A Multi-Channel Seismic Investigation of Ridge Crest and Ridge Flank Structure Along the Juan de Fuca Ridge

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The Juan de Fuca (JdeF) Ridge has been intensively studied for several decades resulting in detailed knowledge of its seafloor geology, tectonics and hydrothermal systems. The region has been the site of several ridge crest observatory efforts, as well as a number of ODP studies targeting ridge flank hydrothermal circulation. In the coming decade, the region will be the focus of increasing activity for both R2K studies and potential cabled observatories. In July 2002, an extensive multichannel seismic (MCS) investigation of the JdeF Ridge was carried out on the R/V Ewing, providing the first regional constraints on crustal structure for these ongoing ridge crest and flank studies. Over 26 days of MCS data were acquired using the Ewing's 10-gun, 3005 cu. in. source and 6-km-long digital streamer. Data were collected from the north end of the Endeavour segment to the Blanco transform with detailed surveys of four of the JdeF segments (Endeavour, Axial, Vance and Cleft) as well as an along-axis profile and isolated cross-axis lines of the Northern Symmetric and Co-axial segments. Data were also collected within three flank transects extending to crustal ages of 4-5 Ma for a study of upper crustal evolution (layer 2a/2b). These transects were located within corridors with differing sediment cover and spreading history and will be used to study the role of sediment burial, basement age, and basement relief on crustal alteration due to ridge flank hydrothermal circulation. Preliminary stacked data reveal a bright axial magma lens (AMC) reflection beneath portions of all of the JdeF segments including Northern Symmetric where the axial region is least inflated and in places, difficult to identify. With the exception of Axial Volcano, the AMC at this intermediate spreading ridge lies deeper within the crust (~0.9 to 1.0 sec twtt or ~2.5 km beneath seafloor) than at the fast spreading EPR. The base of layer 2a, often interpreted as the base of the extrusive crust, is well imaged throughout the dataset. In zero-age crust, Layer 2a is thickest at the Endeavour segment (0.4-0.5 s twtt) and does not appear to thicken away from the ridge crest. However, cross-axis thickening of layer 2a similar to that found on the EPR, is observed at other JdeF segments (from ~0.2-0.3 s to 0.4-0.5 s twtt). Moho is well imaged in much of our data at ~2 to 2.3 sec twtt. In places, similar character Moho is imaged on both flanks of the ridge suggesting axi-symmetric accretion processes associated with formation of the lower crust.