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THE CASCADIA CREEPING SECTION: STRUCTURAL EVIDENCE FOR HETEROGENEOUS PLATE COUPLING AND LINKAGES TO GEODESY AND PALEOSEISMOLOGY

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The submarine Cascadia forearc can be divided into several distinct structural domains. The outer wedge in northern Oregon and all of Washington is a landward/mixed vergence wedge characterized by low wedge taper, widely spaced folds, high pore-fluid pressure and mud volcanoes. This domain is separated from an older complex by a significant landward vergent splay fault, truncating older structural trends and suggesting a Pliocene episode of frontal erosion. This middle domain comprises tight folds and intense deformation occupying much of the upper slope and shelf, but is heterogeneous along strike. Inboard of this domain where observed offshore, deformation is weak and in some cases transverse to the margin. Dextral strike-slip faulting is also observed, and indicates limited forearc sliver motion. A boundary between the inner forearc and upper slope domains may represent a change in principal horizontal compressive stress from ~N-S (inboard) to ~ E-W (outboard), and may map the long-term downdip limit of significant interplate basal shear traction, consistent with scattered borehole breakouts and focal mechanisms. The updip boundary may be located approximately at the transition to the landward vergent domain. Interplate coupling in GPS models is similar to the long-term structural evidence for strong coupling. The lack of coupling in several extending and lightly deformed regions is also matched in GPS and structural data. This suggests that locking heterogeneity is related to long-term forearc architecture, similar to observations in Sumatra (2004) and NE Japan (2011). The proposed stress boundary may be in part responsible for along-strike variability of co-seismic subsidence. However, ambiguity of the subsidence data exists due to the limited landward extent of subsidence data. The coupling model is otherwise compatible with both onshore and offshore paleoseismic data and proposed segment boundaries. A creeping section in northern Oregon may exist where the updip and downdip limits are close together, resulting in a local pinchout of the strongly coupled region, though the mechanisms responsible are unclear. This pinchout might be responsible for the abrupt northern termination of 10 Holocene ruptures interpreted from the offshore paleoseismic record, ~ 22% of the Holocene event total.

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