

Contribution of Seismic Methods to Hydrogeophysics

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Résumé:

The characterisation and monitoring of aquifer systems mainly rely on piezometric and log data. Delineating spatial variations of lithology between piezometers is a delicate task, which inevitably generates errors possibly propagating into hydrogeological models. Seismic methods have been proposed to: (i) improve the low spatial resolution of borehole data, (ii) provide a characterisation of the subsurface geometry, and (iii) estimate the physical parameters of the medium influenced by the presence of water and the associated flow and transport processes. The joint study of pressure (P-) and shear (S-) wave seismic velocities (VP and VS, respectively), whose evolution is strongly decoupled in the presence of fluid, has been proposed through the estimation of the VP/VS ratio and Poisson's ratio. A specific methodology has been developed for the combined exploitation of P- and surface waves present on single seismic records. The use of this methodology in several geological and hydrogeological contexts allowed for estimating VP/VS ratio lateral and temporal variations in good agreement with a priori geological information and existing geophysical and piezometric data. Laser-based ultrasonic techniques were also proposed to put these processing techniques in practice on perfectly controlled physical models and study elastic wave propagation in partially saturated porous media.