

## GSA MONTHLY LUNCHEON

OCTOBER 2021

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**TITLE**            **Hydraulic fracturing-induced seismicity and aseismic slip**

**SPEAKER**        *Thomas Eyre, University of Calgary/ASEISMIC Solutions Inc.*

### **ABSTRACT**

Subsurface fluid injection arising from industrial processes such as hydraulic fracturing has induced moderate earthquakes with potential to cause damage. Earthquake fault activation is typically ascribed to elevated pore pressure or increased shear stress due to the effects of poroelastic diffusion or stress loading. However, these mechanisms are incompatible with high-resolution observations of induced seismicity during microseismic monitoring of hydraulic fracturing in western Canada. Additionally, underground experiments and rate-state frictional models predict stable sliding (aseismic slip) on faults that penetrate rocks with high total organic carbon (TOC) or elevated clay content. An alternative model was therefore proposed, in which distal, unstable regions of a fault are loaded by aseismic slip on stable regions of the fault stimulated by hydraulic fracturing. The model was tested through numerical simulations, and further evidence has since emerged of significant slow slip events during hydraulic fracturing operations. This model has significant implications in terms of mitigating induced seismicity, as it suggests that there may be a potentially measurable deformation signal tens of hours before earthquake nucleation. Improved understanding of fundamental processes of fault activation during hydraulic fracturing is key to developing effective monitoring and mitigation strategies and could also help to inform models for natural earthquake triggering.

### **PRESENTER BIO**



Dr. Thomas Eyre is a research seismologist with over 10 years of experience. He holds a Research Associate position at the University of Calgary and is also a cofounder of ASEISMIC Solutions Inc., a new university spinoff company. His current research focuses on the development of a software tool for induced seismicity risk mitigation. He has a PhD in volcano seismology from University College Dublin, Ireland, and has held postdoctoral fellowships at the University of Alberta and University of Calgary, Canada, where his research has focused on the source mechanisms of induced seismicity and microseismicity related to hydraulic fracturing. He has 11 peer-reviewed publications in leading international journals and has presented at numerous international conferences and workshops, including the SEG Annual Meeting 2020, where his presentation was selected as one of the top 25 talks.