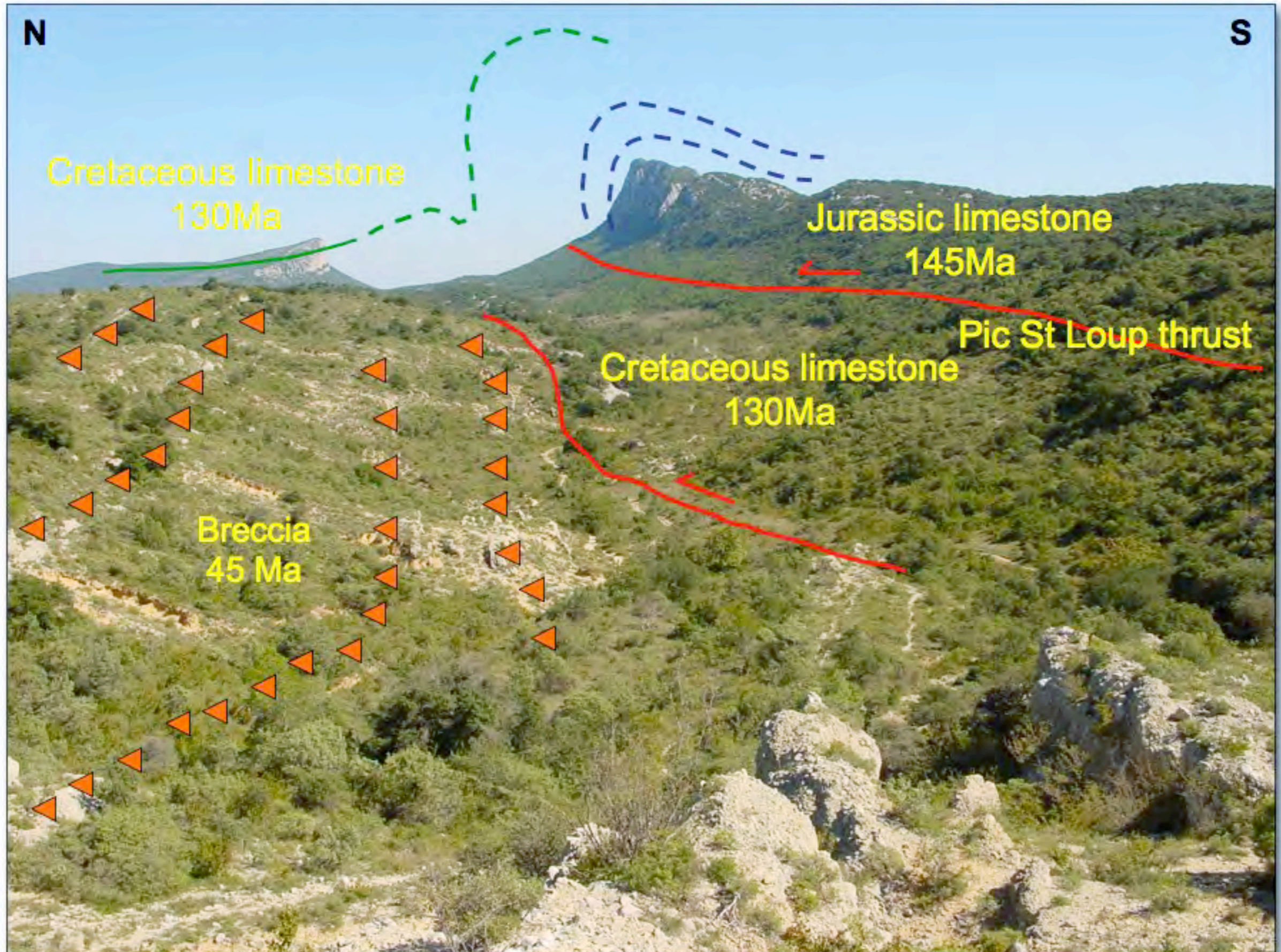


The Pic St Loup : An impressive structure of the Pyrenean foreland

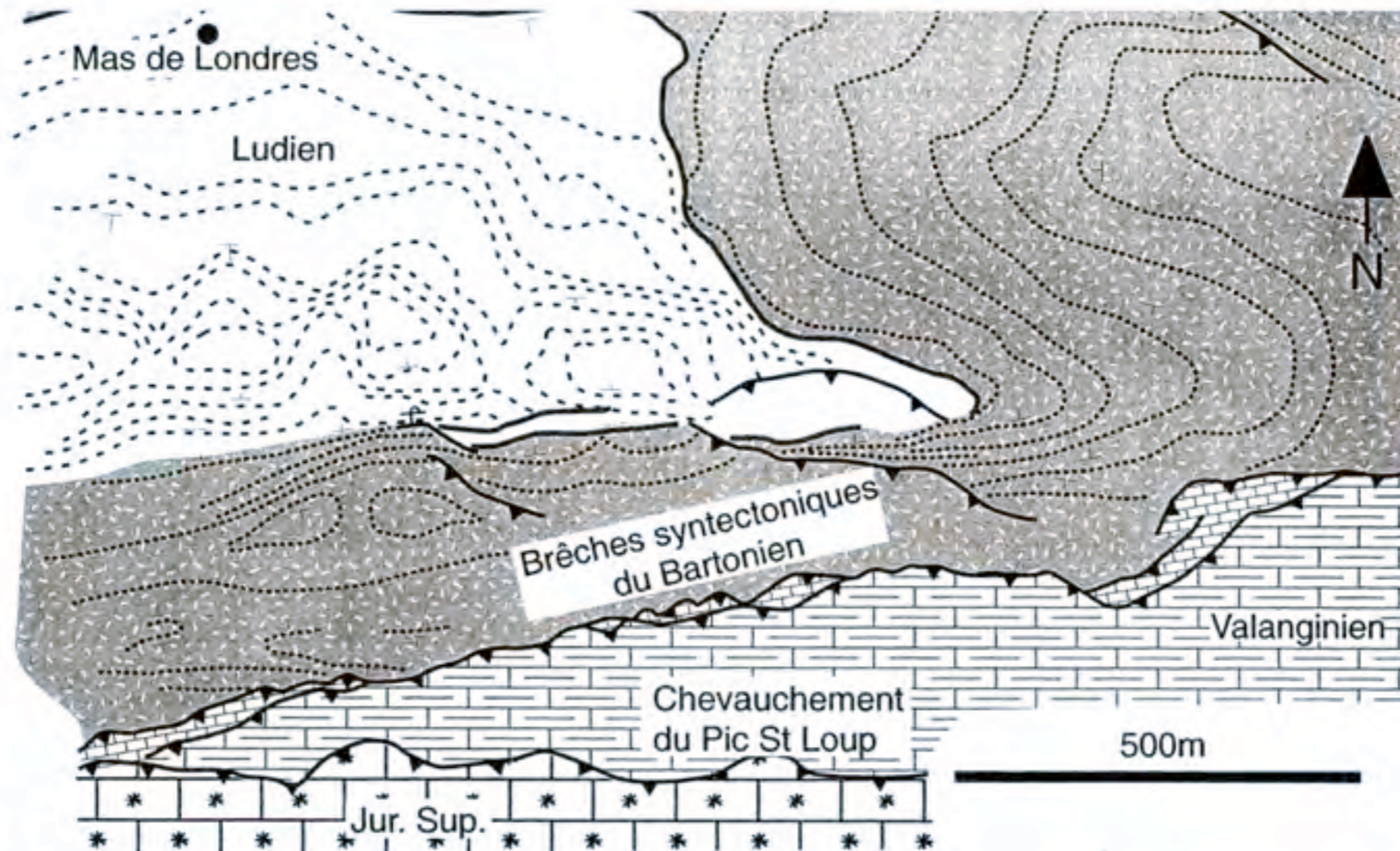
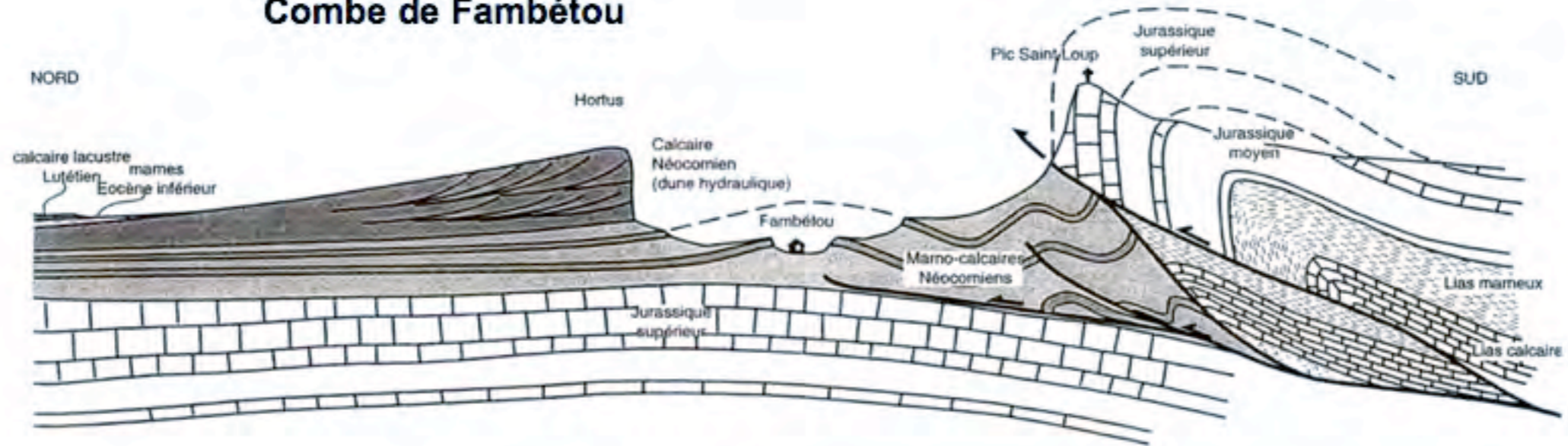
Le pli anticlinal de Mortiers.



