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Application of Static Correction Technique on 2D Land Seismic Data in the South of Iraq

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Abstract

In our research, several different Statics solutions have been implemented in the processing of seismic data in the south of Iraq for (2D) line seismic survey (AK18) of Abu-khama project with length 32.4 Km and their corresponding results have been compared in order to find optimum static solutions. The static solutions based on the tomographic-principle or combining the low frequency components of field statics with high frequency ones of refraction statics can provide a reasonable static solution for seismic data in the south of Iraq. The quality of data was bad and unclear in the seismic signal, but after applying field statics there is an enhancement of data quality. The Residual static correction improved the qualities of seismic data, especially in the shallow part of the seismic section where makes the reflectors flatting, then these data became ready for interpretation, especially after applying of migration.

Keywords: Field Static, Elevation Correction, Refraction Static, Residual Statics.

تطبيق تقنيه التصحيح الساكن علي البيانات السيزميه الارضيه الثنائية الابعاد في جنوب العراق

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الخلاصة

خلال هذا البحث هناك انواع من التصحيح الثابت تم تطبيقها على البيانات الزلزالية في جنوب العراق للخط الزلزالي AK18 الواقع ضمن مشروع ابو خيمة باالبعدين (2D) وبطول 32.4 km. هذه النتائج المستحصلة تمت مقارنتها للحصول على افضل نوعية وتصحيح ازمان وصول الموجه بسبب الطبقات ذات السرع الواطئة نتيجة تجوية الطبقة السطحية , الحلول الاستاتيكية تعتمد على تطبيق مبدا التصحيح الطوبوغرافي للمنطقة او الجمع بين الترددات الواطئة للتصحيح الحقلي والترددات العالية للتصحيح الانكساري الذي يمكن ان يعطي النتائج الاستاتيكية المعقولة لهذه المنطقة. كانت نوعية البيانات الزلزالية للخط غير جيدة وعدم وضوح في الاشارة ولكن بعد تطبيق التصحيح كان هناك تحسن كبير في نوعية البيانات الزازالية,و بعد تطبيق متبقي التصحيح الذي هو مكمل للتصحيح الاستاتيكي الحقلي كانت النوعية جيدة من خلال الحصول على عواكس اكثر استقامة وخاصة في الجزء الضحل من المقطع الزلزالي و بالتالي تصبح البيانات جاهزة للتفسير خاصة بعد تطبيق التهجير.

Introduction

The correction for near-surface velocity and elevation variations of topography with statics is an essential step, and static corrections are very important in the processing of onshore data (land survey), which can be refining the qualities of subsequent processing steps which was related to the quality and resolution of final image section [1]. Static corrections were defined as corrections that applied to

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seismic data in order to compensate for the effects of variations in elevation of source and receivers, weathering thickness, weathering velocity, or referenced to a datum plane. The goals are to determine the reflection arrival times which would have been observed if all measurements had been made on a (usually) flat plane with no weathering or low-velocity material present. Hence it leads to the concept of surface-consistent corrections, which are dependent on the location of the source (or receiver) but are independent of the source to receiver offset or time of the record data [2]. On land, there usually is topography, and needs to correct for that. In seismic terms, if one geophone would be on top of a small hill and the others not, the wave would need extra time to arrive at the geophone on the hill. This means that all the reflections of the subsurface would arrive later than in the neighboring traces. In order to get the timing right, one would have to apply some time shift to the whole trace. Applying a time shift is called a static correction; it is called static because it is one time correction for the complete trace, thus all samples will be shifted with the same constant amount. More specially, when the correction is for static shifts due to topography, we call it the elevation correction, the elevation referring to some datum level [3]. The refraction static correction allows us to derive estimates of the thicknesses and velocities of the near-surface layers by analyzing the first-breaks of the seismic records, Also another correction which considers completing the field statics which is called residual static corrections are defines time shift applied to traces in order to compensate for time delays and the statics model is a function of time and space[4].

Location and Geological Setting of study area

The area is located in Al-Muthanna Governorate in the southern most part of the Western Desert of Iraqi which is near to the international border with Kuwait and Saudi Arabia, as shown in Figure-1. The area is generally flat covered with sand dunes, this area is above sea level by 313 meters towards the location of Abu-Khaima well. There was only one well that drilled in 1975, the drilling reached 3393 meters, where oil proved to be there at Al Yamama Formation which produced 1,650 barrels per day according to the results of the production test. This area is covered with the deposits of the upper Eocene, which is composed of gravel and sand. The deposits of the composition of Dammam, which is composed of limestone rocks covering a small part of the northwest of the well of Abu-Khaima[5].

