

海洋アセノスフェア地震学的構造に対する新たな制約 New Constraints on Seismological Structures of the Oceanic Asthenosphere

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The oceanic lithosphere and asthenosphere are one of the most fundamental features in the plate tectonics. Oceanic asthenosphere is characterized by lower S velocity (lower Vs) and stronger S attenuation (lower Qs), which shows sharp contrast with oceanic lithosphere. These features have been primarily constrained by lower frequency surface waves observed in higher quality land data. To reveal higher frequency features (or frequency dependency) and P structures (or relative behavior of P and S anomalies), in-situ observations on the seafloor would be critical.

In this presentation, we present our recent results on new features revealed by our BBOBS observations. We deployed BBOBSs in the northwestern Pacific (NOMan project) during 2010-2014. Long term and in-situ observations enabled us quantitative inference on the frequency dependent attenuation and Vp/Vs structures of the oceanic lithosphere-asthenosphere system (LAS). We previously analyzed higher frequency scattered waves and reported that the attenuation in the oceanic lithosphere is weak and frequency dependent, while that in the oceanic asthenosphere is strong and frequency independent (Takeuchi et al., 2017, Science). We recently analyzed longer period P body waveforms and revealed Vp/Vs of the LAS. The results show that P velocity reduction in the asthenosphere is large (~6.1%) and is comparable with S velocity reduction observed by surface waves (~7%). The results suggest that Vp/Vs is comparable between the lithosphere and the asthenosphere.

The stronger attenuation and lower velocities in the oceanic asthenosphere has been previously attributed to either of partial melt (Anderson et al. 1970), elevated water content (Hirth and Kohlstedt 1996), or reduced grain size (Jackson and Faul 2010). Grain boundary softening by solid-state-mechanism (Takei et al. 2014) and flaws in the regular atomic packing under oxidising condition (Cline et al. 2018) are also reported by recent laboratory experiments. It is not straightforward to propose the mechanism which reconcile all of our observations, however, at the time of presentation, we plan to discuss consistency and inconsistency of each mechanism with our results.

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