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Predicting Size and Why it Matters: A Structural Diagenesis Approach to Fracture Prediction

Stephen Laubach, Senior Research Scientist
Bureau of Economic Geology, The University of Texas at Austin,
University Station Box X, Austin TX 78713-8924
http://www.beg.utexas.edu/frac/index.php
http://www.jsg.utexas.edu/sdi/

Abstract: Fracture length, height and aperture are key attributes needed for accurate permeability prediction. The longest and tallest fractures are also most likely to interact with and influence the growth of engineered hydraulic fractures. The inherent limitations of core and wellbore observations preclude sampling fracture length or systematically sampling height. Yet even the largest fractures may be below the detection limits of seismic. Extrapolations from subsurface observations or models closely constrained by the mechanical properties, rock dimensions and strains existing in the subsurface have the marked advantage of being relevant to the subsurface rocks of interest. The advantage of outcrops is that sometimes you can see the features of interest. Although outcrops provide a window on fracture size patterns, outcrops have limited dimensions, variable and incomplete exposure, and burial-structural-thermal histories that differ, in some cases substantially, from those of the subsurface rocks of interest. Moreover, outcrops commonly contain prominent fractures formed during uplift or under near-surface conditions that must be separated from fractures likely representative of subsurface conditions. The consequence is that outcrops are attractive sources of information about fracture attributes that cannot be directly measured in the subsurface, but they may be biased or worse: they can be utterly misleading. But with structural diagenetic information from fracture cements, outcrops can be reliably and accurately tied to subsurface situations. Outcrop fracture size studies reveal surprising fracture size patterns that are not independent of diagenetic pathway, suggesting some new routes to accurate fracture size prediction that go beyond statistics or mechanics.

Speaker Bio: Stephen E. Laubach is a Senior Research Scientist at the Bureau Economic Geology where he leads the fracture and structural diagenesis programs, a research and training paradigm in sedimentary geochemistry and structural geology (see Journal of Structural Geology, 2010, v. 32, p. 1866-1872). Dr. Laubach's research interests include unconventional and fractured reservoirs, and microstructural, fluid inclusion and cathodoluminescence applications to structural geology and sedimentary petrology. Dr. Laubach also supervises graduate student research in the Jackson School of Geosciences. Dr. Laubach served as AAPG Elected Editor and a member of the AAPG Executive Committee from 2010-2013. He is past chair of the Jackson School's Energy Geoscience Education and Research Group and served as a Co-opted Member of the Petroleum Group Committee of the Geological Society of London (from 2008 to 2012). He was a Distinguished Lecturer for the American Association of Petroleum Geologists in 2011-2012 and Distinguished Lecturer for the Society of Petroleum Engineers in 2003-2004. He was a member of the Committee to Assess the Science Proposed for a Deep Underground Science and Engineering Laboratory, National Research Council, 2010-2011 and the Committee on Advanced Drilling Technologies, National Research Council, 1992-1994. He served as co-Chairman of the First North American Rock Mechanics Symposium in 1994. He received his Ph.D. from the University of Illinois-Urbana in 1986 and a B.S. from Tufts University in 1978.

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