Here are some notes I (D. Boore) prepared while working on the Atkinson and Boore (2003) subduction ground-motion paper

Was the 1992 Cape Mendocino earthquake and interface event?

Gail–

I am preparing a pdf file with more extended discussion, containing text scanned from Oppenheimer et al, Science.

Argument for interface: projection of fault plane crops out near seaward edge of subduction zone. Preearthquake seismicity is much deeper, and projecting it along its trend has it crop out much farther west. Counterargument: the argument depends on accuracy of locations of pre-event seismicity. Given simple model used and location offshore, the accuracy of the seismicity mau not be adequate to define a plane corresponding to the slab interface.

Argument for crustal: the earthquake was significantly shallower than the pre-earthquake seismicity and it occurred in a region of crust whose velocities seem to correspond to crustal rather than subducted Gorda plate crust (this conclusion is supported by unpublished work by Ann Trehu done after Oppenheimer etal, although Ann should be contacted). Also, thermal modeling suggests that "double seismic layers observed at depths of 20 and 30 km reflect ... the upper brittle crust and the upper mantle of the Gorda plate...".

I lean toward crustal (above the interface)...

–Dave

Excerpt from Oppenheimer et al. (Science paper)

Motion on the Plate Boundary

Interplate main shock. The main shock fault projects to the sea floor within 5 km of the seaward edge of the Cascadia subduction zone (25) (Fig. 3), suggesting that the main shock ruptured the Gorda-North America plate boundary. In contrast, the upper boundary of the pre-main shock seismicity, which is 7 km deeper than the main shock rupture plane (Figs. 2 and 3), projects to the surface about 85 km west of the Cascadia subduction zone and thus does not appear to define the plate boundary. The seismicity gap between the slip plane of the main shock and the pre-main shock seismicity is about the same thickness as the Gorda crust and overlying accretionary sediments, as determined from refraction experiments 10 km east of the seaward edge of the subduction zone (26). The gap may reflect a ductile subducted Gorda crust, and the inception of seismicity at a depth of 17 km may reflect brittle behavior of the Gorda upper mantle (2 7). Tabor and Smith (28) reached a similar conclusion from their observations of seismicity and velocity structure of the Juan de Fuca plate beneath the Olympic peninsula of Washington. However, an inversion for the three- dimensional velotity structure of the region indicates that velocities typical of Gorda crust are evident at depths greater than 15 to 20 km (29). Moreover, modeling of thermal effects on the strength of the subducting oceanic lithosphere (30) suggests that the double seismic layers observed at depths of 20 and 30 km (Fig. 2) reflect, respectively, the brittle upper crust and upper mantle of the Gorda plate; the intervening, relatively aseismic region would correspond to the ductile lower crust. Consequently, these studies suggest that the Cape Mendocino main shock was an intra-plate event in the North America plate. Whether the main shock was an inter- or intra-plate event, the Cape Mendocino main shock clearly relieved strain resulting from the relative Gorda-North America plate motion. We note, however, that the main shock ruptured a region of the plate boundary that differs considerably from the boundary farther north, as indicated by the change in its orientation from north-northwest to north- west (5), the relatively narrow width of the plate, the likely presence of subducted sediments in the region of main shock rupture, and its younger age (4). Thus, this earthquake may not be typical of other Cascadia subduction zone earthquakes. Intraptate aftershocks. The location, depth, and focal mechanisms of the two large aftershocks indicate that they ruptured the Gorda plate. The seismic data indicate that right-lateral slip occurred on a vertical, northwest-oriented fault plane for at least the second event. For most earlier Gorda shocks, rupture occurred as left-lateral slip on a northeast-oriented plane, perhaps because this orientation may allow reactivation of normal faults formed at the Gorda spreading ridge (I 1). From a consideration of stress release, either orientation

References

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