Effective (and Not-So-Effective) Channel Maps

by Mike Cline

After my previous article in the May issue of the HGS Bulletin, “Two Alternative Seismic Fault Interpretation Techniques—Part Two,” which explains how very small faults can be highlighted with surface shading, I decided that there may also be an interest in map displays for stratigraphic interpretations. This article, illustrating how various map types and parameters can affect an interpretation of a channel, is the result.

Typically, the seismic interpretation tools available to most geoscientists working to delineate individual channel systems are seismic amplitude extraction maps, coherency slices and horizon maps. However, it can sometimes be difficult to resolve the channels by relying solely on seismic amplitudes. This is a particular problem if there is very little amplitude contrast between the channel-fill and the surrounding rocks, such as in a Class-1 or Class-2 AVO (non-bright spot) environment. Alternately, the lack of a coherency volume for use in the interpretation process can also be very limiting. When both of these two conditions exist, an interpreter is left with horizon maps. As I will show, horizon maps can be effective tools, but under certain conditions they are not so effective, leaving little to show for the effort.

Effective Channel Map Displays

Figure 1, an autopicked two-way time (TWT) color-filled map, displays a channel in the upper-left quadrant of the mapping area. It is fortunate that this color bar was used in this example because the channel may not have been as evident with other color bars, as we will see later. However, other than the two bounding faults (northeast-trending linear features shown by the black crosses), not a lot of other structural and/or stratigraphic detail is evident. Basically, you can observe a channel that is draped across the southwesterly-plunging nose located between the two adjacent fault blocks—one to the northwest, and one to the south.
In the next figure, a horizon slice through a 3D seismic coherency volume, the channel and the faults are a little more evident. You may have also noticed that there are some north-south striations running through the map area. Because they are so linear, one might interpret them to be an acquisition “footprint” (an amplitude-related over-print caused by the 3D acquisition parameters being less than optimum for this depth—sometimes a necessary evil to keep the seismic acquisition costs in a justifiable range).

Figure 3, the 3D surface map, shows a lot more structural and stratigraphic detail than the previous two images combined! Not only is the channel clearly defined, you can also see other subtle features on the surface. At this viewing angle, however, it is difficult to determine the fault throw of the smaller antithetic fault (down-to-the-north). As I mentioned in last month’s article, this is a restriction of 3D surface maps that can be remedied only by rotating the surface to a more optimum viewing angle for the smaller fault—probably at the expense of the larger fault this time!

Finally, on the fully-illuminated, shaded relief map in Figure 4, the faults and channel edges are clearly defined. Similar to the third figure in last month’s article (the gray-scale, shaded...
relief map of the fault display), the shadows on this map were generated by deflections in the surface, which face away from an artificial illumination source (the red sun in this article's Figure 3).

**Now for the Not-So-Effective Channel Map Displays**

The color-filled time map of the channel horizon in Figure 5 is not very definitive because of a combination of a poor choice for the color bar and the large time difference between the highest and lowest points in the map area. The upthrown fault block, colored in red, increases the time range of the colors so much that the middle fault block, where the channel is located, is almost entirely within the very similar light blue to light green colors. This lack of a dramatic color contrast in the area near the channel leads to less definitive channel edges. A map's “dynamic range” (the

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**Figure 4.** The fully-illuminated shaded relief map clearly defines the faults and channel outline, as well as other subtle features.
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The contour map in Figure 6, with the 20-millisecond (ms) contour interval, is very clearly a poor choice—just include it to dramatize the point that a too-widely spaced contour interval can completely obliterate a prospect. The channel outline in Figure 7, the contour map with a 10-ms contour interval, is a little better defined, but the structural relief information is not immediately apparent because of the lack of enough contour annotation. Of the four figures in the not-so-effective map series, Figure 8, the contour map with a 5-ms contour interval, is the best map. However, the subchannel detail might now be confused as apparent "noises" due to a lack of spatial description. The color-filled channel map does not define the channel very well.
sampling—that is, the individual contour undulations can’t be put into the proper context because the adjacent horizon cells are not visible now, as they were in the first series of images. Additionally, some interpreters will feel that this jaggedness in the contours detracts from the overall map effect.

In my opinion, black-and-white contour maps by themselves (with no associated color-filled or perspective maps) are an obsolete method of map presentation for 3D projects. Not only is a lot of information lost from a 3D seismic interpretation by not using all the data, but I think that there is a natural tendency for some interpreters to smooth out the “noise” of the apparent contour jaggedness. As you have seen in these examples, many times this apparent noise is actually subtle map information.

I hope you find these examples helpful with your stratigraphic interpretations. They can also be applied to structural interpretations.

**Biographical Sketch**

**Mike Cline** is an exploration geophysicist who began consulting in 1985. He has a diverse range of computer-oriented seismic interpretation experience in the energy industry, which is also the basis for his company’s name, Technology/Exploration Resources, LLC (dba. T/X Resources). He holds active, long-time memberships in the SEG, AAPG, HGS and GSH and is licensed by the TBPG (Geophysics). He is also past-Chairman of the Houston Geological Society Personnel Placement Committee (responsible for the HGS GeoJob Bank website, 2000–2005) and a past member of the HGS Website Committee. This is his fourteenth article published in various technical journals and he has over 60 additional articles posted on his blog. He has also given oral presentations and in-house seminars on the subject of computer applications relating to geophysical interpretation.

Contact information and links to other geophysical articles in his blog can be found on his website at http://txresources.com/main/index.php.

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**Figure 6.** The poor choice of a 20-ms contour interval used in this map basically obliterates the channel.

**Figure 7.** This channel two-way time map, with a 10-ms contour interval, is a little better defined than the previous map, with a 20 ms contour interval.
Figure 8. The channel time map with a 5-ns contour interval is better than the previous two figures, but still not the optimum method to display the channel.