Meta Innovation Technologies

Next-generation Knowledge Empowerment

IN-HOUSE TRAINING

Passive Seismic
COURSE CATALOGUE
2019-2020

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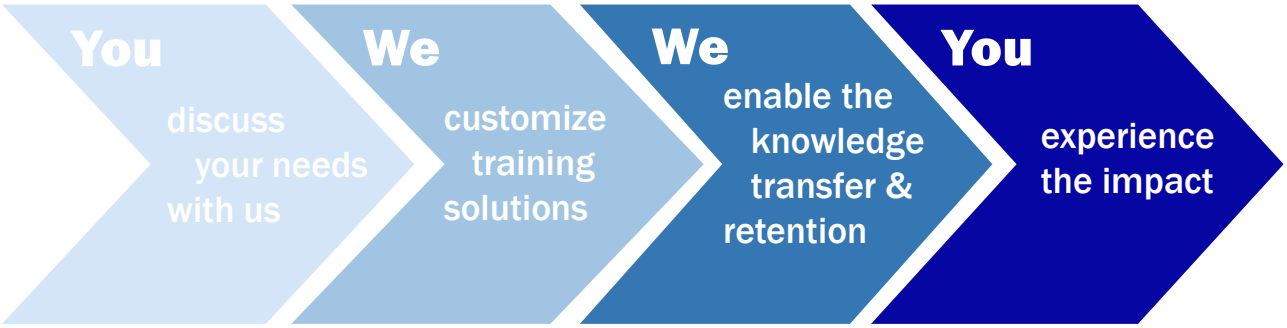
ABOUT US

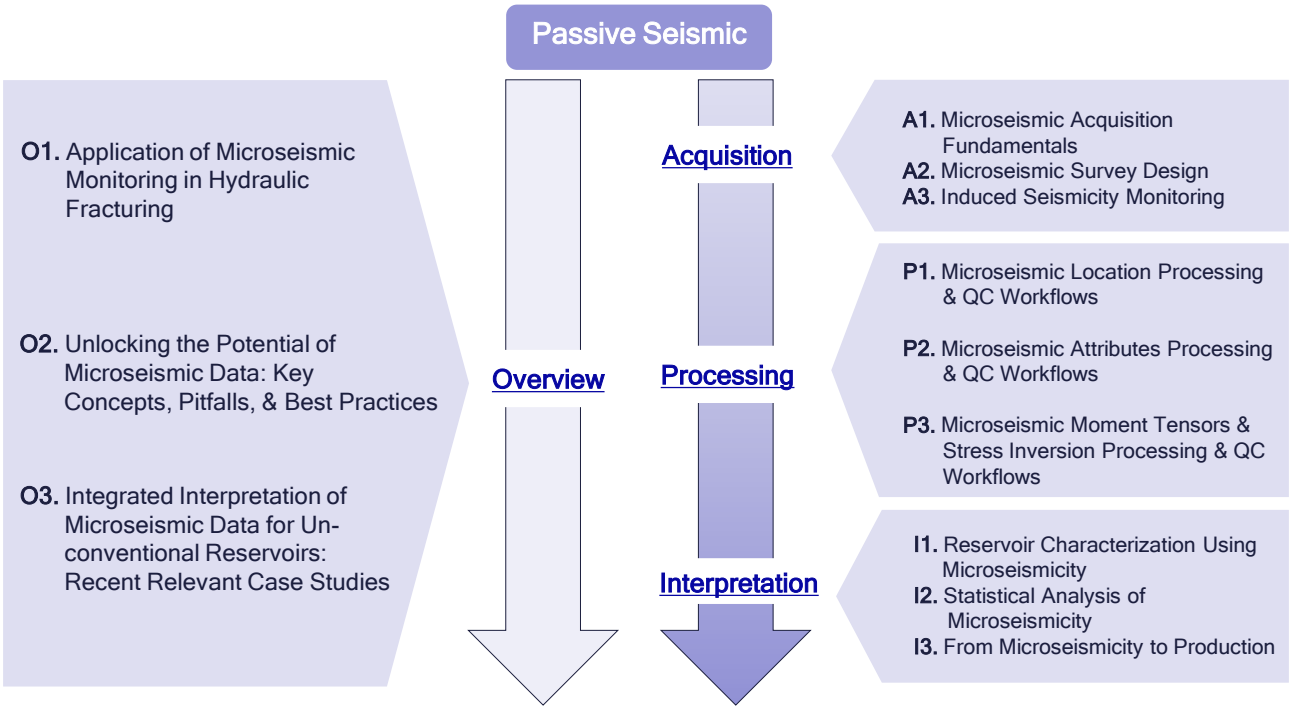
Meta Innovation Technologies is an experienced team of subject matter experts, advisors, and developers dedicated to novel delivery of education to geoscientists and engineers in the energy sector. We deliver in-house technical training sessions and workshops, supplemented by our simulation-based technical training software solution, metaKinetic™. Artfully engineered interactive simulations built on the metaKinetic™ platform give participants the opportunity to build an intuition for technical concepts and their applications effectively and effortlessly.

