SAND2010-6011C

TITLE: 3-D Seismic Imaging of Sedimentary Underplating at the Corner of the Cascadia Mantle Wedge
PRESENTATION TYPE: Assigned by Committee
SECTION/FOCUS GROUP: Tectonophysics (T)
SESSION: T26. From Sediment Inputs to Seismogenesis at Subduction Zones
AUTHORS (FIRST NAME, LAST NAME): Andrew J Calvert[1], Leiph A Preston[2], Amir Mansour Farahbod[1]
INSTITUTIONS (ALL): 1. Earth Sciences, Simon Fraser University, Burnaby, BC, Canada.
2. Geophysics, Sandia National Laboratories, Albuquerque, NM, United States.
Title of Team:
ABSTRACT BODY: In several subduction zones, teleseismic surveys have identified landward dipping zones with anomalously low seismic velocities at depths >20 km, which are interpreted to be the subducting oceanic crust. In the Cascadia subduction zone, two teleseismic profiles (CAFE and POLARIS) lie in an area of dense seismicity and mostly within a group of active source, crustal-scale seismic surveys that were acquired between 1995 and 1999. A 3-D P wave velocity model, which extends to depths as great as 65 km, has been derived by an integrated tomographic inversion of the areally distributed earthquakes and active source data. To identify the low velocity zone in the velocity model, we compare coincident linear sections extracted from the model with the P and S wave velocity perturbations derived from the teleseismic data. Given the uncertainties in the analysis of the different datasets, it is probable that the analyses of the teleseismic data and the tomographic inversion of local seismic travel time data have identified the same landward dipping low velocity zone. In the 3-D tomographic velocity model, the low velocity zone, which can be traced along strike between the two 2-D teleseismic surveys, outcrops in the Olympic Mountains where rocks of the accretionary wedge have been exhumed. The oceanic crust, which is located by PmP reflections, underlies the more shallowly dipping low velocity zone. At depths of 35-40 km, the low velocity zone separates from the descending plate and decreases in amplitude. The plate interface may be located at the top of the basaltic oceanic crust, i.e. near the base of the low velocity zone, but the boundary between the two plates could also be a vertically distributed shear zone corresponding to the deeper part of the low velocity region. At depth, the low velocity zone corresponds to previously identified seismic reflections, which we suggest represent rocks sheared at, or immediately above, the inter-plate boundary. The seismic reflectors indicate laterally extensive interfaces, which may create permeability barriers that trap fluids, raising pore pressures and thus reducing the seismic velocity. We suggest that in northern Washington State, the landward dipping low velocity zone largely represents underplated overpressured sedimentary rocks of the accretionary wedge, and the zone is thus part of the overriding plate. Non-volcanic tremor, which is mainly generated during slow slip on the inter-plate boundary, occurs predominantly within the low velocity zone close to its contact with the subducting oceanic crust and the tip of the mantle wedge.

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