

Toward the reconciliation of seismological and petrological perspectives on oceanic lithosphere heterogeneity

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The character of the high-frequency seismic phases P_0 and S_0 , observed after propagation for long distances in the oceanic lithosphere, requires the presence of scattering from complex structure in 3-D. Current models use stochastic representations of seismic structure in the oceanic lithosphere. The observations are compatible with quasi-laminate features with horizontal correlation length around 10 km and vertical correlation length 0.5 km, with a uniform level of about 2% variation through the full thickness of the lithosphere. Such structures are difficult to explain with petrological models, which would favor stronger heterogeneity at the base of the lithosphere associated with underplating from frozen melts. Petrological evidence mostly points to smaller-scale features than suggested by seismology. The models from the different fields have been derived independently, with various levels of simplification. Fortunately, it is possible to gently modify the seismological model toward stronger basal heterogeneity, but there remains a need for some quasi-laminate structure throughout the mantle component of the oceanic lithosphere. The new models help to bridge the gulf between the different viewpoints, but ambiguities remain.

Keywords: Oceanic Mantle, Heterogeneity, Scattering of seismic wave, P_0/S_0 phases