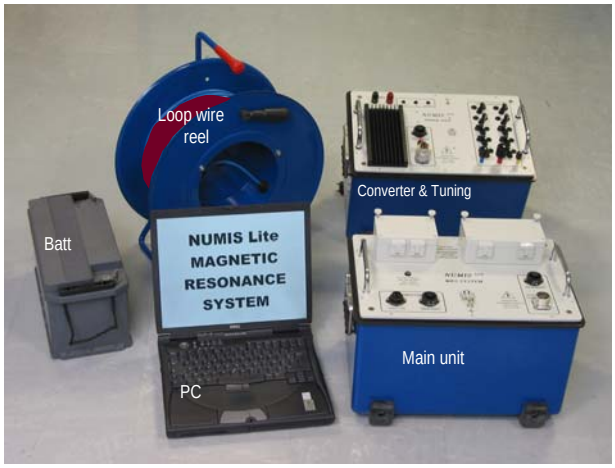
NUMIS^{Lite}

MAGNETIC RESONANCE SOUNDING SYSTEM FOR *DIRECT DETECTION OF SHALLOW GROUNDWATER* DOWN TO 50 m DEPTH

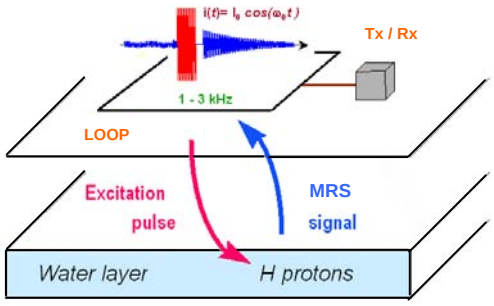
water content
permeability estimate
depth of water layers

MAGNETIC RESONANCE SOUNDING SYSTEM



NUMIS^{LITE} is compact MRS equipment consisting of :

- a converter/tuning unit powered by two 12 V batteries,
- a transmitter-receiver unit for pulse generation and signal measurement,
- a wire loop used as a transmitting and a receiving coil,
- a PC computer for the control of the whole system, and for data processing and interpretation



The Magnetic Resonance Sounding method (MRS):

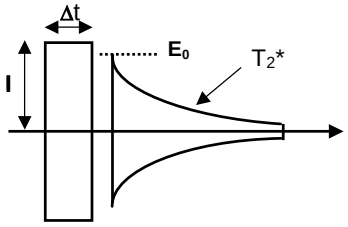
The MRS is the only non-invasive method which directly studies groundwater reservoirs from surface measurements:
A pulse of current, at a given frequency, is transmitted into a loop.
The signal produced in return by the H protons (water molecules) is measured within the same loop.

How to carry out a Magnetic Resonance Sounding ?

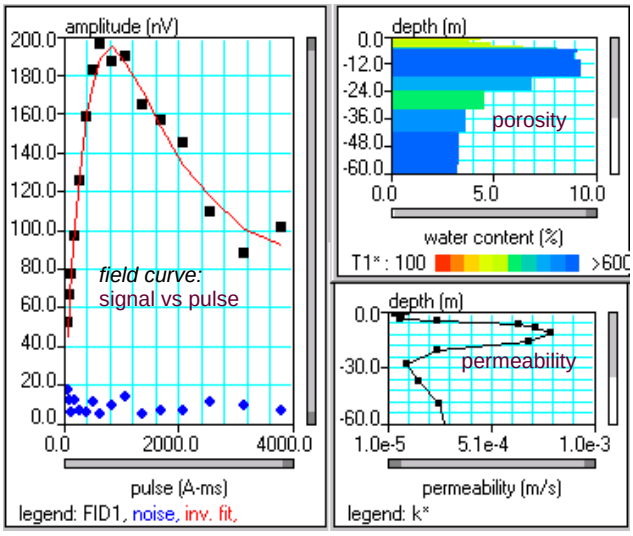
1- *Measure the Earth magnetic field*
to know the frequency to apply
2- *Transmit a pulse of current*
into a loop, at this frequency
3- *Measure the amplitude*
of the water MR signal (≈ porosity)
4- *Measure the time constant*
of the signal (≈ mean pore size)
5- *Change the pulse intensity*
to modify the depth of investigation
6- *Use the inversion program*
to get the porosity versus the depth

GROUNDWATER AND ENVIRONMENTAL APPLICATIONS:

Shallow groundwater resources evaluation
Non invasive water level determination
Pollution studies:
mapping of shallow aquifers



E_0: Initial amplitude of signal (nV)
Proportional to the **water content** (%)
T_2*: Decay time constant of signal (ms)
Related to the **mean pore size** (permeability)
I. Δt: Excitation pulse moment (A.ms)
Related to the **investigation depth** (m)



