MAPSA

UPSTREAM LABORATORY

Profile

2020

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INTRODUCTION

MAPSA CORE ANALYSIS LABORATORY

MAPSA Upstream Laboratory Complex is one of the most equipped and unique specialized laboratories in the non-governmental oil industry in the Middle East.

The laboratory has the ability to perform Conventional and Special core analysis tests (RCAL and SCAL), Geomechanic, Formation damage, Acid treatment, EOR, and geological studies. It is also capable of conducting Fluid Analysis Tests (PVT) and all geochemical tests in cooperation with its external and internal partners.

With a record of around 9 kilometers of core analysis, the unit has extracted the reservoir characteristics of some of the world's largest oil and gas fields and created an extensive database of reservoir characteristics.

The aforementioned capabilities enable the R&D team of the company to provide basic solutions to production problems and consequently, increase the hydrocarbon production.

MAPSA core analysis laboratory can implement the following operations:

Routine Core Analysis (RCAL)

Special Core Analysis (SCAL):

Formation Damage and Acidizing

Geochemistry Analysis:

Advanced Petroleum Geomechanics Laboratory

1. ROUTINE CORE ANALYSIS (RCAL)

Routine Core Analysis instruments are used to measure the properties of rock samples. The reservoir properties and accurate input data are provide for a geological model.

Core gamma, porosity, permeability and fluid saturation are measured as well as lithology and other parameters. Besides, imaging and preservation of cores are done in MAPSA‘s RCAL laboratory.

Available Services:

- X-Ray tomography (core & plug CT-scanning)
- Gamma-ray logging (spectral and total core gamma, depth matching)
- Core preparation (inspection, layout, cleaning, & marking)
- Core sampling
- Core plugging (consolidate & unconsolidated cores, in diameters of 1, 1.2 and 1.5 inch)
- Plug trimming
- Soxhlet cleaning
- Humidity and conventional oven drying
- Dean-stark saturation determination
- Mounting of unconsolidated sand and fractured carbonates
- Ambient Helium porosity and grain density determinations.
- Gas permeability determination & Klinkenberg correction
- Klinkenberg absolute permeability
- Porosity & permeability determination at overburden Condition (up to 10000 psi)
- Brine permeability determination
- Whole core preservation in Wax
- Core slabbing
- Digital core photography (UV & white)
- Core resignation
- Core storage

2. SPECIAL CORE ANALYSIS (SCAL)

Special core analysis instruments are utilized to measure rock and fluid properties at ambient and reservoir temperature and pressure conditions to reduce

Late the real reservoir conditions in order to evaluate the parameters required to model oil and gas reservoirs. Besides, all the hydrocarbon production mechanisms taking place in the reservoir can be studied here and eventually upscaled the results to the reservoir dimensions.

Available Services

- **Sample preparation**
  - Formation brine preparation using different salts
  - Sample saturation
  - Flooding to irreducible water saturation
  - Fluid viscosity and density determination at ambient pressure and any desired temperature condition.
  - Wettability restoration

- **Electrical properties**
  - Formation resistivity factor (FRF), with cementation factor (m), under ambient and reservoir overburden pressure conditions.
  - Formation resistivity index (FRI), with saturation exponent (n), under ambient and reservoir overburden pressure and temperature conditions using reservoir dead oil or synthetic oil. (equilibrium or non-equilibrium methods)
  - Cation exchange capacity (CEC), by core conductivity method (Co/Cw).

- **Impact of overburden (stress) up to 10,000 psi**
  - Determination of pore volume compressibility and porosity reduction.

    Absolute and effective permeability determination.

- **Capillary pressure**
  - Air-brine, air-oil and oil-brine using the porous plate technique samples, at ambient and reservoir overburden pressure and temperature conditions.
  - Air-brine, air-oil and oil-brine using the porous plate technique samples for 15 samples at the same time, at ambient and reservoir overburden pressure.
  - Ultra speed centrifuge technique (up to 13000 RPM) at any desired temperature.
  - Mercury injection capillary pressure (up to 60000 psi)

- **Pore size distribution**
  - Mercury injection capillary pressure (up to 60000 psi)

- **Wettability**
  - Amott cell, USBM (centrifuge), combined Amott/USBM

- **Relative permeability**
  - Unsteady and steady state displacement methods by gas, water or oil
  - Drainage and imbibition full curves and end points determination at ambient and reservoir conditions, with dead and live oil
  - Residual gas saturation determination

- **Nuclear Magnetic Resonance (NMR)**
  - Evaluation of property of pay formation

- Porosity and permeability of core and cutting samples
- Pore size distribution
- Qv determination
- T2 cutoff calculation and separation of movable (FFI) and Bound Fluids (BFV) parts and effective porosity (MPHI) and total porosity (MSIG) measurement on plug or cutting size samples.
- Wettability characterization
- Low resistivity reservoir study

