New Frontier Advanced Multiclient Data Offshore Uruguay

Advanced data interpretation to empower
your decision making in the upcoming bid round

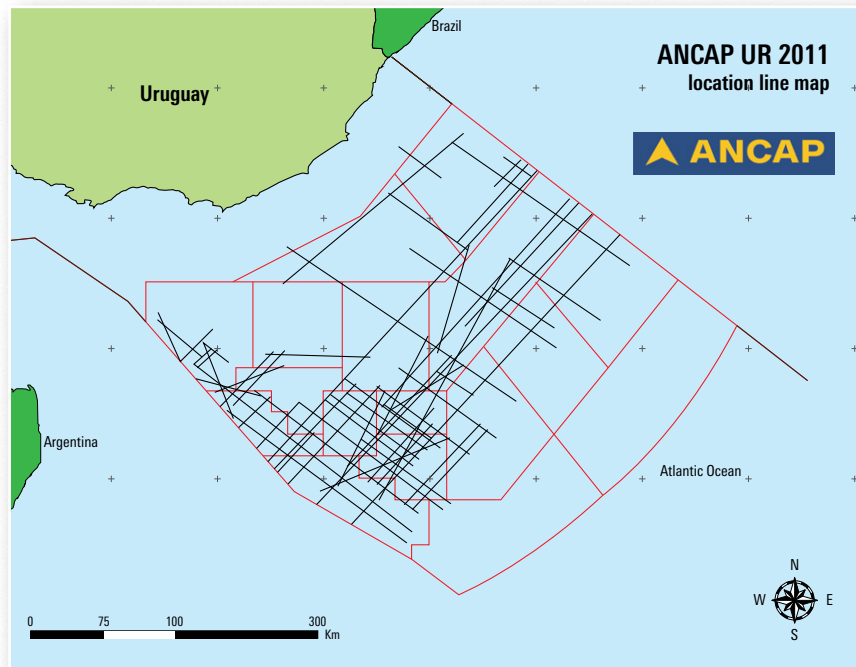# Multiclient data interpretation provides key deliverables for your bidding decision making

Angle stack generation | AVO attribute generation | Seismic inversion | Horizon interpretation

ANCAP UR 2011
location line map

ANCAP

Analysis of 6,293 km of 2D data and complete logs from two wells has revealed new exploration opportunities in Uruguay's frontier fields.

Schlumberger Multiclient Expertise to Unveil Basin Potential

Petrotechnical expertise and enabling technology delivers
advanced data analysis for better-informed decision making

Using seismic amplitude data inversion, seismic AVO attributes, and well data integration techniques, Schlumberger petrotechnical experts are able to estimate acoustic and elastic rock properties, which are related to reservoir properties like porosity, lithology, saturation, stress, and pore pressure. These results are used to screen or evaluate prospects, optimize borehole orientation, explain and predict well behavior, populate static reservoir models, and perform many other applications.

Schlumberger inversion methods that are not driven solely by a seismic-prior model used to estimate property variability beyond the wellbore. Our prestack simultaneous algorithm calculates an accurate P-impedance, and generates S-impedance and density volumes at the same time. Our simultaneous inversion uses a simulated annealing algorithm in a global optimization process to deliver geologically meaningful poststack or prestack AVO inversion results.

Potential Exploration Leads and Prospects

Unexplored Uruguayan offshore basins present interesting geology,
analogies with productive basins

Uruguay's continental margin is largely underexplored, however, its offshore basins have different tectonic and stratigraphic histories, which presents diverse exploratory opportunities. Schlumberger experts have been studying the area to design an advanced processing solution to confirm the geological structure and improve the understanding of the region's subsurface. The interesting geology, as well as the analogies with other South Atlantic basins, increase the basins' exploratory potential. It has been recognized that a northeast depocenter migration took place following the Late Cretaceous period, and a number of structural, stratigraphic, and combined exploratory situations have been identified.

Several direct and indirect hydrocarbon evidences do exist offshore Uruguay, including fluid inclusions of light oil and gas, oil seeps, gas chimneys, amplitude anomalies, AVO anomalies, velocity anomalies, and bottom simulating reflectors. Driven by the geological challenges and characteristics of Uruguay's continental margins, our experts designed an advanced processing program applying Schlumberger inversion techniques and workflows based on the integration of existing 2D seismic and well data. The results of the advanced processing will provide insights to operators looking for new frontier exploration opportunities in the area.

