

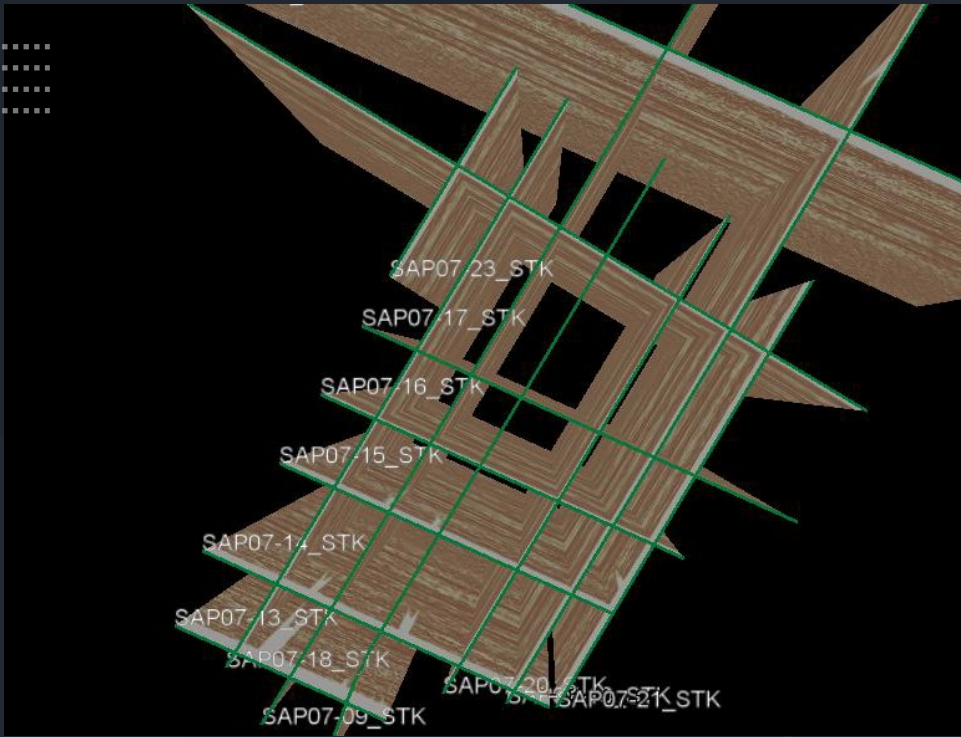


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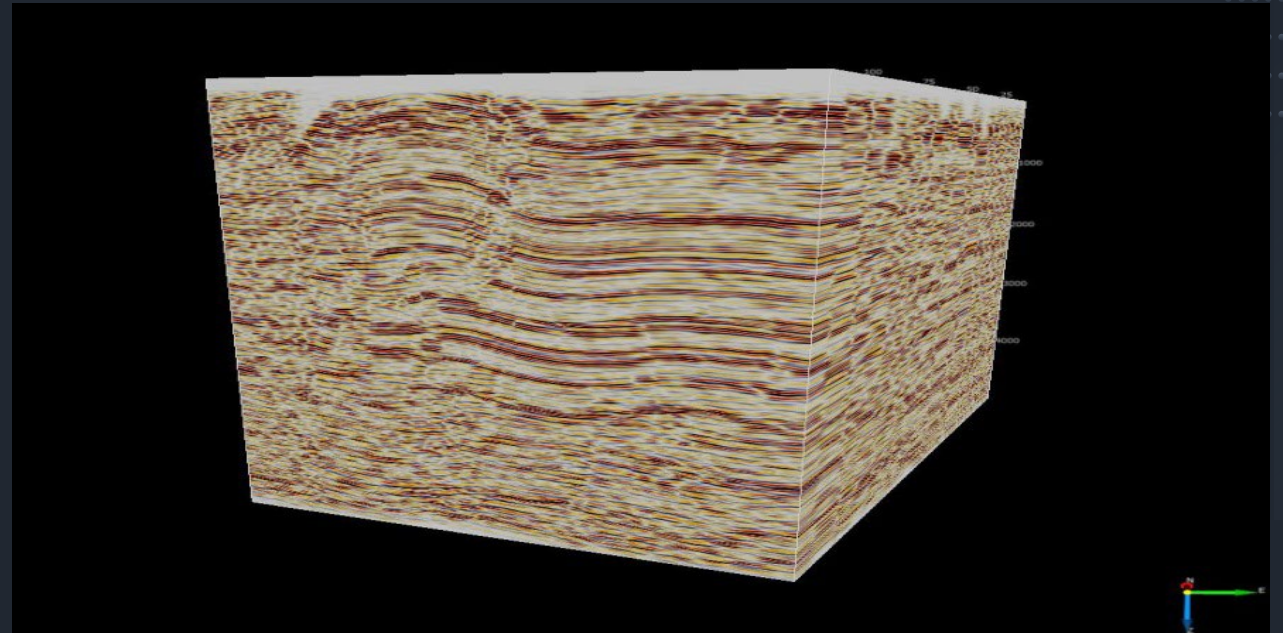
Seismic Data Optimization

Exploration & Production





Fourier Multidimensional Reconstruction



Our Seismic Data Optimization Service is based **on Fourier Multidimensional Reconstruction** from 2D seismic lines, it focuses on the generation of models of an area for early exploration and/or production studies, consolidating it into a volume of 3D data, and a more optimal visualization is achieved that will provide more precise elements for the process of interpretation based on horizons of said data.

From 2D seismic lines, a **Fourier Multidimensional Reconstruction** is carried out, which is based on the calculation of the Fresnel radius to define the minimum mesh necessary to find the radiated energy (amplitude of the seismic trace) and it is possible to obtain a simple 3D seismic cube, where you can apply attributes and make a cooperative interpretation with other types of data that are available, and thus have a better vision of the study area.

HOW DO WE DO IT



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Phase I: Collection and Evaluation:

- We obtain information from the existing seismic over the area of interest. The signal/noise ratio, frequency content and positioning are evaluated. It is important to clarify that its application in marine data, mountain fronts and areas of complex geology is still in the development phase.

Phase II: Link of seismic lines:

- By creating a single file in SEG-Y format, we match seismic lines with the same characteristics, that is number of samples, sample interval, and record length.