45 Ma: Compressional Pyrenean tectonics

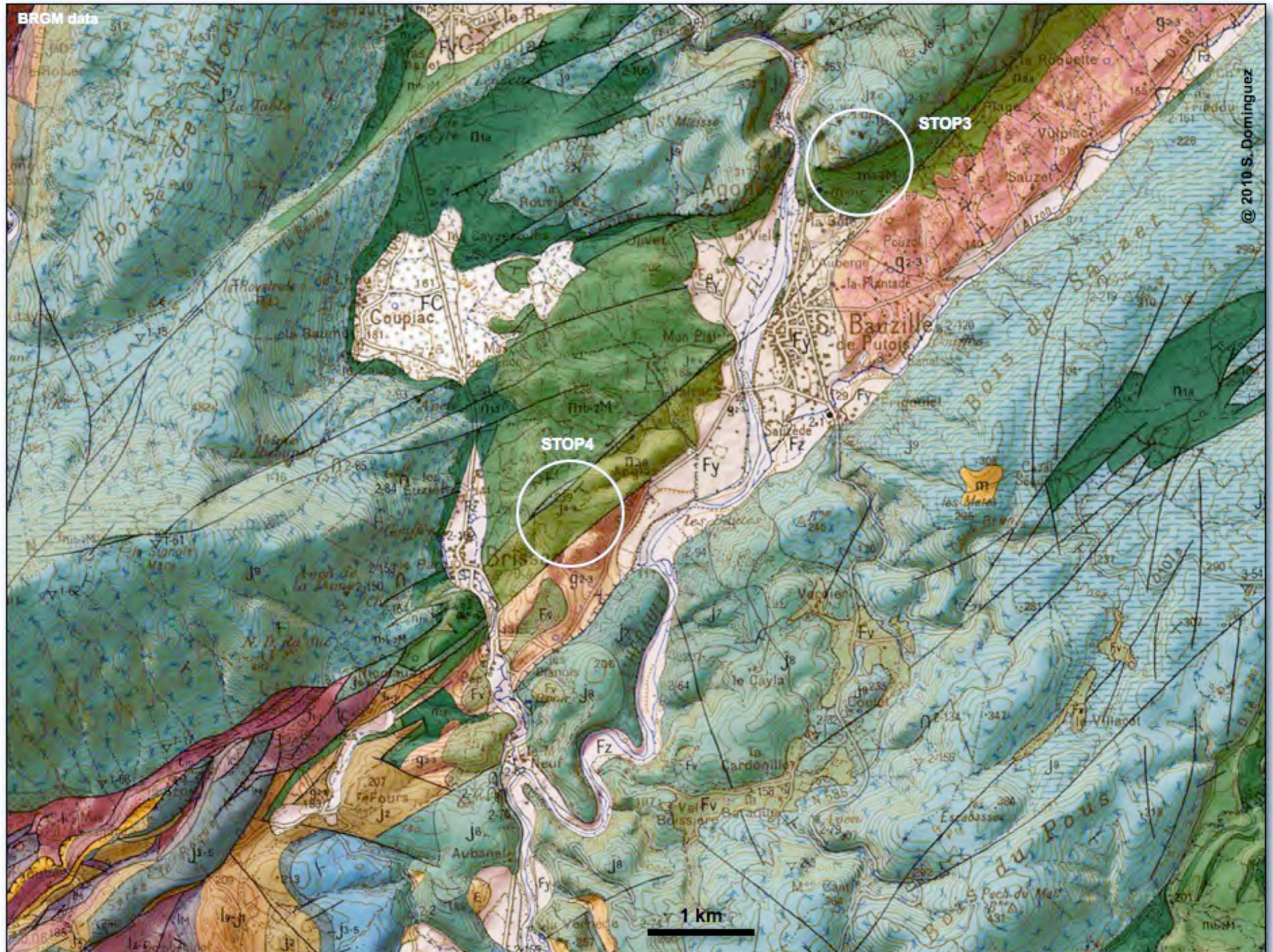


Combe de Fambétou

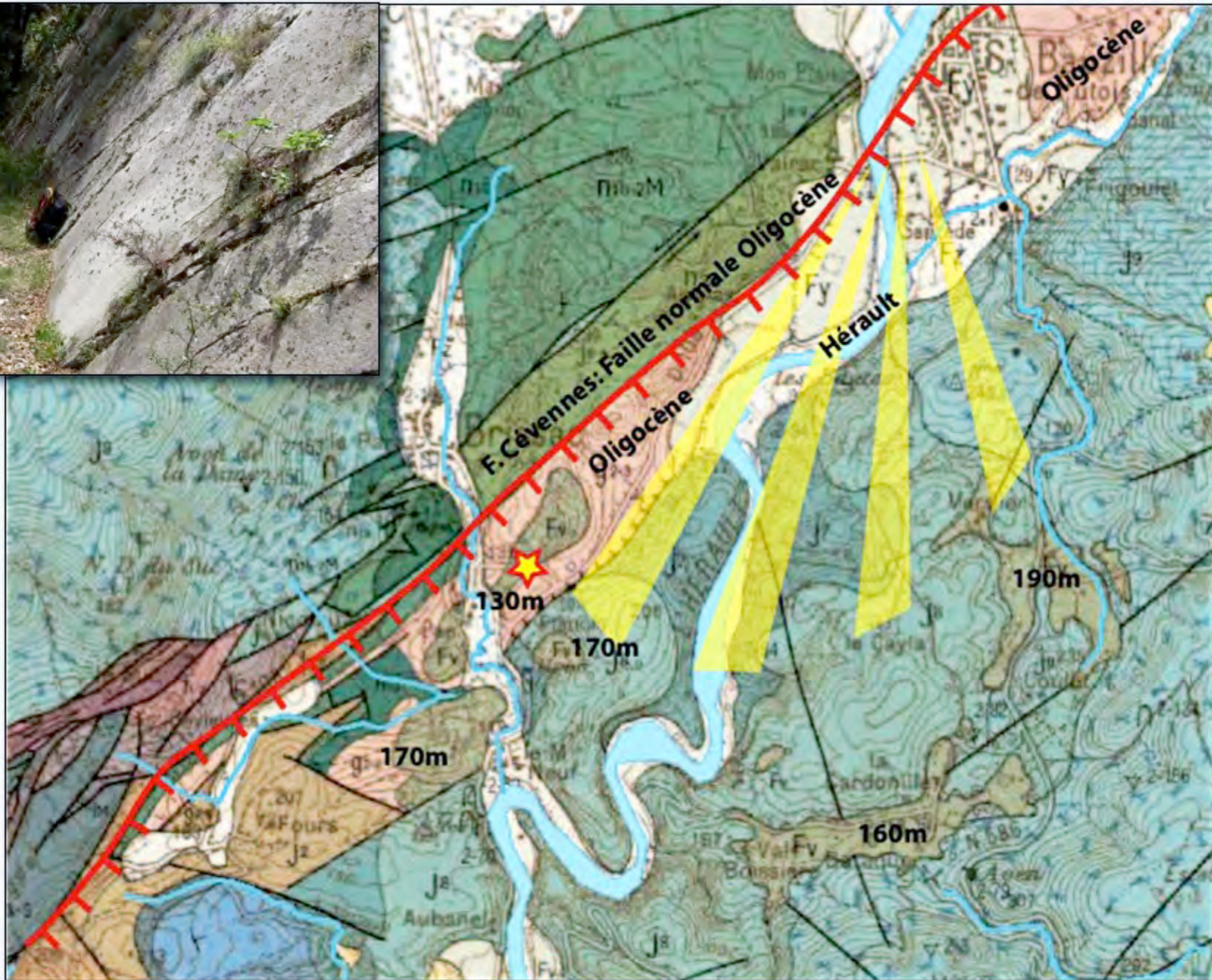


Syntectonic progressive unconformities in front of the Pic Saint Loup structure

The Cevennes Fault : From strike slip to normal faulting



The Cévennes Fault : From strike slip to normal faulting



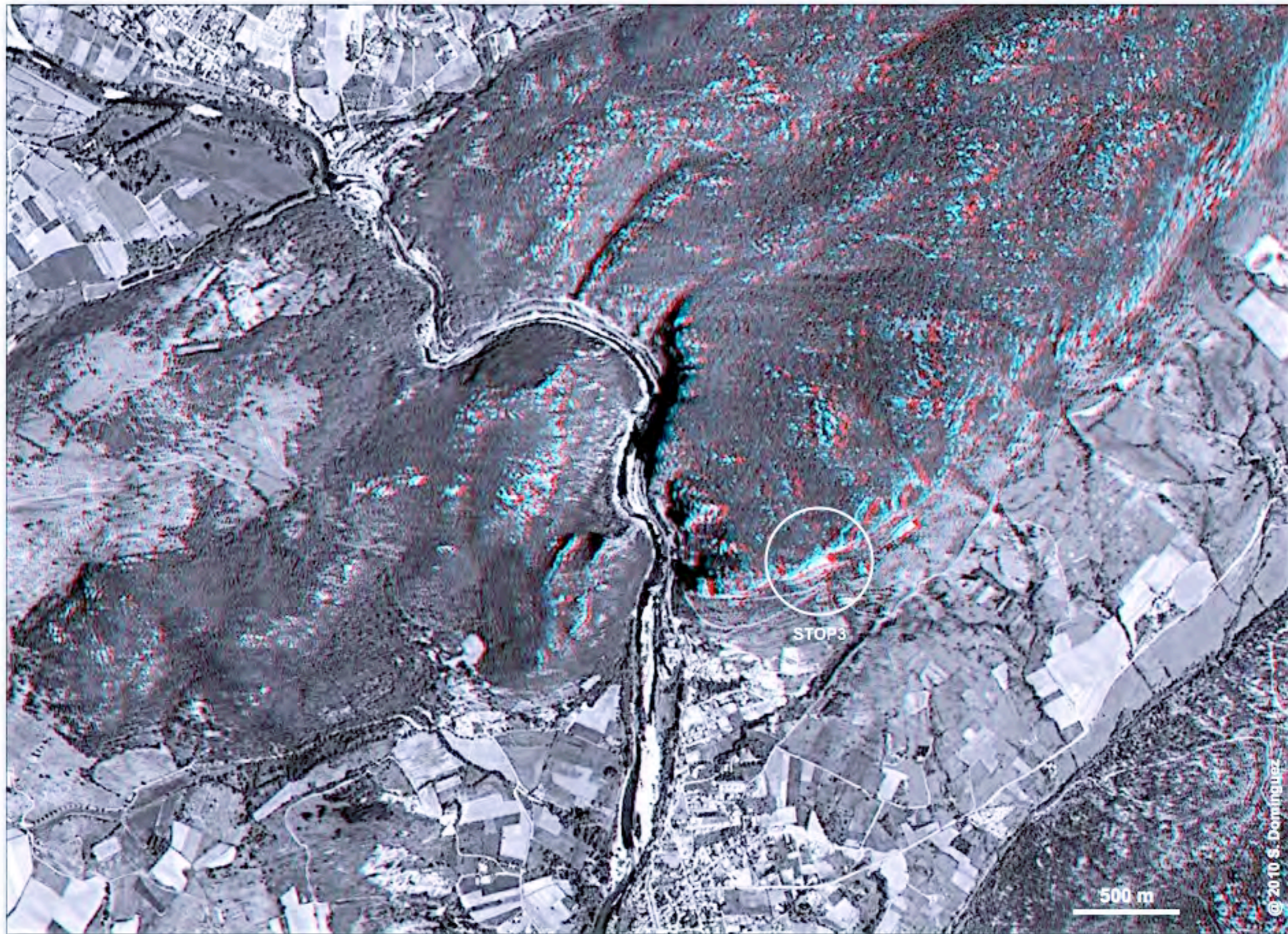
In Séranne et al., 2011



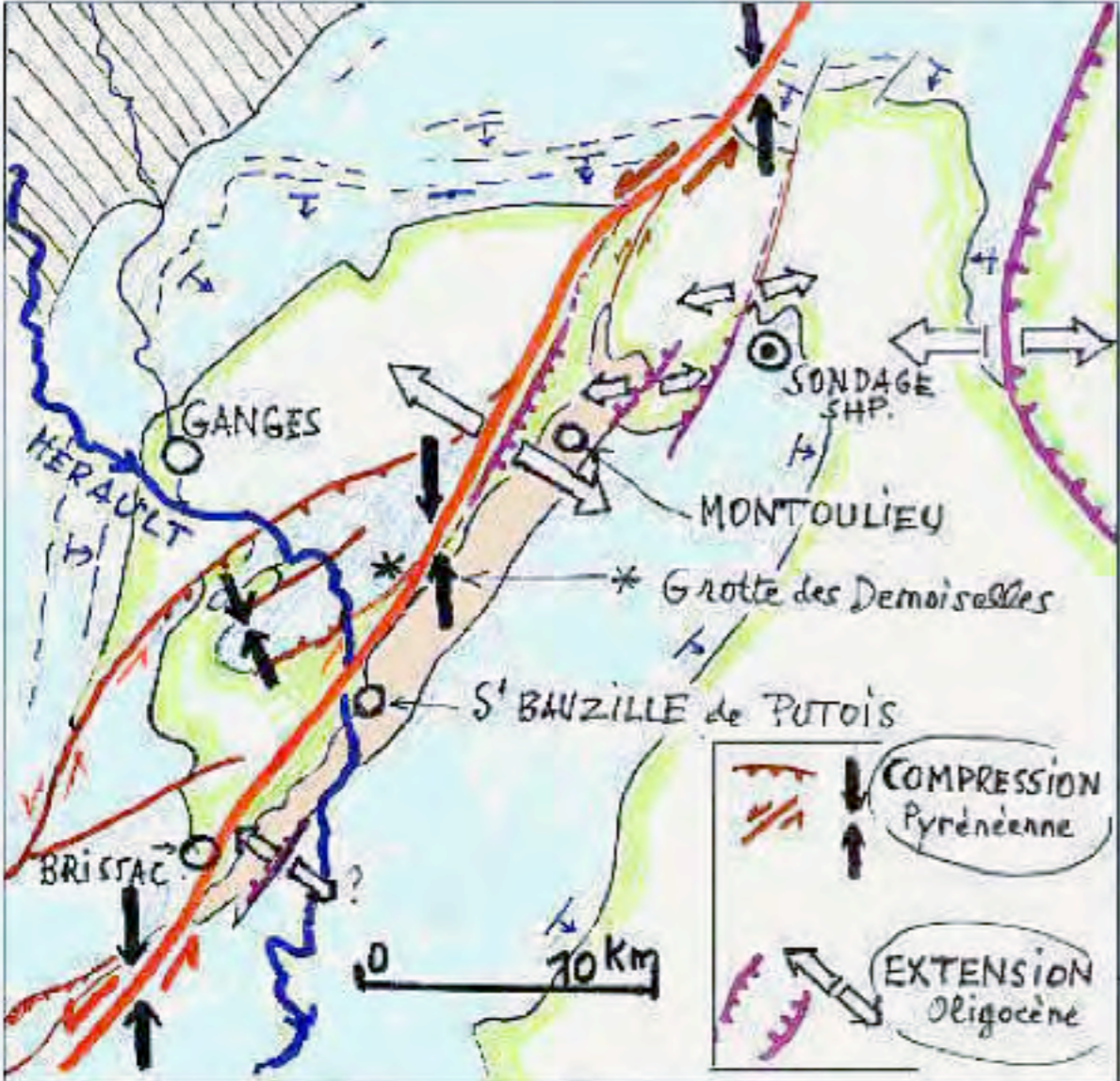
Alluvial sediments coming from the hercynian Cévennes testify for the Hérault paleo river bed

The Cevennes Fault : From strike slip to normal faulting

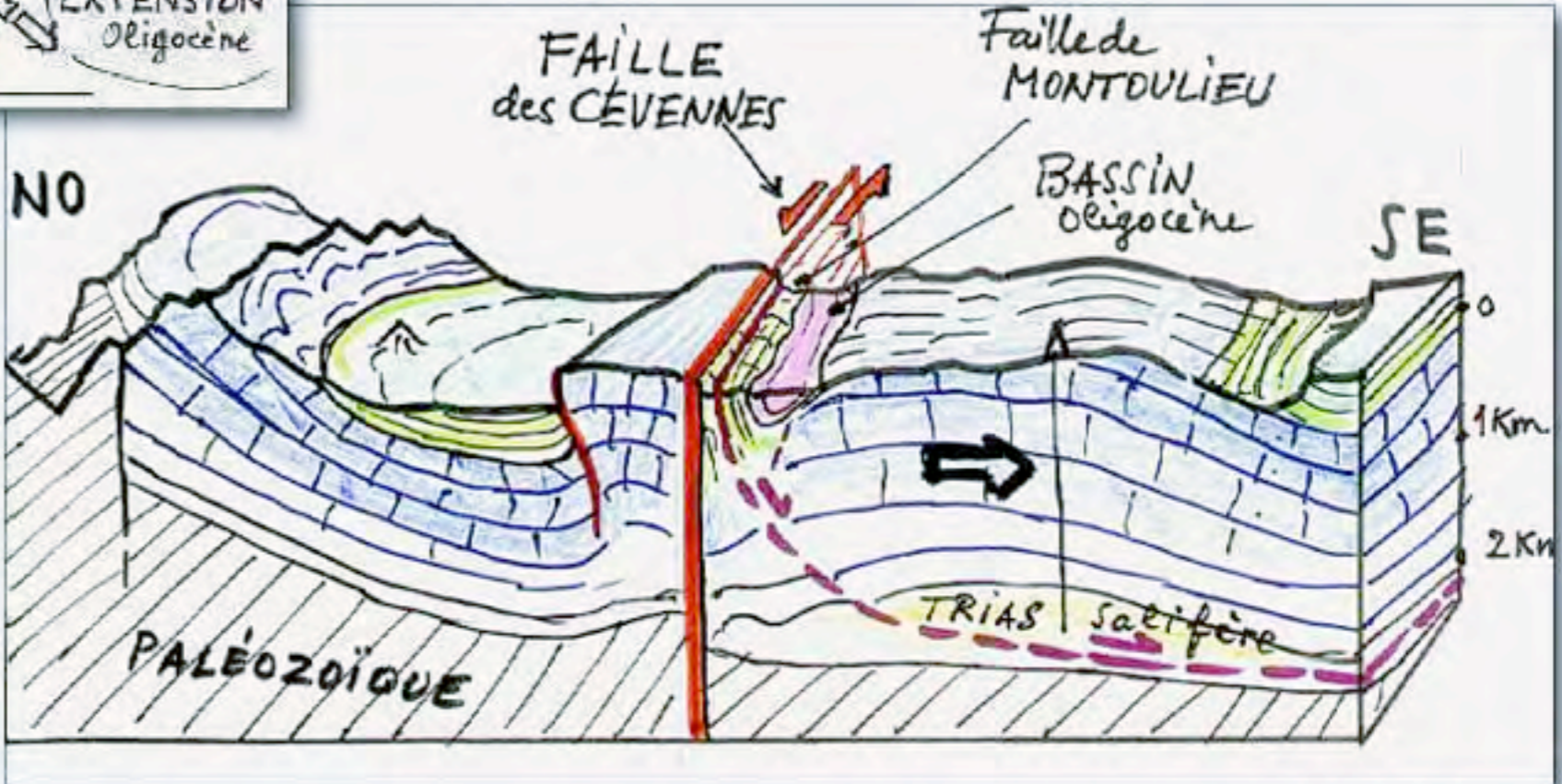
3D



The Cevennes Fault : From strike slip to normal faulting



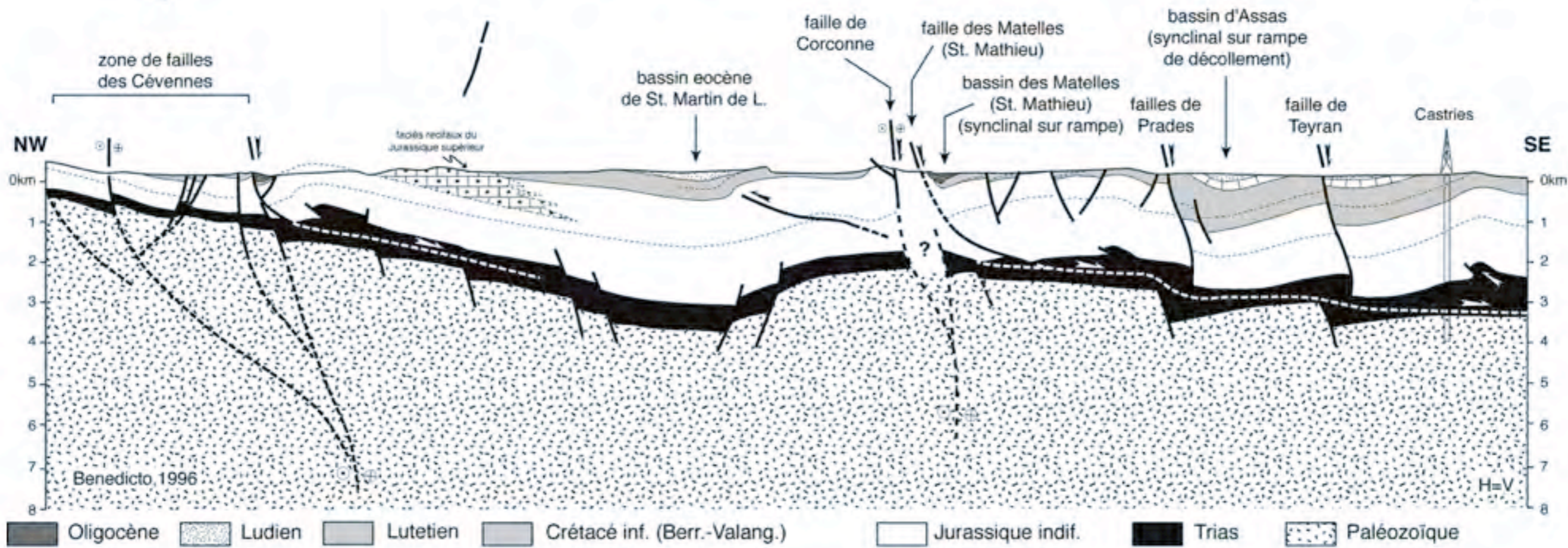
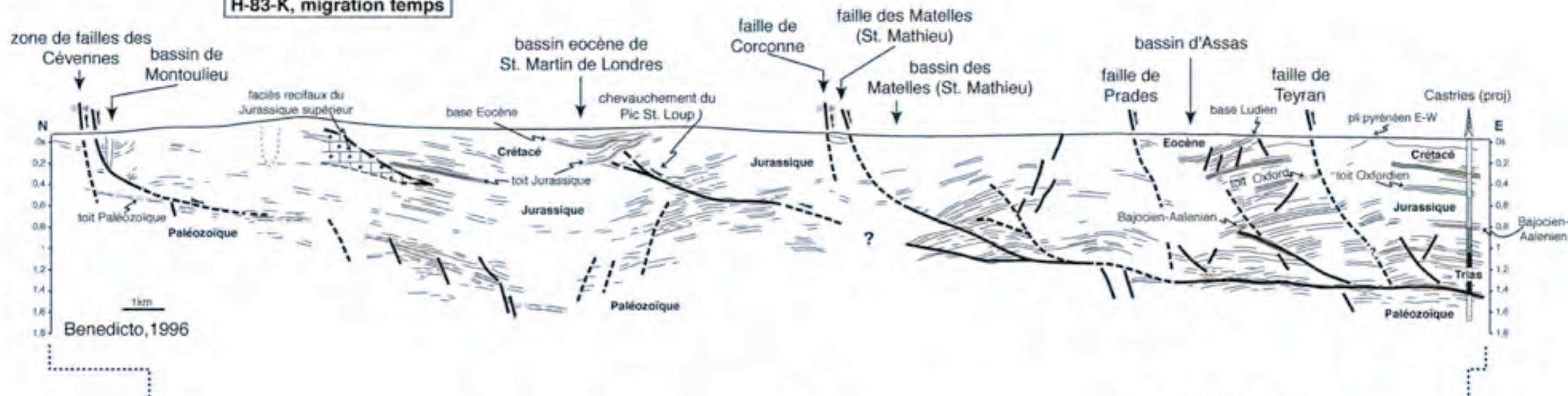
@ 2002 M. Mattauer



