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The Seismic Interpretation for (X) Oil Field Depending on 3D Seismic Data of Nearby Oil Field, Southern Iraq.

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Abstract

This research focused on using seismic data to review the structure of the (X) Oil Field. The study utilises a 3D seismic survey conducted during 2011-2012, covering the (Y) Oil Field 2 km to the west, and with partial coverage across (X), to map the Top Zubair reflector. Seismic rock properties analysis was conducted on key (X) Oil Field wells and used to tie the Top Zubair reflector on (X) Oil Field. The reflector was mapped within the time domain using DecisionSpace Software, and then converted to depth using a velocity model. The depth structure map was then compared to the original oil water contact (OOWC) across the fields to understand the potential structural closure of the Top Zubair reservoir in both fields.

Keywords: 3D Seismic interpretation, Top Zubair, Structural map.

التفسير الزلزالي لحقل نفطي (A) بالاعتماد على البيانات الزلزالية ثلاثية الأبعاد لحقل نفطي أخرمجاور، جنوب العراق.

الخلاصة:

ركزهذا البحث على استخدام البيانات الزلزالية لدراسة تركيب الحقل النفطي (X). حيث تم استخدام مسحًا زلزاليًا ثلاثي الأبعاد تم إجراؤه خلال الفترة 2011-2012، الذي يغطي حقل نفطي مجاور(Y) على بعد 2 كم غرباً، مع تغطية جزئية لحقل (X)، لرسم خريطة عاكس أعلى الزبير. اجريت عمليات تحليل الخصائص الزلزالية للصخور على آبار الحقل (X) الرئيسية والتي استخدمت لربط عاكس اعلى الزبير في الحقل. تم رسم خريطة العاكس ضمن المجال الزمني باستخدام برنامج DecisionSpace، ثم حولت إلى خريطة عمقية باستخدام الموديل السرعي. تم مقارنة الخريطة العمقية مع خط تماس النفط – الماء الأولي (OOWC) لفهم الانغلاق التركيبي المحتمل لأعلى مكمن الزبير في كلا الحقلين.

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1. Introduction

Y Oil Field had 3D seismic survey data during 2011-2012, which was conducted by BGP Company. The survey covers an area of 1814 km2. This data was processed by Western Geco. company Finally, the data resulting from the processing was interpreted by the BP (The British Petroleum Company plc and BP Amoco company). Because the 3D seismic survey of the (Y) Oil Field, covers parts of the neighboring oil fields as field (X), which is 2 km from the (Y) Oil Field, it was necessary to study the (X) Oil Field to connect the Zubair reservoir to both fields [(X) and (Y) Oil Fields].

1.1. Study area

(X) Oil Field lies 2 km to the east of the (Y) Oil Field and about 5 km to the west of (Z) Oil Field [1].

It currently has 46 wells with a variety of data available [2]. The key wells of seismic area are Well-B and Well-D as they have more data, check shots data is available for Well-D. The data available for this study is outlined below in Table (1).

Table (1) (X) Oil Field well data

Well	Drilling date	Total Depth (m MD)	Available Data
Well-A	Mar. 23,1959	3665	Wireline Logs
Well-B	Jun. 08,1977	4397	Wireline Logs
Well-C	Mar. 01,1978	4464	No data
Well-D	Jul. 24,1986	3657	Wireline Logs& Checkshot

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Between January and August 2012, the first 3D seismic survey over the (Y) Oil Field was acquired. Due to the size and shape of the (Y) Oil Field concession, the new 3D seismic survey covered part of the (X) Oil Field (west and central areas). This study aims to review this new dataset to provide further information on the potential structure of the (X) Oil Field and its relation to the (Y) Oil Field.

1.2. Geological description

This study focuses on the structure of (X) Oil Field at the Top Zubair reservoir level. The stratigraphy of (X) and (Y) Oil Fields can be seen below in Figure (1). The Lower Cretaceous Zubair Formation is the most important reservoir in the south of Iraq and adjacent countries [3]. The formation comprises 380-400 m of alternating shale, siltstone and sandstone [4]. The type section was divided into five informal sand and shale units used for reservoir description [5]. To the SW the proportion of shale in the formation rapidly decreases. The thickness of the Zubair Formation ranges between 280 and 400 m with levels increasing towards northeast end of the field [6]. Porosity averages 25 percent and permeability, 1,000 millidarcies [7].

2. Aim of the study

The (X) Oil Field study aims is to review the new 3D seismic data set and provide additional new information on the (X) Oil Field, including the structure of the Top Zubair reservoir. The new interpretation could influence future depletion plans for both (X) and (Y) fields.

- Use New (Y) Oil Field 3D seismic data set which has some data covering (X) Oil Field.
- Identify the Top Zubair across (X) Oil Field.
- Use seismic reflectivity in Time to interpret the top Zubair across Tube, the saddle area and into (Y) Oil Field.
- Provide an interpretation and subsequent depth calibration to establish whether the (X) and (Y) fields are connected across the Zubair, or if there is structural closure separating the fields.