Phase III: Grid Generation:

- Construction of the mesh by calculating the Fresnel diameter.

Phase IV: Parameterization of the multidimensional Fourier reconstruction:

- It consists of the estimation of the frequency ranges, calculation window, maximum inline wavenumber, maximum crossline wavenumber, number of iterations and the amplitude threshold.

Phase V: Process of parallelizing the multidimensional Fourier reconstruction:

- We initiate the logical processing of parallelization through the use of multi-core computing equipment

Phase VI: Quality control:

- We apply a validation protocol through comparison with the reference 2D seismic line to achieve a result consistent with the original data.

Phase VII: Generation of seismic cubes

- We produce seismic cubes from the stacked and migrated multidimensional Fourier reconstruction in the time domain (SEG-Y format).

Phase VIII: Visualization:

- In this phase, we managed to show the main characteristics of the study area for its interpretation.

COMPARISON CHART



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| Conventional Model | Our Model |
|---|--|
| <p>Interpretation of 2D seismic lines has many visualization limitations between the lines.</p> | <p>Our technique consists of applying a parameterization by means of an algorithm that we have developed. Once the data processing is executed, it results in a reorganization and a 3D display model automatically.</p> |
| <p>The execution time of a new 3D seismic project in the study area would be approximately 2 years, which includes acquisition and processing.</p> | <p>The execution time from this methodology in the study area would be approximately 1 month, since we start from available information.</p> |
| <p>The cost for the execution of the 3D seismic project, depending on the serious area, can vary between US\$50MM. And US\$100MM.</p> | <p>The cost for the execution of this methodology would be approximately 5% of a 3D seismic project.</p> |



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Success Cases

Country: Peru

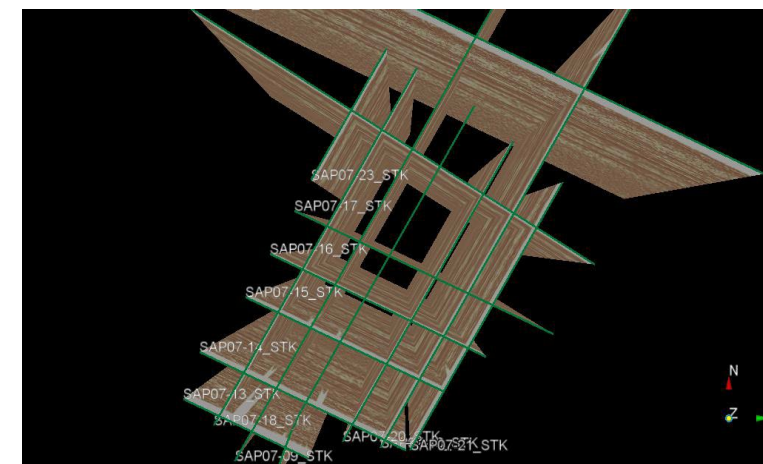
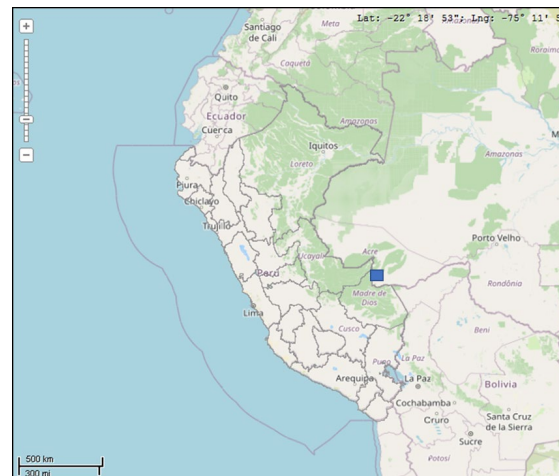


Application: Oil & Gas

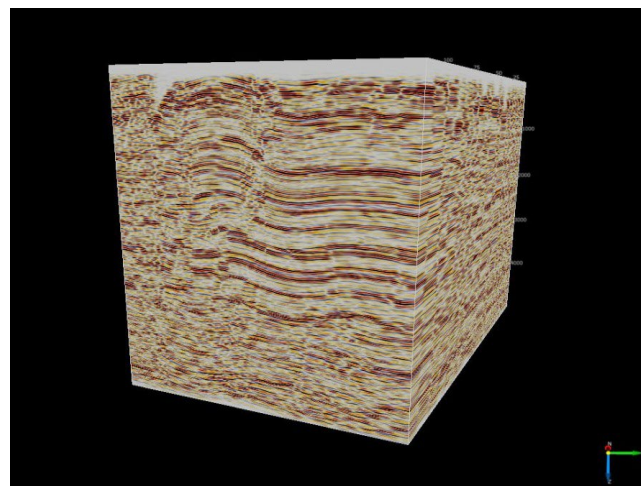
This area had been assigned to a private company to carry out re-exploration studies, evaluate its potential and decide if it was economically profitable for its exploitation. Information was available corresponding to **13 seismic lines**, in a jungle area of difficult access.

From the operational point of view and environmental permits, this would take about 2 years and a budget that would be around **\$60MM**, in order to carry out a 3D seismic acquisition.

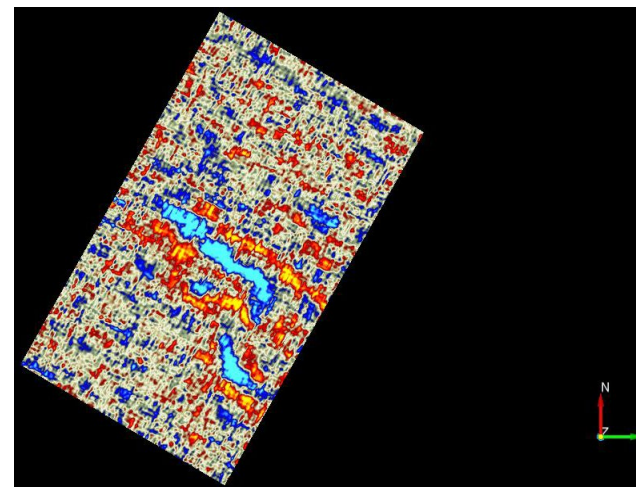
It was decided to work with the available seismic information and apply a **Fourier Multidimensional Reconstruction**, which was carried out in 3 months, the existing data were reviewed and validated, to later generate the simple 3D cube, covering **1,315 km²** of the study area. The cost to obtain these results was **\$600,000 USD**.



