



Exploration & Production  
Laboratory

**E&PLAB**

**INA**

## ABOUT US

The Exploration and Production Laboratory (E&P Laboratory) is primarily dedicated to improve and support the oil and gas exploration and production INA, d.d. projects and also provides services to external clients.

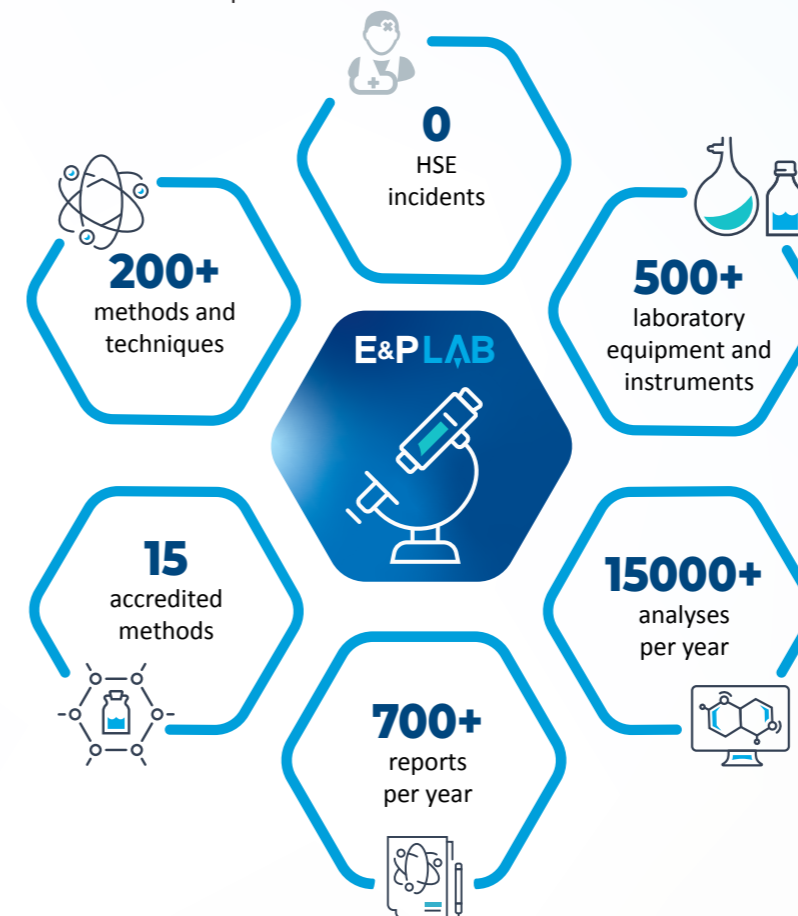
We are offering an innovative approach and tailored made solutions according to the needs of our clients through standardized, internal, and custom-made methods in the fields of oil, gas, and water exploration, development and production. Our services are delivered with the highest level of quality, expertise, and top-level performance in laboratory analyses and data interpretation related to the entire energy sector both in the Republic of Croatia and beyond its borders.

We successfully adapt to the energy transition by introducing new methodologies and technologies in geothermal, hydrogen, CCUS and other projects.

### The scope of the E&P Laboratory is defined through:

- Active collaboration in the exploration and definition of new exploration areas
- Support and optimization of reservoir development processes and oil and gas production
- Providing expert and technical support in the exploration, development, and implementation of geothermal, EOR and CCUS projects
- High-quality performance of laboratory analyses of rocks and reservoir fluids (crude oil, gas condensate, natural gas, water) from geological, geochemical, petrophysical, thermodynamic, corrosion, and physical and chemical aspect
- Preparation of laboratory reports and studies with detailed data interpretation

The laboratory also provides services to external clients according to the **Laboratory Services Catalogue**. In collaboration with clients, we develop new methods and adapt existing ones to meet their specific needs and legal obligations. This enables the improvement of business processes through high-quality laboratory data and the resolution of various engineering challenges using real core and fluid samples.



*Our laboratory team consists of highly educated experts, petroleum, geological and chemical engineers and top technicians with many years of professional experience in the oil and gas industry.*

## VISION AND MISSION

### VISION

Our vision is to become a leading laboratory in the energy industry, providing high-quality and supportive assistance to our clients, helping them create and develop innovative and sustainable projects, as well as making business decisions that ensure long-term growth and success with a focus on energy transition.

