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Attenuation in the Australian-Antarctic region from multiple ScS waves

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The shear attenuation in the mantle beneath the Australian-Antarctic region is analyzed using a large data set of multiple ScSn waves. The data are the transverse components of deep earthquakes from the subduction zones North and East of Australia, recorded at stations in Antarctica, Australia, Indonesia, New Caledonia and New Zealand. The ScS(n+1)/ScSn amplitude ratios of successive ScS phases are compared to the ratios computed for PREM synthetic seismograms for the same paths and same focal mechanisms, in order to eliminate the effects of source radiation and geometric attenuation. A possible Q frequency dependence is investigated using narrow band-pass filters at several frequencies in the range 0.013-0.040 Hz. Assuming that Q heterogeneities are concentrated in the upper mantle, close to the upper bounce points, an inversion of the data at 0.026 Hz is performed to retrieve the quality factor in 5 regions defined using a priori constraints inferred from seismic shear velocities.

Most stable results are obtained when restricting the analysis to ScS3/ScS2 and ScS4/ScS3 ratios, for which seismic phases can be properly isolated and whose bounce points sample sufficiently 4 of the 5 regions. Q values close to PREM's one are found beneath the Australian and Antarctic cratons, lower values beneath the Eastern Australian Phanerozoic margin, and very low values beneath the oceanic region between Australia and Antarctica, where ridges and a triple junction are present. The highest Q values are found beneath the subduction zones, a feature which is not apparent in global attenuation models.

In the frequency range considered (0.013-0.040 Hz), our data do not require a frequency dependent quality factor. This result is robust and is consistent with previous results based on the decay of ScSn spectral ratios, obtained for various regions of the world.