P202 EXPLORING FOR A STRATIGRAPHIC TRAP IN ZULIA ORIENTAL, WESTERN VENEZUELA

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An amplitude map and some well information were the starting point in the study of a stratigraphic trap in Zulia Oriental, Venezuela. The integration of seismic and well information and the use of several disciplines such as stratigraphy, sedimentology, bioestratigraphy, structural geology, petrophysics and geophysics along with a coordinated team work were the elements necessary to establish a model for a stratigraphic trap in the area of Zulia Oriental.

This study involved a wide range of technologies to determine configuration, distribution and characteristics of the trap. Seismic sequence-stratigraphy, seismic attributes and state of the art technologies that includes 3D Visualization, Seismic Similarity, genetic algorithms for petrophysics-attributes correlations and Parametric Seismic Inversion resulted in the identification of oil bearing sand pinch-outs and truncations below the Eocene-Miocene unconformity. This paper presents the flow processes used that made possible the prediction of important hydrocarbon accumulations associated with this stratigraphic opportunity.

The first phase of the study consisted of a preliminary interpretation of the seismic data calibrated with some clue wells. Simple seismic attributes were applied to the interpreted horizons looking for significant amplitude anomalies that could be the response to a stratigraphic feature. Once the anomalies were identified, the information from the rest of the wells was used to check if there was a correlation with the geological and physical characteristics (lithology, porosity, fluids, pressures, etc). of the rocks producing such anomalies. Once the relationship was established, the information was used to define distribution and characteristics of the stratigraphic trap.

A map of Amplitude RMS (Fig. 1) showed strong anomalies that could be associated with sand content. Well log correlation through the anomaly (Fig. 2) shows the sand pinchouts and truncations that are directly related with the border of the anomaly, indicating the possible correlation with the presence of sand.

To clearly understand the situation a detailed seismic and well interpretation was conducted to detect the stratigraphic pinchouts (Fig. 3) and generate a chronostratigraphic framework. The petrophysicist used this correlation to determine sand content, oil and water saturation as well as porosity from the logs. These values were used to generate reservoir trend maps that covered the exploration area. Additionally well cores where analyzed and sedimentological and the biostratigraphical studies defined the main depositional environment as northwest-southeast striking sand bars deposited within an inner to middle shelf.

In the study clinoformal geometries indicating progradations were identified with a north-south direction and three lobes were grossly mapped. It was a difficult task to map the lobes and the following methodology was used to define an overall view of the geometry of the prograding system. An interpreted horizon located above the progradations was selected

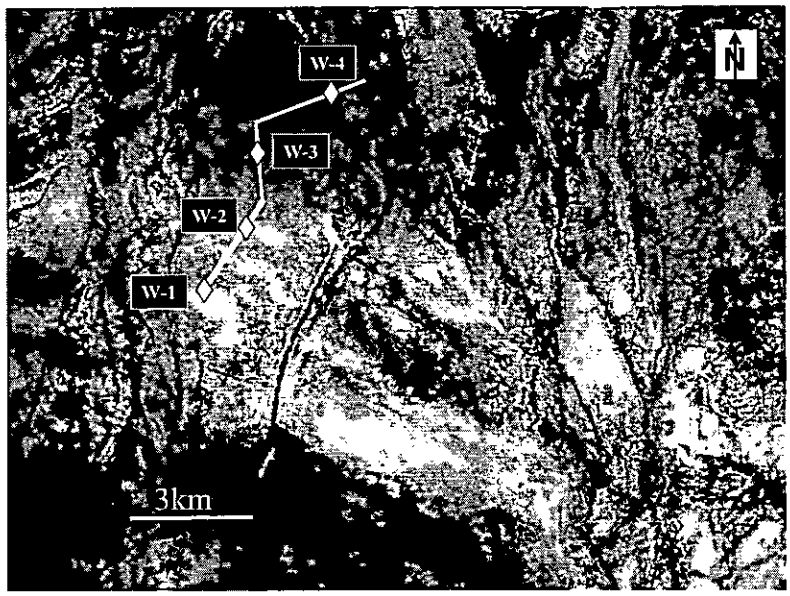

Figure 1. RMS amplitude map of the area. The black line is the cross section trough the anomaly shown in figure 2. The light colors correspond with the high amplitude anomaly.

