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The formation of bookshelf faults: A case study from the volcanic arc of an oblique convergent margin, Nicaragua

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Along the Nicaragua segment of the Middle America Trench, the Cocos Plate subducts eastward with a 10-15° oblique convergence, resulting in slip partitioning into margin-normal and margin-parallel components and trench parallel migration of a forearc sliver. Terrane migration appears to be accommodated by seismically active, trench-normal sinistral strike-slip faults that cut the weakened volcanic arc in Nicaragua. These faults were interpreted as bookshelf faults. This study aims to understand the mechanical conditions that give rise to this style of faulting in Nicaragua.

Slip on transverse faults can be related to pre-existing planes of weakness that re-activate under the current regional stress field (i.e. NW directed dextral shearing) as antithetic left-lateral strike-slip faults. We test an alternative hypothesis whereby the faults are formed by the current regional stress field. The drop of Coulomb stress on rotated antithetic faults and the lack of synthetic right-lateral strike-slip faults in the arc of Nicaragua are inconsistent with the formation of bookshelf faults from antithetic shear planes. We suggest instead that the bookshelf faults originate from tension fractures that develop into strike-slip faults by rotation and that both dextral shearing and arc-parallel stretching may be present in Nicaragua. The relationship of the bookshelf faults with the volcanoes in the arc is also investigated.