TECTONICS ALONG THE TRANSFORM PLATE BOUNDARY: ONSHORE STRUCTURES IN THE TIERRA DEL FUEGO AND THE ATLANTIC OFF-SHORE

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Transform margins are important tectonic features that accommodate horizontal displacements of divergent or convergent deformation along plate tectonic boundaries on all scales in both the oceanic and continental crust. The results are a vast assemblage of related structures connected to the strike-slip deformations involving the lithosphere, modifying the preexisting structures and generating new ones.

The Magallanes-Fagnano continental transform system characterizes the western sector of the South America-Scotia plate boundary with an E-W trend, cutting along the entire continental crust of the Tierra del Fuego region (Lodolo et al. 2003). The island is a landmass with a complex topography that is challenging to access because of the mountain Cordillera in the southern part and the hilly landscape shaped by glaciers in the northeast. Especially in the eastern region, the resulting outcrops are sparse along the few roads and seafront of the Atlantic coast. Many reflection seismic industrial lines are available in the area due to hydrocarbon exploration and geophysical scientific surveys. These data sets permit highlighting the structures and proposing models for the geodynamic evolution of the fold-and-thrust belt (Lozano et al. 2020). However, a scientific debate is still open, especially for understanding and linking field geological data.

The Eastern region of the Tierra del Fuego Island displays continuous outcrops of the Meso-Cenozoic rocks belonging to the Fuegian Cordillera. This orogen developed since the Late Cretaceous by the relative oblique collision between South America and the Antarctic Peninsula, producing significant compressional deformation. Crustal thickening with horizontal shortening characterizes the inner zone by developing the Magallanes fold-and-thrust belt and associated foredeep basin. Thrust sheets, in- or out-of-sequence, also produced rapid exhumation of the basement rocks and the shortening of the siliciclastic sedimentary cover of the foredeep basin, forming a NE verging fold-and-thrust belt. More prominent folds and crenulation cleavage affect the whole orogen, while the slaty cleavage is well developed in the inner and deeper part of the mountain chain. Penetrative structural fabrics with kinematic indicators with S-C mylonites characterize shear zones. These compressional structures are deformed by transtensional faults resulting from E-W sinistral wrench tectonics that have affected the region from the Oligocene to the present.

This stress field relates to a relative motion component between South America and the Antarctic Peninsula, which is associated with the development of the oceanic floor in the western Scotia Sea. The transform boundary displays trans-tensional structures at a regional scale, mainly with fault patterns arranged in a rhomboidal mesh along extensional stepovers.

The geometry comprises an interlink of extensional fault segments, and transcurrent fault strands consistent with a wrench-dominated transmission. The wrench faults are well documented across the Andes of the Tierra del Fuego Island from the Magallanes Straits to the Beagle Channel (Esteban et al. 2018). Releasing step-overs along the main deformation zone are linked with several elongated pull-apart basins with a size of many tens of km in length and a few km in width. The major one is the Lago Fagnano, which consists of at least two overlapping basins extending for a total length of more than 100 km and a width of about 8 km (Esteban et al. 2018). To the east, up to the Atlantic coast, other smaller extensional basins are known mainly by geophysical surveys and allow links to the offshore transform boundaries of the Tierra del Fuego Island (Lodolo et al. 2003).

In the Atlantic offshore, the seismic reflection profiles show at least two basins bounded by a sub-vertical discontinuity reaching the ocean floor. These basins present a strongly asymmetric architecture, indicating rapid tectonic subsidence and displaying increasing sedimentary thickness towards the principal deformation zone (Tassone et al. 2008)

The age of the strike-slip deformations in most of the major faults that constitute the transform boundary needs to be better constrained. The geometry and the spatial relationships characterizing the fault systems may be as old as 30 Ma, coinciding with the early stages of development of the western Scotia Sea (Ormazabal et al. 2024). These structures evolved mainly during the Oligocene and Miocene and could be related to the discrete kinematics characterized by different divergence angles among the discrete corridors of the spreading centers in the western Scotia Sea.

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