

Processing effects on AVO measurements

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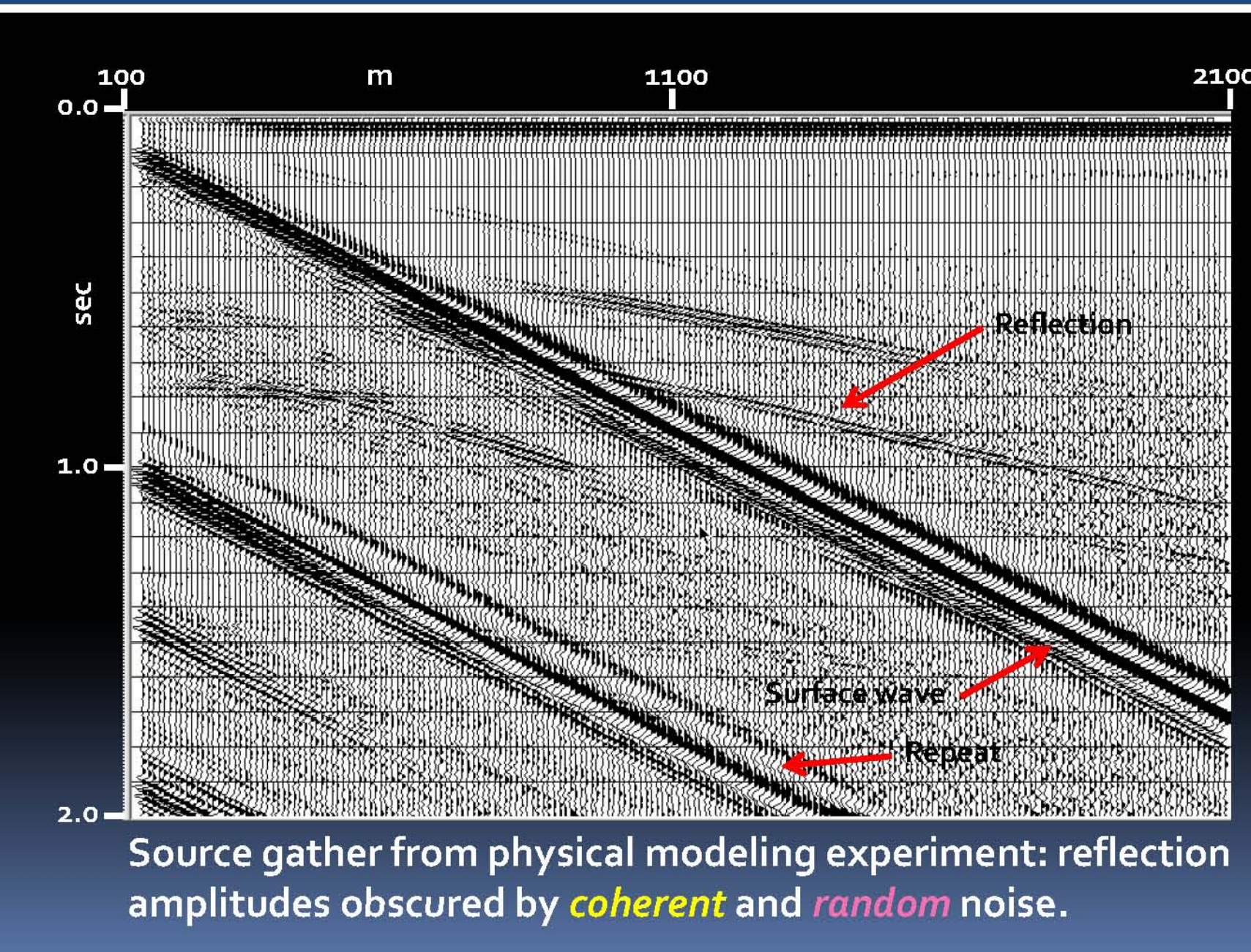


FIG. 1. Amplitudes along much of the indicated reflection *cannot be measured* without some 'cosmetic' processing on these physical model traces.

