

# **GC Pitfalls in 3-D Seismic Interpretation\***

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Search and Discovery Article #40145 (2005)

Posted March 12, 2005

\*Adapted from the Geophysical Corner column in AAPG Explorer, March, 2005, prepared by the author, who presented this article as the keynote address at the RMAG/DGS 11<sup>th</sup> annual 3-D Seismic Symposium March 11, 2005, in Denver, Colorado.. Appreciation is expressed to him, as author and editor of Geophysical Corner, and to Larry Nation, AAPG Communications Director, for their support of this online version.

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## **Introductory Comment**

As a consultant I am often in a position to review seismic interpretations by others. It allows me time to reflect on how geoscientists can improve interpretations and avoid pitfalls.

## **Workstation Mystique**

I was invited to listen to a presentation on seismic attributes, and my opinion was sought. We were shown a map of Attribute no. 1; then we were shown a map of Attribute no. 2; then we were shown a map of Attribute no. 3. At this point I interjected: "What is the objective of this study, and how do these maps relate to that objective?" "I am gathering all the evidence for the study of this reservoir," was the response. We were then shown Attribute no. 4, Attribute no. 5, Attribute no. 6. I could not contain myself any longer: "Could you please explain how you selected these particular attributes?" "Oh, they are all very important attributes." We were shown Attribute no. 7, Attribute no. 8, Attribute no. 9 .He was selecting these attributes because they existed on his workstation. Sadly, too many workstation users today are button pushers seeking the silver bullet rather than analytical thinkers using the workstation as a tool.

Workstations are magnificent tools, but the answers are still to be found in "the minds of men." How many of us realize that the precision of machine autotrackers is typically around one-quarter of a millisecond? In good data this precision represents geology and must be exploited. Thus, autotrackers are indispensable tools of modern interpretation. Derivatives of autotracked time maps, such as residual, dip, and azimuth can yield vital structural detail not visible in any other way.

## **Overdependence on Windowed Amplitude**

Horizon amplitude versus windowed amplitude is another common pitfall. Windowed amplitude is more modern, but this doesn't mean that we use it to the exclusion of horizon amplitude that has been available for 20 years.

RMS (root mean square) amplitude seems to be the most popular type of windowed amplitude. This has splendid application for various reconnaissance endeavors. Figure 1 shows RMS amplitude over a 500 ms window revealing many small bright spots in the

Frio Formation of South Texas. The squaring of the amplitude values within the window gives the high amplitudes maximum opportunity to stand out above the background contamination.

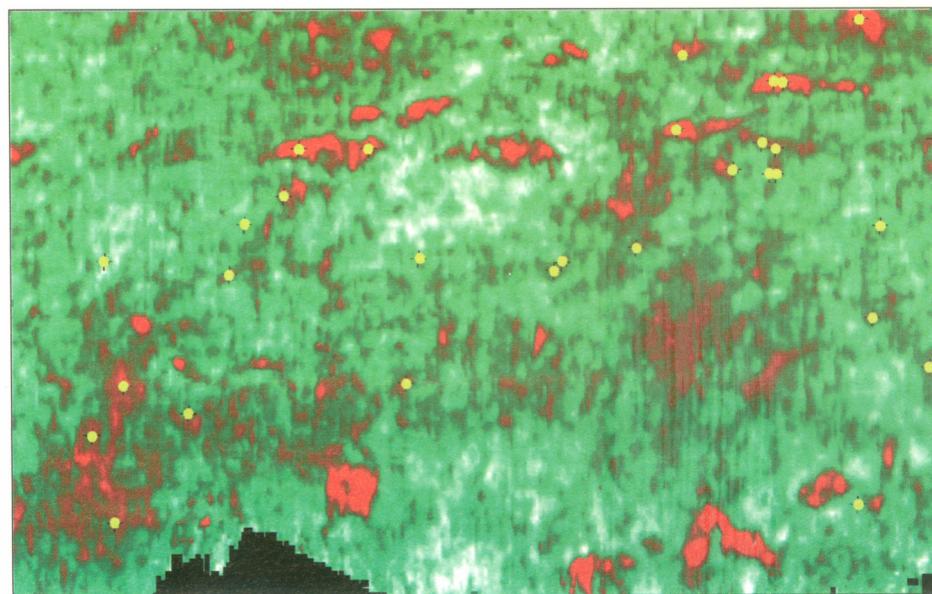
Horizon amplitude (Figure 2), extracted along the high precision autotrack, is much better for studying a single reservoir. Horizon amplitude suffers no contamination but requires that the horizon has been correctly identified and tracked. Horizon slices thus remain the best amplitude displays for selecting the optimum drilling location or measuring the area of a reservoir.