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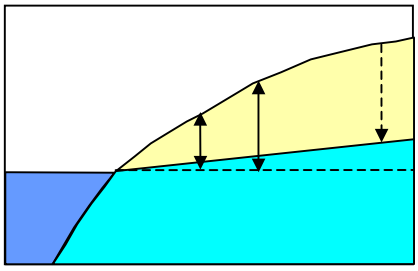
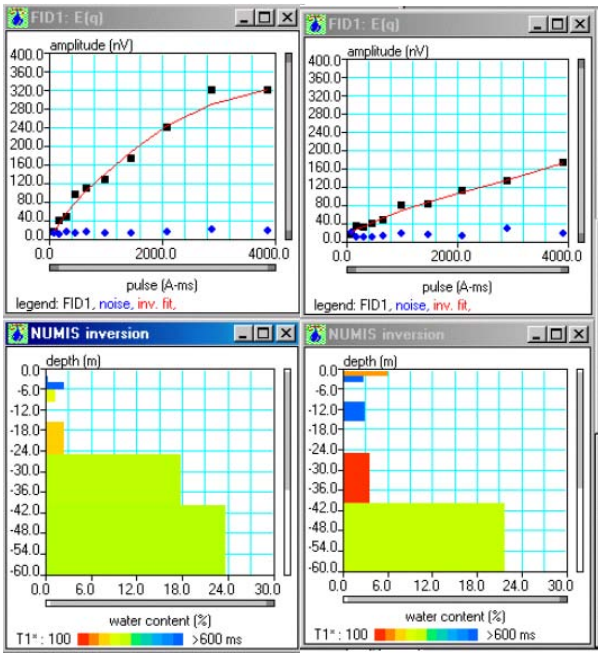
NUMIS^{Lite} MAIN FEATURES

- **NUMIS^{LITE}** is a compact MRS equipment designed for shallow groundwater investigations (down to approximately 50 m depth). It consists in two pieces of 20 kg each, making it easily portable.
- **The Tx / Rx unit** is the core of the system. It ensures the production of the energizing pulses at the Larmor frequency, also the measurement of the MRS response with filtering, amplification and analog to digital conversion.
- **The PC computer** receives raw data, then processes, displays and stores them for further interpretation.
- **The DC / DC converter and tuning unit** for both increasing the voltage supplied by the batteries and optimizing the energy transmitted into the loop.
- **The wire loop (240 m long)** can take the following shapes:
  - *the square one,* 60 m side, for standard applications
  - *the eight one,* 30 m side, in case of noise perturbations
  - *the square two turns,* 30 m side, when the area available does not permit to lay out the standard square 60 m side loop.





NUMIS^{LITE}

TECHNICAL SPECIFICATIONS

DC/DC CONVERTER / TUNING UNIT
- Power supply: two 12 V batteries (38 Ah each)
- 10 to 12 hours reading autonomy
- Capacitance: 0.14F
- Outputs: ± 110 V DC; 0.5 A
- Tuning of the loop to the Larmor precession frequency by capacitors
- Capacitance of 12 to 54 µF
- Dimensions: 43 x 30 x 33 cm; weight: 21 kg

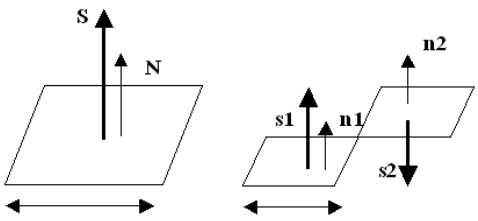
Tx / Rx MAIN UNIT
- Dimensions: 43 x 30 x 30 cm; weight: 19 kg

TRANSMITTER SPECIFICATIONS
- Frequency range: 1.4 to 3 kHz
- Maximum outputs: 1000 V, 150 A
- Pulse amplitude and duration: programmable
- Pulse moment: 100 to 6000 A.ms (loop and frequency dependant) for 40 ms standard pulse duration

RECEIVER SPECIFICATIONS
- Band pass filter width: 100 Hz
- Programmable gain: 10^4 to 10^6
- Noise: less than 10 nV / sqrt(Hz)
- A/D converter: 14 bits
- Sampling frequency: four times the Larmor frequency
- Calibration procedure for phase reference
- Measurement of T_2* (transverse) and T_1 (longitudinal) time constants

TRANSMITTING / RECEIVING LOOP
- Four reels of 60 m wire, 6 mm² section: impedance 0.7 ohm, 0.5 mH
- Other loop configuration on request

PC COMPUTER
- Control of the whole system: converter, transmitter, receiver
- Data processing: DFT and weighted stacking
- Data interpretation: 1D inversion



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