

Visualization of Geological Features Using Seismic Volume Rendering, RGB Blending and Geobody Extraction

Chaves, Michelle U. – Schlumberger; Oliver, Flavio - BG Group; Kawakami, Gregorio - Schlumberger; Di Marco, Leandro - Schlumberger

Copyright 2011, SBGf - Sociedade Brasileira de Geofísica

This paper was prepared for presentation during the 12th International Congress of the Brazilian Geophysical Society held in Rio de Janeiro, Brazil, August 15-18, 2011.

Contents of this paper were reviewed by the Technical Committee of the 12th International Congress of the Brazilian Geophysical Society and do not necessarily represent any position of the SBGf, its officers or members. Electronic reproduction or storage of any part of this paper for commercial purposes without the written consent of the Brazilian Geophysical Society is prohibited.

Abstract

Visualization and extraction of 3D objects from seismic is critical for improving reservoir understanding, detecting anomalies, and defining facies. Geological features of the reservoir can be identified using seismic volume rendering; RGB blending, if applying transparency on regional 3D seismic volumes do not provide a clear identification; and geobody extraction for future reservoir characterization. The Seismic Volume Rendering process is a display of all data within a seismic volume at the same time. By rendering a seismic volume and working with the opacity to make it partially opaque (high amplitudes) and partially transparent (crossover amplitudes), it is possible to identify hidden structural or depositional features. However, even through volume rendering, sometimes it is difficult to identify areas of interest. The RGB method is the best option in that situations because allows the blending of different seismic attributes and its opacity scales using the primary colors (Red, Green and Blue) which enables a better visualization of geological features. After visualizing the 3D object through seismic volume rendering or RGB blending, the body is extracted. Once extracted, volumetrics can be calculated or it can be directly sampled into a geological model as a discrete object to condition the petrophysical modeling. Existing geobodies can be included or excluded from further volume extraction for improved classification of facies. The resulting property can then be used in much the same way as a facies model to condition petrophysical property models.

Introduction

In the latest decades, with the advent of 3D graphical computation, traditional seismic interpretation has started to move from 2D environment interpretation to 3D volumetric interpretation. However, even though the techniques of visualizing a 3D seismic evolved, interpreters still prefer the old 2D interpretation model.

Although 2D interpretation techniques are suitable for most cases, a 3D understanding of the target is needed to have a better assessment of the prospect.

Visualization and extraction of 3D objects from seismic is critical for improving reservoir understanding, detecting anomalies, and defining facies. Geological features of the reservoir can be identified using seismic volume rendering. By also applying RGB blending and transparency of different seismic attributes, a geological feature can then be better delineated and extracted as a geobody. Once extracted, volumetrics can be calculated or it can be directly sampled into a geological model as a discrete object to condition the petrophysical modeling.

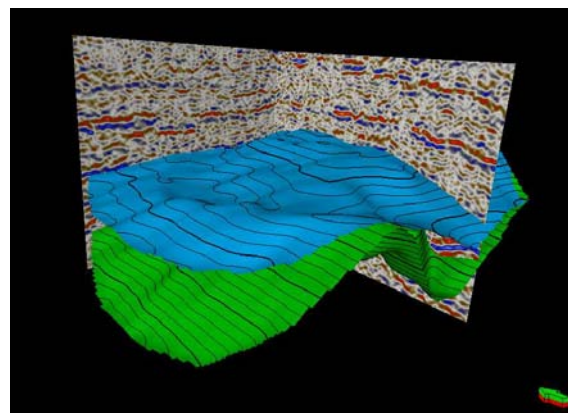


Fig.1: 3D visualization has improved, however, interpretation is still done on planes

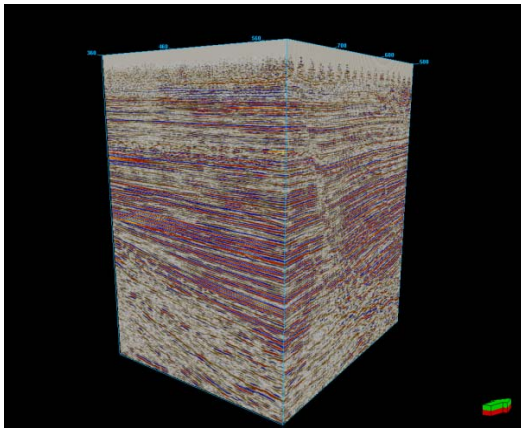


Fig.2: Rendering of a seismic cube

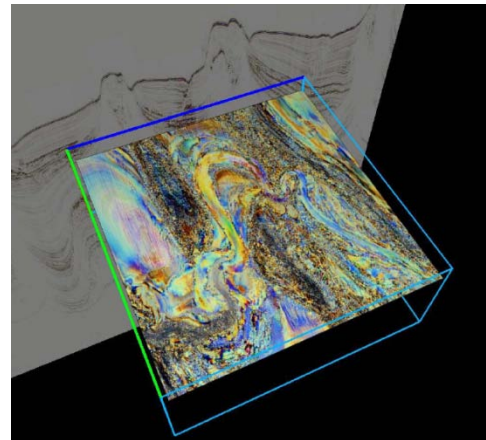


Fig.3: RGB blending of different attributes

Method

The first step in the extraction of a geobody is to understand what kind of features we want to highlight. It is critical to understand the depositional environments and the type of reservoir (i.e. clastic or carbonate). Seismic attributes must then be chosen accordingly to these characteristics.

