Large scale seismic anisotropy: revisited

Ichiro Kawasaki[1]

[1] DPRI, Kyoto Univ.

Aki and his coworkers (e.g., Aki and Press (1961)) first derived polarization anisotropy of surface waves propagating across the Pacific ocean. The polarization anisotropy means that S wave velocities inverted for Love wave dispersion were larger than those inverted for Rayleigh wave dispersion. In 1970s, Asada and his coworkers made an long shot seismic explosion experiment developing ocean bottom seismograms in the northwest Pacific ocean to reveal azimuthal anisotropy of Pn refraction arrivals from 7.8 km/s in the slowest direction of N60E and 8.6 km/s in the fastest direction of N30W (e.g. Shimamura and Asada (1983)), which is consistent with a spatial pattern of paleospreading directions formed at the paleooceanic ridge. In 1980's, Forsyth and his coworkers (e.g. Nishimura and Forsyth (1985, 1988)) plotted the fast directions of Love and Rayleigh wave propagation velocities in the Pacific ocean for periods shorter than 100 s. Tanimoto and Anderson (1985) first obtained global mapping of the fastest direction of Rayleigh wave propagation velocities at a period of 200 s, which was very consistent with flow pattern at the depth from 200 km to 300 km suggested by numerical simulation of Hager and O'Connell (1979). Thus, their mapping was the first seismological tracing of mantle convection flow. Recently, Montagner (1998) had a global mapping of faster directions of surface wave propagation velocity and emphasized importance of the anisotropy mapping as the tracer of convection pattern.

Computation algorithm called as ymethod was developed by Pekeris and his coworkers (e.g., Pekeris an Jarosch (1958)) in 1950s. Saito (1967) and Takeuchi and Saito (1972) provided a very powerful program to compute eigenvalues and eigenfunctions of surface waves. Recently, numerical simulation algorithms such as direct solution method (e.g. Takeuchi et al, 2000) and spectralelement method (e.g., Komatisch and Tromp (2002)) were applied to seismic wave propagation in asymmetric spherical Earth.

Kawasaki and Tanimoto (1981) gave the formulation of the force equivalents to the dislocation in a generally anisotropic medium. Kawasaki and Koketsu (1990) derived exact analytical formulation of the y-method for surface wave propagation in a generally anisotropic flat-stratified medium. One of major feature of the surface waves in the anisotropic media is Rayleigh wave-Love wave coupling at specific periods and directions where dispersion curves intersect each other. When the coupling occurs, particle motion directions anomalously incline and tilt. In the presentation, we will focus on the polarization anomaly, which is the symptom of the azimuthal anisotropy.