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Friction properties beneath the frontal wedge near the Japan Trench: deduction from topographic variation

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The 2011 Tohoku-oki earthquake (Mw 9.0) produced a fault rupture, extending to the Japan Trench. Deformation and frictional properties beneath the forearc are the keys to elucidate this unusual event.

In this study, to obtain frictional properties (μ_b'; the coefficient of effective basal friction), we extracted shape-related parameters from the cross sections of the frontal wedge which are obtained from surveys across the trench that span sporadically along the axis of the Japan Trench. The following two methods were adopted for this study; Critical Taper Theory (CT) and Critical State Theory (CS). Both of the theories are based μ_b' From the Critical Taper Theory. Near latitude 36.1, the taper angles (slope angle + decollement dip angle) has been developed . A possible seamount subduction may differentiate this area. However, near the latitude 38.15 where the largest slip was reported with the 2011 earthquake, the taper angle has also been large without any seamounts. The calculated [or estimated] value of μ_b' in this area is larger than that of the other area, suggesting that the larger strain energy was accumulated in comparison with the other wedges.

From the Critical State Theory, the value of ω (angle between the basal decollement and backstop interface) becomes smaller toward the north. The results of CS show the increase of the ω associate with the increase of the μ_b', suggesting that strain energy is more stored toward the North.

Both results show that the μ_b' has decreased after the earthquake. The change in μ_b' may be due to the earthquake.

It is possible to know friction properties of before the earthquake and that of after the earthquake with bathymetry.

Keywords: Japan Trench, Critical Taper Theory