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Deformation in Western Venezuela: An example of bookshelf tectonics on a plate boundary

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The relative plate motion between the Caribbean and the South American plates is taken up mainly by a complex set of right-lateral, strike-slip faults. In eastern Venezuela the deformation is taken up mostly by the El Pilar fault. Several large historical earthquakes have taken place along this fault. To the west of the El Pilar fault, the relative plate motion is absorbed by a set of E-W and NE-SW trending faults. The most notable are the Bocono and the Oca-Ancoon fault systems. On this general scheme where right-lateral, strike slip faults absorb most of the plate motion, a set of N-S trending faults are present in western Venezuela. The Valera and the El Tigre fault, for example are left-lateral, strike slip faults, in contrast with the overall right-lateral motion of the plate boundary. We analyzed the seismicity of western Venezuela for since 1962, where good-quality data exist to determine the focal mechanisms of earthquakes in this part of the world. From 1962 to 1994, using a formal inversion scheme we used the body waves of the larger events in the region to constrain the focal mechanisms and the focal depth. Since 1994, we used the results of the Harvard Moment Tensor Inversion Catalog to constrain the focal mechanisms. The bulk of the seismic energy release takes place at the southern terminus of the Bocono fault, near the Colombia-Venezuela border. Not many earthquakes take place on the actual Bocono fault. From the seismicity it is clear that the N-S fault system of left-lateral faults is active and several moderate-sized earthquakes can be ascribed to these north-south trending faults. We interpret this system of faulting as a case of bookshelf-tectonics where the N_S trending faults accommodate the motion that takes place along the two main faults of the system in western Venezuela: the Bocono and Oca Ancon fault

system. A moment tensor summation is used to estimate the average rate of motion of the faults in western Venezuela during the last 45 years and compare this to the observations made on several of these faults by trenching.