



3D Seismic Structural and Stratigraphy Study of Shuaiba Formation in Kumait Oil Field-Southern Iraq

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Abstract

The Kumait Oil field was interpreted using 3-D seismic data from Oil Exploration company. The Shuaiba Formation (Cretaceous Age) reflector is detected. Structural map of formation is prepared to obtain the location and direction of the sedimentary basin and shoreline. Depth maps was drawn depending on the structural interpretation of the picked reflector and show several structural feature as closures. The seismic interpretation of the area approves the presence of some stratigraphic features in the studied formation. Some distributary mound and flatspot were observed within the study area, but they are not continuous due to the tectonic effects. These activity elements give reasonable explanation for the hydrocarbon distribution in the area of study and explain the cause of wildcat of Kt-2 is well.

Keywords: 3D Seismic, Shuaiba Formation, Kumait Oil field, Structural features, Sedimentary basin, Iraq.

دراسة زلزالية تركيبية طباقية ثلاثية الأبعاد لتكوين الشعيبه في حقل كميث النفطي-جنوبي العراق

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الخلاصة

بأستخدام المعلومات الزلزالية ثلاثية الأبعاد المتوفرة في شركة الاستكشافات النفطية، تم التقاط عاكس وهو عاكس الشعيبه الذي ترسباً خلال العصر الطباشيري. أعدت خرائط تركيبية وطباقية للتكوين للحصول على موقع واتجاه الحوض الرسوبي وتحديد خط الساحل. رُسمت الخرائط الزمنية، السرعة والعمقية بالاعتماد على تفسير العاكس المدروس وأوضحت وجود عدة ظواهر تركيبية بهيئة أنغلاقات. اثبتت التفاسير الزلزالية للمنطقة وجود ظواهر طباقية في التكوين المدروس بهيئة تقب متراكم ويقع مسطحه في المنطقة لكن امتداداتها غير مستمره في المنطقة بسبب التأثيرات التكتونية. هذه الأنشطة تعطي تفسيراً معقولاً لتوزيع النفط في منطقة الدراسة وكذلك توضح سبب عدم وجود هيدروكربونات في بئر كميث-2.

