

**GEOPHYSICAL**corner

# 'Instantaneous' an Ideal Indicator

*(The Geophysical Corner is a regular column in the EXPLORER, edited by Bob A. Hardage, senior research scientist at the Bureau of Economic Geology, the University of Texas at Austin. This month's column deals with mapping stratigraphic traps with instantaneous frequency.)*

By **BOB HARDAGE**

The numerous seismic attributes that can be calculated with various interpretation software packages are based on three fundamental wiggle-trace attributes: amplitude, phase and frequency. Because these attributes are calculated at every time sample of a seismic trace, they are referred to as "instantaneous" attributes.

Constructing attributes as instantaneous functions is important, because interpreters then have more flexibility in how they use the attributes.

For example, a time-based attribute can be analyzed along an interpreted horizon (only one data point thick); within a thin data window (three or four data points thick) that conforms to a reference surface; or averaged throughout an extensive data window (several tens of data points thick) that spans some portion of seismic image space.

Most seismic interpreters, including

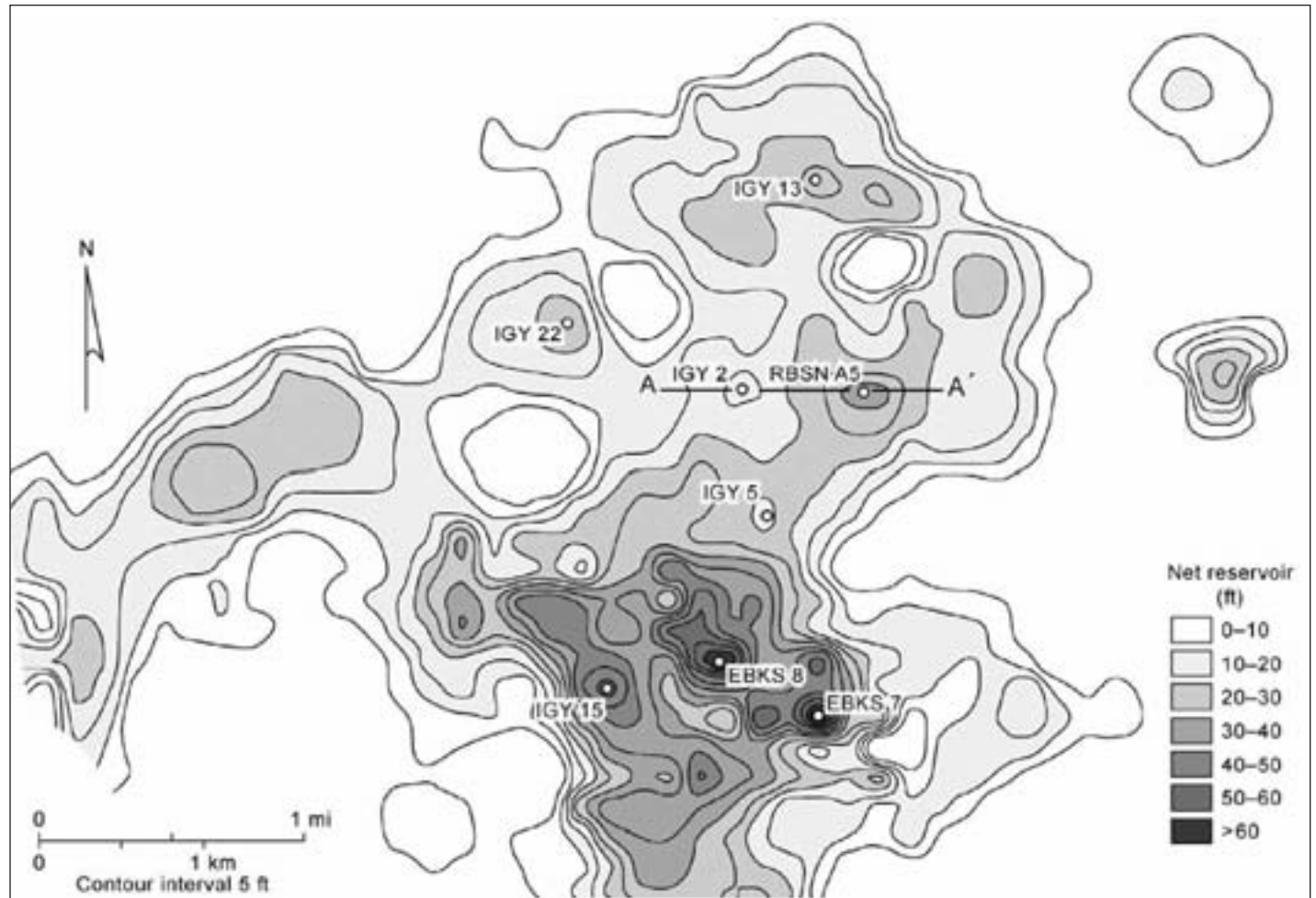

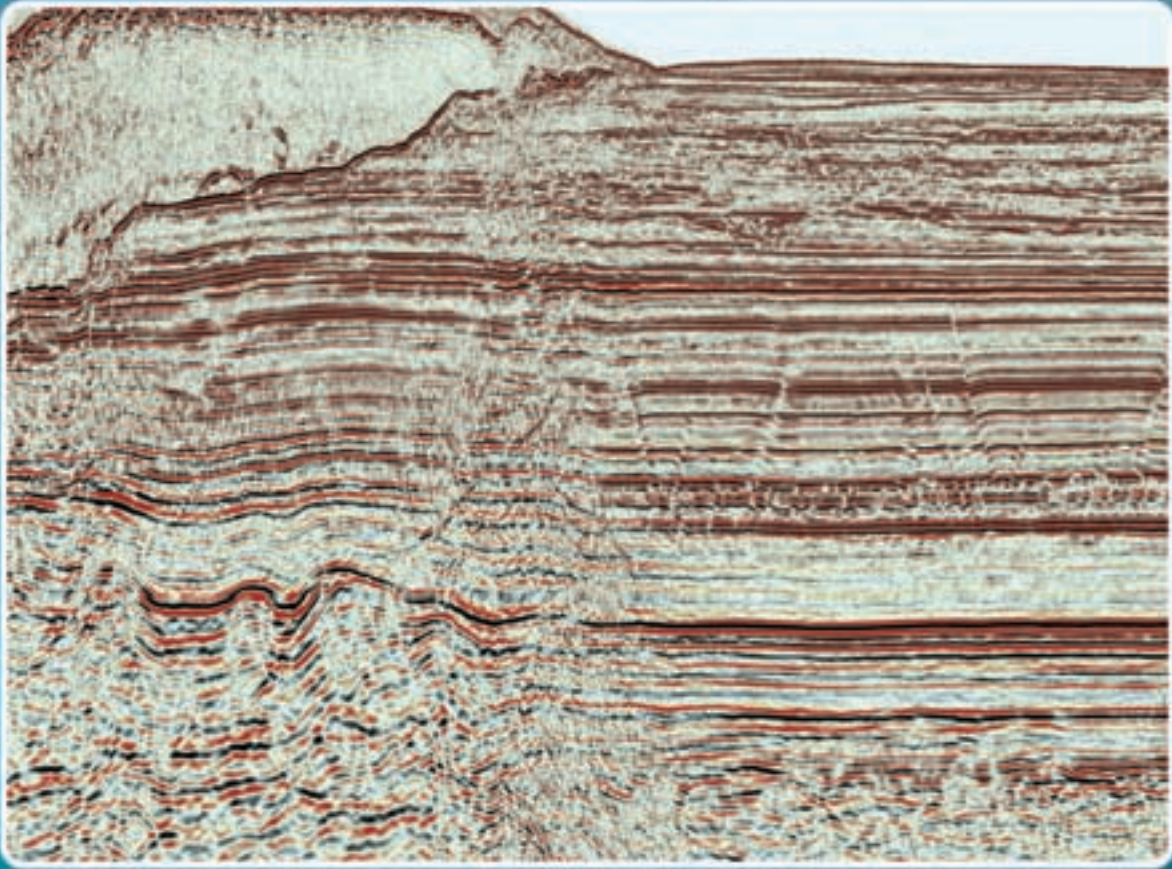


Figure 1 – Net thickness of a Caddo sandstone defined by well logs from numerous wells across a small area of the Fort Worth Basin. Locations of only a few wells of particular interest in a research study are labeled.