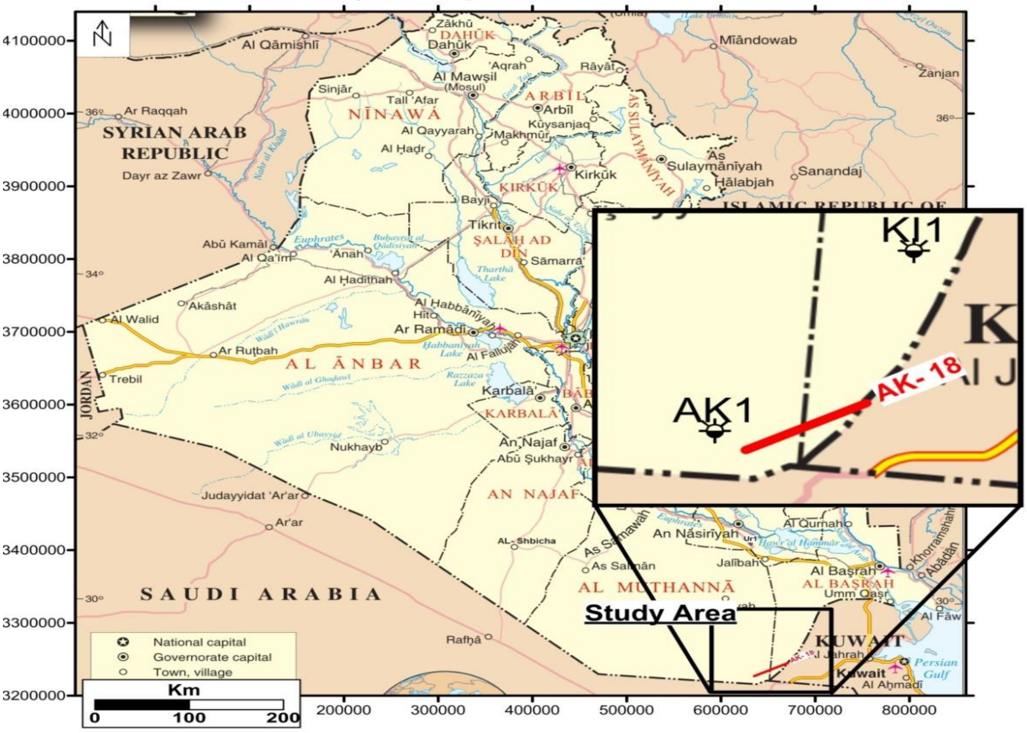

Figure 1-Shows the administrative location of Abu-Khaima Project[5].

Methodology

The advantages of this method to correct static and enhancement the quality of seismic data, The elevation correction was computed as well as, refraction static and residual static correction; these results can be compared with each other about the quality of seismic data. In general, the static correction is the essential case and very important for processing sequence because, it removes the false structures by the field static when it appears long wavelength anomalies, and it removes the short wave length issues by the residual statics when it appears short wavelength anomalies in the section of seismic. In this work, the effect of these statics corrections are shown in on CMP gather and stack section, as shown in the Figures-(2, 3) by using Geovation software (CGG Company). The processing was achieved in the Oil Exploration Company (OEC) department of seismic data processing.

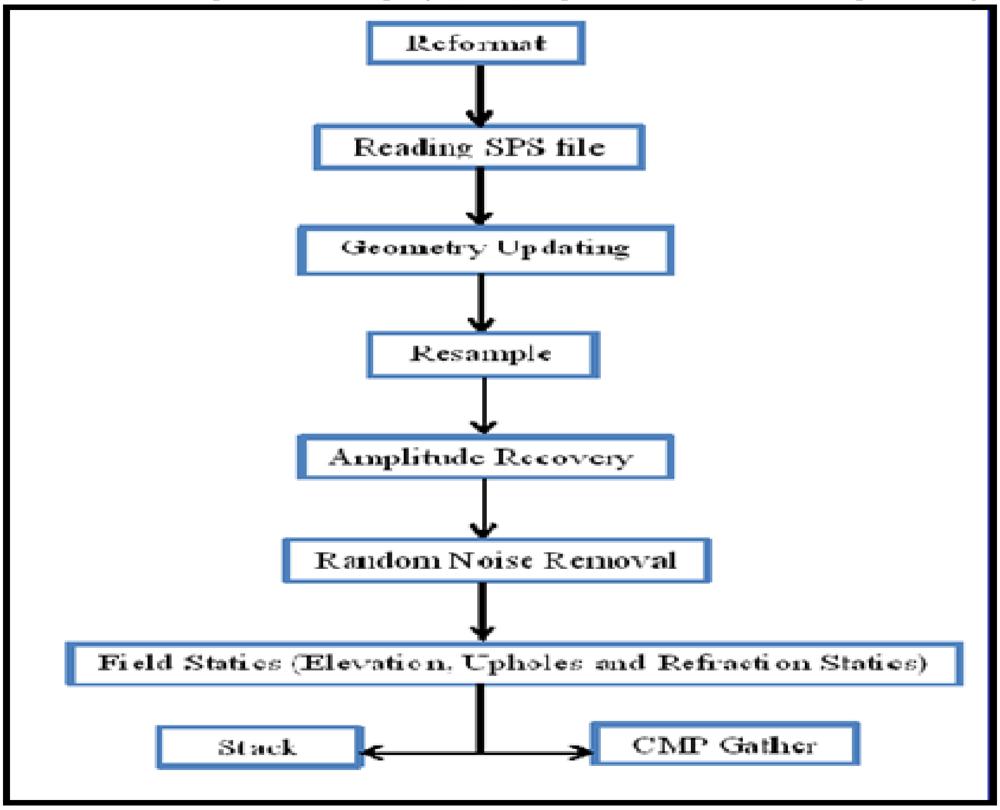

Figure 2-Processing Flow of Field static.

