

Supplementary Information

Seismic structure and geodynamics of the Philippine Sea plate and its surrounding subduction zones

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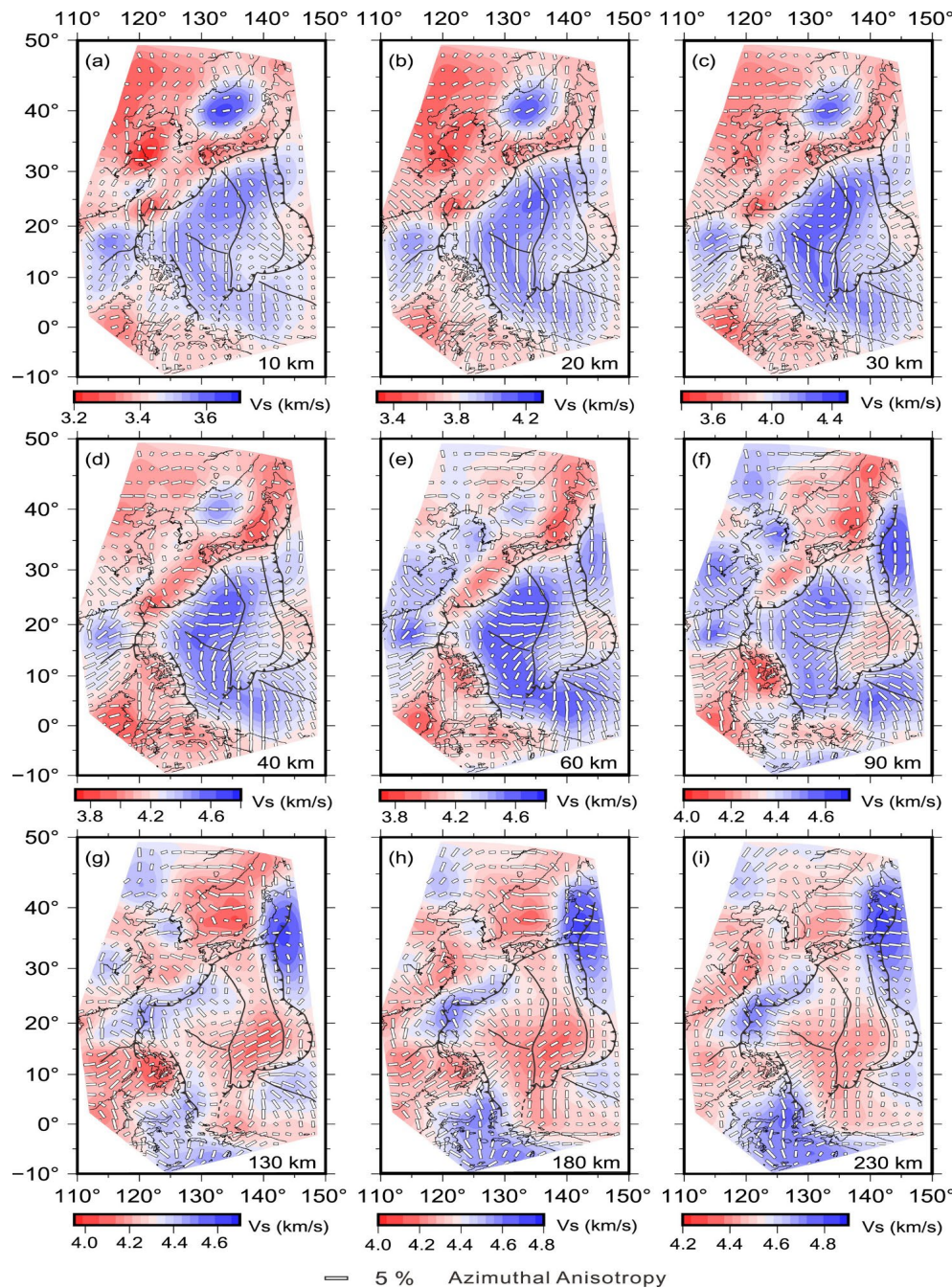


Fig. S1 Lateral variations of isotropic S-wave velocity (V_s) at the depth indicated at the lower-right corner of each map and azimuthal anisotropy in the depth range of (a) 5–10 km, (b) 15–20 km, (c) 20–30 km, (d) 30–40 km, (e) 40–60 km, (f) 60–90 km, (g) 90–130 km, (h) 130–180 km, and (i) 180–230 km. Red and blue colors denote low and high V_s values, respectively, whose scale is shown below each map. The length and orientation of white bars represent the magnitude and fast direction of azimuthal anisotropy, respectively. After *Li et al. (2025)*.

