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TITLE: Along-strike variations in the structure of the downgoing plate in the subduction zone off the Alaska Peninsula

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ABSTRACT BODY: New marine geophysical data indicate that the downgoing plate in the subduction zone off the Alaska Peninsula exhibits significant along-strike variations in the character of the incoming oceanic lithosphere, the style of bending faulting and sedimentary thickness. This part of the Alaska subduction zone also exhibits along-strike changes in the earthquake rupture history, present day coupling, and seismicity patterns at a range of depths. The Semidi segment last ruptured in the 1938 M8.2 event and appears to be locked at present, while the adjacent Shumagin Gap appears to be weakly coupled. This subduction zone thus presents an excellent locality to investigate the impact of the downgoing plate on processes within the subduction zone.

We present new constraints from multichannel seismic (MCS) reflection, wide-angle reflection/refraction, and bathymetric data acquired by the R/V Marcus G. Langseth in the summer of 2011 during the ALEUT program. MCS and bathymetric data reveal large changes in the style of bending in the incoming plate. To the west, outboard of the Shumagin Gap, there is pronounced bending faulting, with fault offsets up to ~250 m at the seafloor and larger offsets observed at depth. Bending faulting creates rugged topography at the seafloor. Plate bending and the associated faulting is concentrated within ~50 km of the trench. Most faults have strikes within ~30 degrees of the trench. In contrast, the downgoing plate outboard of the Semidi segment exhibits less dramatic bending faulting, with maximum offsets at the seafloor of 30 m. Bending faults here are highly oblique to the trench. Plate bending occurs more gradually, continuing ~80 km outboard of the trench. These along-strike changes in bending are strongly correlated with changes in the characteristics of the incoming oceanic lithosphere. The expected strike of pre-existing structures is parallel or near parallel to the trench outboard of the Shumagin Gap, but highly oblique to the trench outboard of the Semidi segment. This implies that more favorably-oriented pre-existing structures may enhance bending faulting, as suggested by previous studies.

MCS data also reveal along-strike variations in sediment thickness on the incoming plate. The sedimentary section is ~1.25 km thick outboard of the Semidi segment, but only ~0.5 km outboard of the Shumagin Gap. These changes in sediment thickness appear to be related to changes in the thickness of sediment being carried into the subduction zone near the plate boundary and in the style of deformation in the accretionary prism.

Variations in the style and amount of bending faulting and the thickness of sediments can impact the conditions at the megathrust and the delivery of water to the seismogenic zone and deeper levels of the subduction zone. We also present constraints on along-strike variations in the hydration of the crust and upper mantle from wide-angle seismic reflection/refraction data. Initial analysis reveals substantial variations in the velocity structure of the incoming plate along the subduction zone prior to bending and reduced mantle velocities and altered crustal velocities as it bends and subducts.

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