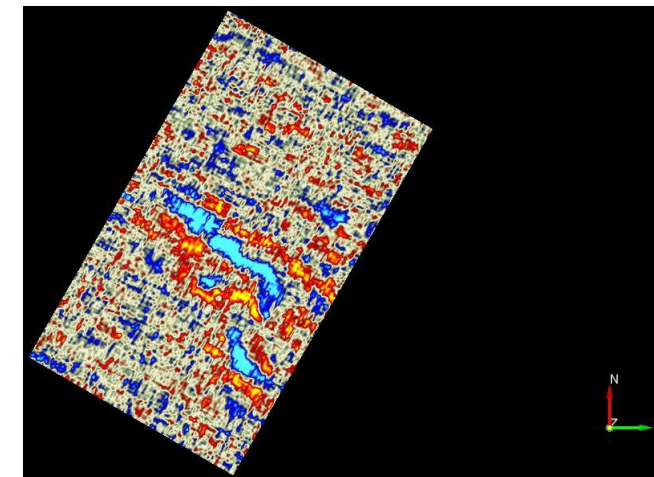
a) Plan View Original 2D Seismic Lines



b) 3D view of the reconstructed volume



c) Plan View Simple 3D Reconstruction stacked volume

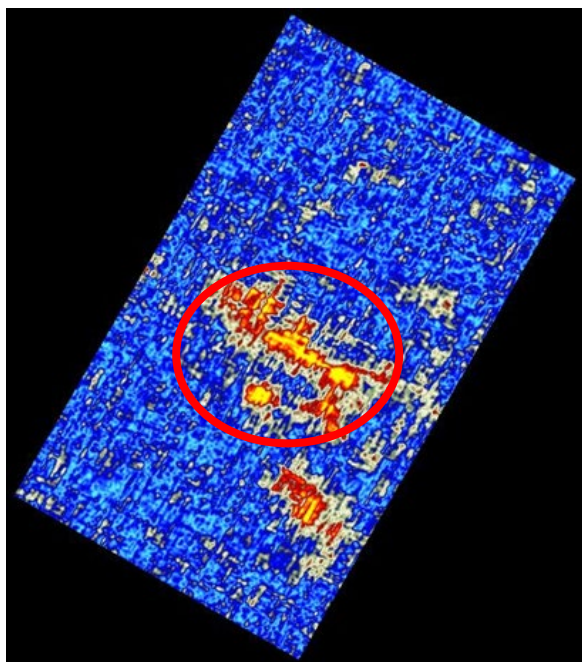


d) Plan View Simple 3D Reconstruction Volume migrated (Post-stacked Kirchhoff Algorithm)

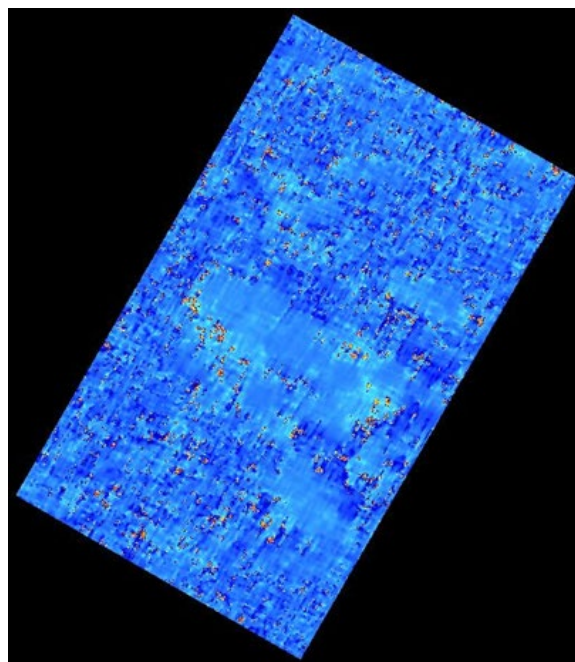
Application: Oil & Gas

The attribute analyzes were carried out from the simple seismic cube generated from the Fourier Multidimensional Reconstruction, in all the results an anomaly associated with the existing reservoir in the study area that could not be identified with 2D seismic data.