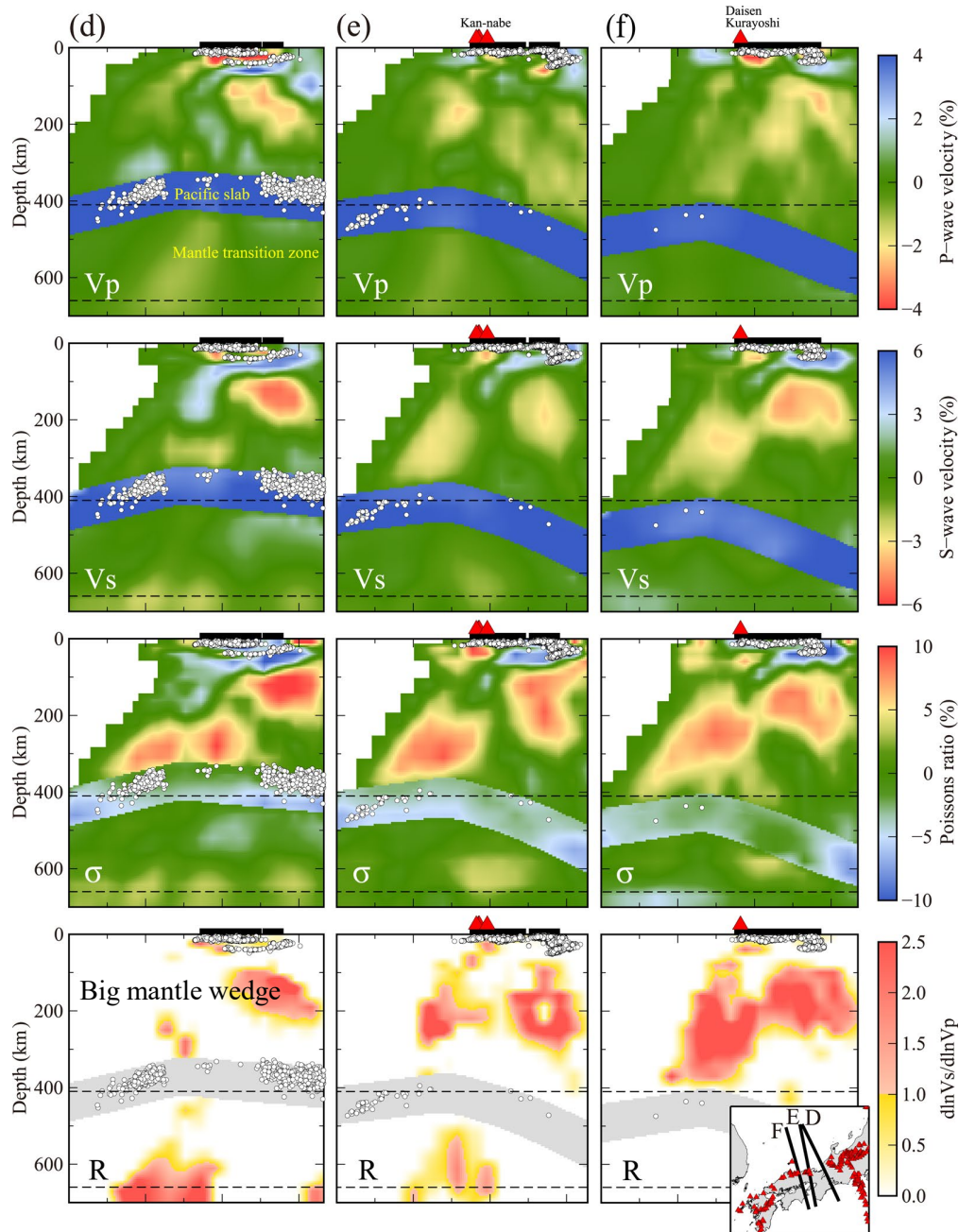


Fig. S2 Vertical cross-sections of V_p , V_s , Poisson's ratio (σ) and $R (= d\ln V_s/d\ln V_p)$ images beneath western Japan along 3 profiles on the inset map. Red colors: low-velocity and high- σ . Blue colors: high-velocity and low- σ . Their scales are shown on the right. Red triangles: Quaternary volcanoes. Black bar atop each panel: land area. White dots: seismicity within a 20-km width of each profile. Two dashed lines: the 410 and 660 km discontinuities. After *Asamori & Zhao (2015)*.