### MISSION

With a multidisciplinary, innovative approach and proactive collaboration, we provide our clients with state-of-the-art laboratory services, supporting them in research and development, both in the exploration and production of oil and gas, as well as in the field of renewable energy sources. We actively contribute to the improvement of INA and MOL Group's operations by integrating new technologies and practices that promote sustainability and efficiency.

We prioritize social responsibility through ongoing and successful collaboration with the academic community, providing students with practical experiences and education that prepare them for future challenges.



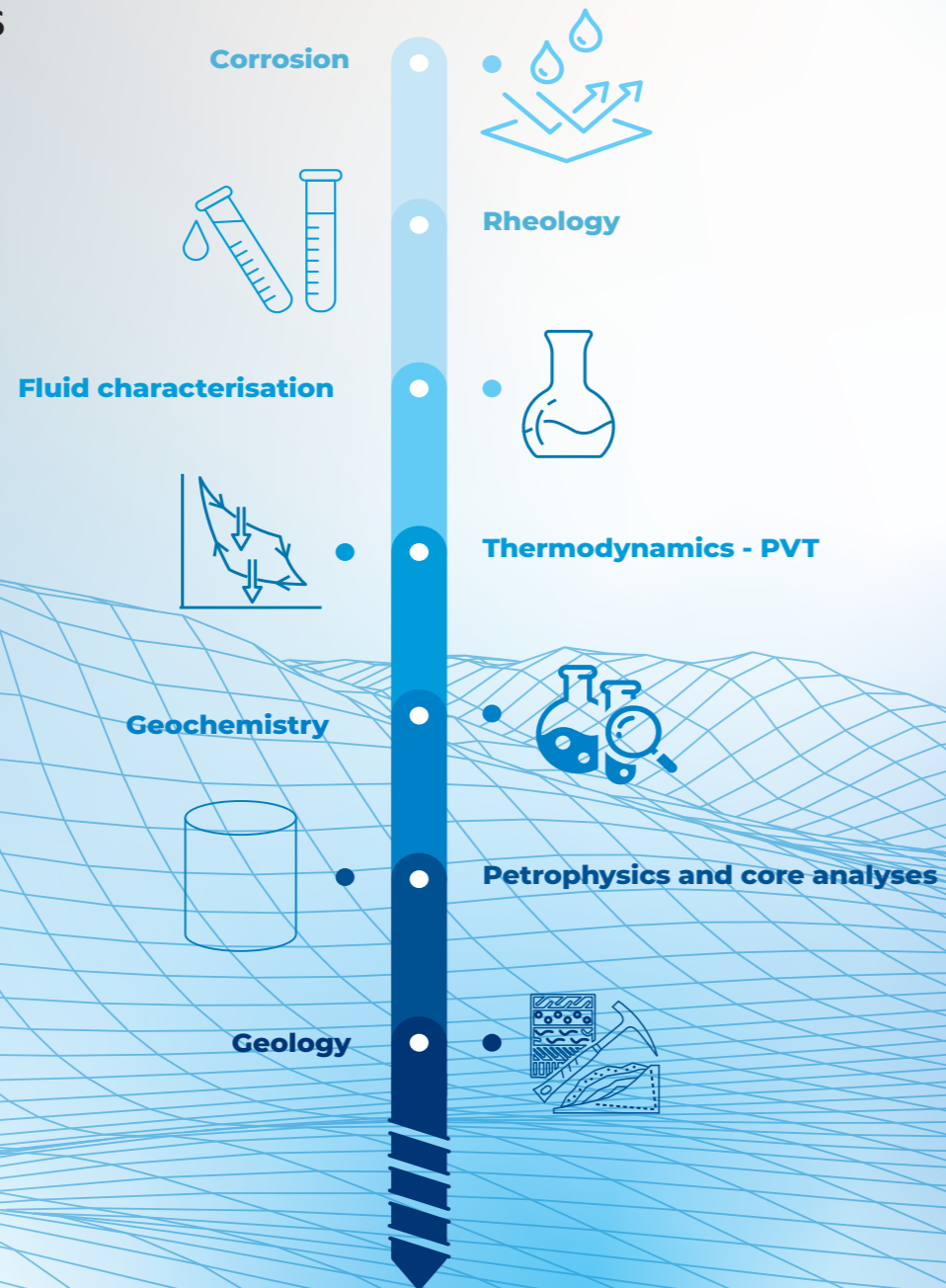
## QUALITY ASSURANCE AND ACCREDITATION

Expertise in the implementation of certain analytical methods is confirmed by the Accreditation Certificate No. 1048 issued by the Croatian Accreditation Agency according to standard HRN EN ISO/IEC 17025:2017 for testing selected characteristics of natural gas, crude oil, lubricating oils, aqueous solutions of ethylene glycol and additives for crude oil.

