The Offshore Golden Lane: New Outline of Opportunities from the Integration of Geological and Geophysical Data

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Introduction

The worldwide famous Golden Lane is located in the eastern part of Mexico (Fig. 1). Geologically, the Golden Lane is framed by the Tuxpan Cretaceous platform, which is genetically related with the Tampico-Misantla basin, which in turn is the westward part of the ancestral Gulf of Mexico basin. Geographically, the Golden Lane is divided almost symmetrically by the current shoreline. Therefore, for exploration and production purposes, it is conveniently defined as onshore and offshore. When the first discoveries were made in 1910 on the onshore part, the Golden Lane, was first called "the ridge" by the technicians and engineers; but later it began to be known poetically as "The Golden Lane" by the common people.

After a long process of geological and geophysical data integration, the present work proposes a strategy outline for exploration and production goals in the offshore part, based on previous work and future expectations, which include three main objectives: (1) find new fields in the reef trend, (2) explore on the continental shelf for a field in the Tamabra play, having the characteristics of the Poza Rica Field, and (3) reservoir characterization in order to increase reserves and production.

Production History

The marine extension of the Golden Lane was delineated with analogic seismic surveys in 1957. Six years later, in 1963, the first field in the offshore structure, "Isla de Lobos" was discovered. The well Isla de Lobos-1B found an oil accumulation in the El Abra Formation at a depth of 2096 meters below sea level (mbsl) having an initial flow of 792 bbl/d, a choke of 8 mm, and bottom pressures of about 217 kg/cm^2. Discoveries between 1964 and 1974 determined the structural crest and established a daily production in 1970 at 36,000 BOPD.

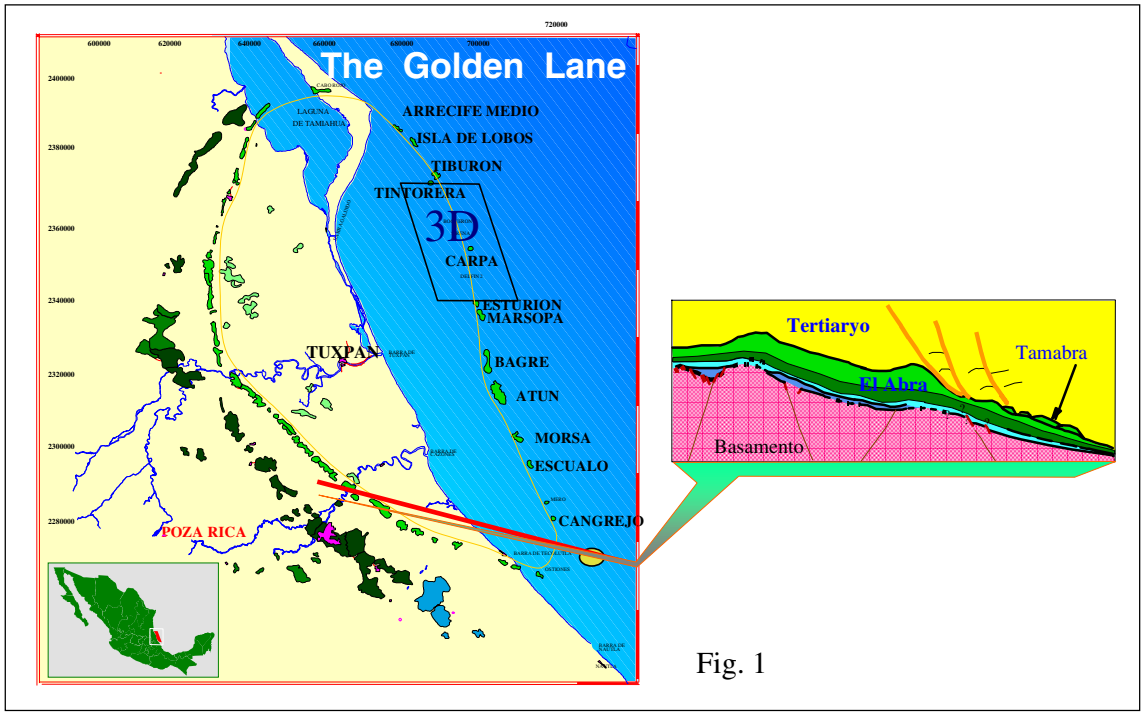


Figure 1. General map and schematic section of the Golden Lane.

