

Using geovolume visualization and interpretation techniques (GVI) on 3-D seismic data to evaluate exploration and production properties.

Terra E. Bulloch, Douglas E. Meyer, Jennifer C. Voncannon, Elizabeth A. Lorenzetti Harvey,
T. Mike Sheffield, and Michael J. Zeitlin

MAGIC EARTH INC. 2000 W. Sam Houston Pkwy S., Suite 750, Houston TX 77042



Summary

Techniques such as multi-attribute event tracking and blocking event tracking with previously interpreted surfaces allow for a more geologically correct interpretation while also reducing cycle time. GeoProbe[®], a Magic Earth Inc. proprietary visualization and interpretation program, will be used to demonstrate the effectiveness of 3-D visualization and interpretation for exploration and development of oil and gas fields. To demonstrate these techniques, a 3-D dataset from a developed oil and gas province will be interactively interpreted during the presentation.

Introduction

Three dimensional data visualization systems allow interpreters to rapidly scan data and identify areas of interest. Geovolume visualization and interpretation (GVI) techniques are used in the data processing workflow to quality control the data and pick horizons and faults quickly. These techniques include recognition, color, motion, and isolation (Sheffield et. al., 2000). *Recognition* refers to determining the distinguishing characteristics of an event to be mapped, then processing the data to enhance those characteristics for the purpose of visualization and mapping. *Color* refers to the selection of an optimum color scheme for visualizing the property of interest. *Motion* is one of the most critical aspects of GVI; motion taps into the human sub-conscious and allows interpreters to see relationships between data in space and time. *Isolation* is the ability to separate the events of interest from other data, and is another key feature of GVI (Harvey et. al., 2000). The following workflow is an example of how GVI techniques can improve the quality of interpretations, reduce risk and cycle time, and increase the value of petroleum assets.

To demonstrate the power of these GVI techniques, a 3-D dataset from a developed oil and gas province will be interactively examined. Faults, surfaces, and geobodies will be generated during the presentation.

Method

Using probe technology allows the interpreter to scan through the data quickly and efficiently, and helps not only to determine regional geology, but also the spatial relationships of events of interest. Due to recent technological advances, interpreters are now able to integrate many seismic attributes into geophysical interpretations from the first look at the data. By examining a large number of attributes, the best set of attributes for characterizing an event can be selected and used to interpret complex geological features. The resulting workflow/technique is faster than manually digitizing the event.

Faults can be mapped first using an innovative surface editing technique and later used as boundaries for picking horizons. Using faults to constrain auto-picking aids in isolating geological units (geobodies) such as fault blocks or reservoirs. These geobodies can then be isolated from the surrounding data using transparency, revealing the 3-D geometry of the geobody.

Using a single seismic attribute to track an event is not always efficient in complex geological environments; tracking with multiple attributes is often necessary. Multi-attribute picking is used to decrease interpretation time, and increase accuracy of interpreted horizon. In the figures shown, instantaneous phase and amplitude were most beneficial picking very low amplitude events without “bleeding” into adjacent reflectors.

Figure 1 is an example of a fault block picked using the fault pair as boundaries with a combination of instantaneous phase and amplitude for seed point picking. The semblance volume was used as a guide while interpreting the faults. Figure 2 is an example of a surface picked using a combination of instantaneous phase, amplitude, and semblance for voxel detection. Three-dimensional well log displays allow interpreters to correlate log responses with the seismic data.

