Upper mantle velocity structure beneath the northern Ryukyu subduction zone revealed from multiscale finite-frequency traveltime tomography

*Shu-Huei Hung[1], Ban-Yuan Kuo[2], Pei-Ying Patty Lin[3], Yuancheng Gung[1], Eh Tan[2], Kate Huihsuan Chen[3], Ching-Ren Lin[2], Chau-Chang Wang[5,4], Shuichi Kodaira[6], Yasushi Ishihara[6], Mamoru Nakamura[7]

1. National Taiwan University, Taipei, Taiwan, 2. Academia Sinica, Taipei, Taiwan, 3. National Taiwan Normal University, Taipei, Taiwan, 4. Taiwan Ocean Research Institute, National Applied Research Laboratories, Kaohsiung, Taiwan , 5. National Sun Yat-sen University, Kaohsiung, Taiwan, 6. Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan, 7. University of the Ryukyus, Okinawa, Japan

We conduct multiscale finite-frequency tomography of upper mantle structure beneath the northern Ryukyu subduction zone, where the Philippine Sea Plate (PSP) subducting beneath the Eurasian continent forms a trench-forearc-arc-backarc system. The data comprises of P and S waveforms of teleseismic earthquakes with an epicentral distance of 30°-95° and magnitude greater than 5.5 recorded by 3 stations from the F-net network of Japan and 21 broadband ocean-bottom seismometers from the Taiwan-Japan collaborative experiment deployed between Sept. 2018 and June 2019 in the study area. Relative traveltime residuals between the recording stations for each event are measured by cross correlating the band-pass filtered waveforms at periods of 8-20 s for P and 10-30 for S. Those with the cross-collelation coefficients > 0.8 are retained for the tomographic inversion of seismic velocity perturbations at least down to the depth of 300 km. Data-adaptive, finite-frequency traveltime kernels in conjunction with a horizontal multiscale wavelet-based and vertical convolutional quelling grid-based parameterization are adopted to resolve the multi-resolution velocity structure. The resulting preliminary P-wave model reveals a low-velocity anomaly in the forearc wedge and a high-velocity lid in the uppermost 80-km depth beneath the northern Okinawa Trough (NOT) and Ryukyu arc which may correspond to the overriding Eurasian continental lithosphere. Besides, a trench-parallel elongated fast anomaly extending at least down to ~200 km depth is observed under the NOT, probably associated with the subducted PSP slab. Further investigation of S-velocity tomography and assessment of model resolution will be undertaken to verify these resulting seismic features.

Keywords: Ryukyu subduction zone , broadband ocean bottom seismometer, multiscale finite-frequency traveltime tomography, Northern Okinawa Trough (NOT)