The Maurice A. Biot Lecture

Department of Civil Engineering & Engineering Mechanics, Columbia University
Engineering Mechanics Committee, ASCE Metropolitan Section
Engineering Mechanics Institute, ASCE

THE EFFECTS OF PORE STRUCTURE, PORE FLUID, STRESS, AND FREQUENCY ON ELASTIC WAVESPEEDS IN SANDSTONES

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Abstract: The speeds at which elastic waves travel through fluid-saturated porous rocks will depend on the mineral composition of the rock, the pore geometry, and the pore fluid properties. Since the pore structure of a rock varies with the external stress and fluid pressure, the wavespeeds will vary with stress. Additionally, since the ability of the pore fluid to contribute to the elastic stiffness of the rock-fluid system depends on the ease with which the fluid can move into or out of a pore as it is being compressed by a passing wave, the wavespeeds will also be functions of the pore fluid viscosity, and wave frequency. In this talk, I will discuss models to relate the wavespeeds to the various parameters mentioned above, show comparisons with experimental data on sandstones, and make some comments about Gassmann's and Biot's contributions to this problem.

Biosketch: Robert Zimmerman is Professor of Rock Mechanics in the Department of Earth Sciences at Imperial College, London. He received a BS and MS in mechanical engineering from Columbia University, and a PhD in continuum mechanics from the University of California at Berkeley. He has been a lecturer at UC Berkeley, a staff scientist at the Lawrence Berkeley National Laboratory, and Head of the Division of Engineering Geology and Geophysics at the Royal Institute of Technology in Stockholm. He is Editor-in-Chief of the International Journal of Rock Mechanics and Mining Sciences, and is also on the Editorial Boards of Transport in Porous Media, and the International Journal of Engineering Science. He co-author, with J. C. Jaeger and N. G. W. Cook, of the definitive monograph "Fundamentals of Rock Mechanics", 4th ed. (Wiley-Blackwell, 2007), and author of the monograph "Compressibility of Sandstones" (Elsevier, 1991). In 2010 he received the Maurice A. Biot Medal for Poromechanics from the American Society of Civil Engineers, for "his outstanding contributions in applying poroelasticity to rock mechanics and fluid flow in fractured media". His papers and books have received over 7000 Google Scholar citations.

The Maurice A. Biot Lecture was established at Columbia University in 2004 in remembrance of the late Professor Maurice Anthony Biot and his renowned achievements as an engineer, physicist, and applied mathematician. Biot was a professor of mechanics at Columbia University in the period 1937-1945.

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