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Focused subaerial Erosion during Ridge Subduction: Impact on the Geomorphology in South-Central Peru

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Data obtained from low-temperature thermochronometers such as apatite fission-track and (U-Th)/He is combined with morphometric information extracted from Digital Elevation Models (DEM). This combination shows several geomorphological effects that are caused by the migration of the Nazca Ridge along the Peruvian Coastal margin. Offshore, the depth of the deep-sea trench decreases by $\sim$1500 m where the Nazca Ridge collides with the continental South American Plate. Onshore the ridge causes an uplift of at least 800 m in the Coastal Cordillera. This uplift results in a westward shift of the coastline thereby focusing and increasing erosion in the uplifted areas. At the trailing edge, the shelf subsides and the coastline retreats eastward, producing at least part of the indentation observed between Paita and Pisco. The Ridge acts therefore like a wave uplifting the Andean margin as it traverses inland and southwards leaving a clear fingerprint on the topographic evolution of the Peruvian coastal margin.

The subduction of oceanic lithosphere with ridges or seamounts may induce tectonic effects on continental margins (von Huene and Scholl, 1991) because ridges and seamounts tend to be more buoyant than the surrounding ocean floor. This buoyancy may therefore lead to low-angle subduction of less than 45˚ (Turcotte and Schubert, 2002). Such effects have been observed in Japan (von Huene and Lallemand, 1990 and references therein) in Central America (Sak et al., 2004, Hühnerbach et al., 2005, Vannuchi et al., 2006) and in South America. The pattern of seismicity and volcanic activity in the Peruvian margin seem to be controlled by the dip of the subducting slab (Barazangi and Isacks, 1976; Jordan et al., 1983; Nur and Ben-Avraham, 1981, 1983; Pilger, 1981). This assumption is supported by the occurrence of similar volcanic gaps farther south, where the Juan Fernandez Ridge collides with the Chilean coast and south of the point where the Cocos Ridge meets the coast of Panama. An effect on the topography of the associated trench as well as on the overlying plate may also be present (von Huene and Lallemand, 1990). While Spikings et al. (2001) showed that the Carnegie Ridge influences the evolution of the Ecuadorian coastal margin, Laursen et al., (2002) described the deformation of the central Chilean margin caused by the Juan Fernández Ridge. However, due to its geometry, crustal thickness, and relatively low density (Tassara et al. 2006) the most pronounced feature being subducted beneath the South American plate is the Nazca Ridge offshore Peru. This should be seen by a refreshed topography over the shallow subduction zone as it causes surface uplift (Spence et al., 1999). It has been speculated that this effect is traceable as far as into the Amazonian Foreland (Espurt et al., 2007). Similarly, Mcnulty & Farber (2002) suggested that the onset of ridge subduction triggered the exhumation of the Cordillera Blanca in northern Peru. Hence, we expect the region overlying the ridge to yield younger exhumation ages for upper crustal sections compared to the neighbouring areas. Similarly, we anticipate that rivers may be rerouted to adjust with the rising landmass. These hypotheses are tested using a combination of thermochronometric and morphometric analyses.