➢ **Fluid Characteristics**

- Interfacial Tension measurement (IFT) at ambient and reservoir conditions
- Sara analysis

3. GEOCHEMISTRY

MAPSA geochemistry department with cooperation of its joints can perform following geochemistry analysis:

- **Sample handling & preparation:**
  - Sample washing & drying
  - Contaminated sample preparation (hand pick cuttings)
  - Oil based mud (OBM) Removal
  - Water based mud (WBM) Removal
  - Basic sample prep (grinding)

- **Rock Eval pyrolysis (Rock Eval 6)**
  - Basic analysis
  - Advanced analysis
  - Kinetic analysis of source rocks (3 Temp or 5 Temp)

- **Thermal maturity analyses**
  - Sample preparation (kerogen Isolation)
  - Vitrinite reflectance (%RO)
  - Thermal alteration index

- **Extraction of organic matter (EOM) by soxhlet**

- **Liquid chromatography (SARA analysis)**
  - Asphaltene separation by IP-143 standard
  - Maltene separation by D-2007 standard

- **Elemental analysis**
  - Analysis of C, H, N, S and O (Oxygen determined by difference)
  - Trace elements (such as Ni, V, and etc.)

- **Pyrolysis gas chromatography of source rocks (PY-GC)**

- **Gas chromatography (GC)**
  - Saturate gas chromatography
  - Aromatic gas chromatography
  - Whole oil GC (WOGC)

- **Gas chromatography- mass spectroscopy (GC-MS)**
  - GC-MS quantitative saturate biomarker
  - GC-MS quantitative aromatic hydrocarbons

- **Isotopic analysis**
  - Stable carbon analysis (whole oil, SARA fraction of oil)
  - GC-IRMS of saturate and aromatic fractions
  - Kerogen isotope Analysis (performed on isolated kerogen)
  - δ13C of hydrocarbon gases
  - δ13C of carbon dioxide
  - δ13C and δ18O on carbonates
  - Deuterium analysis of gases
  - Deuterium analyses of oils
  - Sulphur isotope analysis of oils

- **Fourier transforms infrared spectroscopy (FTIR)**

- **X-ray diffraction (XRD)**
  - Bulk sample
  - Oriented clay mount

- **Scanning electron microscopy (SEM)**

4. GEOMECHANICS

Advanced triaxial tests' system enables MAPSA to perform almost all kinds of geomechanical tests under laboratorial and reservoir conditions with changing the values of saturation percent, pore pressure, temperature, and different stresses.

The following are a list of services render in this section;

- **Performing of the ultrasonic wave velocity test under ambient and reservoir conditions (in various temperatures, pore-pressure, and stress)**
  - Measuring the dynamic elasticity parameters under different laboratorial and reservoir conditions

- **Performing of the fracture toughness test with the aid of CB and CCNBD methods**
  - Measuring critical stress intensity factor

- **Preforming of the uniaxial tests under different laboratorial and temperature conditions**
  - Measuring the UCS, elastic modulus, and Poisson ratio

- **Preforming of the triaxial tests under different laboratorial and reservoir conditions**
  - Measuring the Mohr-Coulomb criteria parameters (cohesion (C) and friction angle (φ))

- **Preforming of the Biot test by measuring of the volumetric strain or of wave velocity under different temperature and pressure**
  - Measuring the Biot coefficient, bulk and grain modulus

- **Preforming indirect tensile strength (Brazilian methods)**
  - Measuring the tensile strength

- **Preforming the hydraulic fracturing tests under various confining pressures**
  - Measuring the break-down pressure (fracture pressure gradient) and hydraulic tensile strength

- **Preforming direct shear test**
  - Measuring friction angle, cohesion, normal and shear stiffness of joint

- **Preforming creep test**
  - Measuring Burgers' model parameters in order to predict the creep behavior of the sample

5. FORMATION DAMAGE & ACIDIZING

- **Formation Damage**
  - Simulating drilling mud circulation process
  - Fulfilment of various enhanced oil recovery techniques (water based and gas based methods)
  - Determination of the penetration depth of drilling mud filtration into the formation
  - Measuring rock permeability before and after formation damage using oil or water
  - Estimation of damage due to drilling mud filtration around the wellbore both in static and dynamic conditions
  - Evaluating the well productivity index before and after damage

- **Matrix Acidizing**
  - Simulating matrix acidizing operation
  - Determination of optimized acid injection rate
  - Evaluating the efficiency of different acid additives in acidizing process
  - Investigation of the effect of acid on rock structure
  - Measuring rock permeability before and after acidizing operation using oil or water
  - Measuring Acid-rock reaction
  - Testing chemical diverters

Evaluating the well productivity index before and after matrix acidizing scenario

