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Transitions in the Banda Arc-Australian Continental Collision Revealed by Surface Wave Tomography

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The Banda arc is the results of the convergence of the Indo-Australian with the Eurasian plate, and is one of the most classic examples of a young oblique arc-continent collision worldwide. Understanding the complex evolution in the Banda arc requires detailed knowledge of seismic structure both along and across the arc from the surface to deep depths. To achieve this goal, we imaged the 3-D shear wave velocity structure up to depth of 150 km by a joint analysis of ambient noise- (5-40 s) and earthquake-based (20-100 s) Rayleigh wave data, recorded by 30 recently installed, temporary broadband seismometers (YS network) in the Timor-Leste and Nusa Tenggara Timur region of Indonesia from March 2014 to the end of 2017 (Miller et al., 2016). At less than 30 km depth, our ambient noise tomographic images show low-velocity anomalies beneath the outer arc island of Timor related to sedimentary units from the incoming Australian plate, which are vertically offset by the high-velocity backstop of the Banda terrane under the inner arc islands of Flores, Wetar and Alor. Along-strike velocity contrast between the two outer arc highs, that is high-velocity anomaly beneath the Sumba and low-velocity anomaly beneath the Timor, might reflect the oceanic nature of the lithosphere of Sumba thickened by involvement of the oceanic Scott Plateau versus the general inputs of continental material from Australia beneath the Timor island. At depths of 30 to 40 km, a NE-SW striking high-velocity patch wrapped by the low continental material is shown beneath the eastern Timor, which might be the onset of lithospheric mantle material of the continent. Such feature might reflect either the different stages of the collision along the strike or the structural heterogeneity of the incoming plate. At depths greater than 100 km, the upper mantle structure along the inner arc shows a sharp change from high- to low-velocity materials from west to east of the Flores island, geographically correlated with the overall variations in Helium isotope signatures of arc volcanism (Hilton et al., 1992; Elberg et al., 2004). Such consistent changes in structure and composition reflects the tectonic transition from oceanic subduction in west to arc-continent collision in east.

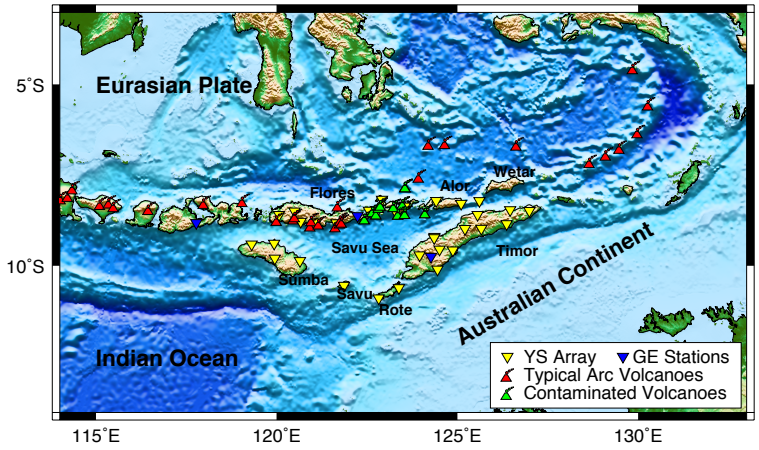

Figure Regional map in the eastern Indonesian archipelago and broadband seismic stations (YS array, yellow inverse triangles) in the Banda arc (Miller et al., 2016). Blue inverse triangles represent three permanent stations from GE network in the region. Triangles with smoked bubbles mark arc volcanoes, where the red ones are typical arc volcanoes in subduction zone (Siebert and Simkin, 2002) and the green ones are arc volcanoes with lithologic changes in crustal inputs (Hilton et al., 1992; Elberg et al., 2004). Major plates and islands referred in the text are labelled.