

Along-strike variations in protothrust zone characteristics at the Nankai Trough subduction margin

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Protothrust zones (PTZs) are assumed to control the development of new frontal thrusts at subduction zones. PTZs are areas of incipient thrust faulting between the deformation front and the frontal thrust. However, limited resolution of previous seismic studies has hindered the study of their role in subduction accretion. New high-resolution seismic reflection surveys enabled detailed analysis of the PTZ along the Nankai Trough, SE Japan. Seventeen multichannel seismic reflection lines were collected perpendicular to the trench axis between Cape Ashizuri and Cape Muroto using a 1200m long, 192 channel hydrophone cable and a 380 in³ (5.24L) cluster airgun array. These lines were processed using pre-stack depth migration. PTZs only existed where a turbidite sequence was present beneath the trench wedge. The PTZs consisted of closely spaced, sub-parallel protothrusts that decreased in spacing and increased in length landward. Where the turbidites were truncated by basement topography, there was a transitional PTZ heterogeneous protothrusts and small displacement thrust faults. We hypothesize that elevated pore pressures due to the low permeability hemipelagic sediment inhibit the formation of PTZs and favor small displacement thrusts in a narrow trench wedge. Conversely, turbidite layers within the hemipelagic sediment allow drainage and reduce the pore pressure. This increases the effective stress and shear strength on faults, resulting in strain localizing protothrusts. This implies that the changes in pore pressure imposed by differences in the sediment permeability control the style of deformation in the trench wedge and consequently, the geometry of the accretionary wedge.

Keywords: Nankai Trough, Protothrust Zone, Subduction zone