Near-vertical multiple ScS phases and vertically averaged mantle properties

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ABSTRACT

Near-vertical multiple ScS phases are among the cleanest seismic phases traveling over several thousand km in the Earth's mantle and are useful for constraining the average attenuation and S-wave speed in the whole mantle. However, the available multiple ScS pairs are limited. We take advantage of the recent dramatic increase in the number of global broad-band stations, and made a thorough computer-assisted search for high-quality data of multiple ScS pairs. We could find 220 station-event pairs which provided us with robust point-wise estimates of average *Q* and 2-way S-wave travel times With the assumption that geometric focusing caused by lateral velocity heterogeneity does not seriously affect the amplitude measurements, the *Q* values exhibit strong short-range lateral variations, with very high and low *Q* regions closely adjacent to each other. The mantle beneath KIP, Hawaii, has normal *Q* and S-wave speed, which supports the result of earlier studies. The mantle beneath AFI, Samoa Islands, has a very high *Q*, possibly larger than 1400, and the slowest S wave speed. The stations on the upper plate of the Tonga, and Japan subduction zones yield average to low *Q* values. In contrast, the stations on the trenchward side of the upper plate of some subduction zones, e.g., LVC, Chile, and PET, Kamchatka, indicate high *Q* values, larger than 1000. We found no obvious correlation between *Q* and S-wave speed, which suggests that different factors like temperature, composition, anisotropy, etc are controlling these properties in the mantle of different tectonic environments.

Keywords: ScS, mantle *Q*, mantle S-wave speed, hot spot, Samoa, Hawaii