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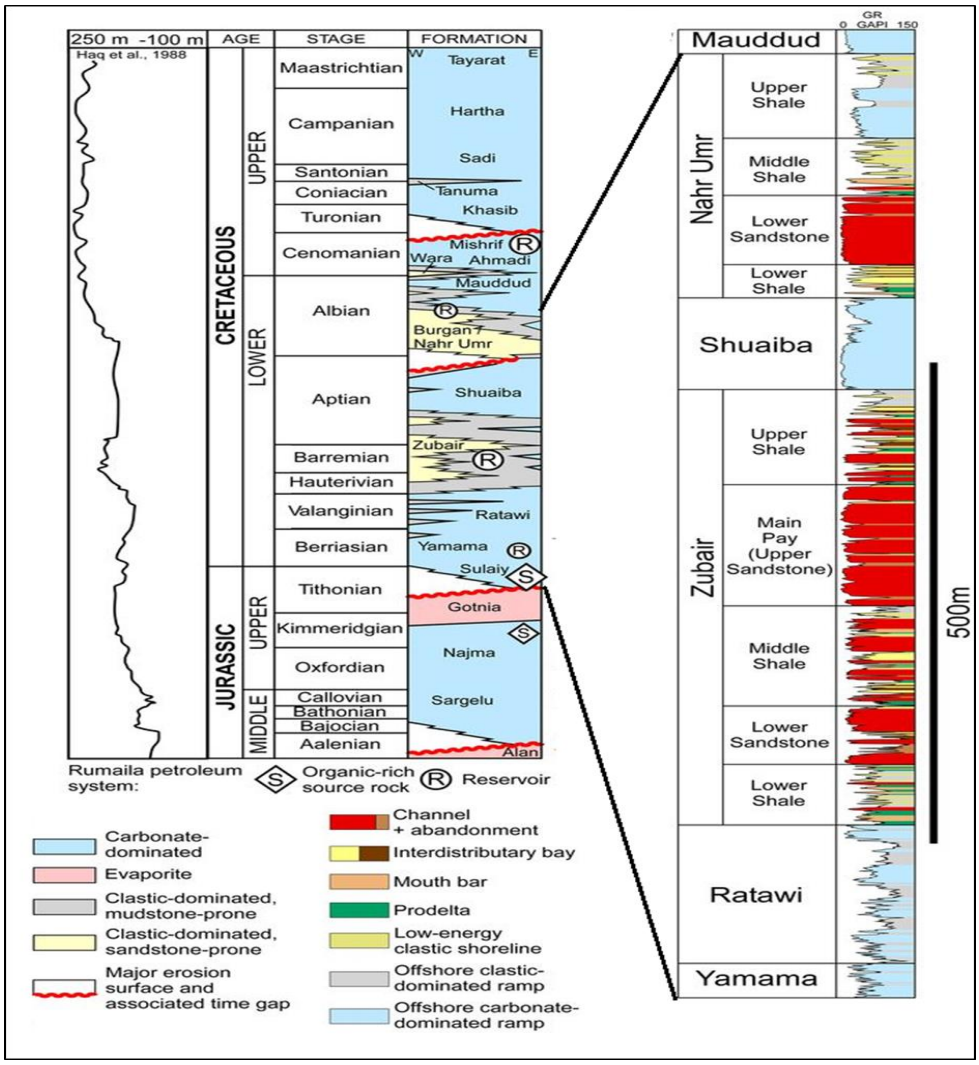

Fig. (1) Stratigraphic column for (X) and (Y) Oil Fields. [8]

3. Methodology

The study objectives were achieved through delivering the products outlined below:

- Well-ties and seismic rock property analysis.
- Time and depth structure maps of the Top Zubair event across (X) Oil Field and into (Y) Oil Field.
- Review seismic attribute maps to QC the interpretation.
- Analyses of structure map and give an interpretation on structural closure of (X) Oil Field.

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Broad outline:

- Petrophysics team provided rock properties work based on the (X) wells, Well-B and Well-D.
- These properties were matched to a single line interpretation of Top Zubair across (X) Oil Field, in Figure (2) the information provided by Petrophysics team at the beginning of the study which guided the interpretation of Top Zubair.
- This information is used as a guide and starting point to produce a complete interpretation over (X) Oil Field, extending across west to (Y) Oil Field, for the Top Zubair pick.