continued on next page



## Gulf of Mexico: In Depth & In "Deep Focus"



All PSTM & PSDM available



**DEEP FOCUS SURVEY**

- 10,000 meter Long Offset Data
- Wave Equation & Kirchhoff PSDM
- PSTM, AVO
- Gravity & Magnetics

**Fugro Multi Client Services, Inc.**

**Kenneth Mohn**  
713-369-5859  
kmohn@fugro.com

**Mike Whitehead**  
713-369-5862  
mwhitehead@fugro.com

**Marvin Taylor**  
713-369-5864  
marvintaylor@fugro.com

[www.fugro.com/geoscience/devprod/nonexcl.asp](http://www.fugro.com/geoscience/devprod/nonexcl.asp)

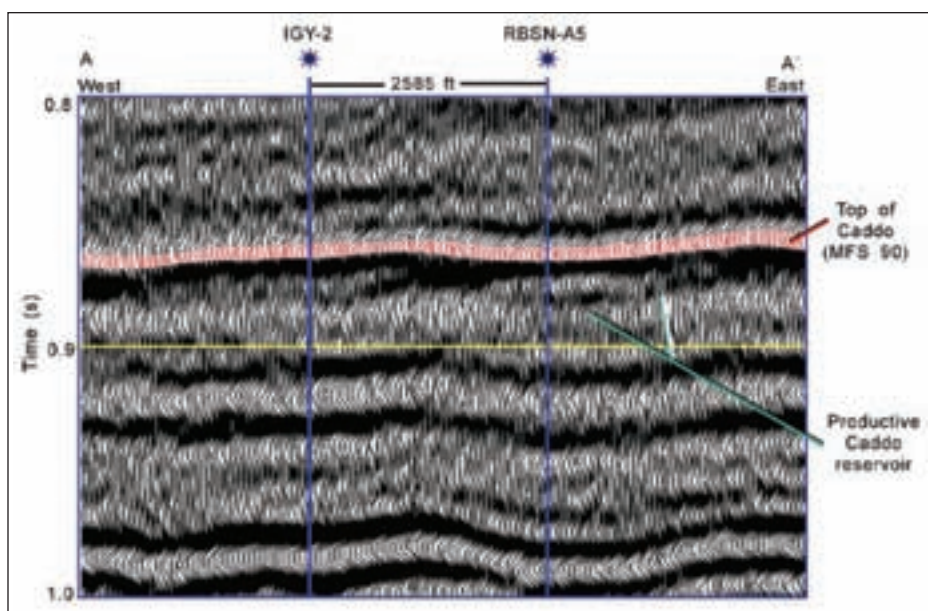


Figure 2 – Seismic section along profile AA' labeled in figure 1 that identifies the unique reflection response of the Caddo sandstone.

