Geophysical Research Abstracts, Vol. 8, 07303, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07303

Approximation of elastic wave velocity versus pressure trends in cracked rocks by means of model functions

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The elastic behaviour of cracked rocks as a reaction on confining pressure is mainly controlled by the progressive closure of pores and microcracks ('extrinsic' effects) and by the rock fabric with the mineral textures as the most important subfabric ('intrinsic' effects). In an experiment, the velocity - pressure trend is characterized by rapid non-linear increase of the elastic wave velocities at low pressures as a consequence of the 'extrinsic' effects, and a much smaller linear increase at higher pressures due to the 'intrinsic' effects. Since actual equipment for the measurement of the elastic wave velocities is often restricted to low pressures, extrapolation of velocity trends to pressures beyond the measuring range may be desirable.

Several model functions proposed for approximation of velocity - pressure trends were inspected with respect to their suitability for extrapolation. All of them led to more or less erroneous extrapolated velocities. Improvements may be achieved by modification of particular relations, however, estimates of the 'intrinsic' velocity trend remain erroneous. In an alternative approach we take advantage of the observation that the 'intrinsic' velocity trend - derived from the fit of suitable model functions to the experimental data - changes systematically in dependence on maximum pressure in the fit. It will be demonstrated that the 'true intrinsic' velocity trend may be estimated well from observed systematic trend changes.