



2007-08 AAPG Distinguished Lecture

Abstract

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Fractured Reservoir Characterization: From Diagenesis and Fracture Mechanics to Reservoir Permeability

This talk describes how core-based diagenetic observations and mechanical properties measurements can be used to constrain natural fracture network geometry and flow properties in clastic rocks. A methodology is described that starts with optical microscopy and SEM-based cathode luminescence, relating pore-space diagenesis to fracture-filling cements. Geomechanical modeling of fracture pattern development and opening rate is constrained by anisotropic strain boundary conditions,

mechanical layer thickness, and core-based fracture mechanics property measurements. Permeability calculations are made on a wide variety of fracture pattern geometries, including the effects of fracture pattern connectivity, heterogeneous aperture distributions, and the degree of aperture occlusion by mineralization. It is demonstrated that fractured rock permeability assessment can be improved with quantifiable geologic fracture attributes.

A Geologist's Guide To Explaining Natural Fracture Phenomena with Fracture Mechanics

This is a review talk designed to introduce a geologic audience to the concepts of fracture mechanics and how they can be applied to make conceptual and quantitative interpretations of natural fracture phenomena. Examples are driven by outcrop and core observations and explained conceptually with simple analytical equations from fracture mechanics. More complex fracture relationships are briefly treated using numerical model results. The talk focuses on opening mode fractures (joints, veins, dikes) and how fracture mechanics can be used to predict their geometric attributes.

Examples include the relationship between in situ stress anisotropy and propagation paths, theoretical predictions of fracture length, spacing and aperture versus length distributions, the role of subcritical (stress corrosion) cracking on fracture clustering, and the concept of natural hydraulic fracturing. The influence of simultaneous diagenesis and fracture growth will also be discussed in the context of preserved fracture aperture (e.g., how does a fracture stay open when the driving stress is gone?).

American Association of Petroleum Geologists

An International Geological Organization

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Jon Olson

Education:

- 1991 Ph.D., Applied Earth Sciences, Stanford University
1984 B.S., Civil Engineering, B.S., Earth Sciences, University of Notre Dame

Experience:

- 2002-Present Associate Professor, Department of Petroleum and Geosystems Engineering, The University of Texas at Austin
1995-2002 Assistant Professor, Department of Petroleum and Geosystems Engineering, The University of Texas at Austin
1989-95 Research Engineer, Mobil Research and Development Corporation, Dallas, TX



Publications and Awards:

2005 Michel T. Halbouty '30 Visiting Chair in Geology and Geophysics, Texas A&M University

Authored or co-authored over 40 journal and conference proceeding papers.

Five publications relevant to the lecture:

Olson, J. E. 2007. "Fracture aperture, length and pattern geometry development under biaxial loading: a numerical study with applications to natural, cross-jointed systems". In: Fracture-Like Damage and Localisation (edited by Couples, G & Lewis, H.). Geological Society of London, Special Publications.

Philip, Zeno, Jennings, James, Olson, Jon, Laubach, Stephen and Holder, Jon, 2005, "Estimating Permeability Multipliers for Reservoir Flow Simulation from Geomechanically Simulated, Weakly

- Connected, Fracture Networks," SPE Reservoir Evaluation and Engineering, 8(4), p. 300-309.
Laubach, S. E., Olson, J. E., and Gale, J., 2004, "Are open fractures necessarily aligned with maximum horizontal stress?" Earth & Planetary Science Letters, v. 222 (1), p. 191-195.
Olson, Jon E., 2003, "Sublinear scaling of fracture aperture versus length: an exception or the rule?," Journal of Geophysical Research, v. 108(B9), Art. No. 2413.
Hennings, Peter H., Olson, Jon E., and Thompson, L. B., 2000, "Combining Outcrop and 3-D Structural Modeling to Characterize Fractured Reservoirs: An Example from Wyoming," American Association of Petroleum Geologists Bulletin, p. 830-849.

Professional Memberships

Society of Petroleum Engineers
American Geophysical Union

Professional Interests:

Involved in a wide range of petroleum and geoscience related research and education, including interdisciplinary geology and engineering efforts and K-12 outreach.

Research interests focus on two primary topics: 1) the characterization of naturally fractured reservoirs, incorporating geomechanics, diagenesis, structural geology and spatial scaling, and 2) the application of geomechanics to solving drilling, completion and production related problems.

Co-director of the Fracture Research and Application Consortium (FRAC) at UT-Austin.