### Phase and Polarity Neglect

Data phase and polarity critically determine seismic character--and character is more important than amplitude in identifying hydrocarbons. Character is key in making an effective well tie and thus correctly identifying seismic horizons. So why do interpreters not think more deeply about phase and polarity?

I believe that every seismic interpreter, with an objective beyond structure, has the responsibility to determine or verify the phase and polarity of his or her data. Many dry holes have been drilled by those who failed to do so!

Figure 3 shows a good well and a dry hole both penetrating high amplitudes. This data is American polarity; so red-over-blue (trough-over-peak) is the character of low impedance prospective sand. We should have been able to recognize that the blue-over-red amplitude was a poor prospect.



**Figure 1.** Root mean square (RMS) amplitude over a 500 ms window shows many small bright spots in the Frio Formation, South Texas.

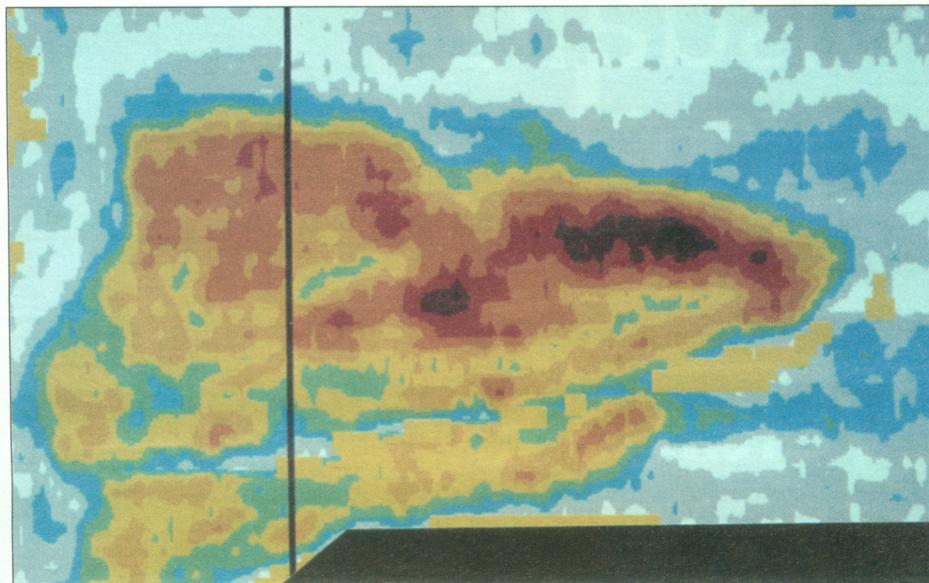


Figure 2. Horizon amplitude, extracted along the high precision autotrack, delineates a single reservoir better than RMS.

