



The East Asian Sea: A vanished Cenozoic ocean between the Pacific and Indian oceans revealed by subducted slab constraints

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We have mapped an extensive 2500 km by 7500 km swath of sub-horizontal slabs at 600 to 1200 km depths that we call the 'East Asian Sea'. The northern margin of the East Asian Sea slabs begin at Taiwan and Japan, and extend south to SE Australia near New Zealand, underlying the Philippine Sea, the Caroline Sea, New Guinea, and northern to eastern Australia. When restored with other mapped slabs under Asia-Oceania, the mapped slabs reveal a vanished ocean that existed between the Pacific and Indian oceans in the Cenozoic. The subduction of the Asian Sea fills a crucial gap in plate tectonic reconstructions of East Asia by accounting for a significant proportion of fast Pacific and Indo-Australian convergence towards Eurasia since 43 Ma, during which time the Pacific moved ~ 3000 km WNW and Australia moved ~ 2500 km northward in a near-orthogonal direction relative to a mantle reference. In addition, the Australian plate expanded up to 2000 km at its northern and eastern margins.

Slabs were primarily mapped from the MITP08 global P-wave mantle tomographic model (Li et al., 2008) and compared to other global P- and S-wave global tomography. Reconstructed slab lengths were assessed by quantitative flexural slip unfolding of mid-slab surfaces to a spherical Earth surface model. Seismic tomographic volumes were also calculated for selected serial cross-sections.

We present a plate tectonic reconstruction with the slab constraints, with the implication that the East Asian Sea was progressively overrun and subducted beneath the Philippine Sea, the Caroline Sea and the expanding Melanesian arcs. Reconstructions to earlier periods indicate the East Asian Sea was originally Pacific or proto-Pacific mantle lithosphere, and was fragmented from the Pacific plate during the major ~ 45 Ma Eocene motion change. This implies that the East Asian Sea was initially the upper plate of the Mariana and Tonga-Kermadec Western Pacific subduction zones.