The Nature of Intrinsic Attenuation

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Intrinsic attenuation plays an important role in investigating the interior structure of Earth, especially for the Lithosphere-asthenosphere system, the best place to understand the physical mechanics of plate tectonic. The dissipation, the high attenuation of seismic waves in the low-velocity zones, and the frequency dependence are the characteristic of intrinsic attenuation. However, N. Takeuchi, et al. measured the Northwestern Pacific Ocean's lithosphere-asthenosphere system, and state the attenuation of the asthenosphere is 50 times larger than the attenuation of lithosphere attenuation. The attenuation of the lithosphere shows strong frequency dependency, but the attenuation of the asthenosphere does not. Previous theories of attenuation failed to explain this phenomenon. Here we demonstrate an explicit attenuation formulation to explain the high attenuation of seismic waves in the low-velocity zones and to show the mechanisms of spectral of teleseismic body waves rapidly fall off as frequency bigger than 1 Hz by perturbing the wave equation with the novel method we proposed. The result also indicates that the difference between the attenuation of the lithosphere and asthenosphere is because their attenuation governs by different physics mechanisms and mathematical models. Moreover, we illustrate the explicit formulation of the relationship between apparent $t^*$, wave velocity, and frequency.