# Role of double subduction and retrowedge thrusting in consuming fast plate convergence in the Taiwan arc-continent collision

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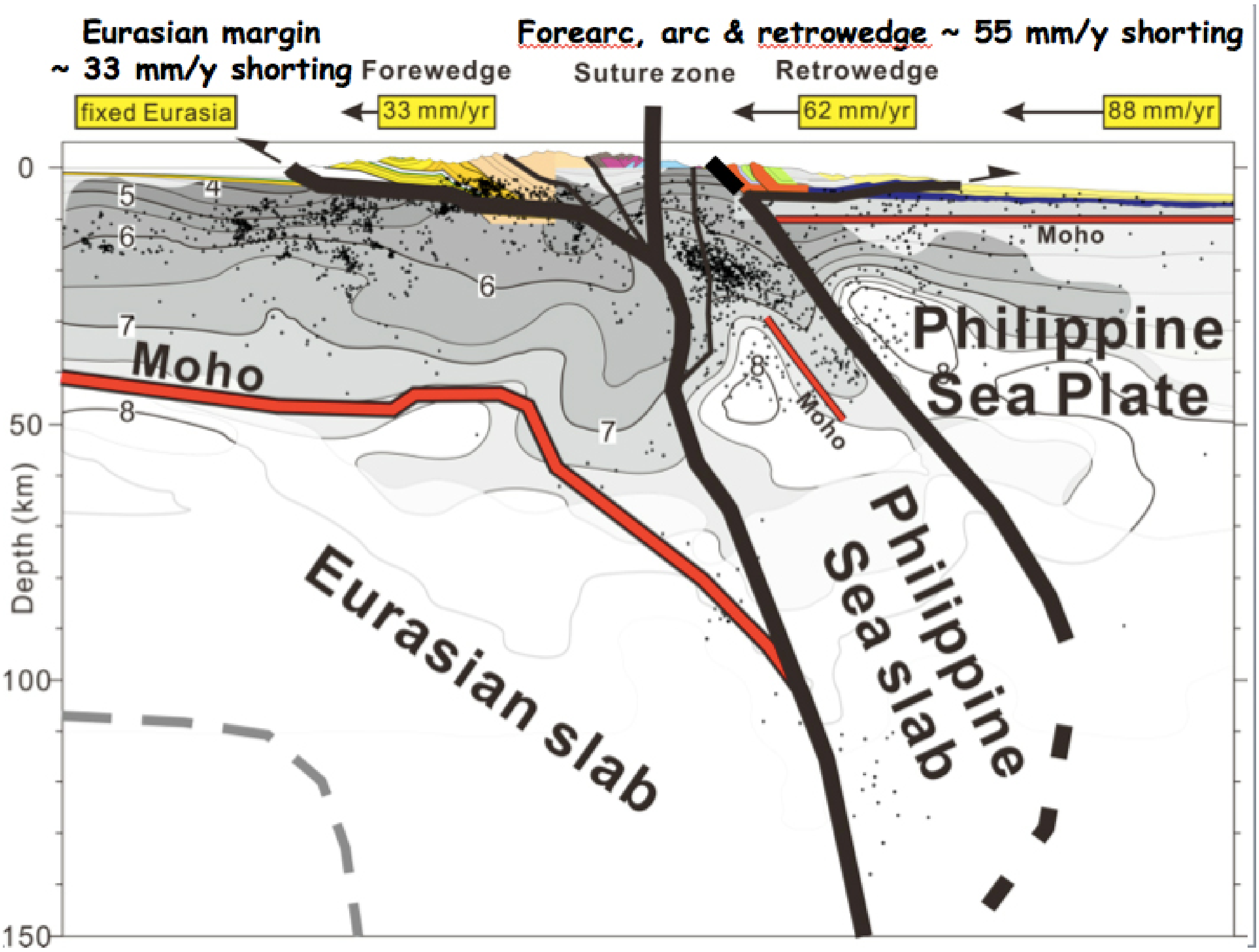
Retrowedge thrust belts commonly develop on the backsides of collisional mountain belts, displaying a vergence opposite to the overall foreland vergence and to the presumed deep-seated subduction polarity. For example, the Southern Alps are a well-known retrowedge whose structures verge southward over the Adria plate, in contrast with the general north vergence of Alpine structure over the European foreland. Numerous models have been constructed to explain the deep structure of such bivergent collisional mountain belts in relation to subduction polarity. However, the details of how these upper crustal thrust belts root into the lower crust and link to the subducting mantle lithosphere, defining the fundamental collisional kinematics, remains relatively unconstrained from a direct observational point of view.
Here we present a synthesis of new observational constraints on the deep crustal and lithospheric structure of the currently active (~25-30mm/y) retrowedge thrust belt within the larger (90mm/y) Taiwan arc-continent collision between the Philippine Sea plate and the Eurasian stable continental margin. We make use of high-resolution local and global tomography and abundant well-located seismicity to define the deep structure and we use geodesy, surface geology, high-resolution bathymetry and new pre-stack depth migration of reflection profiles in the retrowedge thrust belt to define upper crustal structure and kinematics.
The western Taiwan prowedge thrust belt has been converging with Eurasia at ~30mm/y based on geodesy, neotectonic observations (30Ka), and forland basin migration rate (~3-3.5Ma). This equals the long-term subduction rate of Eurasia based on ~450km of subducted slab since the onset of Eurasian subduction at ~15Ma. The remaining ~60mm/y of current plate convergence is taken up by deformation of edge of the Philippine Sea since ~2Ma. Within the upper crust, approximately 60% of this convergence (30-35mm/y) is taken up by west-vergent thrusting of the arc and forearc basin for a total of ~100km shortening. The remaining shortening of the upper crust (25-30mm/y) is taken in the retrowedge for a total ~30km shortening of the Cretaceous and younger sedimentary cover of the Philippine Sea plate (Huatung basin) to the east of the arc, which we document below. The upper crustal shortening is accommodated by secondary west-vergent subduction of lower crust and mantle lithosphere of the arc, forearc basin and the Huatung basin, which is imaged tomographically.
The active thrust front of the 40km wide retrowedge is observed in high-resolution bathymetry as seafloor scarps that extend 130-200km along strike. We image the underlying structure using pre-stack depth migration in areas of high bathymetric relief and deep submarine canyons cutting through the thrust belt. Reflection profiles show a shallow 2-3km detachment near the base of the Huatung basin stratigraphy with the overlying Cretaceous and younger strata forming east-vergent imbrications. The frontal thrust sheet shows a total ~26km shortening with overlying Pleistocene growth strata. The retrowedge detachment appears to join the west-vergent prowedge of the arc and forearch basin near the shoreline, which appears to be the takeoff point of secondary subduction of Philippine Sea lithosphere.

Keywords: Subduction, Retrowedge thrust belt, Taiwan, Arc-continent collision



Eurasian margin
~ 33 mm/y shorting
Forewedge
Forearc, arc & retrowedge ~ 55 mm/y shorting
Suture zone
Retrowedge
fixed Eurasia
33 mm/yr
62 mm/yr
88 mm/yr
Moho
Philippine Sea Plate
Eurasian slab
Philippine Sea slab
Depth (km)
0
50
100
150