The recovery factor in these reservoirs is very high due to a strong natural water drive. For example Atún and Bagre fields have a primary recovery of 40%. The hydraulic drive in these fields is so strong that water encroachment is a real concern. For example Atún and Bagre fields have a primary recovery of 40%.

The oil gravity for all of the fields is in the range of 33° to 40° API. Although gas is present and helps maintain reservoir pressure, for the offshore Golden Lane fields there is no evidence of a gas cap, as is frequently the case in onshore fields. So far, the total cumulative production in the offshore part is about 200 MMBO.

Geological and Geophysical Integration

Geological Model

It seems that everything written about the Golden Lane classical model suggests the classical architecture of a calcareous platform rimmed by a reef. However, new information brings new ideas. It is general knowledge that the structural culmination of the reef trend that surrounds the Tuxpan platform conforms to the Golden Lane fields. Figure 2 is schematic diagram of the classic model for onshore and offshore fields. Nevertheless, few realize that the base of the productive zone in the fields is a function of their position inside the reef subfacies. Thus Atun and Morsa fields have their main development in the back-reef zone, and a subfacies of wackestone-packstones and extended zones of floatstones (as revealed in the analyzed cores) from whose characteristics can be recognized a frame of dolomitized carbonates that includes cripto-algae, developments of fenestrals, and fragments of macrofossils. Bagre Field is also associated with the back-reef, but the subfacies includes bindstones and horizons of rudstones. In all of the reef subfacies, the domain of low magnesium calcite facilitates the breakup and the creation of porosity. The zones of the reef crest and reef front have a highly diffused porosity (vuggy porosity), but in general do not have good permeability.

Three-Dimensional Seismic

The recording of three-dimensional seismic data for the reef trend between Tiburón and Esturión fields, allow us to analyze the sedimentary characteristics in detail, and using seismic stratigraphy, makes clear the sequence of events associated with the shelf margin. One of the more important results of the seismic survey is an understanding of the flank position of the wells Carpa-1 and Tintorera-1. Despite being flank wells, they are field discoveries, for which the three-dimensional control of the structure reveals a significant area for reserves incorporation as well as the definition of unexplored structures along the reef trend.