@ 2002 M. Mattauer

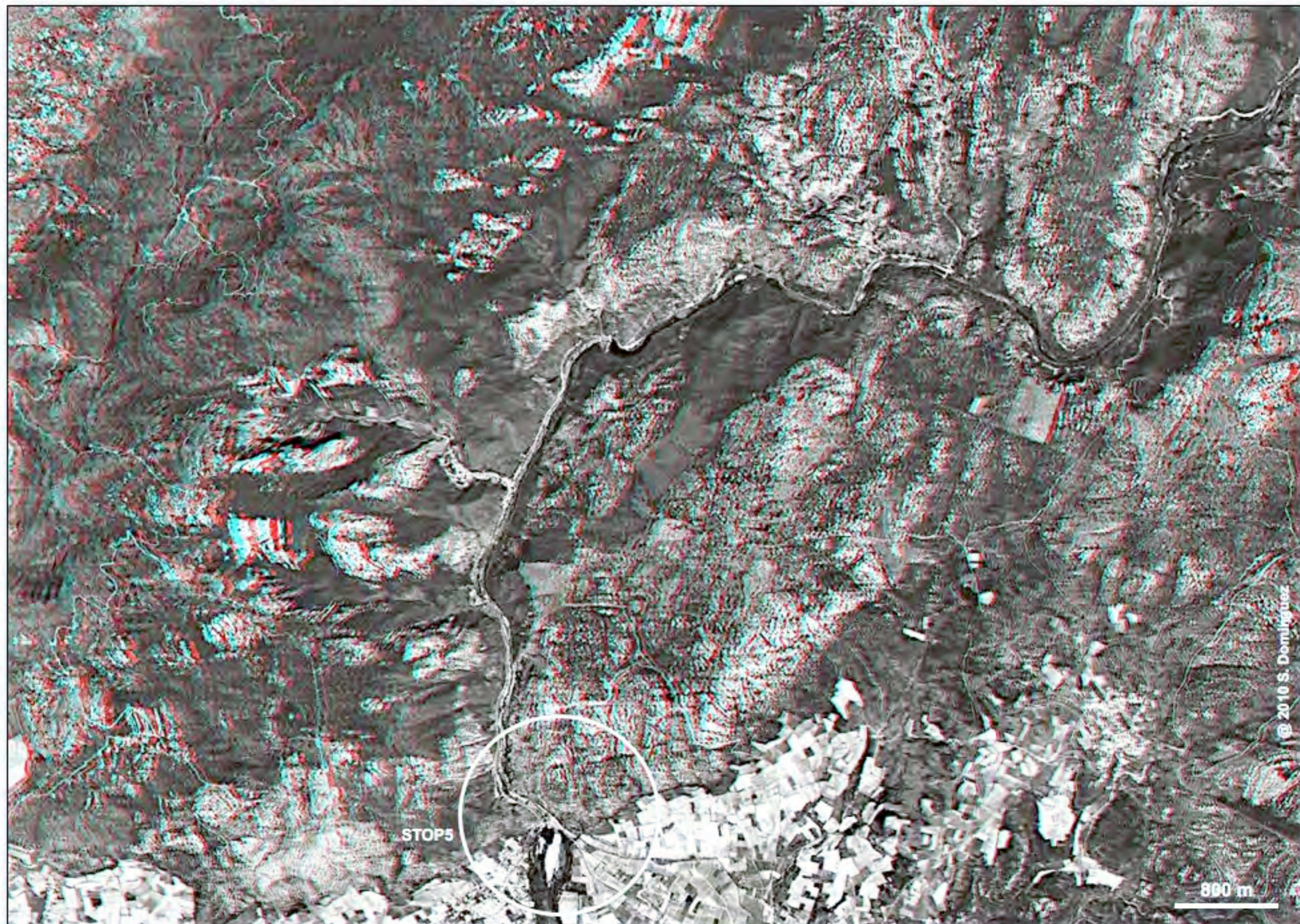
The Cevennes Fault : From strike slip to normal faulting

H-83-K, migration temps

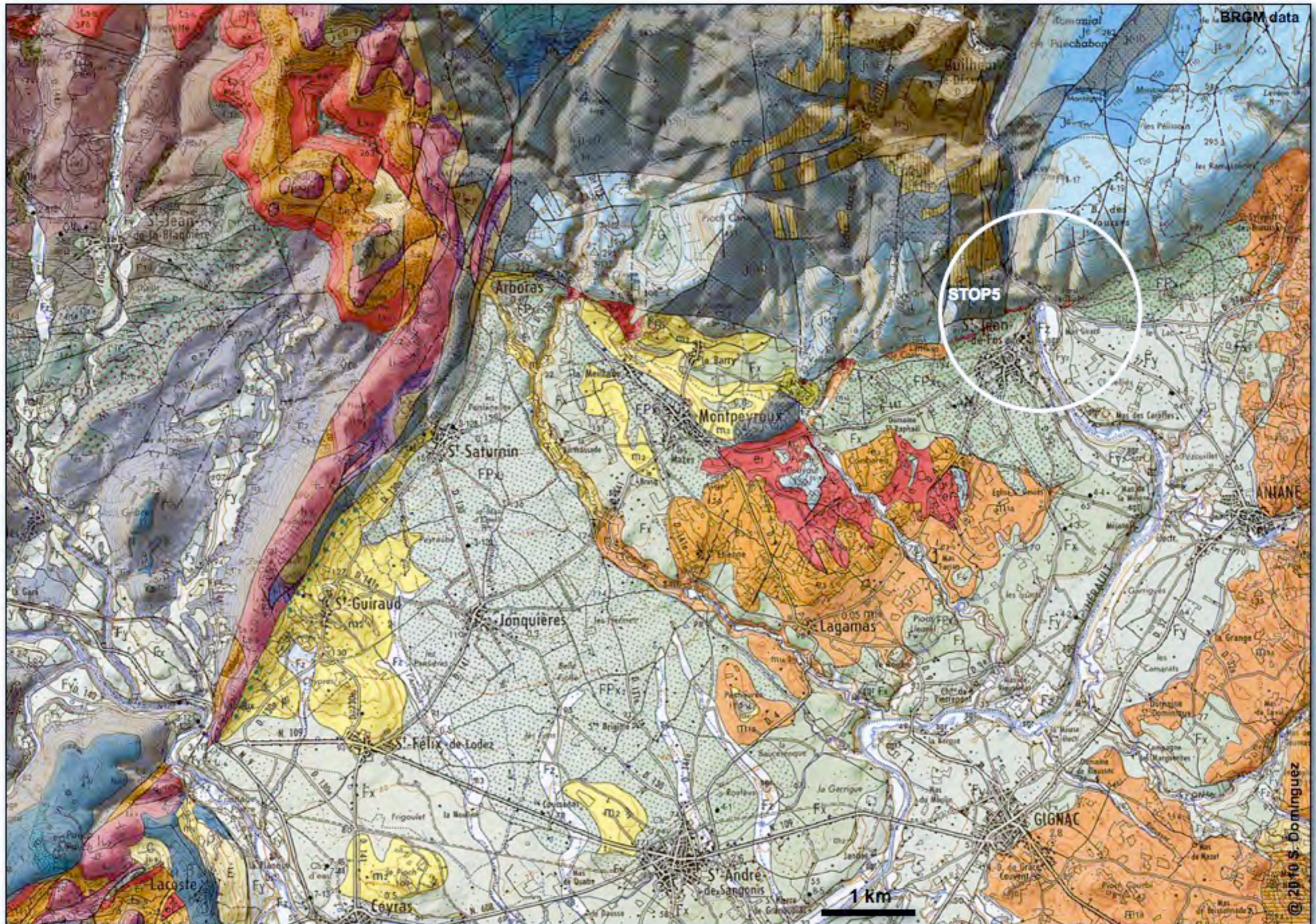


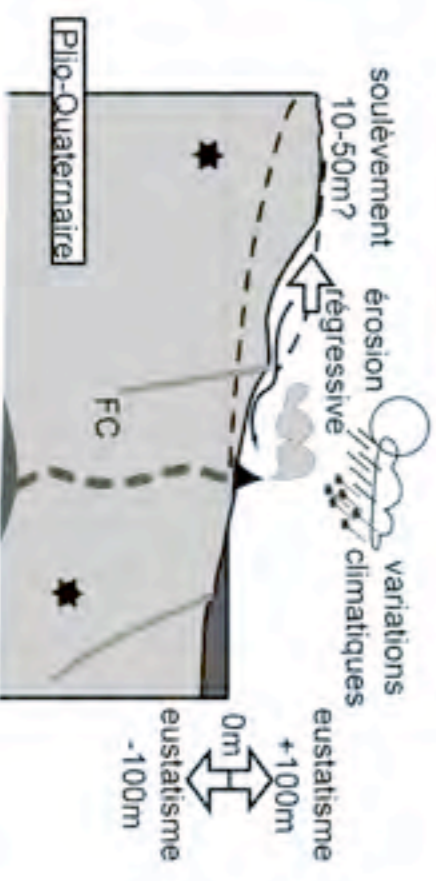
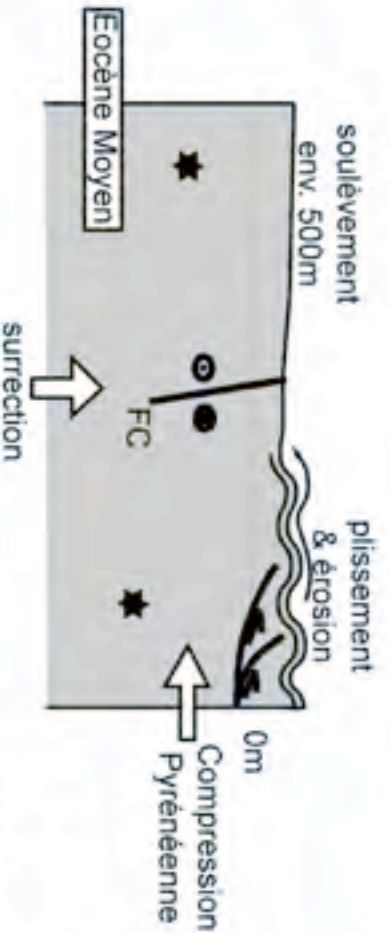
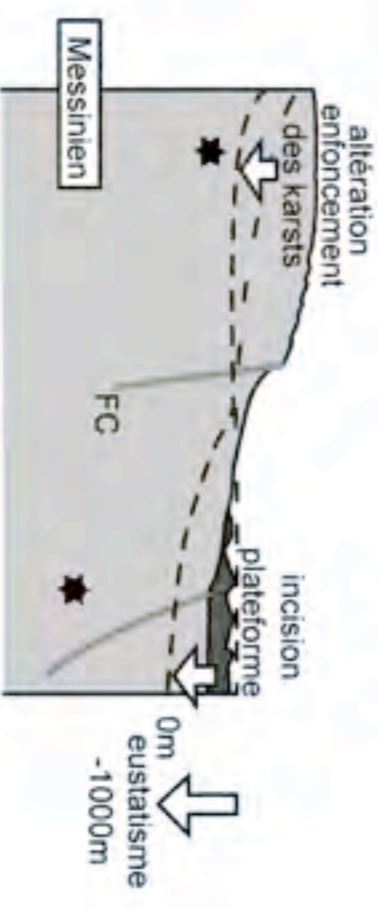
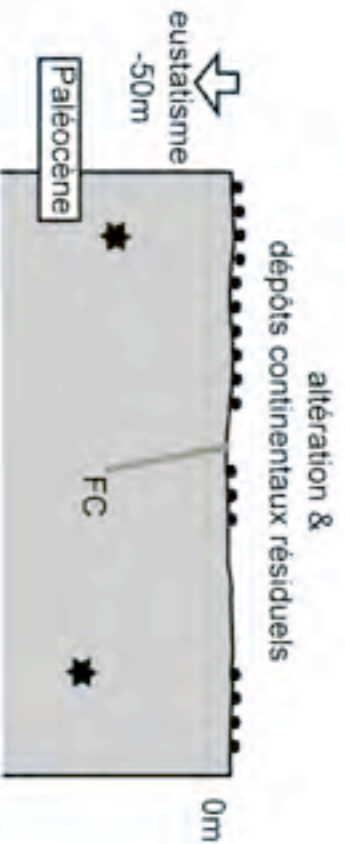
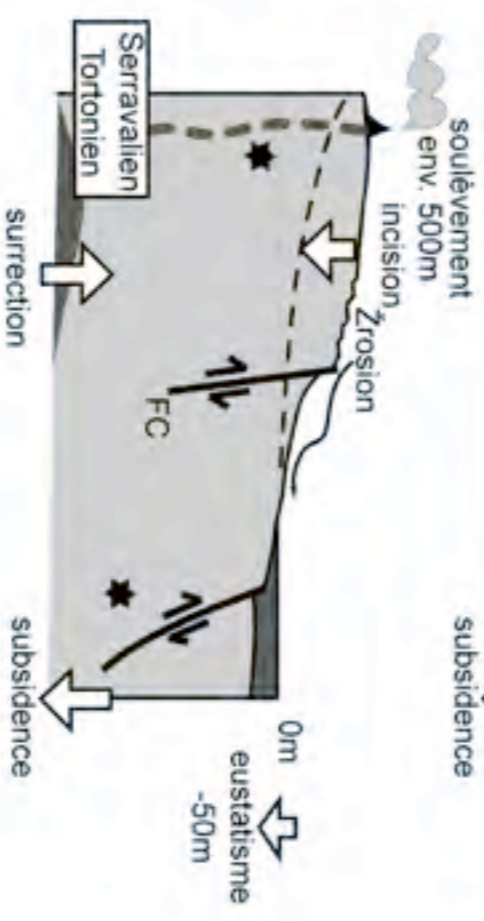
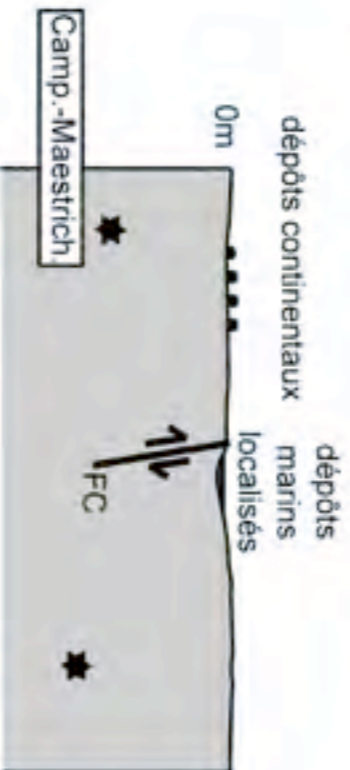
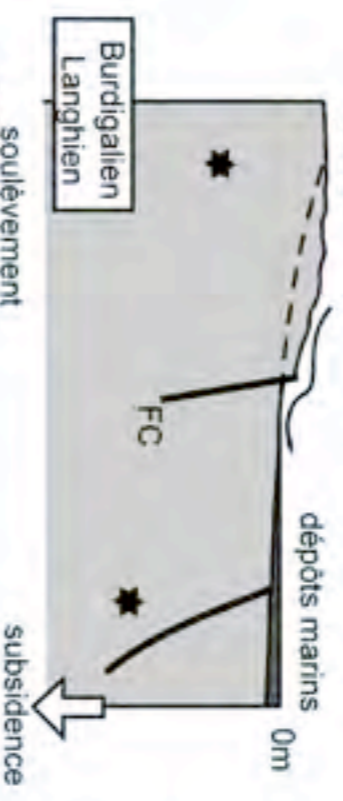
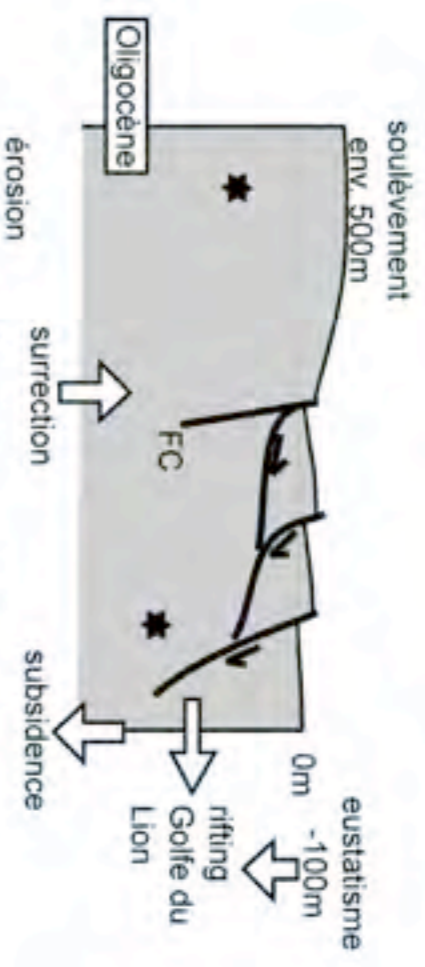
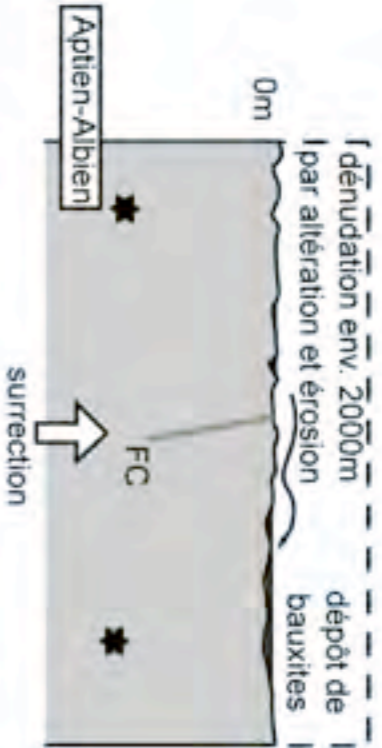
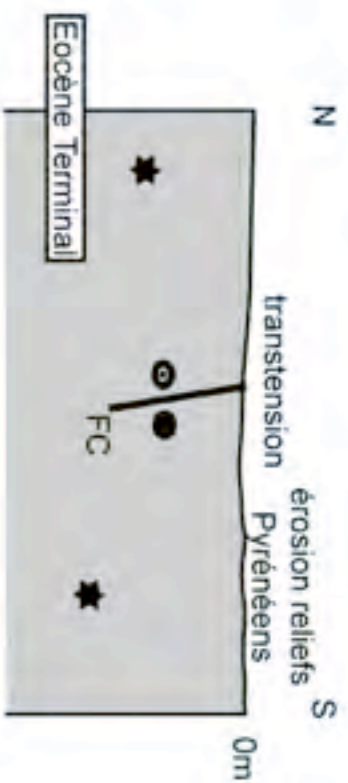
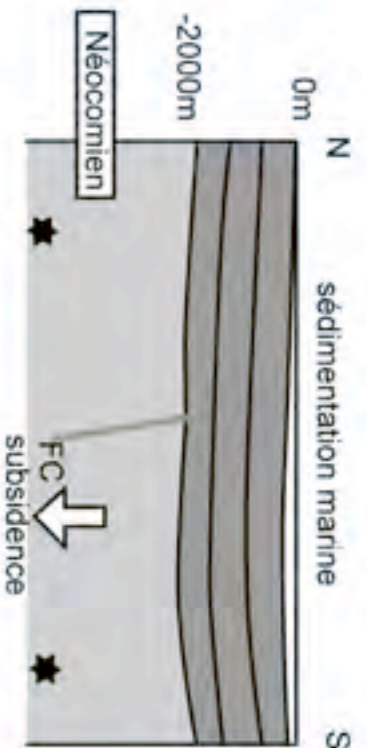
The Herault Gorges : Deep incision in response to Late Miocene uplift