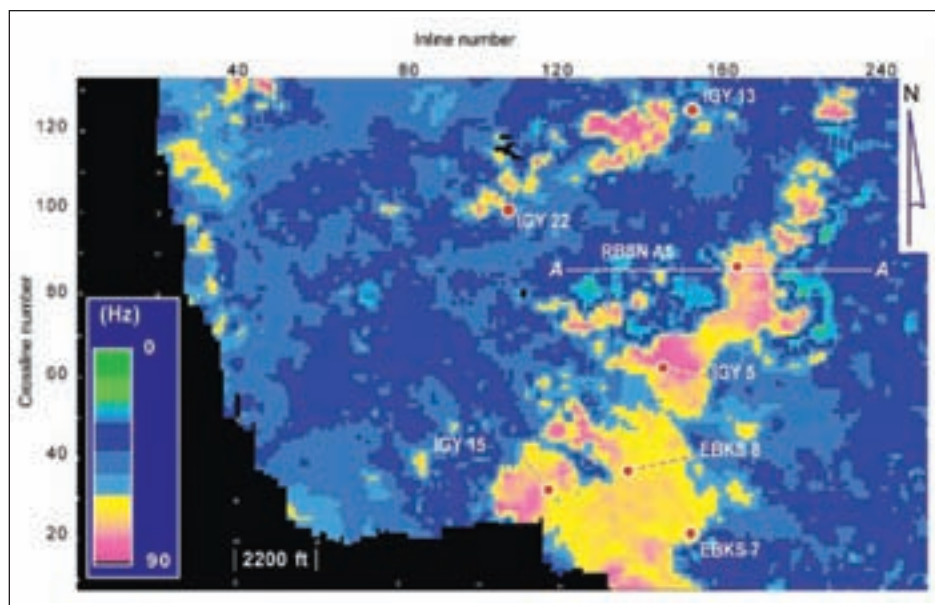


Figure 3 – Map of average instantaneous frequency in a 10-ms window positioned 10 to 20 ms below the Caddo horizon. The trend of 60- to 75-Hz average-frequency attributes on this map is a close approximation to the log-based map in figure 1 and identifies both new drilling locations and locations to avoid.

continued from previous page

the author, tend to focus on amplitude-based attributes as they search a 3-D seismic volume for geologic information. However, phase-based and frequency-based attributes are valuable for depicting subtle targets in many instances.

This article illustrates an application in which instantaneous frequency was used to define a stratigraphic trend of a productive thin-bed sandstone.

\* \* \*

The net-sand-thickness map in figure 1 illustrates the distribution of a productive Caddo sandstone in the Bend Conglomerate interval of the Fort Worth Basin.

Considerable contour detail is shown on the map because reservoir thickness was defined from logs acquired in about 30 wells across the mapped area. Only a few of these well locations are labeled on the figure.

A vertical seismic section along profile AA' is shown in figure 2. The labeled feature shows the reflection character across the thin-bed sandstone and illustrates that the sandstone target is stratigraphically trapped and is not a structural feature.

Several seismic attributes were calculated and analyzed in an attempt to follow the trend of this productive

Caddo target through 3-D seismic image space. Of all the attributes that responded to the presence of this thin-bed unit, the attribute that produced the optimal stratigraphic trap image was instantaneous frequency.

For example, the instantaneous-frequency map in figure 3 is a close match to the log-based map in figure 1 because:

- ✓ The frequency of the reflection signal reacts to the presence of this thin-bed unit.

- ✓ An appropriate color bar is used to display this frequency behavior.

Selection of the color bar used to display a seismic attribute is often the key to attribute interpretation. The correspondence between a seismic attribute value and a targeted geologic condition can be enhanced by the proper choice of color bar that displays the attribute – and, unfortunately, attribute-to-geology relationships can be obliterated by a poor choice of color bar.

Some interpreters justifiably take as much time creating an appropriate color bar for attribute maps as they do creating the attribute that is being mapped.

\* \* \*

The fundamental message from this example is that frequency-based attributes at times can be ideal indicators of stratigraphic-trap conditions. □



# Call for Papers

For its 78th Annual Meeting in 2008, the SEG will head to Las Vegas for the first time since 1983. Do not miss this opportunity to present your case histories, latest techniques, and/or research results to your geoscience colleagues assembled from around the world.

Technical Program Chairman Tracy Stark and his committee officially invite you to submit expanded abstracts for oral or poster presentations at the 78th Annual SEG Meeting and Exposition. Contributions from all geophysical disciplines and from all parts of the world are desired. High-quality contributions, particularly those concerning case histories, new techniques, new uses of old techniques, or submissions to special sessions will receive preferential consideration.

It is the intent of the technical committee to accept only the best contributions in each portion of the discipline spectrum and to limit the number of concurrent technical sessions. Submissions must contain relevant technical information, have good-quality graphics, be written in easily understandable English, and conform to standard SEG formats. Please note that submissions received after the deadline, with deliberate commercialism, unclear text or figures, or formatting problems may be rejected.

**DEADLINE FOR ABSTRACT SUBMISSION IS 9 APRIL 2008, AT 5 P.M. U.S. CENTRAL DAYLIGHT TIME.**

SEG Las Vegas 2008

International Exposition and Seventy-Eighth Annual Meeting

P.O. Box 702740

Tulsa, OK

74170-2740 USA

[callforpapers@seg.org](mailto:callforpapers@seg.org)

SEG International Exposition and 78th Annual Meeting  
9-14 November 2008  
Mandalay Bay Convention Center  
Las Vegas, Nevada

[www.seg.org](http://www.seg.org)



9-14 November 2008  
Society of Exploration Geophysicists  
Mandalay Bay Convention Center • Las Vegas, NV

Geophysics Is Happening!