Seismic data input, ANCAP UR 2011
- 58 lines with anisotropic Kirchhoff prestack depth migration (KPSDM)
- 6,293 km of 2D data

Well data input
- Two wells in the area's southwestern section with a complete set of logs

Prestack time migration and KPSDM data are available for licensing through ANCAP.

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By integrating seismic and well data, a multidisciplinary team of experts can build a unique data set to provide operators with valuable information they can use to make better decisions in the upcoming Uruguay Round 3.
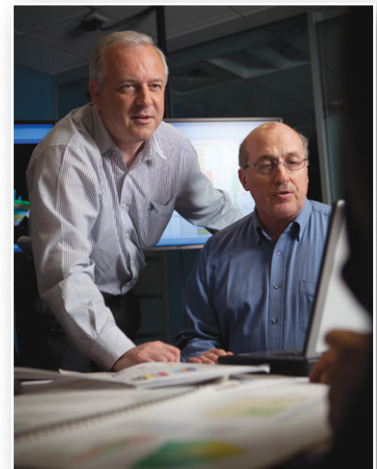
Simultaneous seismic inversion
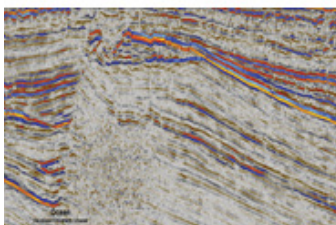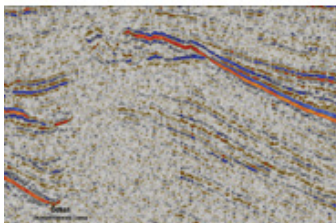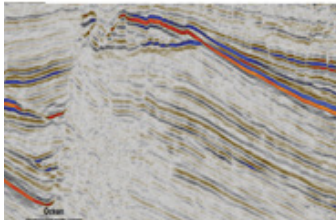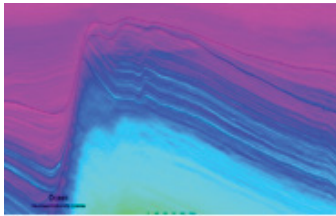
A hybrid elastic model (top) is used to generate a synthetic seismic angle stack (second) to which spectrally shaped noise is added (third) for comparison with observed data (bottom).
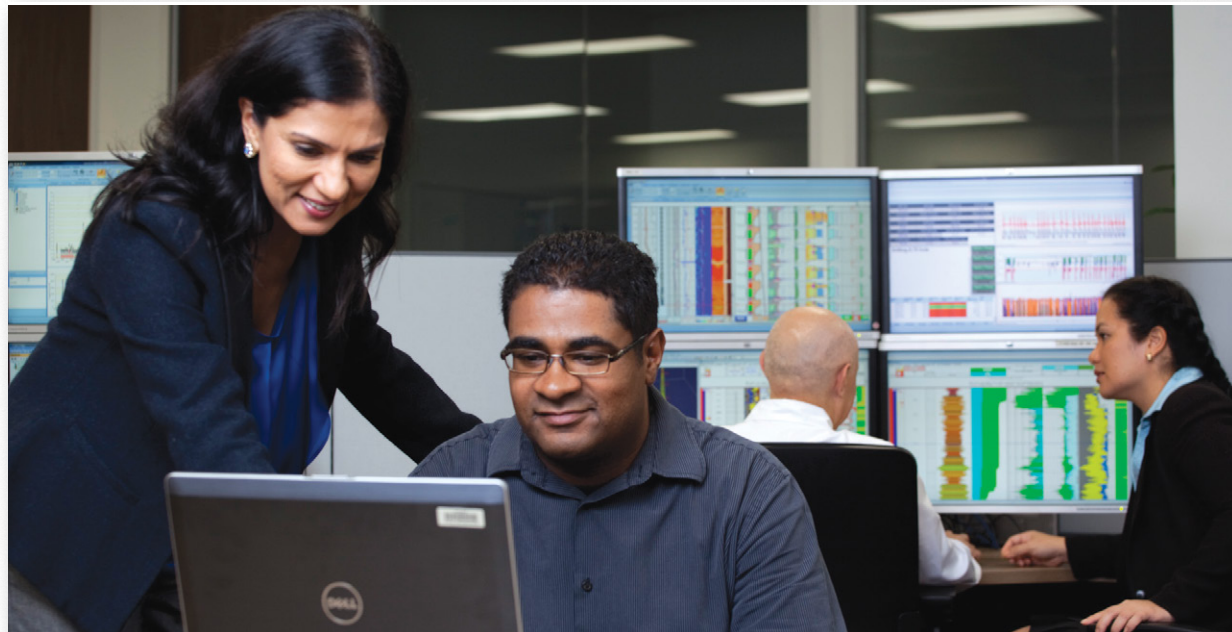
The simultaneous seismic inversion, based on the ISIS* suite of reservoir characterization technology, delivers a breakthrough in the analysis and interpretation of AVO seismic data. Using the ISIS technology, partial-stacks can be inverted directly for high-resolution acoustic impedance, Vp/Vs or shear impedance, and density. From this physical property lithology fluid and other rock properties maybe predicted.

