

### Knowledge

D&M employs experienced petroleum engineers, exploration geologists, geophysicists, petrophysicists, and economists to support its work in estimating reserves and analyzing development recovery strategies for unconventional reservoirs.

### Integrity

Through training programs and engagements in major projects, the firm has helped hundreds of clients around the globe develop clearer pictures of how unconventional reservoirs work.

### Service

D&M provides guidance to help clients develop the most effective development and recovery plans, from first wells to enhanced recovery.

## Maximizing Recovery from Unconventional Resources Requires more than Conventional Knowledge

### Answers for Unconventional Resources

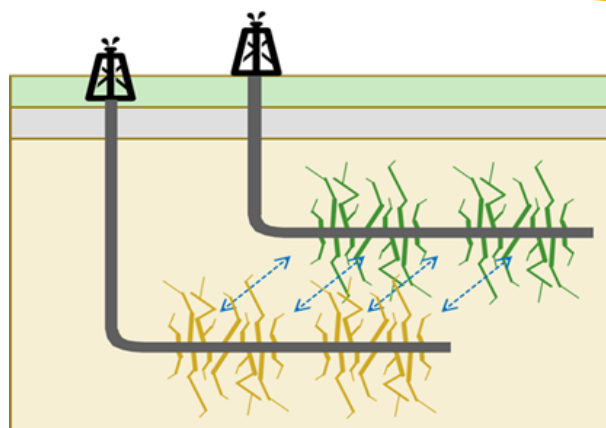
DeGolyer and MacNaughton offers a diverse range of services supporting the evaluation and development of unconventional resources. More and more often, D&M is being called upon to help clients understand how these reservoirs work and to provide support in the design of reservoir evaluation and testing programs that can guide development plans. The firm is also called upon to conduct economic evaluations and to estimate resources and reserves for these unconventional reservoirs.

### Industry Studies

D&M can provide insights regarding basin potential, the applicability of emerging technologies, practices that are most cost-effective, and why various projects in coals, shales, and tight sands/carbonates have been successful or unsuccessful.

### Experience

D&M has extensive experience with unconventional resources:



D&M's involvement in unconventional resources started with Mitchell Energy in 1982, and since then D&M has gathered significant experience and working knowledge on almost all the basins across the world. D&M annually evaluates reserves in more than 50,000 wells just in North America.

In addition to reserves and resource evaluations, recent projects include rate-transient analysis, fracture modeling, reservoir characterization, and modeling studies in various plays in North America and Argentina. D&M has recently performed several integrated reservoir studies in the Middle East, Africa, and Asia. Of particular note, D&M was involved in the exploration, well completion design, and execution of the first offshore unconventional horizontal well pilot in Bahrain.

D&M has been very active in developing novel tools and leveraging internal knowledge built upon studies for many years. D&M has developed Citrine software and has recently been actively utilizing "Big Data" driven solutions.

#### Reservoir Characterization

Petrophysics in unconventional reservoirs

Evaluation of geochemistry

Fluid properties and phase behavior in nano-pores

Rock properties and geomechanics

#### Completion and Stimulation

Completion design and optimization

Natural fractures interaction

Lateral landing point

Choke management and flowback interpretation

#### Reservoir Performance and Reserves

Production diagnostics and flow regime analysis

Model-based completion efficiency analysis

Model-based production forecast

Uncertainty assessment in ultimate recovery

Well spacing and field development analysis

Type curves and relationship with reserves categorization

#### Training and Workshops

Formation evaluation techniques for unconventional resources

Well performance analysis and forecasting for unconventional resources

In-house training



*Description of Services - The main objective is to assist and advise in all aspects of unconventional resources*

# Well Performance Analysis and Reservoir Studies

## Support

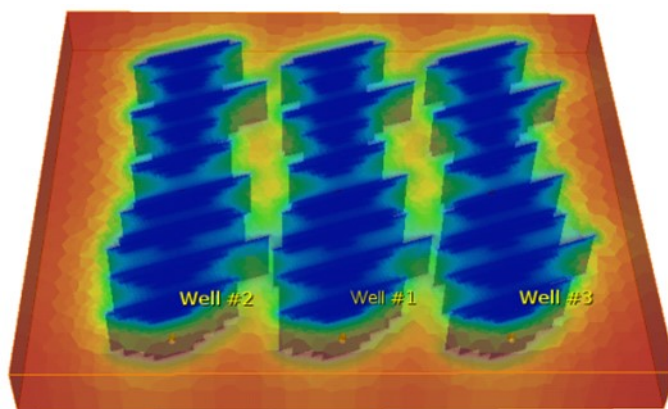
D&M's personnel travel around the world to provide one-on-one support to clients, and D&M staff are readily available for conference-call consultations.

## Advanced Technology

D&M has made significant investments in computing resources and software development to deliver the answers that clients need.

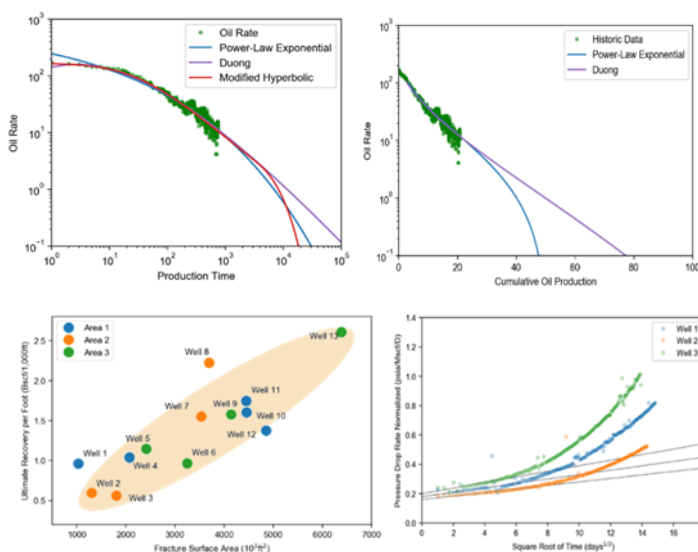
## Solutions

D&M offers a wide range of services to help clients appraise, evaluate the potential of, and improve access to unconventional reservoirs.



## Estimation of Reserves

D&M is a recognized industry leader in the estimation of oil and gas reserves using PRMS, SEC, COGEH, and other reporting standards. D&M applies multiple techniques, including well performance analysis, analytical/numerical modeling, and analogous reservoirs to its estimation work. During the 2018 reserves and resources evaluation cycle, D&M evaluated almost 50,000 wells across all unconventional plays.



D&M applies a systematic methodology that combines diagnostic methods with analytical and numerical techniques to interpret and forecast well performance for unconventional reservoirs. This methodology assists with understanding what controls productivity, evaluating completion and stimulation effectiveness, and providing recommendations regarding well length, well spacing, hydraulic fracture spacing, etc.

Integrated reservoir simulation studies can be used to clearly characterize reservoir behavior and identify strategies to improve recovery. Integrated studies accumulate the knowledge gained from individual geoscientific analyses to create a comprehensive view of the drive mechanisms and hydrocarbon properties. D&M is able to apply specific disciplines to help clients with pre-drilling exploration work and post-drilling development work.

## SERVICES AVAILABLE:

- Reserves and Resources
- Reservoir Characterization
- Fracture Modeling
- Completion Design
- Well Performance Analysis
- Production Forecasting
- Field Development
- Data Collection Programs
- Training and Workshops



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