



B020

## Automated Geomodelling a Nigeria Case Study

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### SUMMARY

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A methodology for automated 3D seismic volume interpretation is presented. Stack of horizons are generated from the 3D volume along with the faults. These horizons can then be used to build a geological model and better visualization of the depositional model.

PaleoScan is a new technology to fast track interpretation of large seismic volumes with an innovative geo-model computation method, based on image processing and optimization techniques. In this work we describe a case study in offshore Nigeria where PaleoScan has been effectively used to map stratigraphic features and reservoir distribution and also build a robust structural model based on the generated horizon and fault cube.

## Introduction

In the common seismic interpretation process, each individual horizon can be either interpreted manually or extracted using auto-tracking methods. From the resulting horizons, a geological model can be defined. This workflow is generally time consuming and presents several limitations depending on the signal's quality and the geological context. The PaleoScan approach is different. A geological model is directly computed from the whole seismic volume. This model is obtained using optimization techniques, which try to find a minimum global low cost function representing an optimum seismic configuration (Fig.1). The cost functions are related to the seismic similarity and the geological consistency.

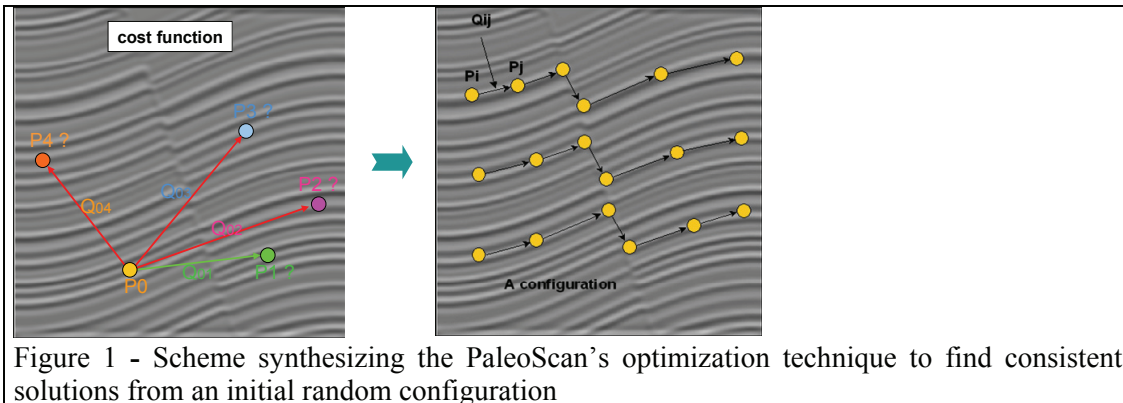


Figure 1 - Scheme synthesizing the PaleoScan's optimization technique to find consistent solutions from an initial random configuration

## Technology

In Paleoscan, each point is assumed to be seismic mini trace. Since the cost function depends on the similarity but also the distance, the algorithm tries to merge points (or traces) in their neighbourhoods. Progressively the system is made of merged regions and then it becomes much easier to link points at a later scale.

In order to obtain the most realistic and supervised results, geological constraints like faults and surfaces can also be inserted in the optimization process. As shown in the figure 2, by adding 3D geological constraints, the amount of solutions is then consequently reduced. The algorithm always tries to find the closest global minimum. Such approach allows obtaining a robust final solution, in a geological point of view, and in addition to consequently improve the time for the computation process.

