Geophysical Research Abstracts,
Vol. 11, EGU2009-13500, 2009
EGU General Assembly 2009
© Author(s) 2009

Frequency-dependent analysis of the relationship heterogeneities/anisotropy for seismic waves

C. Barnes
University of Cergy-Pontoise, Department of Geosciences and Environment, F-95000, Cergy-Pontoise, France (cbarnes@club-internet.fr)

The observation scale is a main issue when studying solid matter and in particular geomaterials as they often exhibit multi-scale structures. The use of effective medium theory, when trying to account for experimental observations, is generally motivated by the need for a simple framework and sometimes by the limited quantity of data available. In geophysical prospecting, two fundamental features should be distinguished: (1) the effective medium, which is based on statistical average of a given physical parameter or observation (related to the notion of averaging volume), for instance the mean flow through a porous rock due to a fluid pressure gradient, and (2) the equivalent medium, which is related to intrinsic limitations of the physical phenomena used to investigate the material, for instance the spectral resolution of the band limited seismic waves. In this latter case, scaling problems are expected when using different wavelengths, and difficulties typically arise in oil exploration when trying to match material properties estimated from well seismic to those derived from sonic logs.

As a consequence, investigating the relationship between heterogeneity and anisotropy at different scales for seismic waves in geomaterials leads naturally to a frequency-dependent analysis.

In our presentation, we will focus on one of the question of the session summary: "When only few data are acquired along different directions, what may be used to decide if the observed anisotropy is representative of the medium investigated or if it results from the presence of some heterogeneity?"

We propose a numerical approach based on 2D finite-difference discretization of the elastic anisotropic seismic wave equation for an experimental layout which resembles an azimuthal velocity analysis on centimetric samples. We first study standard models to check that our approach is consistent with theoretical works. Then we study for different frequencies (including infinite using a travel time method based on Eikonal equation) the azimutal travel time response for a complex sample composed of anisotropic and isotropic parts, and small and large objects with preferred orientations.