Geophysical Research Abstracts
Vol. 18, EGU2016-363-1, 2016
EGU General Assembly 2016

The Manila Subduction Zone Structure and Deformation: Insights from new seismic reflection and bathymetric datasets

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The Manila subduction zone is an active convergent margin included on a complex diffuse boundary between the colliding Eurasian plate and Philippine Sea plate. The subduction trench delineates the ongoing subduction of the South China Sea crust beneath Luzon Island in the Philippine Mobile Belt. This particular margin exhibits heterogeneous deformation patterns both in the subduction interface as well as the overlying forearc regions. Observations from multi-channel seismic reflection images of the subsurface and seafloor morphology exemplify these latitudinal variations. A wide accretionary wedge (from ∼50 km to widths exceeding 100 km on the south of Taiwan) formed north of 17°N latitude. This segment coincides with thick sediments on the incoming ocean crust. To the south, intense deformation is reflected in the overriding forearc between 14.5°N and 17°N latitude. Seafloor morphology indicate steepened inner trench slopes, failure scars, and thin overlying sediments on the incoming oceanic crust. In this segment, observations indicate a history of large submarine slope failures that may be associated with major seismic events in the subduction zone. Identified mass transport deposits (MTD) in the trench fill and associated scarps in the frontal wedge (16.8°N, 16.5°N, and 15° N) point to extensive deformation and erosion of the forearc region. The rough seafloor morphology in the overriding forearc region as well as the complex subduction interface indicate a history of seamount and aseismic ridge subduction in this portion of the Manila trench. Seamount subduction is associated with distinct seafloor features that reflect the downward migration of the seamount and the uplift and subsequent collapse of the overriding forearc crust. The inherent structural complexities of the subducting oceanic crust plays a significant role on the nature of the mega-thrust and the overriding forearc crust. The latitudinal variations in the subduction zone structure and deformation may reflect the varying and evolving nature of the plate coupling in the convergent margin. Further, this complex nature of the Manila trench region have implications on the different mega-thrust earthquake potentials of the subduction zone from north to south; with the northern segments inferred to be less coupled and dominated accretionary wedge growth vs. the more coupled southern segments dominated by surface erosion in the frontal wedge and the rough subduction interface.