Seventh EAGE Workshop
on Passive Seismic
Outreach and Integration

27–29 March 2018
Kraków, Poland

Technical Committee
Stanislaw Lasocki co-chair (Institute of Geophysics PAS)
Ted Urbancic co-chair (ESG Solutions)
Grzegorz Kwiatek (GFZ Potsdam)
Antonella Orefice (Eni)
Pierre-Francois Roux (Baker Hughes)
Stefan Wiemer (ETH Zurich)
William Wills (Avalon Sciences)
Andreas Wuestefeld (NORSAR)
Ulrich Zimmer (Shell)
Welcome

On behalf of the organizing committee, we would like to invite you to Kraków for the seventh instalment of the EAGE Passive Seismic Workshop. Kraków has been a center of excellence in mining induced seismicity for decades, this makes it an ideal location to gather and discuss new insights into passive seismicity. Previous workshops have considered everything from the fundamentals of passive seismic monitoring, from surface to downhole, to the integration with geomechanics and new technologies such as DAS and InSar as primarily related to reservoir behavior. The Kraków workshop, with its historical perspective, will also focus on understanding how passive seismic monitoring is used in various industrial applications, from mining to petroleum and geothermal applications. With an interactive format and keynote discipline experts, the workshop provides an opportunity to explore and tap into the combined knowledge of the participants to learn and discuss specific problems to address the challenges we will encounter going ahead.

We look forward to seeing you in Kraków!

Ted Urbancic & Stanislaw Lasocki
Co-chairs

Workshop Overview

The value of microseismic and other passive seismic data is measured by their capability to impact business critical decisions. Although microseismic data have been used extensively to this effect, often the decision makers receive mixed messages from their technical experts with respect to the validity and accuracy of processing and interpretation results from microseismic projects. This workshop focuses on topics and problem solutions that have a direct impact on the cost-effectiveness of microseismic data application.

Putting the ‘work’ back into ‘workshop’

This highly interactive workshop brings together some of the leading experts in the fields of planning, acquisition, processing and interpretation of microseismic data and allows the participants to work on specific solutions for concrete and current problems in the application of microseismic data.

Why you should attend

• Strong focus on practical solutions
• Direct access to world-class experts from academia, service providers and operators
• Online pre- and post-workshop follow-up discussions

Interactive Format – Conversation Café

Invited keynote speakers and discussions in the morning will introduce the different problems and provide some background information. The poster session during an extended lunch break then provides an opportunity to explore and discuss these topics in more detail. In order to tap into the combined knowledge of the participants, the afternoon will be dedicated to discussions of specific problems in very small groups before concluding the day with a summary that clearly captures the learning and problem solutions.

Topics

The topics for the Seventh Workshop on Passive Seismic will be:

Topic 1: Induced Seismicity

Prominent industry case studies will showcase the different challenges in induced seismicity monitoring and modeling. We will discuss the lessons learned and pitfalls to avoid. High-level key-note presentations will present European case studies, each of which ideally highlight different approaches. These will be discussed in interactive discussion groups, which also consider the posters of the general audience.

Topic 2: Integration

Translating passive seismic monitoring data into business decisions or policy proposals often requires the integration with other disciplines such as geomechanics and reservoir engineering. Although this fact if often acknowledged, realizing this integration across disciplines is often challenging to achieve. This part of the Passive Seismic Workshop will have keynote speakers from different disciplines sharing some examples of successful integration, explore different ways of achieving this level of integration and discuss roadblocks and challenges along the way.

Topic 3: New Directions & Challenges

Microseismicity in the age of big data: Developing synergies between industry and academy to better understand the microseismicity and its physical relation to industrial operations and to discriminate between natural and anthropogenic seismicity.
Seventh EAGE Workshop on Passive Seismic

Oral Presentations - Tuesday 27 March

Renoir room

08:30 Registration & Welcome Coffee
09:00 Welcome Aims & Objectives - S. Lasocki (Institute of Geophysics, Polish Academy of Sciences) & T. Urbanic (Shell)

