Subduction of seafloor asperities revealed by a detailed stratigraphic analysis of the active margin shelf sediments of Central Ecuador

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Abstract

The uplift of the coastal cordillera of central Ecuador is a likely consequence of the subduction of the Carnegie Ridge, a 400-km-long and 2-km-high topographic asperity. This study aims at analyzing the impact of the subduction of the Carnegie Ridge on the continental shelf sedimentation during the Quaternary. We interpret high-resolution (50–450 Hz frequency) multi-channel (72 channels) and single-channel (Sparker) seismic data, piston cores, sediment profiles (3.5 kHz), and high-resolution multibeam bathymetry acquired during the ATACAMES cruise with the RV L'Atalante in 2012. In the La Plata Island–Cabo San Lorenzo Peninsula region, the results show a full and detailed record of the last ten Quaternary sedimentary sequences deposited in intra-shelf basins, at and -just seaward of the shelf break. These 100-ka-scale sequences are tied to piston core data, to well-dated Quaternary onshore exposures and to a flight of coastal marine terraces on Cabo San Lorenzo Peninsula and La Plata Island. These sequences correlate with the global ice volume and deep marine temperature changes (d18O) for the last 0.7 Ma, which points to a strict climatic control on depositional sequence development and preservation. However, the subsidence of the continental shelf acoustic basement, estimated by the stepwise backstripping of the sedimentary record, exhibits a complex deformation pattern with uplifting and subsiding regions. Deep marine seismic data, currently under processing, show evidence for a subducted seamount beneath La Plata Island and GPS data indicate an important interplate coupling in the same area with the potential to generate a Mw 7–7.5 earthquake. The pattern of the continental shelf deformation is consistent with the shape of this seamount. We tested the hypothesis of a link between the margin deformation and the subduction of the seamount, by comparing a stepwise subduction of the seamount to the palinspastic restoration of the deformation of the continental shelf for the last 1 Ma. This comparison shows that the collision probably started c.500 ka ago, together with the syntectonic sedimentation, and drastically slowed down by c.50 ka, with the sealing of most of the deformation on the shelf.

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