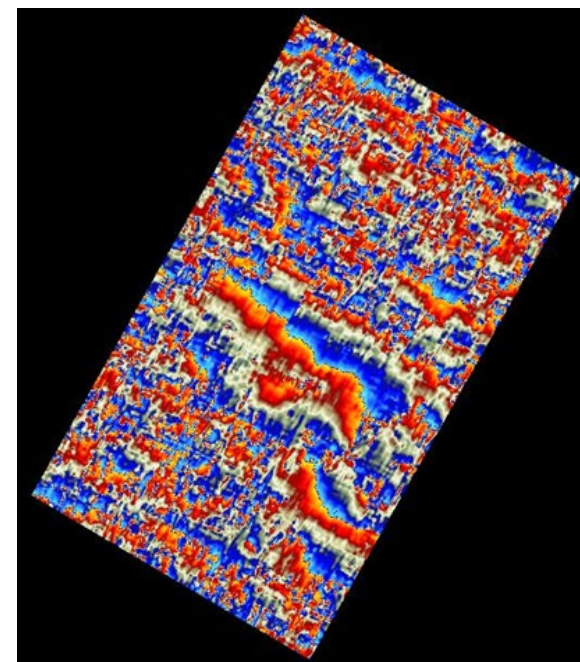
Amplitude



Frequency



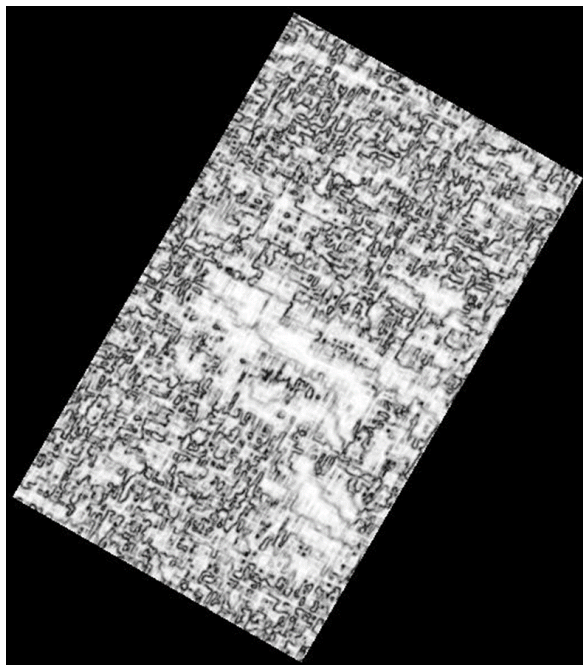
Phase



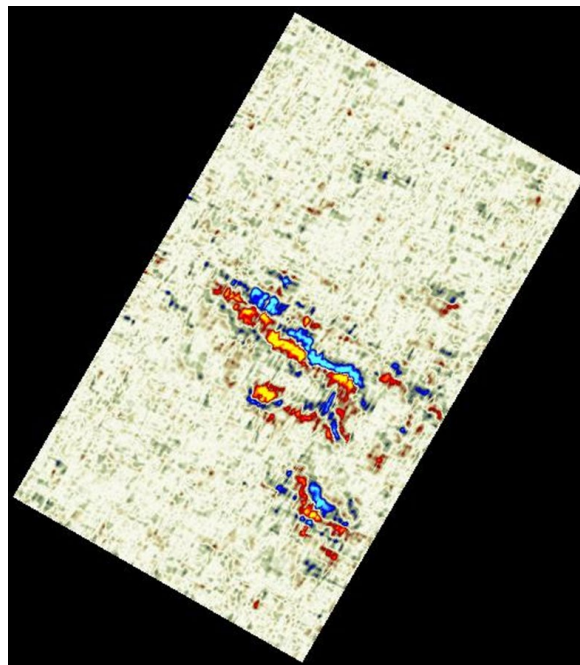
Based on these results, the recommendations were made to concentrate the studies in this area where the anomaly was identified, in the short term and with a minimum economic investment, avoiding having to carry out the studies in the entire area of interest, since the area of interest was delimited. structure where the deposit is.

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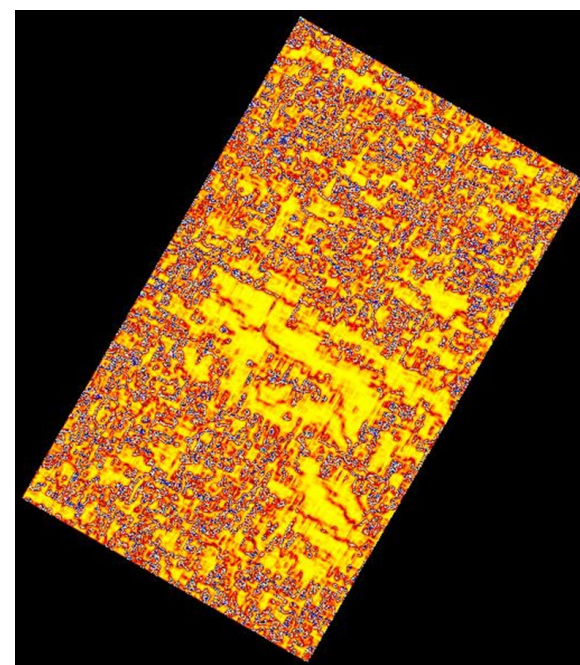
Similarity



Energy



Semblance



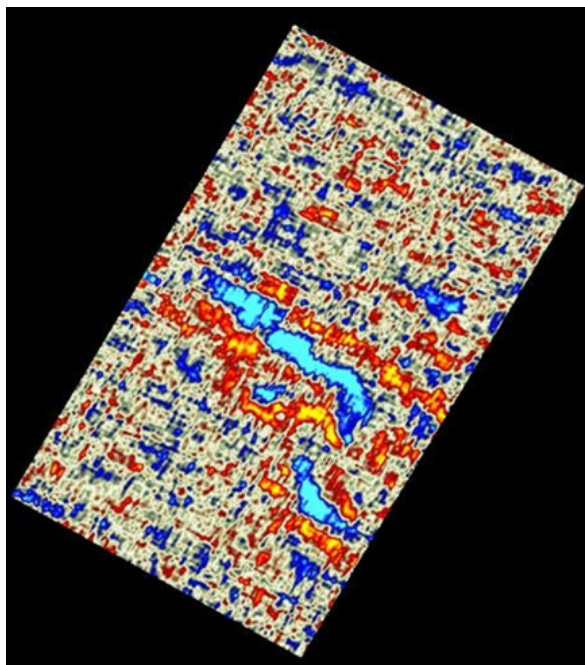
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Application: Oil & Gas

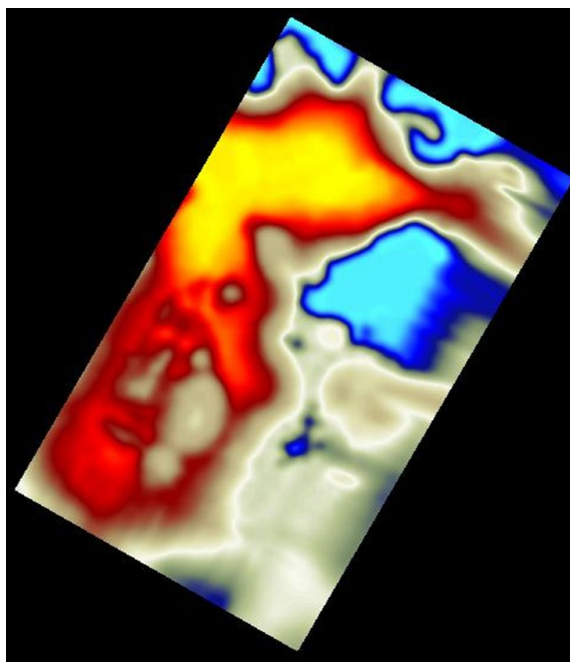


The attribute analyzes were carried out from the simple seismic cube generated from the Fourier Multidimensional Reconstruction, in all the results an anomaly associated with the existing reservoir in the study area that could not be identified with 2D seismic data.