INDUCED SEISMICITY

09:05 Session Introduction
09:15 PSW01 - Differences in Operational and Regulatory Challenges in Monitoring induced Seismicity throughout North America - B. Birkelo (SpectraSeis)
10:00 PSW02 - Limits on Detection and Analysis of Induced Earthquakes - G. Kwiatek (GIZ)
10:45 Coffee Break
11:05 PSW03 - Reservoir Structure and Wastewater-induced Seismicity at the Vol d’Agri Oilfield, Italy Shown by 3-D Local Earthquake Tomography - L. Improta (INGV)
11:50 Lunch Break
13:00 Poster Introductions
13:15 Poster Session

INDUCED SEISMICITY

P01 - Experiment Investigation on the Formation of Hydro-fracture System by Fracturing the Large Scale Coal-rock Combination - P. Wu (Taimyuan University of Technology), W. Lian (Taimyuan University of Technology), H. Liu (Taimyuan University of Technology)
P03 - Passive Seismic for Hydrocarbon Exploration : Study Case East Java Basin - R. Pandido* (Pertamina), F. Rahman (Pertamina), M. Krishnayadi (SKK Migas)
P04 - Microseismic Full Waveform Modeling and Location Uncertainty in Anisotropic Media - P. Shi* (University of Leeds)
P05 - Integration of Passive Seismic Methodologies and its Application on the MAUPASACQ Dataset - K. Polychronopoulou* (Seismotech S.A.), C. Orfanos (Seismotech S.A.), K. Leontarakis (Seismotech S.A.), D. Giannopoulos (Seismotech S.A.), A. Lois (Seismotech S.A.), N. Martaka (Seismotech S.A.)
P06 - Application of Microseismic Reflection Imaging and Moment Tensor Inversion to Determine Completion Effectiveness in the Marcellus - M. Mack (Sigma Cuted Inc), A. Reshetnikov (Sigma Cuted Inc.), J. King (Sigma Cuted Inc.), B. Schaeffer (Sigma Cuted Inc.), S. Taylor (Sigma Cuted Inc.), P. Jones-Fuentes (Southwestern Energy), L. Boyer (Southwestern Energy)

14:15 Round-table discussion on 7 Key questions:
1. How does local geology influences induced seismicity?
2. What is the role of the state-of-stress?
3. How can we manage the risk?
4. Maximum Magnitude estimates: How and Why?
5. What is the value of geomechanical modeling?
6. Can we characterize triggered versus induced categorization?
7. Triggered or Induced: What are the implications for hazard assessment?

16:00 Summary by Table Chairs
16:30 Wrap up Day 1 & Conclusions

Oral Presentations - Wednesday 28 March

Renoir room

09:00 Session introduction
09:10 PSW06 - Data-driven, Cross-disciplinary and Multi-scale Approaches to Risk Governance of Induced Seismicity - S. Wiemer (Swiss Seismological Service)
10:00 PSW07 - Fault Structure, Damage and (Induced) Microseismicity - What do we learn from the lab? - G. Dresen (GFZ Potsdam)
10:40 Coffee Break
11:10 PSW08 - Adaption of Seismicity Induced by Hydraulic Fracturing in Shales - A bedding plane slip model - L. Eisner (Seismik)
11:50 PSW09 - Linking Reservoir Rock Properties and Microseismicity - M. Kendall (University of Bristol)
12:30 PSW10 - Examples and Lessons learned from Mining-induced Seismicity and Geomechanics - S. Maxwell (Itasca-Image)
13:10 Lunch Break
14:00 Poster Introductions
14:15 Poster Session

