DIFFUSION WAVES IN SEISMOLOGY?

Dmitry Silin, Valeri Korneev , Gennady Goloshubin AGU annual meeting
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ABSTRACT:
Attenuation and reflection of seismic waves from fluid-saturated rocks is crucial for adequate interpretation of seismic data. Processing of low-frequency laboratory and field data shows seemingly anomalous phenomena of high reflection amplitudes and phase shifts, as well as very low values of attenuation factor ($Q = 1 - 5$), which can not be explained by the classical Biot-Gassman theory of poroelasticity. We apply the pressure-diffusion wave theory to explain the observed low values of Q. Two prototype examples of diffusion wave model have been considered: elastic fluid flow in single and dual porosity media. In either case, Q is a function of the frequency approaching at low frequency limit a very low value of 0.5. Estimates show that the diffusion waves have relatively slow velocities and high attenuation. The other interesting result consists of wavelengths being inverse proportional to the phase velocities. This mechanism partially explains the observed high reflection amplitudes and phase shifts and promises obtaining of high-resolution seismic images of thin fluid-bearing layers.

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