Characteristics of the Moho transition zone (MTZ) - 3: Implication by petrological and physical properties

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The Moho is defined as the seismological discontinuity at the crust and mantle boundary. Its global depth, thickness of transition zone, and velocity structure has not been studied well. It is also poorly known whether the Moho has the same petrological and seismological properties in the continent and in the ocean, or not. Previous studies propose several petrological models for the Moho: 1) phase transition boundary from basalt to eclogite, and 2) material boundary of mafic and ultramafic rocks. By the petrological observation in the Oman ophiollite, the oceanic crust is modeled as 3) diabase-homogeneous gabbro - layered gabbro-Moho transition layer - harzburgite.

Here, we summarize the results obtained by several seismic surveys in the western Pacific Ocean. These data were obtained during the Deep Sea Survey technologies for Natural Resources in Japan project carried out by Japan Oil, gas and Metals National Corporation (JOGMEC). The companion studies present multi-channel seismic (MCS) reflection profiles (Ike et al., in this session) and synthetic seismograms using several petrological - seismological models of the oceanic crust (Tsuruga et al., in this session).

From the interpretation of MCS reflection profiles, we present the following characteristics of Moho (Ike et al., in this session). 1) It is not identified beneath seamounts and oceanic plateau. 2) Its depth in Ogasawara Plateau deepen toward seamounts; although the thickness of the crust(the thickness between the A-Ref and the Moho) is nearly constant.(TWR ˜2 sec and ˜6km). 3) The continuity of Moho varies from place to pace where relatively flat bathymetry and smooth A-Ref occur. For example, the Moho is continuous for 220 km in the south of Ogasawara Plateau but no tin the northern side. 4)In the west of Izu-Bonin trench, the Moho is not recognized.

T he appearance of Moho within MCS reflection profiles could depend on seismic data acquisition including total chamber volume of air gun array, the length of streamer, and the data processing; although, these possibilities are not consistent in MCS profiles around Ogasawara Plateau. Other factors controlling the appearance of Moho reflections are the thickness of the crust, the morphology of the seafloor and A-Ref, and P-wave velocity (Vp) structure that varies around the Moho transition zone (MTZ).

Conclusion

The synthetic seismogram (4Hz Richker wavelet as the seismic source) studies show the following results(Tsuruga et al., in this session). 1) If the Vp at the bottom of the crust and the top of the mantle are 7.0km/s and 8.0 km/s, respectively, the intensity of Moho reflection strongly depend on the thickness of MTZ. 2) If the dominant frequency of the air gun is 15 Hz, the thickness of MTZ is less than 100-250m for a clear Moho reflection. 3) Results by synthetic seismograms for the thickness of MTZ are consistent with the petrological observation in Oman ophiolite. 4) If the Moho reflection is poorly imaged in the MCS section, the thickness of MTZ could be thicker than a few km. The MTZ could be mixing layers of gabbro and dunite. 5) If the top of the mantle is serpentinized, the Moho might not be observed in MCS reflection records. Note that these results do not fit to the observations by OBS- refraction/wide angle reflections.