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Unraveling the behavior of subduction zones interplate seismicity using a global statistical approach

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Based on the Centennial earthquake, EHB hypocenter and CMT Harvard catalogs, the hypocenters, nodal planes and seismic moments of worldwide subduction plate interface earthquakes were extracted for the period between 1900 and 2007. Assuming that the seismogenic zone coincides with the distribution of $5.5 < Mw < 7$ subduction earthquakes, the plate interface seismogenic zones were mapped for 80% of the trench systems and characterized with their dip, length, downdip and updip limits. Using this database, correlations were isolated between significant parameters to identify cause-effect relationships. Empirical laws obtained in previous studies were revisited in light of this more complete, accurate and uniform description of the subduction-type seismogenic zone. The seismogenic zone was usually found to end in a fore-arc mantle, rather than at a Moho depth. The subduction velocity was the first-order controlling parameter for variations in the physical characteristics of plate interfaces, determining both the geometry and seismic behavior. As such, the fast subduction zones and cold subducting plates were associated with large and steep plate interfaces, which in turn had large seismic rates. The subduction velocity could not account for the potential earthquake magnitude diversity that was observed along the trenches. Events with $Mw>8.5$ preferentially occurred in the vicinity of slab edges, where the upper plate was continental and the backarc strain was neutral. This observation was interpreted in terms of compressive normal stresses along the plate interface. Large lateral ruptures should be promoted in neutral subduction zones due to moderate compressive stresses along the plate interface that allow the rupture to propagate laterally.