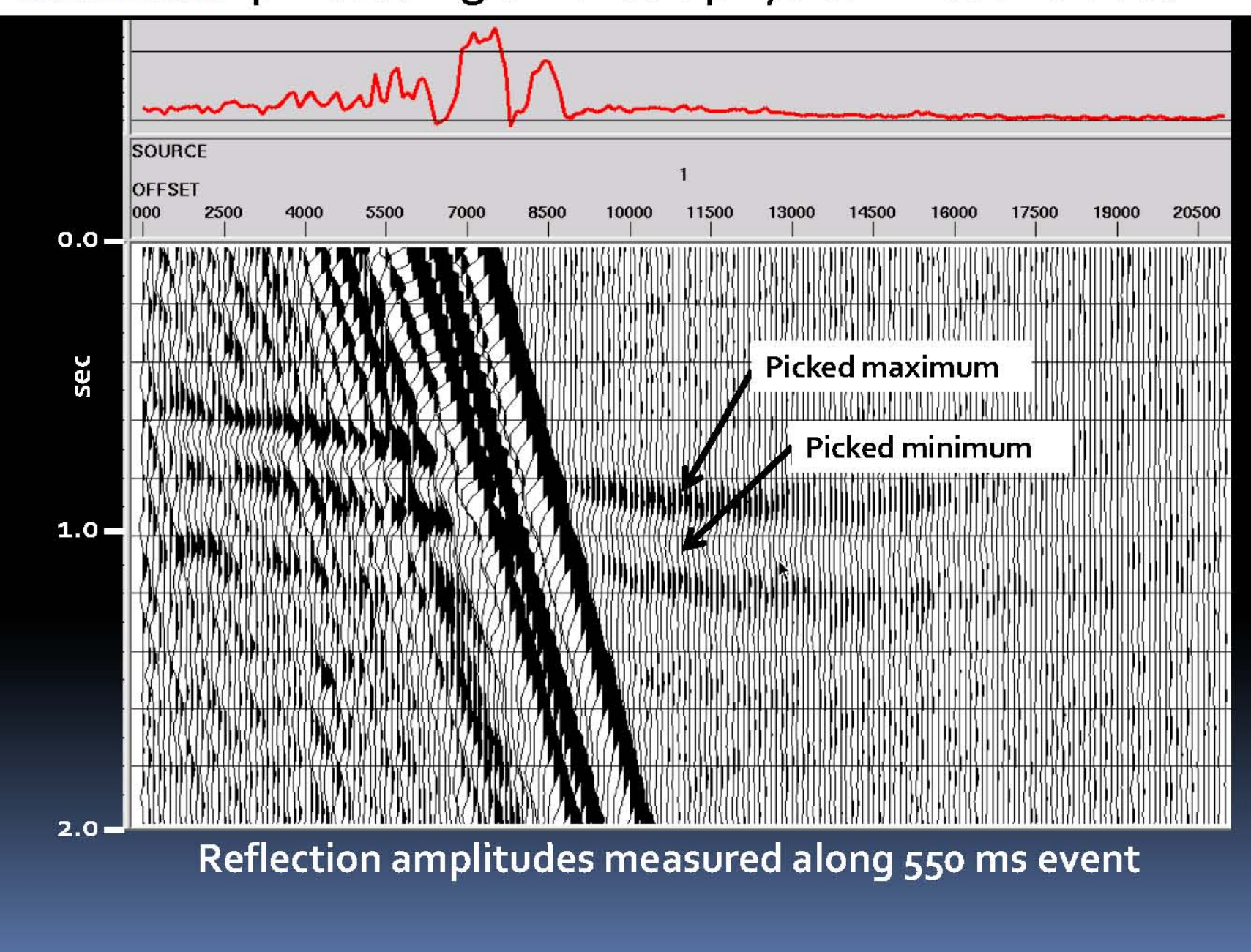


FIG. 3. Close-up of the NMO-corrected reflection at 550ms before any processing. *Amplitudes over much of the reflection are dominated by interfering noise*

