Microseismic Monitoring in Oil & Gas Reservoirs

5-6 Feb 2018

The Geophysical Institute of Israel, in collaboration with Seismik sro., are proud to host the 2018 Microseismic Workshop in Israel.

This 2 day workshop will provide its participants with a deep understanding of the emerging technologies in induced seismicity and microseismicity and the uses of these methods in Oil and Gas.

Attendees will learn in depth about the different methods and limitations of monitoring, analysis and interpretation.

No prior knowledge required.

Leo Eisner, Ph.D.

Leo Eisner is a world leading geophysicist pioneering applied microseismics.

Leo graduated from the Charles University in 1995 (MSc) and Caltech in 2001 (Ph.D.). He spent six years as a Senior Research Scientist with Cambridge Schlumberger Research where he filed five patents and issued numerous publications.

Leo joined MicroSeismic, Inc. in 2008 and was promoted to the Chief Geophysicist in 2009. In 2010 he has accepted honorary position of Purkyne Fellow at the Academy of Sciences of the Czech Republic in Prague.

He is founder and president of seismic service company Seismik s.r.o. His peer reviewed articles (40+) and extended abstracts (70+) cover a broad range of subjects.

Register by 10 Jan 2018 to ensure your spot on this 2 full day event. Includes lunch and refreshments

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Register NOW to ensure your spot

Day 1

Principles of microseismic monitoring ranging from acquisition in a single monitoring borehole to surface and near surface networks to engineering applications of microseismicity. Case studies will be used to illustrate the main concepts. At the end of this class, attendees should be able to select the right kind of processing, design a survey and understand the uncertainties in the microseismicity.

Attendees will be able to understand and avoid interpretation of uncertain observations and gain insight in true information provided by microseismicity.

Social and scientific aspects related to felt seismicity near oil and gas reservoirs will be discussed including recent case studies.

Day 2

The course will also discuss the latest developments in microseismic applications from source mechanisms through anisotropy to engineering applications. The course will focus on what a geoscientist or engineer using microseismic information needs to know to make good decisions procuring, understanding and applying microseismic results and information in their work.

Intended Audience

Entry and Intermediate levels. The course is designed to be followed by anyone with a broad geoscience background and no prior knowledge in the field is required, although knowledge of hydraulic fracturing and seismology helps.

Attendee Outcomes

- Understand magnitude scaling and their uncertainties
- Mitigate hazards associated with induced seismicity
- Design an array for passive seismic (surface or downhole) monitoring and estimate uncertainties of locations for microseismic events
- Orient downhole geophones from a perforation or calibration shot, estimate approximate distance and depth of a recorded microseismic event
- Design a monitoring array that would allow avoiding of significant (felt) seismic events induced by hydraulic fracturing (traffic light system)
- Build a velocity model (P and S-wave) from a sonic log or check shot measurement suitable for microseismic monitoring
- Estimate source mechanism from surface microseismic monitoring

Digital Participation Certificate | Student Discount

VENUE: The GII offices, Ha'Beshet 6, Lod, Israel

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Workshop Schedule

Day 1 *5.2.2018*		
0800	0900	Registration and coffee
0900	0915	Opening remarks
0915	1045	**Session 1 – What is Microseismic?**
1045	1100	Break: tea & coffee
1100	1200	**Session 2 – Earthquakes**
1200	1330	**Session 3 – Overview of Monitoring Techniques**
1330	1430	Lunch
1430	1445	The GII Israel work and recent case study
1445	1545	**Session 4 – Magnitude**
1545	1600	Break: tea & coffee
1600	1700	**Session 5 – Engineering Applications**
1700	1830	**Session 6 – Induced Seismicity & Social Aspects**
Day 2 *6.2.2018*		
0800	0830	Organization and coffee
0830	1000	**Session 7 – Downhole Location Technique**
1000	1115	Break: tea & coffee
1115	1245	**Session 8 – Surface Monitoring Technique**
1245	1345	Lunch
1345	1515	**Session 9 – Source Mechanisms**
1515	1530	Break: tea & coffee
1530	1630	**Session 10 – Anisotropy**
1630	1800	**Session 11 – Recent Important Case Studies**
1800	1830	Workshop Summary