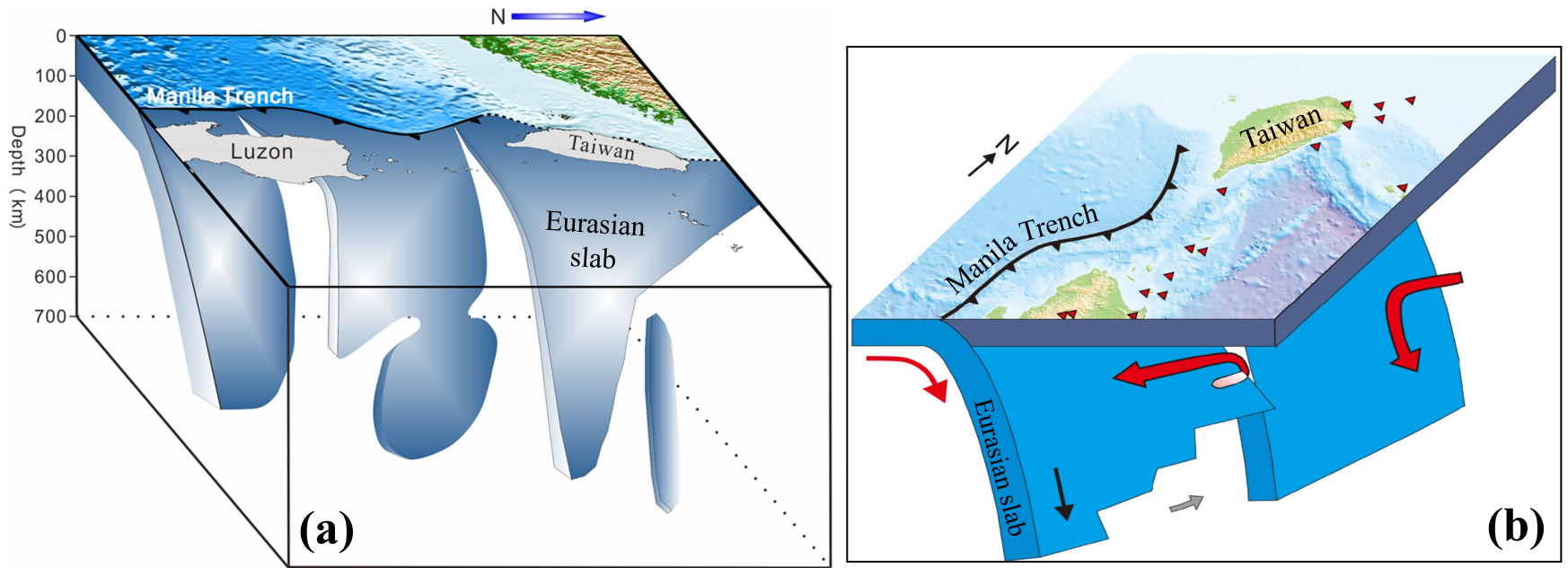


Fig. S3 (a) A schematic diagram showing morphology of the subducting Eurasian plate along the Manila trench (*Fan & Zhao 2021a*). (b) A schematic geodynamic model of the Manila subduction system (*Wei et al. 2022*). Both 2-D corner flow and 3-D toroidal flow (red arrows) are developed due to the existence of a tear in the subducting Eurasian plate.

