Probing the thickness of oceanic lithosphere from continental stations using S-receiver functions

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Oceanic lithosphere is created at mid-oceanic ridges and consumed at trenches by subduction defines the plate tectonic process in ocean. According to this hypotheses the lithosphere is in constant motion over asthenosphere a weak zone seismically characterized by low velocity layer. One of the key questions lies that how the thicknesses of lithosphere vary with its geological age since it took birth from almost zero thickness at ridges. The crustal and upper most mantle seismic structures for the oceanic environment using the body waves are scare due to the absence of ocean based seismometers. Till date most of the information of the oceanic structure comes from low resolution surface wave dispersion studies. Here we attempt to detect the thickness of oceanic plate using converted wave technique utilizing high resolution body waves.

Recently teleseismic S-to-p conversion technique proves to be a good method to map the uppermost mantle discontinuities such as Lithosphere-Asthenosphere Boundary (LAB) in ocean as well as in continents. The chief advantage of using this method is that it is free from any shallow layer multiples as in case of P-to-s conversions in the time window of our interest. Recent analysis of two borehole broadband seismological data from north-west Pacific and Philippine sea plates as well as the dense seismological data from inland Japan reveal the average oceanic lithospheric thickness is ˜80 km (Kawakatsu et al., 2008). The conversion points at a depth of 80 km for IASP91 earth model are ˜80 km away from the station in case of S-to-p whereas it is only ˜20 km in case of P-to-s. This large lateral sampling of S-wave owing to larger slowness provides an opportunity to map the oceanic lithospheres from the data of the stations situated closer to ocean.

In order to map the crustal and upper most mantle structures only for the oceanic plates of diverse geological ages we used data from all the broadband seismic stations (downloaded from IRIS and FNET data centers) situated on continents along the periphery ocean along the entire circum-pacific belt and Indonesian region. Further we took those data set which has the S-p conversion point of S-receiver function in the oceanic regions. Most of the region coherently show at least three prominent phases, positive at 1sec to 2sec corresponding to the upper interface of subducting slab, another positive corresponding to the crust-mantle boundary and a negative phases corresponding to the LAB. The thicknesses of lithosphere in the entire region of our study varies from 40 km to 100 km for the geological age of 15 Ma to 120 Ma. Our preliminary results show age dependence lithospheric thickness with somewhat large scatter.