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NMR properties of partially saturated porous silica glasses

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The signal responses of nuclear magnetic resonance (NMR) is sensitive to the inner surfaces of the water filled porous media. Therefore this method is well suited to noninvasively determine hydrological relevant parameters such as the pore radii distributions or hydraulic permeability of fully and partially saturated rocks and soils. NMR exploits the relaxation of the magnetization of fluids in the pore space of porous medium. In this work we study the dependence of NMR signals on the inner structure of fully and partially saturated artificial porous silica glasses (VitraPOR). The samples are characterized by an accurately defined pore space with well known pore radii distributions and surface properties. The mean pore sizes of the investigated samples range from 0.6 μm to 25 μm. Laboratory NMR saturation recovery (T1) and CPMG (T2) measurements as well as diffusion pulsed gradient mesurements have been carried out using a 3.91 MHz NMR spectrometer. A homogeneous partial saturation down to 5 vol.$\%$ has been realized by applying a uniform negative pressure gradient to the samples at each desaturation step. Additionally the corresponding water retention curves have been recorded and evaluated. On the basis of the results from these experiments the numerical simulation of the pore network using the Delaunay tesselation approach with subsequent simulations of NMR relaxation on the pore scale is performed in order to assess structure, state and thus transport properties of fully and partially saturated soils.