Geophysical Research Abstracts,
Vol. 11, EGU2009-11829, 2009
EGU General Assembly 2009

An Integrated Geophysical View of the Cascadia Subduction Zone

G. D. Egbert (1), M. J. Fouch (2), and A. Schultz (1)

(1) Oregon State University, College of Oceanic and Atmospheric Sciences, Corvallis, United States (egbert@coas.oregonstate.edu, (541) - 737 - 2064), (2) School of Earth and Space Exploration, Arizona State University, Tempe, United States; fouch@asu.edu

The goal of this study is to evaluate correlations between new models of conductivity and seismic structure of the Cascadia subduction zone in the northwestern United States. These models were obtained using data from EarthScope's USArray long period magnetotelluric (MT) and broadband seismic Transportable Array (TA) systems.

Initial MT deployments in 2006 and 2007 acquired long period (10-10000s) data at 110 sites covering the US Pacific Northwest with the same nominal spacing as the USArray seismic transportable array (∼70 km). Three-dimensional inversion of this dataset reveals extensive areas of high conductivity in the lower crust beneath the Northwest Basin and Range, and beneath the Cascade Mountains, contrasting with very resistive crust in Siletzia, the accreted thick ocean crust which forms the basement rocks in the Cascadia forearc and the Columbia Embayment). The conductive lower crust beneath the southeastern part of the array is inferred to result from fluids (including possibly partial melt at depth) associated with magmatic underplating. Beneath the Cascades high conductivities probably result from fluids released by the subducting Juan de Fuca slab. Resistive Siletzia represents a stronger crustal block, accommodating deformation in the surrounding crust by rigid rotation. Significant variations in upper mantle conductivity are also revealed by the inversions, with the most conductive mantle beneath the Washington backarc in the northeastern part of the array, and the most resistive corresponding to subducting oceanic lithosphere.

The Juan de Fuca slab is well imaged in body wave seismic tomography models, extending to depths of ∼500 km and perhaps deeper [Roth et al., 2008]. Significant zones of focused reduced seismic velocities are evident beneath both the Newberry region and the surface expression of the Columbia River basalts. We find no evidence for a zone of low velocities beneath the Juan de Fuca slab. Further, we demonstrate that the absence of a slab signature beneath central Oregon, interpreted by some groups as a "hole" in the slab, is an inversion artifact due to imperfect ray coverage and the presence of the reduced velocity zone coincident with Newberry.

While the MT analyses have so far focused on the lower crustal structure which this data is most sensitive to, and the seismic results to date have emphasized upper mantle structure, notable relationships between the models are already evident. For instance, the Juan de Fuca slab signature is clear in both models, and in both cases exhibits lateral continuity. In addition, the low velocity feature beneath Newberry coincides with a a circular zone of enhanced conductivity in the upper mantle. Interestingly, some features in the MT image, such as the high conductivity zone at shallow depths in SE Oregon, correlate well with structure of similar geometry in the seismic images at mantle depths