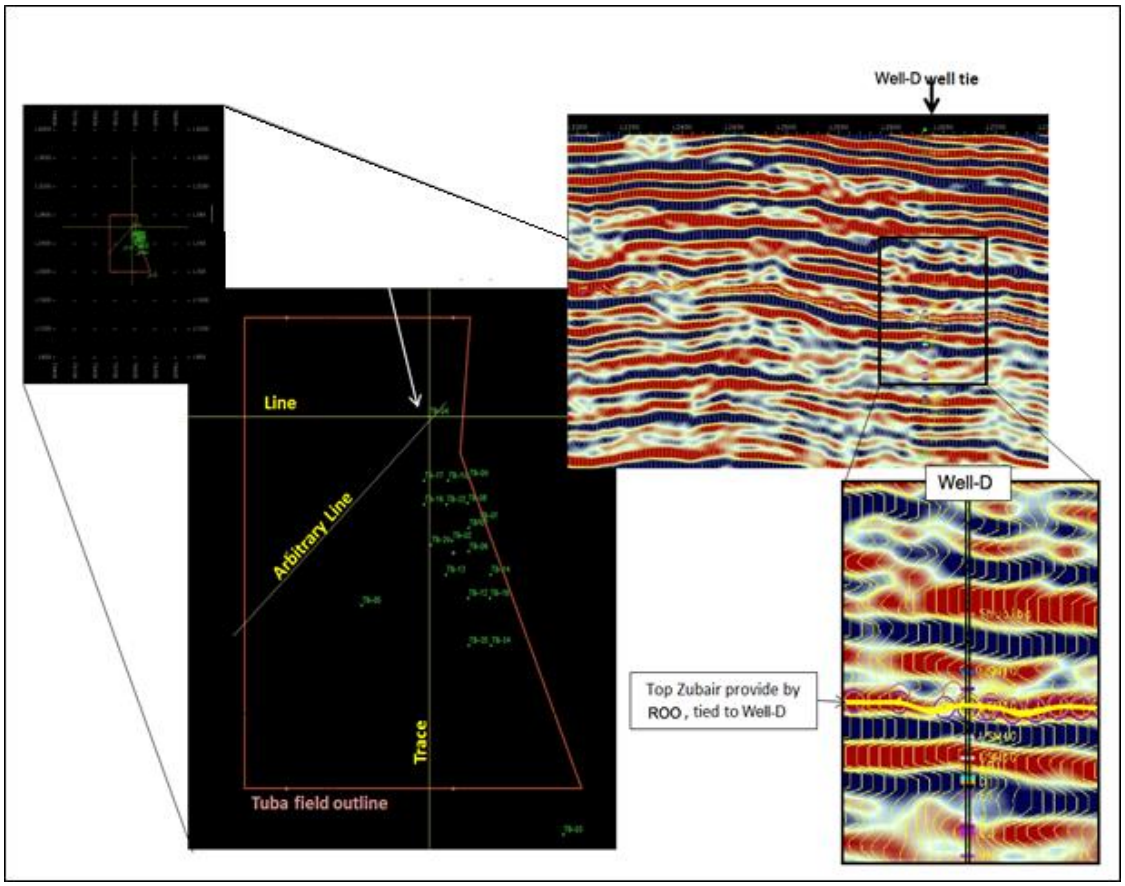

Fig. (2) Rock properties provided by Petrophysics team the beginning of the study.

Create new Top Zubair Horizon across (X) Oil Field

The interpretation of Top Zubair covers an area of about 230 km^2 – from inlines 2000 to 2800 (800 inlines) and crossline 5640 eastward (about 560 crosslines). The

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area of interest is shown in Figure (3) below with the (X) Oil Field interpretation area shown in red.

The study was conducted using Landmark Seisworks Software version 5000.10.0.1. Seisworks is limited to TD interpretation only and has poor capability for gridding. The final structural review of the horizon was conducted using DecisionSpace Software.

The workflow that been used to complete the structural interpretation of top Zubair across (X) Oil Field included using Sesiworks to pick the Zubair horizon top, making multi arbitrary lines through the wells in the area. This provided information over how the pick may change across (X) Oil Field before interpreting starts and helped in highlighting areas which may be more challenging.

The interpretation inline started from the first line through the wells (Well-B, Well-D), and continued every 16 lines to give a regular grid. It is best practice to start the interpretation from the fixed data, this ensured that the correct pick is being used and propagated for the rest of the interpretation. After that coarse grid on a 16-lineregular spacing (50 inlines and ~ 35 traces) were picked. Finally, the infill grid on a smaller 8/4 line spacing as required was picked, for the areas of more complex geology and poor data quality (to guide the auto-track process).

4. Results and Discussion

Horizon interpretation results and challenges

Sesiworks software was used to pick the top Zubair horizon based on the workflow outlined in the previous section. Where possible the auto track function was used to pick the largest trough and correlate along section. The final (X) Oil Field top Zubair horizon is shown below in Figure (5). It was picked on the regular grid spacing outlined in the workflow and areas which were more complex show a denser picking Figure (4).

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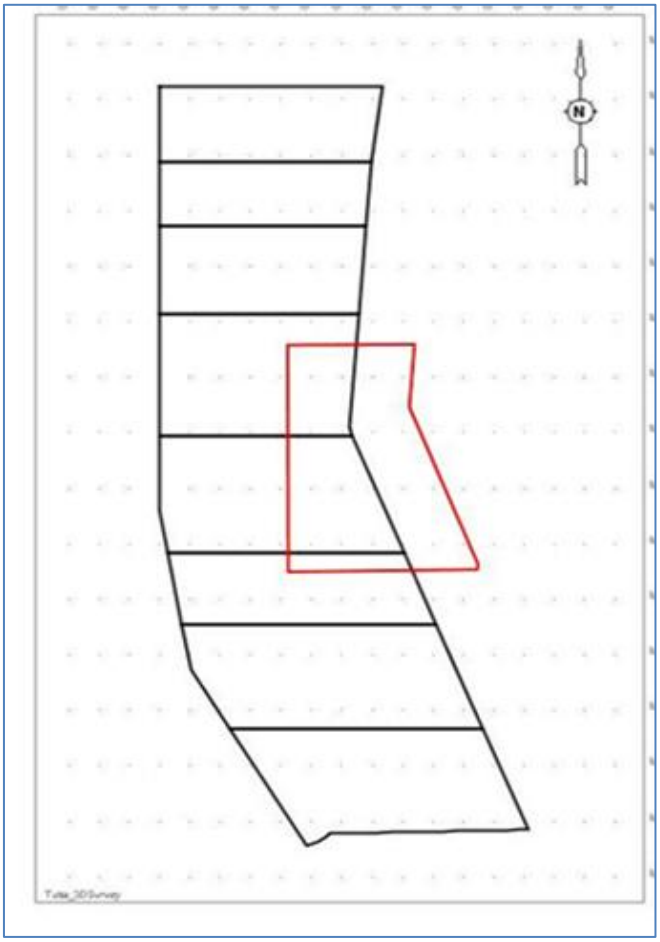

Fig. (3) Map showing the (X) Oil Field interpretation area in red, and the (Y) Oil Field panels in black.

