Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SCG086-15 Room: Function Room B Time: May 25 16:00-16:15

Crustal evolution accompanied with intraplate igneous activity

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Intraplate igneous activity in oceanic lithosphere is one of the important references for understanding mantle dynamics and its influences. Such activities alter original structures of oceanic crusts and have produced many seamounts and LIPs (Large Igneous Province) on seafloors. To confirm effects of intraplate activities on oceanic crusts, we conducted seismic experiments on the Marcus-Wake seamount chain on the western Pacific Basin with three survey lines cutting various sized seamounts formed in the Cretaceous age. Airgun arrays with total volume of 98 and 132 l (6000 and 8040 inch^3) are used as artificial seismic sources for refraction and Multi-channel seismic reflection experiments. OBS (Ocean Bottom Seismograph) setting interval is approximately 5 km.
Obtained crustal structures of the seamounts by applying tomographic inversion analysis and ray tracing analysis show distinct structural features from those of the Jurassic oceanic crusts adjacent to the seamounts, and different characteristic seamount structures depending on their sizes. Slower P-wave velocity in the uppermost mantle below the seamounts than that below the oceanic crusts is a typical feature in the survey area. However crustal flexure caused by the weight of the seamounts and crustal thickening below the seamounts depend on their sizes. Small seamounts (~60 km in diameter) scarcely show crustal flexure and downward crustal thickening. Middle sized (~110 km in diameter) ones show crustal flexure and no or small downward crustal thickening. Large one (~150 km) shows both features. These facts indicate that supplying magma from the mantle were mainly used for constructing the seamount edifices and only large supply of magma can thicken the original crusts.
Though the P-wave velocities in the uppermost mantle below the seamounts seems to have been changed from those below the oceanic crusts through intraplate igneous activities, there is mantle anisotropy below the seamounts as observed below typical oceanic crusts. They still show a velocity anisotropy magnitude of 4-5 %, suggesting that the mantle structure below the seamounts partly preserves its original structure. One of the plausible reasons for the slower P-wave velocity in the uppermost mantle below the seamounts is sill-like intrusion of upcoming partial melt derived from a shallow part of upper mantle. This intrusion may also affect the P-wave velocity in the lower part of the seamount crusts.

Keywords: crustal structure, seamount, seismic experiment