Upper crustal evolution along the Juan de Fuca ridge flanks and its relation to sedimentation and tectonic history

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To study upper crustal evolution along the Juan de Fuca (JDF) ridge flanks we gather velocity structure information by analyzing multichannel seismic (MCS) data collected during the 2002 EW0207 cruise. Our 1D travel time modeling done on super CMP gathers accurately reveals regional 2A velocity increases and 2A thickness changes associated with crustal alteration that are clearly linked to the patterns of sedimentation across the JDF ridge. Shorter wavelength variations, superimposed on the long-term systematic trends, are also apparent. These local variations in the thickness of layer 2A appear to be associated with the abyssal hill topography inherited from crustal accretion, and are perhaps spatially tied to the principal inward facing scarps. We also observe local increase in 2A velocity associated with propagator wakes along the eastern sedimented ridge flank, with the most prominent velocity anomaly at Endeavour transect.

Despite the great density of our layer 2A velocity analysis done on super CMP gathers, detailed upper crustal velocity information cannot be accurately extracted from our modeling because of the limitations of the employed 1D approach. Continuous high-resolution velocity investigations along the ridge flanks, where topography and crustal structure often rapidly change laterally, require advanced velocity analysis techniques such as 2D waveform tomography. To produce continuous high-resolution 2D models of upper crustal P-wave velocity structure along sections of the profiles we start by first constructing smooth 2D velocity models by employing 2D travel time tomography and/or by using the already existing dense grid of 1D velocity models. Good starting 2D velocity models are required in order to achieve convergence during inversion because the success of 2D waveform tomography is dependent upon the accuracy of the starting velocity model. Finally, we apply a 2D waveform tomography method based on the acoustic wave equation and formulated in the frequency domain both to improve computational efficiency and to improve robustness and convergence by permitting sequential fitting of higher frequency/short wavelength data (*Pratt and Worthington,* 1990; *Pratt,* 1999). We use the obtained high-resolution velocity images to evaluate patterns of upper crustal heterogeneity and their linkages to long-term hydrothermal circulation systems.