Fees	One Day	Both Days
Gov/Industry	280 NIS	**500 NIS**
Student	140 NIS	**250 NIS**

Fees include: VAT, Participation, Lunch, Tea and Coffee breaks and Certificate

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Detailed Session Description

Day 1 *5.2.2018*

1. **Introduction: What is Microseisimc?** Why do we perform microseismic monitoring? Definition of microseismicity, induced/triggered seismicity, a brief review of microseismicity outside of oil industry: water reservoirs, mining, geothermal. Oil reservoir production induced seismicity. Historical review of microseismicity in oil industry with focus on hydraulic fracturing (M-site, Cotton Valley, Barnett, etc.).
2. **Earthquakes**: number of unknowns, differences from active seismic. Instruments suitable for measuring earthquakes and their optimal parametrization. Earthquake location techniques. Relative locations. Location techniques.
3. **Downhole and Surface Arrays:** Downhole location technique: single well monitoring acquisition. Optimal design of downhole monitoring array. Detectability of downhole monitoring. Surface monitoring technique: Why do surface and near-surface microseismic monitoring.
4. **Magnitude:** Magnitude and seismic moment, energy of seismic events, Intensity and relative magnitudes. What is the b-value and how can we use it.
5. **Engineering applications of microseismicity**: Current use of microseismicity in the oil industry and implementation of microseismicity into modeling. Microseismic based completions evaluation. Diffusion model for pressure triggering of microseismic events.
6. **Seismicity in the vicinity of oil or gas reservoirs.** Theory and history of induced felt seismicity. Seismic moment and total injected volume. Blackpool case study as an example of induced seismicity. DFW seismicity case study. Oklahoma seismicity triggered by salt water disposal. Hazard assessment and mitigation. Social aspects associated with hydraulic fracturing.

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Detailed Session Description

Day 2 *6.2.2018*

7. **Downhole location technique**: S-P wave time and P-wave polarization technique location, P-wave and S-wave polarization. P-wave or S-wave only location from a single monitoring borehole. Horizontal monitoring boreholes. Picking strategies for downhole microseismic data. Orientation of downhole geophones/deviation surveys/velocity model calibration. Inclined/dual and multi well monitoring techniques. Check list for downhole monitoring.
8. **Surface monitoring technique**: Imaging of microseismic event using P-wave migration. Uncertainty associated with P-wave only locations: depth vs. origin time. Detection uncertainty and signal-to-noise ratio. Frequency content, attenuation and detection. Design of surface monitoring array. Calibration shots/velocity model building: isotropic vs. anisotropic velocity. Relative locations through cross-correlations and using S-wave from surface monitoring. Downhole and surface location case study. Near surface amplification. Check list for surface monitoring.
9. **Source mechanisms**: concept of source mechanism and why do we care about source mechanisms. Definition of the dip, the strike and the rake for a shear source. Description of shear, tensile, volumetric, CLVD source through moment tensor. Inversion for source mechanisms from single monitoring borehole/ multiple monitoring boreholes/ surface P-only data. Radiation pattern of typical source mechanisms.
10. **Anisotropy**: Introduction to anisotropy. Effect of anisotropic media on S-waves: shear wave splitting. Shear wave splitting observed in microseismic data. Inversion of anisotropic media from P and S-waves using microseismic events. P-wave anisotropy in surface monitoring data. Time-lapse changes in anisotropy.
11. **Review of recent important case histories**. Summary of microseismic pros and cons. Business considerations – microseismic timelines, deliverables, minimum standard. Relationship between microseismicity and hydraulic fracturing. The road ahead. Most important things to remember about microseismicity.

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