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Active Strike-Slip Faulting of the Oregon Cascadia Convergent Margin: Structurally Defined Segment Boundaries?

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Three WNW trending left-lateral strike-slip faults on the abyssal plain off northern and central Oregon between 44¡ 40' N and 45¡ 12' N have been mapped using seismic reflection, sidescan sonar, ALVIN submersible dives, and SeaBeam bathymetry. These oblique faults cut the oceanic lithosphere of the subducting plate, and appear to cross the plate boundary. Correlative faults in the North American Plate are mapped in the overlying accretionary wedge, possibly across the upper continental slope and continental shelf. The best example, the Wecoma fault, extends 18 km into the abyssal plain northwest of the deformation front. Horizontal separation is 5-6 km at the deformation front, decreasing northwestward to near zero at the fault tip. The Wecoma fault has been active for approximately 600 ka, based upon correlation of strata with DSDP site 174 and microfossil dating of the cores at that site. The average slip rate has been 7-10 mm/yr. over the life span of the fault. The latest Pleistocene-Holocene slip rate is 5-12 mm/yr., based upon dating of offset morphologic features on the sea floor. The three abyssal plain faults are active as indicated by the offset of the youngest sedimentary units, the presence of surficial fault scarps, and in the case of the Wecoma fault, the venting of deeply sourced fluids. The Wecoma fault has apparently influenced the development of accretionary wedge structures through differential slip of the downgoing plate, resulting in changes in fold orientation and shortening in the initial 3-4 thrust ridges. These three faults are mapped southeastward onto the continental slope based on reflection profiles and SeaBeam bathymetry. En echelon folds and sigmoidal fold axes, consistent with left-lateral motion on the basement faults, are apparent in Sea Beam bathymetry on the central Oregon slope. These faults are characterized by vertical main strands, commonly branching into positive flower structures, down-section reversals of vertical separation, and mismatching stratigraphic horizons. Although these faults are not defined by seismicity, structural evidence suggests that at least one of them is a true segment boundary in the subducting Juan de Fuca Plate.