In some areas, the seismic was more difficult and required choosing between different potential interpretations. In these areas, sometimes the point to point picking function was used to ensure the preferred pick was chosen. Areas of more challenging interpretation have been highlighted in Figures (5) and (6).

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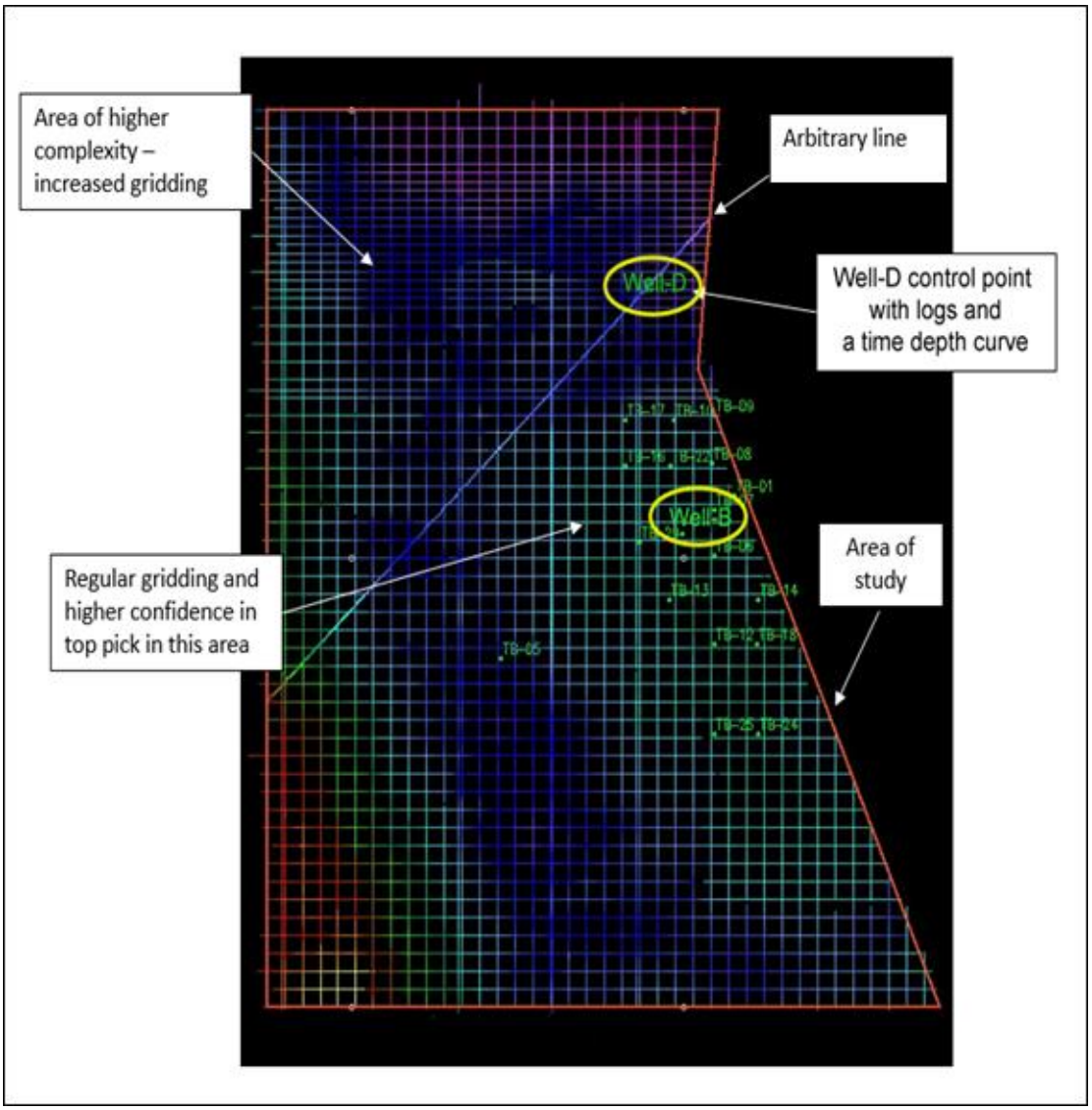

Fig. (4) Final picked horizon before gridding.

