

COMPOSITE TOMOGRAPHIC AND REFLECTION IMAGES OF POTENTIALLY ACTIVE FAULTS IN THE EASTERN JUAN DE FUCA STRAIT, NW WASHINGTON

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Seismic data from the SHIPS (Seismic Hazards Investigation in Puget Sound) survey are used to interpret structural variation along the Devils Mountain Fault Zone in the eastern Juan de Fuca Strait, a region with evidence for large prehistoric earthquakes. Faults were masked by Pleistocene glacial activity and are now most easily investigated with seismic data. In this study, first arrival tomographic velocities are used to characterise shallow P-wave velocity structure, which reflects physical property variation. When combined with reflection profiles, these P-wave models greatly aid in the identification of potentially active faults, which may pose a significant seismic hazard.

Seismic reflection lines (JDF-1 to 6, PS-2 and SG-1) are reprocessed, using variable shot spacing geometry, to improve image quality and allow for more detailed near-surface interpretation. First-arrival tomographic velocities are calculated using an iterative 2D inversion algorithm based on a finite-difference solution to the eikonal equation. Far offsets of ~2600 m, a high raypath density and a 25 m velocity grid, give a high-resolution estimate of P-wave velocity structure for depths to ~500-1200 m.

Seismic profiles of the Devils Mountain fault suggest that the primary fault scarp, related to pre-Quaternary motion, is offset southward by ~ 1.5 km at ~122.95° W. Right-lateral antithetic strike-slip faulting related to left-lateral transpressional motion on the Devils Mountain fault might explain the offset. The southward-offset fault scarp appears to be related to the Utsalady Point fault, which shows a similar scarp west of Whidbey Island. Quaternary deformation has been experienced on the eastward continuation of the Devils Mountain fault, which east of 122.95° W affects a shallow pre-Tertiary basement and thin overburden. Quaternary uplift on the Utsalady Point fault appears to be of a similar magnitude to that on the Devils Mountain fault to the north.