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Constraints on the extrusion of SE Asia from subducted slabs of the Indian, Australian, Philippine Sea and Molucca Sea plates

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We describe the mapped 3D geometries of subducted slabs under SE Asia using global seismic tomography and seismicity. When unfolded and restored in GPlates, these mapped slabs of mantle lithosphere indicate incompatibilities with existing plate-tectonic models. Reconstructions that incorporate the new slab constraints suggest that the Philippine Sea, Molucca Sea, and Celebes Sea plates are fragments of a much larger NE Indian-Australian ocean, once continuous with the Sunda slab and the present Indian Ocean. Transforms are generally oriented N-S but the E-W ridge geometry had some complexity based on heterogeneous spreading rates. The restored extent of this large NE Indian-Australian ocean combined with the known history of Indian-Australian and Philippine Sea motions places important constraints on the extrusion of continental SE Asia, including Sundaland, Borneo, South China Sea and Indochina. In particular, possible locations of extruding continental SE Asian lithosphere during the Cenozoic are constrained by the trajectories of the present West Philippine Basin and Celebes Sea and by the shape and age of the Wharton spreading ridge slab window.

In this study, we have added significant new constraints of subducted slab geometries and seismic velocities to SE Asia plate tectonic reconstructions. Gocad software was used to map the slabs in 3D based on MITP08 global P-wave seismic tomography data, Benioff zone seismicity and published local tomography. The slabs were unfolded in Gocad within a spherical Earth model, minimizing changes in area and distortion, to assess their restored sizes and shapes. GPlates software was used to compare the unfolded slab geometries with existing plate reconstruction models. Mapped slabs include the those of the Philippine Sea, Eurasia, Celebes Sea, Molucca Sea, Australian-Indian and Pacific plates, as well as additional unnamed detached slabs.