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Teleseismic Traveltime Tomography of Sulawesi, Indonesia

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Located in the eastern region of Indonesia, Sulawesi exhibits a distinctive K-shaped configuration due to the Cretaceous to present day tectonic interaction of the Indian-Australian, Sunda, and Philippine plates. This tectonic interaction has delineated two main tectonic provinces of Sulawesi: the Western Sulawesi Province, including the South and North Arms with large plutono-volcanic rocks generated during the Paleogene, and the Eastern Sulawesi Province, comprising the East and Southeast Arms characterized by the ophiolite complex and metamorphic belt emerging after the Early Miocene collision between the northern part of the Australian continental plate and the North Arm of Sulawesi. The present configuration of Sulawesi is attributed to the Sulawesi Orogeny, the attachment of eastern Sulawesi and Buton-Tukang Besi as well as Banggai-Sula Islands by subduction, accretion, and collision that led to the development of two major active tectonic structures in Sulawesi: the left-lateral Palu-Koro strike-slip fault to the west and the Celebes Sea subduction zone to the north.

We present preliminary P-wave tomographic images of the crust and upper mantle beneath Sulawesi, obtained by exploiting teleseismic earthquake data. Passive-seismic data are recorded by approximately 89 seismic stations of the Agency for Meteorology, Climatology, and Geophysics (BMKG) network running from January 2020 to July 2023. We employ an adaptive stacking technique to extract relative P-wave traveltime residuals from nearly a thousand teleseismic events recorded across the network. The relative arrival-time residuals from first-arriving, core and reflected P phases are then utilized to map 3-D P-wave perturbations using an inversion technique implemented in FMTOMO.

The final tomographic model reveals several distinct features, including a south-dipping, high-velocity anomaly beneath northern Sulawesi that we associated to the subducting slab of the Celebes Sea.