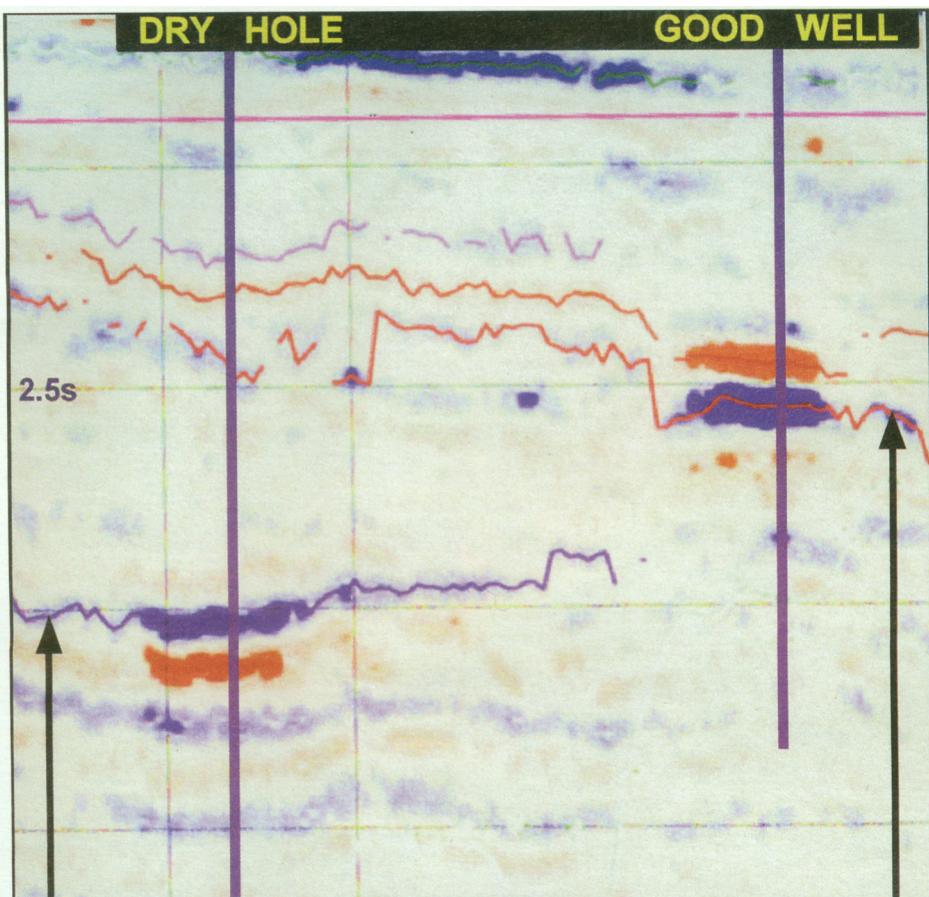


Figure 3. Seismic section with dry hole and good well penetrate high amplitudes, but only the latter with red-over blue (trough-over-peak) is representative of low-impedance prospective sand. The blue-over-red amplitude represents a poor prospect.

## **Acquisition and Processing Defects**

Seismic data can contain defects caused by the acquisition and processing, and interpreters must attempt to understand these. Amplitude is full of geologic information; consequently, amplitude must be preserved as thoroughly as possible in data processing.

## **Surface Obstacles**

The presence of surface obstacles or the lack of access (no permit) causes reduced and variable seismic coverage. This tends to be the principal acquisition-induced problem facing interpreters of land surveys. Amplitude changes and pseudo-faults can both result from this type of defect.

## **Recommendations**

Recommendations to help today's interpreter get more geology out of 3-D seismic data in a reasonable period of time are outlined below. These will also help avoid common interpretation pitfalls. Seismic interpretation today involves a delicate balance between geophysics, geology, and computer science. As interpreters we must be continuously learning to improve our understanding of geophysics and our skills in using the workstation.

- Expect detailed subsurface information.
- Do not rely on the workstation to find the answer.
- Use all the data.
- Understand the data and appreciate its defects.
- Use time (or depth) slices/horizontal sections.
- Visualize subsurface structure.
- Use machine autotracking and snapping.
- Select the color scheme with care.
- Question data phase and polarity.
- Tie seismic data to well data on character.
- Try to believe seismic amplitude.
- Understand the seismic attributes you use.
- Prefer horizon attributes to windowed attributes.

Use techniques that maximize signal-to-noise ratio.