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Geometries and kinematics of the Magallanes–Fagnano transform system, a major segment of the South America–Scotia plate boundary

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The left-lateral Magallanes-Fagnano fault system defines a continental transform boundary between the South America and Scotia plates, extending from the western sector of the North Scotia Ridge to the Chile Trench south 50˚S, and traversing the Tierra del Fuego Island. This system is composed by several distinct tectonic lineaments arranged in an en-echelon geometry, along which restraining and releasing structures have been developed. Restraining bends and overlapping step-over geometries characterize few sectors of the strike-slip faults with pop-ups, pressure ridges, and uplifted slivers of crust. These structures are well displayed on many outcrops of the Tierra del Fuego Island, and in seismic reflection profiles acquired in the Atlantic and Pacific off-shore areas, as well as in the western arms of the Magallanes Strait.

These strike-slip structures evolved mainly during the Oligocene through the Miocene time, and could be related to the complex tectonic events responsible of the development of the western Scotia Sea oceanic plate. However, their geological history could be significantly older, and referred to the Mid-Cretaceous, E-W sinistral strike-slip tectonics that affected the southernmost part of the South America as a consequence of the relative motion between South America and the Antarctic Peninsula. This strike-slip activity is well documented in the Tierra del Fuego Andean Cordillera, from the Carbajal valley to the Beagle Channel region. Releasing step-over along the fault system formed several elongated pull-apart basins with a size of the order of many tens

of km in length and a few km in wideness. In the Tierra del Fuego Atlantic off-shore, a series of basins bounded by sub-vertical discontinuities which reach the ocean floor, present a strongly asymmetric architecture, indicating a rapid tectonic subsidence, and displaying increasing sedimentary thickness towards the principal transform zone. Similar pull-apart geometries and structures are present in the Lago Fagnano, the largest pull-apart basin formed within the Magallanes–Fagnano transform system.

The shear zones and the kinematic indicators, show a prevalent transtensional component of motion along the system, in a both brittle and ductile deformation regime. This deformation pattern is superimposed onto the older lineaments, and suggests that they may have reactivated pre-existing weak zones related to the Cretaceous-Tertiary Andean orogenesis.