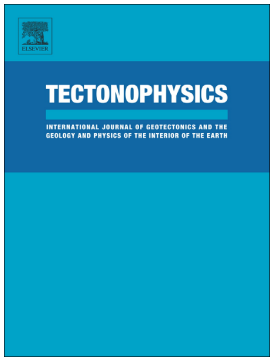

Does slab-window opening cause uplift of the overriding plate? A case study from the Gulf of California

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Does slab-window opening cause uplift of the overriding plate? A case study from the Gulf of California.

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Complete subduction of an oceanic plate results in slab-window opening. A key uncertainty in this process is whether the higher heat flux and asthenospheric upwelling conventionally associated with slab-window opening generate a detectable topographic signature in the overriding plate. We focus on the Baja California Peninsula, which incorporates the western margin of the Gulf of California rift. The topography and tectonics of the rift flank along the peninsula are strongly bimodal. North of the Puertecitos accommodation zone, the primary drainage divide attains a mean elevation of ca. 1600 m above sea level (asl), above an asthenospheric slab-window opened by Pacific-Farallon spreading ridge subduction along this section of the trench at ca. 17-15 Ma. To the south, mean topography decreases abruptly to ca. 800 m asl (excluding the structurally distinct Los Cabos block at the southern tip of the peninsula), above fragments of the oceanic Farallon slab which stalled following slab tear-off at ca. 15-14 Ma. Along the peninsula, a low-relief surface established atop Miocene subduction-related volcaniclastic units has been incised by a west-draining canyon network in response to uplift. These canyons exhibit cut-and-fill relationships with widespread post-subduction lavas. Here, we utilise LANDSAT and digital elevation model (DEM) data, integrated with previously published K-Ar and $^{40}Ar/^{39}Ar$ lava crystallisation ages, to constrain the onset of rift flank uplift to ca. 9-5 Ma later than slab-window formation in the north and ca. 11-10 Ma later in the south. These greatly exceed response time estimates of ca. 2 Ma or less for uplift triggered by slab-window opening. Instead, uplift timing of the high-elevation northern region is consistent with lower-lithospheric erosion driven by rift-related convective upwelling. To the south, stalled slab fragments likely inhibited convective return flow, preventing lithospheric erosion and limiting uplift to the isostatic response to crustal unloading during rifting.

Keywords: Slab detachment; asthenospheric upwelling; rift flank uplift; stream profile analysis; Gulf of California.

1. Introduction

Oceanic slab detachment and consequent slab-window formation can occur by ridge subduction or slab tear-off following ridge-trench collision (e.g., Isacks and Molnar, 1969; Chatelain et al., 1992), and can be recognised by the presence of unpaired magnetic anomalies or stranded slab fragments