The forces involved in mountain building: Albania and Tibet

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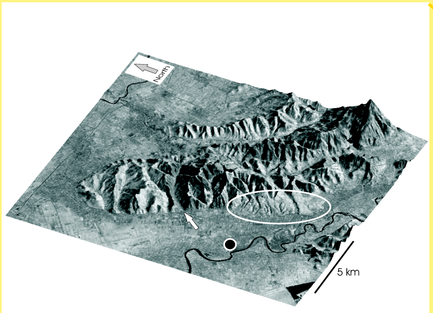
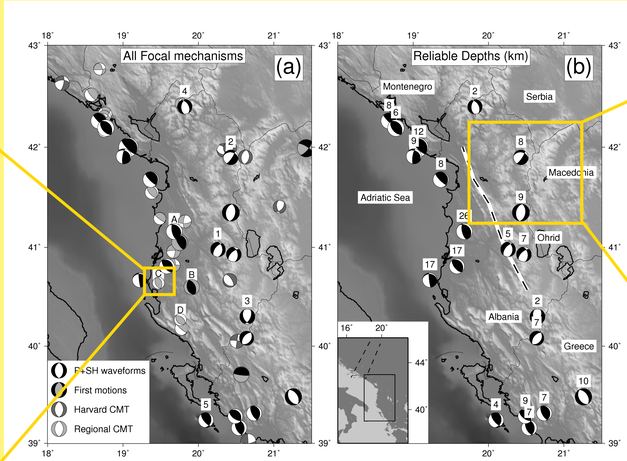
1. Albania

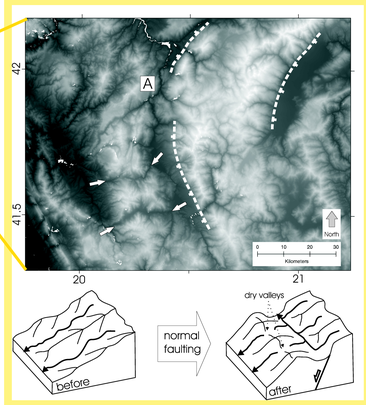
(with Fran Boait, James Hollingsworth, James Jackson, and Dan Mckenzie)

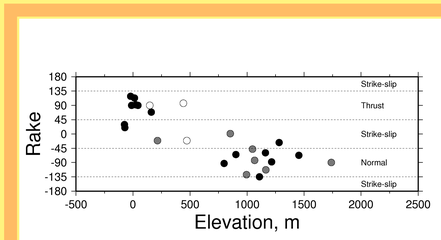
The active tectonics of Albania and surrounding regions, on the eastern margin of the Adriatic Sea, is characterised by sub-parallel thrust and normal faulting which, we suggest, is likely to be related to gravitational potential energy contrasts between the low-lying Adriatic Sea and the elevated mountainous areas inland. We calculate the magnitude of the force which the mountains and lowlands exert upon each other as a result of this potential energy contrast. It is likely that this force is supported by shear stresses on faults, and if so these stresses are in the range 1-20 MPa. Alternatively, if the mountains are supported by stresses in the ductile part of the lithosphere, the stresses are likely to be ~30-100 MPa in magnitude. We suggest that the lowlands of the Adriatic Sea may have been weakened through time as a result of the deposition of large thicknesses of sediment, which lead to heating of the crystalline basement, a reduction in the potential energy contrast that could be supported by the lowlands, and so normal faulting in the mountains of eastern Albania.