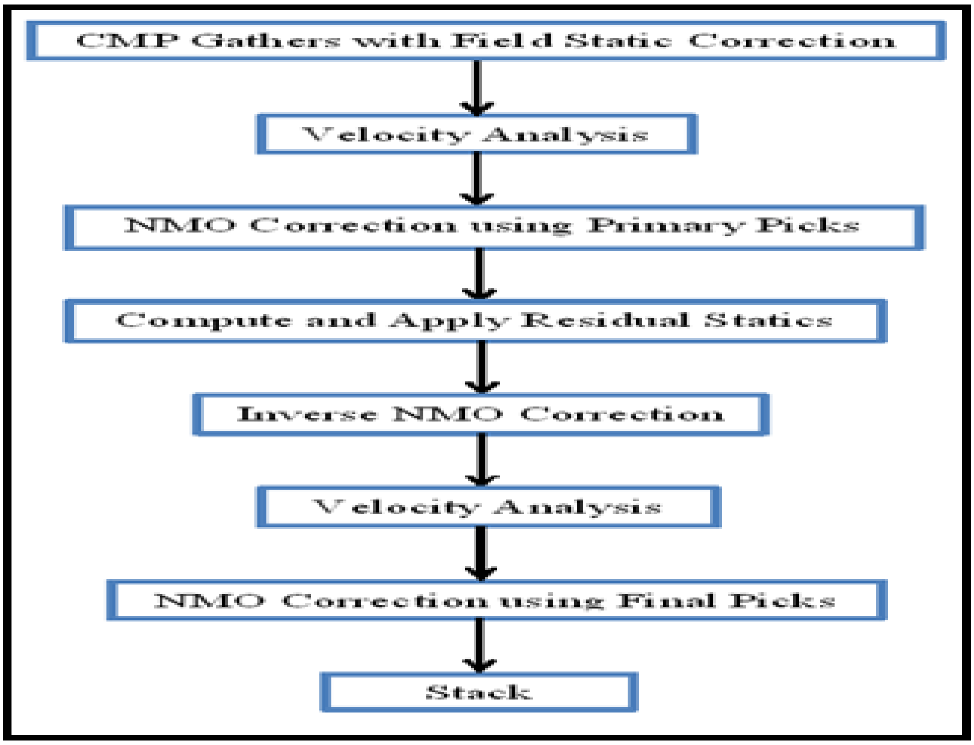

Figure 3-Processing Flow of Residual static.

Computations of Elevation static correction

In the field, the elevation values of source and receiver are computed as shown in Figure-4 the elevation of source and receivers in the same behavior because the source used is a vibrator and this explains that the positions of source and receivers on the same tomography of the surface. The datum plane that was used to calculate the elevation static above sea level is sea level. The replacement velocity was used 3200 m/s. Then the elevation static correction of source and receiver can be computed, and this elevation statics of source and receiver can be used to calculate the CMP static (Regional static) by the module called (TOPOR) topography in the Geovation System.

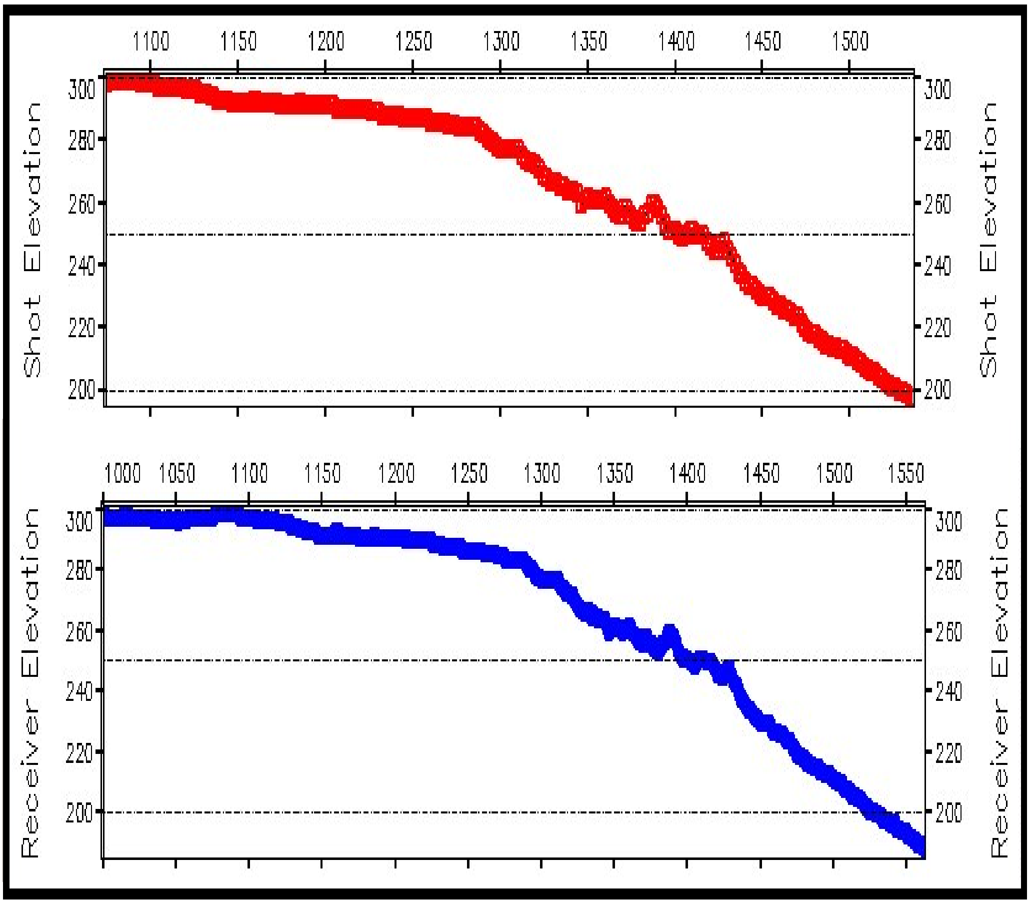

Figure 4-Shows the elevation of source and receivers

First break Picking

The refracted energy associated with the base of the weathering layer often constitutes the first arrivals on a shot gather. The honesty of these first arrivals was referred to as the first break. The first break occurs in varying degree of quality depending on the source type and near surface conditions **[6]**. So, the first break was picked on the shot gather along the line of seismic to estimate the near surface model parameters by the application of First Break Picking (FBPick) in the Geovation system as shown in Figure-5. The type of phase is zero phases because the source is a vibrator, and the picking was on the peak of amplitude. These picks of the first arrival exported to XPS file in the system and then going to the application of (Geostar) this competent for the refraction static correction. For this purpose one must a project is created to import the information of geometry and the picks of the first break after that, the offset viewing should be opened to select the best picking for each seismic record through the layer to build near surface velocity model (earth model) as shown in Figures-(6 & 7).

