Encouraging the use of seismic methods for the hydrogeophysical characterization of the critical zone

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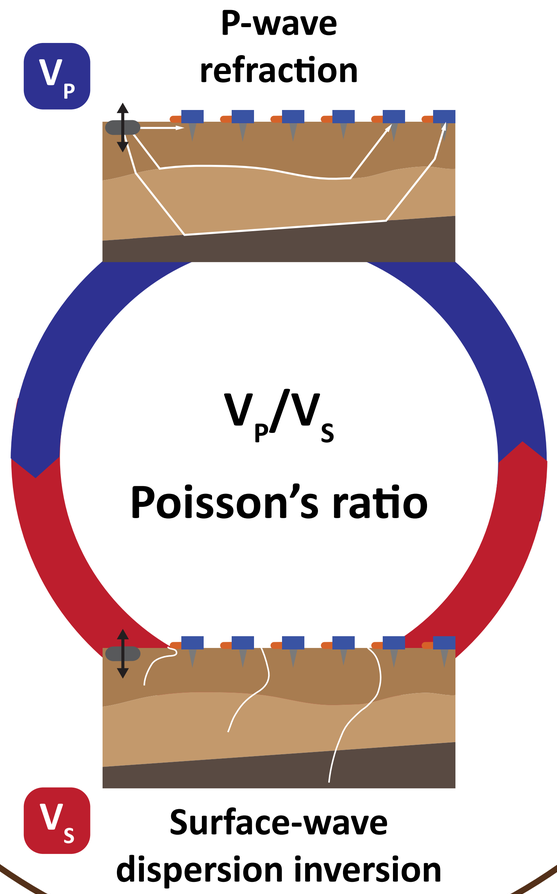
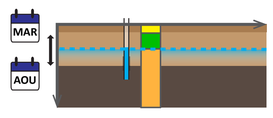
HYDROGEOPHYSICS

Characterization and monitoring of aquifer systems
Interpolation of piezometric and log data
Description of the geological model
Estimation of physical param. influenced by water



SEISMIC METHODS FOR CZ CHARACTERIZATION

Joint P- and surface-wave acquisition
V_P => P-wave first arrival interpretation
V_S => surface-wave dispersion inversion
V_P and V_S strongly decoupled with fluids => V_P/V_S



SEDIMENTARY AQUIFER

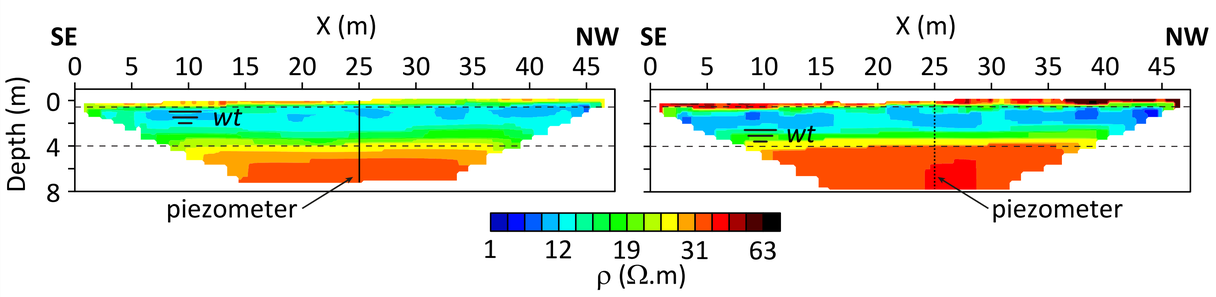
1D TIMELAPSE

Coll. : Mines ParisTech
Pasquet *et al.*, 2015 (JAG)