Introduction

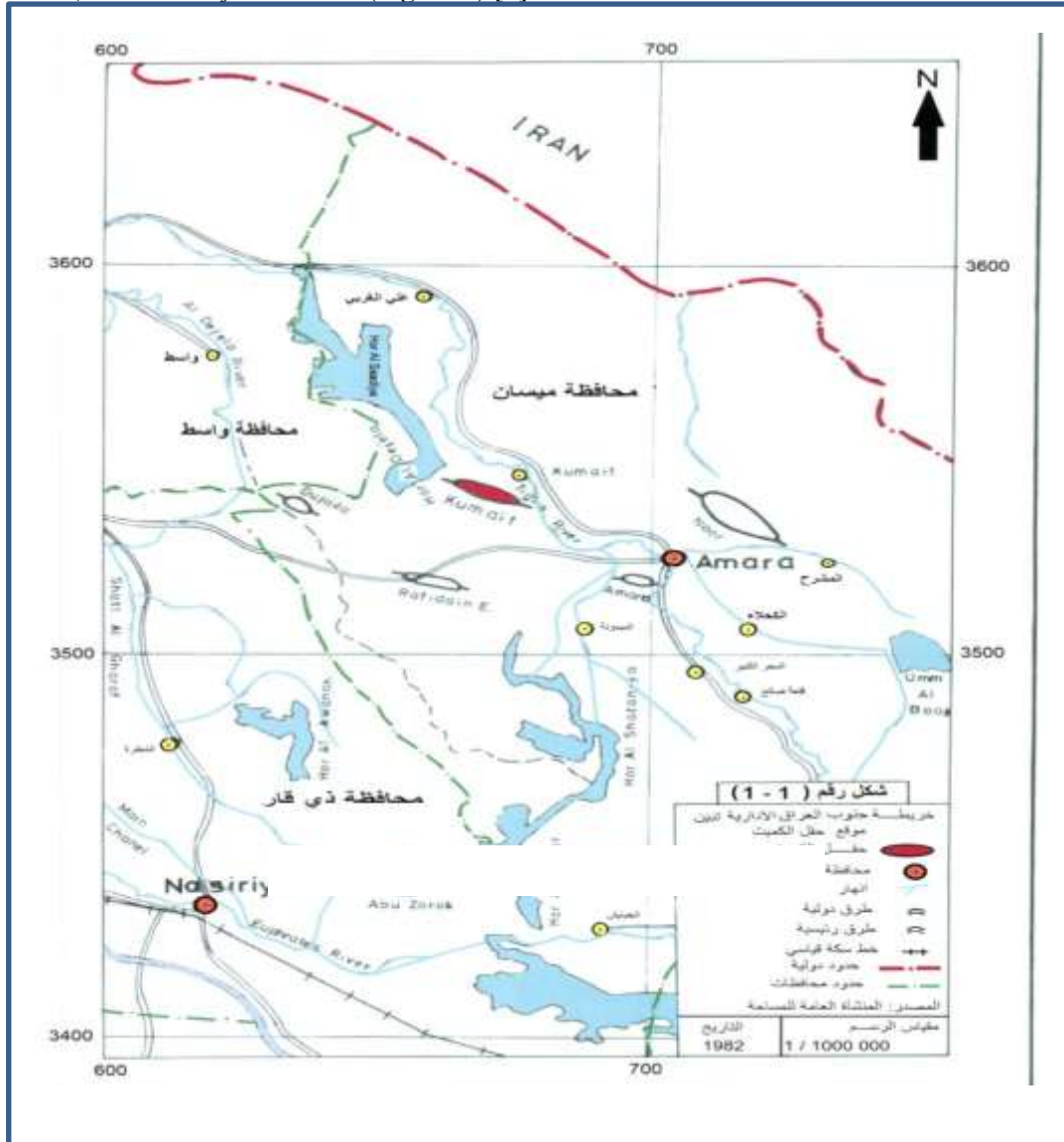
The geophysical research history for hydrocarbon accumulations returns to the beginning of the last century and a seismic reflection exploration applied of that accumulations [1]. The seismic methods are the most widely used of all geophysical methods used in petroleum

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exploration [2]. The role of seismic in the petroleum studies is to provide the most accurate graphic representation of the earth's subsurface and its geological structures, where it gives a seismic section, velocity & time contour maps for determination of a structural traps, as well as, a seismic stratigraphy and seismic facieses for determination of an internal stratigraphic geometry interpretation in terms of environmental deposition paleo-geography, in addition to sedimentary basin analysis [3]. Seismic reflection gives more direct and detailed picture of the subsurface geological structures. It is more suitable in areas where the oil is in structural traps, but it is also useful for locating and detailing certain types of stratigraphic features [4].

Location of Study Area

The study area which represent Kumait oil field is about (1200) km² located at the eastern parts of southern Iraq as part of the administrative border of the province of Maysan, to the East of the Tigris River, near the city of Kumait (Figure-1) [5].



Structural of the Study Area

Kumait field is located within Zone near to the north-east side of the Arabian-African platform. The field is straddled between the Arabian shield from the west and Zagros Mountains to the east. The direction of tectonic forces resultant is to the north-east. This resultant led to group of small bumps creating blockage in Aldijlah, Mesopotamia, east Mesopotamia, and Kumait structure. The axial direction of Kumait is in the same direction of the adjacent structures

(northwest and southeast). The small area of the blockage can be attributed to the fact that the region is relatively far from the main axis of the tectonic movements [6].

Shuaiba Formation

Carbonate-clastic succession which including the Shuaiba is represented a part of Aptian - Albian Sequence (Wasi'a Group), it is comprises 62 m of pseudo-oolitic limestone, sometimes sandy, fine-grained organodetrital limestone grading into chalky limestone and limestone with shale streaks near top. It contain *Orbitolina cf. discoidea* Gras, *Choffatella decipiens* Schlumberger and globigerinids which (together with stratigraphic position of the formation) indicate an Aptian age [7]. This Formation shown in the wells kt-1 and kt-2 as in the following ranges: Kumait-1: 3848.5m to 4020.5m, Kumait-2: 3865m to 3874m. This formation is composed of chalky limestone followed by porous limestone containing bitumen in the upper part and converts in the lower part of the formation to a chalky limestone then to a clay limestone [6].