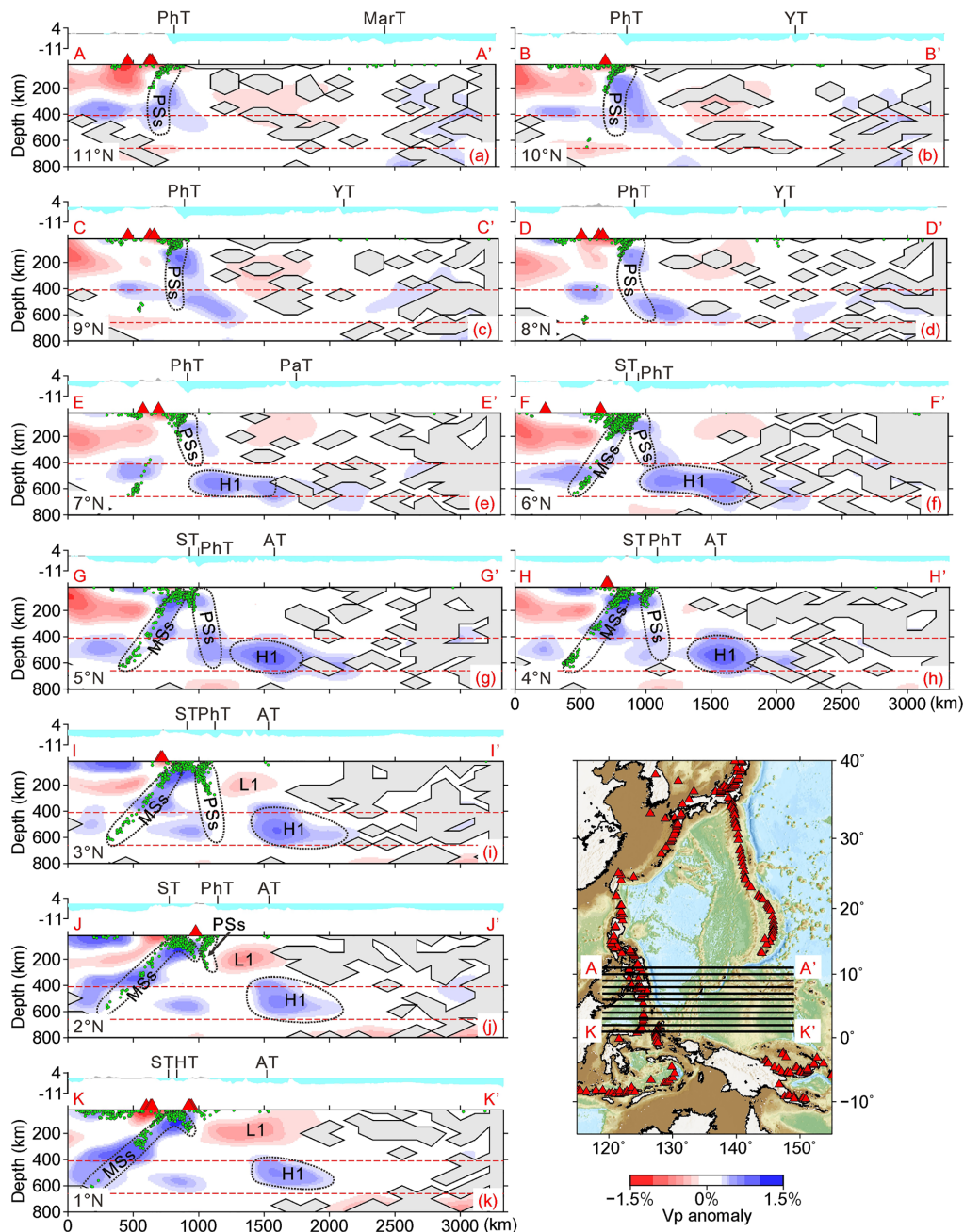


Fig. S4 E-W vertical cross-sections of Vp tomography along 11 profiles on the inset map. The latitude of each profile is shown at the lower-left corner of each panel. Green dots: seismicity (1964–2018) within a 30-km width of each profile. Two red dashed lines: the 410 and 660 km discontinuities. Surface topography along each profile is shown above the cross-section. Gray patches denote low-resolution parts. AT: the Ayu trough; HT: the Halmahera trench; MarT: the Mariana trench; MSs: the Molucca Sea slab; PaT: the Palau trench; PhT: the Philippine trench; PSSs: the Philippine Sea slab; ST: the Sangihe trench; YT: the Yap trench. After *Fan et al. (2023)*.