Our in-house training modules are fully customized based on your business needs & objectives.



In addition to our product-offering and modular in-house training, we provide advisory and technical evaluation services on passive and active seismic acquisition, processing, and interpretation to empower operators to ask the right questions of service providers and get the most value out of their geophysical datasets.

Get trained using your own data set: We help you to apply what you learned to your own data sets.



Pre-built Courses

Overview courses provide attendees enough familiarity with the technology, methods, and practices to be able to understand the underlying concepts and applications in the oil and gas industry. Each course is unique in the topics covered with emphasizes on different aspects of the technology.

All courses are standalone one-day long and include a variety of topics.

Modular Training

Passive Seismic modules are separated into three categories; Acquisition, Processing, and Interpretation. This allows clients to select courses based on their immediate organizational needs to bridge the skill gap or build upon existing knowledge and experience.

All courses are a half-day long and can be combined with other courses for a desired learning outcome.

ACQUISITION

Acquisition-focused courses provide in-depth knowledge of the criteria that have to be taken into account for a successful monitoring project. Choosing the appropriate survey design capable of delivering the operators expected technical outcome, based on preliminary feasibility studies proposed by service providers is not always a straight forward decision. The in-house acquisition focused training modules helps you to make the right technical decision within the allocated project budget.

PROCESSING

Processing-focused courses introduce the participants to applicable microseismic data processing workflows to ensure the quality of the results including event locations, microseismic attributes, moment tensors, and stress inversion. The quality control procedures offered in the courses creates a firm understanding of the underpinning importance of technical methods used in these measurements and calculations.

INTERPRETATION

Interpretation-focused courses demonstrate the best approaches to use in interpreting microseismic data independently and in combination with other types of data sets. Through multiple case studies, our experts introduce you to highly effective workflows for meaningful interpretation of these data streams. The results of integrated interpretation lead to better decisions for future completion projects.

ACQUISITION

A1. Microseismic Acquisition Fundamentals
A2. Microseismic Survey Design
A3. Induced Seismicity Monitoring

A1

Description

The success of a microseismic monitoring project is critically dependant on the ability for the signals to be recorded as faithfully as possible, such that these events are properly located and characterized.

In this course, participants will be taught the acquisition fundamentals and the various effects of instrumentation, coupling, and the footprint of equipment and digitization have on recorded signals. These effects will be discussed as well as approaches to recognize their effects in the signals and mitigate their impact on the characterization of microseismic attributes.

Audience

This course is targeted to the geoscientists who are tasked with designing or supervising a microseismic data acquisition project.

Learning Outcomes

- Understanding of microseismic monitoring fundamentals including how to determine locations and microseismic attributes
- Knowledge of different effects imposed on the signals by different sensor types and the effect on recorded signals
- How to mitigate the effects of poor recording configuration and signal quality to minimize their impacts on the recorded data

A2

Description

The acquisition geometry both for downhole and surface as well as the choices of instrumentation are key parameters for a successful survey.

After taking this course, participants will understand how to design microseismic surveys to maximize the outcomes of the monitoring efforts and understand how these parameters affect the ability to resolve locations, microseismic attributes. In addition, the role of different types of sensors on the observed signal bandwidth, to ensure the quality of the measurements of microseismic attributes like magnitude will be discussed.

Audience

This course is targeted to the geoscientists and engineers who are tasked with designing or supervising a microseismic monitoring survey.

Learning Outcomes

- How the design of a microseismic survey affects the ability to resolve event locations and microseismic attributes
- How the recording bandwidth of the sensors and digitization system can be tuned to avoid systematic recording biases
- The conditions which allow for the determination of microseismic attributes from different sensor array geometries

A3

Description

Numerous jurisdictions require that operations such as waste-water disposal and hydraulic fracturing be accompanied by a seismic monitoring network that is capable of characterizing relatively large magnitude events that may be felt by the public. In this course, participants will gain an understanding of how a seismic network can be designed to optimize the resolution of event locations and magnitude determination, either as a stand-alone array or complementing other monitoring configurations. Additionally, we will discuss how induced seismicity can be parametrized in terms of what can be felt on the surface, and how it can be compared to design thresholds for structures.

