Detachment Faulting on the Cascadia Continental Shelf: Active Extension in a Compressional Regime?

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Analysis of multichannel seismic reflection profiles on the Washington continental shelf, Cascadia subduction zone, has revealed many listric detachment faults. To date, only one growth fault has been identified on the Oregon shelf. The faults trend approximately N-S, dip west, and exhibit growth strata, rollover folds, and sole out at a basal décollement. The faults are located close to the shelf edge where many coincide with the heads of submarine canyons, such as Grays and Quinault canyons. Faulting initiated in the late Miocene or early Pliocene, based on growth strata analysis, and the faults cut late Miocene to Holocene sediments to a depth of 2 km below the seafloor. Submersible dives on a fault at Grays Canyon revealed a fresh Holocene scarp of 1-2 m height and angular broken boulders at the base of the scarp. This scarp was traced for about 5 km with sidescan sonar. The association of some of the listric faults with submarine canyons suggests that movement may occur as a result of gravitational failure. The regularity of growth strata suggests a cyclical cause of failure, such as earthquake loading or sea level fluctuations. Detachment faulting and failure was probably initiated by high sedimentation rates during the Neogene. Sediment transport through the submarine canyons would prolong activity of some of the detachments by oversteepening and undercutting, but the apparent recent activity of the faults, as indicated by submersible observations, suggests active tectonic faulting rather than passive slope failure. If the faults are tectonic features and not simply slope failure detachments, the obvious question is: how does active E-W extension occur in a convergent margin where active E-W compression is also active, as indicated by geologic and geophysical evidence? The relative absence of these faults from the Oregon shelf may be explained by lower sedimentation rates and a more rigid basement, forme basaltic Siletzia terrane. Similar detachment structures h been identified on the northern Peru margin where associated with massive slope failure.

Submittal Information

1. 1995 Fall Meeting

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11. Yes