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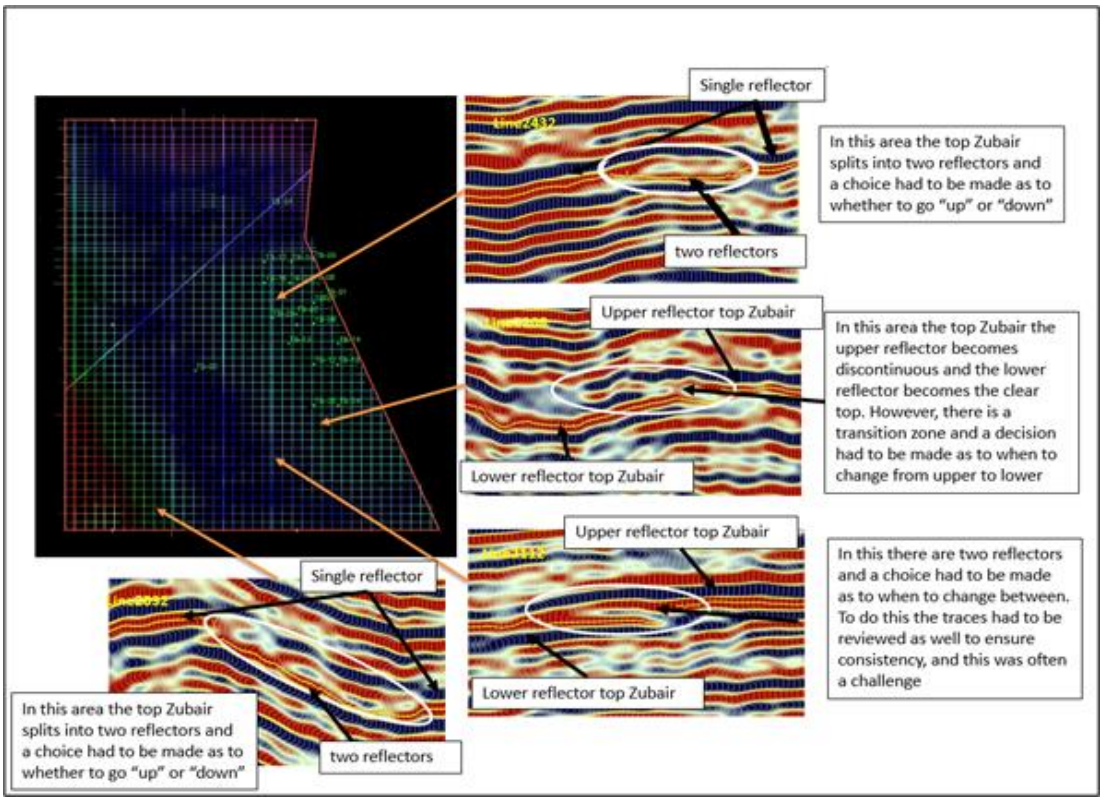

Fig. (5) Details of the challenging areas to interpret to the SE of (X) Oil Field.

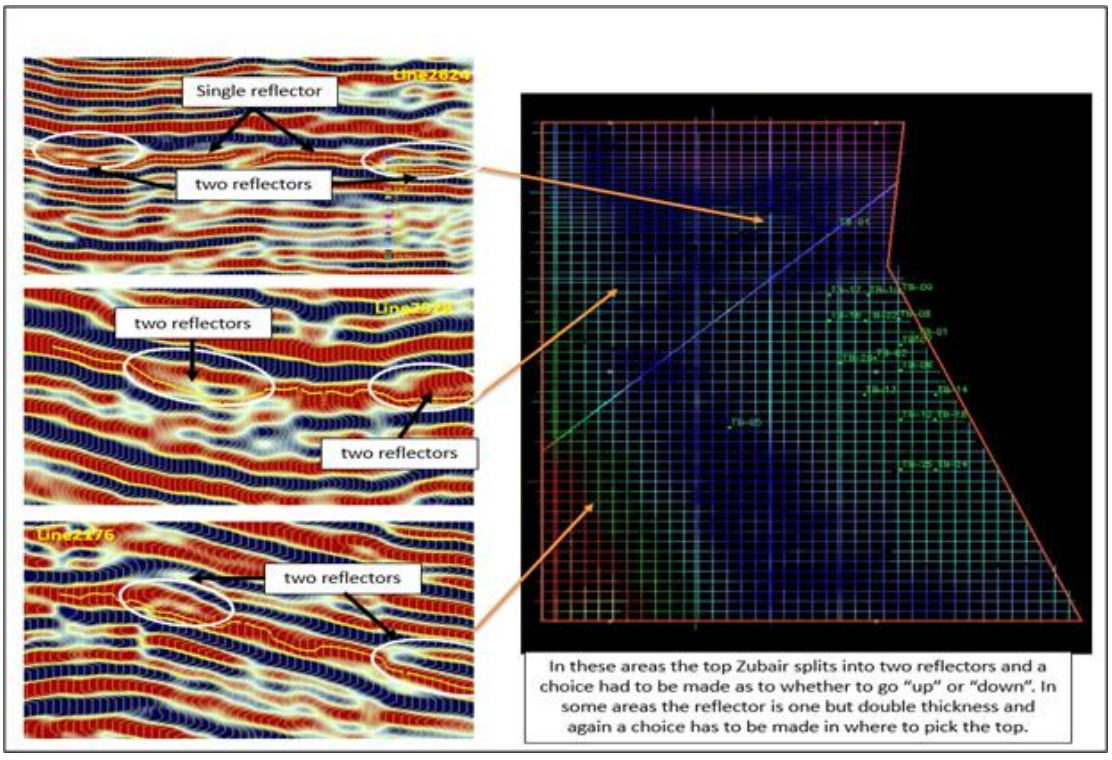

Fig. (6) Details of the challenging areas to interpret to the NW of (X) Oil Field.

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Gridding and contouring, depth conversion and QC

The final QC'd horizon was then depth converted using the new velocity model which was provided by ROO. The depth horizon was then imported into its newly available Decision Space Software. This software provided quick and easy options for gridding and contouring [9]. Initially both the Time and Depth horizons were gridded with the same properties [10], [11], as a QC step and this is shown below in Figure (7).

The final parameters used for the gridding and contouring can be seen in Figure (8), the final depth grid with contours can be seen in Figure (9).