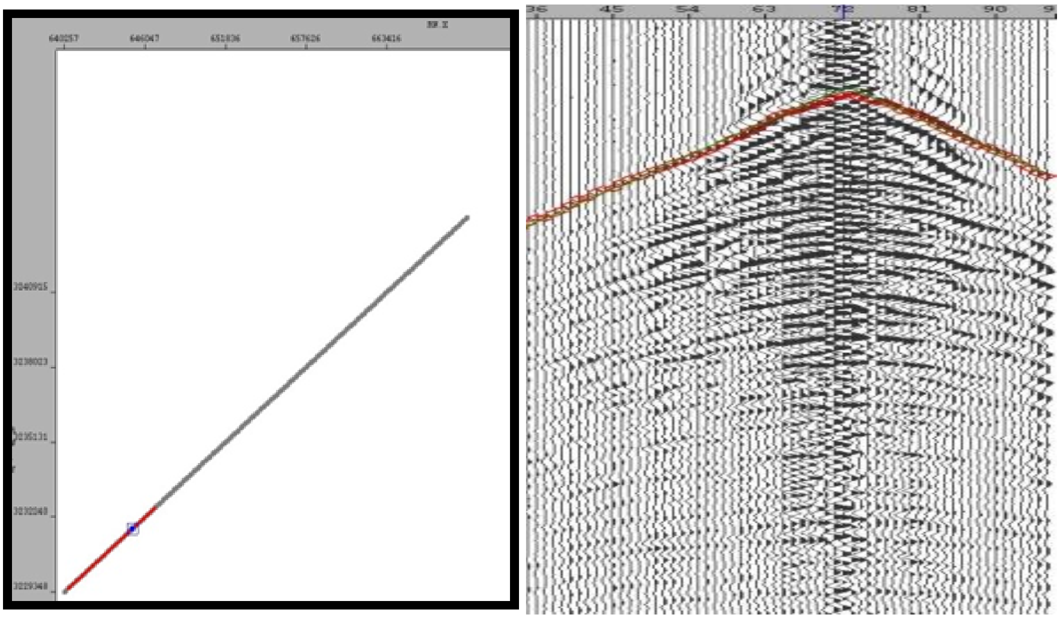

Figure 5-Shows the map of shot picking line and the first break picking on the shot gather.

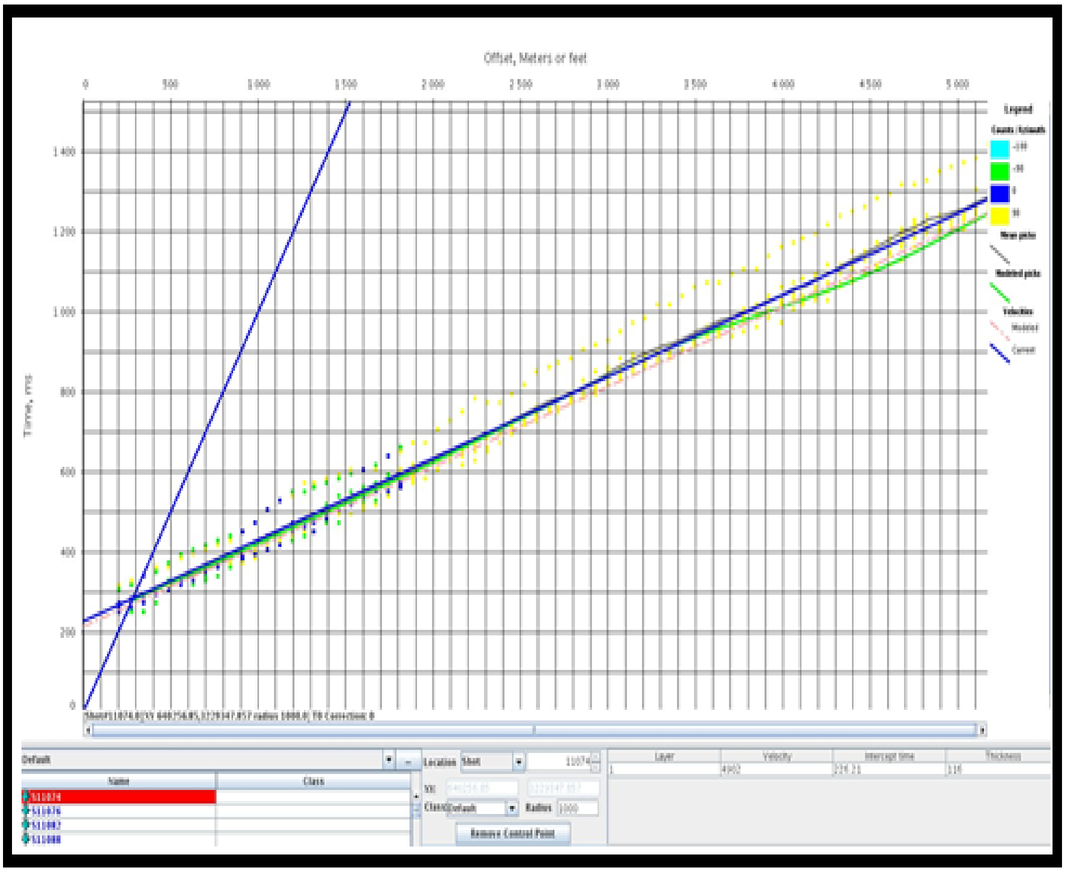

Figure 6-Shows layer picking of first arrival and (Time Vs Offset).

