Statics: the abusive power of trimming

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ABSTRACT

The application of trim statics directly to each seismic trace can be very dangerous as *any* seismic response can be generated. A high fold data set is used to produce totally different stacked sections.

INTRODUCTION

The summing of traces in a common midpoint (CMP) gather assumes the reflection data is aligned and the amplitude will increase with the fold or number of traces in the gather. Noise will also sum, but its RMS amplitude will increase with the square-root of the fold. The corresponding gain in the signal to noise ratio (SNR) will be proportional to the square root of the fold. It may be assumed that a high fold will give a better SNR. However, when the reflection data is misaligned, the amplitudes will not increase proportional to the fold, and a lower SNR may be obtained. The objective of estimating statics is to align the reflection data to improve the SNR of the stacked section.

Statics are estimated from the time shift found by cross-correlating input data with a model trace. This time shift may be applied to the input trace when the time shifts are very small, say less than 6 ms, and is referred to as a *trim* statics. However, the initial estimate of the cross-correlation static is typically used as input to a secondary surface-consistent process. This secondary process decomposes all the estimated statics into source, receiver, offset, and structure statics, with only the corresponding source and receiver statics applied to an input trace. This secondary process is designed to reduce the timing errors that will occur if the correlation static is applied directly to the input trace.

The term *trim* static will now be used to refer to any time shift that is estimated from the cross-correlation process and applied directly to the input trace. It is the purpose of this paper is to emphasize the danger of using trim statics when they may be large.

When trim statics are applied to noisy data, the noise may be aligned with the model trace. The sum of a number of traces in a common mid point (CMP) gather, in which trim statics have been applied, will therefore produce a stacked trace that tends to be similar to the model trace. Consequently, the resulting stacked section may also appear similar to the model trace giving the illusion of reflection data.

The following examples illustrate the abusive application of trim statics to noisy real data by creating stacked data that tends to always match the model traces, whether they contain reflection data or noise. A companion paper (Ursenbach and Bancroft, 2000) uses random noise traces to evaluate the apparent SNR's that may be obtained with various folds and correlation parameters that are used to estimate the trim static.

DATA EXAMPLES

A stacked section (from the Middle East) is illustrated with a best processing stack shown in Figure 1. A muted CMP gather with NMO correction is shown in Figure 2. Note the maximum fold exceeds 70. Traces in the stacked section of Figure 1 are formed from four CMP gathers, giving a maximum fold in each trace of 280. It will be assumed that the fold at a time of 1.5 seconds will be approximately 100. The structure in the data will be assumed to be due to a surface static and trim statics will be applied to remove the "apparent" structure. A very large correlation window of 2.0s will be used to *eliminate* problems typically associated with trim statics. A *large* maximum time shift of ±250 ms will be used to allow the reflection data to be aligned. (Both are bad assumptions). A model trace is found by stacking 25 traces from the stack section in Figure 1 (in the area of CMP3400) that appears to have stable horizontal reflection energy.

The resulting trimmed section is shown in Figure 3. Note the horizontally aligned data and how well it corresponds to the model trace that is inserted in the middle of the section. *Obviously* the assumption of surface statics is correct (but only in the mind of the data manager) and that the trim statics have produced a very good section, even in areas where the original section is poor. It appears that we have been able to reach into the prestack data and draw out the true reflection energy. The only problem is that there is no structure in the data for prospective drilling location.

The processor however, then chose data from an Alberta section to form a new model trace. Using the same parameters as above, another stacked section was created and is displayed in Figure 4. The resulting trimmed and stacked section has an equally good appearance as that in Figure 3. At this point, one may suspect that the continental drift theory is correct and that Alberta was once connected to the middle east. Another possibility is the high fold allowed the trimming process to align the noise to the model trace, creating a section that will always math the model trace.

Use of the trim static, when applied directly to this data only aligns the noise to produce a section that matches the model trace. Additional examples are included that illustrate that the stacked data will match the model trace within the time window that corresponds to the correlation window. The input data in each of these stacked section was limited to 1300 meters, with a corresponding fold close to 100. Figure 5 shows the same correlation parameters used in the creation of the data in Figure 3, i.e. the correlation window ranges from 0.3 to 2.3 seconds and the maximum correlation time shift was ± 250 ms. Figure 6 uses a correlation window from 0.3 to 1.3 seconds, Figure 7 a correlation window from 0.8 to 1.6 seconds, and Figure 8, a correlation window from 1.3 to 2.34 seconds. Note that only the data within these correlation windows will match the data in the model trace.