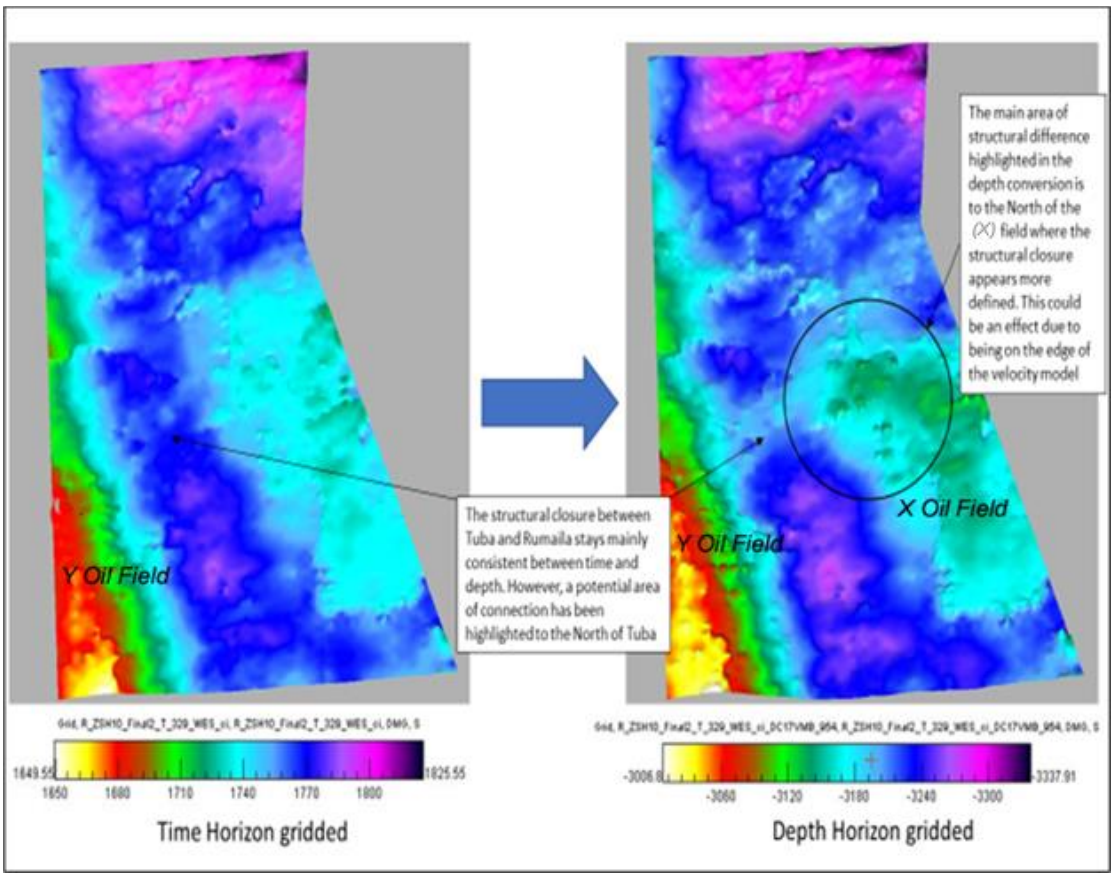

Fig. (7) Time and Depth gridding

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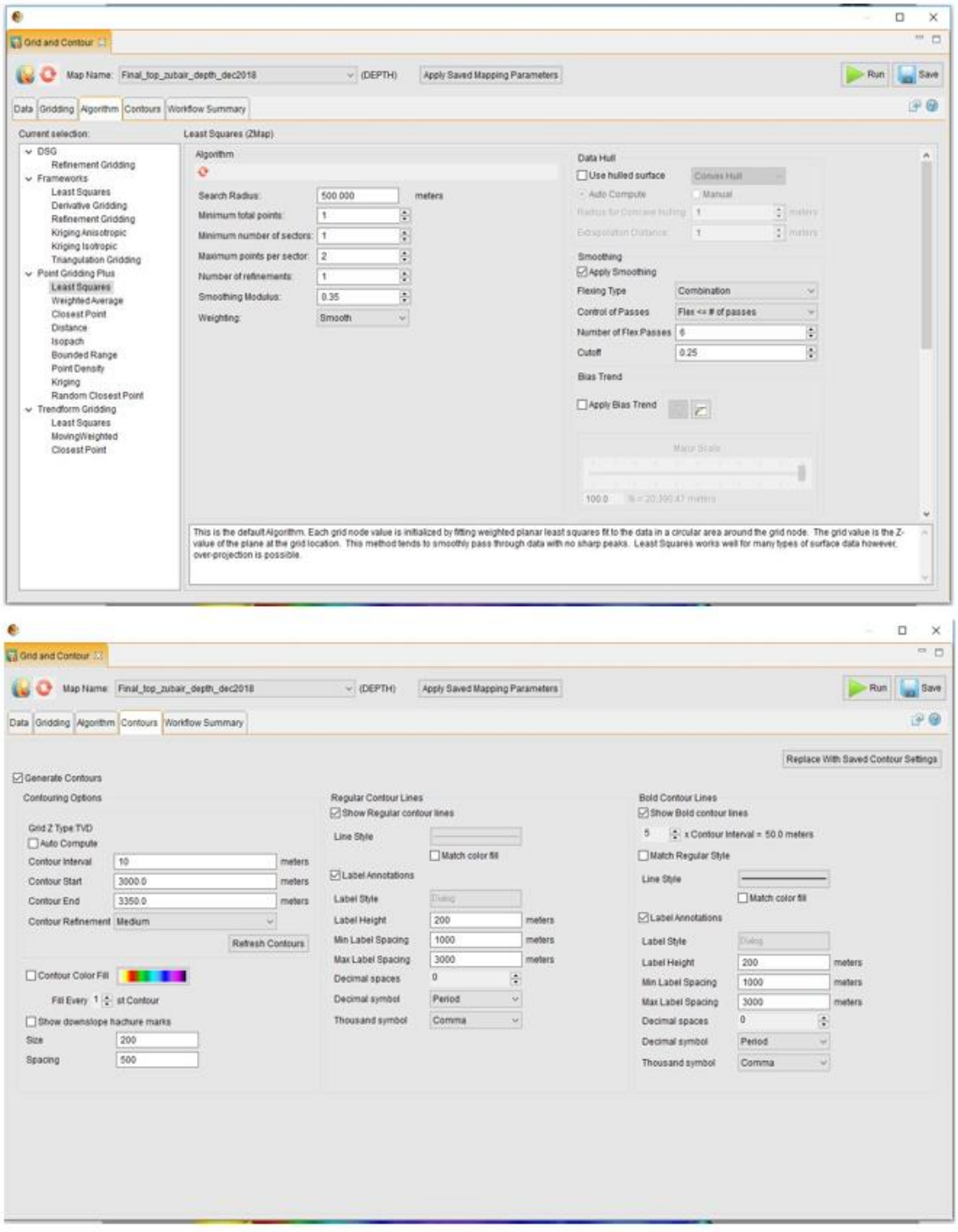