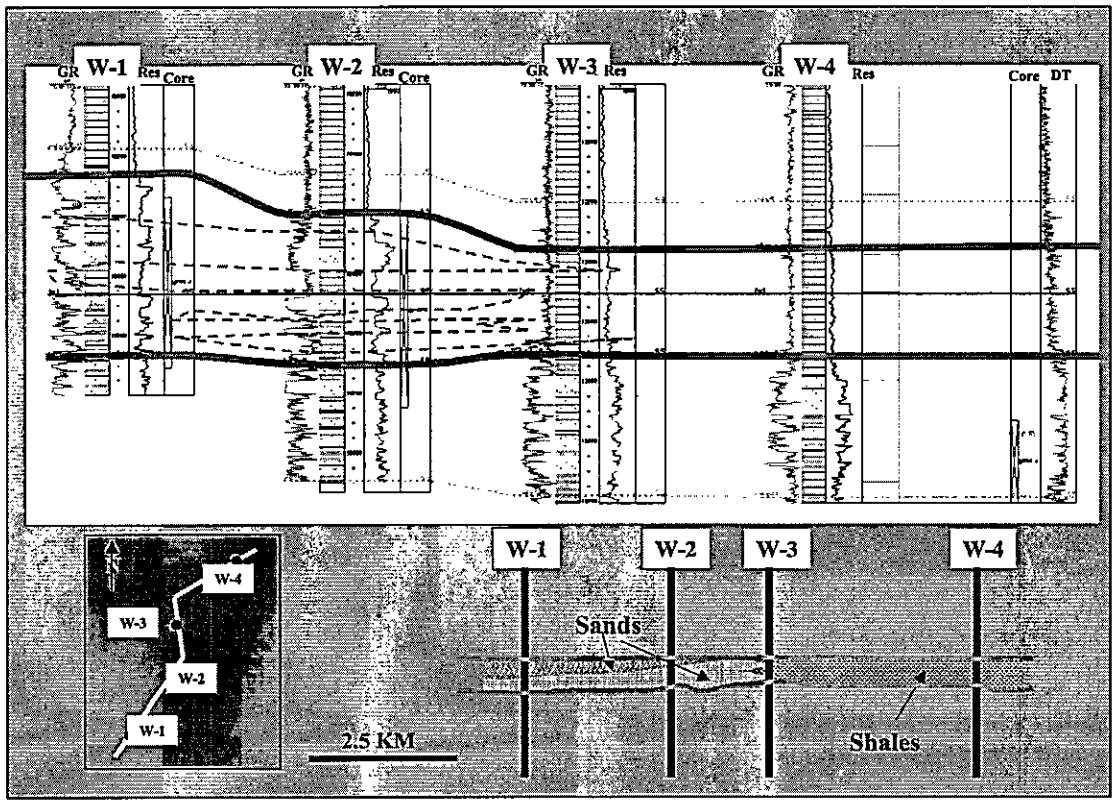

Figure 2 Cross section through the anomaly that shows the sand pinch-out that coincides with the limit of the anomaly shown in figure 1.

and various amounts of time (milliseconds) were added to generate several horizons. These artificial horizons intersects the progradations at different levels. An amplitude extraction was applied to each new horizon and when mapped resulted in interesting patterns that honor the NE- SW prograding sand bars deposited with a northwest southeast strike(Fig. 4).

