Case Study
He/H exploration

Fonts Bouillants

The adaptation of conventional Oil and Gas exploration techniques to enhance the exploration of essential gases like Helium and Hydrogen is one of the key drivers of the global energy transition. The Fonts-Bouillants area, located in the Paris Basin, onshore France, has been initially known as producer of sparkling water until the 1980s due to high gas concentration in subsurface water reservoirs. Nowadays, Fonts-Bouillants is the very first project in France for helium and natural hydrogen exploration.

Location:
Paris Basin, onshore France
270 kilometers south of Paris in the Nièvre department

Surface area:
251 km²

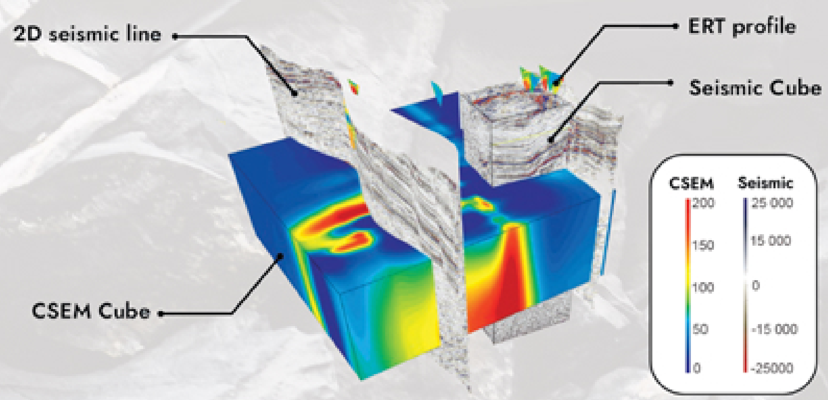
Age of sediment:
Triassic to Jurassic

Geological context:
Intra-cratonic basin

Depositional environment:
Mainly continental (Triassic)

Main challenges:
Onshore data (low signal/noise ratio)
Imaging terminations along faults
Co-interpreting various type of geophysical data

Data Available: *3D Seismic Cube (5 km²), 2D seismic lines, CSEM (Controlled Source ElectroMagnetic) cube, ERT (Electrical Resistivity Tomography) profiles, Magnetotellurics and gravimetry*



3D viewer showing CSEM and seismic cubes, 2D seismic lines and ERT profiles available for the interpretation.

Import of various type of geological data

Co-visualizing and co-interpreting various types of geophysical data is key to understand geological settings and to help delivering a reproducible workflow for Helium exploration. The integration of domain of expertise makes it possible to adapt and improve workflows from Oil & Gas exploration to other resources exploration.

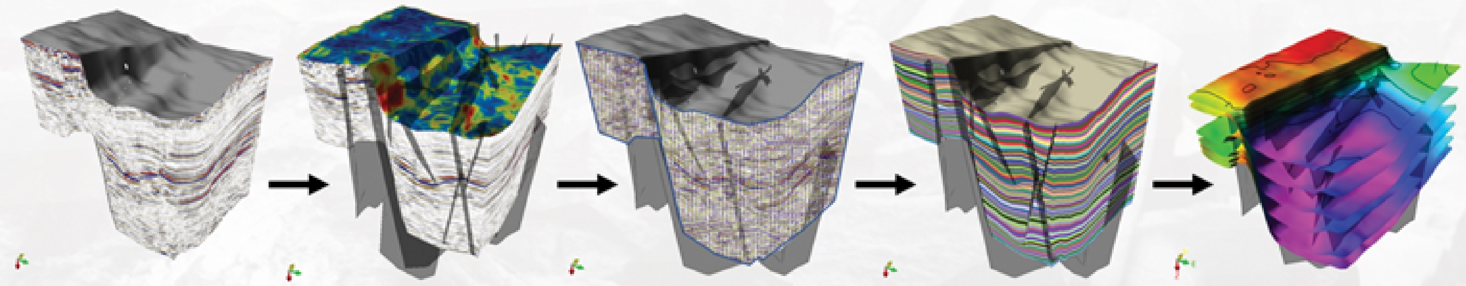
Adapting conventional hydrocarbon workflows to renewable resources exploration

Structural interpretation from seismic amplitudes

In the Fonts-Bouillants case study, surface leakages occur near major faults. Understanding the structural framework is essential to identify, characterize and delineate potential accumulations and migration pathways. In the Automated Fault Extraction (AFE) workflow, an initial representation of the vertical deformation component is generated in the form of fault planes or fault sticks. This representation is further enhanced by the incorporation of human expertise to validate fault framework consistency and eliminate any residual noise, which ultimately results in the establishment of a robust fault network.

