9th FTSES 2024 Penghu, Taiwan

9th France-Taiwan Symposium in Earth Sciences
Session: Mantle dynamics and Earth interior

Seismic anisotropy constrained from SKS/SKKS splitting beneath southern Taiwan using the SALUTE array

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The Taiwan orogen emerges as a distinctive outcome of oblique convergence between the WSW-ENE trending Chinese continental margin of the Eurasian Plate (EUP) and the N-S trending Luzon Volcanic Arc (LVA) of the Philippine Sea Plate (PSP). Shear-wave splitting analysis is prevalently used to deduce two essential splitting parameters. One is the polarization direction of the fast-polarized shear wave characterizing the preferred alignment of fractures, cracks, or minerals and the direction of the maximum horizontal stress or mantle flow, while the other is the delay time between the fast and slow shear waves quantifying the degree of anisotropy and the thickness of the anisotropic layer. By analyzing core-refracted SKS/SKKS splitting data from multiple seismic events and locations, we can establish a direct link between surface observables of receiver-side seismic anisotropy and intricate lithospheric deformation and mantle dynamics. This study primarily focuses on determining SKS/SKKS splitting parameters, utilizing teleseismic earthquake data in the distance range of 85-140 degrees recorded by the Southern Array for the Lithosphere and Uplift of Taiwan Experiment (SALUTE) between Dec. 2021 and Oct. 2023. The SALUTE array mainly comprises both east-west and north-south transects, featuring a total of 30 closely spaced broadband stations deployed across southern Taiwan which lies in a transition from continental subduction to oceanic arc collision. We employ a widely recognized and extensively used MATLAB tool, SplitLab (Wustefeld et al., 2008), for conducting a comprehensive analysis of splitting parameter measurements for individual seismic events. Three well-established methods: rotation-correlation (RC, Bowman and Ando, 1987), energy minimization (SC, Silver and Chan,1991) and minimum second eigenvalue of covariance (EV, Silver and Chan, 1991) are adopted to grid search the best polarization azimuth and delay time between fast and slow-polarized SKS/SKKS phases and their 95% confidence regions. Additionally, we adopt a multi-event approach to enhance the accuracy and stability of our shear wave splitting results. In this approach, events with similar backazimuths are grouped into four quadrants, and we apply the methods of error surface stacking (WS, Wolfe and Silver, 1998) and normalized surface stacking weighted by signal-to-noise ratios (RH, Restivo and Helffrich, 1999) implemented in another MATLAB tool, StackSplit (Grund, 2017), to obtain robust splitting parameters with significantly reduced uncertainties. We categorize our measurements as good, fair, or poor following the same quality criteria outlined in SplitLab. The good and fair results reveal that the observed fast polarization azimuths are predominantly within ±25° from north, and the delay times range from 1.5 to 2.5 s. This suggests that both the orogen-subparallel shear deformation in the lithospheric domain and toroidal asthenospheric flow induced by the quasiorthogonal subduction of the PSP and EUP may contribute to the observed seismic anisotropy in southern Taiwan.

Keywords: Southern Taiwan; Shear wave Splitting; Anisotropy; Toroidal flow; SALUTE Array