

НАЦІОНАЛЬНА АКАДЕМІЯ НАУК УКРАЇНИ  
ІНСТИТУТ ГЕОФІЗИКИ ім. С.І. СУББОТІНА

# ЗВІТ

про виконання роботи аспірантської підготовки

за темою дисертації:

Microseismic Monitoring as Technology  
Required for Ukrainian Oil & Gas Sector

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Energy independence of Ukraine is a strategic task that determines the agenda of the energy industry and oil and gas companies

“We usually find oil in new places with old ideas. Sometimes, also, we find oil in an old place with a new idea, but we seldom find much oil in a old place with an old idea.” Parke A. Dickey, 1958

The volume of forecast resources of unconventional hydrocarbons in Ukraine (V. A. Mykhaylov et al. Monograph 2014):

- ❑ **Shale gas: 13-25 trillion m<sup>3</sup>**
- ❑ **Gas from tight reservoir rocks: 4-11 trillion m<sup>3</sup>**
- ❑ **Shale oil: 500-650 million tons.**

To produce this volume not drilling only is requires. But drilling and stimulation.

One of the effective method of stimulation is hydraulic fracturing

In 2021, more than 90% of all gas wells in the world and 70% of oil fields was developed using stimulation technology - hydraulic fracturing.



# Hydraulic fracturing issues

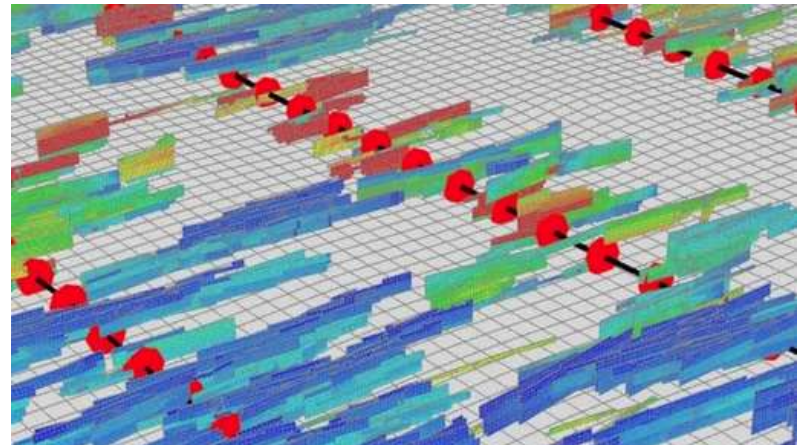
## Mechanical

- Poor cementation
- Casing failure
- Failure of the hermeticity of the stages



## Geological

- Heterogeneity of the distribution of rock properties
- Unpredictable reaction of rocks
- Out of zone stimulation
- Fault reactivation



# Micro seismic monitoring

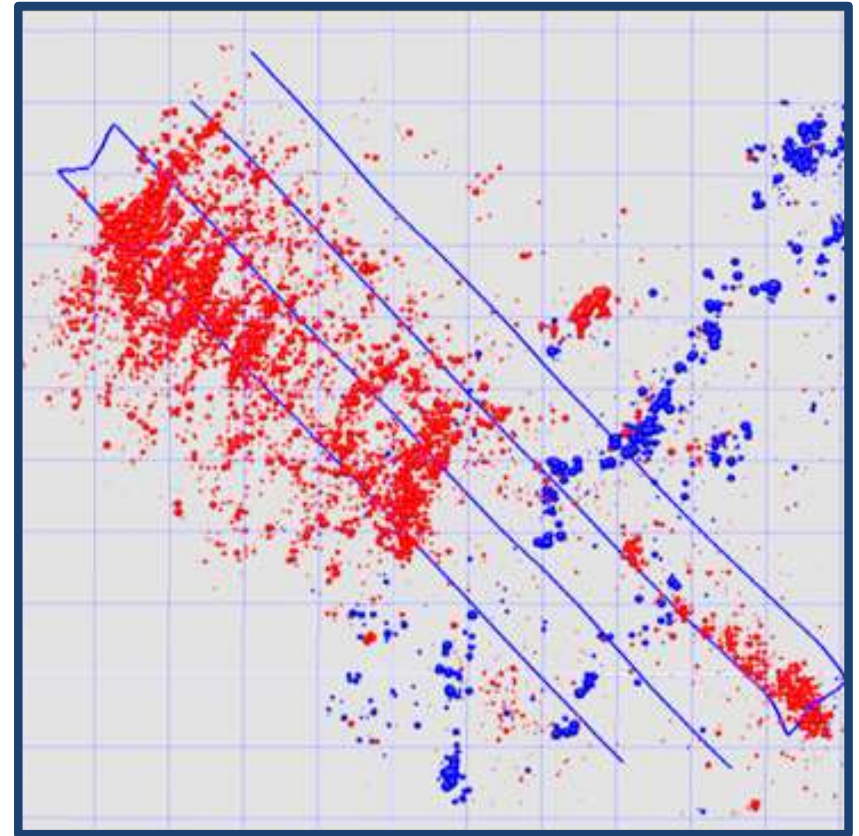
- ❑ Data Acquisition
  - Surface system (Frack star, sun, path)
  - Borehole system geophone string, DAS)
  