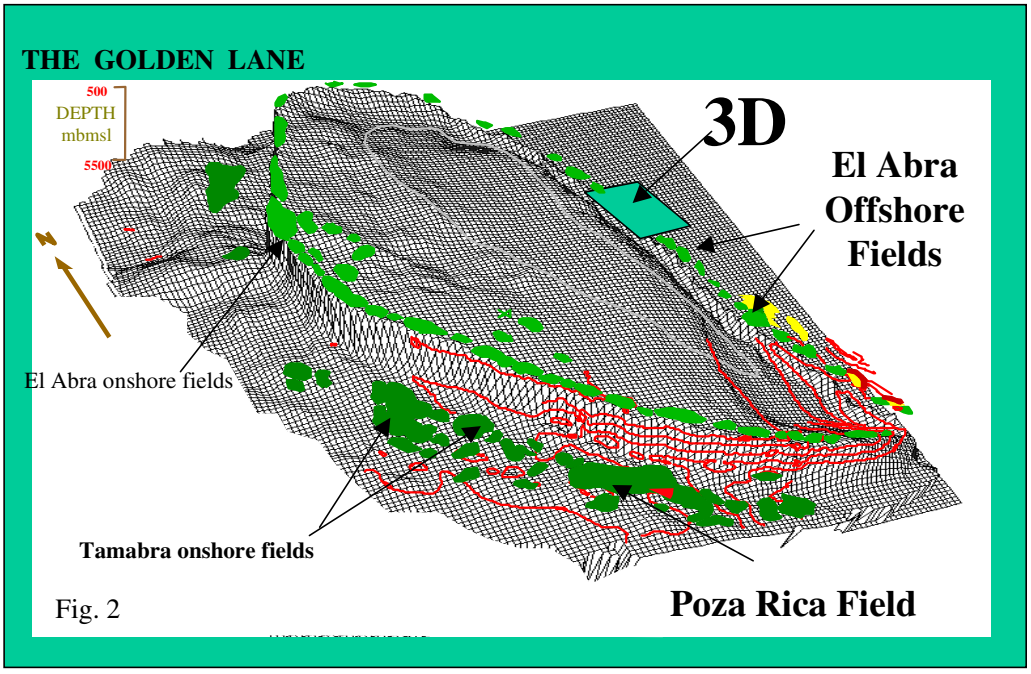


Figure 2. Three-dimensional projection of the Golden Lane structure.

New Prospects

From the results of the 3D seismic study for this part of the Golden Lane, a group of prospects headed by Carpa-101 have been selected as the best candidates to increase reserves (Figs. 3, 4, and 5). Carpa-101 appears to be the best prospect based on log analysis of Carpa-1. The reservoir is conventionally saturated and indicates a gross pay of 39 m and a net to gross ratio of 75%.

Although the structural relief in the Carpa trap is about 110 m, the practical closure is restricted to 39 m, based on the oil-water contact in the wellbore.

The prospect Tintorera-101 is second in importance. It is a similar structural trap as Carpa-101, but unfortunately the well Tintorera-1 does not have log information to evaluate the net pay, because it was drilled (in 1968) as a directional well from the conductor pipe of the Tiburón-7 in the Tiburón field, and has a horizontal throw of about 2347.3 m. However, the position of the Tintorera-1 as revealed by the 3D seismic suggest an extensive unexplored area in which the prospect Tintorera-101 has excellent possibilities to add reserves.

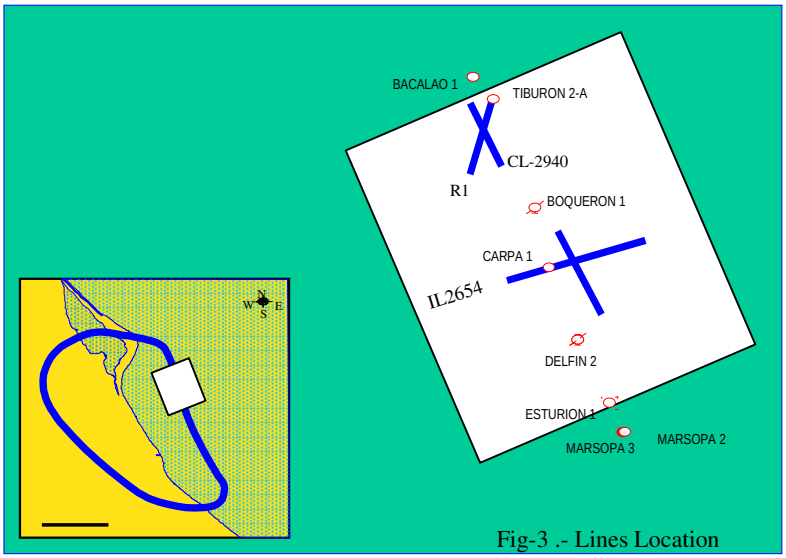


Figure 3. 3D seismic location and positioning of selected images.