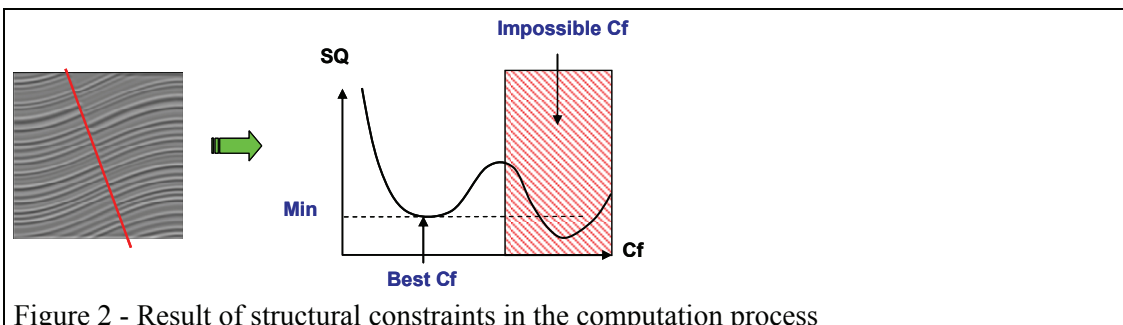
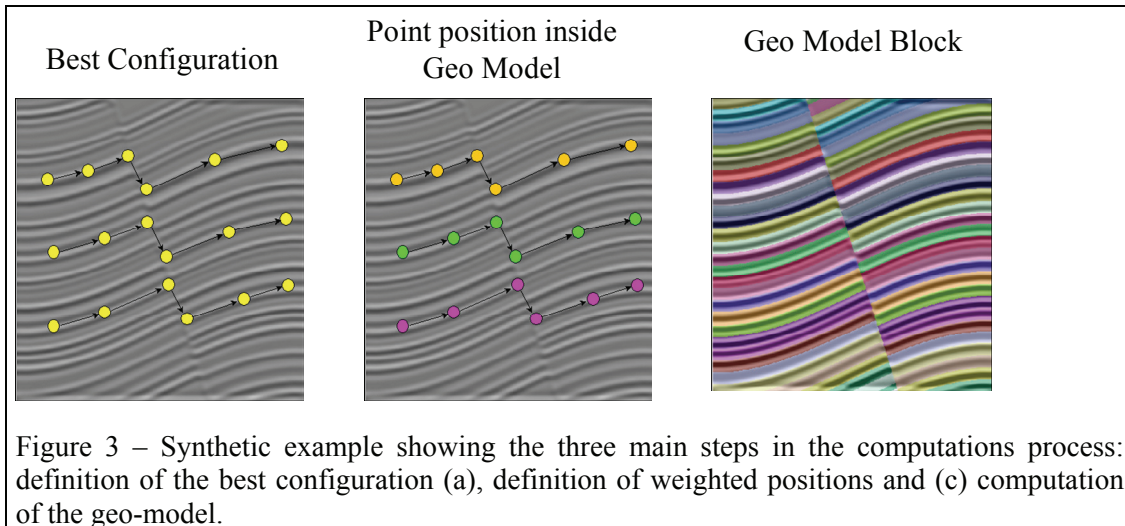


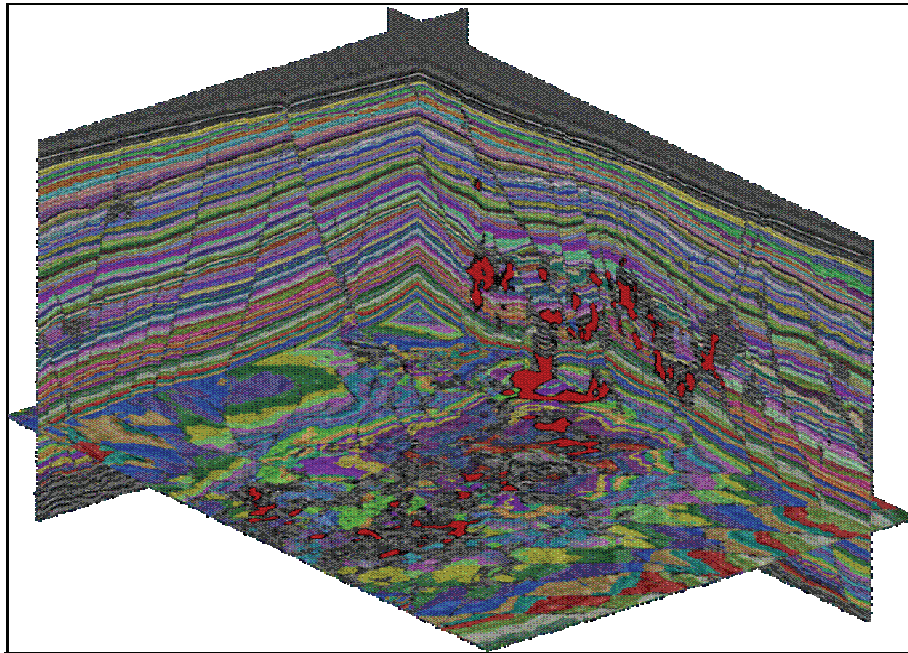
Figure 2 - Result of structural constraints in the computation process

