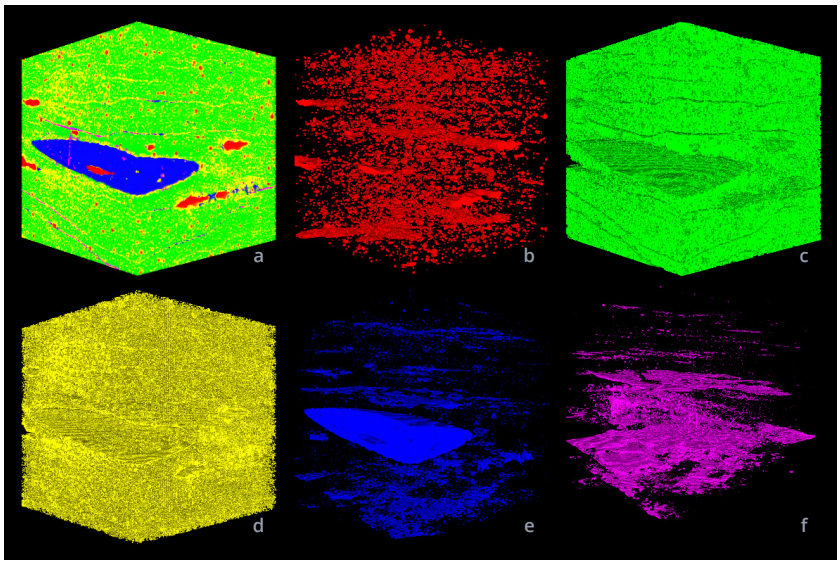
Laboratory Capabilities

APPLIED SUBSURFACE CHARACTERIZATION

THE NEED FOR PRACTICAL, economical, and environmentally sound energy solutions has never been more urgent. The Energy & Environmental Research Center (EERC) has a strong energy research heritage in conducting applied research and development in pursuit of real-world solutions to pressing energy and environmental issues for clients worldwide. As energy sources and needs have changed, the EERC's facilities have grown and changed with them.

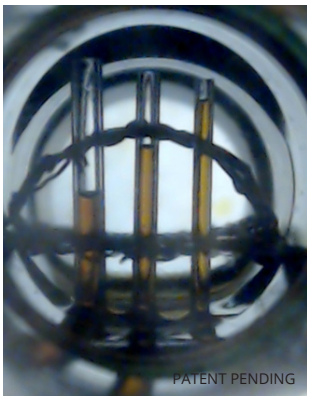
EERC laboratories possess analytical capabilities suitable for determining properties of subsurface reservoir rocks and materials used throughout the petroleum industry and CO_2 storage. Past evaluations have focused on assessing petroleum systems and applications for CO_2 storage throughout the Williston, Denver–Julesburg, Alberta, and Powder River Basins. Specific assessments have focused on the determination of proppant strength and conductivity, mechanical rock properties, petrophysical characteristics of rocks, and chemical effects of rock and fluid interactions. In each case, EERC researchers have worked with industry and government partners to provide results of site-specific evaluations conducted at multiple scales of examination.

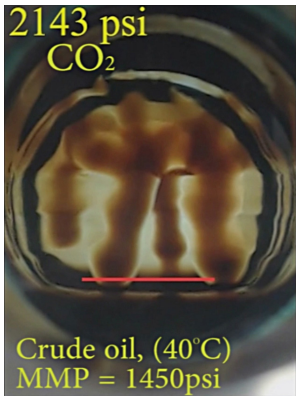


Digital image analysis of a Lower Bakken Shale core plug: a) composite image, b) isolated pyrite grains, c) dense matrix grains, d) less dense matrix grains, e) organic matter, and f) pores.

In September 2015, results of research conducted by EERC laboratories were featured on the cover of the Society of Petroleum Engineers monthly publication, Journal of Petroleum Technology. The image showcases the use of scanning electron microscopy for the determination of mineralogical content and identification of fractures in a tight petroleum reservoir.

CO_2 miscibility is a determining factor in the mobilization and production of hydrocarbons. The EERC is conducting research demonstrating an improved method for determining this physically.