3D



The Herault Gorges : Deep incision in response to Late Miocene uplift





The Permian Lodeve Basin :





STOP5

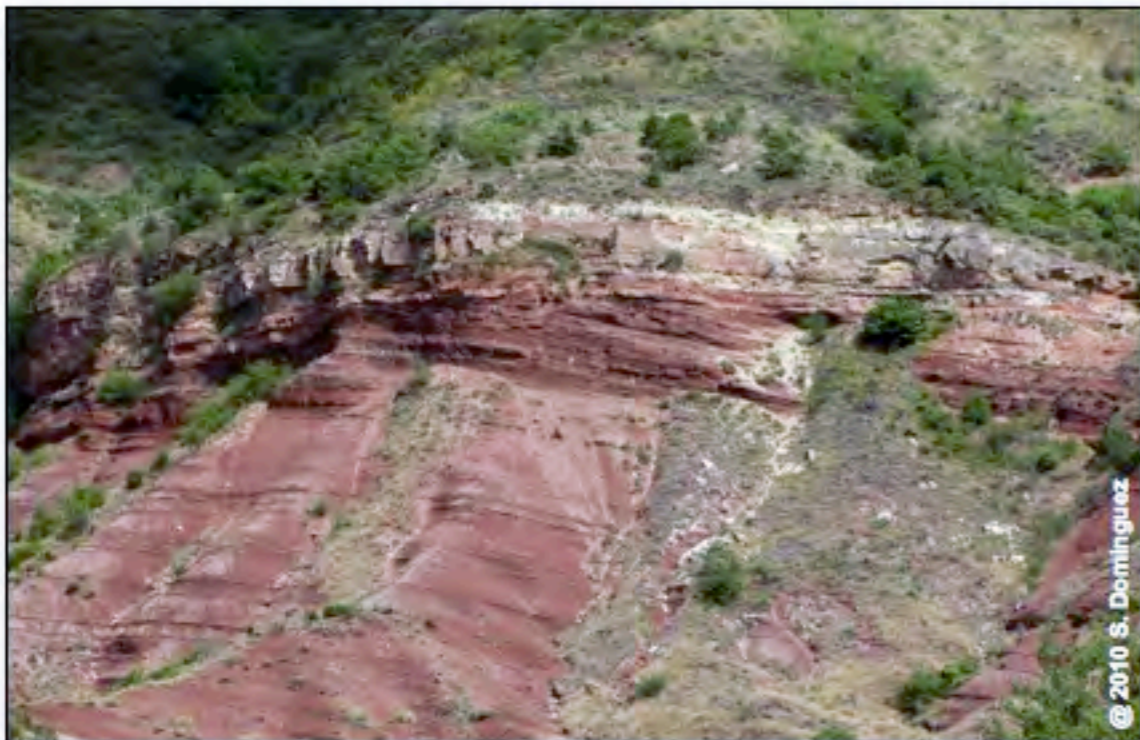
1 km

NE

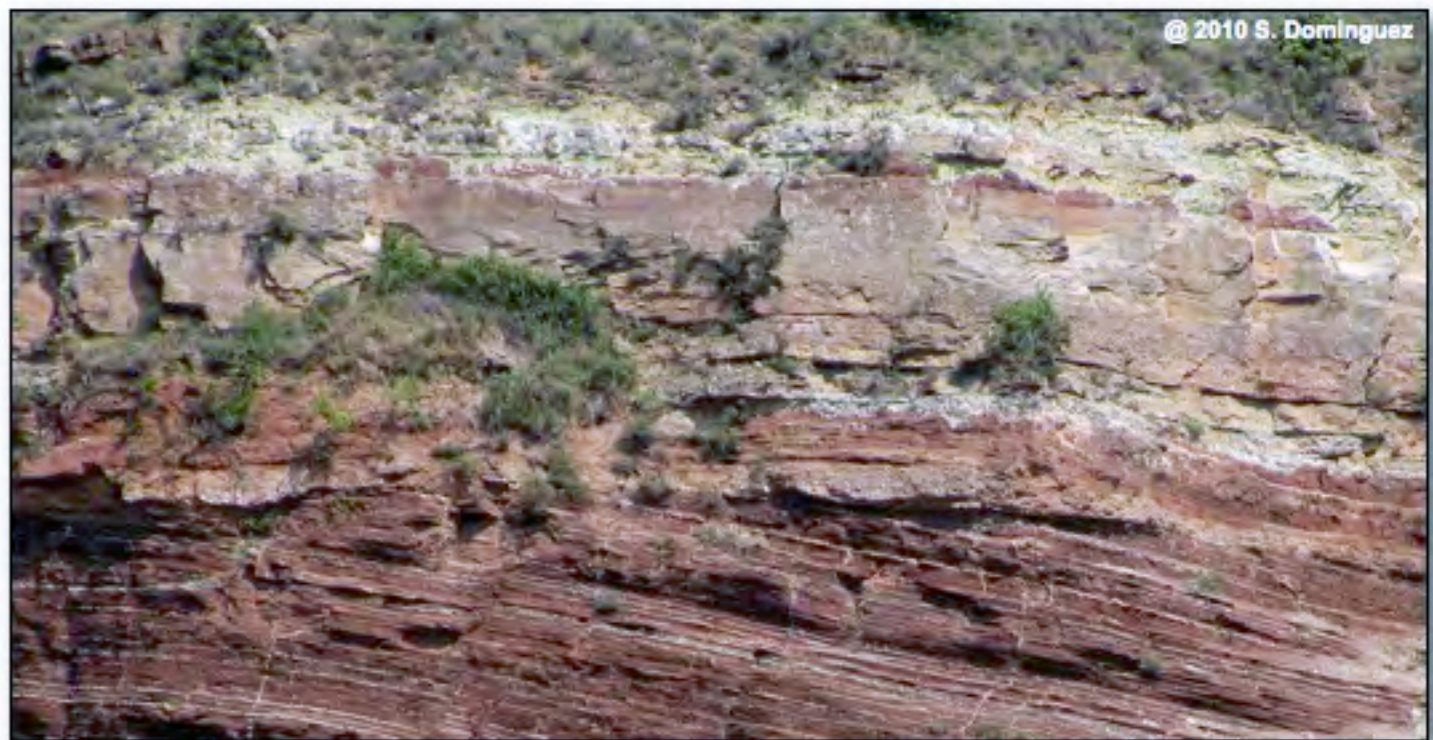
SW



@ 2010 S. Dominguez

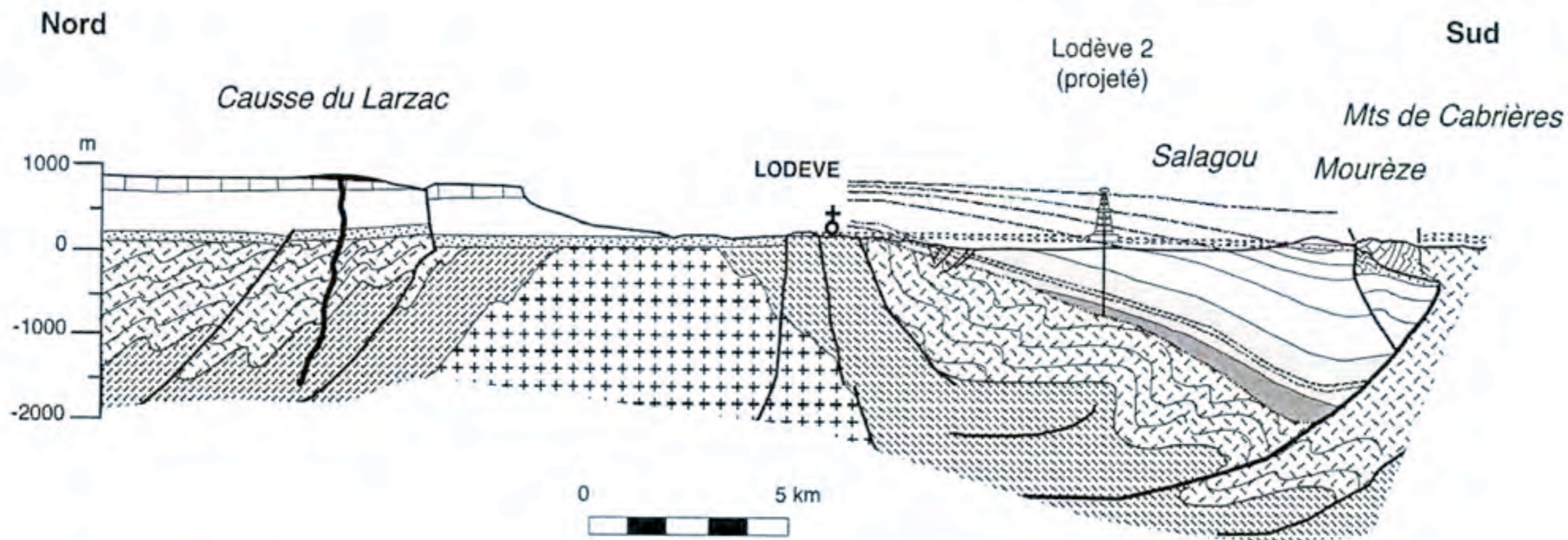


@ 2010 S. Dominguez






@ 2010 S. Dominguez




Geological section from the «Grands Causses» to Lodève basin







Substratum hercynien

-  Granites du Mendic
-  Série schisteuse antécambrienne
-  Cambrien : grès, dolomies et calcschistes