INTEGRATION

P07 - Use the Seismic Interferometry Method to Assess the Effects of Hydro-fracturing in Wysin Borehole - H. Marczak* (Institute of Geophysics Polish Academy of Sciences), J. Mirek (IG-PAS), M. Lasak (IG-PAS)
P08 - A Correlation Analysis between Injection Rates and Magnitude Distribution in The Geysers Geothermal Field - K. Leptokaropoulos* (Institute of Geophysics, Polish Academy of Sciences), S. Cielesta (IG-PAS), M. Staszek (IG-PAS)
P09 - Uncertainty of B-value Estimation in Connection with Magnitude Distribution Properties of Small Data Sets - K. Leptokaropoulos* (Institute of Geophysics, Polish Academy of Sciences), A. Adamaki (Uppsala University)
P10 - The SHEER Approach to Shale Gas Exploration and Exploitation Associated Risks - S. Cielesta (Institute of Geophysics Polish Academy of Sciences), S. Lasocki* (IG-PAS), K. Leptokaropoulos (IG-PAS), S. Cesca (GFZ German Research Centre for Geosciences Potsdam)
P11 - Active Mapping of Geologic Structures Using Microseismicity and Their Role in Large Magnitude Occurrences Associated With Water Flooding - I. Nizkous (ESG Solutions), T. Urbanic* (ESG Solutions)
P12 - Aftershocks and Seismic Efficiency for the Cooper Basin (Australia) Geothermal Stimulation - E. Caffagni* (University of Vienna), G. Bokelmann (University of Vienna)
P13 - Laboratory Acoustic Emission Test with a Brittle Shale Cap-rock – J. Park* (NGI), L. Grande (NGI), M. Soldal (NGI), G. Sauvin (NGI), B. Bohloli (NGI)
P14 - A New Conceptual Model for Enhancement and Inhibition of Low-magnitude Microseismic Events related to Fluid Injection - B. Bohloli* (Norwegian Geotechnical Institute), T. Bjornara (NGI), V. Oye (NORSAR), B. Goertz-Allmann (NORSAR)
P15 - Toward Offshore Microseismic Data Source Mechanism Determination - A synthetic sensitivity study - N. Langet* (NORSAR), A. Wuestefeld (NORSAR), V. Oye (NORSAR)
P16 - Downhole Microseismic Monitoring At A Pilot Hydraulic Fracturing Site In Poland - W. Gajek* (Institute of Geophysics, Polish Academy of Sciences), J. Trojanowski (IG-PAS), M. Malinowski (IG-PAS)
P17 - Developing an Inversion Algorithm for a Velocity and Location of Microseismic Events Using the Maximum Intersection Method in Linear Velocity Gradient Model - W. Choi* (Inha University), S. Pyun (InHA University)
P18 - The Largest Event of the DFW Seismicity 3 Years After the Injection Termination - Is it an evidence for natural origins of DFW seismicity? - P. Wozniakowska* (Seismik s.r.o.), L. Eisner (Seismik s.r.o.), M. Musil (Seismik s.r.o.)

P19 - Seismic Attenuation in the Delaware Basin - M. Drwila*, L. Eisner (Seismik s.r.o.), Z. Jechumtalova (Seismik s.r.o.), D. Anikiev (Seismik s.r.o.)

P20 - A Comparison of Microseismic Source Location Method - Probabilistic vs migration-based approaches - I. Abakumov* (Freie Universität Berlin)

P22 - Recent Seismicity in West Texas - A. Savvaidis* (University of Texas at Austin), D. Huang (University of Texas at Austin), A. Lomax (ALomax Scientific), B. Young (University of Texas at Austin)

15:15 Round-table discussion on 6 key questions:
1. Which of the outputs from passive seismic data is most useful for integration?
2. What constraints do we need for better microseismic results?
3. Which disciplines (Earth/petroleum sciences) would benefit and how?
4. Where do we have examples of successful cross-disciplinary integration?
5. What are the main challenges in cross-disciplinary integration and how do we overcome?
6. How can we communicate our results more appropriately to non-specialists?

17:00 Wrap up Day 2 & Conclusions
18:00 Departure to Salt Mines from venue
19:00 Guided Tour and Dinner
22:30 End of Day 2

Oral Presentations - Thursday 29 March

Renoir room

NEW DIRECTIONS AND CHALLENGES

08:45 Day Introduction by the Sub-committee
09:00 PSW11 - Seismic and A-seismic Response of Fluid Injected Faults - P. Dublanchet (Mines ParisTech)
09:40 PSW12 - Effects of Oil and Gas Production and Wastewater Injection on Surface Deformation - A. Sowter (Geomatic Ventures Ltd.)
10:10 Coffee Break
10:30 PSW13 - A Step-change in Tackling Grand Challenges of Seismic Hazard Associated with Exploitation of Geo-resources - B. Orlecka-Sikora (Polish Academy of Sciences)
11:10 PSW14 - Laboratory and Small Scale Field Experiments of Hydraulic Fracturing Using Super-critical Carbon Dioxide for Heat Extraction from Hot Dry Rock and Shale Recovery - T. Ishida (Kyoto University)
11:50 Panel Discussion
12:30 Lunch Break
13:30 Poster Introductions
13:45 Poster Session