Input into the simultaneous seismic inversion consists of a separate wavelet for each partial-stack and a low-frequency model for each physical property to

be estimated in the inversion. Simultaneous seismic inversion will be performed using a model based on the Aki and Richards approximation to the Zoeppritz equations. Another important element of this implementation is that there is no need for frequency balancing or special phasing of the seismic data before inversion.

An analysis of AVO attributes from seismic gathers, plus attributes from AVO inversion, together will permit a clearer identification of exploratory leads.

Deliverables

- Angle stacks

- Seismic AVO attributes: gradient (G), intercept (P), product (P×G)

- ISIS technology full-stack relative inversion: AI

- Horizons interpretation

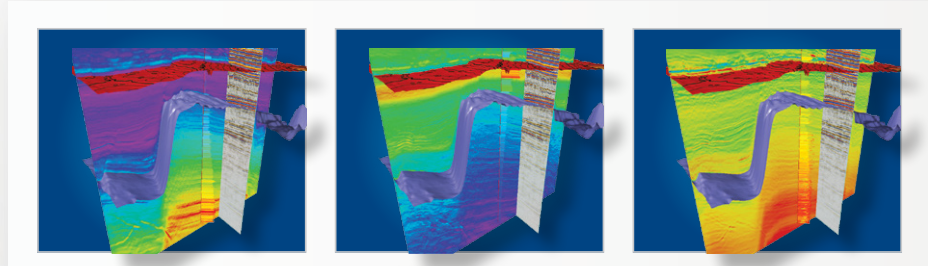- ISIS technology simultaneous AVO inversion: AI, Vp/Vs, density (RHO)

INPUT

*Near-, mid-, and far-angle stacks,
and extracted wavelets*

Low-frequency models

**Simultaneous
Seismic Inversion**

OUTPUT

Inversion result

Earth Characterization
*Pore pressure prediction,
fracture mapping, and gas hydrates*

Reservoir Characterization
*Lithology analysis, porosity,
and saturation inversion*

Advanced processing provides a breakthrough in AVO seismic data analysis and interpretation

Designed Data Processing

Seismic data preconditioning

- Radon transform on KPSDM gathers
- Time-variant filtering
- Residual amplitude compensation
- Full-stack generation
- Partial angle-stacks generation
- Residual noise attenuation on full and partial stacks
- Angle-stack alignment: nonrigid matching

AVO attributes generation

- P intercept
- G gradient
- P×G product

ISIS technology full-stack relative inversion

- Data loading and QC
- Well calibration and wavelet estimation
- Full-stack seismic inversion for acoustic impedance (AI)