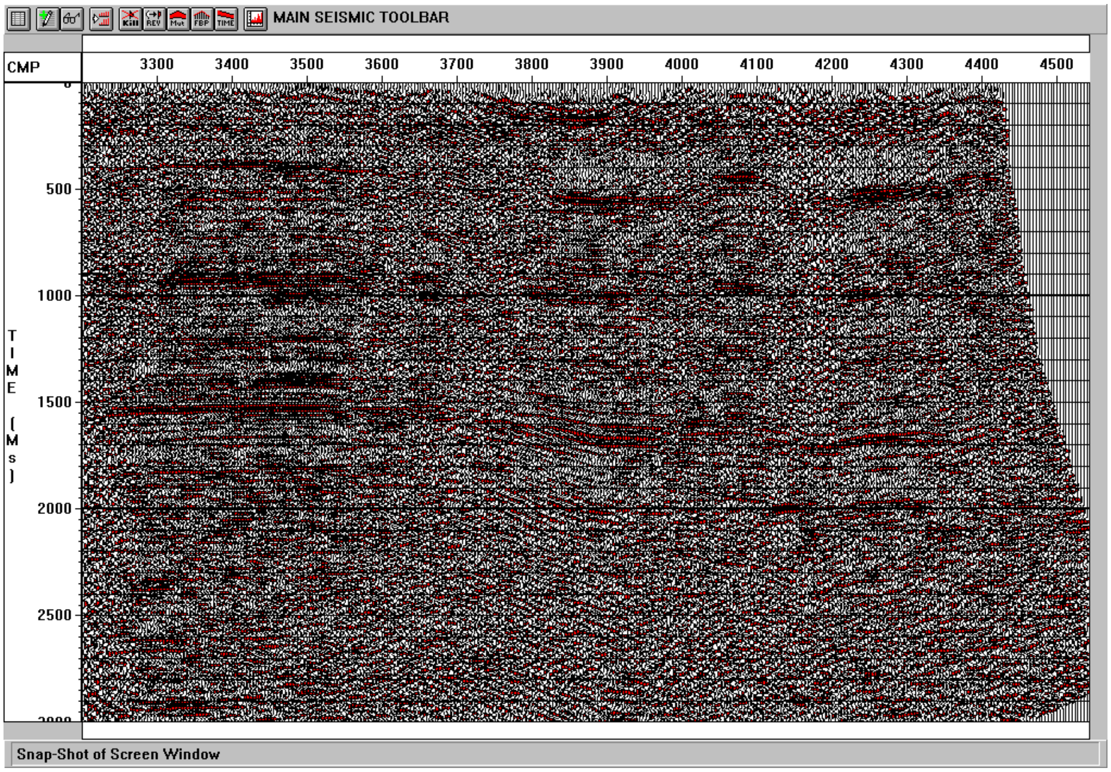

Figure 1. Best stack

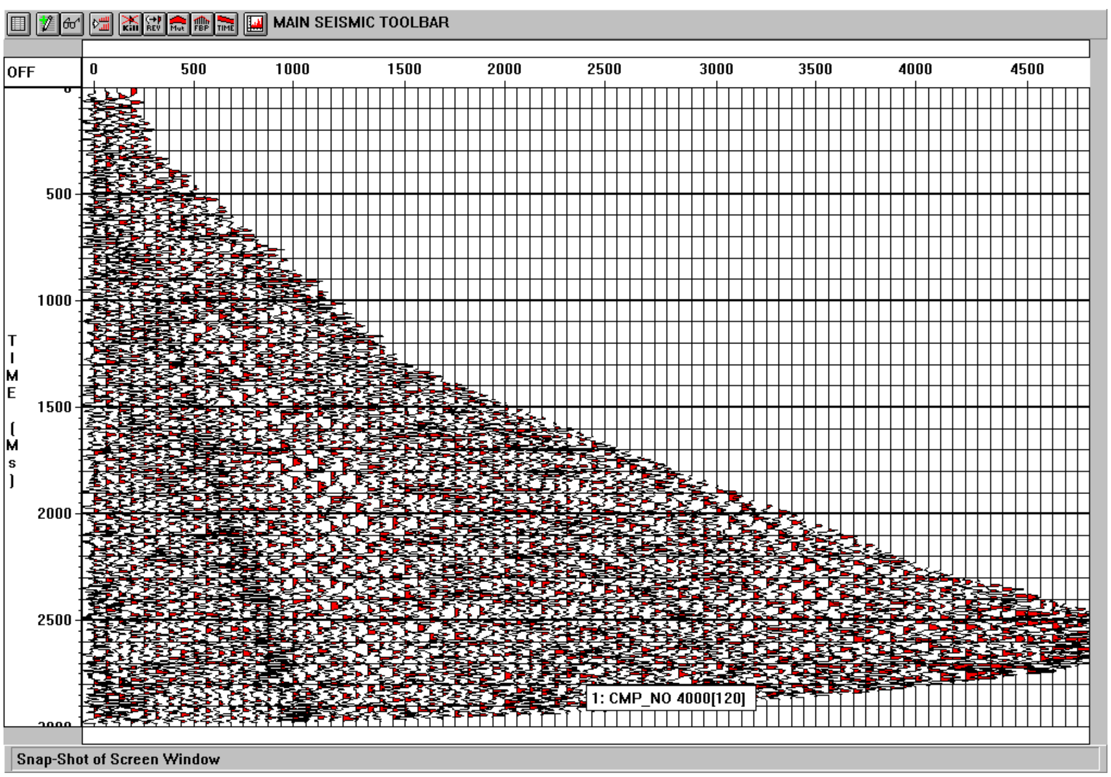

Figure 2. CMP gather (4000) before trim statics.