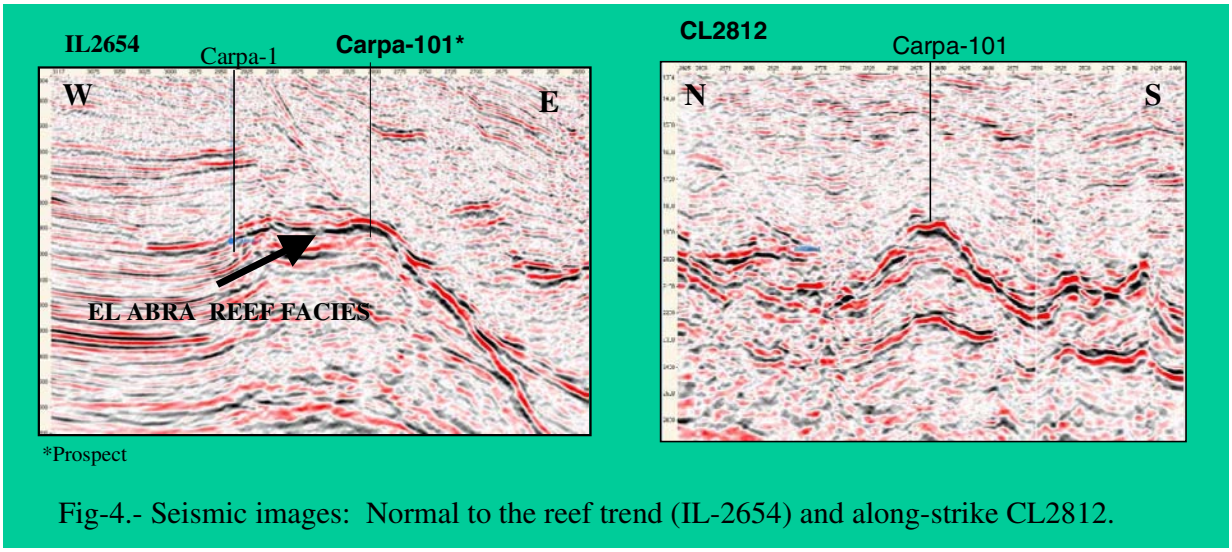


Figure 4. Seismic images: normal to the reef trend (IL-2654) and along-strike CL2812.

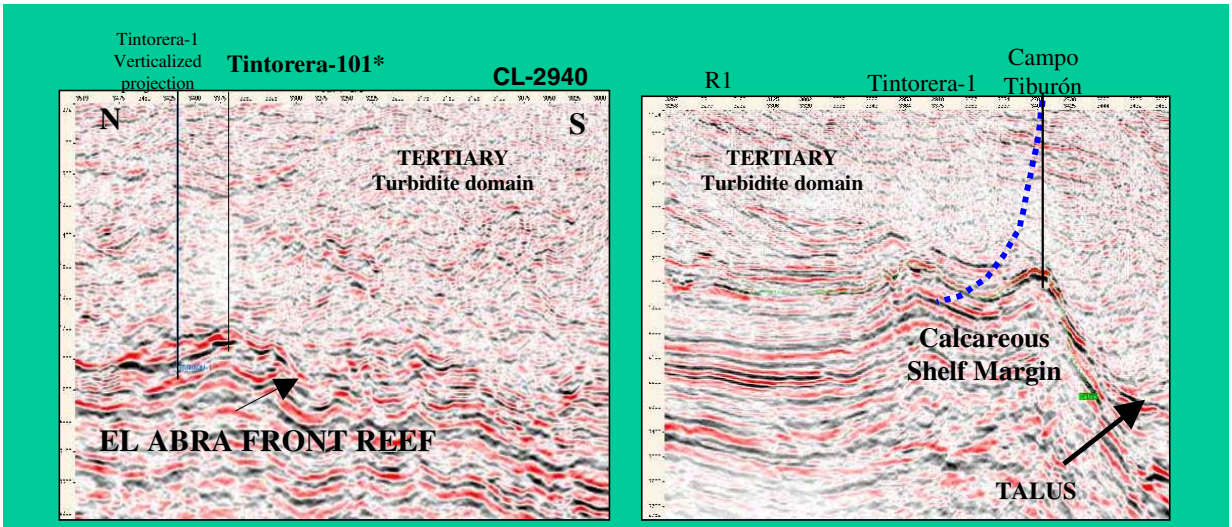
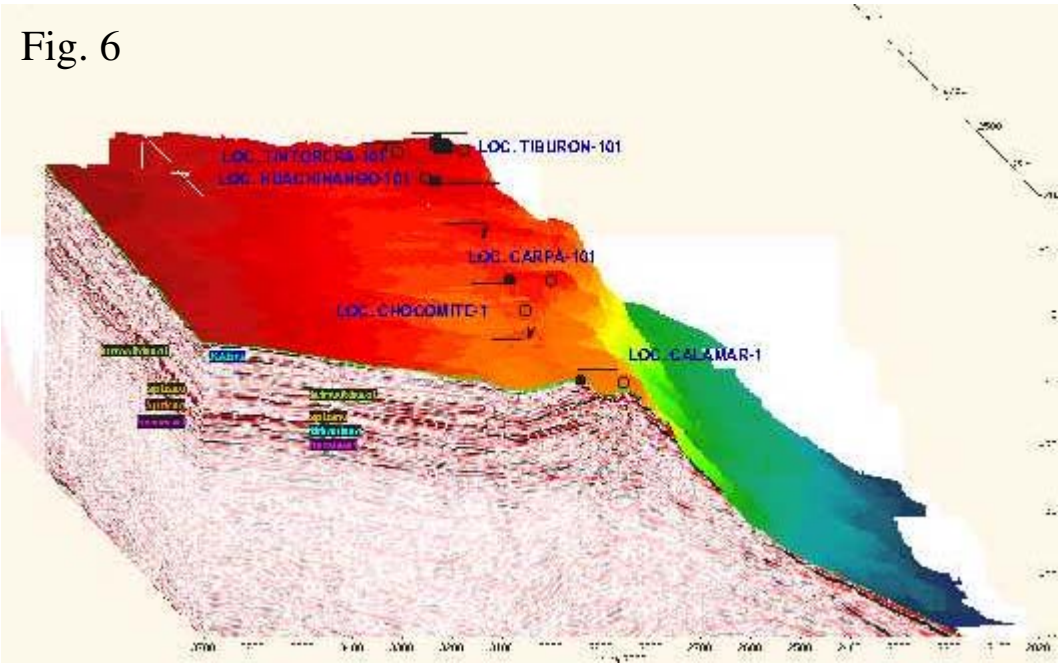


