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Shear Velocity Structures from Subduction to Collision in Southern Taiwan Revealed by Rayleigh Wave Tomography

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In order to obtain high-resolution seismic images beneath the transition from subduction to collision in southern Taiwan, we established a passive broadband amphibious seismic network called the Southern Array for the Lithosphere and Uplift of Taiwan Experiment (SALUTE), which has spanned southern and adjacent offshore southeastern Taiwan since 2021. Combining SALUTE data with existing stations from Broadband Array in Taiwan for Seismology (BATS), we extracted Rayleigh waves over a wide range of periods between 8 and 70 s, using cross-correlation functions of ambient noise and intra-array cross-correlation analysis of teleseismic surface waves between all the suitable station pairs during the SALUTE operation. The extracted waves are then used to invert for phase velocity maps and 2D shear-wave velocity tomography profiles, revealing the detailed structures of the lithosphere in southern and offshore southeastern Taiwan.

Our tomography results reveal several key findings: (1) Subducted fore-arc fragment: Beneath the eastern offshore of the SALUTE main line, a high-velocity anomaly potentially representing a subducted fore-arc fragment is found at depths of 70 – 100 km. (2) Velocity contrast coincide with the seismicity: At depths of 10 – 40 km beneath the fore-arc region, a significant velocity contrast is observed to coincide with the seismicity. (3) Potential source of the fluids for mud diapirs: A low-velocity anomaly located at depths exceeding 55 km beneath the subducted Eurasian slab in southwest Taiwan, is likely the source of the fluids for mud diapirs. (4) Magmatic underplating: In the northwest of our study region near the Peikang basement high, a high-velocity anomaly within depths of 20 – 25 km is potentially associated with magmatic underplating. The SALUTE data expands observational coverage across southern Taiwan. By integrating both ambient noise and teleseismic data into analysis, our final Vs models offer greater insight into the crustal to lithospheric-mantle structures and dynamics associated with the transition from subduction to collision in southern Taiwan.