Integrated Shale Gas Workflow

Due to the interdependence of the reservoir parameters that determine the economic potential of a shale gas play, close integration is required between the subsurface disciplines throughout the entire evaluation process. This means, for example, that the reservoir engineer must be involved in building the static model, and the geologist in developing the dynamic model.

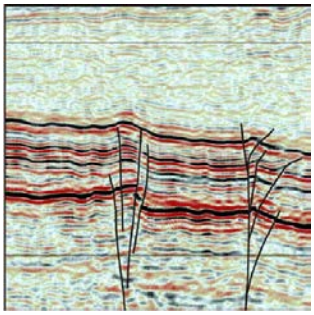
We have divided our Shale Gas Workflow into three main components:

- Prospect Evaluation
- Resource Potential
- Reserves and Development

Within each particular area, a number of specific deliverables will be provided (more than 80 in total; depending upon the available data).

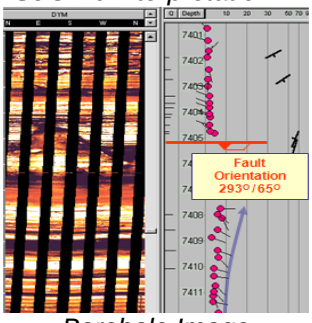
Prospect Evaluation

The Shale Gas Prospect Evaluation focuses on gathering all available data and information within a basin that is relevant to gain a full understanding of the basin's evolution and source rock potential.

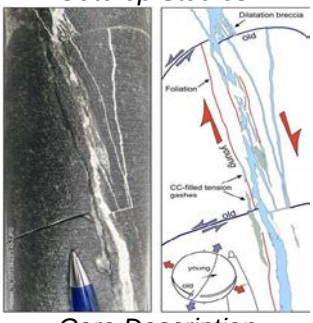


Seismic Interpretation

Outcrop Studies



Borehole Image



Core Description

In this process we recognize six main areas of interest which require a thorough assessment by a multidisciplinary team:

- Tectonic history and Structure
- Stress system
- Stratigraphic overview
- Petroleum system
- Geochemistry
- Regional or Basin synthesis

The results of this process will be used to build a strategy for the development of the resource play.

Resource Potential

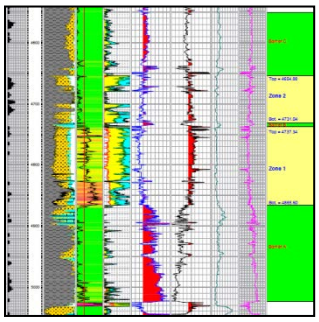
The Shale Gas Prospect Evaluation is followed by the assessment of the resource potential. In this phase, the focus of the evaluation process is placed upon: Matrix Storage Capacity; In-depth Analysis of the Natural Fracture System; Fluid Properties; and Dynamic Estimation of Gas in Place. The result of this evaluation phase will be a geological model that consists of:

- Structural framework
- Stratigraphic framework
- Sweet spot distribution
- Hydraulic rock properties
- Discrete Fracture Network model
- Volumetrics (HC in place)
- Distributary drainage volumes
- Uncertainty and risk assessment

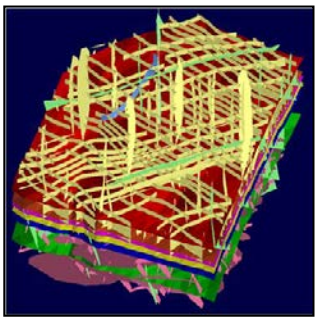
An important component of this evaluation phase will be a Discrete Fracture Network (DFN) Model which, in addition to providing estimates of the resource potential, supplies the basis for the subsequent planning and execution of drilling, completion and stimulation, and field development planning.

The DFN approach can be defined as a modeling and analysis technique that explicitly incorporates the geometry and properties of discrete fractures as a central component controlling flow and transport.

DFN models incorporate also the properties of the matrix system which, in shale gas, provides most of the gas content in the form of free and adsorbed gas (dual porosity/single permeability model).



TOC & Gas Content



Reservoir Model

The basic steps for the construction of a DFN model consist of the following tasks:

- Characterization of features such as large scale faults derived from seismic data
- Identification of smaller-scale features such as sub-seismic faulting / fracturing and joint sets
- Statistical modeling of the various fracture sets derived from the analysis of outcrop, cores, and image data

Building a DFN model requires the estimation of the properties associated with each of the fracture sets observed in the data, the main ones being represented by:

- Static properties, such as size and aperture distribution, dip and dip azimuth distribution and density
- Dynamic properties, such as the effective permeability (permeability tensor)

Several sources of information are used with this aim, some of them through direct measurement (formation images, cores, outcrops) and others through indirect measurements such as seismic data, petrophysical logs, analogue fields, and dynamic data, among others.

As such, the DFN model represents the most comprehensive and consistent characterization of the subsurface, incorporating all static and dynamic available information.

The upscaled DFN-based geocellular model, once calibrated through history matching, provides an indispensable tool to characterize the main features impacting reservoir performance, as well as the mechanism to optimize well placement, well completion and stimulation. At this stage of the evaluation, justification to construct the DFN model will depend upon the quantity and quality of the available data

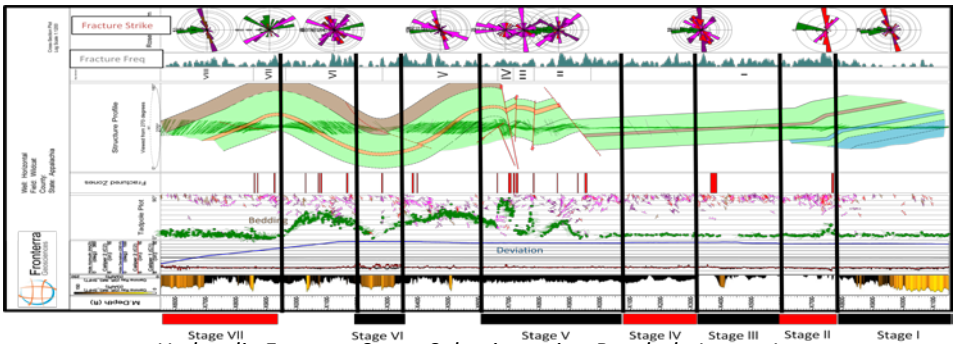
Reserves and Development

The ultimate objective in our Shale Gas Workflow is the optimization of the drilling, completion and stimulation operations, to reach a successful technical and economic development of the shale play. To achieve this, a number of critical aspects of the shale play require an in-depth analysis and understanding:

- Geomechanical reservoir properties
- Dynamic fracture system
- Production analysis
- Dynamic modeling
- Well placement
- Completion and stimulation analysis

The results of this evaluation phase will enter into the field development plan which will represent the planning instrument for our client's operations.

It is important to note that shale gas evaluations cannot be accurately performed using automated software packages. At Task Fronterra, we use carefully selected software to ensure an efficient process and accurate results, whilst at all times our highly educated and experienced consultants retain the ability to assess the validity of the results.



Hydraulic Fracture Stage Selection using Borehole Image Logs

Task Fronterra Geoscience is a global independent provider of industry leading, integrated geoscience solutions, from single well analysis to complete reservoir studies.
Some tasks described herein may be performed by one or more associates.

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