Geophysical Research Abstracts
Vol. 13, EGU2011-7138, 2011
EGU General Assembly 2011

Rock uplift and exhumation of continental crust in response to the collision of heterogeneous oceanic crust, examples from the northern, central and southern Andes

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A comparison of thermochronological and geophysical data from rocks that have been subducted by passive volcanic ridges along the western margin of the South American Plate suggests that i) collision and subduction of topographically prominent, and thick volcanic ridges with continental plates drives rock uplift in the continental plate, ii) the amount and spatial extent of exhumation that occurs is strongly dependant on climate induced erosion, and the life-span of the dynamically supported, topographically prominent crust, and iii) slab-flattening and plate coupling may play a less important role than horizontal compressive stress originating at the trench during ridge collision. Spikings et al. (2001) utilised the fission track and (U-Th)/He methods to show that the Carnegie Ridge collided with the northern Andean margin at 15 Ma, resulting in a sudden increase in exhumation rates in the upper plate during 15–14 Ma, and the erosion of ∼6 km of crust. Similarly, the spatial coincidence of the younging trend of the onset of late Miocene exhumation along the Chilean Main Cordillera (35-38°S) with the Juan-Fernandez Ridge and pampean flat-slab (Yáñez et al., 2002) strongly suggests a cause and effect relationship during 7.5 - 0 Ma.. Gullier et al. (2001) showed that the Carnegie Ridge is currently not associated with a flat-slab, which contrasts with the flattened slab that hosts the Juan Fernandez ridge that currently subducts the Chilean margin. Therefore, the tectonic response of the upper plate is not solely a simple function of slab-dip. Wipf (2006) obtained apatite fission track data from Cretaceous and older granitoids along coastal Peru, and were unable to detect distinct periods of elevated exhumation rates since the late Miocene, which may have been driven by subduction of the Nazca Ridge, as it migrated southwards from ∼11.5°S to its current location at ∼15°S, since its collision at ∼11.2 Ma (Hampel et al. 2002). However, Pleistocene marine terraces crop-out at a maximum elevation of ∼800m along coastal Arequipa (Hsu, 1992). Current annual rainfall along the region of coastal Peru is less than 5cm/yr, and arid conditions persisted along the coast throughout the Cenozoic (Dunai et al. 2005). We suggest that low exhumation depths along coastal Peru, compared with the upper plate above the Juan-Fernandez and Carnegie ridges, corroborates the combined effects of the lower erosive power of the climate in coastal Peru, and the short life-span of the dynamically supported land-surface (∼3.5 my; Hsu 1992) during the SE directed displacement of the Nazca Ridge, relative to the South American Plate.