Competency, systematic approach and quality in performing tasks have been confirmed by the ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 and ISO 50001:2018 certificates issued to INA, d.d.

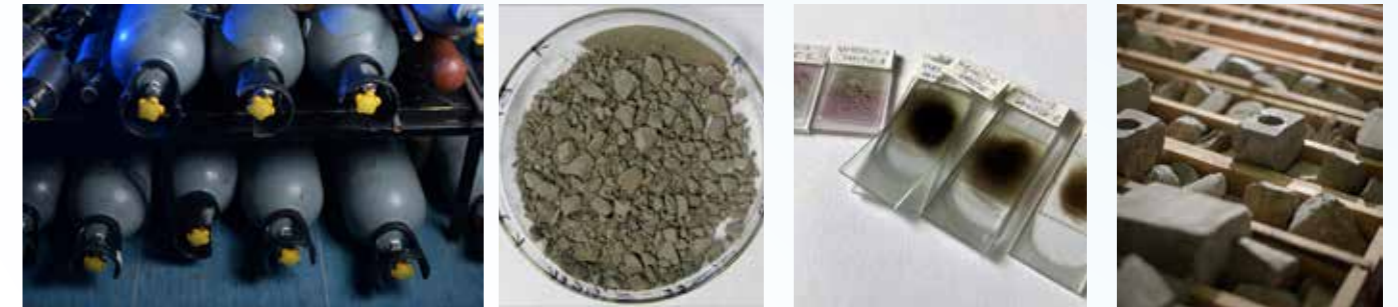


## EXPERT DISCIPLINES



## SAMPLING AND SAMPLE PREPARATION

- Sampling of natural gas, gas condensate, crude oil, water and other process fluids on the field
- Rock sampling (wellsite, outcrop, core storage)
- Rock and fluid sample preparation for different laboratory analysis
- Recombination of reservoir fluids according to the production data

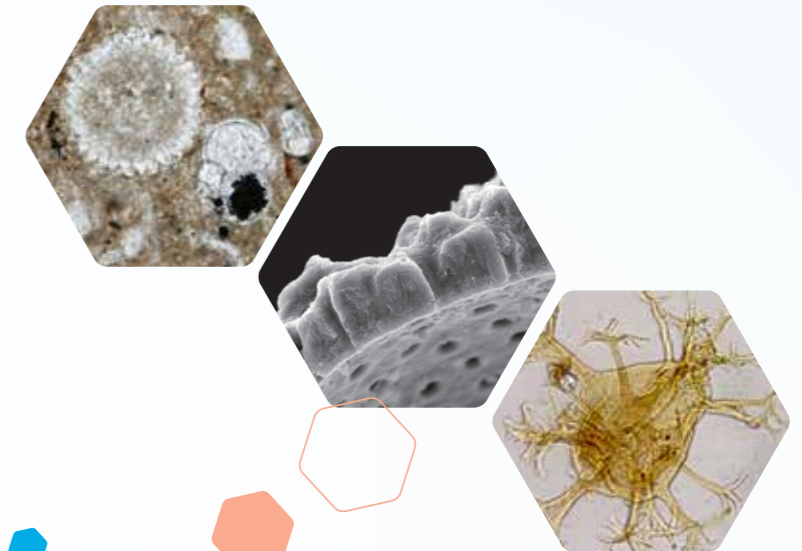
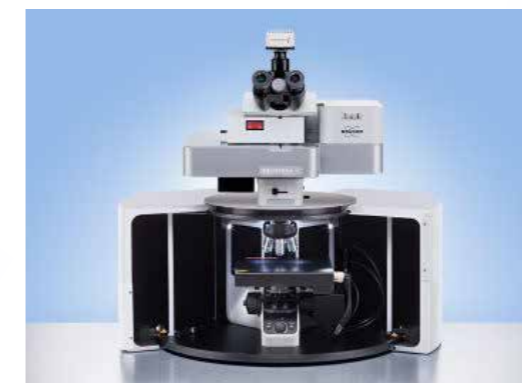


## GEOLOGY

Biostratigraphic, petrographic, and sedimentological laboratory analyses and interpretations are carried out, covering everything from urgent preliminary analyses and detailed reports to comprehensive studies, complex reviews of existing data, basin assessments, and sedimentological modeling.