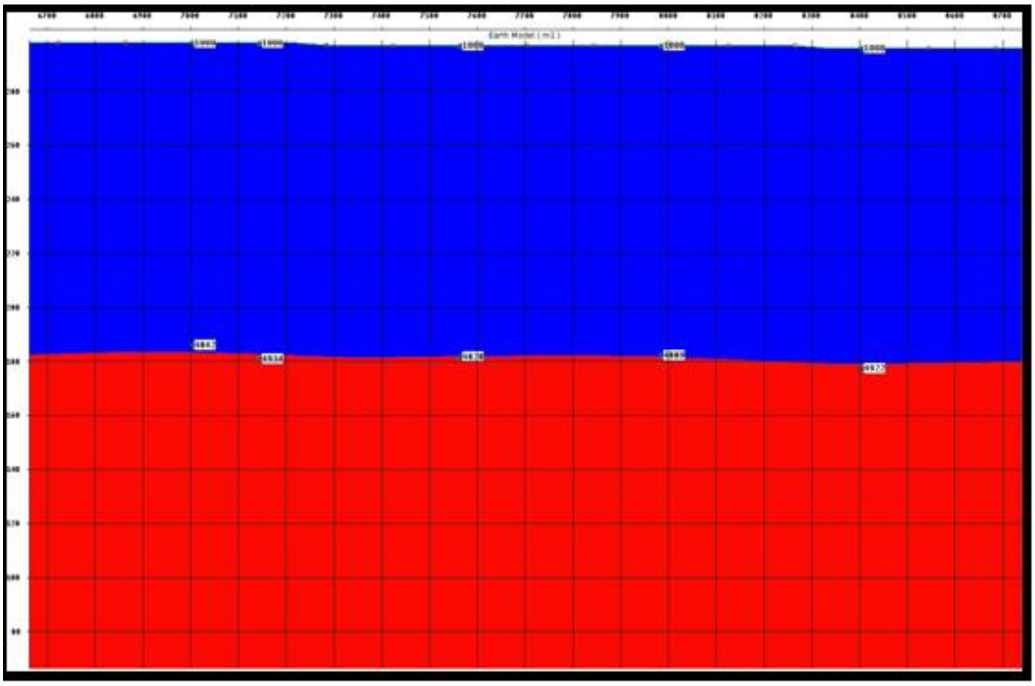

Figure 7-Shows the near surface velocity layer model.

Results & Discussion

To compute datum static corrections from a near-surface model which is a straightforward procedure. First, the time in the weathered layer or layers is removed (the weathering correction is always a negative time correction). This correction is added to the elevation correction, which is the time from the base of the weathered layer or layers down to (or up to) the reference datum. The elevation correction is thus either negative (or positive), respectively. By using this simple approach, it is easy to visualize and compute the basic components of the datum static correction and the sign of the final correction **[7]**. The elevation static takes effect the tomography of this area for the source and receiver to the datum plane from sea level and above sea level, so there is no essential difference in the quality of seismic data between CMP gather and stack section. The area generally is flat and there is no variation in the topography of the area. There is a bulk shift after applied elevation static about 67 ms due to the elevation of source and receiver, and these elevations approached. The elevation static cannot alone solve the anomalies in the seismic data as shown in Figures-(8 & 9(a, b).

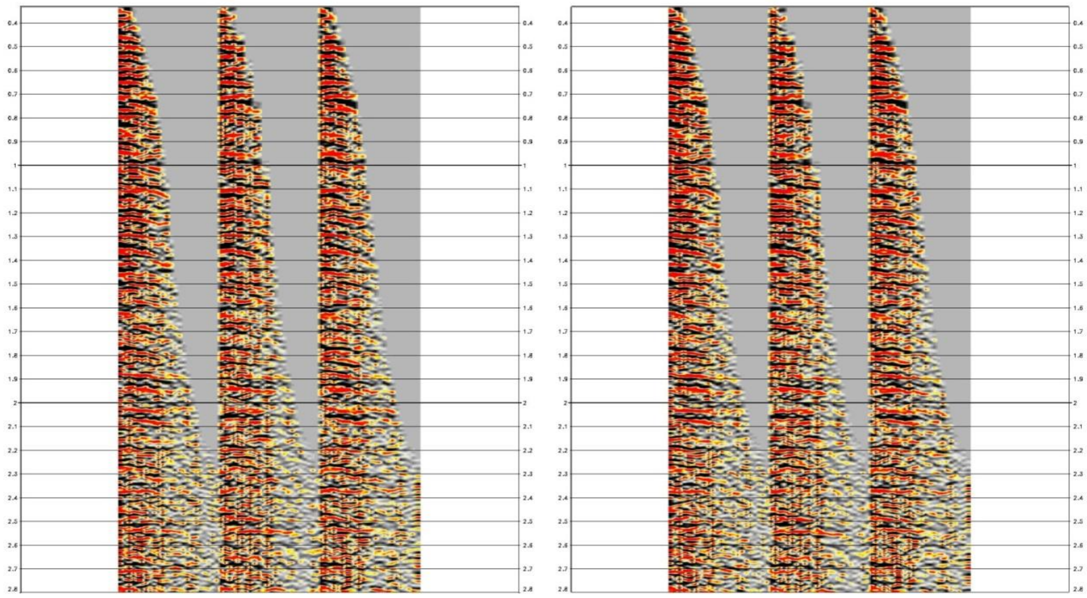

Figure 8-Shows the difference between the CMP gather on the left before and on the right after elevation statics