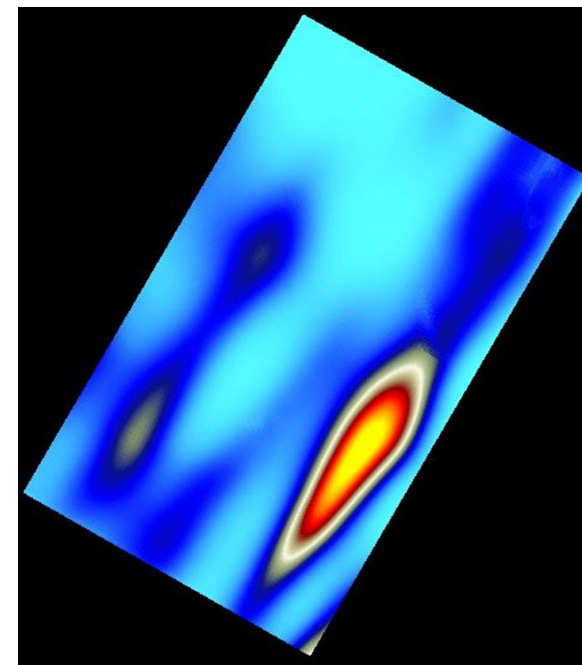
3 DFR Depth



**Density (gr/cm³)
(Gravimétric Inversion)**



**Magnetic susceptibility
(Magnetic inversion)**



Based on these results, the recommendations were made to concentrate the studies in this area where the anomaly was identified, in the short term and with a minimum economic investment, avoiding having to carry out the studies in the entire area of interest, since the area of interest was delimited. structure where the deposit is.

Application: Oil & Gas

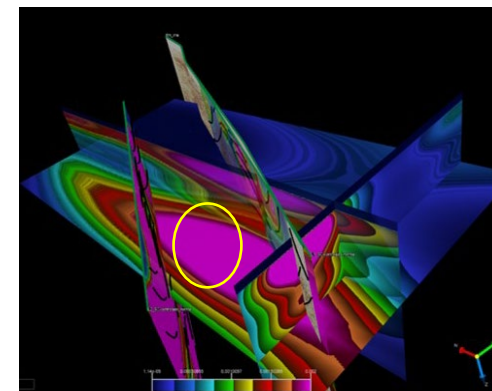
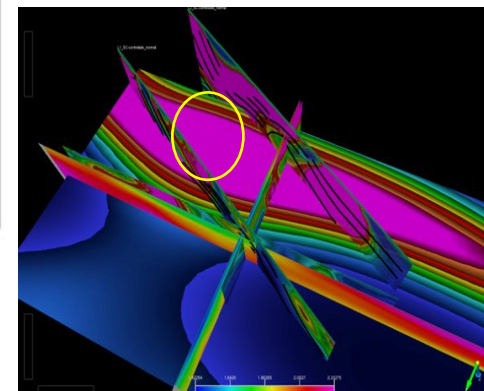
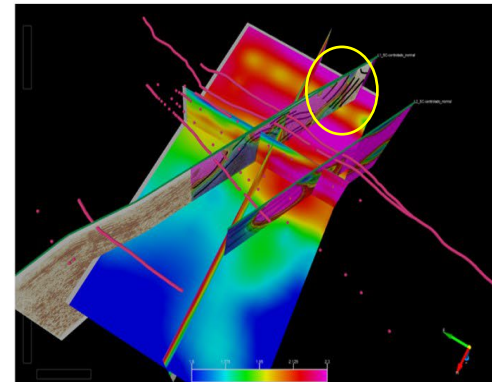
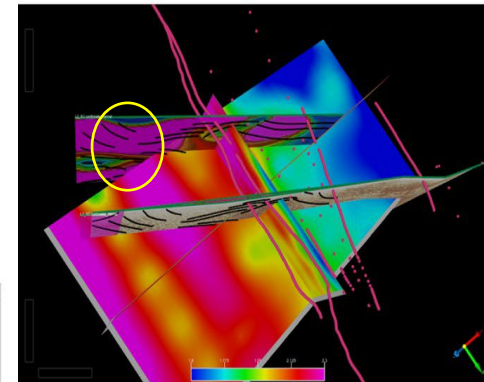
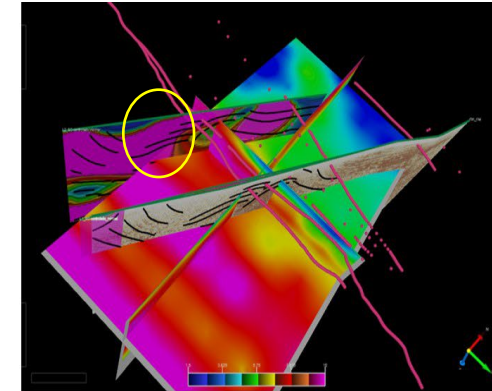
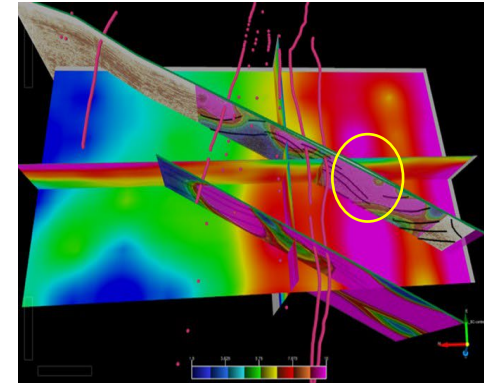
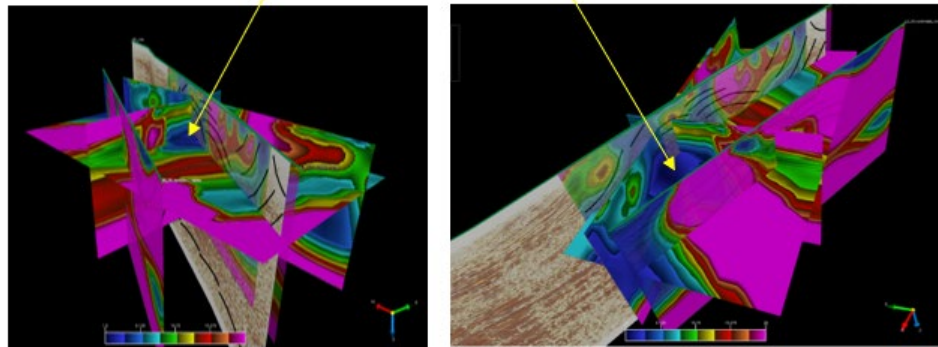
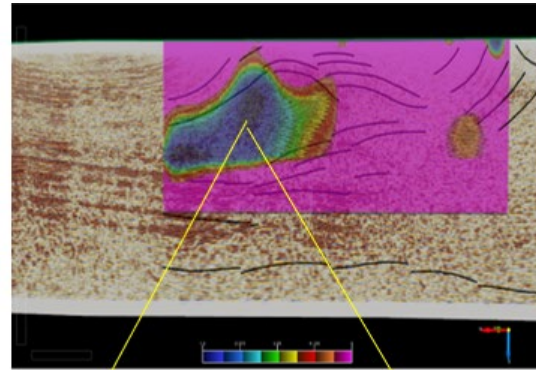