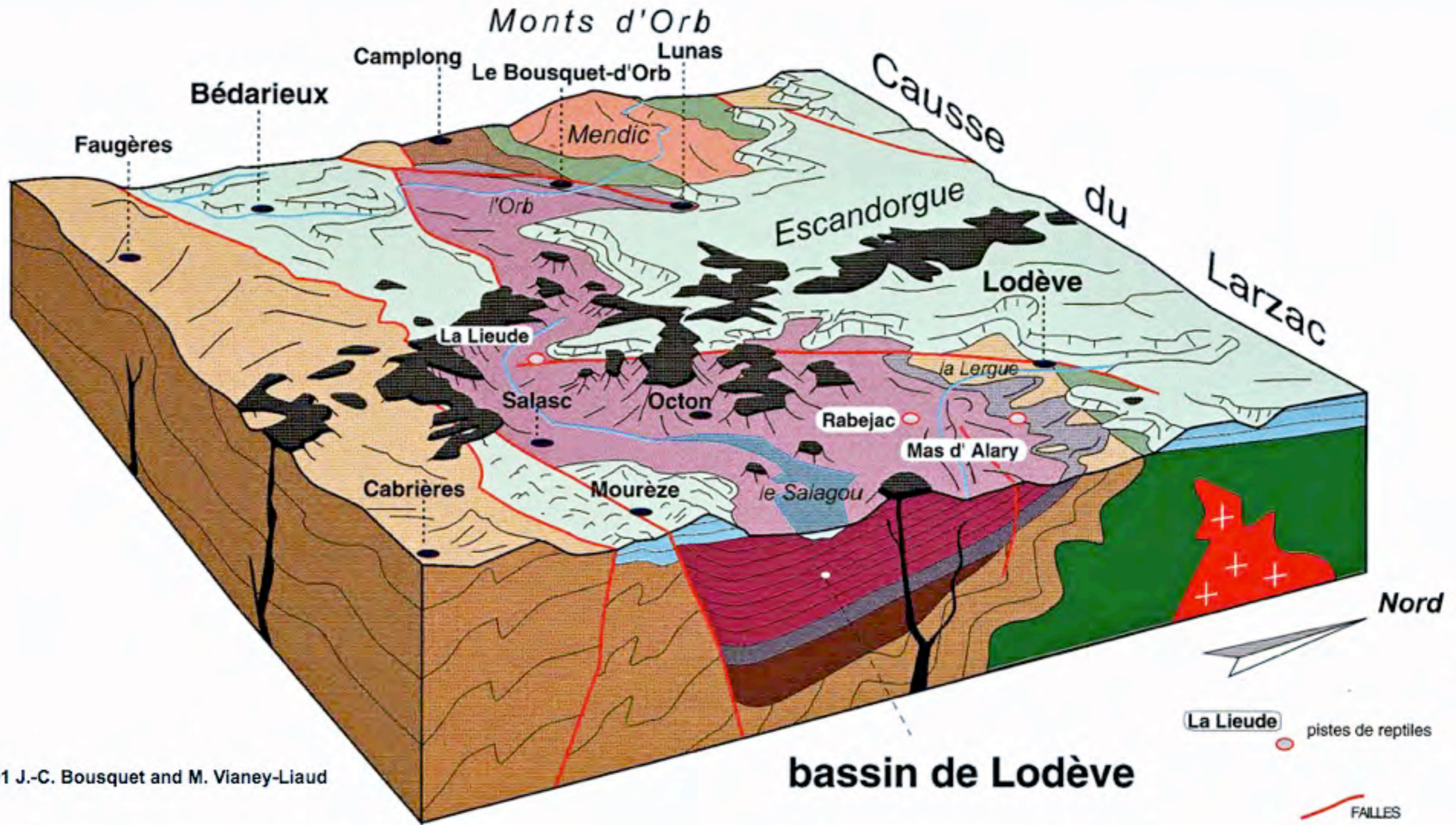
Paléozoïque

-  Stéphanien : grès, pélites et charbons
-  (1) Autunien : grès et shales gris, (1): cinérites repères
-  Saxonien/Thuringien : grès et pélites rouges

Mésozoïque

-  Trias : grès et argiles évaporitiques
-  Lias : dolomies, calcaires et marnes
-  Dogger : dolomies saccharoïdes
-  Volcanisme Plio-IV : basaltes et tufs

Bloc diagram showing relations between surface geology and deep structures



@ 2001 J.-C. Bousquet and M. Vianey-Liaud

bassin de Lodève

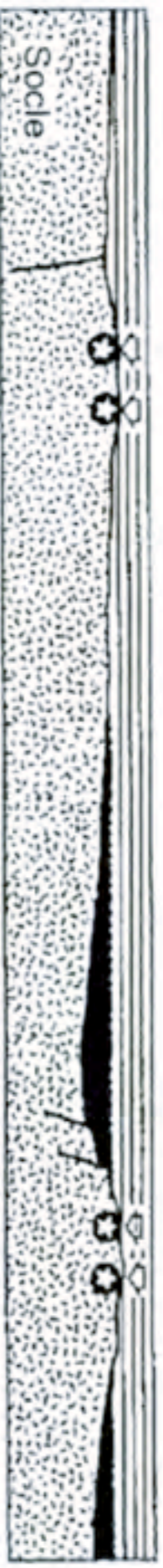
Evolution of the Permian basin

N

S

Ride de Lodève

Ride de Cabrières



Permien Gris : Sédimentation lacustre profonde, subsidence homogène



Permien Rouge : Sédimentation de plaine d'inondation/playa, subsidence différentielle

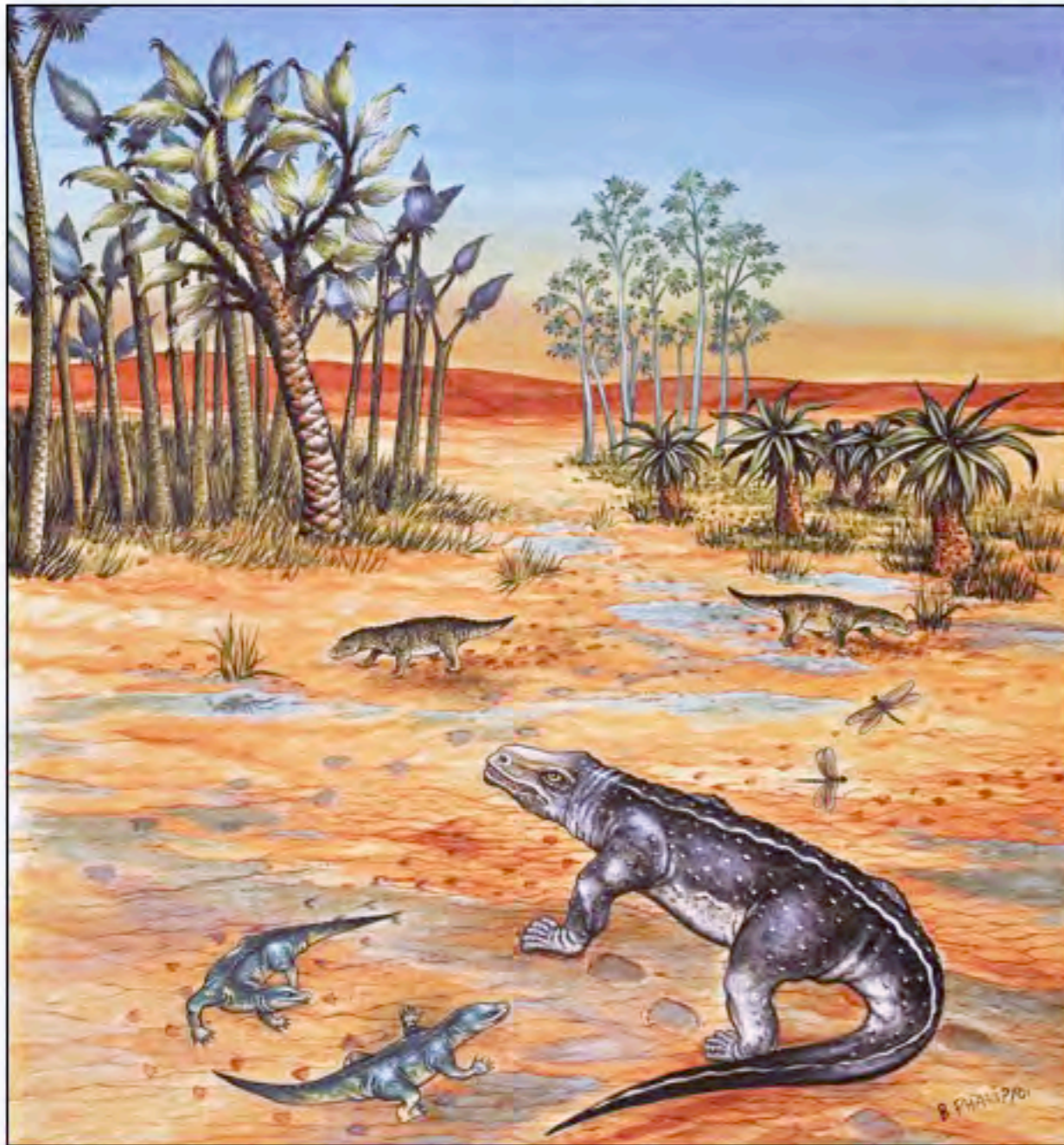


Permien supérieur : Fin de remplissage continental du demi-graben - circulation de fluides

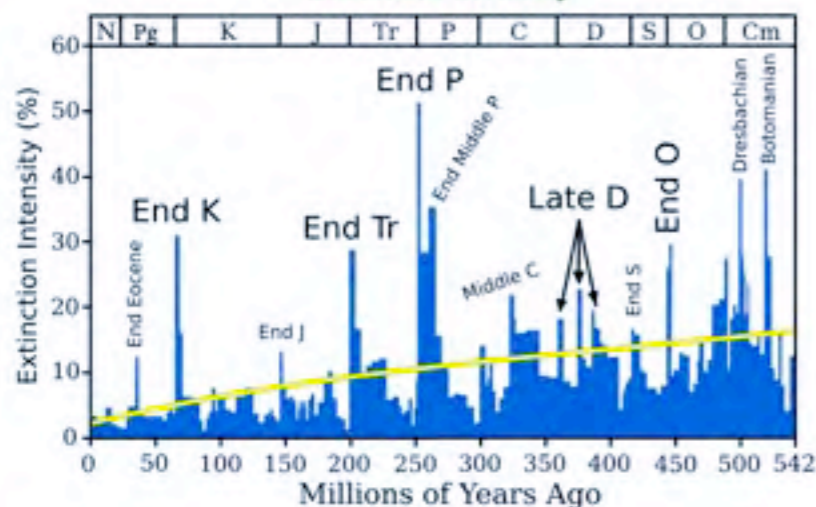


EROSION GENERALISEE / DÉCONFINEMENT DU BASSIN

Trias moyen : Reprise de la sédimentation fluviale et évaporitique, subsidence homogène post-rift



**Marine Genus Biodiversity:
Extinction Intensity**



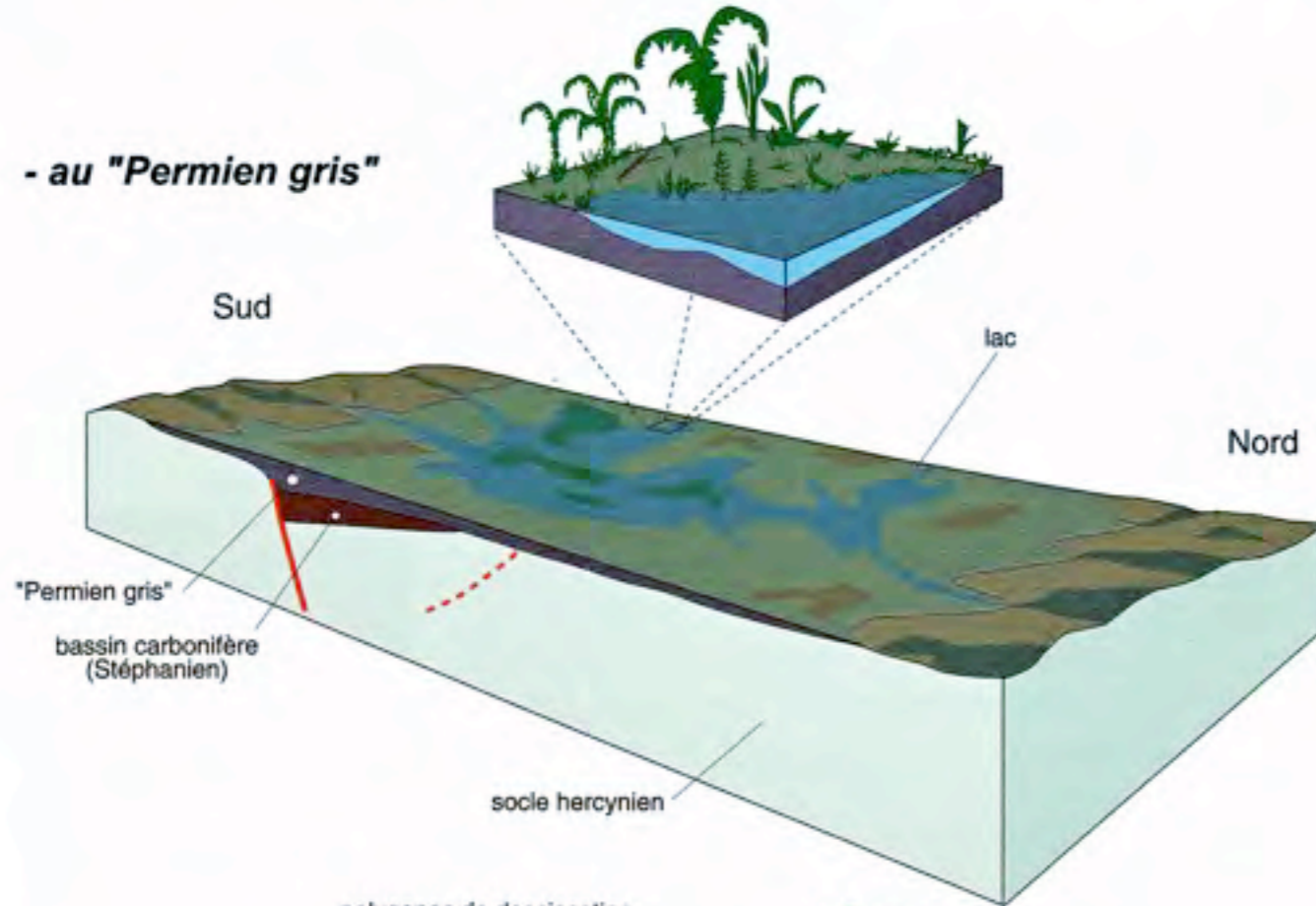
The Permian ends around -254 Myr with the most massive species extinction. According to scientific estimations, 75 % of onland species and 96 % of marine species disappeared at that time. Among those, the Permo-Trias limit marks the end of the trilobites, the graptolites and many species of coral and tetrapods : amphibians and pelycosaurus.

The reasons of this massive extinction remain under debate. The oceans seem to have been asphyxiated, may be in response to a major volcanic activity reported in Siberia and/ or to large change in world sea level.