E&P Lab is equipped with state-of-the-art laboratory equipment such as a scanning electron microscope (SEM/EDS), a Raman confocal microscope and optical microscopes for various purposes.

- Biostratigraphic analysis (chronostratigraphic determination, fossil content, paleoecology, palinofacies, interpretation of biofacies and paleoenvironment)
- Petrographic and sedimentological analysis (classification of rocks, mineral composition, structural and textural characteristics, UV inspection, diagenesis, provenance, grain size and shape, sorting, maturity, micro-porosity, SEM & EDS analysis, Raman mineral identification and phase analyses, digital image pore space phase analysis, interpretation of lithofacies and determination of depositional environments, construction of lithology columns)
- Sedimentological modelling (integration and interpretation of biostratigraphic, petrographic and sedimentological studies, geochemical, petrophysical and all other available data for the purpose of defining facies and their distribution)





## GEOCHEMISTRY

Organic geochemistry studies the distribution, composition and transformation of organic matter in the geosphere at a fundamental and molecular level, combining aspects of geology, chemistry, and biology. Geochemistry is primarily used in the process of hydrocarbon exploration, enabling the determination of source rocks, their generative potential, the efficiency of hydrocarbon expulsion processes and the resolution of hydrocarbon migration phenomena. The genetic characterization of hydrocarbons from reservoirs is achieved through the application of geochemical analyses, as well as their correlation, identification and alteration within reservoirs.

### GEOCHEMICAL ANALYSES

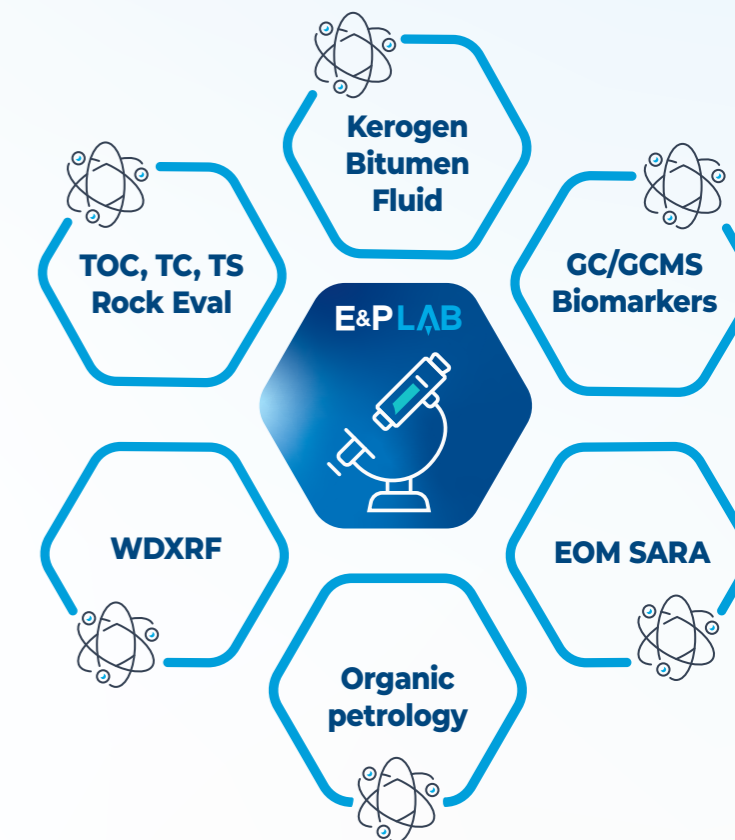
- Source rock determination
- Petroleum potential
- Organic facies, kerogen type
- Thermal maturity
- Geochemical characterisation of hydrocarbons
- Biomarker analyses
- Genetic correlation
- Migration and accumulation studies
- Reservoir geochemistry
- Definition of petroleum & geological relation, interpretation and reconstruction of depositional environment and depositional conditions, ecosystems

### GEOCHEMICAL MODELING

- Data integration and interpretation for basin modelling

### OTHER

- Chemical composition of rock and sludge
- Acid solubility test of rock and sludge
- Stabilization/solidification of drill cuttings
- Geochemical investigation of environmental pollution





## CORE ANALYSES

Measuring the petrophysical properties of cored material defines the pore space and its size, determines fluid saturation and the ability to produce hydrocarbons, obtain geothermal energy and store carbon dioxide.

