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An interpretation of the seismicity in the Pyrénées range based on topography analysis.

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The 400km long Pyrénées range stands at ∼2500m of elevation between the Iberia and European plate. Within the range, most of the deformation is ascribed to upper Cretaceous to Eocene deformation phases and the present-day rate of deformation is low. The range is however characterised by a permanent seismic activity with moderate magnitude (M∼5) for the largest events, showing a spatial repartition stable through time. It is very difficult to identify and characterise the active faults that produce this seismicity. Only the Capcir and Cerdagne faults have been proposed to be active from their morphology (e.g. Briais et al., 1990), and even in that case the recent activity of the faults and their association with the largest historical seismic events, are highly controversial. Consequently, active tectonics and present-day deformation of the Pyrénées is poorly understood, and major question about the deformation regime of the range are still unresolved. Is the range under compression or extension ? Is there a component of strike-slip absorbed by the range ? Is the deformation regime homogeneous within the range ? Is the present-day topography shaped by active deformations or is it a relic one ?

We have investigated the relationship between the present-day topography and the instrumental seismicity along a series of cross-sections perpendicular to the range. On the northern flank of the range, the most striking result is that the largest cluster of instrumental seismicity, which stretch from Bagnères-de-Bigorre to Arette, corresponds to a very sharp topographic transition between the foreland and the range, not observed elsewhere. We interpret this topographic change as due to a change of the geometry at depth of the North Pyrenean Frontal Thrust that bounds the range. Our

hypothesis is that between Bagnères-de-Bigorre and Arette thrust motions occur along a steep emerging ramp, while farther to the east the ramp would be less steep at depth and connected with a flat thrust emerging $\sim$20km farther to the north. The cluster of moderate-size seismicity could occur in the hanging-wall of the steep thrust ramp, while the flatter thrust would not produce any moderate-size seismicity but only larger and much less frequent earthquakes.

If our interpretation is correct it would imply that the instrumental seismicity is linked to active roughly N-S compression across the North Pyrenean Frontal Thrust, and that the present-day deformation regime of the range is coherent thickening between the north and south front.

Briais, A., et al. (1990). “Morphological evidence for Quaternary normal faulting ans seismic hazard in the Eastern Pyrenees.” Annales Tectonicae **IV**(1): 14-42.