Magnetic Resonance Imaging of coarse sediment

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Non-destructive observation methods for coarse sediments are usually limited to two dimensions, for instance in opened cores or at the surface. We report a trial of a promising new method for three-dimensional imaging of gravelly sediments: Magnetic Resonance Imaging (MRI). MRI maps contrasts in density and relaxation properties of protons, which are very different for sediment and water in the pores. Images of glass bead mixtures show that the local porosity varies with sorting patterns or imperfect sample mixing, illustrating the potential for this non-destructive imaging method. As a quantitative test, we verify that a macroscopic sediment property – porosity – compares well to a standard lab determination and a recent model for predicting porosity for arbitrary grain size distributions. Finally we discuss potential applications and limitations of MRI to porosity and permeability, sedimentary structures, benthic life and slow groundwater or mass flows.

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