6. STUDIES & PROJECTS

Studies and Projects performed by Core Analysis Laboratory of MAPSA

Item	The subject of the contract	length	Client	Contract duration (months)	Contract start date	Date of termination
1	Core analysis and geological study on GOLSHAN-4 gas field (KANGAN & DALAN formations	**347.3**	POGC	120	2008/12	2012/06
2	Core analysis and geological study on GOLSHAN-5 gas field (KANGAN & DALAN formations	**595.9**	POGC		2010/07	2015/03
3	Core analysis and geological study on FERDOUS-3 oil field (DARIAN & FAHLIAN formations	**240.73**	POGC		2010/09	2012/08

4	Routine and Geomechanic study on SPD-18 gas field (KANGAN & DALAN formations)	**405.35**	POGC		2014/3	2016
5	Routine core analysis and geological study on SPD-21 (KANGAN & DALAN formations)	**406.7**	POGC		2014/4	2016
6	Core analysis and geological and geochemical study on SPD-16 gas field, (KANGAN & DALAN formations)	**402.16**	POGC		2011/05	2016
7	Routine core analysis and geological study on SPOC pikot field, (KANGAN & DALAN formations)	**167.11**	POGC		2012/10	2015
8	Routine and Special core analysis and geological study on cores from ICOFC Co.	**604.11**	NISOC	24	2011	2011
8.1	Fields : • Aabaan(Aasmaari & Sarvak formatiions (45m)) • CHESHMEKHOSH (Aasmari, GURPI & ILAM formations (142.95m)) • Saadatabad (ILAM & SARVAK formations (59.06m)) • SARKHON (RAAZAK formation (36.3m)), • SARVESTAN (SARVAK formation (55.7m)) , • PAYDAR GHARB (SARVAK formation (27m)) , • KHANGIRAN (MOZDOURAN & SHOORIJEH formation (183.3m) , • GONBADLY (SHOORIJEH formations (54.8m))					

9	Routine core analysis & geological study & geochemical & geomechanic experiments on SPD-13 C&D (KANGAN & DALAN formations (377.83m))	**377.83**	PGFK	60	2012	2015
10	Consulting Service for core analysis and geological study of IOOC (RCA , geological , SCAL , geomechanic, and geochemical)	**1381.38**	IOOC	66	2011	2015
10.1	• HANGAM: (DARIAN formation) RCAL geological study (10m) • SOROUSH: (Asamari, Darian, Burgan, Gadvan, Yamama fromations) RCAL SCAL, geological, geomechanic, NMR (661.51m) • GAVARZIN: (Aasmari and Gachsaran formations) RCAL, SCAL, geological study, (180.35m) • ABOOZAAR: (Aasmari and Dammaam formations) RCAL, SCAL, geological study and formation water injection (167.43m) • RESHADAT: (Sho'ayba, Arab, Hait formations) RCAL SCAL, geological & geochemical study, (124.53m) • SALMAAN: (Bouvaib, Sho'ayba, Havaar, Zoubir formations) RCAL, SCAL, geological, geomechanic and NMR (207.41m) • ESFANDIAR: (Yamama, Ratavi, Kajdomi, Medved formations) RCAL and geological (30.15m)					
11	Core Analysis (RCAL, SCAL, Geological, Geomechanic, Geochemistry) for NISOC Company	**3538**	NISOC	96	90/12/06	in progress

- Fields of Experiment:
- AHWAZ: (Aasmari formation) RCAL, SCAL, geological, NMR
- BALAROOD: (Aasmari formation) RCAL and geological study
- RAMSHIR: (Aasmari formation) RCAL, SCAL, geological & geochemical study
- QALENAAE: (Aasmari formation) RCAL, SCAL, geological & geochemical study and NMR
- MANSOORI: (Aasmari formation) RCAL, SCAL, Geomechanic
- MANSOORABAD: (Aasmari formation) RCAL, and geological study
- LALI: (Aasmari formation) RCAL, SCAL, geological study
- PARSIAH: (Aasmari formation) RCAL, SCAL.
- KOUPAL: (Aasmari formation) : RCAL, SCAL, geological and geochemical study
- CHAHARBISHEH: (Aasmari formation) RCAL, SCAL, geological study
- GACHSARAN: (Aasmari formation) RCAL and geological study
- KABOOD: (Aasmari formation) RCAL , SCAL, geological study
- BIBIHAKIMEH: (Aasmari formation) RCAL and geological study
- KARANJ: (Aasmari formation) RCAL, SCAL, geological study
- MAROUN: (Aasmari formation) RCAL, SCAL, geological study
- PARANJ: (Aasmari formation) RCAL, SCAL, geological study
- Aabteimour: RCAL, geological study
- Karoon: SCAL

12	AZAR Field , SARVAK formation,SCAL		TAVANA Co.	24	95/06/06	97/9/30
13	AZAR Field , SARVAK formation,NMR	20samples	SAED	3	98/10/10	98/12/10
14	SPD14B-08 well: (KANGAN & DALAN formations) RCAL SCAL, geological, NMR, Geomechanic	**180.63**	TA'SISAAT DARYAYI Co.	24	96/2/20	98/02/15

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