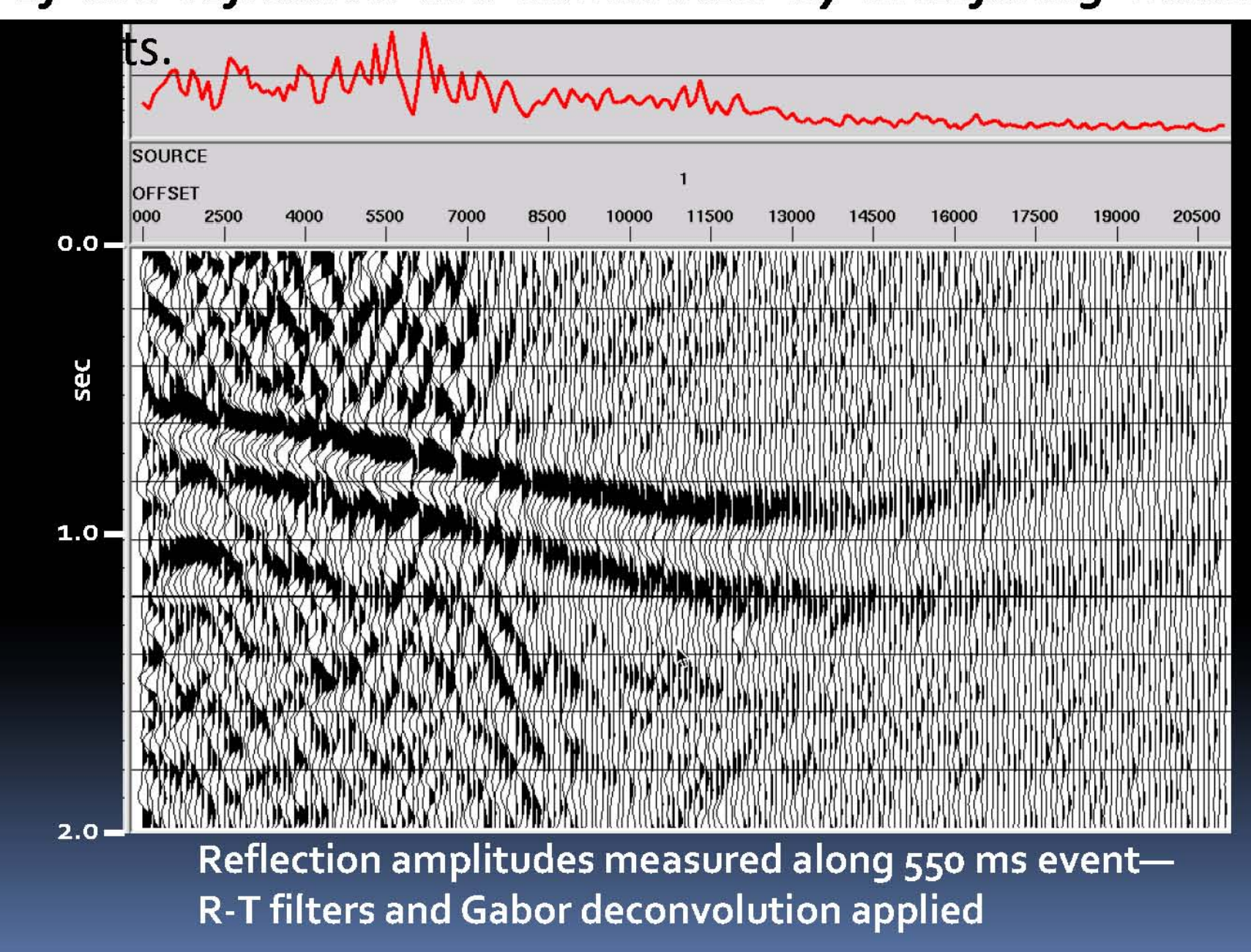


FIG. 4. After noise removal and Gabor deconvolution, *amplitudes are much easier to measure.*

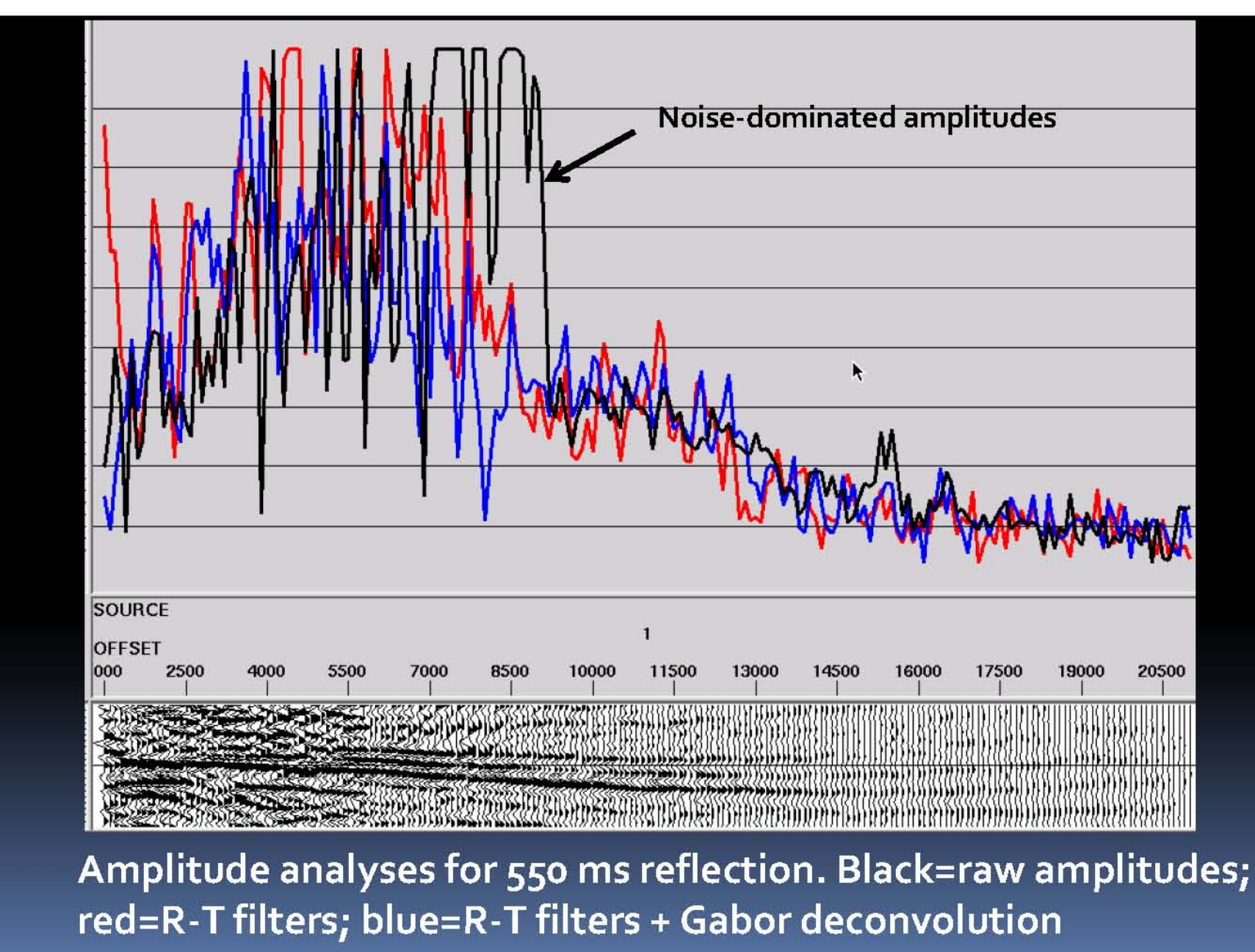


FIG. 5. AVO amplitude measurements compared before and after processing. *R-T filtering and Gabor deconvolution both leave AVO intact.*