A detailed understanding of oil and gas reservoirs, reservoir volume and reserves estimation with determination of production plan, requires additional precise measurements obtained on core samples utilizing special core analysis.

### ROUTINE CORE ANALYSES

- Total and spectral gamma log for precise core depth and log correlation
- Profile permeability on whole core
- Porosity and permeability at standard or reservoir conditions
- Grain density and grain-size distribution analysis
- MicroCT – Digital Rock Analysis

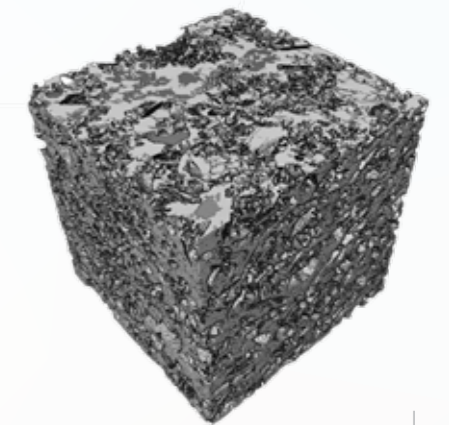
### SPECIAL CORE ANALYSIS

- Capillary pressure, formation factor and resistivity index
- Relative permeability at standard or reservoir conditions for implementation in reservoir simulation
- Pore volume compressibility
- Caprock analysis for underground gas storage
- Permeability change test & return permeability

### DIGITAL ANALYSES OF ROCKS AND POROUS MATERIALS

Digital analyses provide an in-depth insight into the structure and pore space of the scanned sample. We use nondestructive methods, i.e. SEM and micro tomography (x-CT), to create 3D digitized models suitable for digital analyses and simulations. Most valuable rock properties obtained by digital analyses are:

- Porosity and permeability
- Distribution of pore and throat size
- Distribution of grain size
- Capillary pressure
- Electrical properties and tortuosity
- Geomechanical properties





## PVT ANALYSES

PVT analyzes are one of the most important analyzes in reservoir characterization, and they must be performed immediately at the beginning of the production life of the reservoir. With the obtained experimental data, it is possible to create an accurate thermodynamic model of the reservoir fluid and use it to describe the behavior of the reservoir fluid. Furthermore, additional PVT studies in combination with petrophysical tests allow the application of secondary and tertiary methods of increasing the depletion. In terms of experimental fluid characterization, we are implementing tailored workflows for investigation of reservoir oil, gas-condensate or brine samples, either taken as the separator or downhole fluids. Using the PVT laboratory results it is possible to estimate the reserves of oil and gas and to forecast reservoir fluid's properties within reservoir simulation models.

### Reservoir Oil:

- Wellstream analysis – determination of reservoir fluid composition
- Constant Composition Expansion test (CCE)
- Differential Liberation (DL)
- Separator test

### Gas-condensate

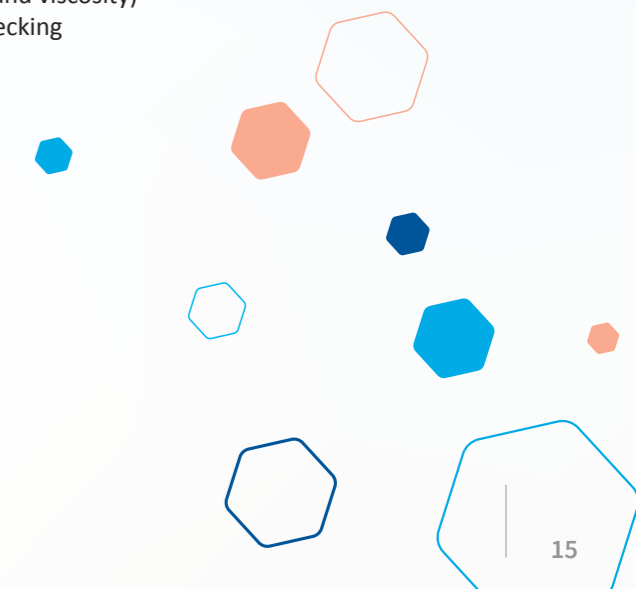
- Wellstream analysis – determination of reservoir fluid composition
- Constant Composition Expansion test (CCE)
- Constant Volume Depletion (CVD)