In this area we apply cooperative integration, based on seismic, gravimetric, magnetic and magneto telluric data.

The objective was to determine a structural model associated with a triangular zone, which could not be determined by seismic data.

From the operational point of view and environmental permits, carrying out a 3D study would take about 2 years and a budget that would be around \$50MM.

This work was carried out in 2 months, the existing data was reviewed and validated, to later generate the 3D data, covering 300 km² of the study area. The cost to obtain these results was \$100,000 USD.





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Success Cases

Country: Venezuela



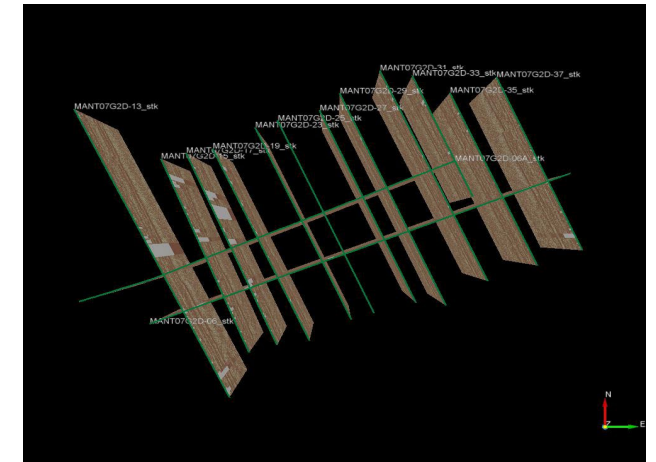
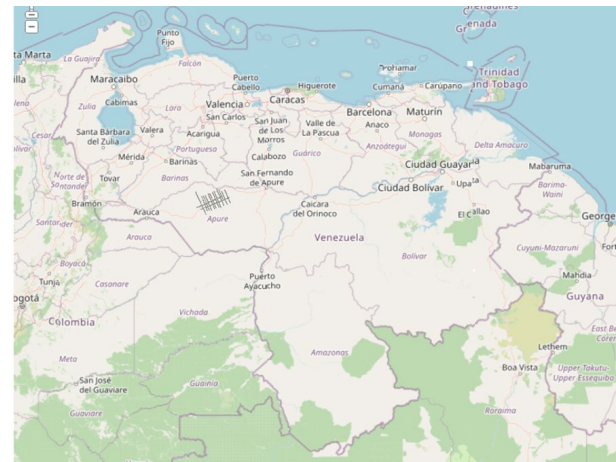
Aplicación: Oil & Gas

This area had been explored by means of a 2D seismic survey, a well was drilled without commercial success. Information was available corresponding to 13 seismic lines, in an area of difficult access and flooded. From the operational point of view and environmental permits, this would take about 2 years and a budget that would be around \$150MM, in order to carry out a 3D seismic acquisition.

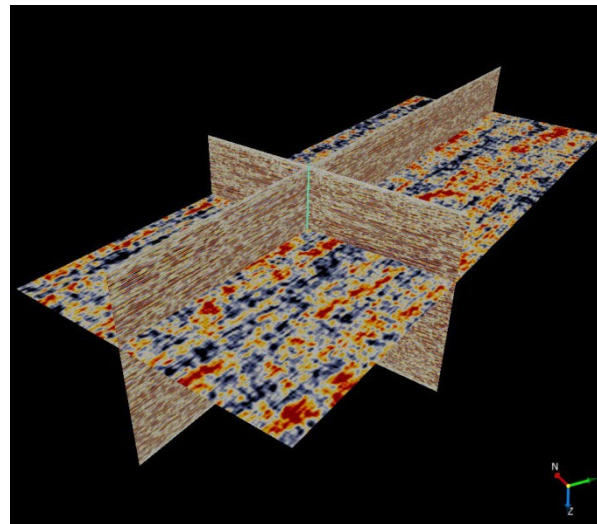
It was decided to work with the available seismic information and apply a **Fourier Multidimensional Reconstruction**, which was carried out in **3 months**, by reviewing and validating the existing data, to later generate the simple 3D cube, covering **3,825 km²** of the study area.

Additionally, gravimetric and magnetic data that were available in the study area were used.

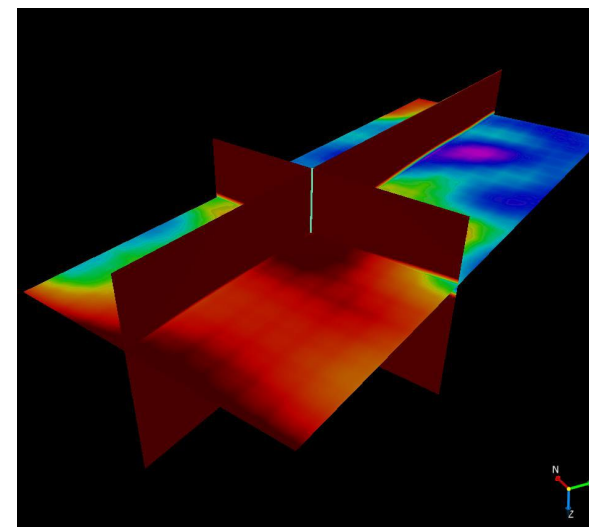
The cost to obtain these results was \$2,200,000 in 3 months.