Reflection Coefficient and Acoustic Impedance

It represents the amount of the exerted resistance of the rock to the particles movement during an energy passage through the rock. If a seismic wave front strikes a planner interface between two rock layers with impedances I_1 and I_2 at right angles (normal incidence), refracted and reflected waves are generated. In other words, the energy of incident seismic wave on the interface is divided into longitudinal, transverse refracted and reflected energies [8]. This distribution is produced at each time when the wave arrived at an interface separating two media. The amplitude of the incident wave could be described by the reflection coefficient R_c is given by:

$$R_c = \frac{I_2 - I_1}{I_2 + I_1} \dots \dots \dots (2 - 5)$$

$$R_c = \frac{V_2 \rho_2 - V_1 \rho_1}{V_2 \rho_2 + V_1 \rho_1}$$

$$= \frac{A_r}{A_i} \dots \dots \dots (2 - 6)$$

V_1 and V_2 are the seismic velocities of the first and second media respectively.

ρ_1 and ρ_2 are the densities of the first and second media respectively.

A_i and A_r are the consequent amplitude of incident and reflected rays respectively.

The contrast in acoustic impedance between the two media determines the polarity of the reflected signals. R_c varies from positive when $I_2 > I_1$ to negative when $I_2 < I_1$. The negative values are an indicator of the phase inversion (the phase change by 180°). Reflection coefficient is an expression of the amount of the energy reflected from a given interface, it ranges from (0 – ∓ 1). A study of the reflection amplitude of the seismic signal can give an indication about a layer thickness [9].

Signal and Noise

A seismic signal is all the events or information that can be recorded and used to know facts about structures and geology under the surface, while unwanted seismic signals are noise [10]. Therefore, all seismic exploration process aims to increasing signal to noise (S/N) ratio in seismic records. It is done by reducing the noise effect in the field (designing appropriate source-receiver spread to obtain maximum cancellation of noise) and using processing that leads to enhance the signal [11]. The seismic noise consists of coherent and random noise. Coherent noise is all the regular effects or multiple reflections, and it can be identified on the seismic record [12]. It is caused by poor distribution of source and receiver points. Effect of wind and electrical disturbance of the recording devices used in the field are also source of random noise, the effect of this noise could be minimized by using multiple points of the energy sources (multiple coverage) and appropriate style of the geophone groups using common depth point (CDP) technique [13].

Processing

The seismic data were processed at the Processing Center of Oil Exploration Company. The primary objective is to enhance the quality of the 3-D recorded data. Basically, this improvement is essential to facilitate the structural & stratigraphic seismic interpretation.

Noise attenuation process leads to improve reflection continuity and enhance ability to compute seismic attributes.

The main steps in processing are:

- 1-Editing and muting
- 2- Gain recovery static correction.
- 3-Deconvolution of source

The order in which these steps are applied is variable.

Data Base

The data base includes 3D survey, there are two wells to the area have been drilled in this study, they are Kumait_1 and Kumait-2. Marker, check shot and sonic logs information were available for Kumait_1 and Kumait-2 wells .

Velocity Survey

A type of borehole seismic data designed to measure the seismic travel time from the surface to a known depth. The result of this survey will be time -depth curve, that can be used for depth to time or time to depth conversion. This check-shot survey can be used to convert log data which acquired in depth into time, so the data can be correlated to surface seismic data by correcting the sonic log and generating a synthetic seismogram to confirm or modify seismic interpretations, and the time-depth curve from check shot can be used to convert the time map section into depth sections. (Figures-2, 3) show a check-shot of well Kumait_1 and Kumait_2.