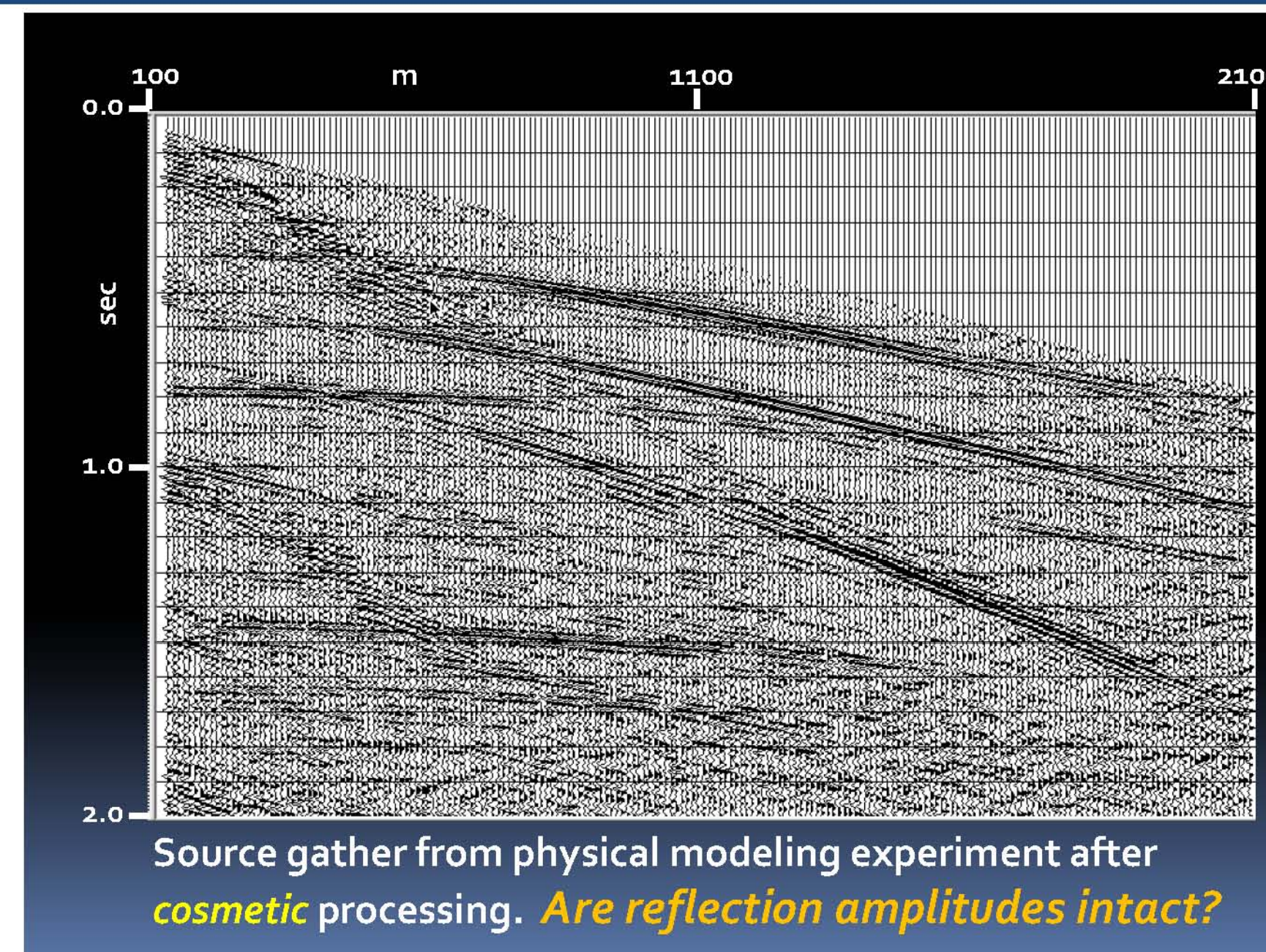


FIG. 2. Amplitudes *can now be measured* relatively easily, *but are the AVO relationships intact?*

Results

Figure 1 shows a raw source gather, while Figure 2 shows the 'cosmetically' processed gather after *R-T domain filtering* and *Gabor deconvolution*. Figures 3 and 4 show a windowed, NMO-corrected reflection at 550ms, *before* and *after* processing, respectively. Figure 5 shows the overlaid amplitude measurements along this same reflection, on the *raw traces*, the *de-noised* gather, and the *de-noised and Gabor deconvolved* gather. This figure confirms that *R-T filtering* and *Gabor deconvolution* have *negligible effect on AVO*. Though not shown here, *F-X deconvolution* smooths amplitude jitter and hence has a *significant* effect on amplitudes. *These results apply equally to field data.*

Kids, don't try this at home!