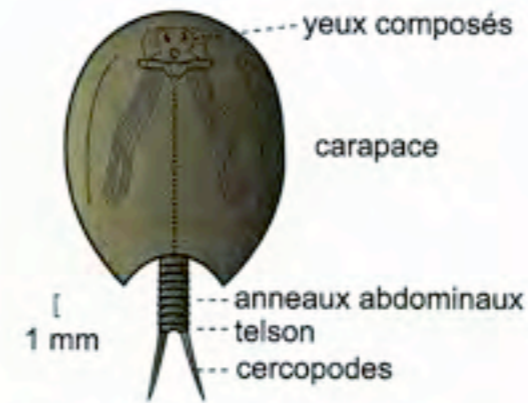
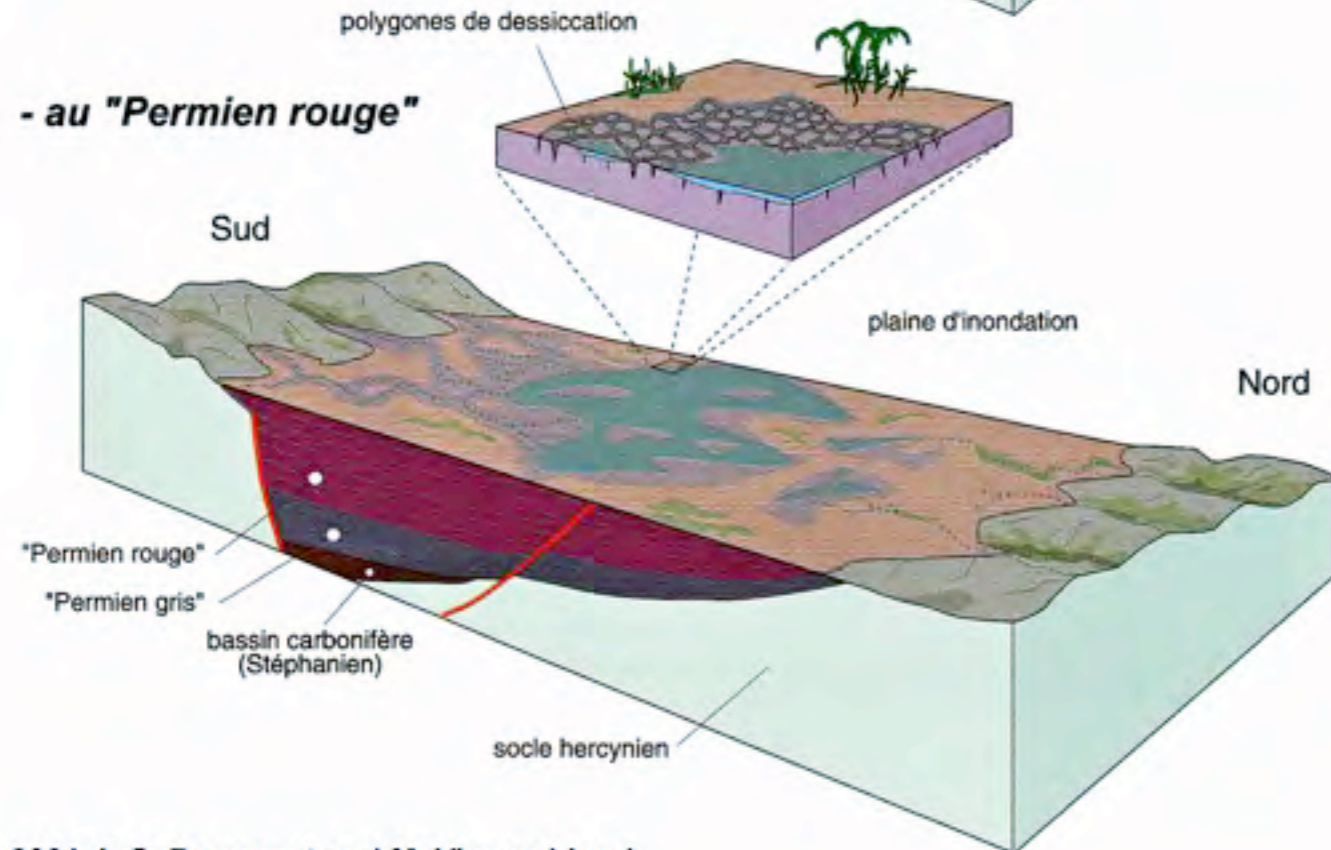
Some evidences of a large comet impact (48 km in diameter) have been recently discovered in Antarctica (2006).

The Permian Lodeve Basin : Stratigraphy and Paleoenvironments

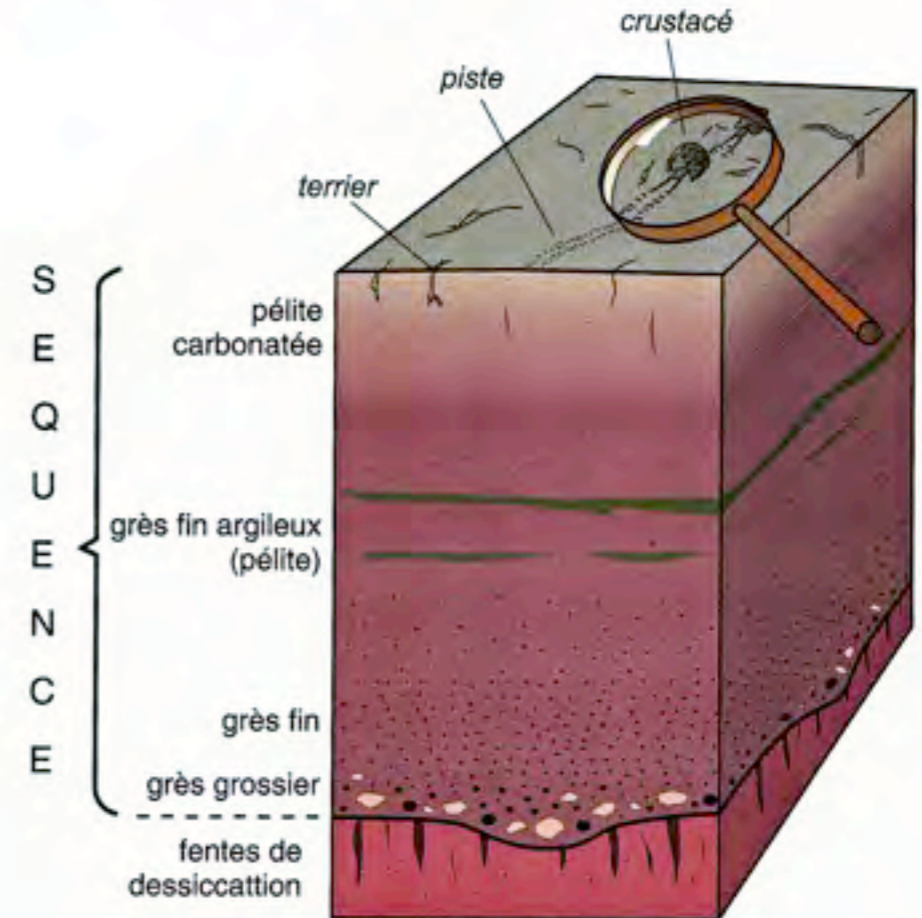
- au "Permien gris"



- au "Permien rouge"



Triops cancriformis permiensis.
Reconstitution d'après Gand et al., 1997.



The Quaternary volcanism of the «l'Escandorgue»

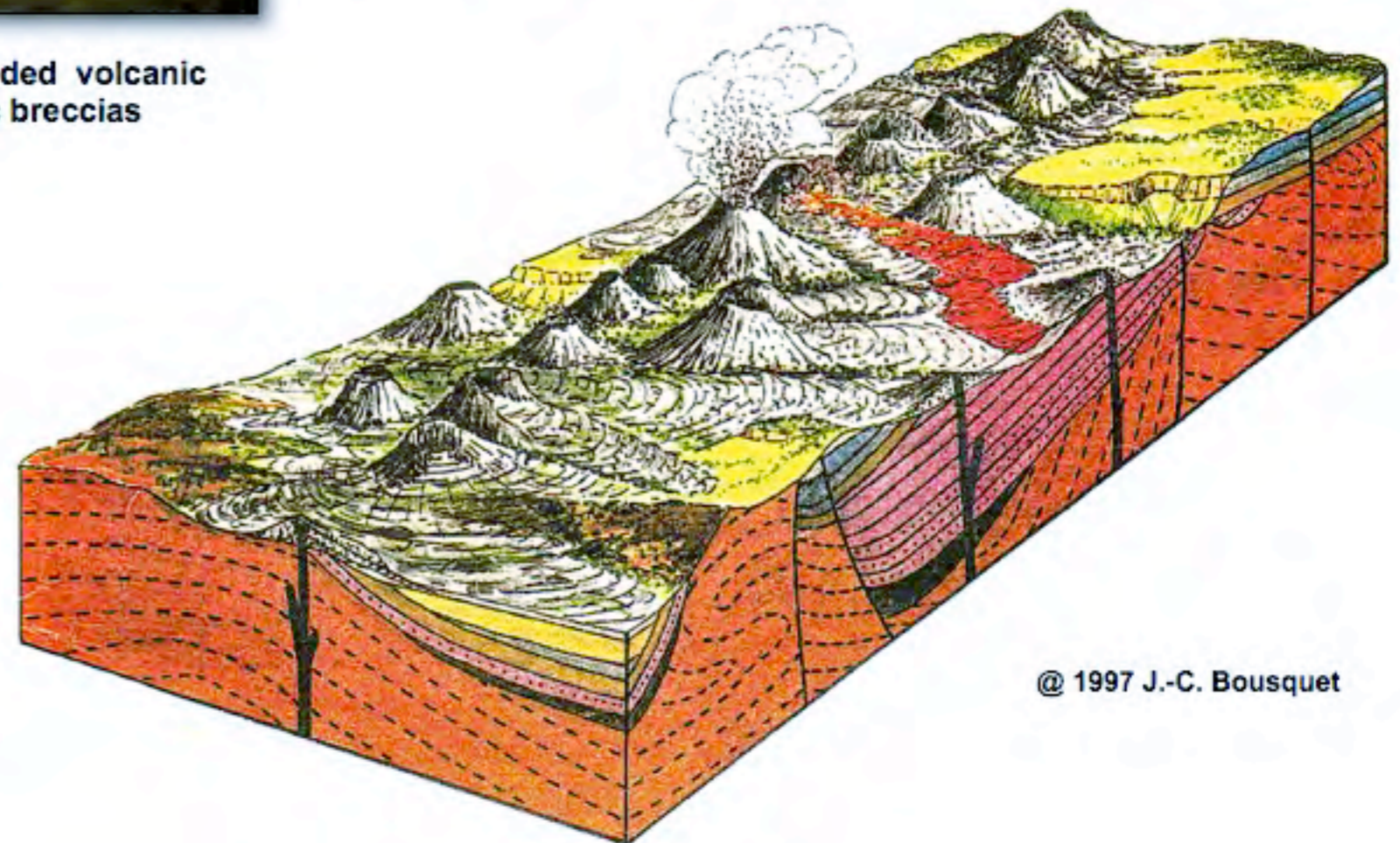


Ruins of the Malavielle castle on top of an eroded volcanic chimney composed of basalt and volcanic breccias



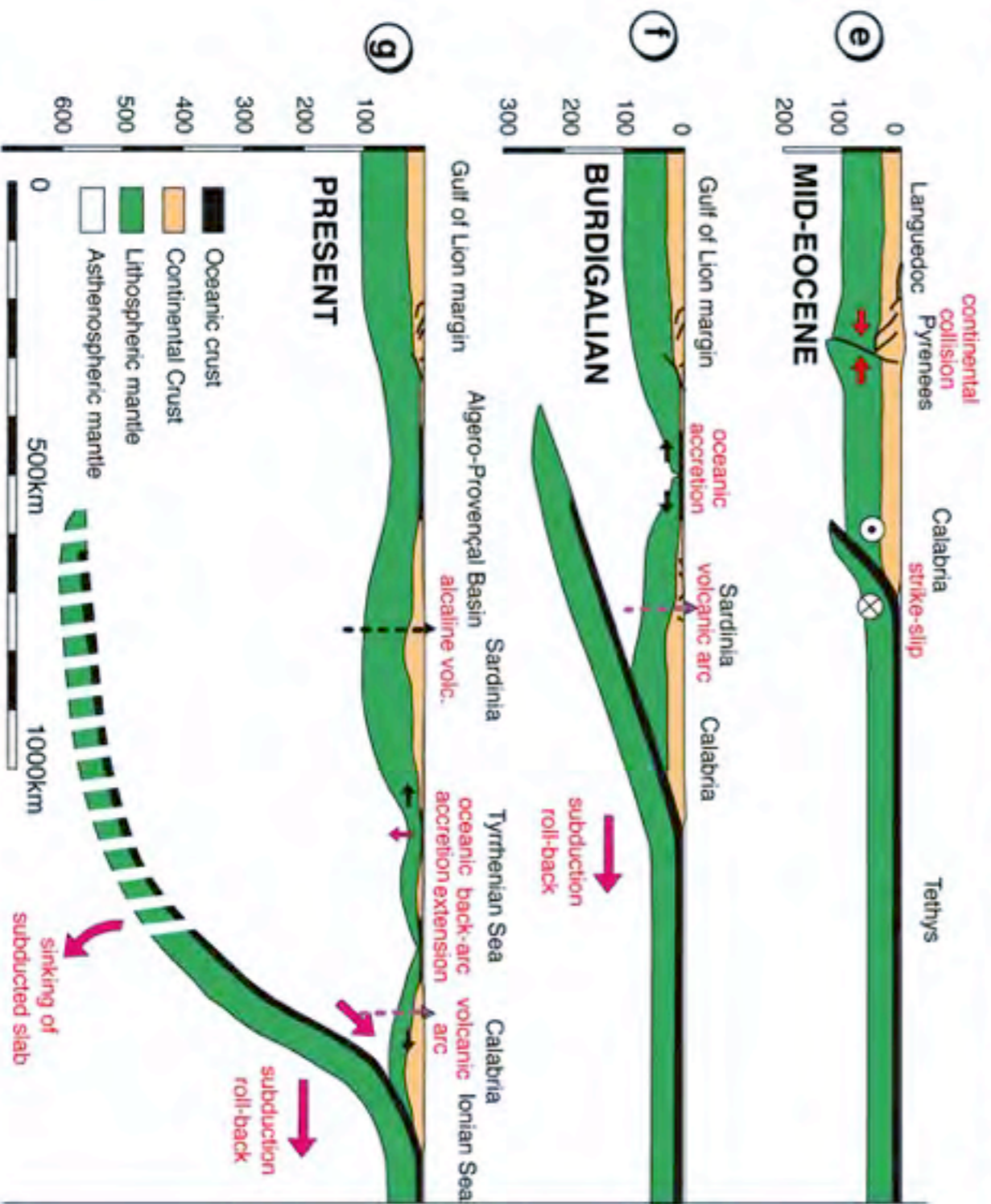
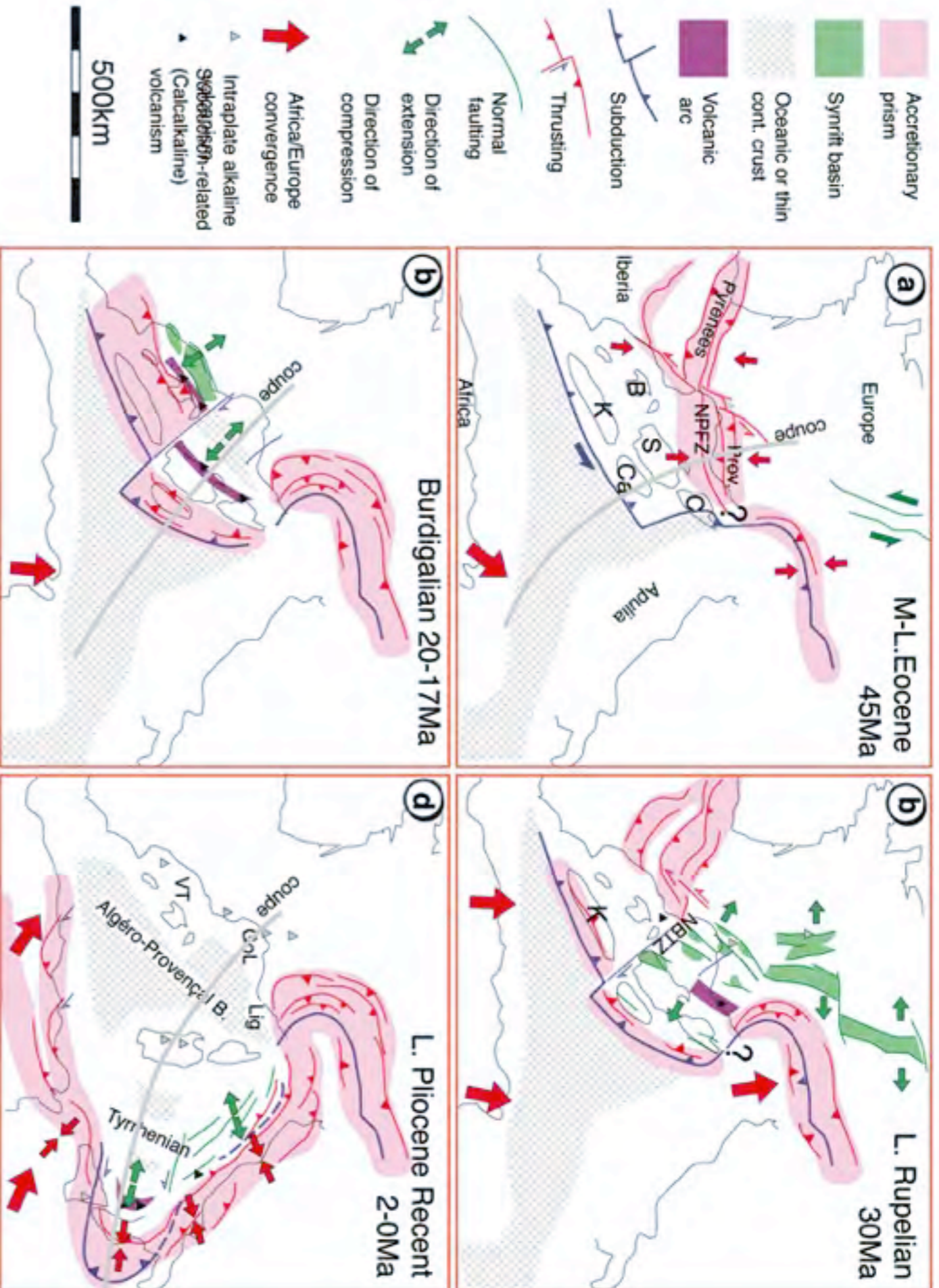
Late Quaternary lava flow (basaltic organs) on top of a hill constituted by Permian sediments. topography is inverted

