Multichannel Seismic Images of Cascadia Forearc Structure at the Oregon Margin

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Authors	Han, S*, Marine Geology and Geophysics, Lamont Doherty Earth Observatory, Palisades, NY, USA Carbotte, S M, Marine Geology and Geophysics, Lamont Doherty Earth Observatory, Palisades, NY, USA Carton, H D, Marine Geology and Geophysics, Lamont Doherty Earth Observatory, Palisades, NY, USA Canales, J, Woods Hole Oceanographic Institution, Woods Hole, MA, USA Nedimovic, M R, Dalhousie University, Halifax, NS, Canada
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Abstract

We present new Multichannel Seismic (MCS) images of the Cascadia forearc and downgoing Juan de Fuca plate offshore Oregon. The data were collected during the Cascadia Ridge-to-Trench experiment conducted in June-July 2012 aboard the R/V Langseth. 2D processing including geometry definition, filtering and editing, deconvolution, amplitude correction, velocity analysis, CMP stacking, and post-stack time migration, has been conducted. The new images confirm some previous observations on the location of the plate boundary and structure of the forearc and also reveal new features of the Oregon margin. West of the deformation front, the Juan de Fuca Plate has a dip of ~1.5^{o} and sediment thickness is > 3 km. A bright Moho reflection and reflections from faults cutting through the crust are imaged. The subducting oceanic crust can be traced continuously landward at least to 15 km from the deformation front. One major forearc basin and a smaller basin 10 km from its west end are imaged.

Sediments in both basins are folded with wavelengths of 4-6 km and several faults are identified in the larger basin. Beneath the major basin, a low-frequency reflection is imaged at 3.7 s TWTT similar to that imaged by Trehu et al (1995) and interpreted as originating from the top of Siletz terrane. About 70-80 km from the deformation front, a shallowly dipping reflection is imaged at 7.3 s, which likely corresponds to the top of the downgoing plate. Based on existing velocity models for the margin, the location of this reflection is approximately coincident with the July 2004 earthquake cluster interpreted to have occurred at the plate boundary. This bright reflection is presumably similar in origin to the "bright spot" imaged from two prior multichannel and wide-angle seismic reflection surveys lines located 40 km and 60 km north of our line. The brightness of the reflection may reflect high pore fluid pressure at the plate interface. Just 4 km west of this presumed top-of-subducting plate reflection, there is another deep reflection at around 7 s dipping landward. This reflection may correspond to the base of the Siletz terrane, which would imply a subduction channel beneath the Siletz terrane. Alternatively, this reflection may be related to a subducted seamount identified from magnetic anomalies by Trehu et al (2012). In addition, we image several small diffractors at 5-7 s TWTT to the west, which are likely related to heterogeneities within the accretionary complex. MCS images of the Cascadia forearc at the Oregon margin illustrating these features will be presented and will be compared with the forearc structure imaged along our Washington MCS line from the same survey.

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