- ❑ Processing:
  - Trace redaction,
  - Filtration,
  - Noise attenuation,
  - Velocity model building,
  - Static correction.
  - Migration
  
  - Events correlation;
  - focal mechanism
  - events localization and magnitudes,
  - SRV.



# Results of micro seismic monitoring

## Applying for:

- Assessment of stimulation effectiveness;
- Understanding whether a crack has formed, and what its geometry. If not formed, then why;
- Understanding the reaction of rocks to a specific method of stimulation for its further adjustment;
- Stress orientation allows you to locate your wells correctly because you always want to drill perpendicular to stress orientation.



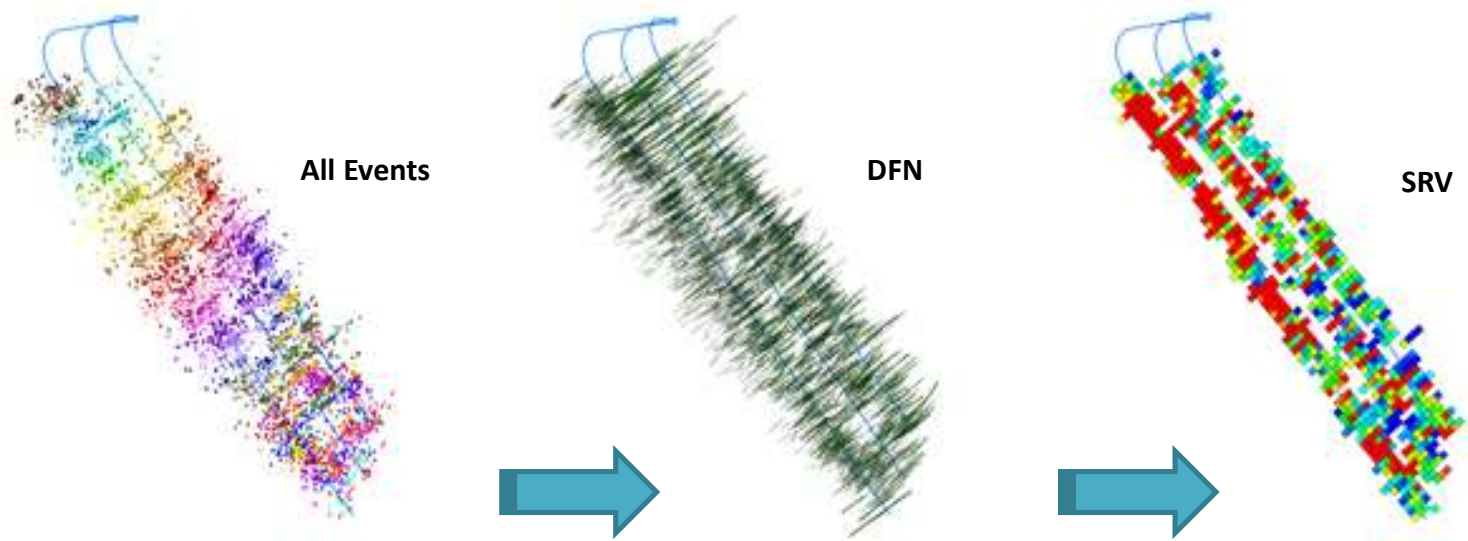
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Length  
Asymmetry  
Azimuth (orientation)  
Fracturing density  
Position in space



# Events / Discrete Fracture Network Modeling / Stimulated Reservoir Volume

- One fracture is modeled per microseismic event.
- Individual fracture orientation is determined by focal mechanism.
- SRV is determined from moment magnitude, maximum stress direction and injected fluid volume.



