Mechanical property of subducting plate interface inferred from spatial variation in b-value

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I have shown that m-value of AE events during frictional sliding evolves with sliding (SSJ meeting, 2001). The m-value increases with sliding for small displacements. For larger displacements than a critical one, the m-value takes a stable value. The critical displacement for the m-value almost coincides with that for a friction parameter where (a-b)-value evolves from positive to negative. In the present study, I apply this observation to the spatial variation in b-value in Gutenberg-Richter's relation derived by Hirose et al. (2001, SSJ meeting) for earthquakes on subducting plate interface beneath northeast Japan.

Distance from trench axis to a point on the plate interface along subducting direction may approximate the cumulative displacement of subducting plate. I examined spatial variation in seismic b-value along subducting direction. Points where the b-value becomes stable were determined by the eye. Depths of the points were about 20 km, in general. The transition depth for (a-b)-value from positive to negative is often assumed to be 5-10 km in numerical models for this region, and much shallower than the depths estimated in the present study. Umino et al. (1995, GJI, vol 120, 356-366) reported that dip angle of the plate interface becomes steeper at the depth of 20 km. A line connecting the points determined as being the critical displacement bounds the eastern edge of asperity distribution obtained by Yamanaka and Kikuchi (2001, Joint meeting). Strongly locked regions estimated by Nishimura (2000, PhD thesis, Tohoku Univ.) from GPS observation extend at the western side of the line. Further, low-frequency earthquakes occur in the western region of this line. The line connecting the possible critical-points determined from spatial variation in seismic b-value seems to define a boundary between seismic and aseismic regions estimated form seismic and geodetic observations.

The auther thanks Mr. Hirose for providing the b-value list.