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Revisiting the physical characterisitics of the subduction interplate seismogenic zones

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Based on the Centennial earthquake catalog, the revised 1964-2007 EHB hypocenters catalog and the 1976-2007 CMT Harvard catalog, we have extracted the hypocenters, nodal planes and seismic moments of worldwide subduction earthquakes for the 1900-2007 period. For the 1976-2007 period, we combine the focal solutions provided by Harvard and the revised hypocenters from Engdahl et al. (1998). Older events are extracted from the Centennial catalogue (Engdahl and Villasenor, 2002) and they are used to estimate the cumulated seismic moment only. The selection criteria for the subduction earthquakes are similar to those used by Mc Caffrey (1994), i.e., we test if the focal mechanisms are consistent with 1/ shallow thrust events (depth $>$ 70 km, positive slips, and at least one nodal plane gets dip $<$ 45°), and, 2/ the plate interface local geometry and orientation (one nodal plane is oriented toward the volcanic arc, the azimuth of this nodal plane ranges between $\pm$ 45° with respect to the trench one, its dip ranges between $\pm$ 20° with respect to the slab one and the epicentre is located seaward of the volcanic arc).
Our study concerns segments of subduction zones that fit with estimated paleoruptures associated with major events ($M > 8$). We assume that the seismogenic zone coincides with the distribution of $5.5 < M < 7$ subduction earthquakes. We provide a map of the interplate seismogenic zones for 80% of the trench systems including dip, length, downdip and updip limits, we revisit the statistical study done by Pacheco et al. (1993) and test some empirical laws obtained for example by Ruff and Kanamori (1980) in light of a more complete, detailed, accurate and uniform description of the subduction interplate seismogenic zone. Since subduction earthquakes result from stress accumulation along the interplate and stress depends on plates kinematics, subduction zone geometry, thermal state and seismic coupling, we aim to isolate some correlations between parameters.
The statistical analysis reveals that: 1- vs, the subduction velocity is the first order controlling parameter of seismogenic zone variability, both in term of geometry and seismic behaviour; 2- steep dip, large vertical extent and narrow horizontal extent of the seismogenic zone are associated to fast subductions, and cold slabs, the opposite holding for slow subductions and warm slabs; the seismogenic zone usually ends in the fore-arc mantle rather than at the upper plate Moho depth; 3- seismic rate ([U+F074]) variability is coherent with the geometry of the seismogenic zone: [U+F074] increases with the dip and with the vertical extent of the seismogenic zone, and it fits with vs and with the subducting plate thermal state; 4- mega-events occurrence determines the level of seismic energy released along the subduction interface, whatever [U+F074] is; 5- to some extent, the potential size of earthquakes fits with vs and with the seismogenic zone geometry, but second order controlling parameters are more difficult to detect; 6- the plate coupling, measured through Upper Plate Strain, is one possible second order parameter: mega-events are preferentially associated to neutral subductions, i.e. moderate compressive stresses along the plate interface; high plate coupling (compressive UPS) is thought to inhibit mega-events genesis by enhancing the locking of the plate interface and preventing the rupture to extend laterally.

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