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Measuring the Scattering and Atteunation of Seismic Waves in Mars with the InSight Seismometers.

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Title:
Measuring the Scattering and Atteunation of Seismic Waves in Mars with the InSight Seismometers.

Abstract:
The amplitudes of seismic waves decrease over distance due frequency dependent energy loss via scattering and attenuation. Scattering, or extrinsic attenuation, is dependent upon the size, strength, and abundance of elastic heterogeneities within the medium. Intrinsic attenuation results from dissipation due to anelastic processes and internal friction between molecules and defects within crystal lattices. Both forms of attenuation are described using the seismic quality factor, Q. Scattering can arise from compositional heterogeneities, mechanical boundaries (such as fractures, cracks, veins, cavities), and other major non-radial changes in material properties of an object. Intrinsic attenuation is tied to grain boundary processes, crystal defects, fluid-filled cracks, and other dissipative viscoelastic processes. Attenuation is vital for understanding the detectability, travel times, and propagation properties of seismic waves, as well as the properties of the interior of a world.
The Interior Exploration using Seismic Investigations Geodesy and Heat Transport (InSight) Seismic Experiment for Interior Structure (SEIS) has placed a very broadband (VBB) and short period (SP) seismometers on Mars that allows us to investigate the fundamental geophysical process of seismic attenuation at Mars, which is expected to have properties falling between the Earth and the Moon. In the Earth, attenuation by seismic scattering is found to be relatively weak, and is typically confined to small-scale compositional heterogeneities in the crust, lithosphere, and mantle. Intrinsic attenuation varies throughout the Earth, and is especially high where fluids, elevated temperatures, and changes in grain size are present. On the Moon, seismic scattering is pervasive in the highly fractured and dry crust and uppermost mantle, and intrinsic attenuation is large in the deep interior. At present, the total Q, layering in Q, and relative proportion of seismic scattering to intrinsic attenuation within Mars remains unconstrained.