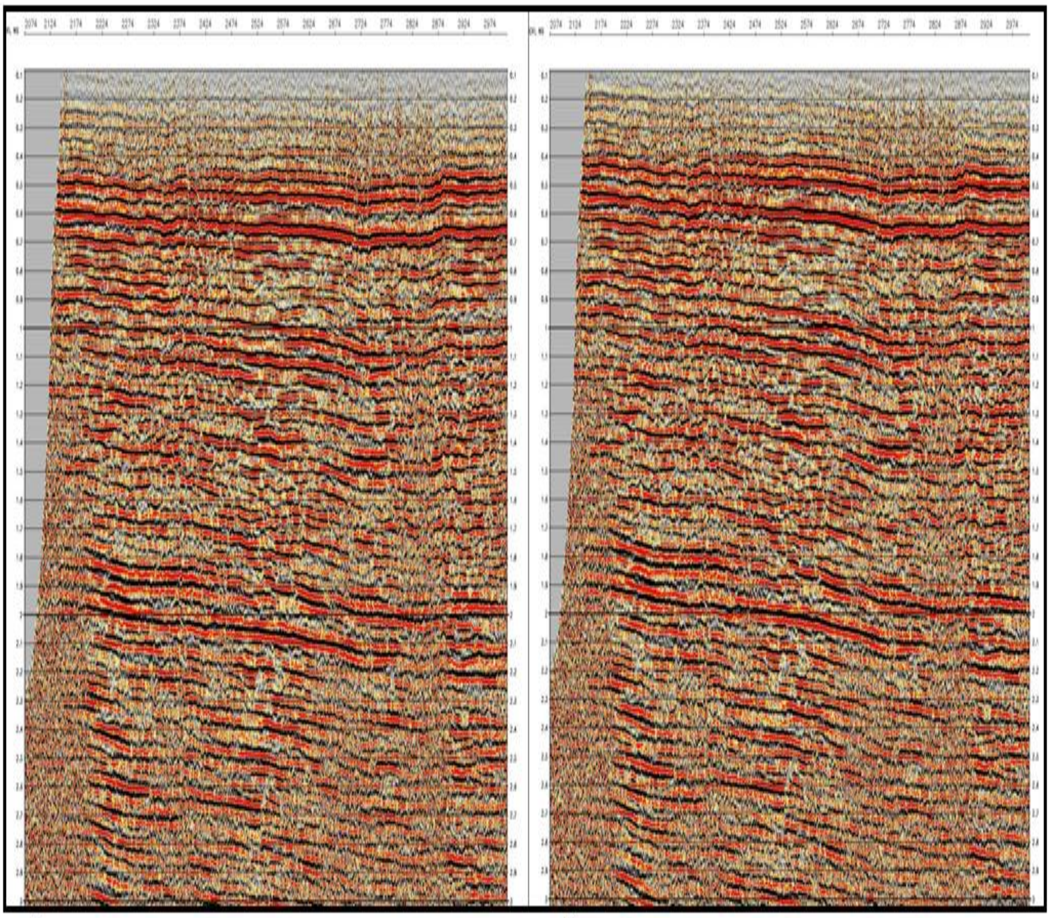
a b

Figure 9-Shows the stack section a) without applying elevation static b) with applying elevation static.

The refraction static estimates the thickness and velocities of near surface layer by analyzing the first break of seismic records, so there is enhancement in the quality of seismic data on the CMP gather and stack section after refraction static applied especially in the shallow part of section as shown in Figures-(10a, b & 11a, b). The wavelet suffered when entered the weathering layer and it's attenuate in the energy due to the low velocity and low density of the weathering layer. In this area the refraction static estimates the time delay by the velocity layer model and compensates the weathering layer (unconsolidated) with the sub weathering layer (consolidate), that means to remove the effect of weathering layer in this area. The first arrival of seismic records was uniform and clear so, the picking of the first break was good and this is reverse work of refraction static to estimate the near surface layer of this area. The offset plays an important role to enhance the quality of seismic data because we select the good picking offset of traces, especially in the far offset of seismic records, there is bad data in the seismic records and can be removed it from the estimations. The technique of refraction static in (Geovation software) estimate the long wavelength, short wavelength and both of them, so one can select the mixing of wavelength(long & short) because it's work to solve the anomalies of high and low frequency components and that the quality of refraction static was good compared with elevation static correction.

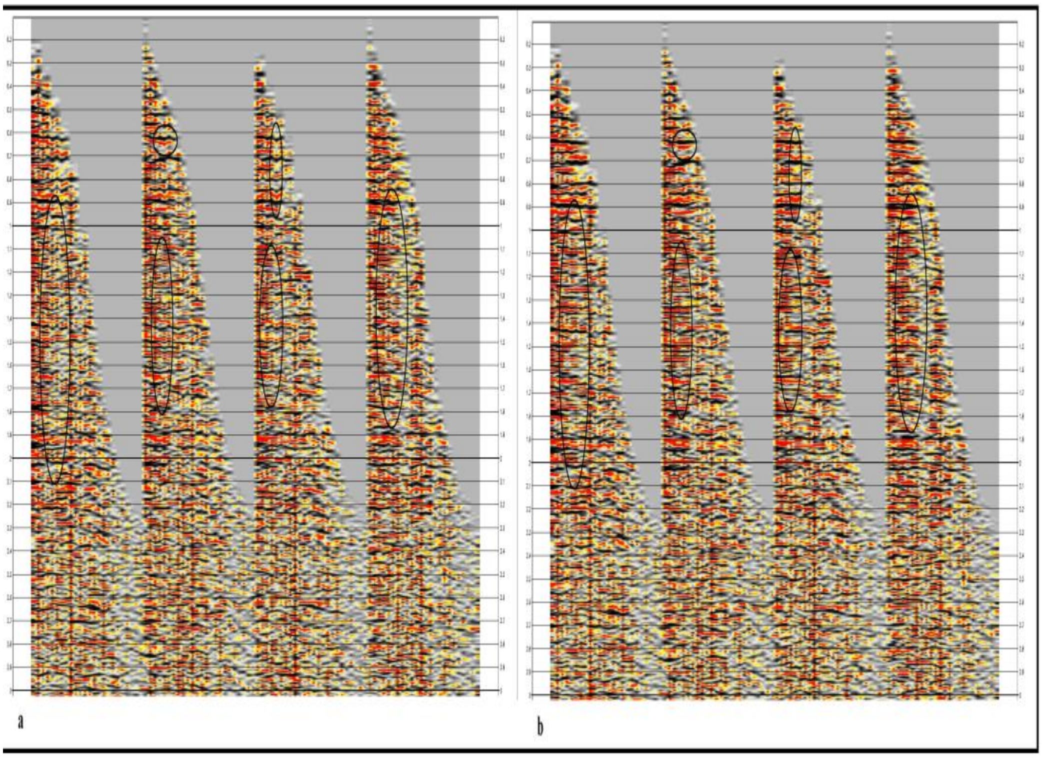

Figure 10-Shows CMP gather a) with elevation static b) with refraction static.

