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The Têt fault escarpment in Eastern Pyrenees : how anisotropic diffusive transport may preserve steep slopes imitating active fault scarps.

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We present a 2D numerical model accounting for diffusion anisotropy linked to the existence of a rock planar fabric (bedding or foliation) and use it to determine in which conditions steep topographic slopes can be preserved. We define maximum and minimum diffusion coefficients varying as a function of topographic slope, and an anisotropy strength which describes how the diffusion coefficient varies with the anisotropy. We assume that the diffusion coefficient should be maximum when the topographic slope is perpendicular to the rock planar fabric, and minimum when it is parallel to it. The diffusion coefficient is allowed to vary following a Gaussian curve which half-width defines the anisotropy strength.

The model is used to reproduce slope variations measured across a triangular facet of the Têt fault in Eastern Pyrenees, which is 80 km-long, steeply dipping NE-SW normal fault formed during the Oligocene rifting episode preceding the opening of the Gulf of Lions in the Eastern Mediterranean. The fault has accommodated the subsidence of hanging-wall basins such as the Conflent basin accumulating 2000 meters of Oligocene to Pliocene clastic sediments and the exhumation of Variscan gneissic units like the Canigou massif. The Pleistocene and Holocene fault activity is subject to debate. Based on morphological analyses of triangular facets, some authors concluded that the Têt fault is still active and can be responsible for the historical earthquake sequence that stroke eastern Pyrenees in 1427 and 1428. This hypothesis has been challenged by others who interpret the good state of preservation of the fault escarpment as resulting from the burial of the base of the escarpment under ∼400 m of sediments which were then removed by incision of the Têt river during the middle Pleistocene. These authors suggest that triangular facets in the Têt valley are preserved because the fault trends parallel to the Variscan mylonitic foliation bounding the north of the Canigou massif.

We model the evolution of the Têt fault escarpment since its exhumation in the Late Pleistocene (i.e. 500 kyr). We show that the observed slope distribution on the escarpment as well as the topographic profile can be reproduced assuming an initially 600m high scarp and a slope of 35° with a rock planar fabric dipping at 45°, maximum and minimum diffusion coefficients of 0.015 and 0.001 m2/yr respectively, and an anisotropy strength of ∼30°. The resulting slope distribution displays a peak at 45° corresponding to the rock planar fabric, in agreement with field observations. We conclude that the apparent freshness of the Têt fault escarpment does not reflect an active fault but is more likely due to the good preservation of structural surfaces corresponding to the mylonitic foliation.