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## Introduction

Traditionally, structural interpretation from seismic data is a labour-intensive process of manual picking or auto-tracking methods by considering more or less numerous seismic attributes. Interpreters develop specific know-how for selecting and combining them in order to highlight faults and fractures. The method presented in this paper is based on a new approach, which consists in modelling the faults and fractures from a geological-model obtained directly from the seismic volume.

## Method for Faults and Fractures Enhancement

A continuous geological model is constructed with the software "PaleoScan" using an innovative global optimisation method based on links between seismic samples (Figure 1). This algorithm correlates the seismic traces and moves in directions that lead to a global lower minimum to produce an optimum geological model. Such approach allows a high level of flexibility to adjust the model in the software PaleoScan without being limited by the geology or signal's quality. 3D constraints, such as faults or manually picked horizons, can be inserted in order to improve the quality of the geo-model and connect fault blocks in the entire seismic volume.

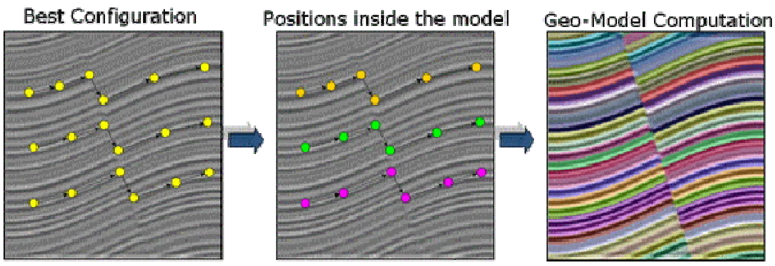


***Figure 1:*** *Extraction of the Geo-Model using an optimisation algorithm.*

A 3D fault throw attribute is produced on the basis of the geological model. The algorithm to map the faults is based on time differential analysis' method where the throw break points are mapped as an independent fault throw attribute volume. Because the geo-model is continuous, the throw can be mapped beyond the seismic resolution (Fig. 2). According to a minimum fault throw threshold, the faults can be identified as linear features and extracted from the geo-model. The algorithm threshold permits larger faults to be mapped whilst aiming to avoid the identification of noise that may be mistakenly interpreted as smaller faults. At a later stage, the fault throw attribute can be used in Ant Tracking to extract the faults plane and map in 3D the displacement on the fault's place (Pedersen et al., 2003; Carrillat et al., 2004),

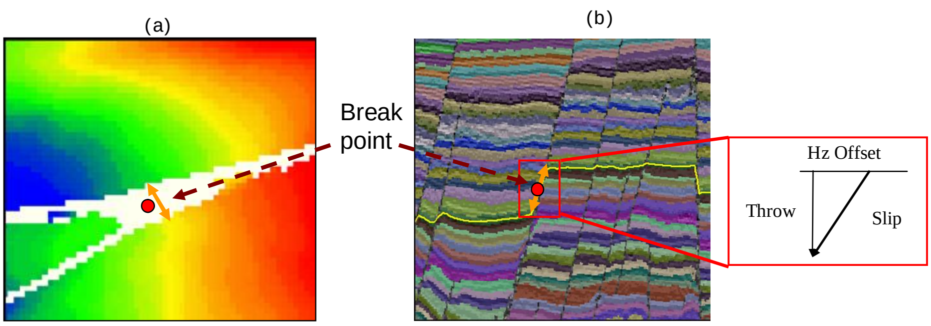


***Figure 2:*** *(a): Faults break points are shown on a time map and computed as an independent attribute, (b): Representation of the fault's throw inside the "geo-model".*

## Example Case Study Offshore Nigeria

The method of fault throw computation was performed on a 3D seismic data cube, located on the Niger Delta. This geology is characterised by innumerable normal faults and gas chimneys related to shale diapirism that makes seismic imaging difficult. All the faults have been detected from the geo-model analysis and presented as a SEGY cube, which can be incorporated to a structural model (Fig.3). On the horizon slice, faults are displayed and colour coded by fault throws where red shows the highest amount of throw. It shows the fault having the maximum throw at the centre and tips towards the two ends (Gupta et al., 2008). As a result, compared to traditional methods of discontinuity detection attributes like curvature, coherency and similarity applied to seismic cube, the fault throw attribute cube produced from the geo-model in the PaleoScan software is more precise for the faults identification.

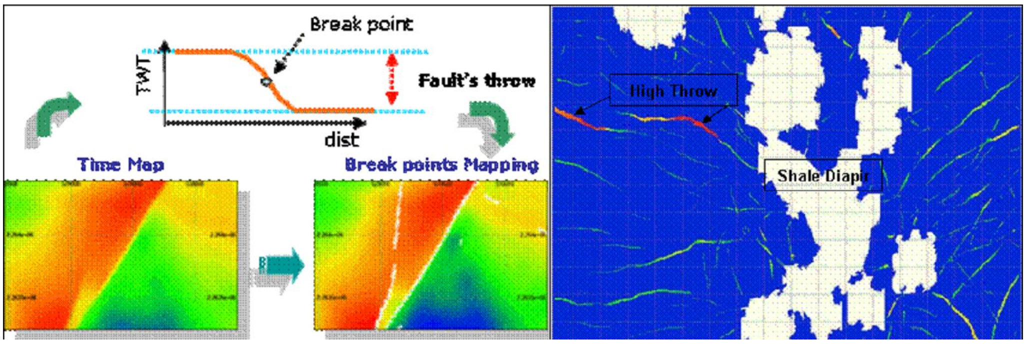


***Figure 3:*** *(a) Geo-Model time differential analysis, showing the break points. (b): Horizon slice through the fault throw attribute cube (Data courtesy of BG Group).*

## Conclusions

The 3D differential analysis of the geo-model enhances the spatial distribution of the faults network with a very high level of accuracy and quantifies the throw along the faults planes. It allows a rapid modelling and visualization of the structural geology across layers and surfaces. As a result, the process is much faster to interpret a large number of faults compared to the conventional interpretation methods. Such workflow could be used for projects where detailed fault's throw analysis is required to identify sealing faults in geo-steering and well placement applications.

## Acknowledgements

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## References

Carrillat, A., Borgos, H.G., Randen, T., Sonneland, L., Kvamme, L., and Hansch, K., 2004. Fault Systems analysis using Automatic Fault Displacement Estimates. EAGE Expanded Abstracts, B037.

Gupta, R., Cheret, T., Pauget, F. and Lacaze, S., 2008. Automated Geomodelling a Nigeria Case Study. EAGE Expanded Abstracts, B020.

Pedersen, S.I., Skov, T., Hetlelid, A., Feyemendy, P., Randen, T., and Sønneland, L., 2003. New Paradigm of Fault Interpretation. SEG Expanded Abstracts, **22**, 350.