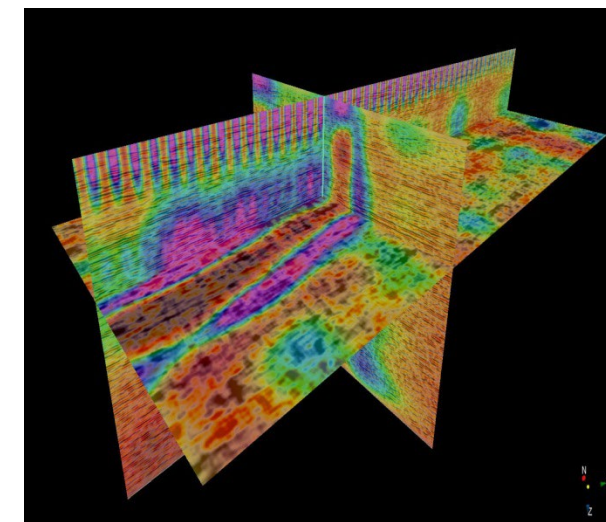
a) Plan View Original 2D Seismic Lines



b) 3D view of the reconstructed volume



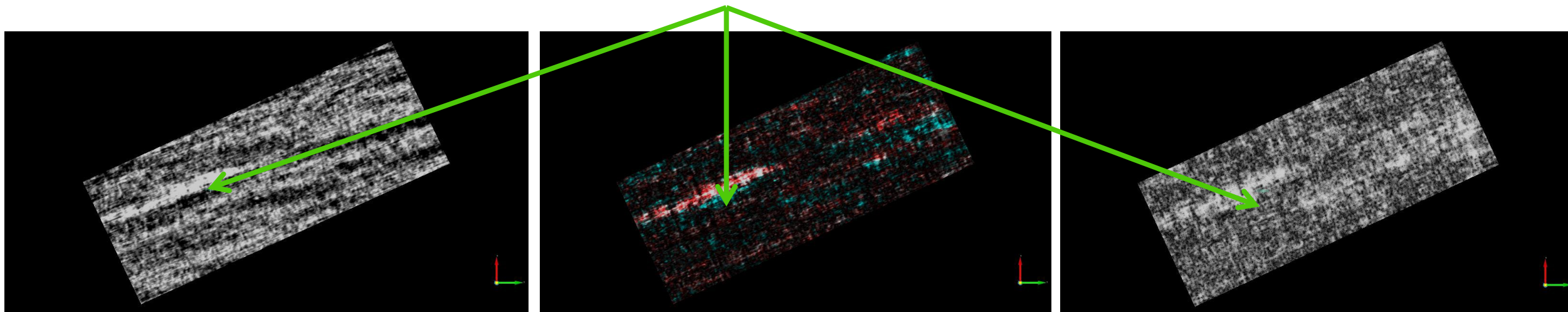
c) Gravimetric Inversion



d) Magnétic Inversion

The attribute analyzes were carried out from the simple seismic cube generated from the Fourier Multidimensional Reconstruction, in all the results the anomaly associated with the existing reservoir in the study area that could not be identified with the 2D seismic data is clearly identified. and as the well was located on the edge of the deposit, due to the lack of this information.

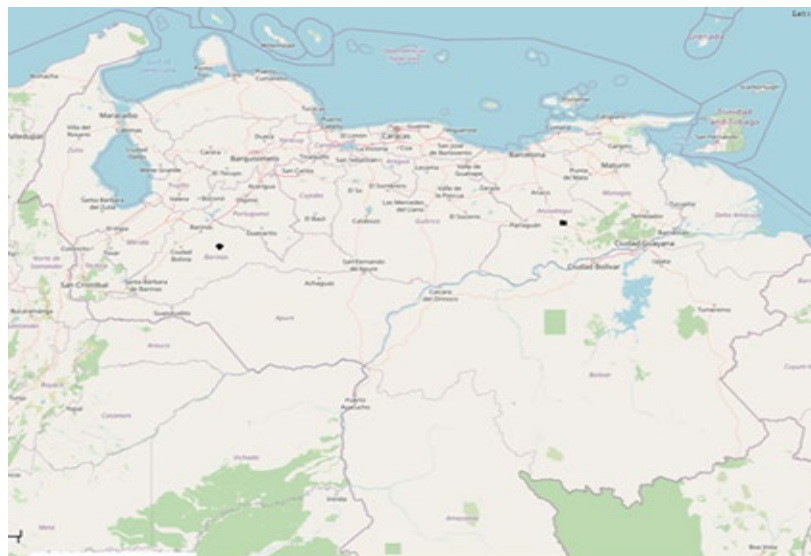
Well Location



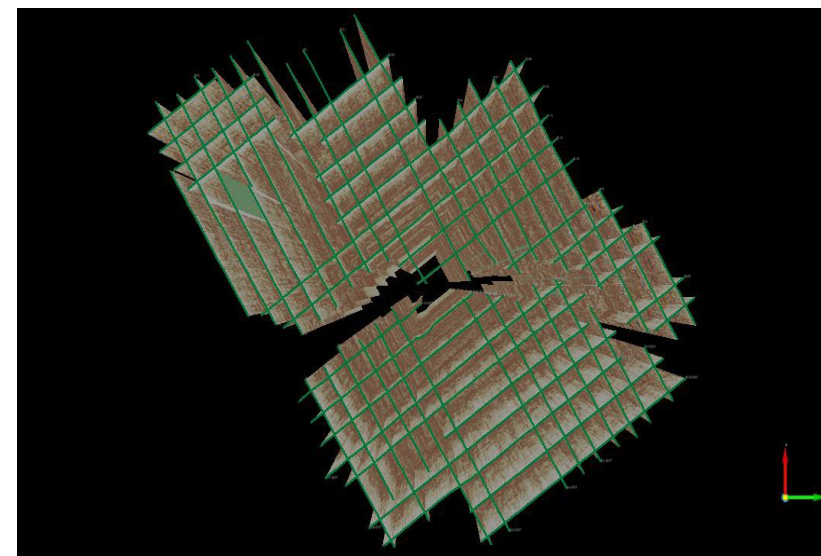
From these results, it is evident that carrying out these studies allows obtaining more information in the area of interest, in the short term and with a minimum economic investment, reducing uncertainty when deciding to drill a well. For this case, the client decided to invest an additional \$12MM to the cost of acquisition, processing and interpretation of the 2D seismic, which was in the order of \$25MM.

