

DYNAMIC BOREHOLE NMR MEASUREMENT OF FLUID FLOW AND MIXED PHASE SYSTEMS

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Borehole NMR logging is a valuable technology for characterizing aquifer properties, allowing direct detection and quantification of water content. NMR logging measurements are also commonly used to estimate fluid mobility and hydraulic conductivity through established relationships between measured NMR relaxation times and the static pore geometry. In this work, we extend beyond NMR measurements of static systems, and demonstrate the ability to perform borehole NMR measurements during dynamic fluid flow in order to better constrain the hydrogeologic response of the formation. The approach translates basic flow imaging strategies from medical-MRI, including methods that highlight groundwater flow as well as methods that probe the flow of injected contrast agents. In addition, we investigate how dielectric measurements can be combined with NMR measurements to better characterize multi-phase systems, including formations contaminated by hydrocarbon NAPLs. Experiments are conducted using the Dart NMR logging tool in a meso-scale test cell that provides a direct analog for in-situ borehole NMR logging measurements.