Fig. (8) The final parameters used for gridding and contouring.

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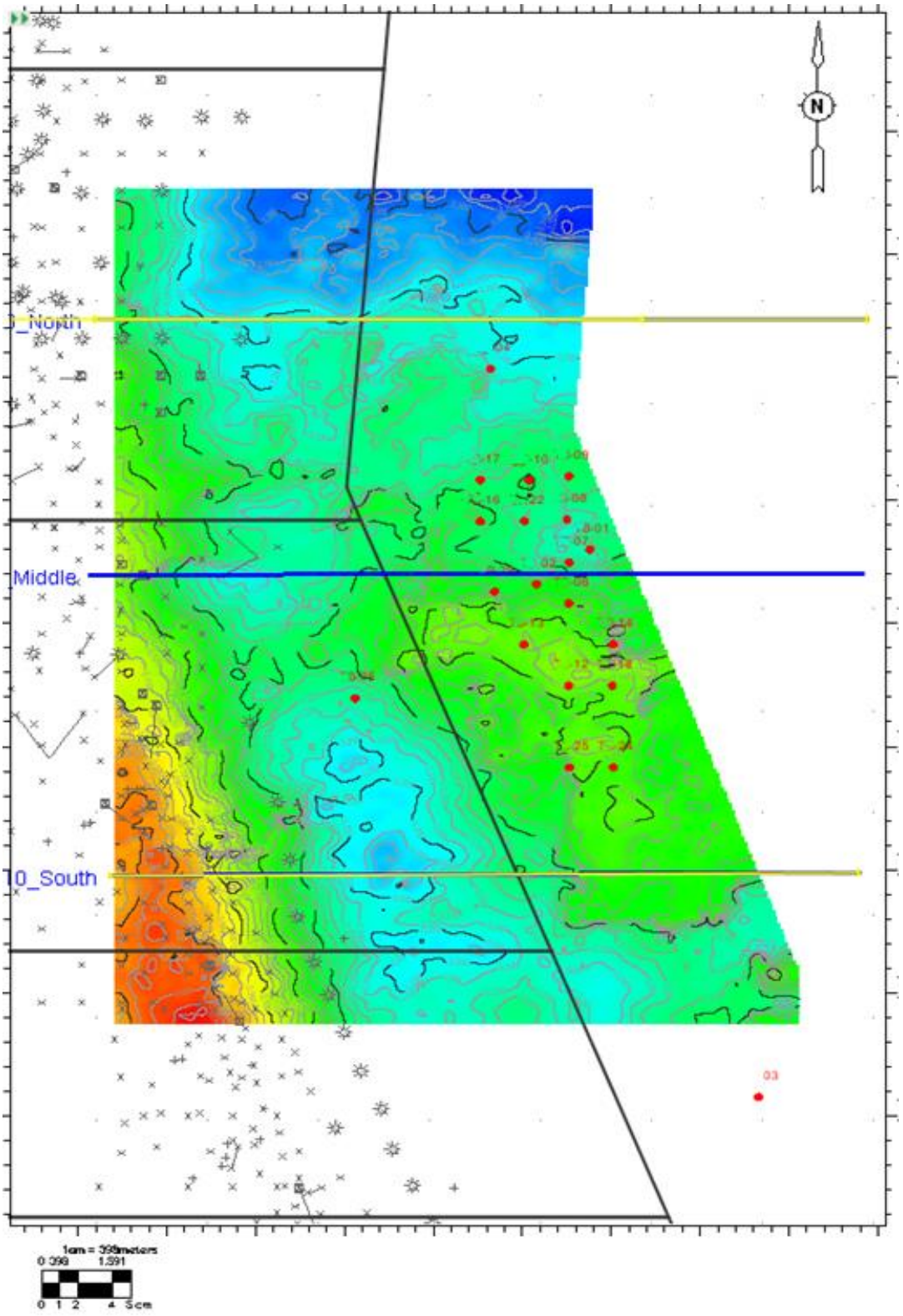

Fig. (9) The final depth grid with contours.