We illustrate one *cosmetic* process that, although *very effective*, is destructive to AVO. In the example at right, Figure 6 shows an R-T dip transform of the original raw gather (Figure 1). Figures 7 and 8 show the result of applying a *regular R-T dip filter* and a non-linear operation, *AGC in the R-T domain*, respectively. As can be seen in Figure 8, the non-linear operation is more effective at attenuating the strong surface wave. But, as Figures 9 and 10 show, *the regular R-T filter preserves AVO, and the R-T domain AGC does not.*

Background

We need to make *accurate measurements* of relative reflection amplitudes (*AVO*) on physical model data, so it is often necessary to apply '*cosmetic*' processing to *attenuate coherent* and *random noise*, *shorten waveforms*, and so forth. It is important to know how this processing affects the relative reflection amplitudes. We examined the effects of *R-T filtering*, *Gabor deconvolution*, and *F-X deconvolution* on measurements of reflection amplitude on a source gather of traces from a physical model generated at the CREWES modeling facility.

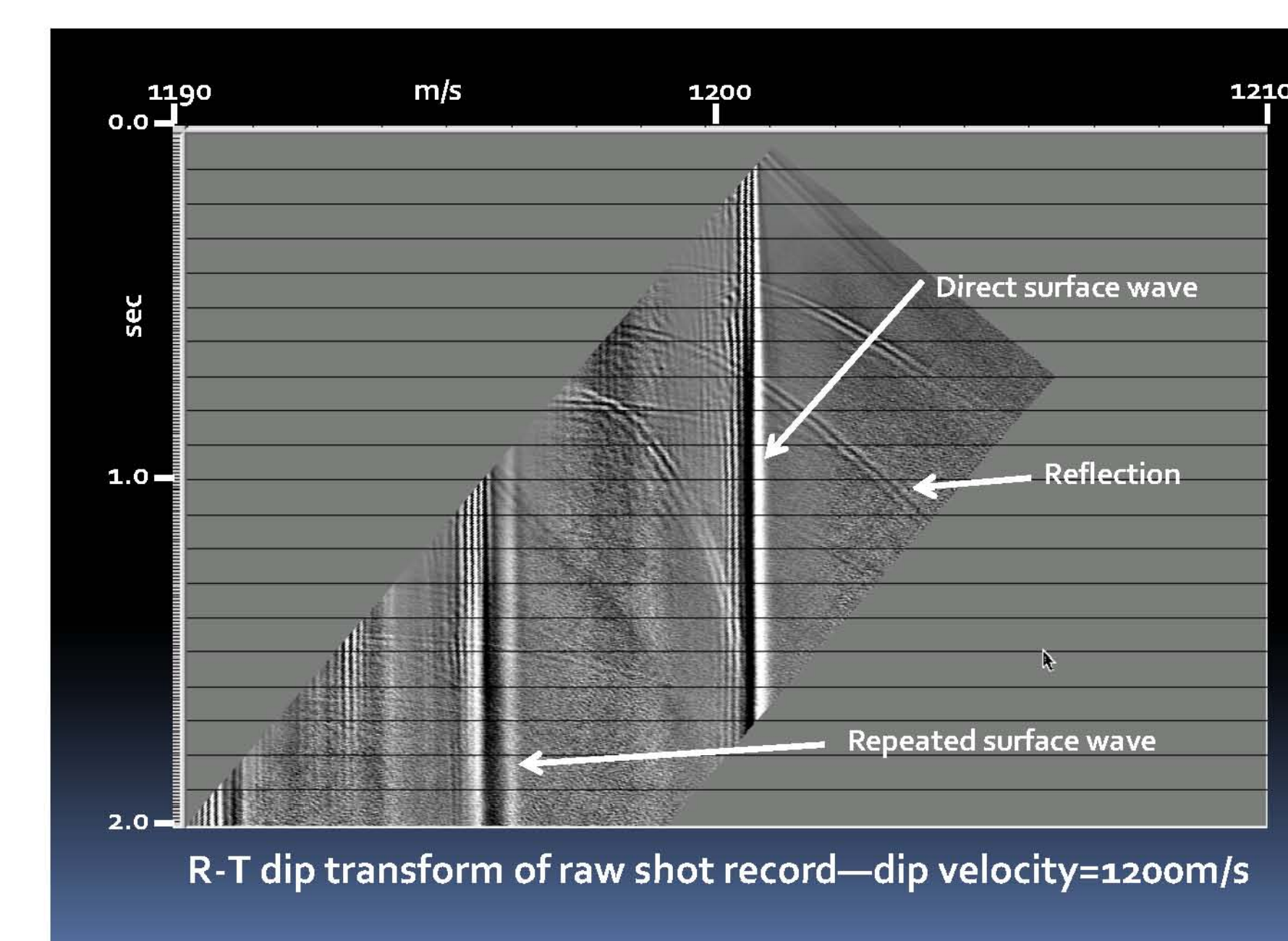


FIG. 6. R-T dip transform of the original raw trace gather. *Strong surface wave and its repeat are vulnerable in this domain.*