### Individual analyses

- Basic and extended composition analyses (gas chromatography, GC) of liquid hydrocarbons and natural gas, with calculation of its properties (heating values, density and specific density, Wobbe index and viscosity)
- P-V curve and flash test on separator or downhole samples for quality checking
- Determination of liquid density at standard or HPHT conditions
- Fractional distillation of liquid hydrocarbons (C7+, C10+ methods)
- Viscosity of reservoir fluids at different HPHT conditions
- Separator fluid recombination

### PVT STUDIJE

- EOS characterization – equation of state (PVT software)
- complete PVT study of oil, gas condensate or gas





## FLUID CHARACTERISATION AND RHEOLOGY

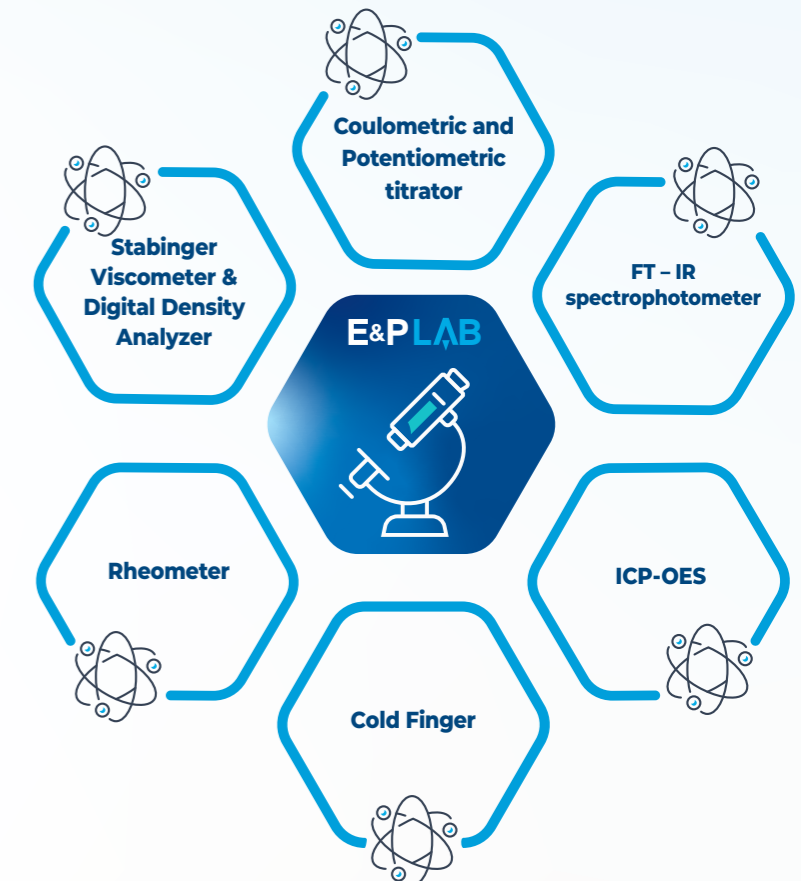
The characterization of crude oil and gas condensate enables to classify them taking into consideration their physical and chemical properties. The properties of crude oil and gas condensate are very important in the design and operation of almost every piece of equipment in the oil industry. According to standard ASTM, ISO and UOP methods, the following characteristics are determined for this purpose: density, viscosity, content of paraffin wax and asphaltenes, distillation curve, content of sulfur, pour point, content of water, etc.

The transport of crude oil must be achieved with minimal energy consumption. Therefore, one of the conditions for the unobstructed transportation of crude oil with an increased content of paraffin wax is the prior modification of crude oil rheological properties. In addition to the rheological properties of untreated crude oil samples (flow curve, viscosity curve, wax appearance temperature, Cold Finger analysis), the rheological properties of crude oil samples with the addition of additives are also determined (pour point depressant, demulsifier, deparaffinator, paraffin inhibitor, etc.) in order to improve the rheological crude oil properties.

The content of hydrogen sulfide and thiols in natural gas and gas condensate is monitored.

Additionally, the total mercury content is determined in gas, gas condensate, crude oil, and petroleum products.

In laboratory, monitoring of lubricating oils, water solutions of ethylene glycol (antifreeze) and triethylene glycol from process equipment is carried out in order to optimize their consumption and monitor the condition of process equipment (corrosion), as well as the efficiency of equipment and processes.