RESERVOIR CHARACTERIZATION

GEOCHEMICAL

- Batch reaction vessels rated to 6000 psi and 350°C
- Multisample continuous exposure for extended durations

ROCK PROPERTIES

- Optical mineralogy/thin-section analysis
- Core description
- Sample selection/preparation
- Porosity/bulk volume/grain volume/grain density
- Permeability to air and water
- Fracture analysis
- Relative permeability
- Wettability analysis

ORGANIC GEOCHEMISTRY

- Aromatic/aliphatic determination
- MMP (minimum miscibility pressure) studies
- Mixtures of CO_2 and hydrocarbon gases routinely handled
- Supercritical CO_2 extraction of hydrocarbons from reservoir rocks
- Oil fingerprinting

FLUID SAMPLING & ANALYSIS

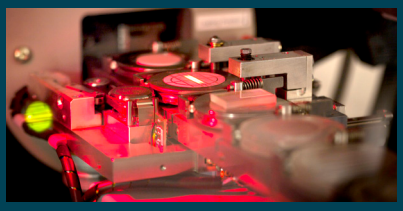
- Fossil fuels
- Rare-earth elements (REEs) and high-value minerals
- Biomass
- Combustion by-products
- Plant materials
- Groundwater
- High TDS (total dissolved solids) reservoir brine
- Wastewater
- Pressure, volume, temperature (PVT) determination

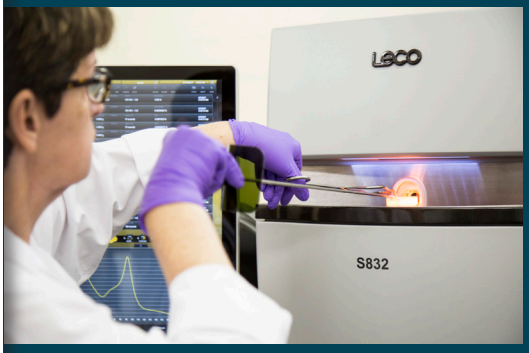
MATERIAL ANALYSIS

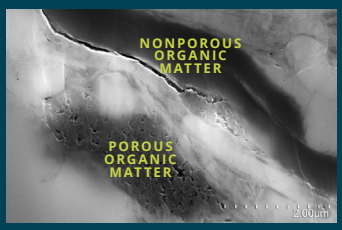
- Scanning electron microscopy equipped with x-ray microanalysis
  - Quantitative chemical analysis
  - Image analysis
  - Mineral-phase mapping
- Field emission scanning electron microscopy with ion mill sample preparation
- X-ray fluorescence
  - Bulk chemical analysis
- X-ray diffraction
  - Quantitative phase analysis
  - Clay-typing analysis

