

P-Waves Behavior at Transition from Liquid to Gas-Saturated Porous Media

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According to the Frenkel-Biot theory, two P-waves can propagate in saturated porous medium. The 1st wave is faster wave and has small attenuation. The 2nd wave is slower, extremely damped wave. But, for gas-saturated media the situation can be changed. As Nikolaevskiy had shown, the 2nd wave is determined mainly by rock matrix deformation. For liquid saturated media, a porous matrix deforms only if saturating fluid may flow through a pore system. The Darcy resistance creates extremely high attenuation. However, the saturating gas has high compressibility and therefore the matrix volume deformation becomes possible without gas flow. Correspondingly, such 2nd wave can have small attenuation. On the base of full linear dynamical equations of poroelasticity, the comparison of P-wave behavior for water and gas saturated media was performed. This confirms that for gas-saturated media the 2nd wave has low attenuation, but the 1st wave is extremely damped. Moreover, for gas-saturated media at low frequencies the wave dispersion radically differs from ones for liquid-saturated media. It is shown, such P-waves transformation happens if gas pressure exceeds some threshold value.

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