

GC Thin-Bed Interpretation Using Reference Surfaces*

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General Statement

The fundamental criteria required of a seismic reflection event that is to be used as a reference surface for interpreting thin-bed geology are that the seismic reflection should:

- 1) Extend across the entire seismic image space and have a good signal-to-noise character.
- 2) Be reasonably close (vertically) to the geology that is to be interpreted.
- 3) Be conformable to the strata that need to be analyzed.

Criterion 3 is probably the most important requirement on this list.

Example

Figure 1 shows a data window from a vertical slice through a 3-D seismic volume centered on a channel system that is to be interpreted. The seismic reflection event labeled “reference surface” was selected as an appropriate conformable reflection for interpreting the thin-bed channel system identified on **Figure 1a**. The reference surface in this case follows the peak of the seismic

reflection event on which it is positioned.

Four horizon surfaces labeled A, B, C and D, each conformable to the reference surface, pass through the targeted channel system on [Figure 1b](#). Each of these horizon surfaces can tentatively be assumed to be a reasonable approximation of a stratal surface that intersects the channel system because each horizon is conformable to the selected reference reflection event, and a fundamental thesis of seismic stratigraphy is that seismic reflection events are chronostratigraphic by definition.

[Figure 2a](#) shows reflection amplitude behavior on horizon surface B. This horizon surface does a reasonable job of defining the targeted channel system (channel 1) across the lower right quadrant of the display and also depicts a second channel system (channel 2) at the top of the image display. The image on [Figure 2a](#) is a horizon-based image, meaning that the seismic attribute that is displayed is limited to a data window that vertically spans only one data point.

In challenging interpretation problems, it is important to try to define two seismic reference surfaces that bracket the geological interval that is to be interpreted – one reference surface being below the geological target and the other being above the target. An interpreter can then extend conformable surfaces across a targeted interval from two directions (from above and from below). Sometimes one set of conformable surfaces will be more valuable as stratal surfaces than the other at the level of a targeted thin bed.

To illustrate the advantage of this opposite-direction convergence of seismic horizon surfaces, a second reference surface was interpreted above the targeted channel system and was placed closer to the target interval. This second reference surface followed the apex of the reflection troughs immediately above the channel system. The two bracketing reference surfaces are shown on [Figure 3](#).

The reflection amplitude response on a horizon surface conformable to reference surface 2 and positioned 26 milliseconds below that reference surface is displayed on [Figure 2b](#). This image is again a one-point-thick attribute display (i.e. a horizon-based attribute). The channel systems are a bit crisper in appearance and their geometries are more definitive on this second imaging attempt than they were on the first effort ([Figure 2a](#)).

Conclusion

This dual-direction approach to constructing horizon surfaces that traverse thin-bed targets is a concept that often will provide valuable results. An even better approach would be to calculate stratal slices through a bracketed data window – a concept discussed and illustrated in the Geophysical Corner article published June 2006

(http://www.searchanddiscovery.net/documents/2006/06036zeng_gc/index.htm).

Unfortunately, not all interpretation software provides a stratal slicing option. In those cases, a dual-direction-approach strategy such as described here can be valuable for constructing horizon slices that approximate stratal slices.