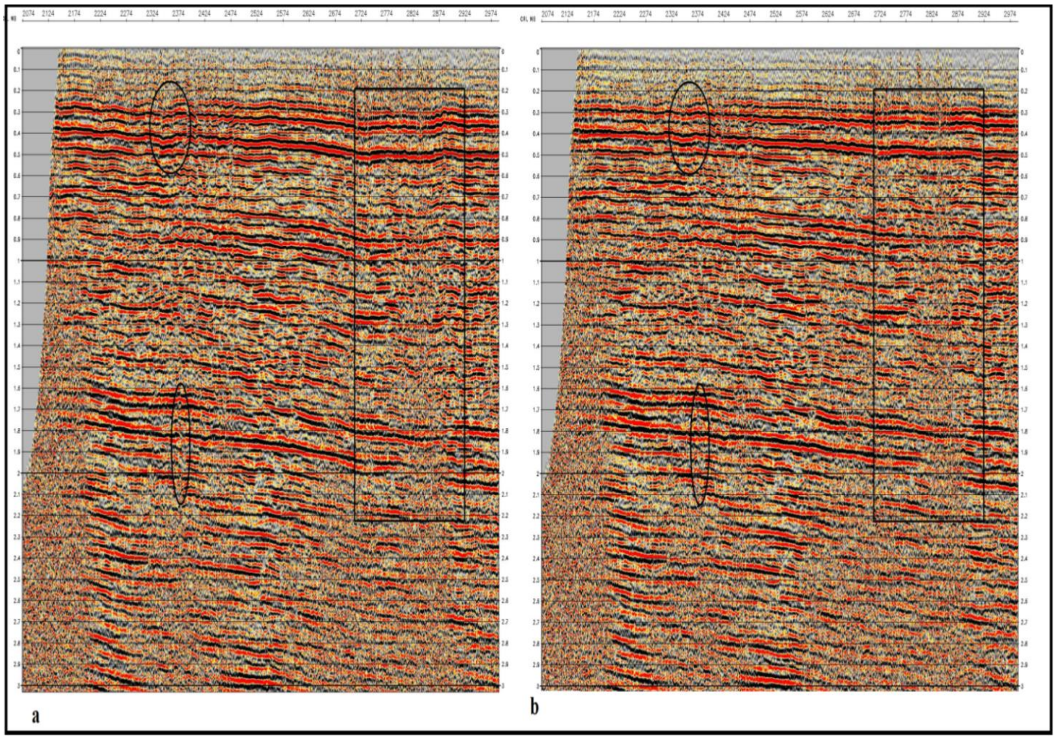

Figure 11-Shows CMP stack a) with elevation static b) with refraction static.

Residual static corrections were designed to correct small inaccuracies in the near-surface model. Their application should lead to an improvement in the final processed section compared to one with just datum static corrections applied. The residual static correction considers completeness to the field static technique so that after refraction static residual static could be applied to enhance the reflectors by the cross correlation between the pilot trace and the stack section. It makes the reflectors more flatting and its remove the assumed time anomalies on the seismic traces. Figure-12(a, b) and Figure -

13(a, b) show the difference between the refraction static and residual static on the CMP gather and stack section, where the maximum total residual correction is 20 ms and the optimum correlation window (500-2700 ms), as it is shown that the correlation confined to the mute zone but it provides the sufficient statistics on seismic data and also the signal to the noise ratio was good, so this is better tested for correlation window with deep seismic data. As it is noted there is the improvement in the seismic data after applying residual static, especially in the shallow part (high frequency components) around (200-900 ms), also there is an enhancement in the reflectors they have more continuity in the target area around (1600-2400 ms). Usually, the residual static solves the short wavelength anomaly it's called (fine tuning) when the spread length longer than the variations of the tomography surface. So that the residual static enhances the quality and increase the continuity of reflectors, also improve the ratio of signal to the noise as shown in Figure-(14 a, b).

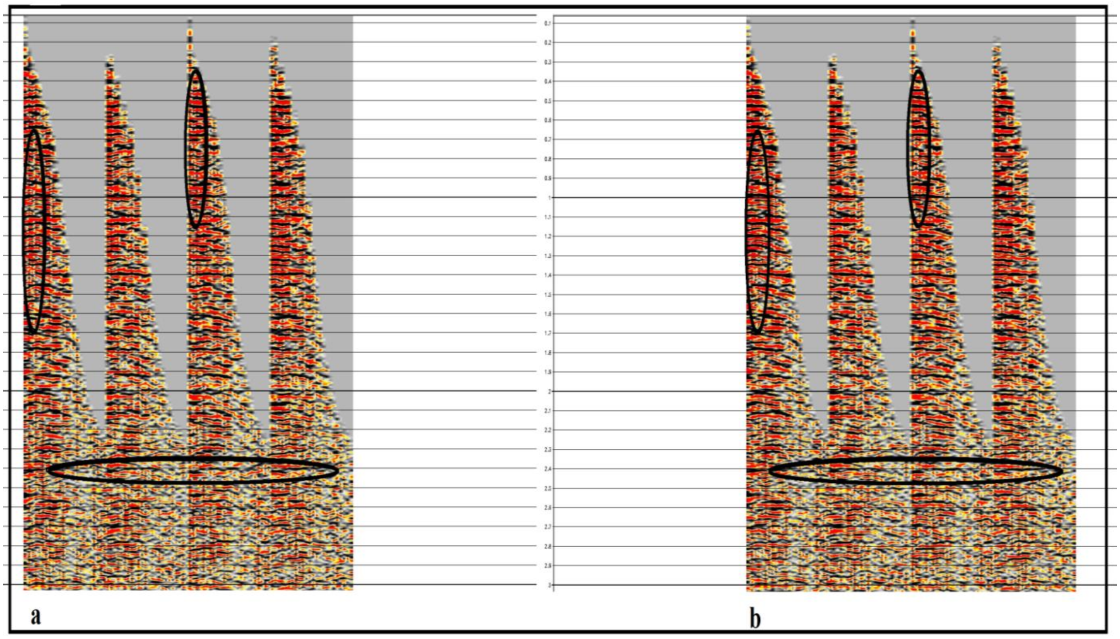

Figure 12-CMP gather with a) Refraction static b) Residual static correction.

