New life to an old field - Main Pass 73 Gulf of Mexico Shelf

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Summary

The Gulf of Mexico shelf has been a prolific oil and gas production region for over seventy years. With limited ability to acquire new seismic streamer data due to dense surface platforms, seismic data used for interpretation and prospect generation has been in many cases sub-optimal. However, much advancement has been made in imaging technology that has enabled us to improve the interpretation and understanding of old producing fields.

The case study presented in this paper demonstrates how the use of improved model building and depth imaging technology has led to a change in the interpretation of the salt model of Main Pass 73 (MP73) Field. A drilling program targeting the Lower Pliocene and Upper Miocene sands resulted in significant new discoveries of up dip oil and gas reservoirs, thus giving new life to an old producing field.

Introduction

Many of the producing fields in the GOM shelf consists of hydrocarbon bearing sands truncated against steeply dipping salt domes. Unfortunately, in many cases the salt bodies defining the reservoir edges are not well imaged on associated seismic data, making the accurate mapping of the producing reservoir very difficult.

In the past few years, efforts have taken place to acquire new data on the GOM shelf. The newer data is mainly acquired using ocean bottom node technology which results with wide azimuth seismic data. The new data has the potential to have much better seismic resolution than the older narrow azimuth streamer data used by the industry for many years. In addition, nodes can be placed much closer to surface installations, creating better illumination in these areas.

In parallel to the development and deployment of new acquisition technology, much progress has been made in the past several years in processing and imaging technology. The main advancements include (a) the ability to construct more detailed anisotropic earth models with much more complex salt bodies and (b) the use of more accurate depth migration algorithms.
In general, processing and imaging results will only be as good as the quality of the input seismic data and the velocity model. However, the use of more accurate models and depth imaging algorithms can result in much more reliable data, even when we are limited to the use of older seismic data.

In the following study we present the recent anisotropic model building, anisotropic prestack depth migration, updated interpretation, prospect generation and new drilling program of MP73 Field. This case study demonstrates the link between seismic imaging technology and a successful drilling plan, significantly increasing the production from an old oil and gas field.

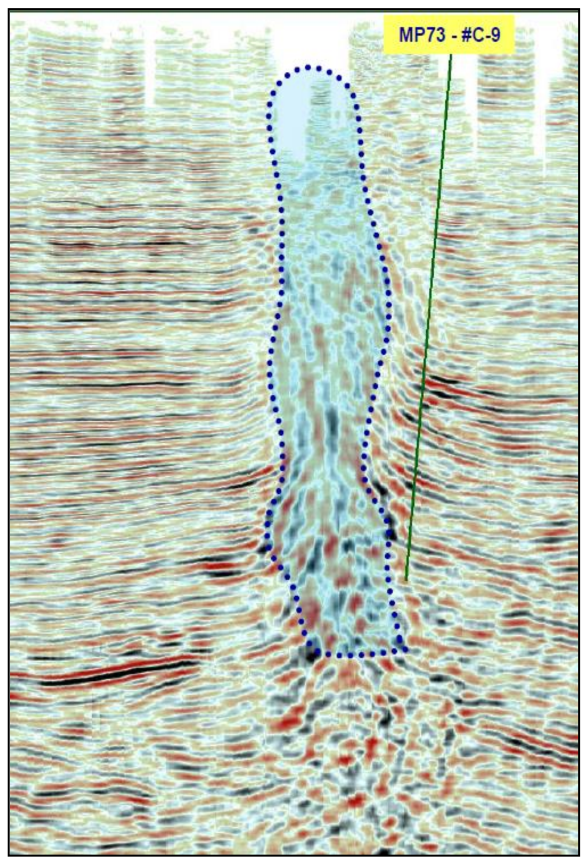

Figure 1: Main Pass 73 historical salt model. The historical model consists of a steeply dipping salt dome surrounded by hydrocarbon bearing sands. The well path displayed was drilled through the producing zones.

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Changing a historical salt model and interpretation

MP73 Field was discovered in 1974 by Mobil Oil Company. Based on 2-D seismic data and well control, a salt model was developed. The model consisted of a salt dome with steeply dipping flanks and hydrocarbon bearing sand around the dome (Figure 1). In 1992 a 3-D dataset was acquired over the field. The 3-D dataset did not add a clear image of the salt dome, and therefore the historical model did not change. In 2007 Energy XXI acquired the field and found discrepancies between well data and seismic data. In order to resolve these discrepancies Energy XXI decided in 2008 to reprocess the existing seismic data. Anisotropic model building and depth imaging was added with the objective to clarify the image and interpretation around the salt dome.

