Field Equations for Deformable Porous Media with Spatially Varying Porosity

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Macroscopic equations of motion for inhomogeneous porous media are constructed by volume averaging pore scale equations. The porous medium considered, consists of an elastic solid with interconnected void spaces filled with a chemically inert viscous fluid. The two constituents are assumed homogeneous in their material properties, but the porosity (and other macroscopic parameters) may be spatially varying. Points of contact with Biot's(1962) work are established and utilized. The two systems of equations are found to have some distinct differences.

This theory is used to construct a complete set of equations which describe low frequency seismic phenomena in a porous medium that is inhomogeneous and anisotropic. In particular the unperturbed porosity may be spatially varying, and it is seen that the volume averaging procedure naturally leads to terms proportional to the porosity gradient. Because of anisotropy the parameters are generally tensorial. All tensorial parameters of second rank, in particular and are symmetric. This conclusion is arrived at by comparing with the work of Biot (1962), where he invokes the concepts of a macroscopic dissipative function and kinetic energy density. The number of independent components of this tensor is reduced to a manageable 15, in the most general case.

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