Intrinsic Attenuations in the Oceanic Lithosphere and Asthenosphere Constrained by Seismogram Envelopes

*Nozomu Takeuchi[1], NOMan Project Team

1. Earthquake Research Institute, University of Tokyo

It is widely accepted that the oceanic lithosphere and asthenosphere have high-Q and low-Q, respectively, however, it is not very clear to which extent such attenuations are affected by seismic wave scattering (e.g., Shito et al. 2015, JGR; Kennett and Furumura 2013, GJI). To distinguish the intrinsic and scattering attenuations, analyzing seismogram envelopes is known to be effective. We deployed broadband ocean bottom seismometers on the old Pacific seafloor between 2010-2014 (NOMan Project, http://www.eri.u-tokyo.ac.jp/yesman/). We had quite large number of aftershocks of 2011 Great Tohoku Earthquake and succeeded in obtaining envelopes of Po/So and T-phase at various distances. The data purely sample the old ocean, which should provide unique opportunities to quantitatively constrain the attenuations in the ocean. We applied our envelope simulation method (Takeuchi 2016, JGR) and obtained the attenuation model by grid-searching the best structural parameters to explain the observations.

One of the most unique features of Po/So is that spatial attenuation (i.e., energy loss rate per unit propagating distance) is independent from wave type (P- or S-wave) and frequency (Butler 1987, JGR). Several previous studies (e.g, Sereno & Orcutt 1987, JGR; Mallick & Frazer 1990, GJI) explained such features by slightly ad-hoc attenuation models (strong frequency dependency; larger P attenuations than S). In contrast, we tried to explain the observations without such assumptions and succeeded in explaining most of the observed features. The results suggest that the saturation of backscattering coefficients at higher wavenumbers is primarily responsible for the constant spatial attenuation.

Keywords: attenuation, scattered wave

