# PS Application of Structural Seismic Attributes for "Polygonal Faults" Interpretation in Unconventional Carbonate Reservoir*

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## Abstract

Seismic attributes are specific functions derived from seismic data, to enhance the appearance of different geologic features along the main seismic reflectors in both cross section and map views. In this work we applied volume seismic attributes in order to enhance the appearance of the polygonal faults located at the Abu El-Gharadig Basin, North of Western Desert, Egypt. The main objective is to illuminate the small or sub-seismic faults to determine their implications on the unconventional carbonate reservoir of the Middle Eocene Apollonia Formation.

The workflow started with the application of the structural smoothing attribute on a 3D post-stack, depth migrated seismic volume, in order to highlight the discontinuities of the seismic reflectors along the seismic sections. This is followed by the calculation of two main attributes, seismic coherence and curvature attributes. The most positive and most negative curvature attributes allowed us to identify small faults that are below seismic resolution. We found that the curvature attributes delineate faults distribution in our area of study better than other attributes. The presence of these faults had been verified by the geosteering technique applied during the drilling of one of the horizontal wells in the field. As a result, this study can potentially enhance the quality interpretation of seismic data and better identification of the major and minor faults that have an important implication on the fluid flow characterization of the reservoir.

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# Application of structural seismic attributes for "polygonal faults" interpretation in unconventional carbonate reservoir

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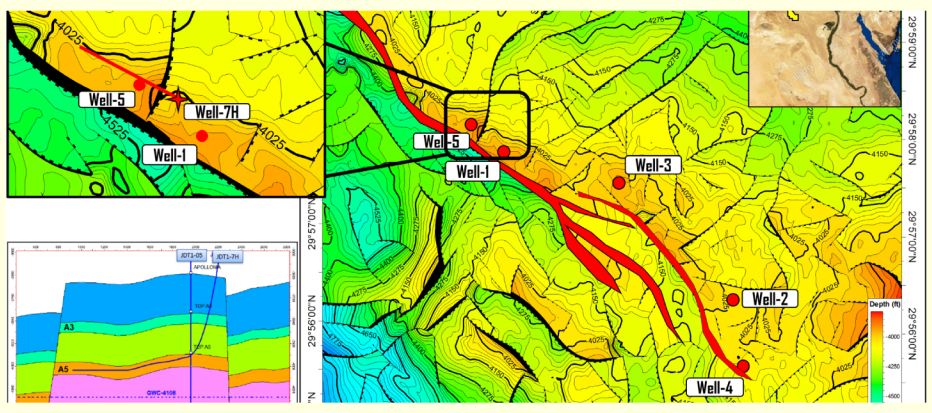
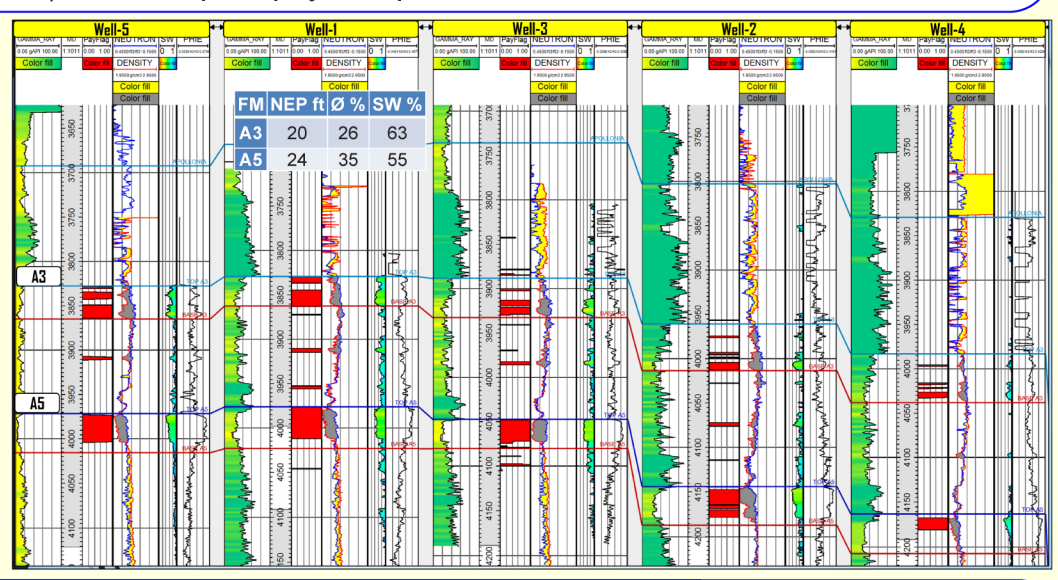
## ABSTRACT

Seismic attributes are specific functions derived from seismic data, to enhance the appearance of different geologic features along the main seismic reflectors in both cross-section and map views. In this work we applied volume seismic attributes in order to enhance the appearance of the polygonal faults located at the Abu El-Gharadig basin, North of Western Desert, Egypt. The main objective is to illuminate the small or sub-seismic faults to determine its implication on the unconventional carbonate reservoir, of the Middle Eocene Apollonia Formation. The workflow started by the application of the structural smoothing attribute on a 3D post-stack, depth migrated seismic volume, in order to highlight the discontinuities of the seismic reflectors along the seismic sections. This is followed by the calculation of two main attributes, seismic coherence and curvature attributes. The most positive and most negative curvature attributes allowed us to identify small faults that are below seismic resolution. We found that the curvature attributes delineate faults distribution in our area of study better than other attributes. The presence of these faults had been verified by the geosteering technique applied during the drilling of one of the horizontal wells in the field. As a result, this study can potentially enhance the quality interpretation of seismic data and better identification of the major and minor faults that have an important implication on the fluid flow characterization of the reservoir.