Once the best configuration is obtained, it is then possible to establish weighted relationships between every seismic sample of the volume. Based on these relationships a continuous geo-model is computed and stored as an independent block (Fig.3).

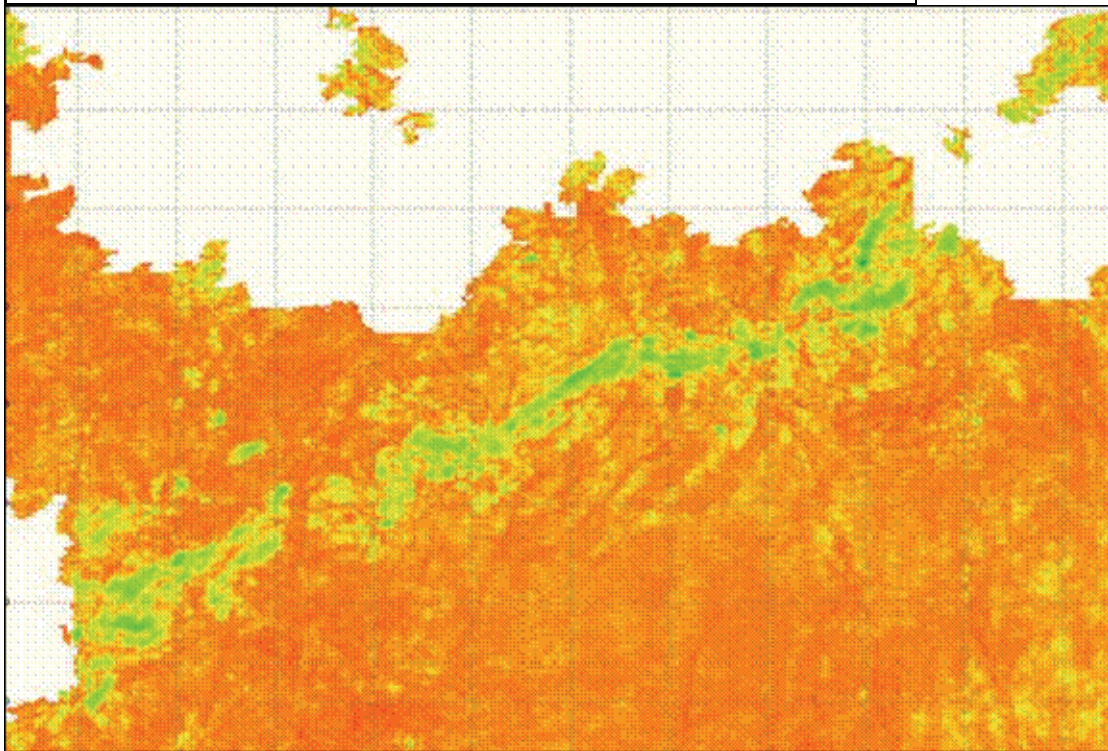


### Case Study

The PaleoScan technology has been tested on a 3D seismic dataset from offshore Nigeria. The SEG Y data has been used to compute a GeoModel and produce a volume with stack of horizons. At first the data poor areas with very low signal to noise ratio is outlined and removed from the computation of the horizon stack. The resulting horizons were then validated against the manually interpreted horizons. To manually map a single horizon on this dataset the interpreter would spend anything between 3-5 days where the PaleoScan output was 600 odd horizons within a 2 second time window (Fig.4) in just 20 days. These horizons have been extracted of a continuous geo-model; their number could also be increased depending on the objectives. Based on this horizons stack, the PaleoScan software application allows scanning the whole seismic volume. The instantaneous amplitude is displayed on every horizon, which has been used to interpret the depositional setting. For example, in the present data set a channel running across the data from WNW-ESE at horizon level 263 is seen (Fig.5). Apart from getting an idea of the change in the depositional setting by looking at the sedimentary feature, geobodies have been created and exported for use in volumetric computation. Also the horizons generated by PaleoScan have been exported to other standard software to perform attribute analysis for reservoir characterisation.