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Review of structural closure of (X) Oil Field

Using the final depth grid, a framework model is created to evaluate the structural closure of the Top Zubair horizon from (X) Oil Field to Rumaila. To evaluate closure, the original oil water contact (OOWC) for the fields was used (-3269m TVDSS) within the model. In Figure (10) cross sections have been reviewed to evaluate structural connectivity between the two fields. The results suggest that there is potential for structural connectivity between the two fields, in the middle and southern areas of (X) Oil Field, at Top Zubair level. However, there is uncertainty in this interpretation due to a lack of adequate well control in the saddle between (X) Oil Field and Rumaila, data quality, and a relatively smooth seismic velocity field.

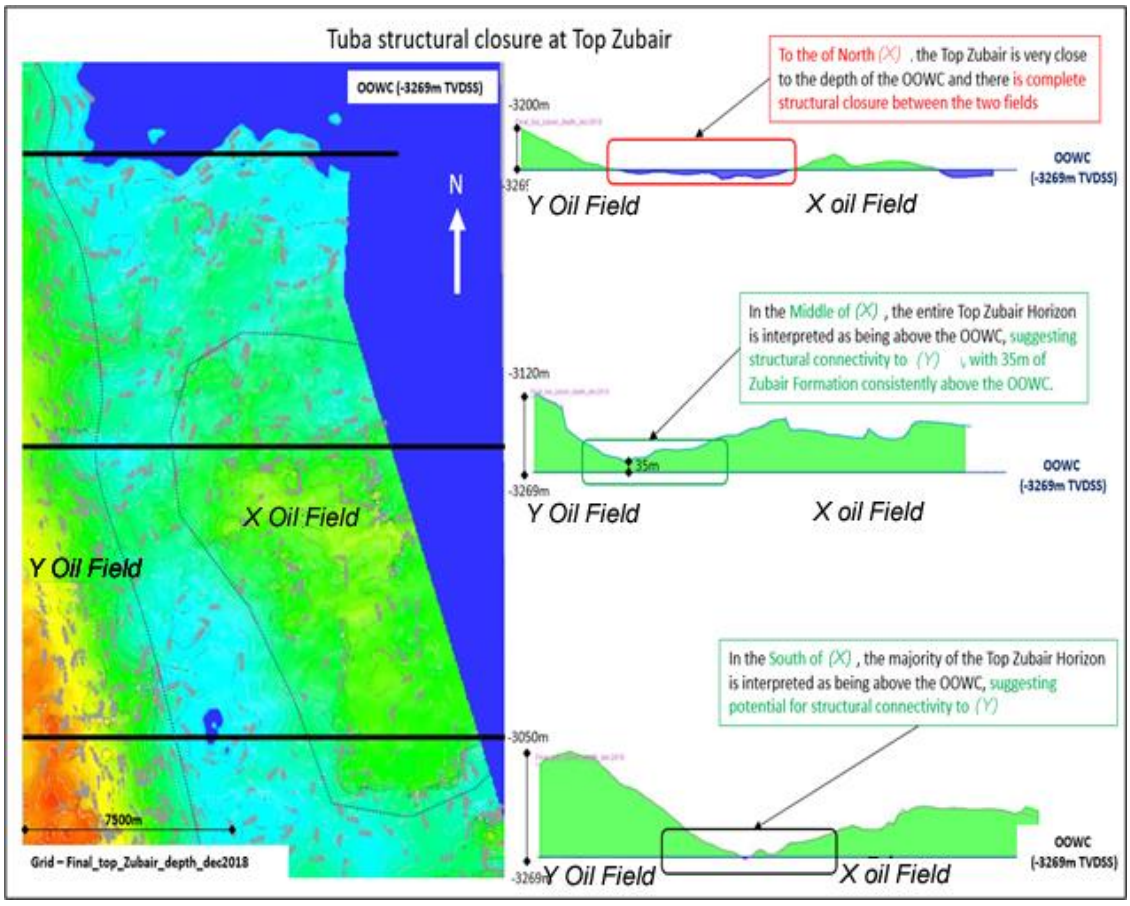

Fig. (10) Structural framework of Top Zubair across (X) Oil Field.

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5. Conclusion and Recommendation.

This study has reviewed the structural closure potential of the Top Zubair between (X) and (Y) Oil Fields. This was done by mapping the Top Zubair, depth converting, gridding the horizon and creating a framework model using the OOWC, to evaluate closure.

This study shows a potential for (X) and (Y) Oil Field and to be structurally connected within the Upper Zubair above the OOWC. However, this is based on several assumptions and to confirm any connectivity. We propose further studies to support this result:

- A review of the stratigraphic potential for connectivity within the Top Zubair.
  - This study has not reviewed stratigraphy as part of the scope. As such a future study is recommended to develop an Upper shale depositional model to understand sand distribution across the area.
  - Attribute mapping of potential channel features identified during this study.
  - Review of well information in (X) and (Y) Oil Field for the Upper shale.
  - Potential to integrate new well data.

- A review of potential different OOWC within the Upper Shale Formation
  - This study has assumed a single OOWC based on (Y) Oil Field data. It is known that within the Upper Shale several different OOWC may be present. Further work could review the structure against different OOWC within the Upper shale.
- A review of the depth conversion model and update
  - It is noted that several artefacts are seen within the data, and ROO are in the process of updating their depth conversion model. The new model should take into account new wells drilled within the area.
  - The New model should be used to re-depth convert this data in future to understand if there are any structural updates.

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