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Lithospheric Imaging of Northern Taiwan Using Teleseismic Full Waveform Inversion: from Volcanic Reservoirs to Plate Boundaries

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The tectonic of northern Taiwan is in a post-collisional stage and has undergone a subduction polarity flip between the Eurasian Plate (EP) and Philippine Sea Plate (PSP). The shallow crust of northern Taiwan features the Tatun Volcano Group (TVG) and the Turtle Island magma reservoirs, with their proximity to Taipei metropols highlighting the volcanic risks to densely populated regions and critical infrastructure. However, it is challenging to image all these structures from the surface down to several hundred kilometers depth with classical passive tomographic approaches. Here, we present tomographic models of density, P-wave velocity (Vp), S-wave velocity (Vs), and the Vp/Vs ratio beneath northern Taiwan, obtained by inverting complete teleseismic waveforms from 18 P and 9 SH events recorded by 175 broadband stations from the Formosa Array and the permanent stations. In our final model, the plate boundary between EP and PSP is clearly depicted as a west-dipping plane, consistent with the western boundary of slab seismicities. Our model identifies two distinct low-velocity, high VP/VS bodies beneath the TVG and Turtle Island, indicative of underlying magma reservoirs. The reservoir beneath the TVG is beaker-shaped, extending from a depth of 6 to 20 kilometers. The reservoir beneath Turtle Island, located on the island's eastern side, is larger than TVG's but less well defined due to sparse station coverage. The crust north of the Hsueshan Range is thinner, likely related to the post-collisional delamination of the lower crust. This process leads to increased mantle heat flow, providing the heat source for the TVG. With the new 3-D model, we also relocate the local events by utilizing a nonlinear location method, in order to improve their spatial accuracy and get better constraints on the seismogenic structure.