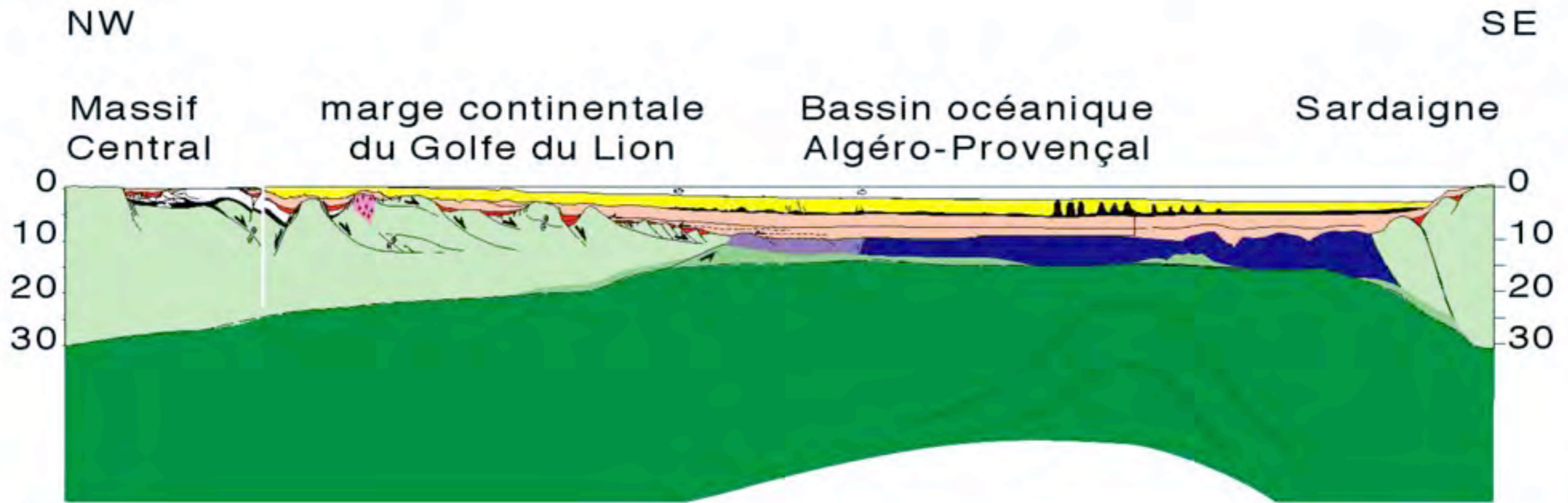
Bloc diagram showing the Lodève Basin during Late Quaternary (-2.5 Myr). Strombolian type volcanoes developed on a relatively flat region, filling the river valleys



@ 1997 J.-C. Bousquet

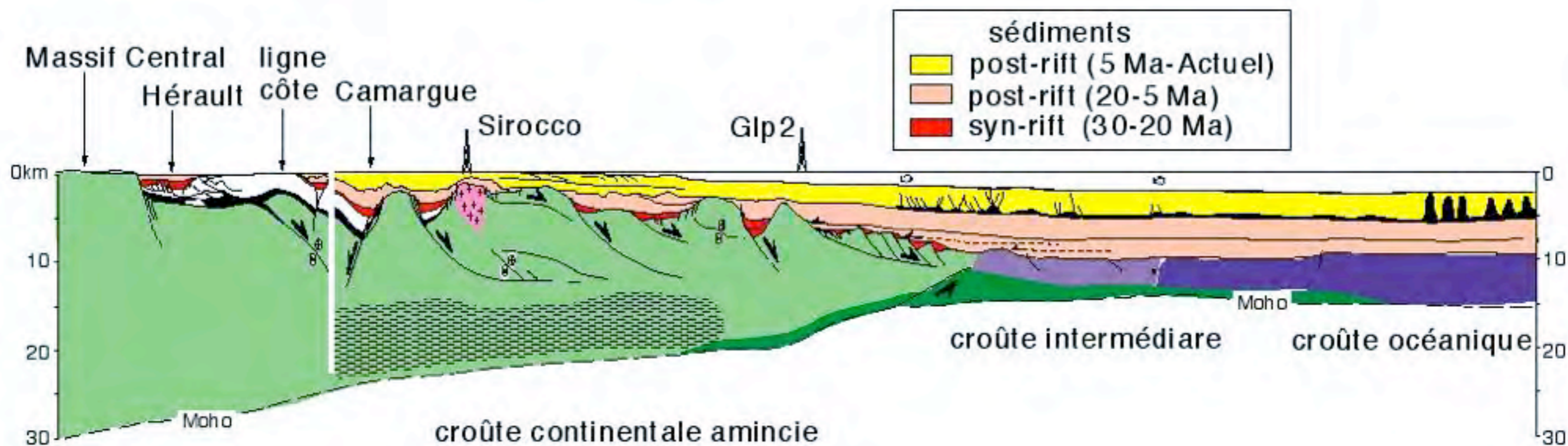
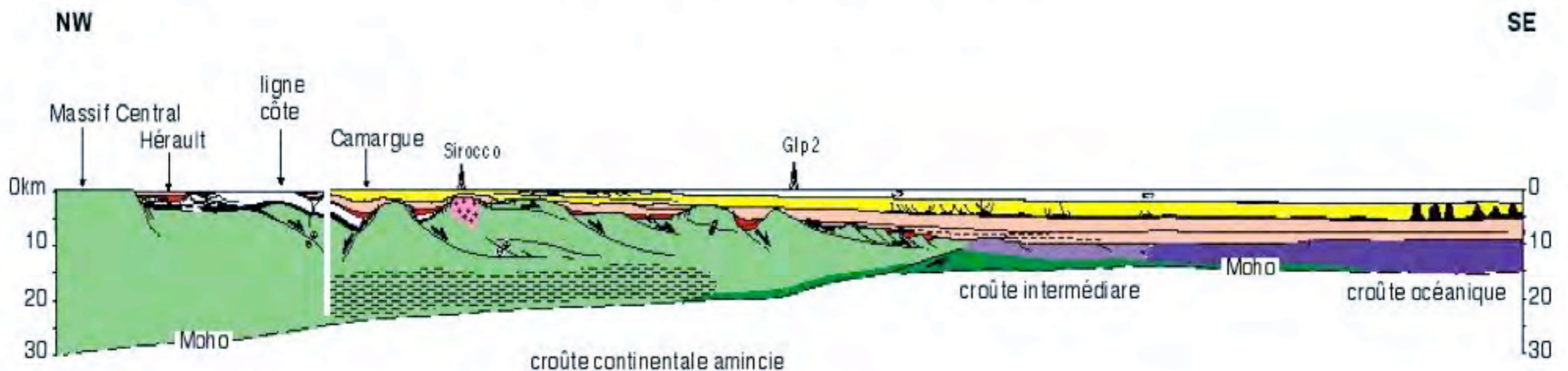
Oligo-Miocene rifting of the Golfe du Lion



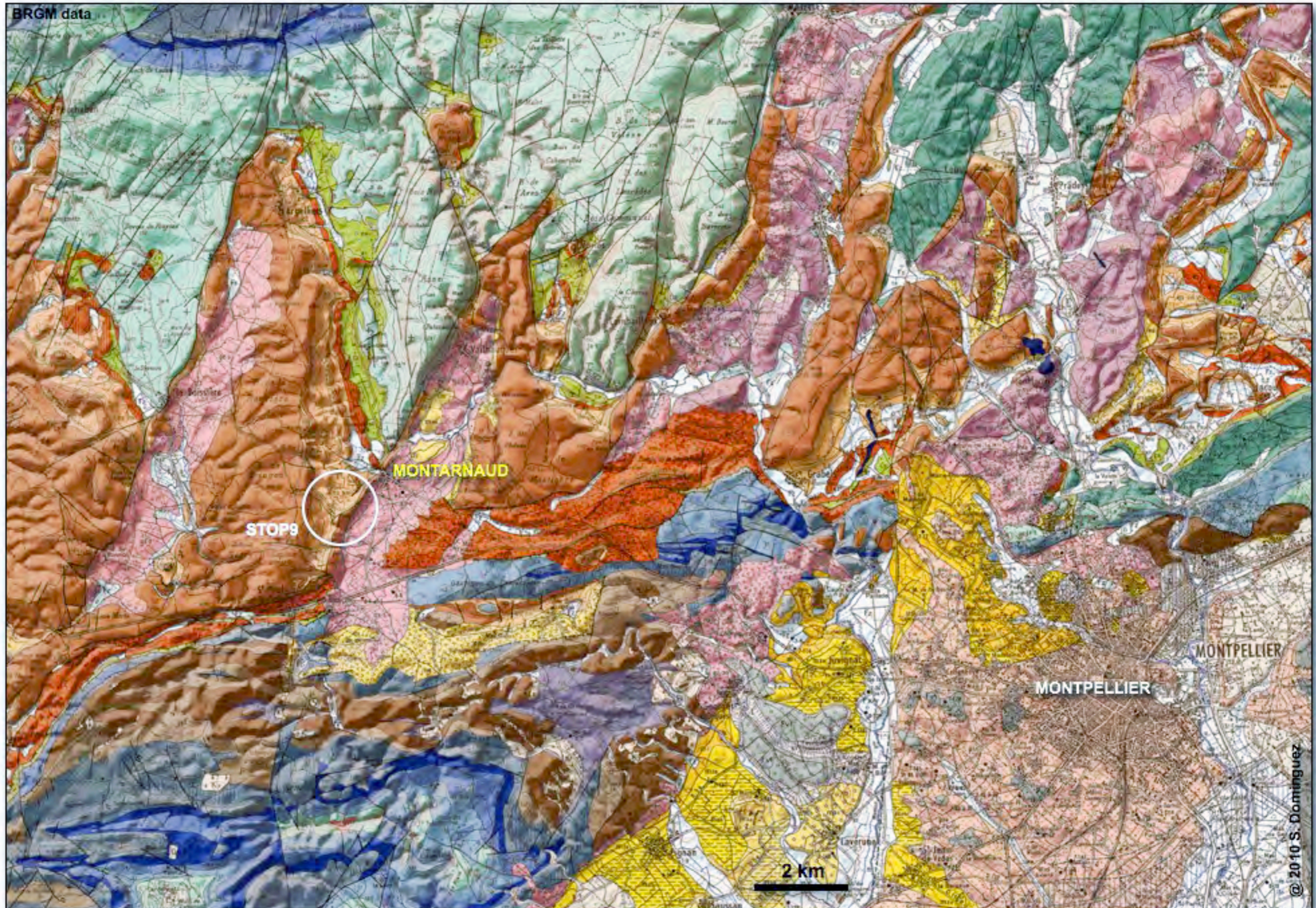


The Golfe du Lion results from the rotation of the Corso-Sarde block

Golfe du Lion geological section



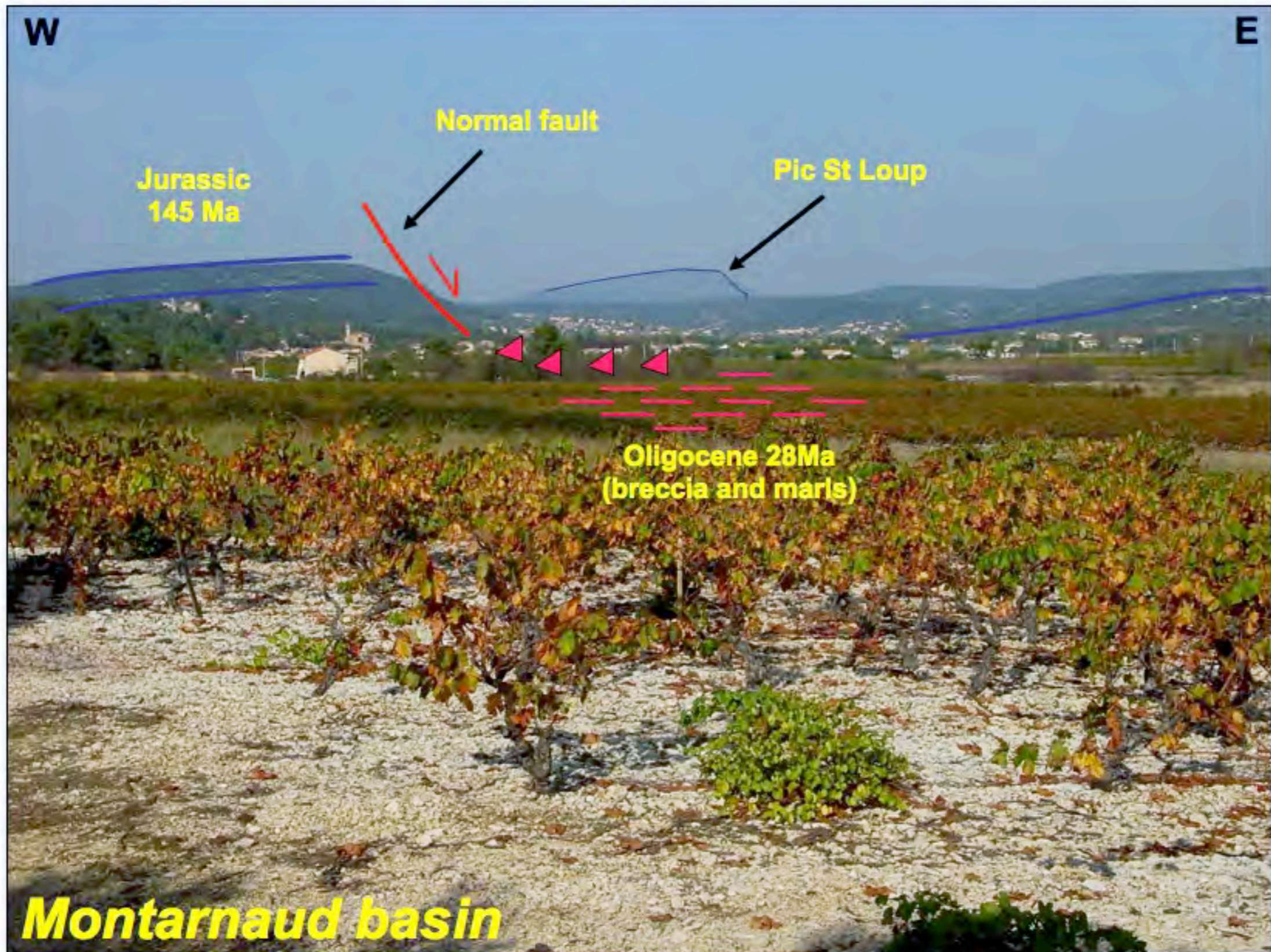
Opening of the Mediterranean Sea and Golfe du Lion : Extensionnial Tectonics