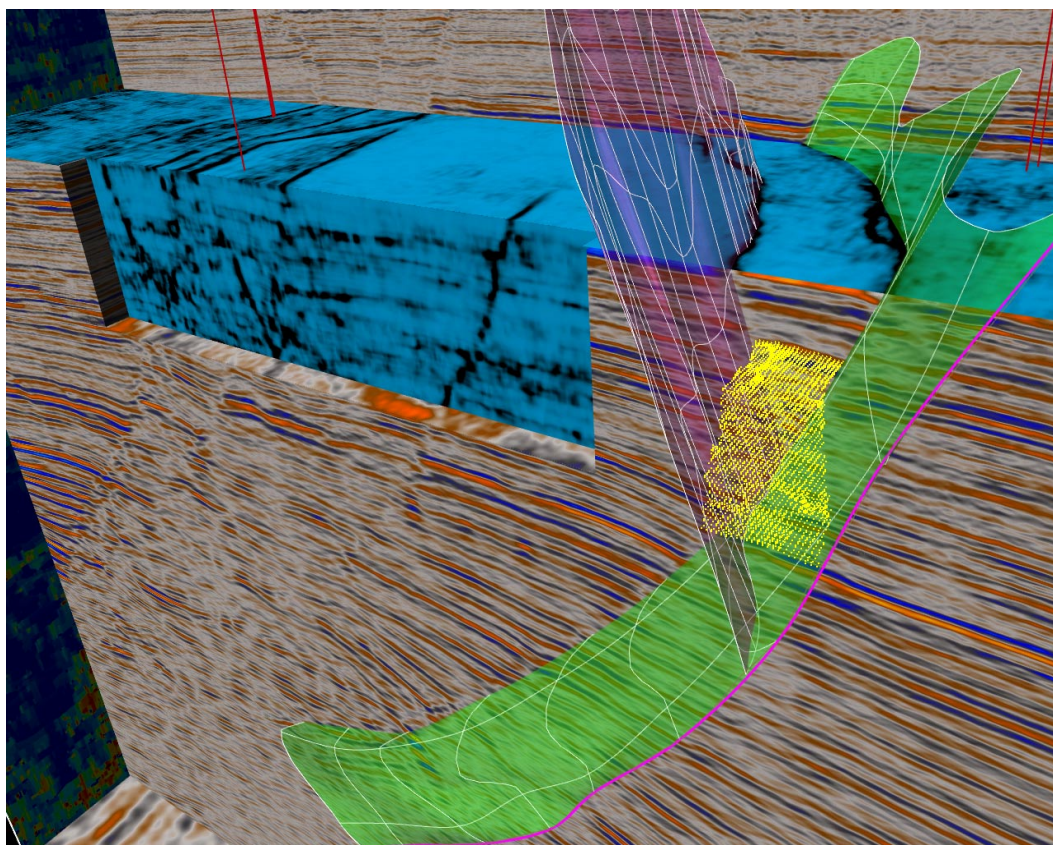


Figure 1: Points (in yellow) picked using the fault pair as boundaries plus a combination of instantaneous phase and amplitude for seed point picking. The seismic attributes displayed are amplitude and semblance. The points form a geobody, from which a horizon map or reservoir volumetrics can be generated.

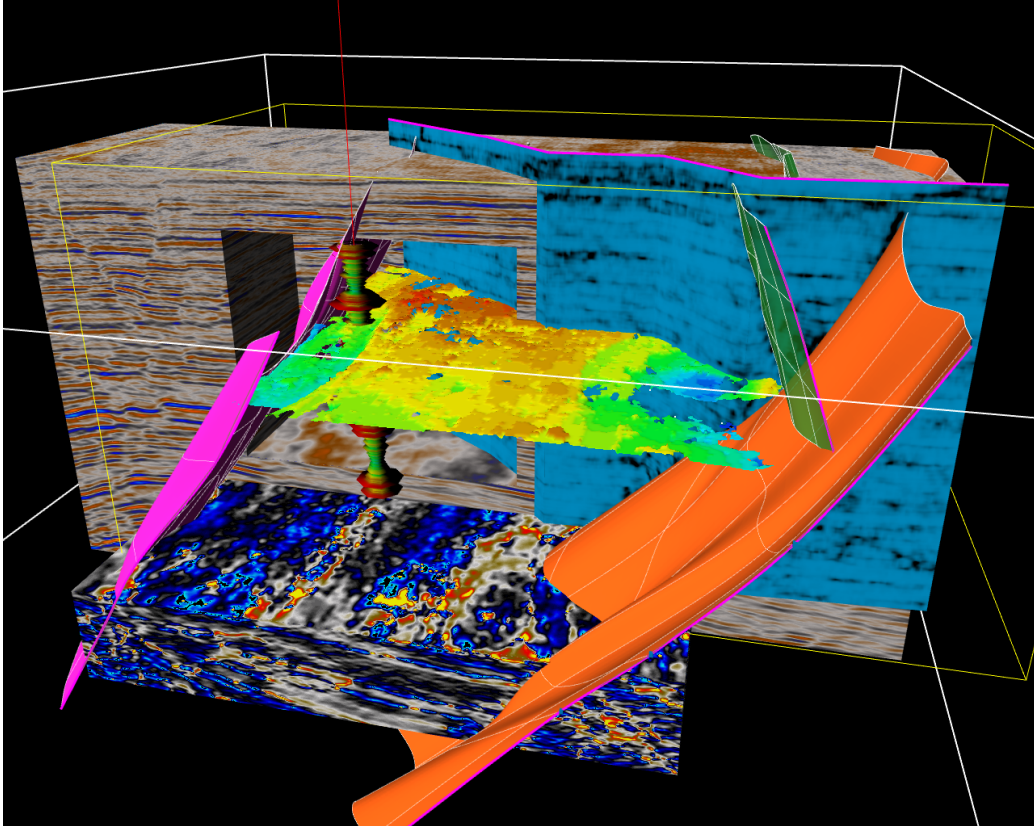


Figure 2: The surface shown (displayed with a rainbow color scale; red values show highest structure) was picked using the faults as a boundaries plus a combination of instantaneous phase, amplitude, and semblance for voxel detection. The seismic attributes displayed are amplitude, semblance, and instantaneous frequency.

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References

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