## WATER ANALYSIS

Water analysis is crucial for the accurate understanding and management of water quality in various environments, as well as in industrial and energy applications. Water analyses are conducted for the purpose of characterizing and classifying a wide range of water types, including drilling brine, formation, surface, groundwater, wastewater, process and geothermal waters. Laboratory analyses provide data on the chemical, physical, and biological properties of water. Detailed laboratory water analyses enable the monitoring and assessment of various process parameters, corrosion processes, industrial applications, and water contamination.

Geothermal waters, used for energy production and heating, require precise analytics due to their specific chemical and physical properties, and the data obtained are essential for evaluating the safety and efficiency of water use in industry and energy sectors.

Physical and chemical water analysis:

- pH, electric conductivity, alkalinity, carbonate, bicarbonate, salinity, density
- water hardness (calcium, magnesium, total)
- suspended solids and total dissolved solids
- total solids dried at 105°C
- dissolved gases (oxygen, hydrogen sulphide, carbon dioxide)
- mercury
- anions and cations
- metals
- surfactants (anionic, cationic, non-ionic)
- chemical oxygen demand and biochemical oxygen demand (KPK i BPK5)
- total oil and grease, hydrocarbon oil index
- total nitrogen
- phenols
- Permanganate index of water
- Total organic carbon (TOC) and dissolved organic carbon (DOC)



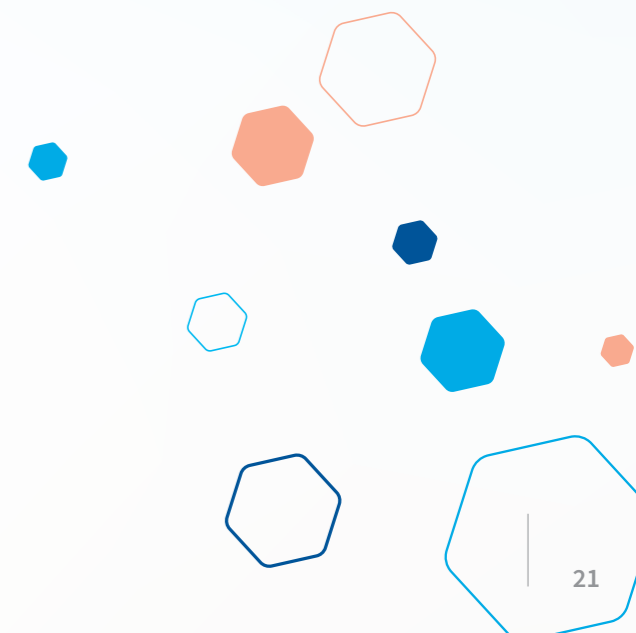
## CORROSION MONITORING

E&P Laboratory services focus on the analysis and control of metal corrosion in petroleum and geothermal explorations and production, ensuring uninterrupted operation of processing facilities and the employee safety. With various methods, techniques, modern tools and laboratory equipment, the effect of corrosion is minimized.

On selected materials, using appropriate control and monitoring methods, the degree of corrosion is quantitatively measured and evaluated, enabling effective corrosion management in oil, gas and geothermal infrastructure systems. Commitment to precision and innovation ensures long-term sustainability and safety in all aspects of exploration and production.

The most commonly used methods for monitoring and testing corrosion effects are:

- Fluid corrosion testing at HPHT and atmospheric conditions,
- Laboratory efficiency testing of corrosion inhibitors at HPHT and atmospheric conditions
- Material resistance to corrosion,
- Effectiveness of fluids used for well stimulation, corrosiveness of packer fluids,
- Solving corrosion problems in the production, transport and fluid storage,
- Corrosion monitoring in the field,
- Studies on the impact of corrosion on production systems,
- Pilot station for testing the effects of corrosion by monitoring corrosion in the field.



## ENERGY TRANSITION

### EOR & CCUS

The E&P laboratory utilizes state-of-the-art equipment and technologies for applying innovations in EOR (Enhanced Oil Recovery) and CCUS (Carbon Capture, Utilization, and Storage) projects.

Daily support is provided for the implementation of field optimization and well stimulation projects in onshore oil and gas fields. Special attention is placed on EOR projects, which are important investments in continental Croatia. These projects aim to enhance hydrocarbon recovery in the Žutica and Ivanić production fields and potentially others.