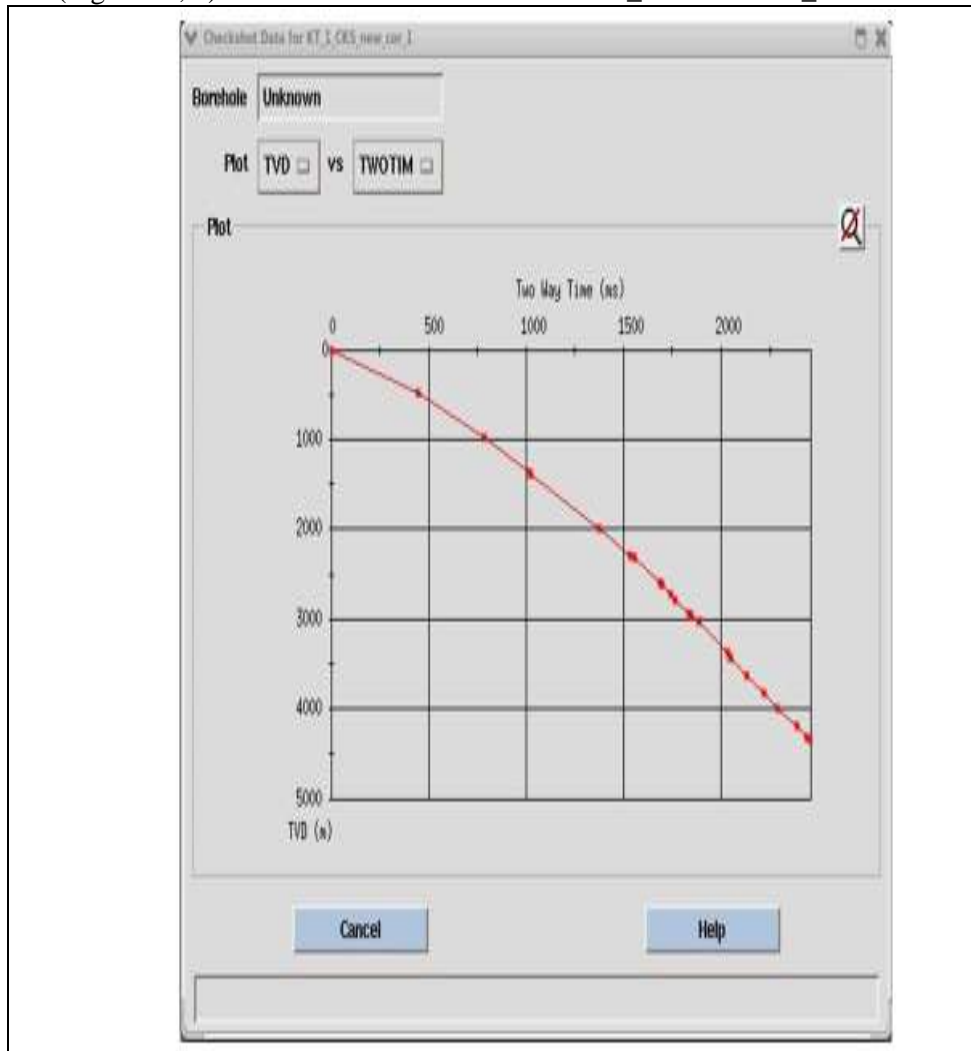


Figure 2-Illustrates the check shot curve for Kt-1 well .