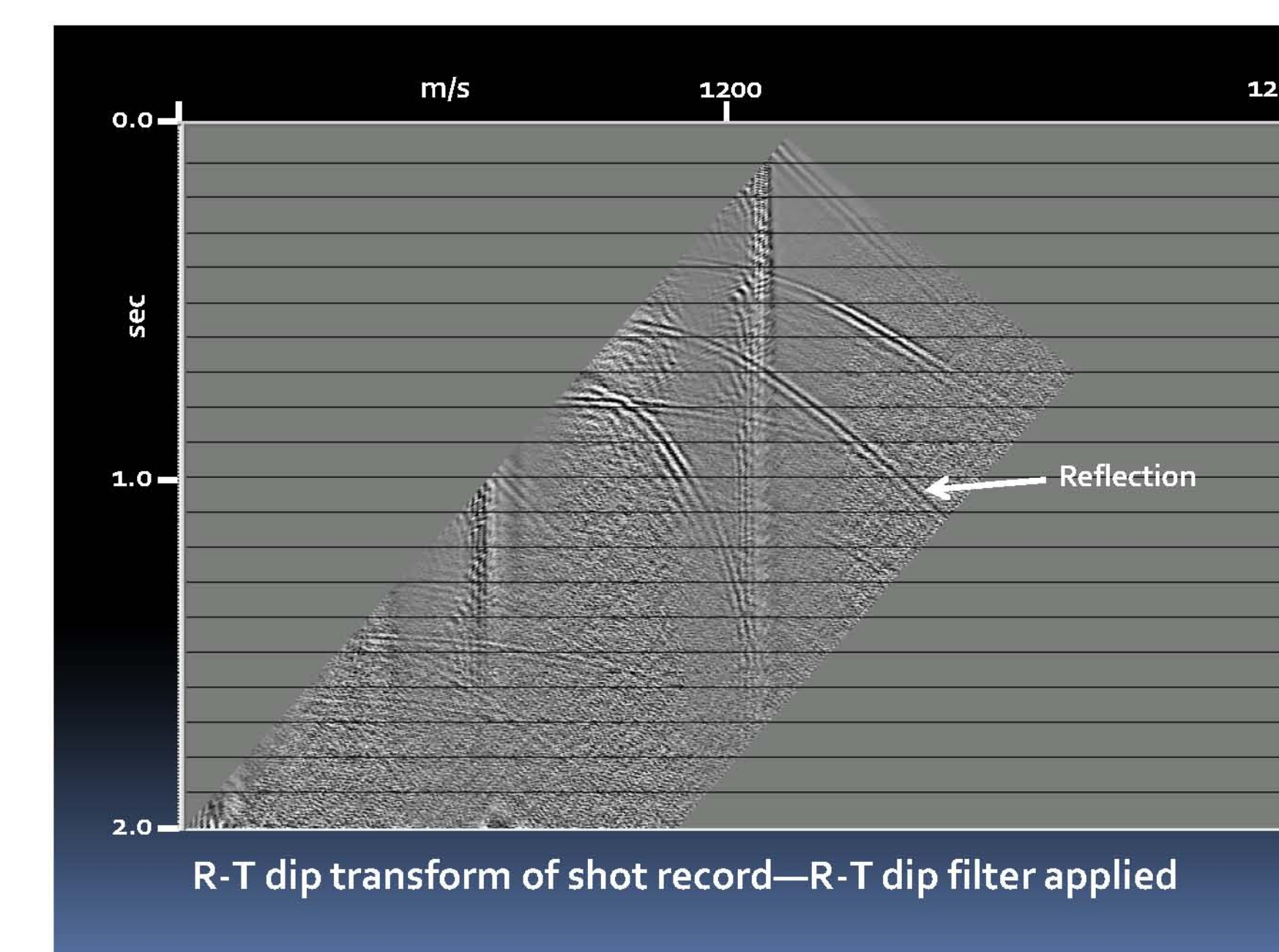


FIG. 7. R-T dip transform of the trace gather after applying *R-T dip filter (estimate and subtract)*.