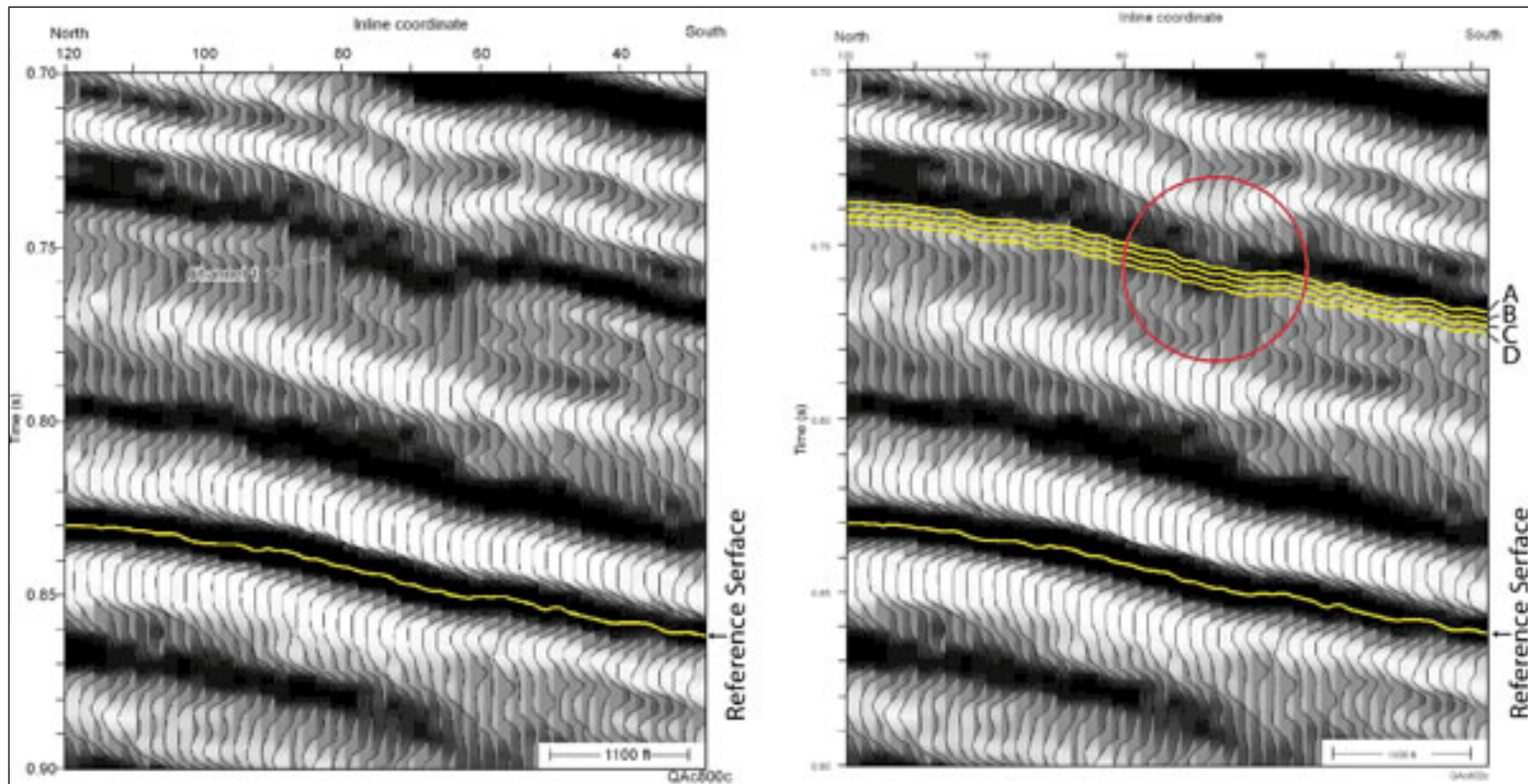


Figure 1. Vertical slices through a 3-D seismic volume showing a targeted channel system (a), and horizon slices A, B, C and D which cut through the channel window (b). These four horizon surfaces are approximations to stratal surfaces because they are conformable to the indicated reference surface, which is a chronostratigraphic reflection event. This profile is labeled 200 on Figure 2.