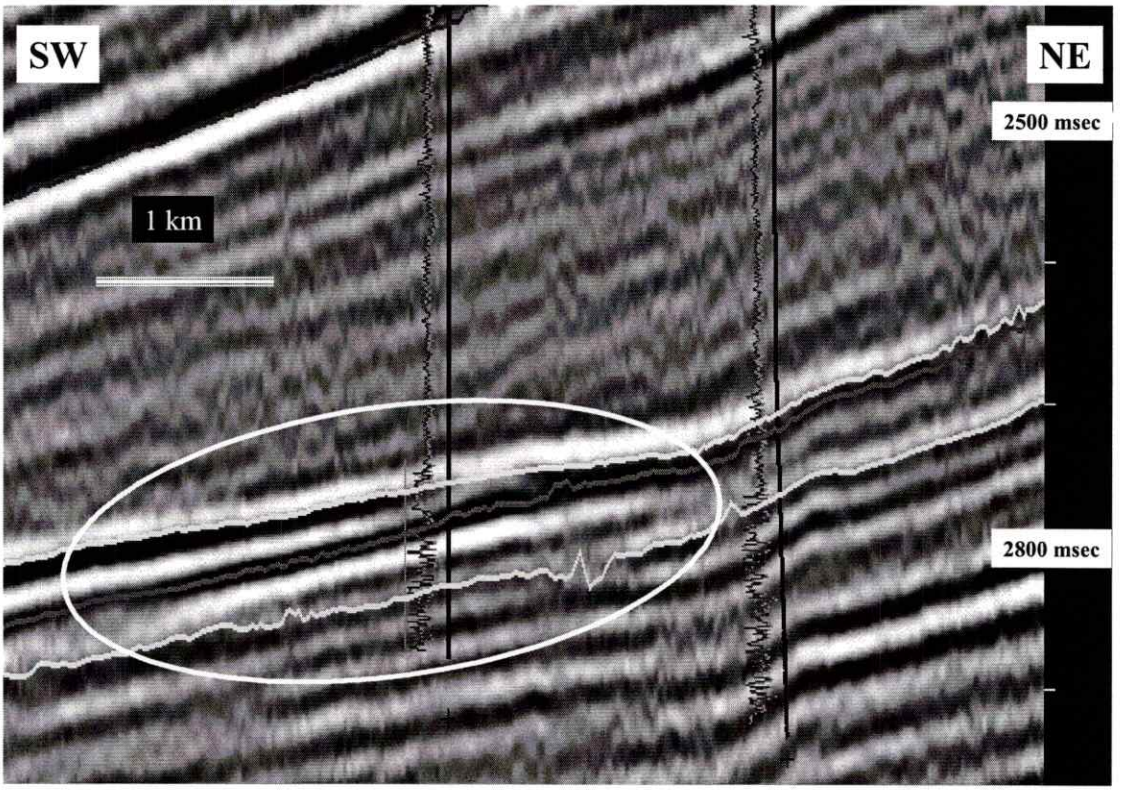

Figure 3 Seismic line showing the stratigraphic pinch out and truncation. The white reflections (negative amplitudes) correspond to the sands while the dark gray corresponds to the shales as shown in the gamma ray logs of the wells.

A preliminary application of both seismic attributes and seismic inversion was conducted to test the validity of these techniques in the area. Both tests were positive only for a certain interval where it was possible to obtain information especially about the lithologies in the area. A set of seismic attributes was applied to the interpreted data and the correlations using the petrophysical data made possible to obtain information for the exploration zone. Also Seismic Similarity technique was used successfully to obtain good mathematical correlations that made possible to infer the presence of sand bodies aligned in a southeast-northwest direction. The maps obtained showed high similarities values related with the sandy producing wells and low similarity values related with the areas of non-producing shally wells.

Seismic inversion was also performed and allowed the identification of sand bodies in the same direction as the ones mapped with the other techniques (Attributes, Similarity,.) Through this technique it was possible to estimate porosity and rock volume. The areas of

high sand content coincide in all the seismic attributes and inversion maps with the trends interpreted from the petrophysical data.