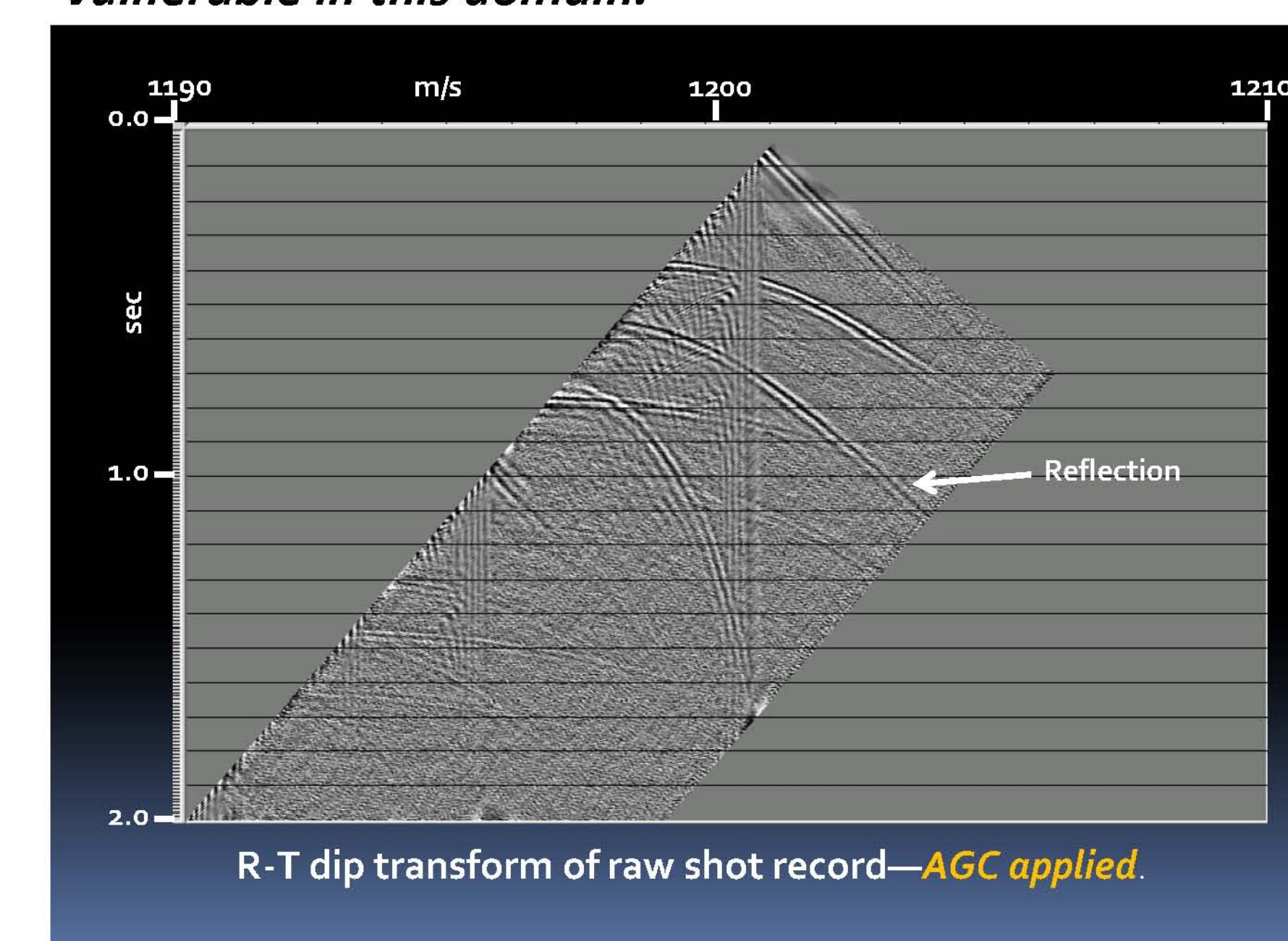


FIG. 8. R-T dip transform of the trace gather after applying *R-T domain AGC*. *These results are visibly better than those in Figure 7, but there is a price...*

