Short Description

ROOT (ReservOir PrOperties from ExperimenTal Workflows) is our state of the art laboratory characterization products. It comprises RCAL, SCAL, Rock Mechanics and High Resolution Petrophysical properties.
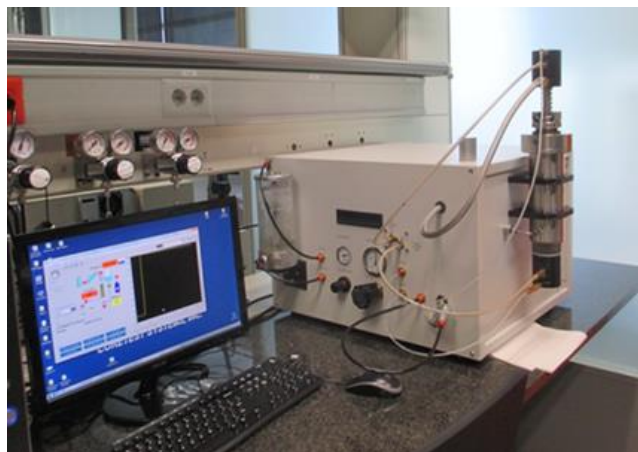
Deliverable

- RCAL Data (Porosity, Permeability, NOP)
- SCAL Data, (NMR, Pc, m, n, FF, Vp, Vs, Wettability)
- Rock Mechanics (Young, Poisson, UCS, Triaxial Testing)
- High Resolution Petrophysics (UCS, Mineral Composition, Permeability, Vp, Vs, Young Modulus) [Continuous log at mm resolution on non slabbed and slabbed cores.
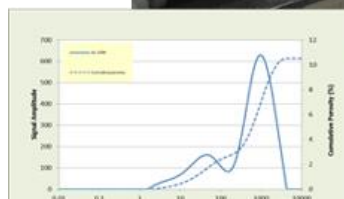
Benefits

- Poro-perm generates values of porosity and permeability for reservoir performance calculation.
- All the Special Core Analysis (SCAL) techniques use the results of these tests.
- SCAL data is used to support log and well test data in gaining an understanding of individual wells and overall reservoir performance.
- Better Velocity models for inversion/migration geophysical protocols.
- Increase knowledge for petrophysical evaluation of AVA/AVO applications.
- Fully integration between rock mechanics and petrophysical data (ALL in 1 lab)

General view of the He Porosity and Permeability equipment

Differential Features

- Poro-perm: Unsteady state permeability measurements using pulse decay method gives more accurate and quicker results than steady state measurements with a time reduction in data reporting.
- NMR equipment can apply confining and pore pressure.
- Capillary pressure curve can be obtained for unconsolidated samples with the ultracentrifuge.
- Taylor-made test protocols for rock type or kind of rock mechanics problem.
- Simultaneously mechanical/petrophysical testing capability on the same sample.
- Full client interaction during testing plan execution.

General View of NMR with the magnet module on the right and the pressure and temperature module for reservoir conditions on the left. T2 distribution and porosity plot.

Requirements

- Cylindrical with parallel faces following the ASTM rock samples (plugs) of 1'' and 1.5'' of diameter and a maximum length of 4''.
- Samples have to be dry to start laboratory protocols.
- Certain dimensions are needed for specific instrumentation protocols.
- At least three samples at very close depths (as similar as possible) for failure envelope calibration are needed.
- CT Scan images for plugs quality control (recommended).
- Full core for High resolution Petrophysics

Limitations

- Permeability from 0.001 to 10,000 mD and porosities from 0.1 to 40% can be measured.
- Core plugs must meet the geometrical specifications and faces parallelism established on the International Standards ASTM D-4543 and on the Suggested Methods of the ISRM.
- Samples should be used only for one type of experiment.
- Avoid samples with very low pore volume and very high permeability in the ultracentrifuge test.
- Capillary pressure curve on low porosity and permeability samples could not be obtained with conventional methods.

The Product in Depth

Sample handling, acquisition, cleaning and conditioning (Irreducible Water Saturation State, Wettability Indexes Measurement by Amott-USBM Method, Wettability Indexes Measurement (USBM Standard)) if needed. Poro-Perm Analysis is based on boyle/darcy helium system. FF/m/n acquisition is based on custom made saturation/resistivity system. Pc/Ultracentrifuge uses a high precision camera to monitor specific fluid production at certain centripetal force. NMR studies are conducted adding a gradient to the magnetic field to obtain 1D images of the saturation of the sample based on hydrogen spin response. Rock Mechanics protocols uses Stress/Strain measurements for elastic modelling. Critical paths and peak load triaxial testing are used to access failure criteria modulus. High Resolution petrophysycal protocols provide reservoir properties in a continuous log (mm scale) on full core samples. They are based on the application of a scratch machine and a high-end robot with several Multiphysics tips to obtain multiple points of petrophysical properties in the core slabbed plane face at cm spacing. Specific, deeper information on each named protocol and instrument can be delivered on demand.

Some Use Cases

Use Case / Model	Client	User	Cost (K€)	TimeToMk (m)
Special and Routine core analysis on core samples from several wells from Reggane (RG-5, RG6, RG-16ST, RG-20) (Algeria) (2018)	• Algeria	• Petrophysics • Reservoir Engineers	20	5
Special and Routine core analysis on core samples from MGR-5/MGR-6/MGR-7/MGR-8 of Margarita field and SRB-I5/SRB-A3/SRB-B1/SRB-D1 on Mamoré field on Bolivia (2017-2018)	• Repsol Bolivia	• Geologists • Petrophysics • Reservoir Engineers	80	9
Mechanical characterization of the Margarita and Mamoré fields for feeding 1D/3D Mechanical Earth Models (2018)	• Repsol Bolivia	• Petrophysics • Geomechanics	38	1
Scratch test campaign on the well cores: HST-1X and CKD-1X_ST1. This study help the client to take the decision for sampling the mechanical less competence rock for a Sanding study. (2016)	• Repsol Vietnam • Petrovietnam	• Geomechanics	32	0,5