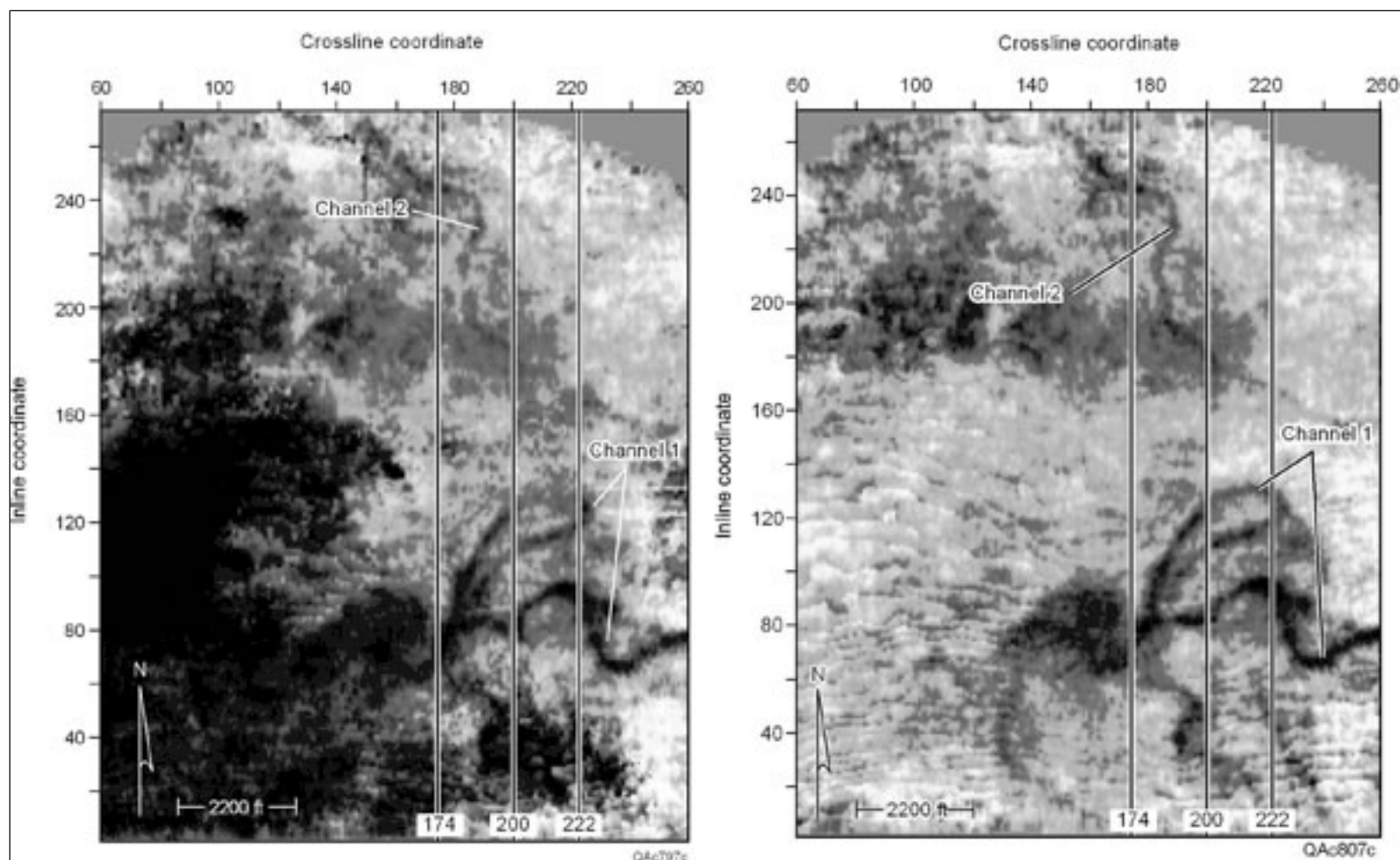


Figure 2. (a) Reflection amplitude across seismic image space on horizon B (Figure 1b); (b) Reflection amplitude across seismic image space on a horizon 26 meters below reference surface 2 (Figure 3, below).