NEW DIRECTIONS AND CHALLENGES

P23 - Synthetic Modelling of a DAS Cableís Sensitivity and Performance in Microseismic Monitoring Applications - M. Wilks* (NORSAR), A. Wuestefeld (NORSAR)

P24 - Application of Tomography and Dynamic Parameter Analysis in a Block Caving Mine - G. Viegas* (ESG Solutions), K. Bosman (ESG Solutions), D. Angus (ESG Solutions), T. Urbancic (ESG Solutions)


P26 - Microseismic Monitoring of Hydraulic Fracture Propagation with a DAS array - A. Reshetnikov (Fracture Imaging LLC), B. Schaeffer (Sigma Cubed Inc.), J. King (Sigma Cubed LLC), S. Taylor* (Sigma Cubed Inc.), D. Kahn (Devon Energy), J. Rich (Devon Energy), K. Silver (Devon Energy)

P27 - How the Choice of Location Algorithm Affect Results - A synthetic comparison - A. Wuestefeld* (NORSAR), S. Nasholm (NORSAR), S. Greve (NORSAR)

P28 - Remote Real-time Processing of Hydraulic Fracture Treatment Microseismic Data Using Large Arrays - D. Diller* (NanoSeis, LLC), T. Shuck (NanoSeis, LLC), W. Heigl (NanoSeis, LLC)

P29 - The Enigma of Dip-Slip and Aligned Strike-Slip Events Within The Same Event Cloud - W. Heigl* (NanoSeis, LLC), D. Diller (NanoSeis, LLC), B. Fish (NanoSeis, LLC), T. Shuck (NanoSeis, LLC), S. Wilson (Seismogenic)

14:45 Round-table discussion on 8 key questions:
1. What can we learn from other Earth Science disciplines (Volcanology, InSAR, etc)?
2. What is next step-change after Moment Tensors?
3. What are the limitations of microseismicity mapping?
4. How can we best extract statistically significant characteristics from the numerous available data sets?
5. Is DAS a threat or opportunity for microseismic?
6. Which new business areas can we expand our expertise into (building safety, military acoustics, etc)?
7. Beyond microseismic: How can we measure deformation modes other than brittle cracking?
8. New hydraulic fracturing technologies: will different microseismic response be a threat or opportunity?

16:00 Round-table discussion summary
16:30 Wrap up & End of Workshop
Social Programme

Icebreaker Reception
Monday 26 March 2018, 18:00 – 20:00 hrs

Please join us at the Holiday Inn for welcome drinks and finger food in the patio to meet your fellow participants.

Workshop Dinner
Wednesday 28 March 2018, 19:00 - 22:30 hrs

The workshop dinner will take place in one of the chambers of the Wieliczka Salt Mine. After a guided tour through the mines, which passes all the highlights and chambers, we sit down together to enjoy the Polish gastronomy 100 meters below the surface!

Important Dates

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<tr>
<td>Online Registration Closes</td>
<td>26 March 2018</td>
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<tr>
<td>Icebreaker Reception</td>
<td>26 March 2018</td>
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<tr>
<td>Workshop</td>
<td>27-29 March 2018</td>
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Registration

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Venue

Holiday Inn Krakow City Centre
Renoir Meeting Rooms
Wielopole 4, 31-072 Kraków
Poland

Company Display

Contact

The Seventh EAGE Workshop on Passive Seismic is organized by EAGE Europe, please contact the Europe office on +31 889955055 or email events@eage.org

EAGE PSW – LinkedIn Group
If you wish to be involved in the discussion on microseismic please join our LinkedIn Discussion Group EAGE-PSW. The group will also hold informal get-togethers at all the major conferences, including the EAGE Conference in Copenhagen and SEG in Anaheim.

We hope to see you in Kraków!