## GEOLOGICAL SETTING

- The area of study is NEAG-JDT field, which is located at the north east portion of Abu El-Gharadig Basin, north Western Desert, Egypt.
- Structurally, there are two main types of faults dissected the carbonate reservoir at Abu El-Gharadig basin. A major tectonic NW-SE normal fault bisected the field into two major hanging wall and footwall blocks and extends until the cretaceous sequence.
- Another group of minor non-tectonic, layer bound, polygonal faults restricted only to the uppermost members of the Apollonia formation.
- Wireline logs show the top of the Apollonia pay zone members (A3 & A5) and their petrophysical parameters.



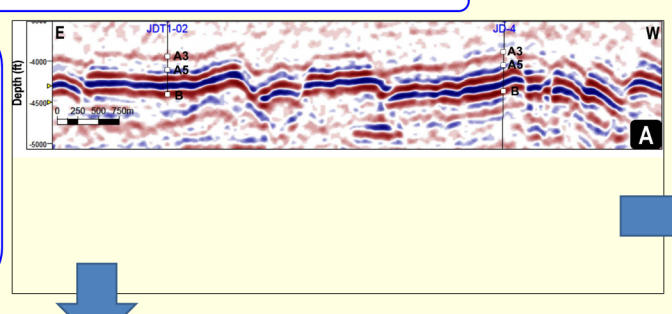

| FM | NEP ft | Ø % | SW % |
|---|---|---|---|
| A3 | 20 | 26 | 63 |
| A5 | 24 | 35 | 55 |

## SEISMIC ATTRIBUTES

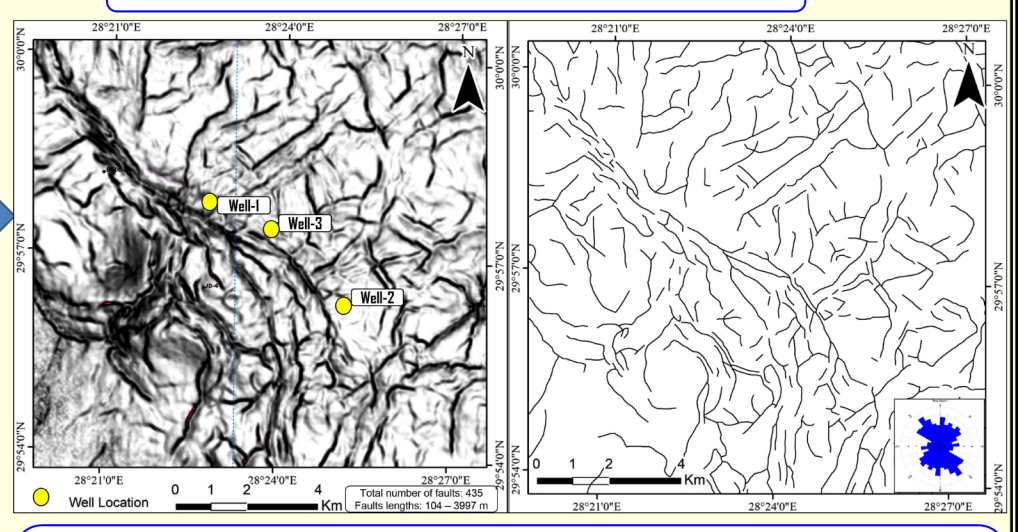
- We are concerned mainly with the geometric attributes, that are used to enhancement the appearance of any kind of discontinues (fractures and faults) along the seismic data.
- The work flow began with the application of structural smoothing attributes followed by the application of both the coherence and curvature attributes.

### 1. STRUCTURAL SMOOTHING

- Structural smoothing of the input seismic data, guided by the local structures is used to highlight the discontinuities of the seismic reflectors.