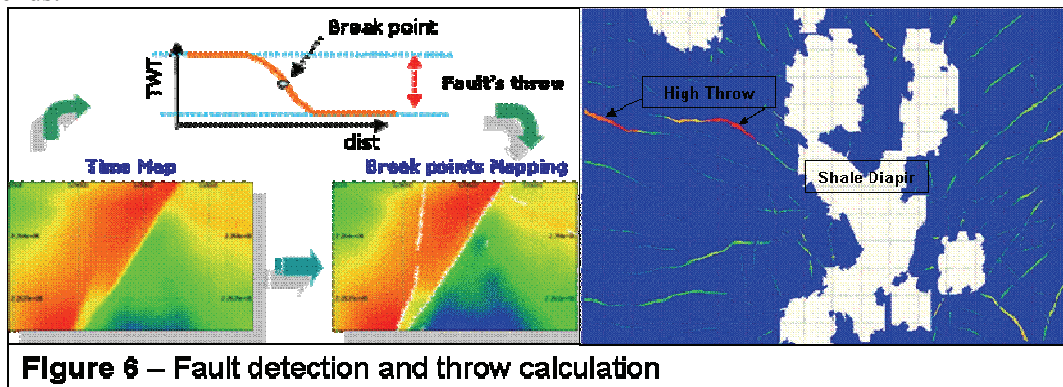
**Figure 4 – Horizon stack (data poor areas in red)**



**Figure 5 – Horizon slice 263 showing E-W channel**

Fault Interpretation – Based on a differential analysis of the geo-model, the faults throw can be mapped with a resolution beyond the seismic resolution. Because the level of the faults throw can be set up in the application (Fig.6), PaleoScan allows a rapid modelling and visualization of the faults in three dimensions across layers and surfaces. In the present data set there are innumerable normal faults related to extension due to shale diapirism and as well as sediment loading. All these faults have been detected by PaleoScan and presented as a SEGY cube which can be incorporated to a structural model (Fig.6). In this horizon slice all 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.



### Conclusion

The PaleoScan approach unlike the traditional interpretation is finding a global solution to the whole dataset. Even the most advance horizon tracker is using local information for mapping each individual horizon whereas in PaleoScan all the horizons are constrained by the globally optimized parameters. As a result the process is much faster to interpret a large number of horizons compared to the conventional interpretation methods. Furthermore, since the horizons are extracted from a continuous geo model, a fault cube can be easily obtained using the break-point analysis.

### References:

- Le Guern, P., B. Savary, H.G. Borgos, G.V. Dahl, L. Sonneland, A.R. Elias, and J.F. Rosalba, 2006, A new 3D seismic-stratigraphic methodology applied to an offshore Brazil case: 76th Annual International Meeting, SEG, Expanded Abstracts , 1600-1604.
- Carrillat, A., H.G. Borgos, T. Randen, L. Sonneland, L. Kvamme, and K. Hansch, 2004, Fault Systems Analysis Using Automatic Fault Displacement Estimates – A Case Study: 66th Meeting, EAGE, Expanded Abstracts , B037.
- Borgos, H., T. Skov, T. Randen, and L. Sonneland, 2003, Automated geometry extraction from 3D seismic data: 73rd Annual International Meeting, SEG, Expanded Abstracts, 1541-1544.
- Pedersen, S.I., T. Randen, L. Sonneland, and O. Steen, 2002, Automatic fault extraction using artificial ants: 72nd Annual International Meeting, SEG, Expanded Abstracts , 512-515.