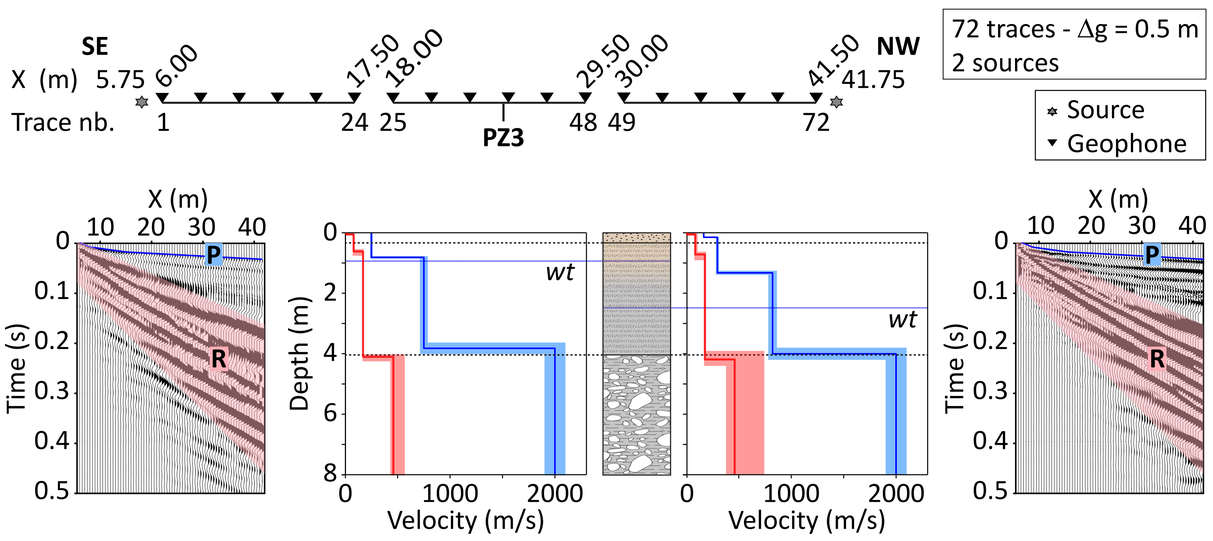
Orgeval experimental basin

Multi-layer aquifer system
Dense network of piezometer
Plateau area with tabular layers
Two distinct hydrological conditions

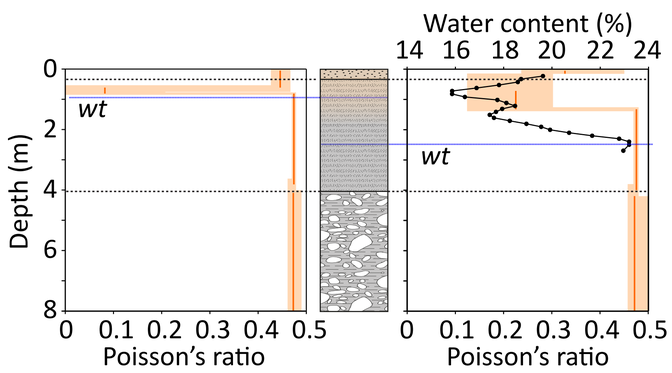
Mouhri *et al.*, 2013 (J. of Hydrol.)



Electrical resistivity tomography: 1D medium (soil / loess / limestone)



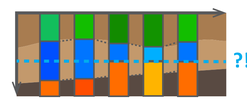
Seismic data interpretation: V_P => litho. limits + supplementary interface
V_S => litho. limits / no influence of water table



V_P / V_S and Poisson's ratio: Water table detection at high water
Low water => progressive increase of water content

FRACTURED AQUIFER

2D LATERAL VARIATIONS

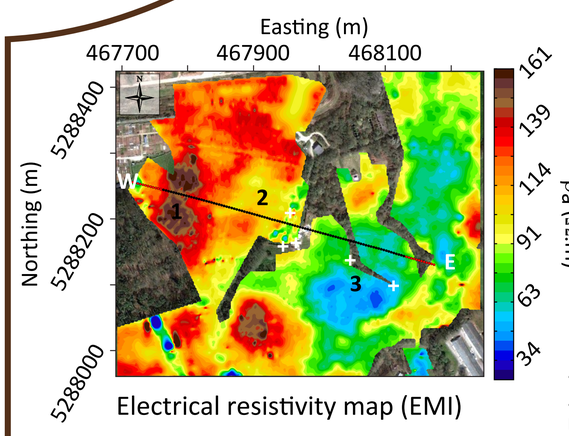


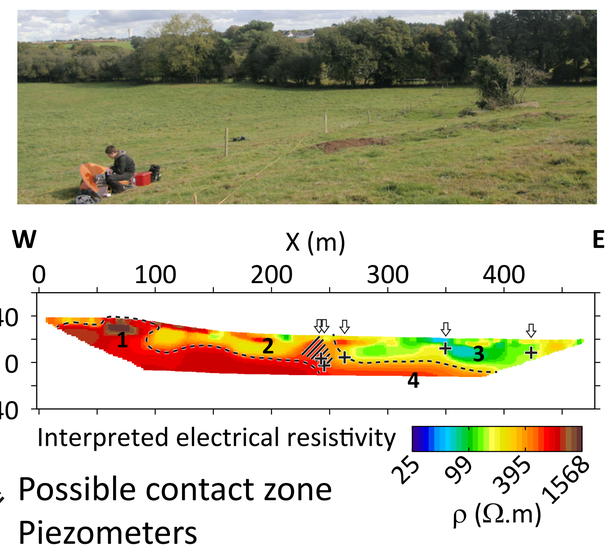
Coll. : Géosciences Rennes
Pasquet *et al.*, 2015 (NSG)

