INTRODUCTION TO APRIL FOCUS:
Induced Seismicity

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Microseismic monitoring in the oil and gas industry is the process whereby typically low magnitude seismic events (below ~1 moment magnitude) are detected and located in the subsurface during hydraulic fracturing utilizing downhole, surface or shallow subsurface arrays. Many definitions have used wording such as small scale or micro earthquakes which technically could have a negative impact on our community and probably should be reassessed. According to the Oxford dictionary, earthquakes are defined as “A sudden violent shaking of the ground, typically causing great destruction, as a result of movements within the earth’s crust or volcanic action”.

Induced Seismicity in the oil and gas industry in Canada evolved from microseismic monitoring; that is, Induced Seismicity Monitoring (ISM) can be considered an application of microseismic monitoring. ISM is more of a sparse surface microseismic monitoring array, meaning ISM generally has less receiver points than surface/subsurface shallow arrays. Although there are similarities between ISM and microseismic monitoring, their objectives can differentiate them somewhat. ISM focusses mainly on detecting and locating larger magnitude events in the order of 1 to greater than 4 moment magnitude, whereas microseismic monitoring involves smaller events of less than ~1 moment magnitude. There can certainly be an overlap in the scales mentioned here for ISM and microseismic monitoring.

Microseismic and/or ISM are probably the best indicators of how effective the hydraulic fracturing is performing. However, they are not recommended to serve as a standalone solution and must be integrated with other disciplines, such as traditional seismic, geology, horizontal logging, geomechanics, petrophysics and engineering to understand how the subsurface reacts to the input of energy from hydraulic fracturing.

The articles in this special edition address the advancements of ISM in the present day and how essential it is to economically monitor hydraulic fracturing operations for large magnitude events that may be caused by drastic or sudden changes in the stress regime, sometimes resulting in fault reactivation.

“Injection-Induced Seismicity: End of the Beginning?” (Shawn Maxwell, 2018) highlights the progress of ISM in North America and the collaboration that exists among operators, academia and societies. As indicated in this article, these improvements are as a result of collaboration, integration, communication, transparency, and trust.

“Ranking Operation Scenarios for Effective Mitigation of Hydraulic Fracture-Induced Seismicity” (Shawn Maxwell et al., 2018) introduces the now popular traffic light protocols that were implemented by various governing bodies over the last few years and which eventually influenced the deployment of ISM arrays over seismically active plays in North America. This paper reviews some mitigating steps in hydraulic fracturing projects, which include operational changes such as volume reduction, rate reduction, shutting in/flowing back, skipping stages, changing fracture system, changing completion design and changing well design.

“Economics of Induced Seismicity. Trying to identify faults in the horizontal well planning stage” (Schulte 2018) describes the need to better understand the fault regime, which may have additional cost implications if additional analyses are implemented. Higher density acquisition techniques, depth imaging, diffraction imaging, frequency enhancement, noise attenuation and structural attributes are some techniques that can be used to better understand the subsurface to manage induced seismicity.

I sincerely thank the authors and co-authors for their efforts in providing these excellent articles. I hope these articles will provide clarity and insights on Induced Seismicity in North America as we adapt to the challenges in this ever-changing industry of hydraulic fracture monitoring.

Wendell Pardasie is a Senior Geophysicist with over 15 years’ experience. He is responsible for the technical sales/business development for microseismic and borehole seismic in Schlumberger Canada, based in Calgary. Previously he was Senior Geophysicist for Calmena/ApexHi-Point (now SigmaCubed), where he was formally introduced to the world of microseismic and its applications. Mr. Pardasie has worked as a Geophysicist/Explorationist at Talisman Energy (now Repsol) and as a Geoscientist for Paradigm, both based in Calgary, Canada. Prior to this, Mr. Pardasie worked as a Senior Geophysicist in the Ministry of Energy, Trinidad and Tobago, where he was involved in offshore seismic acquisition, processing and interpretation for large multinational oil and gas operators on behalf of the Government of Trinidad and Tobago.

Mr. Pardasie holds a BSc. (1st class honors) in Physics with a minor in Mathematics from the University of the West Indies, Trinidad and Tobago, as well as a MSc Geophysics from the University of Alberta, Canada. Mr. Pardasie has been an active member in the CSEG for over 15 years.