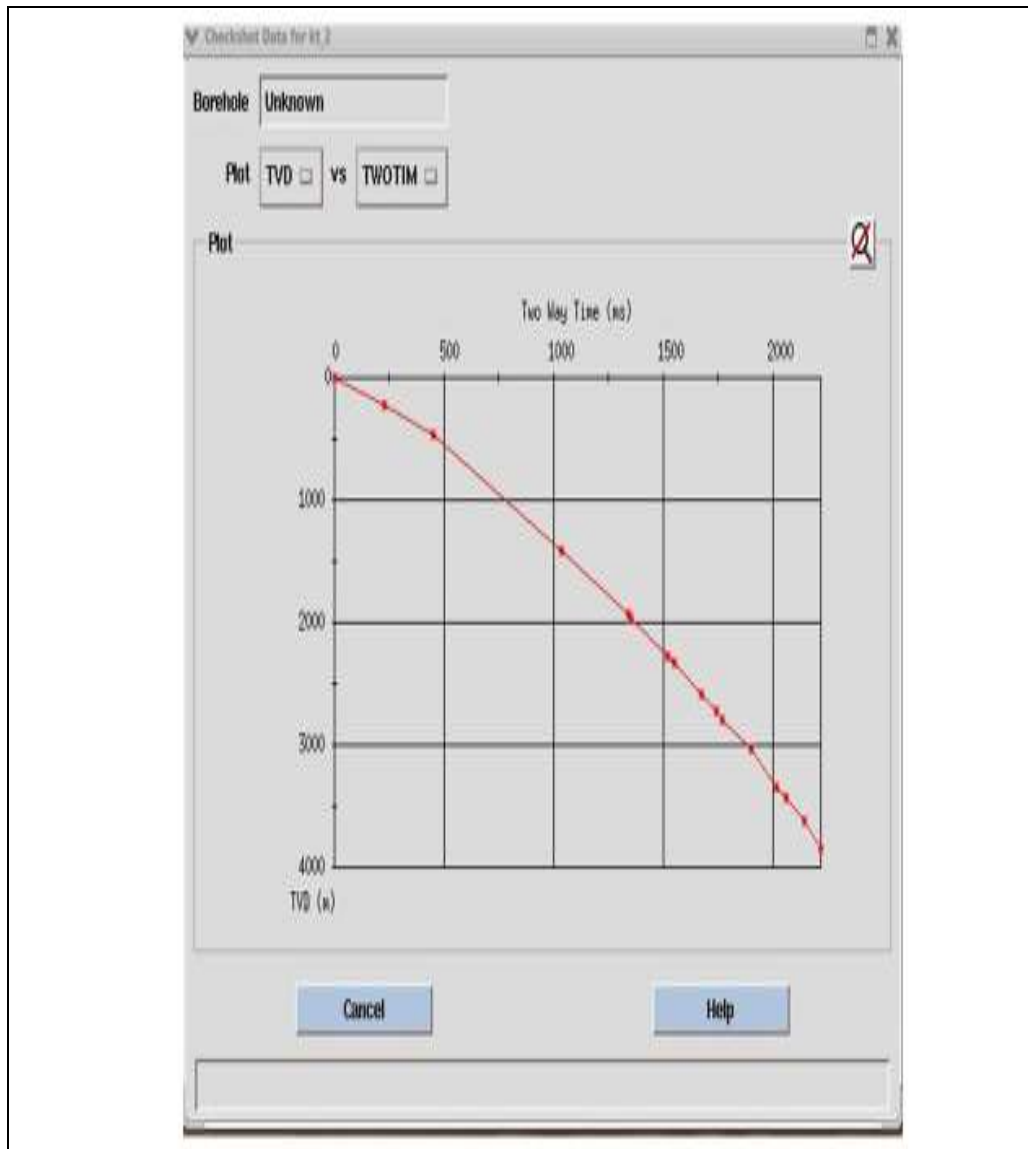


Figure 3-Illustrates the check shot curve for Kt-2 well.

Depth Maps

In seismic methods, the time map of a given reflector is used with its average velocity map to extract the depth map, as follows:

Depth at any point = (velocity \times TWT/2) at this point.

By using /CPS3/ program within geoframe system, two depth maps with contour interval 5 m was prepared for the studied Shuaiba reflector.

Shuaiba Depth Map

Figure-4 shows depth feature having general trend NW-SE direction. Structural noses observed in the study area also in the NW-SE direction.

