Geophysical Research Abstracts,
Vol. 11, EGU2009-7175, 2009
EGU General Assembly 2009


# 2D and 3D Magnetic Resonance Tomography : synthetic cases and field applications.

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Magnetic Resonance of the proton is used as a Sounding method (MRS) specifically sensitive to the free water content in the near surface down to several tens of meters of investigation. It provides quantitative information on the amount of groundwater but also on the hydraulic conductivity of the rock material. After calibration, use of empirical laws allows estimation of the aquifer transmissivity and consequently to evaluate an aquifer productivity.

Ability to obtain information about the 2D or 3D distribution has long ago been noticed but scarcely applied in field surveys. Indeed, acquisition time may be often long: several hours are commonly required per sounding, depending on the noise conditions and the amount of groundwater. This approach is nowadays referred as Magnetic Resonance Tomography (MRT). As part of the French national research project ANR REMAPRO, forward and inverse modelling for 2D and 3D distribution of underground water has been developed. A data set consists in a profile (or several profiles for the 3D case) of "coincident loop soundings" where the distances between two neighbouring loops are sufficiently narrow to make several loops sensitive to the same underground area. Typically, half-overlapping loops and up to side to side loops distances are sufficient.

We present a discussion about the resolution of MRT based on synthetic cases. Comparison between 2D/3D tomography results with interpolation of 1D results will be discussed, including the field constraints on acquisition time and the gain of resolution thanks to tomography. Two examples from field surveys will illustrate the discussion. A grid of small size loops (20x20m) covering a peat bog and its surrounding (80x 80m) was performed in the Alps during the 2008 summer. This dataset was interpreted in 3D using the two approaches. A second field case which is interpreted in 2D consists in a 800m long profiles using 75x75m loops crossing a faulting zone between a sandy aquifer environment toward a thick chalk medium.