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The evolution of shallow crustal structures in early rift-transform interaction: a case study in the northern Gulf of California.

Georgios-Pavlos Farangitakis (1), Jeroen van Hunen (1), Lara M. Kalnins (2), Patricia Persaud (3), and Kenneth J.W. McCaffrey (1)

(1) Department of Earth Sciences, Durham University Durham, United Kingdom (georgios-pavlos.farangitakis@durham.ac.uk), (2) School of GeoSciences, University of Edinburgh, Edinburgh, United Kingdom (lara.kalnins@ed.ac.uk), (3) Department of Geology and Geophysics, Louisiana State University, Baton Rouge, United States (ppersaud@lsu.edu)

The Gulf of California represents a young oblique rift/transtensional plate boundary in which all of the transform faults are actively shearing the crust, separated by active rift segments. Previous workers have shown that in the northern Gulf of California, the relative plate motion between the Pacific and North American plates is distributed between: a) the Cerro Prieto Fault (CPF) in the NE b) the Ballenas Transform Fault (BTF) in the SW and c) a pull-apart structure located between these two faults consisting of a number of extensional basins (the Wagner, Consag, and Upper and Lower Delfin basins). A plate boundary relocation at approximately 2 Ma, continued to separate Isla Angel de la Guarda from the Baja California peninsula and created the 200x70 km2 NE-SW pull-apart structure located northeast of the BTF.

Here we use seismic stratigraphy analysis of the UL9905 high resolution reflection seismic dataset acquired by the Lamont-Doherty Earth Observatory, Caltech, and the Centro de Investigación Científica y de Educación Superior de Ensenada to build on previous structural interpretations and seek to further understand the processes that formed the structural and sedimentary architecture of the pull-apart basin in the northern Gulf of California. We examine the formation of depositional and deformation structures in relation to the regional tectonics to provide insight into the development of structural patterns and related seismic-stratigraphic features in young rift-transform interactions.

Using bathymetric data, characteristic seismic-stratigraphic packages, and seismic evidence of faulting, we confirm the existence of three major structural domains in the northern Gulf of California and examine the interaction of the seismic stratigraphy and tectonic processes in each zone. The first and most distinctive is an abrupt NE-SW 28x5 km2 depression on the seabed of the Lower Delfin Basin. This is aligned orthogonally to the BTF, is situated at its northern end, and is an active rift. The second structural domain is a large, NE-SW-trending anticlinorium 60 km wide to the southeast of the rift zone, towards the Tiburon basin. One possibility is that it represents a positive flower structure and thus indicates a transpressional domain. However, individual structures within the broader zone are normal faults and negative flower structures, suggesting transtensional deformation, and the overall structure may be a roll-over antiform formed on a deep detachment structure. Finally, a strike-slip-dominated zone occurs along the northward continuation of the Ballenas Transform Fault. This is accompanied by the formation of submarine volcanic knolls. These patterns can be compared with seismic stratigraphy facies and structural patterns in mature transform margins and potentially give insight into their early history.