- Determining the optimal distance between future stimulations to increase development efficiency;
- Building a development model based on the volume of stimulated rocks.

# Summary

- ❑ Microseismic monitoring of hydraulic fracturing is an important geophysical method that contributes to the effective stimulation and development of reservoirs by hydraulic fracturing.
  
- ❑ It provides **not theoretical but actual information** about results of frack job, and support **G&G** to:
  - Understand **whether a crack has formed.**
  - Understand the **geometry** of fracture.
  - Understand the **reaction of rocks** to a specific method of stimulation and **efficiency of stimulation**;
  - Support future development. Determine the **optimal parameters** of stimulations and **distance** between stages and wells.

Thank you.



## РЕЗУЛЬТАТИ

Курс Філософія науки та культури 2023 р., іспит 92 бали

Курс Іноземна мова (англійська мова) 2023 р., іспит 92 бали

- ознайомлення з літературними джерелами, що стосуються мікросейсмічного моніторингу гідророзриву пласта і визначення актуальних задач досліджень для родовищ України.
- аналіз літературних джерел, пов'язаних з теорією, методикою і практикою мікросейсмічного моніторингу гідророзриву пласта.

Подача тез та доповіді на конференції:

IX Міжнародна наукова конференція ГЕОФІЗИКА І ГЕОДИНАМІКА: ПРОГНОЗУВАННЯ ТА МОНИТОРИНГ ГЕОЛОГІЧНОГО СЕРЕДОВИЩА Львів, 10 - 12 жовтня 2023 р. Інститут геофізики ім. С.І. Субботіна Національний університет «Львівська політехніка»

**Доповідь: «Мікросейсмічний моніторинг ГРП для родовищ України»**

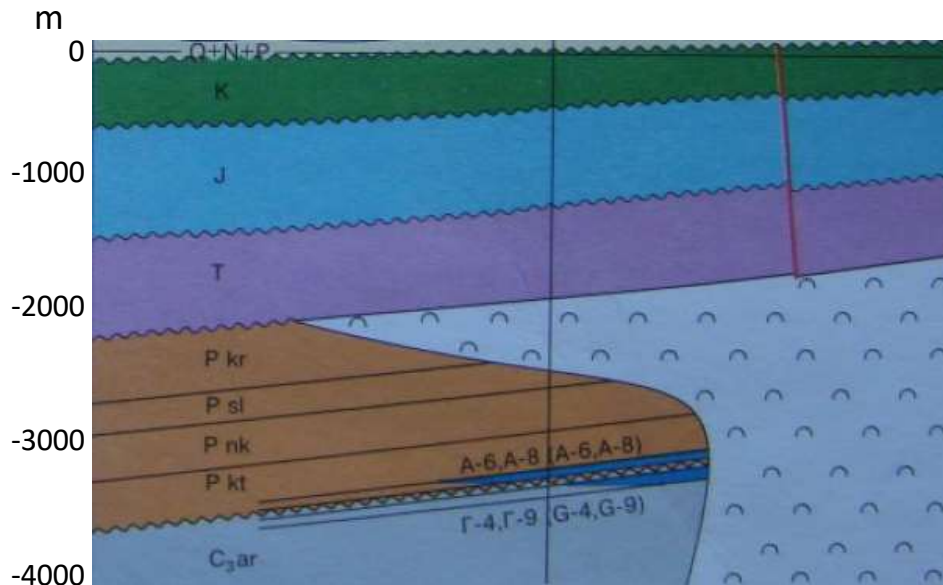
XVII International Scientific Conference "Monitoring of Geological Processes and Ecological Condition of the Environment« 7 - 10 November 2023, Kyiv, Ukraine

**Доповідь: Microseismic Monitoring as Technology Required for Ukrainian Oil & Gas Sector**



# Example of a play stimulation in Ukraine

## West-Efremivske gas field



Atlas of Oil and Gas Fields of Ukraine.

2014. A new well was drilled and 4 stages of fracturing performed.

The stimulation results in terms of production were generally the same as the well average rates obtained in the past without hydraulic fracturing.

- What happened in reservoir?
- What fracture was formed during the hydraulic fracturing stimulation?
- Is there are any?