Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07500, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07500
EGU General Assembly 2008

Constraints on the permeability structure of surficial alluvial aquifers from P-wave sonic logs: methodological considerations and application to observed data

L. Baron and K. Holliger

Faculty of Earth and Environmental Sciences, University of Lausanne, Switzerland
(ludovic.baron@unil.ch)

Biot's theory predicts a frequency-dependence of the P-wave seismic phase velocity in porous saturated media. Based on this theoretical framework, two end-member-type, asymptotic P-wave phase velocities can be evaluated for a given set of petrophysical parameters. These asymptotic P-wave phase velocities correspond to the hypothetical cases of seismic waves propagating at infinitely low and infinitely high frequencies. Since the transition between these end-member-type velocities depends largely on the hydraulic properties of the probed media, this may open the perspective of obtaining estimates of the permeability structure from broad-band seismic measurements. Modern slim-hole sonic logging tools designed for relatively shallow environmental and engineering applications allow for making P-wave phase velocity measurements over a remarkably wide frequency band ranging typically from less than 1 kHz to more than 30 kHz. Methodological considerations and numerical modeling for typical unconsolidated, water-saturated deposits indicates that in a number of realistic situations the observable P-wave velocity dispersion in this frequency range may be sufficiently pronounced to allow for obtaining reliable first-order estimates of the underlying permeability structure. These methodological results and predictions are then tested with regard to a pertinent case study. The results available to date indicate that for the considered data the possibility of estimating the permeability from the dispersion of P-wave sonic log velocities seems to be limited to certain regions along the borehole.

Our results do, however, also indicate that the thus obtained permeability estimates are remarkably consistent with corresponding estimates obtained through more traditional hydrological techniques.