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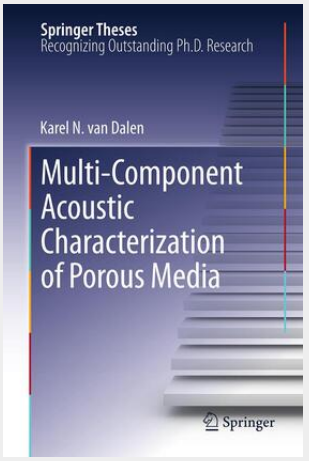
Multi-Component Acoustic Characterization of Porous Media



The feasibility to extract porous medium parameters from acoustic recordings is investigated. The thesis gives an excellent discussion of our basic understanding of different wave modes, using a full-waveform and multi-component approach. Focus lies on the dependency on porosity and permeability where especially the latter is difficult to estimate. In this thesis, this sensitivity is shown for interface-wave and reflected-wave modes. For each of the pseudo-Rayleigh and pseudo-Stoneley interface waves unique estimates for permeability and porosity can be obtained when impedance and attenuation are combined. The pseudo-Stoneley wave is most sensitive to permeability: both the impedance and the attenuation are controlled by the fluid flow. Also from reflected-wave modes unique estimates for permeability and porosity can be obtained when the reflection coefficients of different reflected modes are combined. In this case the sensitivity to permeability is caused by subsurface heterogeneities generating mesoscopic fluid flow at seismic frequencies. The results of this thesis suggest that estimation of in-situ permeability is feasible, provided detection is carried out with multi-component measurements. The results of this thesis argely affect geotechnical and reservoir engineering practices.

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