Seismic evidence for residual mantle underplating the lithosphere beneath the Ontong Java Plateau

Takehi Isse¹, Daisuke Suetsugu², Akira Ishikawa³, Hajime Shiobara¹, Hiroko Sugioka⁴, Aki Ito⁲, Yuki Kawano¹, Kazunori Yoshizawa⁵, Yasushi Ishihara², Satoru Tanaka², Masayuki Obayashi², Takashi Tonegawa², and Junko Yoshimitsu²

¹the University of Tokyo, Tokyo, Japan
²Japan Agency for Marine-Earth Science and Technology, Kanagawa, Japan
³Tokyo Institute of Technology, Tokyo, Japan
⁴Kobe University, Kobe, Japan
⁵Faculty of Science, Hokkaido University, Sapporo, Japan

The Ontong Java Plateau (OJP), one of the largest oceanic plateaus located in the western Pacific Ocean, was first formed by a massive volcanism at 122 Ma, which had a major effect on the Earth’s environments, including global climate change, oceanic anoxic events, and mass extinction of marine life. However, the cause of the volcanism remains controversial since the underground structure beneath the OJP has been poorly understood due to limited geophysical and geochemical data. To improve such situation, we conducted about 1.6-year long-term seafloor observation on the OJP and its vicinity. Using seismograms obtained by this observation as well as those from existing seismic stations, we obtained three dimensional radially anisotropic shear wave velocity structure beneath the OJP at depths down to 300 km.

Obtained structure shows the following new features:

(1) Beneath the Caroline Islands, in the north of the OJP, 1% slow anomalies exist, which may be associated with the Caroline hotspot activity;

(2) In the center of the OJP at depths between 70–130 km, about 2% fast anomalies, whose shear wave speed is about 4.45-4.55 km/s, exists.

(3) The seismic structure clearly shows that the lithosphere–asthenosphere boundary (LAB) beneath the center of the OJP is located about 40 km deeper than that beneath the surrounding normal oceanic seafloor.

Judging from our results and petrological/rheological constraints given by previous studies, we interpret that the LAB is deepened by dehydrated residual material from hot mantle plume underplating a pre-existing lithosphere during a formation of OJP.