The main steps in the geobody extraction are the following:

- 1) Identification
- 2) Isolation
- 3) Extraction

In the first step, there are numerous tools that let us better visualize our target. They are all based on rendering techniques, such as box probes, surfaces probes or well probes. However, the use of different attributes can be applied to better understand the target. In order to apply the best characteristics of each attribute, the technique of RGB blending can be performed.

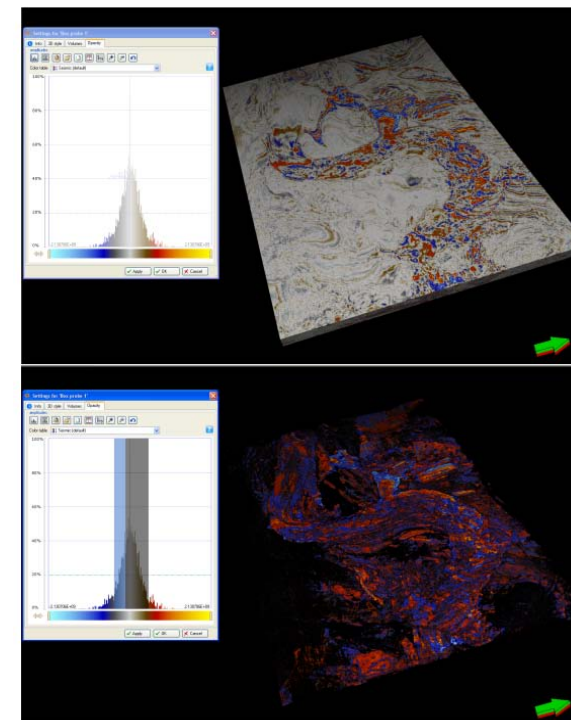


Fig.4: Isolation of a distinct geological feature

The geobody extraction is based on its opacity threshold value. By default, the threshold value is set to 20%. If a cell of the 3D model has an opacity threshold of less than 20%, it will not be included in the geobody however, this value can be edited by changing the Voxel connectivity opacity threshold value.

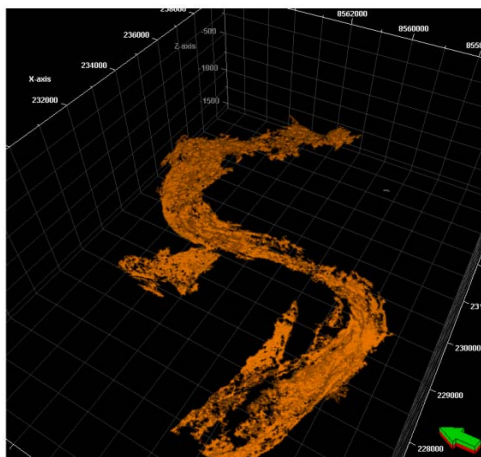


Fig.5: Extracted geobody

The extracted body can now be used in property modeling, increasing the confidence in the volumetrics of the reservoir.

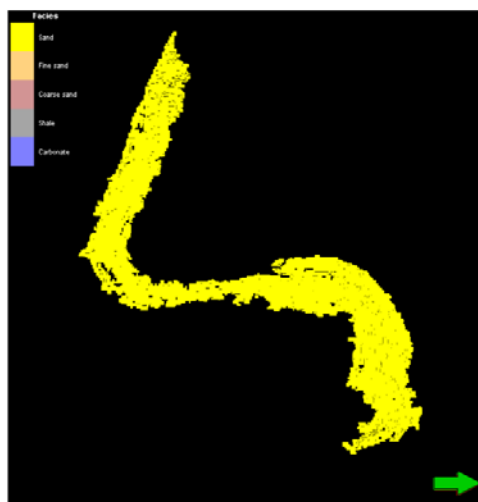


Fig.6: Facies properties applied to the geobody in a geological model

Existing geobodies can be included or excluded from further volume extraction for improved classification of facies. The resulting property can then be used in much the same way as a facies model to condition petrophysical property models.

Conclusions

As it was shown in this paper, the use of rendering visualization techniques is a powerful tool in geological/geophysical interpretation.

The better understanding of the reservoir and geological features has become extremely important and the technological advance in graphical computing allowed us to better visualize our targets.

This is critical in the definition of drilling targets, risk assessment and volume calculation.

References

- Ma, Chunyu; Rokne, Jon [2004]. 3D seismic volume visualization, Integrated image and graphics technologies
- Brown A.R. [2004] Interpretation of Three-Dimensional Seismic Data, Sixth Edition. AAPG-SEG, Tulsa.
- Weiskopf D., Engel K., and Ertl T. [2003] Interactive Clipping Techniques for Texture-Based Volume Visualization and Volume Shading. IEEE TVCG