Is the Ontong Java Plateau thick oceanic crust?

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The Ontong Java Plateau, arguably the most massive Large Igneous Province (LIP), covers an area of 1.9 x 10^6 km^2 (Coffin and Eldholm, 1994), equivalent to five times the area of Japan. From scientific ocean drilling results on the OJP, the basement is basalt with ages of about 120 million years (e.g. Shipboard Scientific Party, 2001), suggesting that formation was geologically instantaneous. Many models for the origin of LIPs have been proposed, such as plumes from the deep mantle (e.g. Richards et al., 1989), impact-induced decompression melting (e.g. Ingle and Coffin, 2004), lithospheric delamination (e.g. Elkins-Tanton, 2005), etc. However, no models for LIP origin explain existing observations. Crustal structure studies of the OJP have not yielded consistent results: Moho depths determined by a wide-angle seismic experiment were ~42 km (Furumoto et al., 1976), whereas that of gravity modeling was 25 km (Sandwell and Renkin, 1988). To obtain robust crustal structure information, including Moho depth, that is necessary to understand the origin of OJP, a large-scale seismic experiment was conducted across the central OJP (High Plateau) involving a large volume seismic source and one hundred ocean bottom seismometers (OBS) in 2010 by the Japan Agency for Marine-Earth and Technology (Miura et al., 2011). The new data are high quality, showing first arrival traveltime signals from offset distance >300 km in OBS profiles. From inversion analysis using first arrival and Moho reflection (PmP) traveltimes, we determine the Moho depth to be about 43 km on the central OJP. The new P-wave velocity (Vp) structure of the OJP indicates an upper crust with a relatively large velocity gradient and a lower crust with a relatively small velocity gradient, which is similar to typical oceanic crust except for different thicknesses. Moreover, the S-wave velocity (Vs) structure and Vp/Vs ratio are also similar to typical oceanic crust. Density estimates derived from simple calculations of the upper and lower crusts of the OJP confirm isostatic compensation without any anomalous high density crust, consistent with the OJP’ s submarine history. The velocity model of the OJP resembles that of Iceland (Foulger et al., 2003), although crust of the former is thicker than that of the latter. Iceland’ s subaerial crust is related to the Mid-Atlantic Ridge coinciding with a hotspot. Although the tectonic settings of Iceland and OJP are different, the tectonic setting of Iceland provides clues to the origin of OJP and LIPs. In this presentation, we will consider the origin of the OJP and LIP.

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