Audience

This course is targeted to geoscientists, engineers, managers who are tasked with designing or supervising an induced seismicity monitoring survey.

Learning Outcomes

- Review of the fundamentals of induced seismicity monitoring and regulations
- Understanding of the conditions that lead to larger magnitude events
- Understanding of the role of sensors in determining the attributes of an induced seismic event as well as recommendations for best practices in deploying monitoring equipment
- How to use ground motion measurements and shakemaps in projecting the felt seismicity over an area

PROCESSING

P1. Microseismic Locations Processing & QC Workflows
P2. Microseismic Attributes Processing & QC Workflows
P3. Microseismic Moment Tensors & Stress Inversion Processing & QC Workflows

P1

Description

In this course, participants will be exposed to the fundamental of microseismic data processing with an emphasis on how to properly locate microseismic events on downhole arrays. From triggering events in continuous data, the discussion will progress into concepts of how to determine sensor orientation, how to calibrate velocity models, and how to pick and locate events.

With an emphasis on the principals of seismic waves propagation in sedimentary rocks, participants will come away with an understanding of best practices in forming workflows for locating events. The course includes workflows for quality control of resolved event locations.

Audience

This course is targeted to geoscientists who are tasked with processing and/or QCing the locations of a microseismic monitoring project.

Learning Outcomes

- Understanding of different algorithms to trigger microseismic data streams and workflows to resolve micro-seismic event locations
- Approaches to determining the sensor orientation, and how that can be implemented in a workflow
- Best practices in determining velocity models, including anisotropic effects, and how they can impact the locations of microseismic events
- How to use QC workflows for micro-seismic event locations

P2

Description

In this course, participants will be exposed to the fundamental concepts of measuring microseismic attributes, the model of the source that is used to facilitate these measurements, and what they mean in terms of elucidating the driving processes behind the observed seismicity.

Different strategies for estimating these microseismic attributes will be discussed as well as workflows that can be used to establish confidence in the calculations.

Audience

This course is targeted to geoscientists who are tasked with processing and interpretation and/or QCing microseismic event attributes.

Learning Outcomes

- Familiarity with different micro-seismic attributes
- The role of sensor bandwidth in determining these attributes
- How to mitigate the effects of the poor recording configuration and signal quality in characterizing microseismic events
- Workflows to calculate micro-seismic event attributes
- How to use QC workflows for microseismic event attributes

P3

Description

The moment tensor is a powerful rep-resentation of a microseismic source that can be used to reveal the underlying failure process, the stress/strain state, and the fracture orientations.

In this course, participants will receive a detailed workflow for determining confident moment tensors from microseismic data, appropriate acquisition geometries for moment tensor inversion, filtering, and processing the data so that high quality mechanisms are obtained. The workflow is extended to stress inversion and how it is used for understanding the geometries of the activated discrete fracture network.

Audience

This course is targeted to geoscientists who are tasked with processing and interpretation and/or QCing the microseismic moment tensor datasets and stress inversions.

Learning Outcomes

- Understanding the appropriate array configurations for moment tensor inversion
- A workflow for selecting the appropriate microseismic events for moment tensor inversion
- A robust process for determining moment tensors and stress inversion given microseismic data including QC steps at key points
- How to connect moment tensor data to the subsurface stress state and activated fracture network

INTERPRETATION

I1. Reservoir Characterization Using Microseismicity
I2. Statistical Analysis of Microseismicity
I3. From Microseismicity to Production

I1

Description

The interpretive value of microseismic monitoring results rests with its ability to produce reliable predictions. As an example, if the producing volume of a hydraulic fracture can be established, then the optimum well spacing that can be determined. However, establishing reliable fracture volumes from microseismicity is non-trivial.

In this course, participants will be taught the approaches to take in interpreting microseismic data, and how to distinguish volumes within the reservoir where the microseismicity is indicative of activation of a interconnected fracture network leading to production.

Audience

This course is targeted to the engineers and geoscientists who are tasked with integrated interpretation of microseismic data.

Learning Outcomes

- Understanding of the recording network parameters that results in a successful interpretation
- How to establish the connectivity of a fracture network from microseismic measurements
- How to estimate effective fracture geometry
- Workflows to facilitate effective interpretation

I2

Description

The value of microseismic data in hydraulic fracturing is realized when the behaviour of the reservoir is described based on statistical analysis of microseismicity in space and time.

