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Unraveling seismic attenuation mechanisms in saturated alluvial sediments

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The attenuation of seismic waves is an important material parameter, which contains potentially valuable information on key hydraulic and geomechanical properties of the probed medium. An inherent and important complication arising in the interpretation of such measurements is, however, that there are multiple physical mechanisms contributing to the dissipation of seismic energy, such as wave-induced fluid flow at the micro-, meso-, and macroscopic scales as well as scattering and inelastic effects, and that their relative contributions and importance is generally unknown and difficult to unravel. To address this problem for the practically particularly relevant case of unconsolidated surficial alluvial sediments, we analyze multi-frequency sonic logs with dominant source frequencies ranging roughly between 1 kHz and 30 kHz. This broadband dataset in conjunction with a comprehensive suite of complementary logging data allows for building a realistic rock physics model, which in turn provides the basis for simulating the various seismic attenuation mechanisms and for assessing their relative importance.