Fig-5.- Seismic images: Longitudinal view (CL-2940) and Random (R1). The wellbore Tintorera-1 was drilled from the Tiburón field (dashe line). *Prospect

Figure 5. Seismic images: longitudinal view (CL-2940) and random (R1). The wellbore Tintorera-1 was drilled from the Tiburón **field (dashed line).**



Seismic Visualization of the Tuxpan Platform

Figure 6. Three-dimensional segment of the Golden Lane showing the tilted platform and abrupt talus.

Future Projections

The strategy to be followed according to this work is to drill first the prospects Carpa-101 and Tintorera-101 in order to add a volume of resources of 85.92 MMBOE. If this venture is a success, then exploration of higher risk zones should be followed. The second phase could include a 3D seismic survey on the Tamabra play, in the south part of the Tuxpan platform, and after a consistent interpretation and data integration, the prospect Medusa-1 in the Tamabra play would be drilled. The Tamabra play has produced more than 2600 MMBOE, in the Poza Rica Field just in the onshore Golden Lane.

Conclusions

1. The Offshore Golden Lane does possess a high potential of undiscovered oil resources.
2. The area has a low exploratory risk and therefore low risk for the investment because a productive play already occurs (El Abra Play) and has a cumulative production of 200 MMBOE.
3. The area offers great advantages such as: facilities, shallow bathymetry, an accessible depth of objectives (about 2500 mbsl), and a port (Tuxpan, Ver.).
4. A resource of 85.92 MMBOE in the 3P (proved+probable+possible) category of reserves could be incorporated by the eventual drilling of the prospects Carpa-101 and Tintorera-101.
5. To demonstrate this high potential, has required an integrated methodology in which there has been the close interaction of geology and geophysics, from the first regional studies to core analysis, log analysis, 2D seismic interpretation, and finally the analysis of 3D seismic as well as the integration of engineering data. All of that effort has been the critical part of the process for the revival of the Golden Lane.

Acknowledgments

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Notes