ISIS technology simultaneous AVO inversion

- Data loading and QC
- Synthetic shear generation
- Wavelet estimation for each angle stack
- Regional consistency horizons interpretation
- Low-frequency model (LFM) generation
- Simultaneous seismic inversion for AI, Vp/Vs, and density
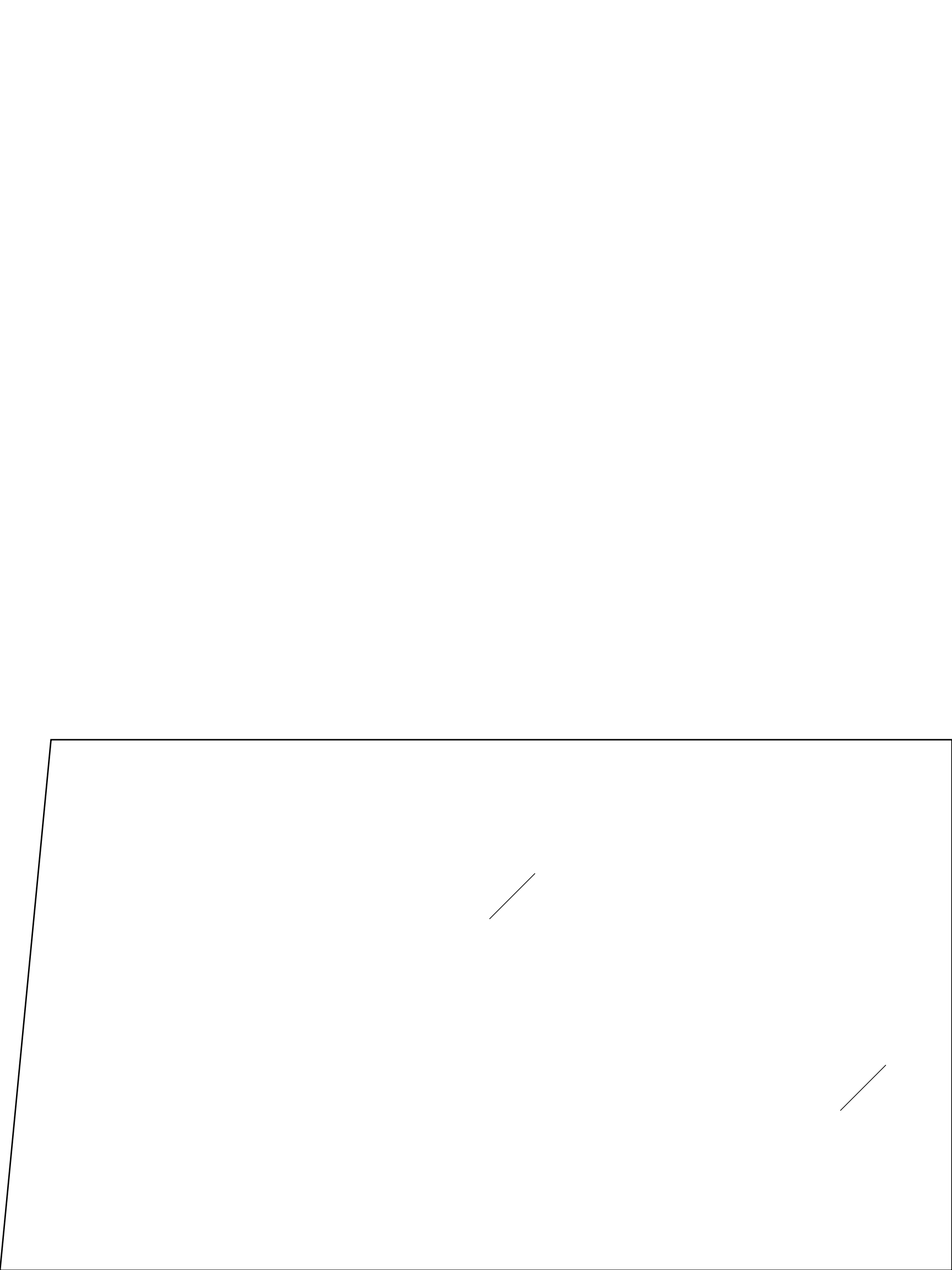
Multiclient

With years of experience and global presence, Schlumberger Multiclient Services provides E&P technical solutions that combine technological innovations, global expertise, and local reservoir experience to deliver a complementary technical capability through collaborative business models. Offering a unique combination of multidomain expertise, proprietary technologies for seismic acquisition, and advanced software, the Schlumberger portfolio of petrotechnical services transform multiclient data into a tool to aid operators in making better-informed business decisions at every stage of the E&P life cycle.

multiclient.slb.com/uruguay

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