Because of the lack of salt flank image, model building and depth imaging was done using a unique model building technique called the "salt expansion technique". It is based on the generation of multiple prestack depth migration (PSDM) volumes where a trial salt model is used for each iteration. Due to the absence of salt flank reflections, analysis of the noise patterns around the salt body are used as a guide for the construction of the salt body model. During the application of this process, we discovered that primary reflection seismic events were imaged inside the historical boundaries of the salt body. In order to preserve these seismic reflections an alternative salt model was created consisting not of a single dome type salt body, but several smaller detached salt bodies with sedimentary layers between the salt bodies (Figure 2). This seismic processing observation leads to a dramatic change of the historical salt model. In 2009, 35 years after the discovery of MP73 Field, a new salt model, consisting of several smaller and detached salt bodies was developed.

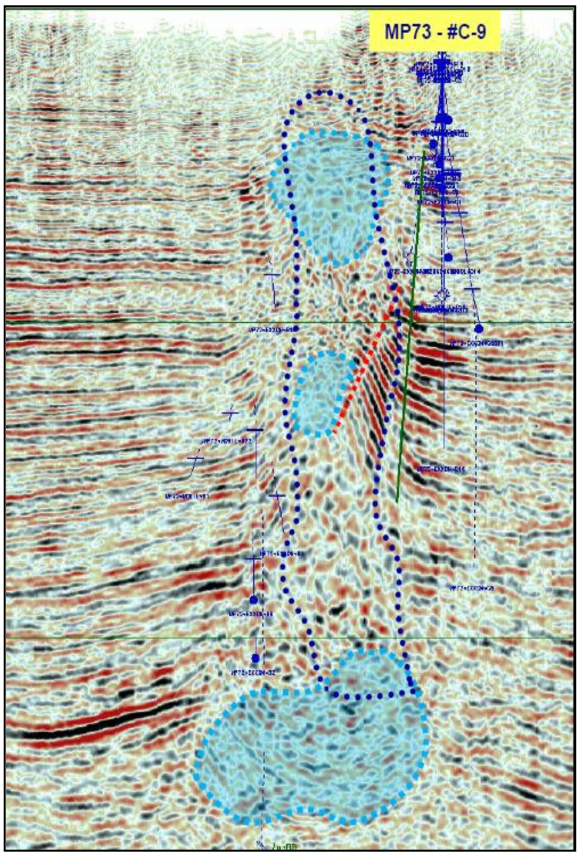

Figure 2: Initial modification to Main Pass 73 historical salt model. The 2009 revised model consisted of smaller, detached salt bodies.

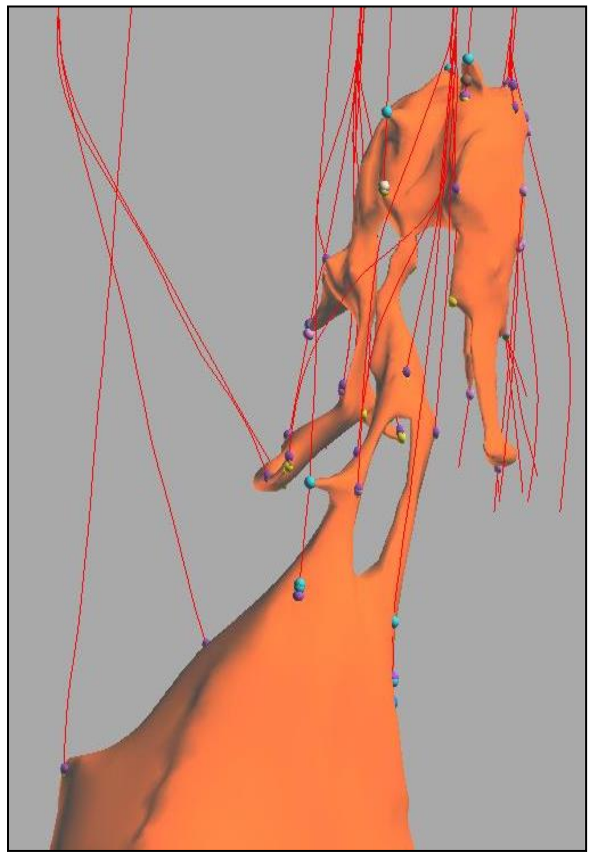

Figure 3: Revised 2010 salt model constructed using all available well data and analysis of seismic noise patterns around the salt body. Sand tops are displayed on the well trajectories.