In this course, participants will be taught how to parameterize the response of the reservoir in terms of relative contributions of fluid vs stress-driven deformation. These statistical analyses result in better prediction of effectively stimulated reservoir volumes and production.

Audience

This course is targeted to the engineers and geoscientists who are tasked with interpreting microseismic data and its integration with other type of datasets.

Learning Outcomes

- Introduction of different statistical methods that can be meaningfully applied to microseismic data
- How to transition from microseismic event location and attributes to a description of reservoir properties using statistical approaches
- How statistical analyses of microseismicity brings confidence in its interpretation and integration with other datasets and models

I3

Description

The promise of microseismic evaluation of hydraulic fracturing is that it can yield estimates of NPV of an unconventional reservoir soon after stimulation. However, the workflow of relating the dimensions of microseismic clouds to stimulated reservoir volume often results in overestimation of production. To obtain realistic estimates, a detailed examination of the events themselves needs to be undertaken.

In this course, participants will be exposed to methods of evaluating the effectively stimulated volumes and tying the microseismic clouds to other data streams and models to understand where primary production may be expected.

Audience

This course is targeted to the engineers and geoscientists who are tasked with interpreting microseismic data and its integration with engineering, geological, and geophysical datasets and models.

Learning Outcomes

- How microseismic data can be differentiated into clouds that are representative of areas of primary production to areas where production will be more limited
- How microseismic data can be used to infer relative degrees of fracture network connectivity in the reservoir
- How microseismic clouds can be integrated with other data streams and models in order to constrain credible stimulated volumes around treatment wells

OVERVIEW

01. Application of Microseismic Monitoring in Hydraulic Fracturing
02. Unlocking the Potential of Microseismic Data: Key Concepts, Pitfalls, and Best Practices
03. Integrated Interpretation of Microseismic Data for Unconventional Reservoirs: Recent Relevant Case Studies

01

Description

Microseismic monitoring is one of the key technologies to understanding and managing unconventional plays. Microseismic events Location and their attributes can be used to map frac growth, geometry, and stimulation effectiveness.

After a brief review of microseismic technology and hydraulic fracturing fundamentals, this course will take the participants through the application of event locations and their attributes to obtain images of stimulated regions of the unconventional reservoir. The lessons learned throughout this process, if done properly, provide insight for better future completion designs.

Audience

This course is targeted to the engineers, geoscientists, and executives who want to know about the added value of microseismic technology in hydraulic fracturing.

Learning Outcomes

- Familiarity with microseismic monitoring technology and hydraulic fracturing fundamentals for unconventional reservoirs
- How to determine locations and microseismic attributes and establish QC workflows
- How to apply microseismic data to obtain images of effectively stimulated regions of the unconventional reservoir

02

Description

In this course, participants will be exposed to the fundamental concepts of microseismic acquisition, processing, and interpretation in unconventional reservoirs. Through understanding the fundamental concepts of earthquake seismology, the common pitfalls and best practices within the industry associated with this technology are discussed.

The course then walks participants through different methods that leads to extracting more value from microseismic monitoring projects. This added value is essential in understanding the reservoir behaviour and estimation of effectively stimulated regions.

Audience

This course is targeted to the engineers and geoscientists who want to extract more value out of their microseismic monitoring projects to use it in future practices.

Learning Outcomes

- Understanding the effect of array geometry and instrumentation on resolving microseismic locations and event attributes, respectively
- Hands-on experience with quality control of processing workflows
- Familiarity with best practices in the art of interpreting microseismic data and it's integration with other data streams

03

Description

Beginning with a brief overview of acquisition and processing of microseismic data, this course is focused on methods to derive meaningful interpretation in the context of completion programs. In addition to standard practices with focus on event locations and primary attributes such as magnitude, interpretation of advanced analyses results such as moment tensors, strain and stress fields, deformation, and fracture network connectivity are discussed.

Throughout the course, a series of case studies are presented to demonstrate the goals achieved through microseismic interpretation by itself or in conjunction with other data streams.

Audience

This course is targeted to the engineers and geoscientists who are tasked with interpreting microseismic data and its integration with engineering, geological, and geophysical datasets and models.

Learning Outcomes

- How to arrive at meaningful interpretation of microseismic data
- How microseismic data can be integrated with other datasets or used for constraining frac models
- How to get from microseismic clouds to a realistic prediction of primary production zones
- How microseismic data can be used to infer relative degrees of fracture network connectivity in the reservoir