Ploemeur hydrological observatory

Productive fractured aquifer
Granite-micaschists contact and fault
Dense network of piezometric wells
Low permeability and porosity lithologies

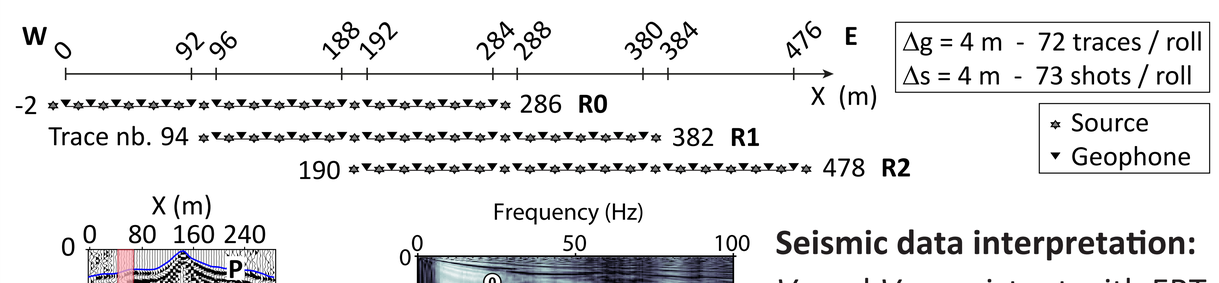
Ruelleu *et al.*, 2010 (JAG)





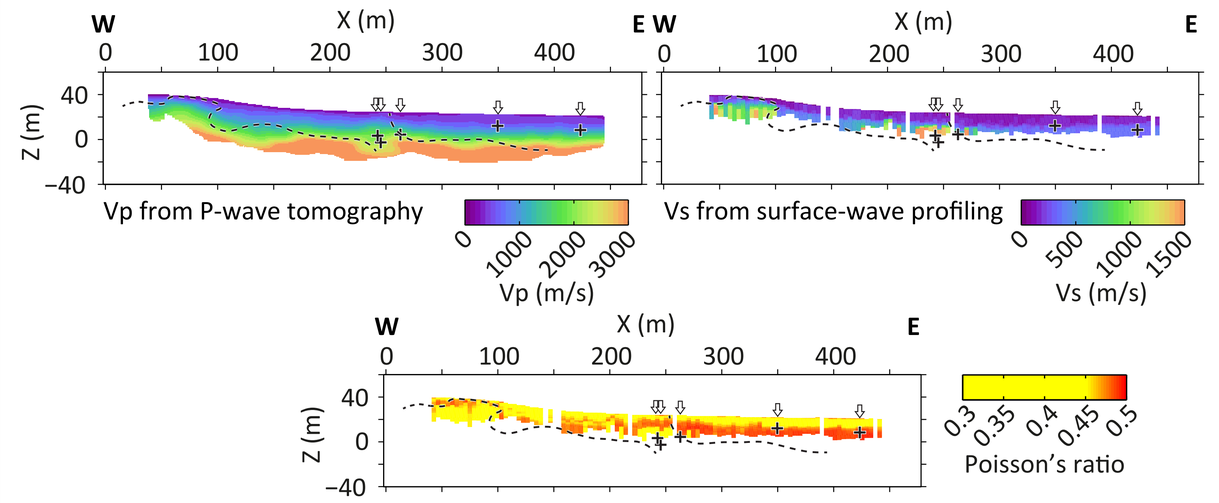
Interpreted geological structures:

1- Granite
2- Weathered granite
3- Clays
4- Micaschists
Possible contact zone
Piezometers



Seismic data interpretation:

V_P and V_S consistent with ERT
V_P => lateral contrasts - depth of investigation +
V_S => lateral contrasts + depth of investigation -



V_P / V_S and Poisson's ratio: Strong lateral contrasts consistent with ERT
Correlation with water table depth in clays (East)

CONCLUSIONS

Seismic methods are proposed for the hydrogeophysical characterization of the critical zone. A specific methodology has been developed for the combined exploitation of P- and surface waves present on seismic records. The use of this methodology in two distinct hydrogeological contexts allowed for estimating V_P/V_S ratio lateral and temporal variations consistent with *a priori* geological information and existing geophysical and piezometric data.

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References

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Ruelleu *et al.* (2010), *J. of App. Geophys.*, **70**