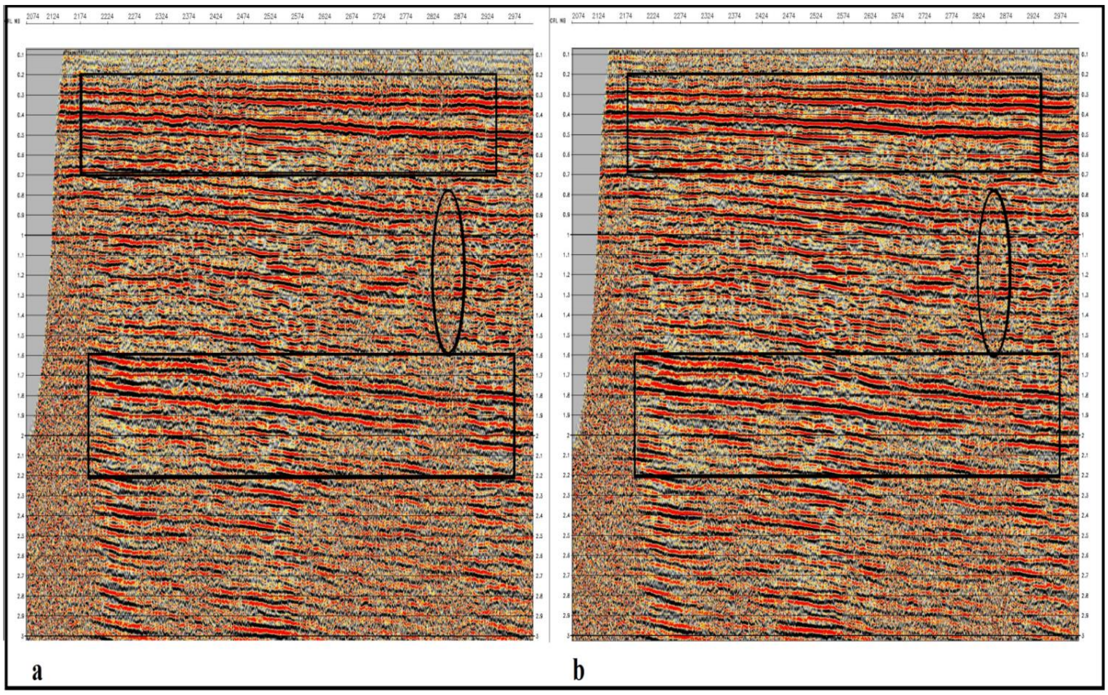

Figure 13-CMP stack with a) Refraction static b) Residual static correction

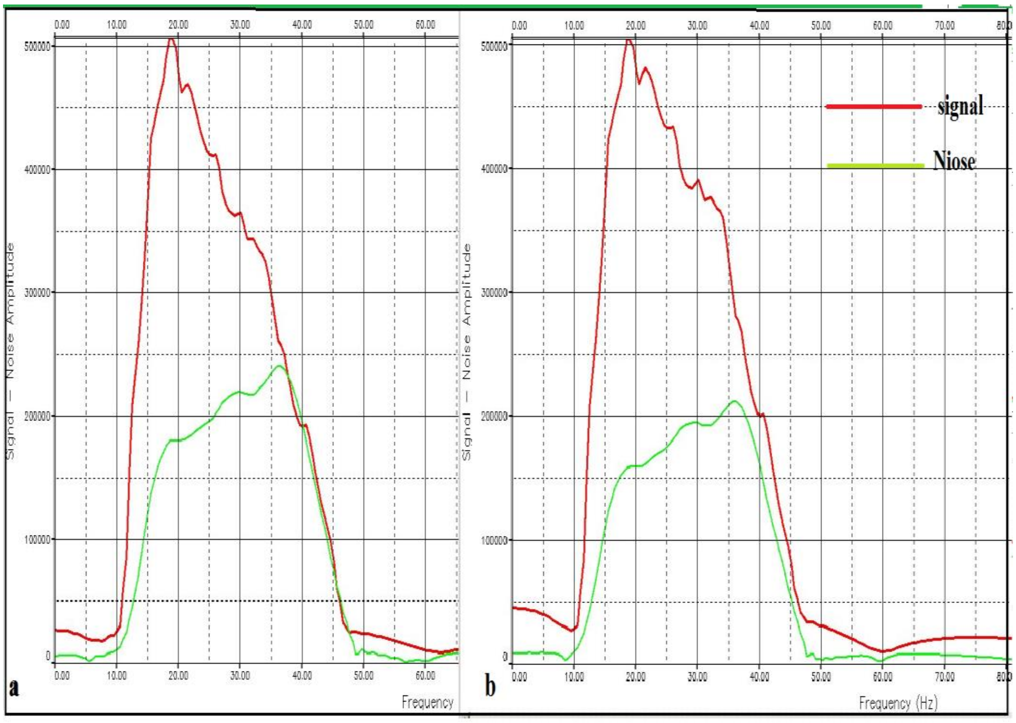

Figure 14-Signal to noise ratio a) before residual static b) after Residual static

Conclusions

A. The area of Abu-Khaima generally is flatting and does not contain large variations of tomography. So that the elevation static took the effect of surface tomography (simple bulk shift), and there is no variation in the quality of seismic data.

B. The first arrival of seismic records for this line (AK18) was uniform and clear this is led to that the picking of the first arrival that was identical. So that the refraction static correction gave good results compared with the elevation static.

C. The selection in the offset for Abu-Khaima area was very important where removal the far offset from the estimations of refraction static which was the effect on the quality of seismic data.

D. The residual static correction removed the short wave length anomalies that were deformed the stack section and increased the S/N ratio.

8. References

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