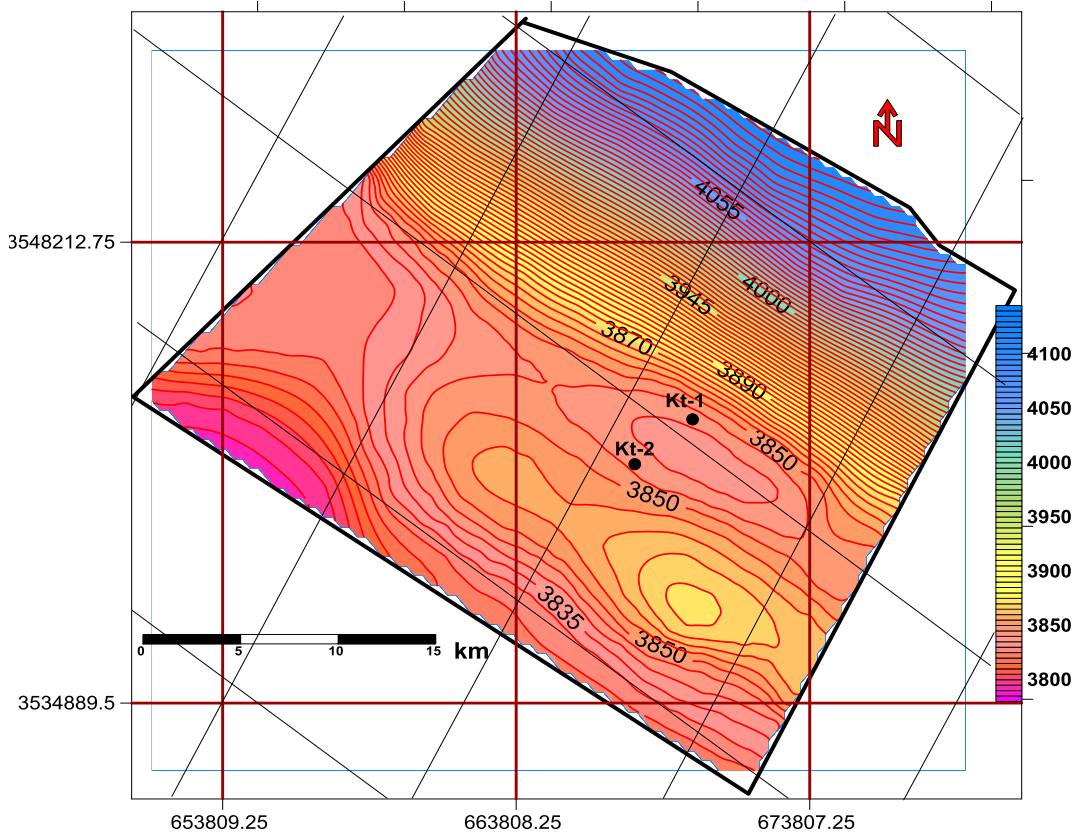


Figure 4-Top of Shuaiba depth map.

Dim Spot, Flat Spot and Mound

The seismic reflection mound configuration are noted in studied reflectors (Figure-5). Existence of dim spot, flat spot and mound were noted which are refers to direct hydrocarbon indicator (DHI) near Kt-2 and may be indicate hydrocarbon accumulation Figure-5.

