Hydraulic Stimulation and *In Situ* Stresses

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Prof. Maurice Dusseault, Ph.D., P.Eng., Professor of Geological Engineering Department of Earth and Environmental Sciences, University of Waterloo, Waterloo ON Canada, will speak on Thursday, August 19, 2021.

The topic is "Hydraulic Stimulation and In Situ Stresses."

Abstract

M. King Hubbert noted the importance of *in situ* stresses in hydraulic stimulation over 60 years ago, and his conclusion that *in situ* stress is the primary factor in hydraulic stimulation and induced fracture propagation remains valid. *In situ* stresses govern the placement of dikes and sills in volcanic and igneous processes, and the eruptive growth of continental spreading centers, such as the one that bisects Iceland, is understandable only in terms of hydraulic fracturing and *in situ* stresses.

The presentation will touch briefly upon several hydraulic stimulation subjects related to the orientation and distribution of *in situ* stresses.

A. Hydraulic fractures in nature. What is a dike? A laccolith?
B. Hydraulic parting or hydraulic fracture? Is opening a pre-existing joint "fracture" or "parting"?
C. Why do hydraulically induced fractures rise?
D. Why might they stop rising? Is "risk of fracture to the surface" ever possible? (Yes, but rare)
E. What about induced seismicity during stimulation? Is *in situ* stress governing this process? (Yes)

F. Are there new ideas out there on how to quantify stress state quickly from borehole data? (Yes)

Knowledge of the *in situ* stress state constitutes one of most important inputs to the design of stimulation activity and understanding of paleostresses helps geotectonic experts deconvolve the past. However, when we do stimulation, we must also acknowledge the importance of natural rock mass fabric (joints, natural fractures…), especially in rocks that are inherently stiff and strong. We must acknowledge the importance of hydraulics and fluid flow as well. These all interact and affect stimulation activities. Understanding the interactions will improve your outcomes in the field.

Brief Intro to Maurice B. Dusseault

Maurice is a Professional Engineer and Professor of Geological Engineering at the University of Waterloo, where he has taught and carried out geomechanics research since 1982. His research focuses on deep subsurface engineering issues including oil production, hydraulic stimulation, energy storage, geothermal energy, carbon sequestration, and deep injection disposal of granular solids and liquid wastes. He holds over 90 international patents and has about 600 full-text papers published in journals and conferences. Maurice is a well-known educator and consultant, an advisor to companies and governments on matters relating to energy development, hydraulic stimulation, energy geostorage, wellbore integrity, technology, and innovation. Maurice is deeply interested in energy technologies that scale to community levels to provide robust and reliable heat and power. These include integrating natural gas, hydrogen, compressed air energy storage, and heat geo-storage.

Another important component of his research is environmental geomechanics: safe and permanent sequestration of carbon (CO2, petcoke, biosolids…), particulate solid slurries, and waste fluids through injection deep into sedimentary strata. Maurice is also an entrepreneur, having started six companies over the years, most still in existence, and of course struggling to make headway in difficult conditions.