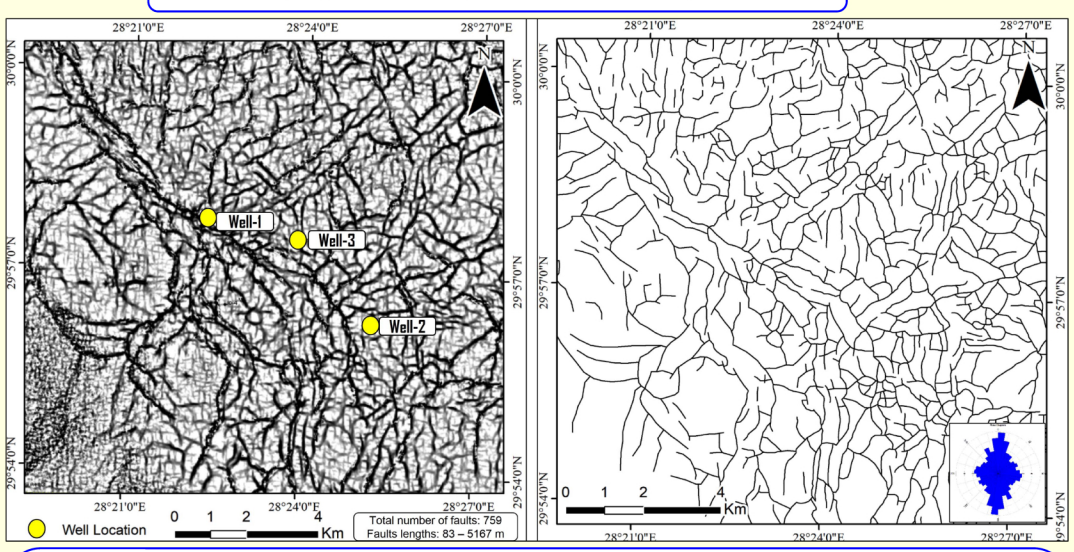


### 2a. COHERENCE ATTRIBUTE

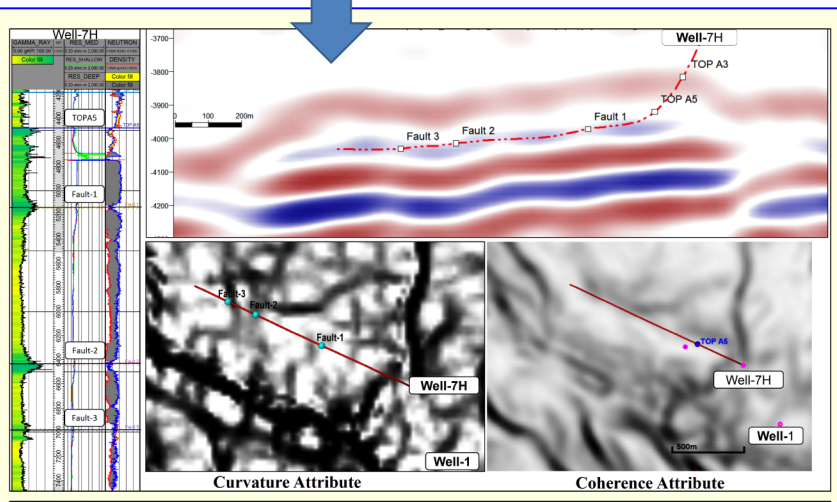


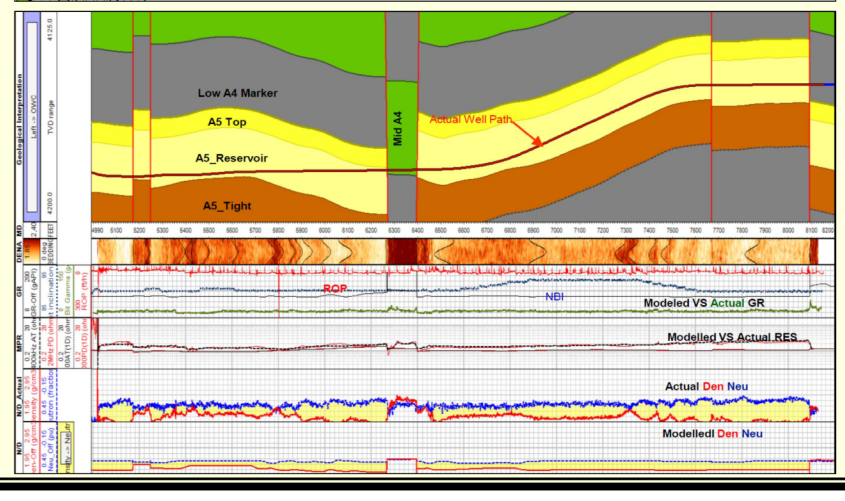

- Seismic coherence is an edge detection attribute that depends upon the comparison of waveforms across the adjacent traces, and gives apparent continuity to the discontinuous features, such as faults.

### 2b. CURVATURE ATTRIBUTE




- Curvature is a measure of the surface deformation at a particular point. The more deformed the surface, the larger its curvature. In a simplest way, it can be represented by arcs of circles with different radii, and determines how much the curve deviates from the straight line at a certain point.




## RESULTS & CONCLUSION

- According to the faults determined by the curvature and coherence attributes, we found that both attributes can be considered as a perfect geophysical techniques for the determination of the faults or discontinuities in the carbonate reservoir.
- During the drilling of the horizontal well Well-7H, geosteering determined the occurrence of sudden faults that was not appeared in the 3D structural model constructed for the JDT field. By correlating the depth and location of this fault, we found that these faults recognized only on the curvature slice, without any appearance on either the coherence slice or the seismic sections. This indicates that curvature technique have the ability to determine more minor faults than that resulted from the coherence attribute.