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# The Sisteur project : a mcs-obs survey of the rupture zones of the great Ecuador-Colombia subduction earthquakes

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Multichannel seismic reflection (MCS) and wide angle seismic data were collected across the rupture zones of the 1958 and 1979 Ecuador-Colombia subduction earthquakes to investigate the nature of the seismic barrier between the earthquake rupture zones, and examine possible causes for the 1979 earthquake seismic asperity. MCS and bathymetric data show evidences for the margin wedge to be segmented by inherited transverse crustal faults that correlate with the limits of co-seismic slip zones. The newly discovered Manglares crustal fault cuts transversally through the margin and correlates with the limit between the 1958 and1979 rupture zones. The fault, which is considered as a weak mechanical barrier to elastic strain release, allows local, high-stress concentration on the plate interface during the earthquake cycle. A massive outer basement high, which fronts the margin seaward of the1958 rupture zone is proposed to act as a buttress to seaward propagation of co-seismic slip along a mega-thrust splay fault. A model of weak transverse faults decoupling adjacent margin segments, complemented by a mega thrust splay fault is proposed to account for the rupture process of the 1958 earthquake. Wide-angle data were collected along a dip OBS line and a strike line cutting across the area of the 1979 earthquake seismic asperity. Reflections arrivals are mainly returned from the top and the Moho of the subducting oceanic crust. Arrival times of refracted and reflected waves were 2D-modeled to construct a velocity model for each wide-angle line. At the intersection of the strike and dip lines, wide angle data show evidence for intra-margin basement reflections, and exhibit higher P-wave velocities than further seaward and southward along the margin. These observations were modeled as a $\sim$10-km-thick basement body with a 6-6.5 km/s P-wave velocity, bounded by velocity discontinuities at its base and top. The

body extends landward for over 60 km and at least 50 km northward. In addition to the high-velocity body, bathymetric and MCS data show that the area of the seismic asperity coincides with extensive crustal shortening outlined by thrust faulting and folding, supporting a relatively strong interplate coupling. The origin for the high-velocity body may alternatively relate to a large and tectonically thickened subducted seamount, or more likely, to a crustal heterogeneity inherited from the pre-subduction history of the oceanic terranes that form the margin wedge.