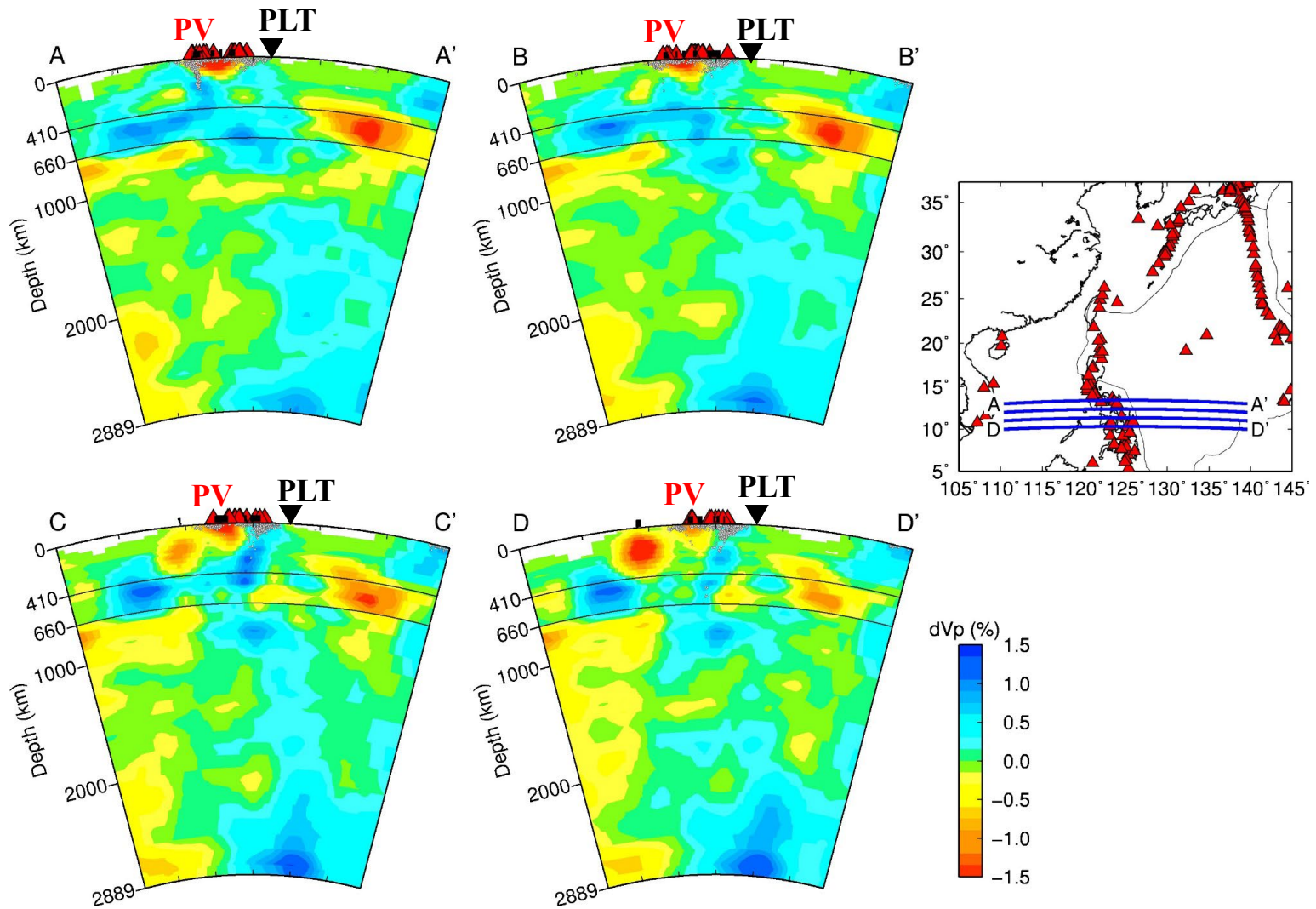


Fig. S5 E-W vertical cross-sections of Vp tomography along 4 profiles on the map. Red triangles: active volcanoes. Black bars: land areas. Black lines: 410 and 660 km discontinuities. White dots: seismicity within a width of 111 km of each profile. The reverse black triangle: the Philippine trench (PLT). PV: volcanoes in the Philippines. After *Zhao et al. (2021)*.