The integration of all the techniques mentioned above made possible the generation of the reservoir's stratigraphic model of the trap. This model that describes the distribution and characteristics of the reservoir rock was then integrated with geochemical information and tectonic history to produce a complete definition of the stratigraphic trap.

The application of this methodology allowed the team to make a systematic identification and documentation of the stratigraphic trap that can also be done with the same results in many other areas with the similar geological characteristics such as pinchouts and/or truncations. This trap located in a syncline between two excellent producing structural highs would have never been considered without all the support presented by the technique mention above. The risk-weighted expectation for hydrocarbons in this accumulation runs over 100 MMBLS of oil and 30 MMMCF of gas make this trap an attractive opportunity to be tested

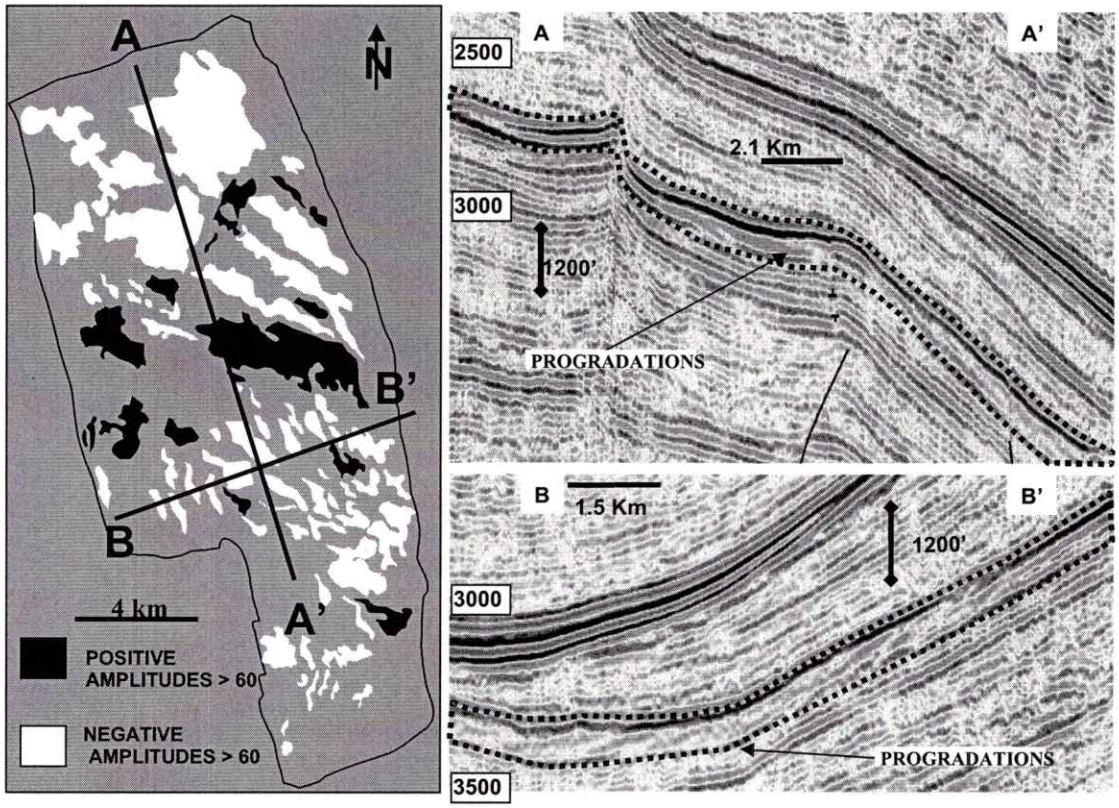

Figure 4 Seismic lines A-A' and B-B' show the NW-SE and NE-SW progradations observed in the area. The map shows the geometries of the anomalies observed in one of the amplitude extraction maps generated.