



Landscape response at the edge of a tearing slab

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Tearing at the edges of subducted slabs permits the migration of narrow orogenic arcs. Dynamic models predict that the active segment of subvertical tears migrates in the sense opposite subduction modifying the topography and tectonic regime along its path. However, the effects of slab tearing on surface deformation and landscape evolution, remains virtually unexplored. Here we show the landscape response to slab tearing, including drainage development and reorganization in the Betics, with analogies to the southern Caribbean arc. After approximately 400 km of slab tearing since 10 Ma the Betics show a transient topography with positive residual values over regions stripped from their subcontinental lithospheric mantle and negative anomalies outboard of the tear. The landscape evolves through crustal shortening and flexural uplift in the foreland of the active tearing segment producing land emergence and drainage development, with fluvial diversion around uplifting structures. Slab pull and orogen transverse extension inboard the active-tearing segment foster basin development followed by emergence and drainage reorganization by fluvial incision and capture. Mantle upwelling, flexural rebound and further extension affects teared regions, driving positive residual topography amplified in the footwall of extensional domes. Mantle flow around the slab drives uplift hundreds of km away from the slab edges.