

**Berryman, James G.**

**Geomechanical analysis with rigorous error estimates for a double-porosity reservoir model.**

(English) [Zbl 1140.74436](#)

*Int. J. Numer. Anal. Methods Geomech.* 30, No. 5, 441-453 (2006).

Summary: A model of random polycrystals of porous laminates is introduced to provide a means for studying geomechanical properties of double-porosity reservoirs having one class of possible microstructures. Calculations on the resulting earth reservoir model can proceed semi-analytically for studies of either the poroelastic or transport coefficients, but the poroelastic coefficients are emphasized here. Rigorous bounds of the Hashin-Shtrikman type provide estimates of overall bulk and shear moduli, and thereby also provide rigorous error estimates for geomechanical constants obtained from up-scaling based on a self-consistent effective medium method. The influence of hidden (or presumed unknown) microstructure on the final results can then be evaluated quantitatively. Detailed descriptions of the use of the model and some numerical examples showing typical results for the double-porosity poroelastic coefficients for the type of heterogeneous reservoir being considered are presented.

**MSC:**

[74F10](#) Fluid-solid interactions (including aero- and hydro-elasticity, porosity, etc.)

[74L10](#) Soil and rock mechanics

[74Q20](#) Bounds on effective properties in solid mechanics

**Keywords:**

[double-porosity](#); [up-scaling](#); [multiscale modelling](#); [semi-analytical methods](#)

**Full Text:** [DOI Link](#)

**References:**

- [1] The Theory of Composites. Cambridge University Press: Cambridge, U.K., 2002; 77–78, 163, 457–498. · [Zbl 0993.74002](#) · [doi:10.1017/CBO9780511613357](#)
- [2] Random Heterogeneous Materials: Microstructure and Macroscopic Properties. Springer: New York, 2002. · [Zbl 0988.74001](#) · [doi:10.1007/978-1-4757-6355-3](#)
- [3] Hill, Proceedings of the Physical Society of London A 65 pp 349– (1952)
- [4] Lehrbuch der Kristallphysik. Teubner: Leipzig, 1928.
- [5] Reuss, Zeitschrift für Angewandte Mathematik und Mechanik 9 pp 49– (1929)
- [6] Hashin, Journal of the Mechanics and Physics of Solids 10 pp 343– (1962) · [Zbl 0102.17401](#)
- [7] Berryman, Journal of Geophysical Research 107 (2002)
- [8] Berryman, Journal of Geophysical Research 100 pp 24611– (1995)
- [9] Berryman, Journal of the Mechanics and Physics of Solids 53 pp 2141– (2005)
- [10] Cribb, Nature 220 pp 576– (1968)
- [11] Berryman, Geophysics 56 pp 1950– (1991)
- [12] Levin, Mechanics of Solids 2 pp 58– (1967)
- [13] . On micromechanics of inelastic and piezoelectric composites. In Theoretical and Applied Mechanics 1996, , (eds). Elsevier Science: Amsterdam, 1997; 65–81.
- [14] Lewallen, International Journal of Solids and Structures 35 pp 4845– (1998)
- [15] Biot, Journal of Applied Mechanics 24 pp 594– (1957)
- [16] Skempton, Geotechnique 4 pp 143– (1954)
- [17] Gassmann, Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich 96 pp 1– (1951)
- [18] Berryman, ASCE Journal of Engineering Mechanics 128 pp 840– (2002)
- [19] Backus, Journal of Geophysical Research 67 pp 4427– (1962)
- [20] Postma, Geophysics 20 pp 780– (1955)

- [21] Transversely isotropic poroelasticity arising from thin isotropic layers. *Mathematics of Multiscale Materials*, , , (eds). Springer: New York, 1998; 37–50. · [Zbl 0938.74018](#) · [doi:10.1007/978-1-4612-1728-2\\_3](#)
- [22] Berryman, *Journal of Applied Physics* 96 pp 4281– (2004)
- [23] Peselnick, *Journal of Applied Physics* 36 pp 2879– (1965)
- [24] Watt, *Journal of Applied Physics* 51 pp 1525– (1980)
- [25] Berryman, *Geophysical Journal International* 127 pp 415– (2004)
- [26] Effects of stress, pore pressure, and pore fluids on bulk strain, velocity, and permeability in rocks. Ph.D. Thesis, Massachusetts Institute of Technology, Cambridge, MA, 1984.
- [27] Hashin, *American Institute of Aeronautics and Astronautics Journal* 4 pp 1411– (1966) · [Zbl 0145.45205](#) · [doi:10.2514/3.3686](#)
- [28] Hashin, *Applied Mechanics Reviews* 50 pp 481– (1983) · [Zbl 0542.73092](#) · [doi:10.1115/1.3167081](#)
- [29] Vinogradov, *Journal of the Mechanics and Physics of Solids* 53 pp 1248– (2005)
- [30] Pride, *Journal of Geophysical Research* 109 pp b01201– (2004)

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.