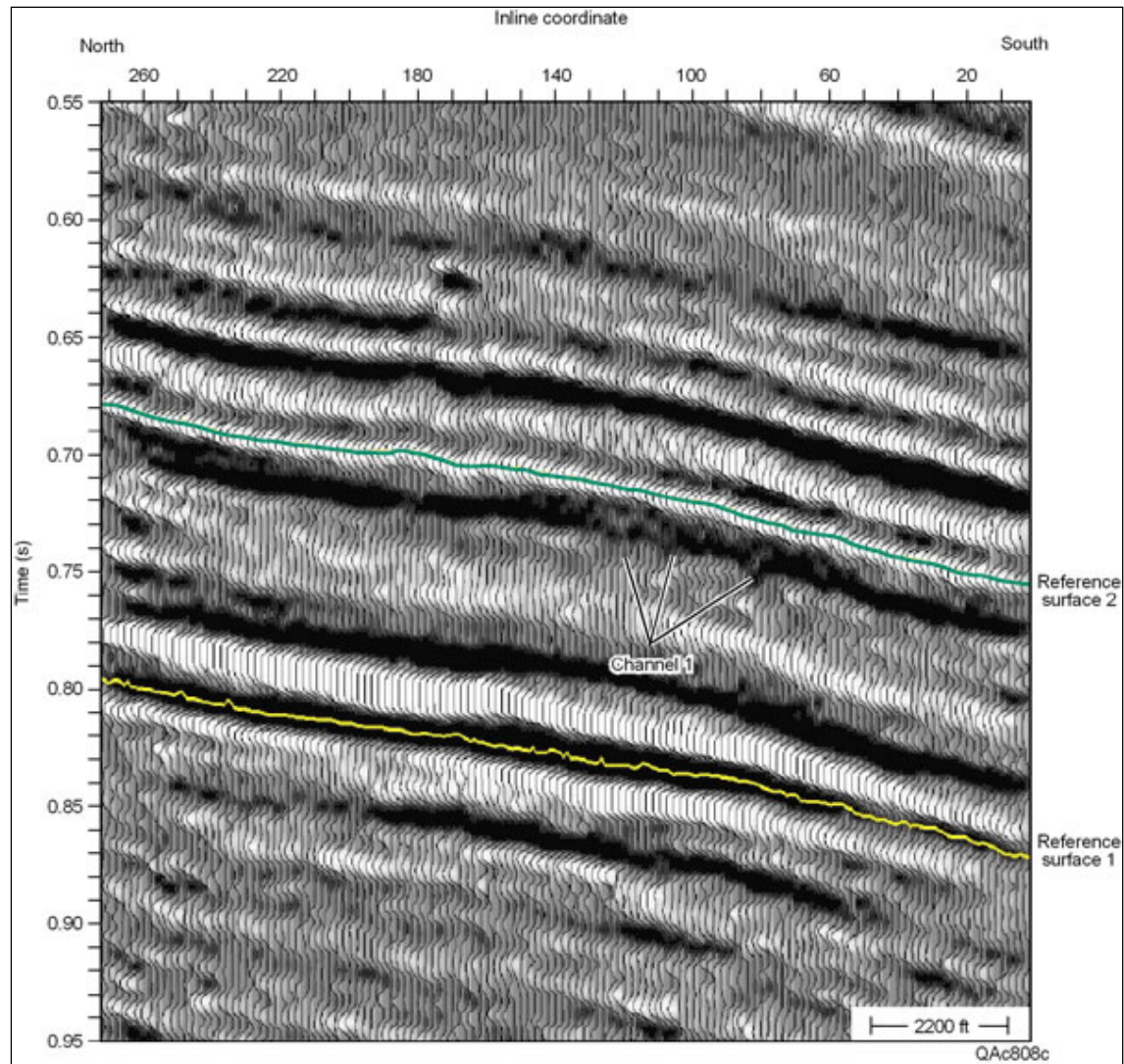


Figure 3. Seismic profile 222 shown on Figure 2. Reference surface 1 is the surface defined on profile 200 (Figure 1) below the channel target. Reference surface 2 is a second choice for a reference surface located above the channel that can be used to construct horizon slices that cut through the targeted channel complex.