Upper Mantle Attenuation and Velocity Anomalies beneath Antarctica Constrained by Teleseismic Body Waves

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The seismic attenuation and velocity structure of the upper mantle beneath Antarctica is important for estimating mantle temperature, and thus viscosity. These parameters control glacial isostatic adjustment in response to ice mass changes, which has a crucial impact on future ice-sheet stability. Deployments of temporary broadband seismic stations over the past twenty years provide a good dataset and have been extensively analyzed for velocity structure. However, no previous studies have investigated the large-scale seismic attenuation structure. In this study, we estimate the attenuation structure of Antarctica by analyzing broadband teleseismic P and S waveforms using spectral slope methods, yielding the Δt* of each seismic station relative to the rest of the array. At the same time, cross-correlation travel time anomalies are used for calculating travel time residuals. We use least-squares inversion to determine the relative travel time anomaly for each station, after corrections for ice and crustal thickness. The attenuation and travel time anomalies are highly correlated, as expected for a thermal origin for the variations. High attenuation and slow differential travel times are observed throughout most of West Antarctica, whereas East Antarctica shows low attenuation and fast velocities. This pattern is consistent with previous results showing thick, cold continental lithosphere beneath East Antarctica and warmer upper mantle beneath West Antarctica. The highest attenuation and slowest velocity anomalies are observed beneath the Marie Byrd Land and Mt. Erebus, which are volcanically active and have been proposed to represent mantle plumes.