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Abrupt S velocity variations in the lower mantle inferred from BBOBS data

Nozomu Takeuchi[1*], Hajime Shiobara[1], Takehi Isse[1], Hiroko Sugioka[2], Toshihiko Kanazawa[1]

[1]ERI, Univ of Tokyo, [2]IFREE, JAMSTEC

Ocean bottom seismographs have potentials to provide data samplings where path coverages by land stations were poor. To improve the quality and quantity of data, formidable challenges have been continuously conducted. Although dense array observations have been achieved in sea-floor observations, lower signal-to-noise ratios and limited observational terms are still obstacles for obtaining accurate models for deep Earth's interiors. Horizontal components of the waveforms for teleseismic events are especially difficult to analyze, and exploiting information from these data are a challenging subject. Several attempts are beginning to be conducted including receiver function analyses (e.g., Suetsugu et al., 2005; Tibi et al., 2007; Suetsugu et al., 2007), splitting measurements (e.g., Barruol et al., 2009), and delay time tomography (e.g., Tanaka et al., 2009).

A three-years project was recently conducted to deploy 12-15 broadband ocean bottom sensors (BBOBS) in and around the Philippine Sea (e.g., Shiobara et al., 2009; Isse et al., 2009). Very long term observations (Oct 2005-Nov 2008) were achieved by repeating one-year observations three times. During these periods, 11 BBOBSs, at least, recorded data, which is one of the largest BBOBS array data set. It therefore provides unique opportunities to test applicability of further detailed analyses to the BBOBS data.

In this study, we analyzed horizontal (transverse) components for teleseismic events to detect fine-scale (about 100-200 km scale) S velocity heterogeneities in the lower mantle. We here focus on the events in the Tonga-Fiji, Kermadic, and Vanuatu regions because of higher seismicity and appropriate distances from the array. By applying a band pass filter with corner frequencies of 0.0 1 and 0.08 Hz, we could measure 53 ScS-S traveltime residuals. These S and ScS sample the lower mantle beneath the western Pacific, where it is considered that we have no strong heterogeneities except for the core-mantle boundary region (e.g., Takeuchi, 2007). We observed abrupt changes in ScS-S traveltime residuals, suggesting the large S velocity gradients somewhere in the lower mantle. After concluding that the observed anomalies are robust, we will discuss the locations of the large velocity gradients.