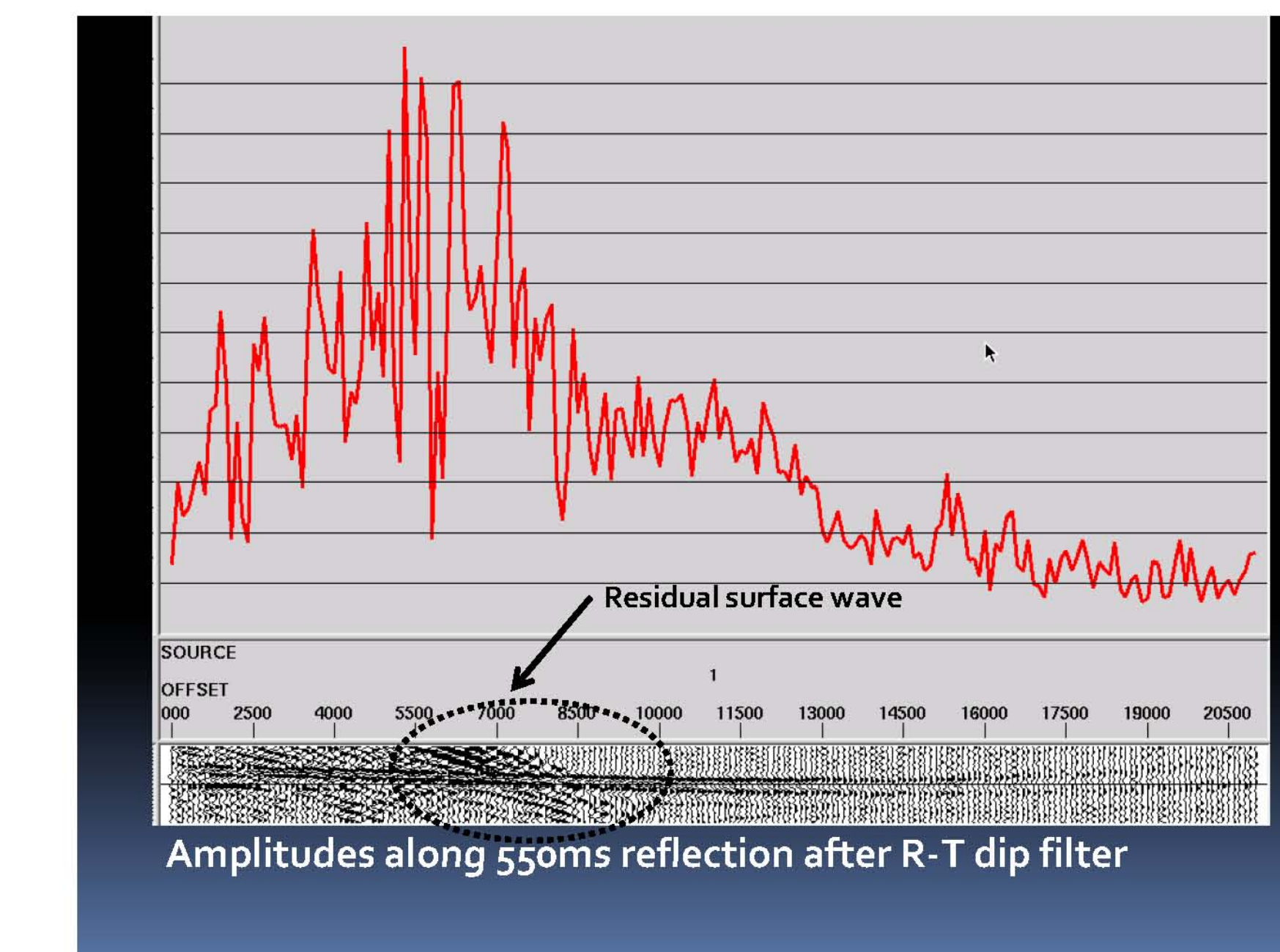


FIG. 9. Plot of AVO amplitudes along the 550ms reflection after R-T domain dip filter. *Although amplitudes contain 'jitter', AVO is preserved.*

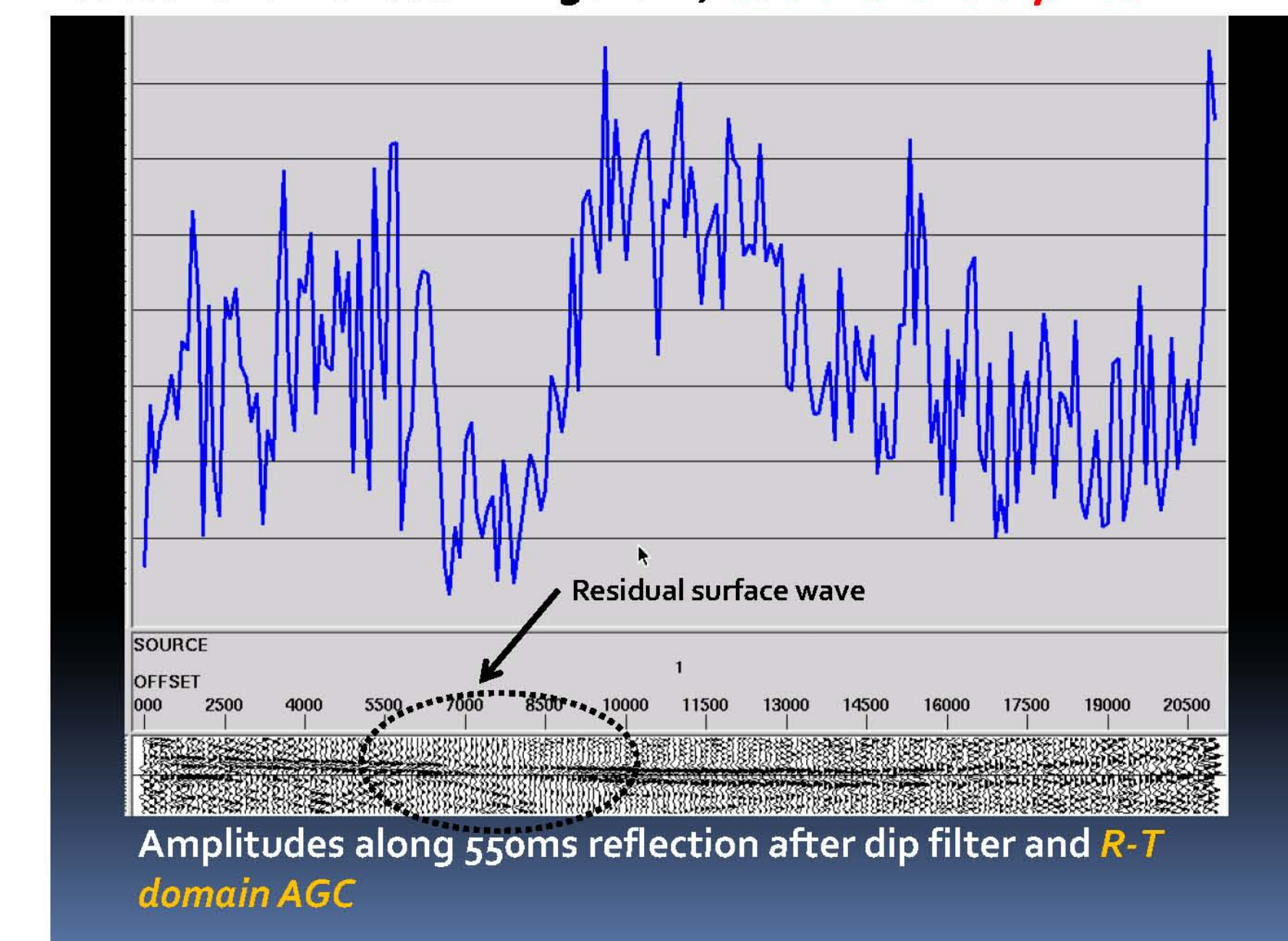


FIG. 10. Plot of AVO amplitudes along the 550ms reflection after R-T domain AGC. *Original AVO relationships are totally disrupted.*