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Interactive comment on "The relative contributions of scattering and viscoelasticity to the attenuation of S waves in Earth's mantle" *by* Susini deSilva and Vernon F. Cormier

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Reviewer: The connection of the modeling results to inferences about Earth's mantle via comparison with observational results is much weaker on account of the choice to ignore the wealth of relevant and easily accessible seismic data in modern community archives. Consequently, I am cautious about the value of the interpretations regarding the balance of scattering and intrinsic attenuation in the real rather than synthetic model mantle. The observational component of the manuscript should be substantially expanded to use global data from many sources and a large number of receivers as the available data resources have advanced greatly beyond those used in most of the

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references. Comparing a more statistically significant set of waveform analyses to thermodynamic modeling results would be a powerful approach for evaluating the relative influences of scattering and intrinsic attenuation. Given the quality of the modeling component I would suggest focusing on that in this manuscript and refraining from insights into actual mantle properties rather than just model implications. Or, with much more observational analysis a compelling observational component could be added to this study.

Addressing the reviewer's comment on use of dense modern waveform data, we point out that the analysis and conclusions of our paper are supported by a heterogeneity model that was determined from many 100's of waveforms observed from deep focus earthquake in 3 regions recorded by sensors in the USArray of Earthscope. Fig. 1 attached from the publication that resulted from that study plots the deep focus earthquakes and stations we used in that analysis. The peaks in heterogeneity power determined from that study closely match those predicted in the theromodynamic mantle models of Stixrude and Lithgow-Bertelloni. The only feature that was not directly determined from the model of maximal heterogeneity was the additional peak we added for heterogeneity concentrated near a post-perovskite phase transition that appears in the thermodynamic models. For examining effects of heterogeneity on S waves we assumed a scaling of dlnVs/dlnVp = 2. Fig. 2 shows a plot of our upper mantle heterogeneity P velocity fluctuations (red) with our estimated error bars is compared with the predictions of the thermodynamic model (blue).

The close correspondence of our estimated heterogeneity and that of the thermodynamic model with an assumed scaling between P and S velocity fluctuations, combined with several publications that have proposed that a significant fraction of mantle attenuation is due to scattering (e.g., Yicard et al. , EPSL, 2014, doi: 10.1016/j.epsl.2013.12.008), primarily motivated the current study.

The supporting section discussing the analysis of attenuation inverted from 2 representative deep focus earthquakes is important for demonstrating that coda levels and

waveform complexity as well as the shape of the initial pulse are also important for constraining the effects of heterogeneity. We chose events that we felt best represented the span of attenuation values determined in earlier works published by Sipkin, Jordan, Revanaugh, Okal, and others. We acknowledge the reviewer's point that a much larger volume of data is available for reexamining the mantle attenuation from ScSn observations. A voluminous data sample would enable stacking to more quantitatively characterize coda shapes. Our goal in this paper, however, was to simply demonstrate some maximal bounds on the contribution of scattering by choosing some representative events with quite different levels of apparent scattering in their ScSn codas. Our wish was to simply pursue some obvious consequences of our paper on stochastic tomography bearing on suggestions that the scattering attenuation exceeds intrinsic attenuation of body waves. We do not feel that a new global study of ScSn waveforms is necessary to support the conclusions of our paper, but we do agree that such a study is certainly ripe for a revisit.

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Fig. 1.

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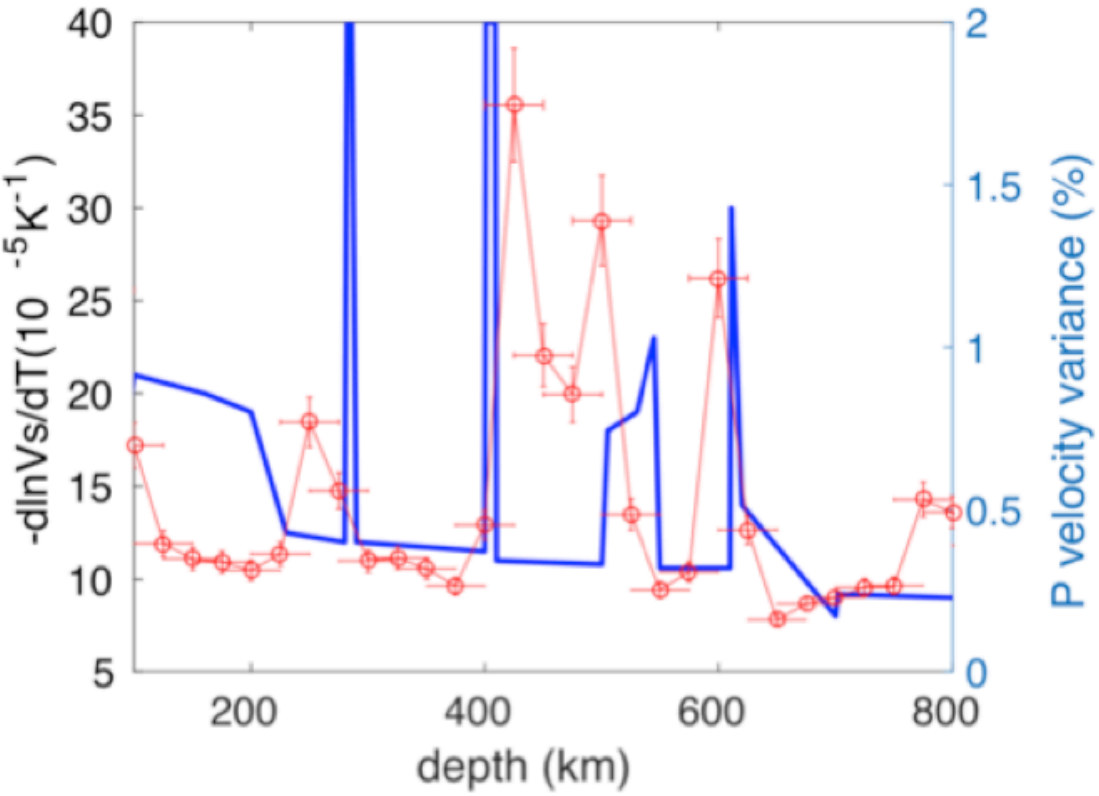

Fig. 2.

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