Continuous stratigraphic framework from seismic

Horizons are auto-tracked across the full seismic volume, chronostratigraphically sorted in real time and used to generate the Relative Geological Time (RGT) model. The interpretation is controlled and refined in an iterative way, especially along the faults. Due to the quality of the data, the RGT model only follows the refined key chronostratigraphic surfaces.



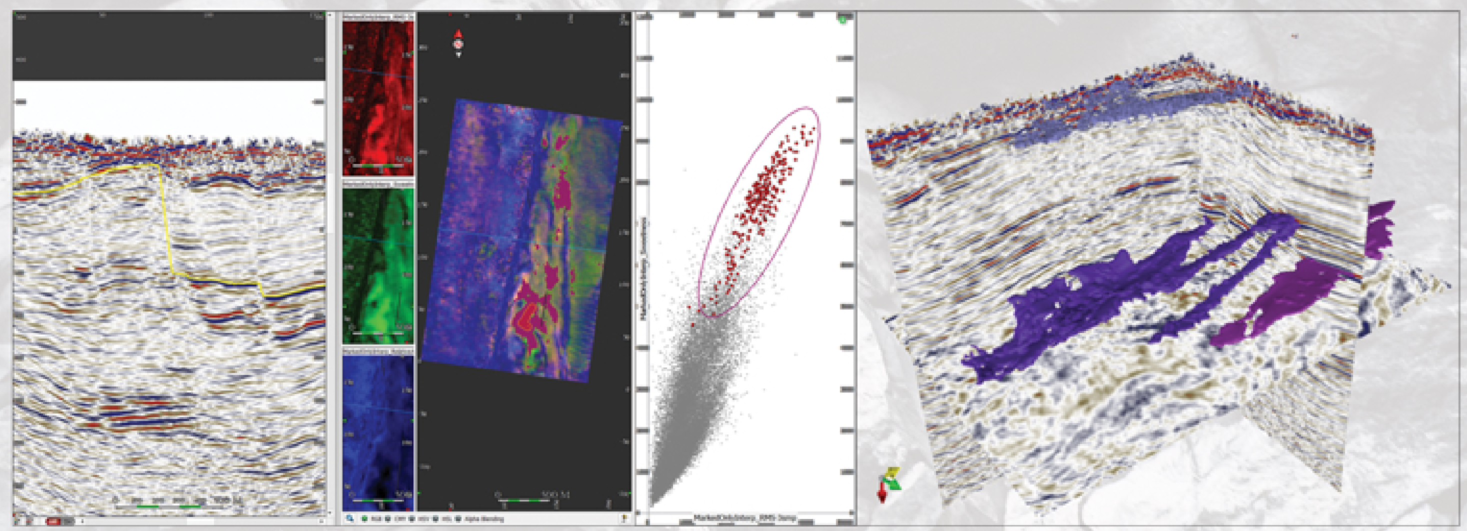
Comprehensive semi-automated workflow for structural and stratigraphic interpretation

Geological reconnaissance and targets delineation

Subtle stratal slicing allows identifying the potential areas for gas accumulation. The use of Deepest Descent Gradient (DDG), Sweetness and 3D Gradient on the same stratal slicing emphasizes the stratigraphic and the structural information from the seismic.
The DDG enhances structural features, and allows a thorough understanding of the structural framework, especially in areas with low signal/noise ratio. The Sweetness yields to a better appreciation of the sedimentary events by identifying features where the overall energy changes in the seismic data. The 3D gradient combines both structural and sedimentary information.
Co-analyzing these attributes gives robust information on the structural and stratigraphic framework to identify the main areas of interest.

Geobody extraction

Once the area of interest are identified, the Root Mean Square (RMS) amplitude, the Sweetness and the Relative Acoustic Impedance attributes are useful to highlight respectively, seismic contrast, overall energy changes and relative porosity contrasts. They are computed from the seismic and mapped on each horizon of the stack. A cross plot of those 3 attributes combined with the creation of classes allows the delineation of the main areas of interest.
Following this workflow, three areas of interest have been extracted, one at a shallow depth and two at deeper depths. Lately, a well targeting the shallowest geobody has been drilled and revealed the presence of a Helium-rich gas accumulation.



Geobody extraction workflow. A cross plot is derived from the three attributes: RMS amplitude, Sweetness and Relative Acoustic Impedance. The areas of interest are then extracted as geobodies. Finally, the geobodies can be displayed in a 3D viewer (right) and quantify.