CAPABILITIES

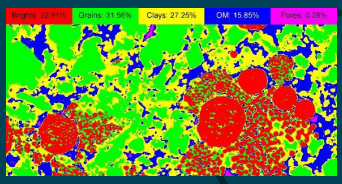
RESERVOIR CHARACTERIZATION



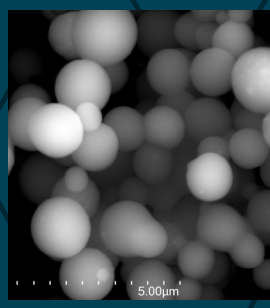




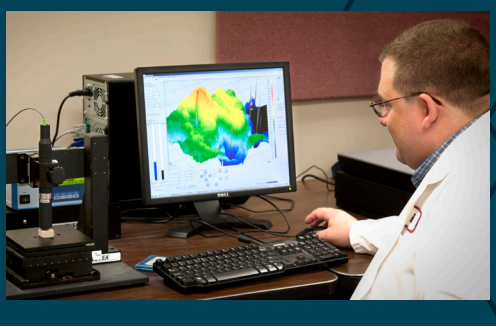
ORGANIC GEOCHEMISTRY



FLUID SAMPLING & ANALYSIS

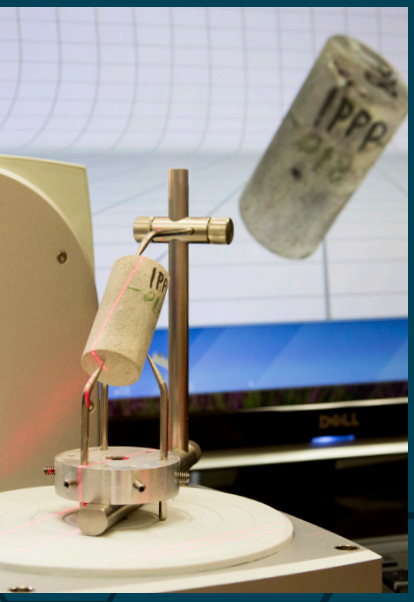


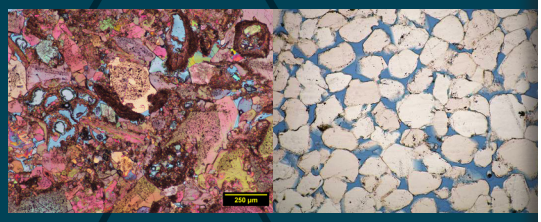
MATERIAL ANALYSIS



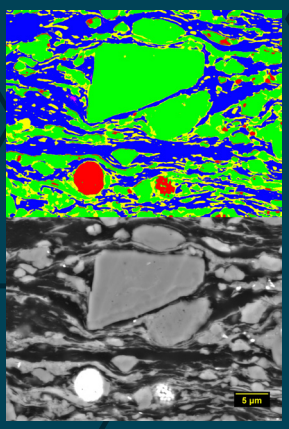
EXPERTISE

CONVENTIONAL OIL RESERVOIRS





UNCONVENTIONAL TIGHT RESERVOIRS



CO_2 STORAGE & EOR

PUBLICATIONS

Integrating petrographic and petrophysical analyses with CO_2 permeation and oil extraction and recovery in the Bakken tight oil formation, SPE-185081-MS.

Measured crude oil MMPs with pure and mixed CO_2, methane, and ethane and their relevance to enhanced oil recovery from Middle Bakken and Bakken shales, SPE-185072-MS.

Utilization of produced gas for improved oil recovery and reduced emissions from the Bakken Formation, SPE-184414-MS.

Extraction of oil from the Bakken shales with supercritical CO_2, URTeC Paper No. 2671596.

Effects of reservoir temperature and percent levels of methane and ethane on CO_2/oil MMP values as determined using vanishing interfacial tension/capillary rise, Presented at the 13th International Conference on Greenhouse Gas Control Technologies (GHGT-13), 2016.

Laboratory characterization and modeling to examine CO_2 storage and enhanced oil recovery in an unconventional tight oil formation, Presented at the 13th International Conference on Greenhouse Gas Control Technologies (GHGT-13), 2016.

Characterization and evaluation of the Bakken petroleum system for CO_2 enhanced oil recovery, URTeC Paper No. 2169871.

Relative permeability of Williston Basin CO_2 storage targets, Presented at the 13th International Conference on Greenhouse Gas Control Technologies (GHGT-13), 2016.

Investigation of improved conductivity and proppant applications in the Bakken Formation, SPE 163489.

CO_2 storage and utilization in tight hydrocarbon-bearing formations—a case study of the Bakken Formation in the Williston Basin, Energy Procedia, v. 63, p. 7852–7860.

MORE INFORMATION AVAILABLE AT

UNDEERC.ORG

LABS AT A GLANCE

APPLIED GEOLOGY LABORATORY (AGL) has the ability to perform testing ranging from basic petrographic and routine core analysis to advanced evaluations such as relative permeability and proppant embedment.

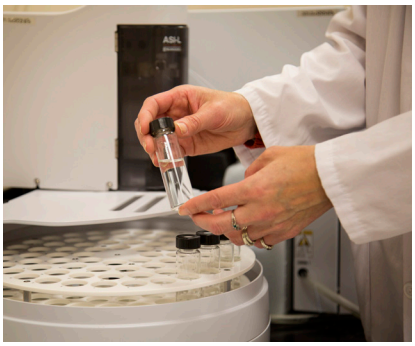
ANALYTICAL RESEARCH LABORATORY (ARL) is equipped for routine and specialized analyses of inorganic and organic constituents using laboratory procedures and analytical methods that adhere to nationally and internationally recognized or approved standards and methods.

FUELS AND MATERIALS RESEARCH LABORATORY (FMRL) analyzes coal and other fuels, determines the physical properties of coal ash and other ceramic materials, and tests the utility of coal ash as a valuable by-product of coal utilization.

NATURAL MATERIALS ANALYTICAL RESEARCH LABORATORY (NMARL) provides a full range of advanced materials characterization and data interpretation.

ENVIRONMENTAL CHEMISTRY LABORATORY focuses on extraction and analytical method development to study the mechanisms of environmental fate, transport, and removal of organic pollutants.

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