Application: Oil & Gas

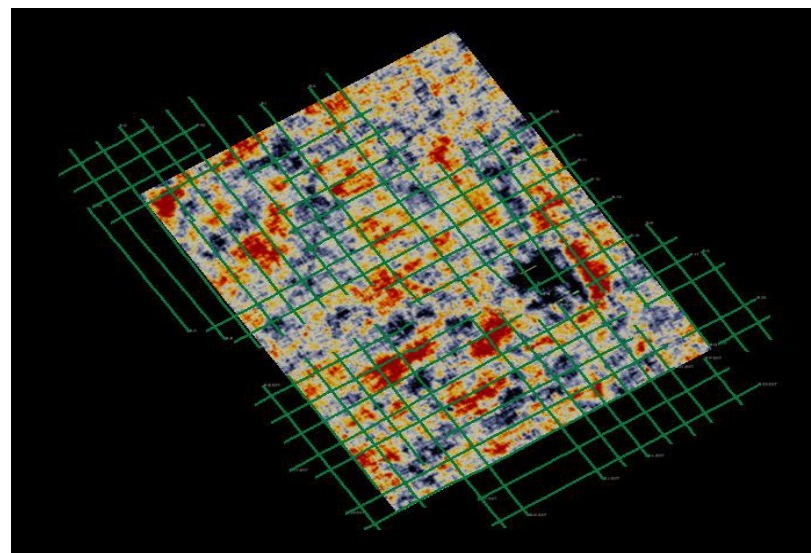
This area had been assigned to a private company to carry out re-exploration studies, evaluate its potential and decide if it was economically profitable for its exploitation. This area had information corresponding to 36 seismic lines, in an area of difficult access. From the operational point of view and environmental permits, this would take about **1 year** and a budget that would be around **\$40MM**, in order to carry out a **3D** seismic acquisition.



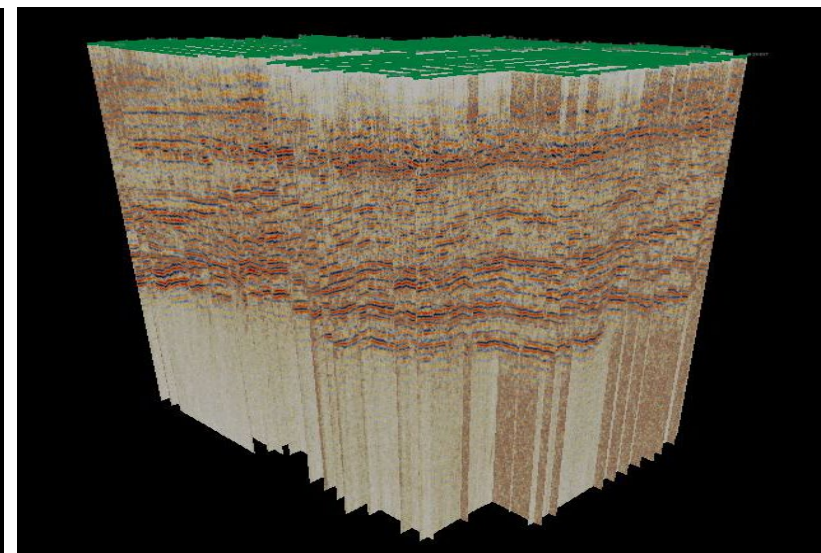
a) Plan View Original 2D Seismic Lines



It was decided to work with the available seismic information and apply a Fourier Multidimensional Reconstruction, which was carried out in **1 month**, the existing data was reviewed and validated, to later generate the simple **3D** cube, covering **4000 km²** of the study area. The cost to obtain these results was **\$450,000**. In the cut in time, an amplitude anomaly could be evidenced that it was not possible to see with the **2D** seismic and due to the lack of information due to the obstacle of the river present in the area. This is another area to re-evaluate from an exploratory point of view.



b) 2D plan view



c) Simple 3D view of the reconstructed volume

- ✓ Fourier Multidimensional Reconstruction is a technique that generates confidence in our clients, through a pilot test with their own data and the efficiency of our results is verified.
- ✓ Our service is applied in exploratory areas and re-exploration zones, to determine their economic potential.
- ✓ Our results demonstrate efficiency and economic accessibility to our clients, with optimized delivery times. We work in synergy with the client, during the application process, we establish collaborative work with the operational areas that affect the exploratory processes, this allows establishing a support in the validation of the results obtained.
- ✓ Our specialists have proven experience in the area, and we have the versatility to promote and apply our methodology in any part of South America, as we have demonstrated with the work we have done.



BUSINESS MODEL

- **Pilot Test:** It is proposed to carry out a pilot test (approximately 25 km²) in an area of interest, to demonstrate to the client the effectiveness of our methodology.
- **Referential Amount:** The referential amount per Km² is \$600. Once these preliminary results have been validated, we carry out a detailed study to generate the final products. - **Note: For particular cases, this amount may vary adjusting to customer budgets.**
- **The fundamental objective is to complement existing exploratory and early production studies, to guarantee better decision-making.**

PROTECTION OF INFORMATION



PENTATEX GROUP



- **We have Google servers, 20 TB (Expandable) for the protection of our clients' information.**
- **Encrypted Data Transmission and Secure Connection via VPN.**
- **Availability of information from anywhere in the world.**



Contact

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