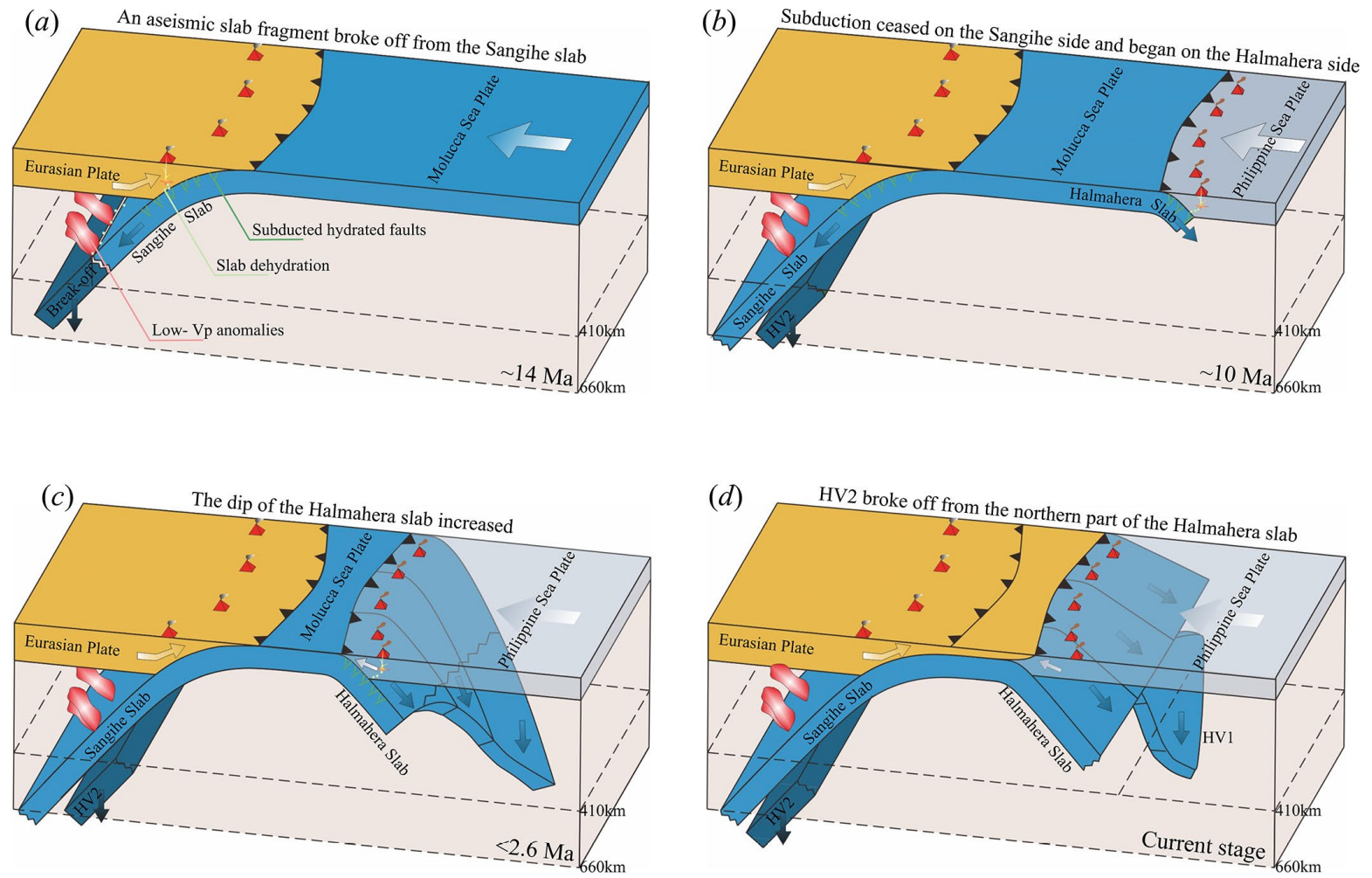


Fig. S6 Cartoons illustrating break-off processes of the Molucca Sea slab. Panels (a) to (d) show the general geometry of the subducted Molucca Sea slab in different periods. The arrows show the general moving directions of the plates. Red triangles denote volcanoes. After *Yuan et al.* (2024a).