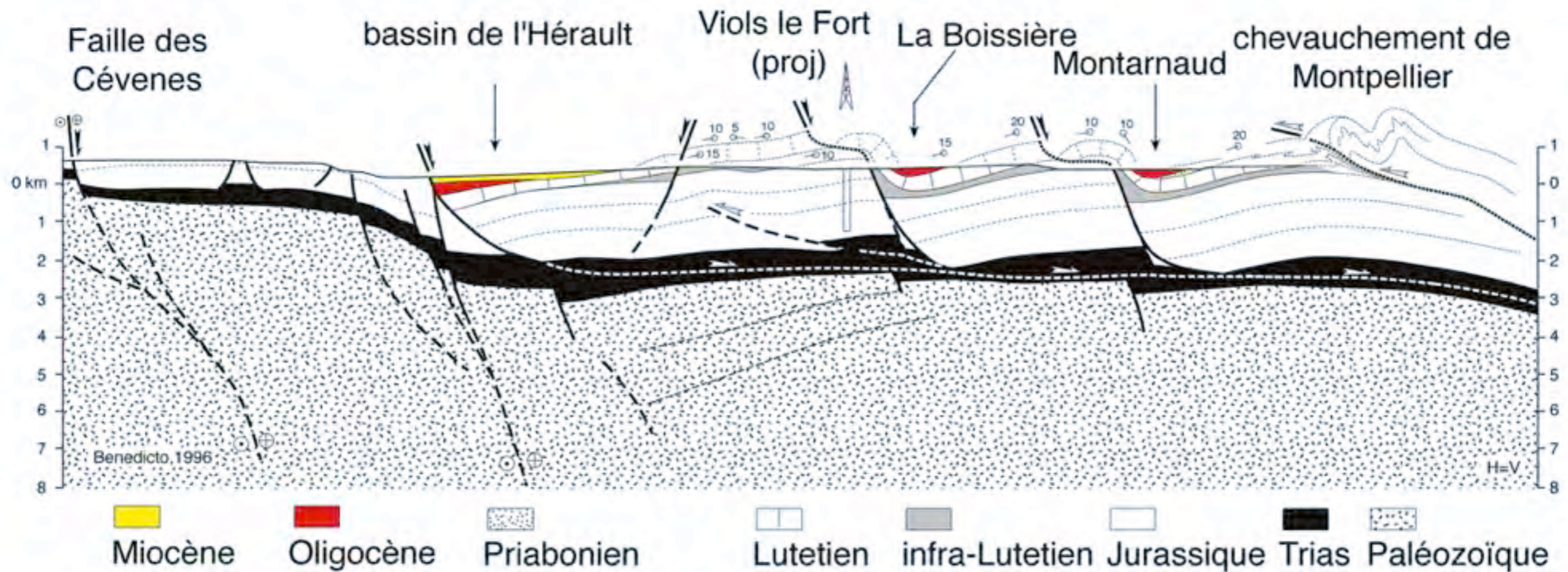
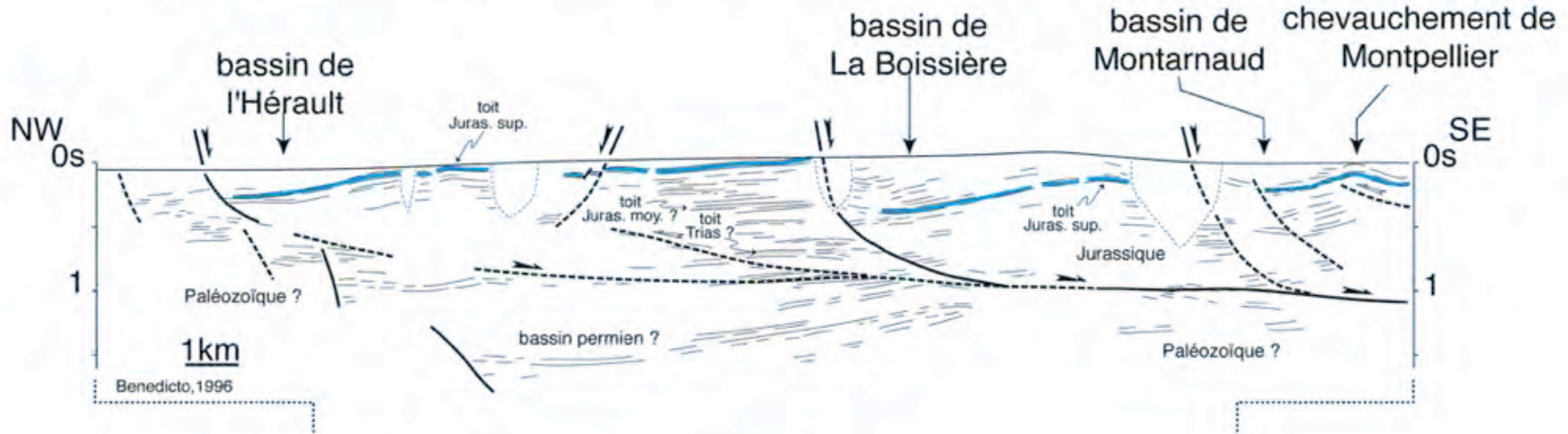
Opening of the Mediterranean Sea and Golfe du Lion : Extensionnall Tectonics



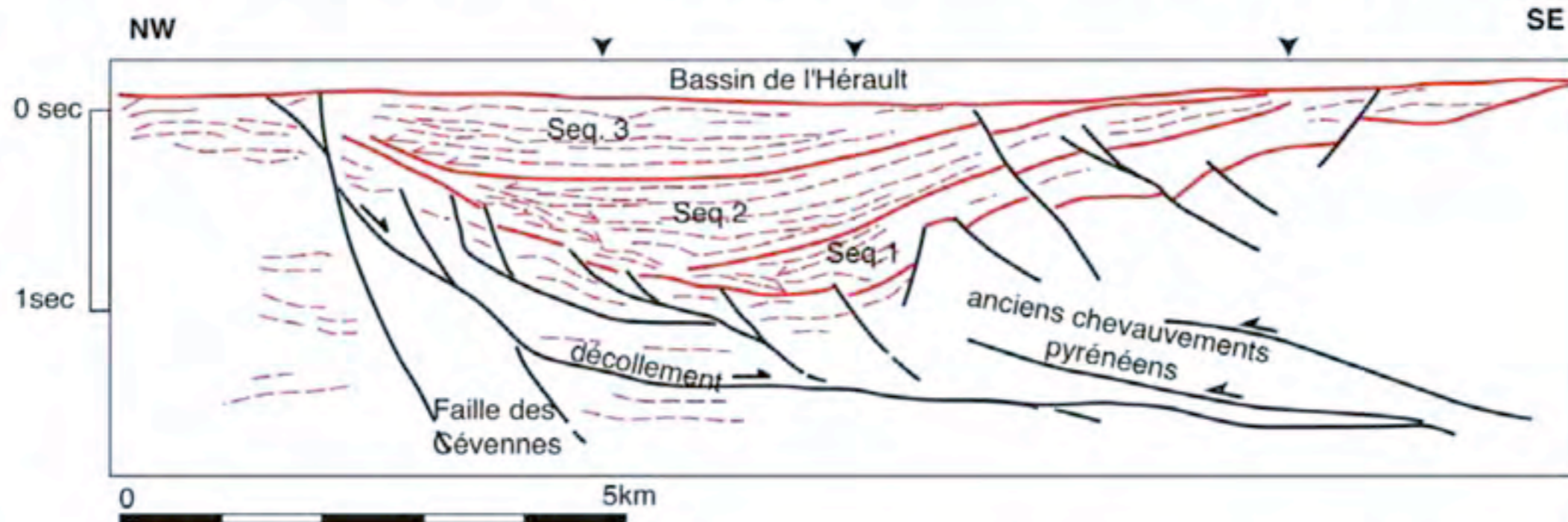
28 Ma : opening of the Golfe du Lion (extensional tectonics)



Opening of the Mediterranean and Golfe du Lion : Extensionnall Tectonics

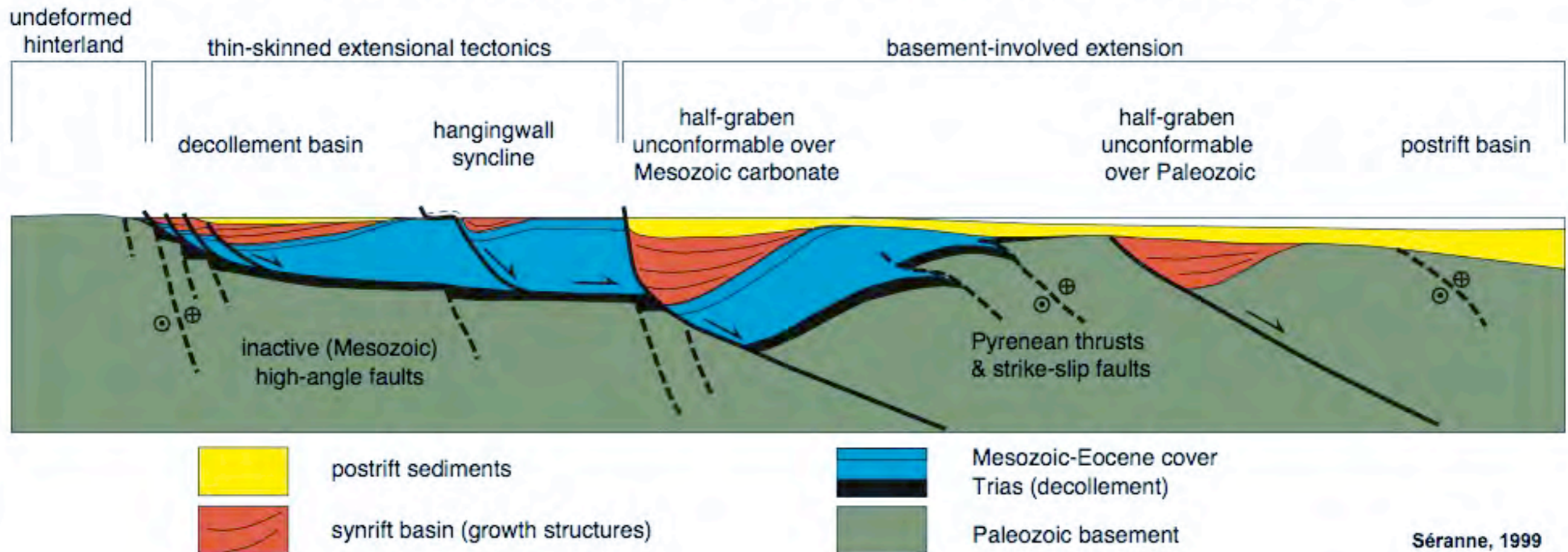


Line drawing of a seismic line through the Hérault basin



Séranne et al., 2011

Model for the extensional basins of the Golfe du Lion margin



Séranne, 1999

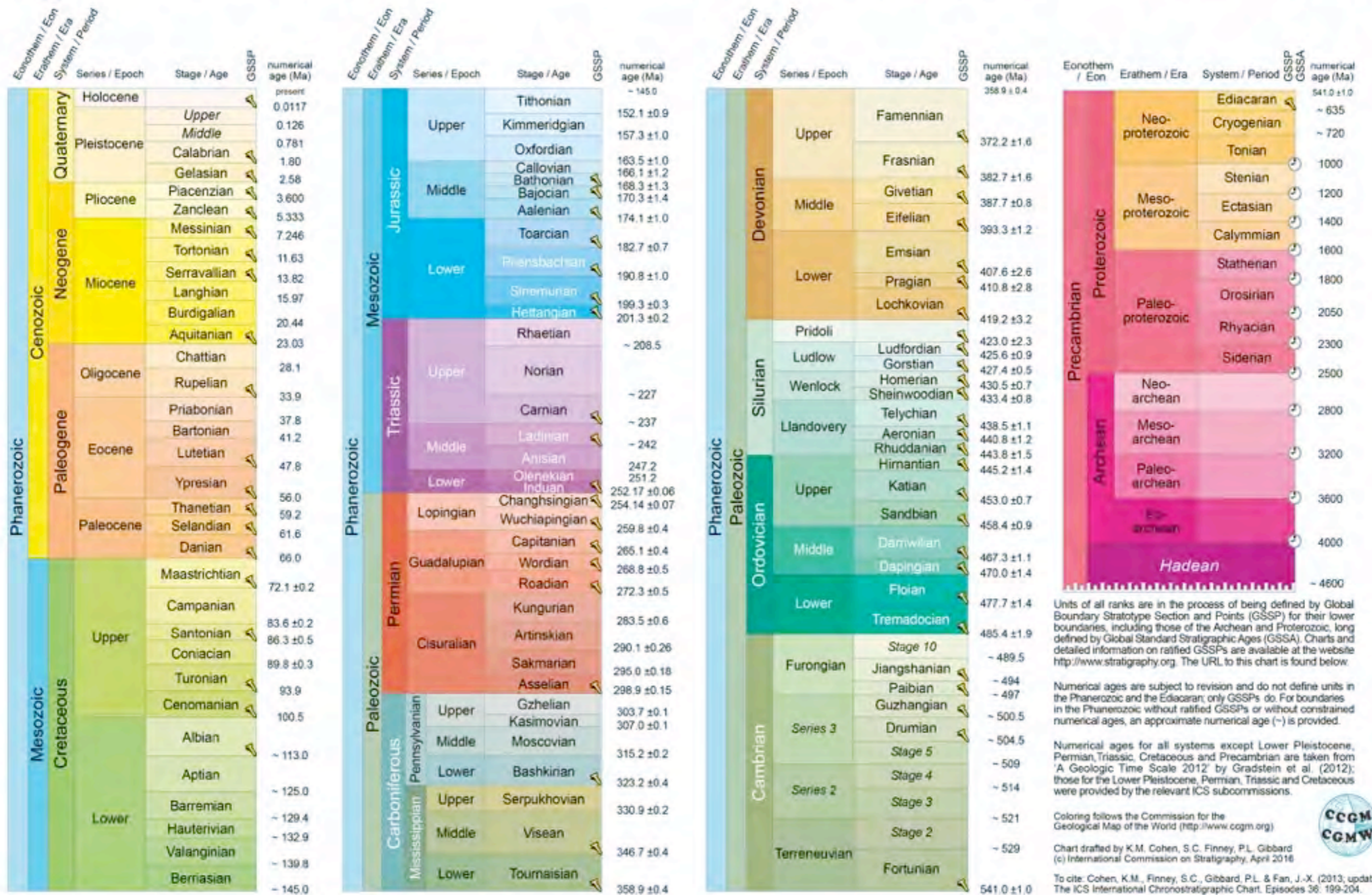


INTERNATIONAL CHRONOSTRATIGRAPHIC CHART

www.stratigraphy.org

International Commission on Stratigraphy

v 2016/04



Units of all ranks are in the process of being defined by Global Boundary Stratotype Section and Points (GSSP) for their lower boundaries, including those of the Archean and Proterozoic, long defined by Global Standard Stratigraphic Ages (GSSA). Charts and detailed information on ratified GSSPs are available at the website <http://www.stratigraphy.org>. The URL to this chart is found below.

Numerical ages are subject to revision and do not define units in the Phanerozoic and the Ediacaran; only GSSPs do. For boundaries in the Phanerozoic without ratified GSSPs or without constrained numerical ages, an approximate numerical age (~) is provided.

Numerical ages for all systems except Lower Pleistocene, Permian, Triassic, Cretaceous and Precambrian are taken from 'A Geologic Time Scale 2012' by Gradstein et al. (2012); those for the Lower Pleistocene, Permian, Triassic and Cretaceous were provided by the relevant ICS subcommissions.

Coloring follows the Commission for the Geological Map of the World (<http://www.cgmw.org>)

Chart drafted by K.M. Cohen, S.C. Finney, P.L. Gibbard (c) International Commission on Stratigraphy, April 2016

To cite: Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; updated) The ICS International Chronostratigraphic Chart. Episodes 36: 199-204.

URL: <http://www.stratigraphy.org/ICSchart/ChronostratChart2016-04.pdf>

