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Coherent crust and upper mantle deformation around a cratonic core: Evidence from surface geology, numerical modeling and shear wave splitting.

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The Ribeira and Brasília Neoproterozoic belts in Brazil formed respectively along the eastern and western edges of the São Francisco craton. At the southern tip of the craton, the NW-trending Brasília belt is intersected by the NE-trending Ribeira belt which is slightly younger and displays a structural fabric dominated by wrench-faulting partitioned between numerous strike-slip shear zones 1-10km wide. Northward, the Ribeira belt curves to almost N-S and its structural fabric is characterized by a low-angle foliation associated to thrusting toward the craton. Both wrench-faulting and thrusting are broadly coeval with a granulitic metamorphism.

Numerical modeling of the deformation of a lithospheric plate involving a stiff block (craton) has shown that the change in tectonic style from wrench-faulting to thrusting within the Ribeira belt, as well as the cross-cutting relationship between the Brasília and Ribeira belts may be explained by the termination of the São Francisco craton and the related change in rheology of the lithosphere. It also suggests that, in such a geodynamic system, the deformation of the lithospheric mantle is coherent with the crustal deformation. This implies that the upper mantle fabric and the resultant shear wave splitting parameters should correlate positively with the surface geology.

We present preliminary results on core shear wave splitting around the southern termination of the São Francisco craton. Although only a limited number of reliable measurements have yet been obtained, a good correlation between the direction of the fast split shear wave polarization plane (ϕ) and the surface structural grain is observed. In the southern Brasília belt ϕ trends NW. In the southern Ribeira belt, where wrench-faulting dominates, ϕ trends ENE then slightly rotates northward to NE and NNE. In the domain where occurs the transition from orogen-parallel wrench-faulting to orogen-transverse thrusting, ϕ shifts from NNE to WNW, i.e., from parallel to perpendicular to the structural trend of the belt.