Shale Gas GeoEngineering

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COURSE DESCRIPTION

The shale gas industry has made great strides in North America in the last five years; costs of drilling and fracturing a well are 60% of what they used to be, the success of hydraulic fracturing and re-fracturing is improving, and shale gas continues to be profitable despite low oil and gas prices. Fundamental to the success of a shale gas project is knowing the quality and characteristics of the resource, choosing the best development approach and evaluating the results in a science and economics framework. The geoscience foundation of shale gas reservoir knowledge will be presented, giving the participant a broad knowledge of the geoscience models, essential information that must be collected, and the methods of collecting it to yield valuable engineering information. Then, the course will focus on developing a strong qualitative and semi-quantitative understanding of hydraulic fracturing mechanisms in naturally fractured rocks. Because the basis of a successful stimulation design is understanding rock mechanics and hydraulics, this course will focus on the geomechanics aspects of fracturing using injection fluids such as slickwater or viscosified fluids to carry proppants.

Participants will receive a library of shale gas publications, all of the presentation materials in PowerPoint format, and a great deal of valuable guidance in how to establish a geoscience and geoengineering framework that will lead to better economic results in the long term. Although the presentation is not based on mathematical developments and modeling, useful information that may help understand modeling will be discussed.

The reason you should attend this course if you will work in this area is to expand and refine your conceptual mechanical understanding of how hydraulic fractures behave in the real world. This will guide expectations for modeling and help in the interpretation of measurements that are used to monitor fracture propagation. This strong focus on a physical understanding of the mechanics will help you in the design and execution of fracture stimulation of unconventional reservoirs. Even though the focus is on shale gas, the knowledge is easily transferred to shale oil development and tight gas reservoirs.

The course will focus on North American experience where the shale gas industry is highly developed. However, there remains a great deal to be learned to improve results, and to transmit that knowledge to other jurisdictions that stand to benefit economically from the development of the natural gas found in low permeability strata. Some countries outside of North America have begun to more deeply study and start developing their shale gas resources (China, Australia); other countries are in the early stages of resource evaluation and trial drilling (UK, Germany,

Poland, Argentina, Denmark to name a few); and yet other countries, for political reasons, have "banned" hydraulic fracturing at this point (France, Italy).

In Canada, the Western Provinces have vast shale gas resources, sufficient to supply Canada's current needs for many hundreds of years. Those resources are being slowly developed (pending export facilities for LNG), but fracturing moratoria are in place in several eastern provinces (Quebec, New Brunswick, Nova Scotia, Newfoundland). The political evolution of these moratoria and how the technical and social issues are being addressed will also be described because the course instructor has been implicated in hydraulic fracturing assessments in all of these eastern provinces.

AGENDA

First Day, 25 June

08:30 – 10:00 1: **Shale Gas Geoscience**: Major shale gas plays in North America
10:00 - 10:15 Coffee
10:15 – 12:00 2: **Shale Gas History**: Shale gas development in the USA and Canada: Why all the fuss?
12:00 – 13:00 Lunch Hour
13:00 – 14:45 3: **Rock Properties**: Geomechanical and petrophysical properties of shale gas reservoirs
14:45 – 15:00 Coffee
15:00 – 17:00 4: **Earth Stresses**: Defining the initial conditions and rock mass characteristics

Second Day, 26 June

08:30 – 10:15 5: **Basic HF Mechanics**: Rise, extension, viscosity, rate, impact of rock properties
10:15 - 10:30 Coffee
10:30 – 12:00 6: **HF in NFR's**: HF behavior in naturally fractured reservoirs, including stress shadowing
12:00 – 13:00 Lunch Hour
13:00 – 15:00 7: **Modeling**: Complexity, expectations, uncertainty, approaches and some results
15:00 – 15:15 Coffee
15:15 – 17:00 8: **Designing for Success**: Monitoring, verification, stress field evolution during production, refracturing issues, new concepts and directions in HF

INSTRUCTOR

Maurice Dusseault, Professor of Geological Engineering, Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, Ontario, Canada

After flunking out of university and working as a roughneck for several years on the drilling rigs, Maurice returned to school and graduated from the University of Alberta in Edmonton, taught there for five years, then moved to Waterloo in 1982. Maurice carries out research in coupled problems in geomechanics including thermal and non-thermal oil production, wellbore integrity, deep disposal technologies for solid and liquid wastes, hydraulic fracture mechanics, CO_2 sequestration in saline aquifers, shale gas and shale oil mechanics, and compressed air energy storage in salt caverns. He holds over 75 international patents covering about six different technologies, and has co-authored two textbooks and over 530 full-text conference and journal articles. Maurice is a well-known instructor of professional short courses and currently works as an advisor on technology in Alberta, Quebec, New Brunswick and Newfoundland. He has served on expert review panels at the provincial and federal levels, evaluating risks associated with petroleum industry technologies. He is an ARMA Fellow.

Current projects are focused on:

- Hydraulic fracturing;
- Wellbore integrity and gas seepage;
- Compressed air energy storage in salt caverns;
- Enhanced geothermal energy systems;
- Deep disposal of solid and liquid wastes and CO_2 sequestration; and
- Induced seismicity.