Lithospheric structure of East Sea of Korea from teleseismic receiver functions: Seismic evidence of ancient back-arc basin opening

*HyeJeong Kim[1], Younghee Kim[1]

1. School of Earth and Environmental Sciences, Seoul National University

We investigate lithospheric seismic structure beneath Ulleung back-arc basin in East Sea of Korea, which opened ~28 Ma due to Pacific Plate subduction. Formation of ocean basin in response to subduction typically causes characteristic features such as thinned crust and trench-normal fast-velocity directions in the mantle. Previous seismic studies reported a presence of a thick crust (thicker than normal oceanic crust) and prominent low-velocity anomaly in the lithospheric upper mantle (at ~100 km depth) beneath East Sea. Also, shear-wave splitting and tomography results show trench-normal fast-velocity directions beneath the oceanic basin.
We constrain azimuthal anisotropy of crust and lithosphere of the volcanic islands (Jeju, Ulleung, and Dok islands) by modeling amplitude variations of both radial- and transverse-component receiver functions (RFs) by back-azimuths. Our analysis results show that all islands commonly have thicker crust (more than 20 km). In particular, under Jeju Island, we observe a large variation in crustal thickness (18-26 km). The thinnest part of the crust is observed in the middle of the island along a N-S direction. Modeling of the transverse RFs requires an existence of a dipping Moho and localized anisotropy above the Moho. Also, a presence of paleo-oceanic sediments shifts the arrival time of a direct P wave in the radial RFs by 0.5 s. Crustal structure of Ulleung Island includes a dipping Moho with strike roughly parallel to contour line of the island. Under Dok Island, we observe large variations in amplitudes of the transverse RFs in back-azimuthal domain, suggesting a similar crustal structure as that in Ulleung Island.
Our teleseismic constraints on the structure and anisotropy provide an insight on the opening of the ancient back-arc basin in East Sea. Direction of anisotropy under Jeju Island is along a N-E direction, and is consistent with the constraints from previous body-wave anisotropy studies. Also, this direction is along the mantle shear which might have induced focusing of the magmatism, causing the monogenetic volcanism of the island (Brenna et al., 2012). Also the dipping Moho structure beneath Ulleung Island can be a geophysical evidence of an existence of continental block suggested in geochemical studies (Jolivet et al., 1992; Kim et al., 2008). Variable Moho depths under Jeju Island may be related with the activity of Mt. Halla, the largest shield volcano of the island.

Keywords: Back-arc basin opening, Receiver Function, Seismic anisotropy, Ulleung Basin, Volcanic island