Sub-parallel thrust and normal faulting

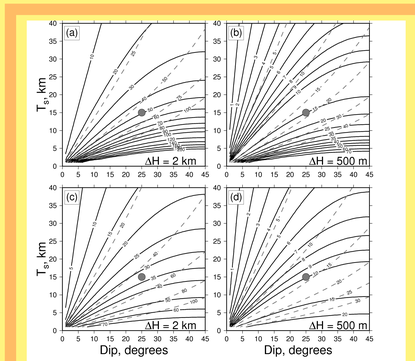




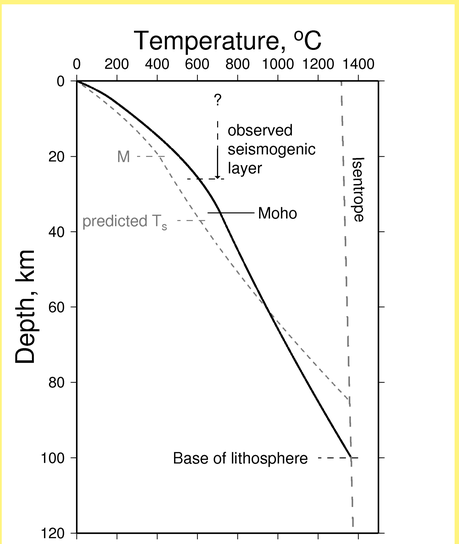




Relation between surface elevation and rake (with normal faulting seen at high elevations) suggests the importance of gravitational potential energy contrasts in the tectonics of Albania

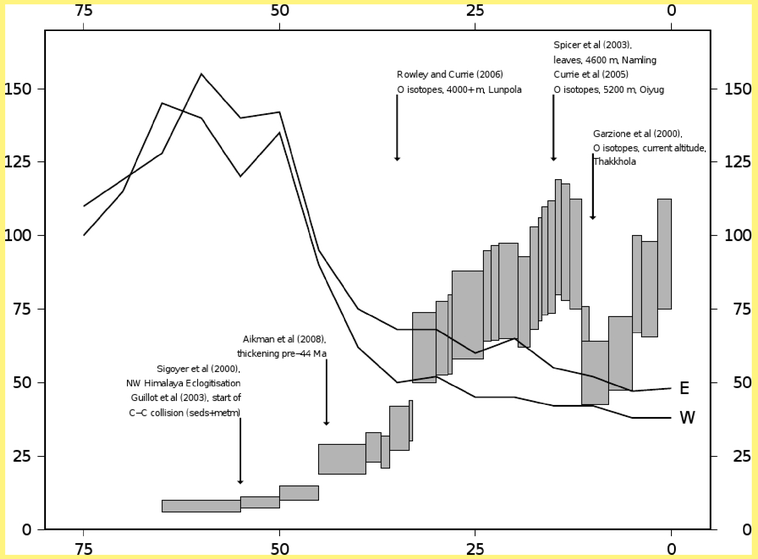


Shear stresses required to entirely support GPE differences by stresses on faults



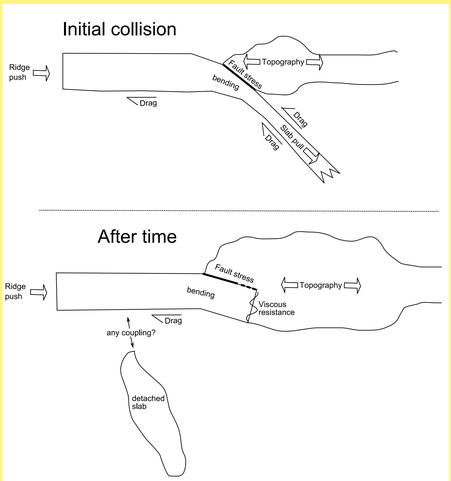
Geotherms before (grey) and after (black) sediment deposition in the Adriatic Sea. The presence of a ~15 km thick sedimentary sequence reduces the thickness of crystalline basement cold enough to be seismogenic and/or load bearing, possibly leading to GPE induced normal faulting in the neighbouring mountains

2. Tibet (work just begun)



(Royer and Patriat 2002, Clift 2006)

Changes in convergence velocity (lines) and sediment flux (boxes) coincide with timing of India-Asia collision



Simple force balance in cross-section

Forces change due to building topography and changing velocity

ridge push + slab bouyancy = +/- basal drag + fault stress + viscous resistance + topography + bending

(red depend on current velocity)