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This new model replaced the historical continuous diapir shape salt dome, leading to a new and optimistic interpretation of the producing sands.

Using additional geological considerations and gathering salt markers from any older well drilled in the area of the producing field, the salt model was further modified during 2010. We noticed the presence of welds (i.e. evacuated salt) connecting the smaller salt bodies. In the resulting 2010 model modification, the smaller salt bodies were connected through a series of thin salt welds leaving a sedimentary cavity inside the salt body (Figure 3).

To complete the salt model an anisotropic model was developed for the sedimentary section around the salt and application of anisotropic PSDM was done in late 2010. Interpretation of the depth migrated data using the new salt model resulted in several new prospects located both up-dip to older well penetration and inside the historical boundaries of the salt dome model.

Drilling Results

The interpretation of the anisotropic depth migrated data using the new anisotropic model and salt body was completed in 2011 and resulted with two new drilling locations and well plans.

The first well, named Ashton C15-st1 was drilled in 2011 targeting a series of seismic amplitude located inside the historical salt body and outside the new model. The well encountered multiple hydrocarbon sands and was completed in 2011 (Figure 4).

The second well, named Onyx was drilled in 2011 into a series of sand layers that were not imaged on any previous prestack time migrated data. Onyx initial production rate (IP) reached 5,500 BO/D, which made it the highest producing oil well on the GOM shelf at the time.

The drilling success of Ashton and Onyx wells resulted in the identification of several other new prospects located ‘inside’ the boundaries of the salt dome model.

Conclusions

With the application of more advanced model building workflows such as the “salt expansion technique”, the construction of more accurate anisotropic models, and by incorporating all available subsurface information, legacy salt models can be updated and improved.

In the study presented in this paper, incorporation of advanced model building and depth imaging technology of the legacy streamer 3D dataset acquired over MP73 field lead to the construction of an accurate working salt model and subsequently a sedimentary model.

Successful drilling that was executed using the new PSDM data resulted in significant new finds of additional oil and gas reserves in MP 73 Field, validating the viability of the model building and depth imaging techniques used. With further improvement of depth imaging technology and using new wide azimuth datasets currently acquired in the Gulf of Mexico Shelf, we expect to further improve the interpretation and models of additional salt bodies in this area.

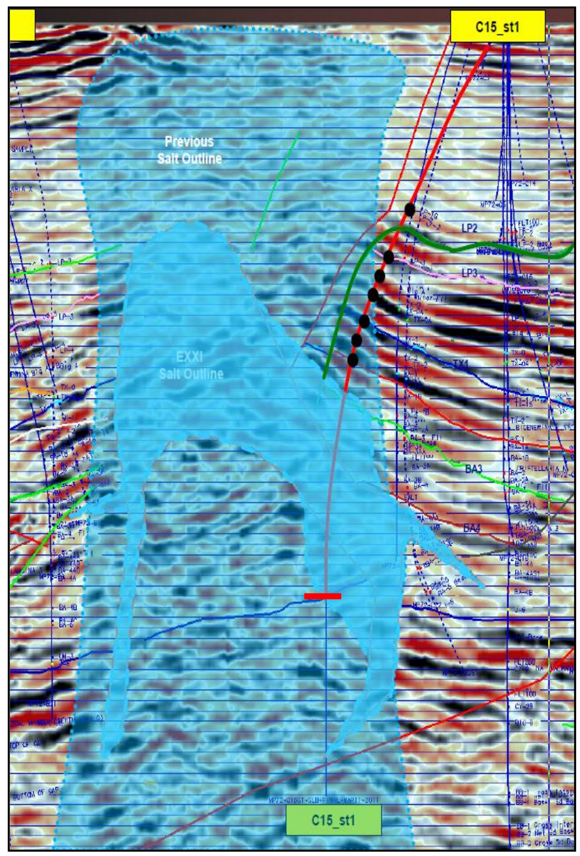

Figure 4: Ashton Well. The seismic section shown is the anisotropic PSDM constructed using the new salt model. The red color well trajectory is the Ashton well. Black dots marks sand layers penetrations. The old and new salt models are displayed in transparent blue color. Ashton sands are located ‘inside’ the old, dome type salt body.

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EDITED REFERENCES

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REFERENCES

No references.

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