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## State of Hydration of the Juan de Fuca Plate Along the Cascadia Deformation Front from Controlled-Source Wide-Angle Seismic Data

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**Abstract:**
Understanding the structure and state of hydration of the young Juan de Fuca (JdF) Plate prior to being subducted beneath Cascadia is important because water incorporated into the downgoing plate plays a critical role in many subduction zone processes. Here we present the structure of the JdF plate along a ~400-km-long wide-angle seismic profile extending from offshore Northern WA to offshore Central OR, ~10 km seaward from the Cascadia deformation front (CDF). Vp in the lower crust decreases from north to south: 7.0-7.1 km/s north of 46°N, and 6.85-6.95 km/s south of 45°30'N. Vp in the upper 2.5 km of the mantle is highest north of 46°50N (7.85-7.95 km/s) and south of the 45°N (7.85-8.1 km/s). In between these latitudes, mantle Vp is 7.75-7.85 km/s north of 45°45'N, and reaches a minimum value of 7.55 km/s at 45°15'N. MCS images across the southern part of the plate show evidence for faulting in the lower crust and upper mantle while images across the northern part of the plate do not [Han et al., this meeting]. Therefore we interpret the along-CDF variations in lower crustal and upper mantle velocity largely resulting from the increasing north-to-south effect of bending-related faulting. Taking into account plate age, inferred thermal structure, and expected mantle anisotropy, we explore end-member scenarios on the amount of fracturing and water stored in the lower crust and uppermost mantle of the JdF plate off the CDF. Assuming that Vp variations are due to fractures containing free $H_2O$, we estimate that lower crust/upper mantle porosity increases from <0.1% north of 46°N to 0.15-0.25% to the south of this latitude, with free $H_2O$ content at these depths reaching a maximum of 0.08 wt% between 45°15'-30'N. At the other end of the spectrum, Vp variations may be explained by fractures filled-in with hydration products such as serpentine; in which case we estimate a porosity south of 46°N as large as 5-9%, with chemically-bounded $H_2O$ content reaching a maximum of 0.5-1.0 wt% between 45°15'-30'N. Since our thermal model predicts a temperature below the Moho of ~550 °C, which would severely limit the formation of serpentine, hydration of the JdF plate is probably better represented by an intermediate case in which both free and chemically-bounded water are present at lower crustal and upper mantle levels.

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