#### EOR STUDIES (INJECTION OF CO<sub>2</sub>, N<sub>2</sub>, METHANE, RICH OR LEAN GAS)

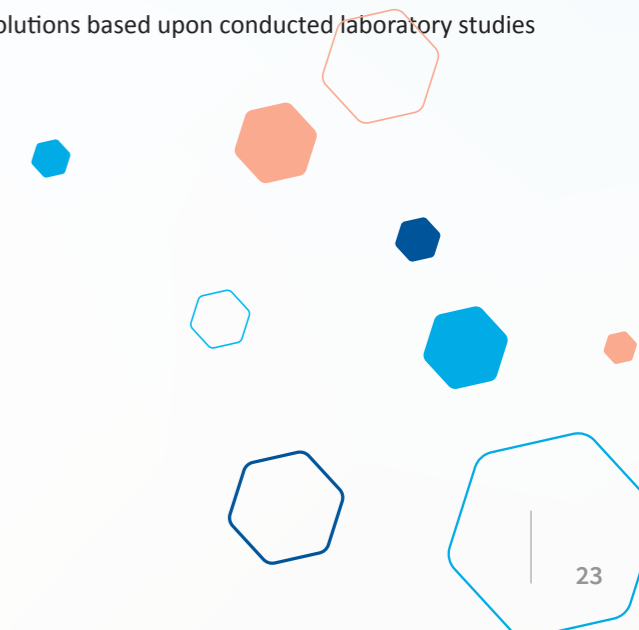
- EOR solubility study and swelling test
- EOR waterflooding, polymer and or surfactant injection study

#### SPECIAL STUDIES OF RELATIVE PERMEABILITIES

- Gas Condensate Blockage Study
- Steady state & unsteady state oil/water and gas/oil relative permeability test at reservoir conditions

#### ADVANTAGES OF USING STATE-OF-THE-ART TECHNOLOGIES

- The best possible solution for maximum exploitation of old wells and reservoirs
- Extend the lifetime of mature oil and gas fields
- Lower the carbon footprint with an active participation in the green transition
- Using existing infrastructure and knowledge to create additional values
- Gaining of extra profit and savings by implementing the best possible solutions based upon conducted laboratory studies

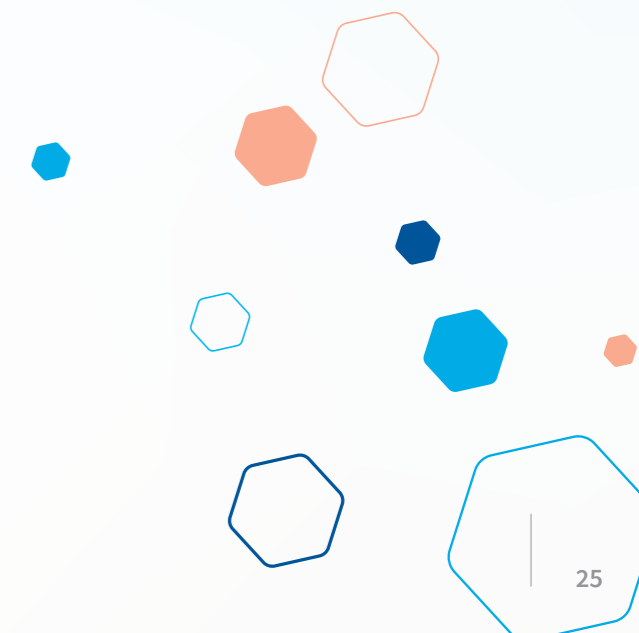


## GEOHERMAL PROJECTS

We dedicate significant attention to geothermal projects, providing a wide range of advanced laboratory services that support research, development, and implementation in this important field. Extensive expertise and experience of the E&P laboratory enable active participation in every step of the process, from the initial phase of geothermal resource exploration and analysis to the development of sustainable and highly efficient solutions. As a result, we not only contribute to sustainability and energy efficiency but also ensure the highest quality standards, contributing to the long-term growth and transformation of the energy sector.

### Specific Analyses for Geothermal Projects

- Complete physical and chemical characterization of geothermal waters
- Determination of phase behaviour of formation water under various pressure and temperature conditions
- Analysis of the quantity and composition of gas dissolved in formation water
- Study of corrosion inhibition
- Study of scale formation inhibition
- Geological, geochemical, and petrophysical analyses of rock material, etc.



## REFERENCE LIST



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