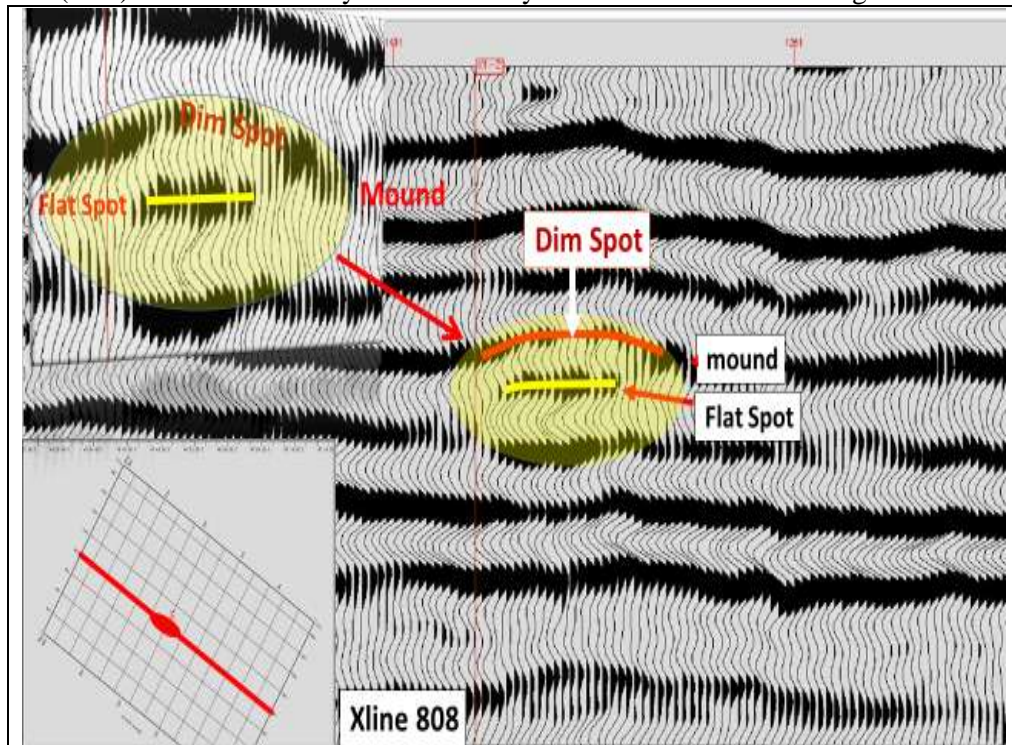


Figure 5-Show mound, dimspot and flatspot in Xline 808.

Instantaneous Phase Sections

Instantaneous Phase Section refers to a phase display the continuity of seismic event [14]. It is very important to study the faults, discontinuity of reflector, angular unconformity, pinch out and onlap. The information of instantaneous phase is very important in showing and distinguishing the ends of continuity of reflective surfaces [15]. The downlap in seismic section were noted by the application of Instantaneous Phase Section (Figure-6).

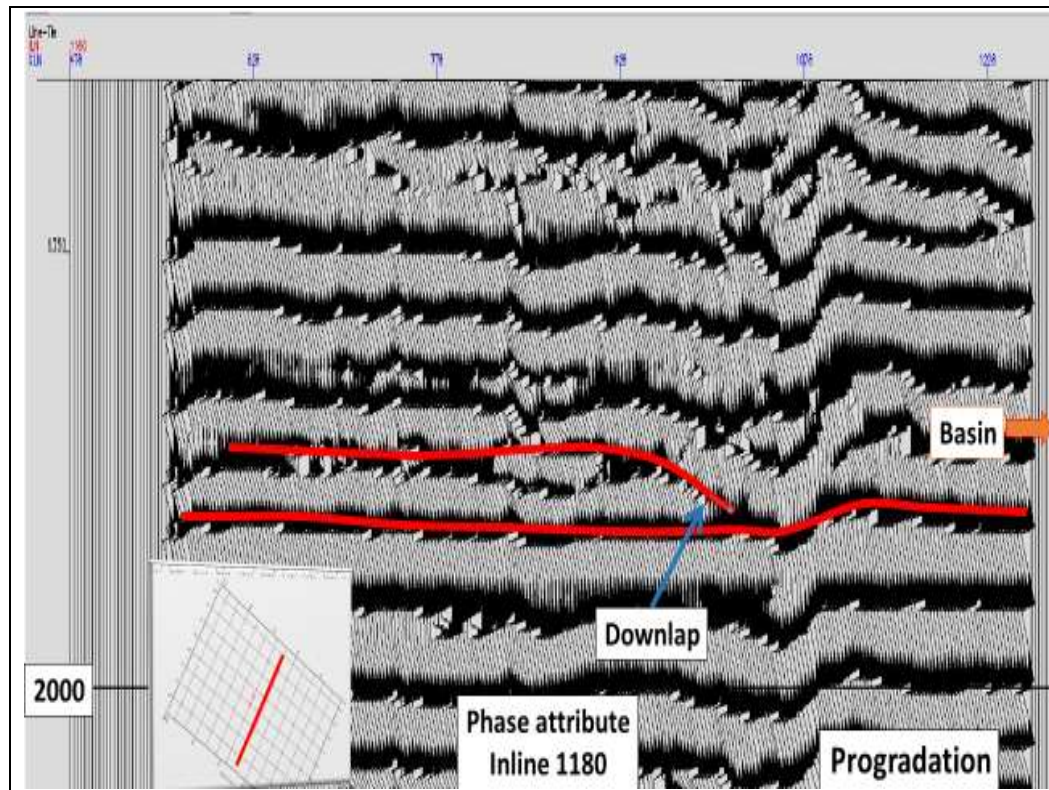


Figure 6-Seismic section display the variation in instantaneous phase of studied reflector

Conclusions

- Depth map of the studied reflector showed that the depth increases to the North East and decreasing towards the south west within the boundaries of the study area.
- Instantaneous phase shows the downlap in the study area, which are probably the area of hydrocarbon reservoir.

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