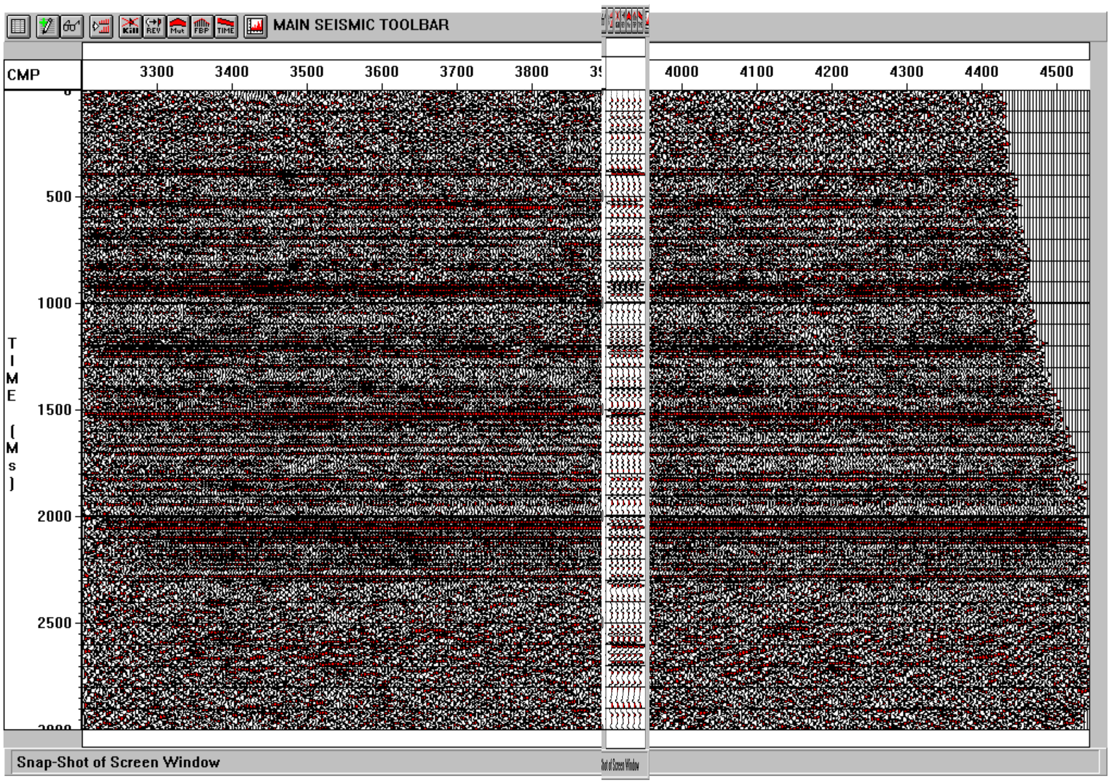

Figure 3. Trim static using pilot trace from data. Window 0.3 to 2.3 sec, correlation time shift ±250ms.

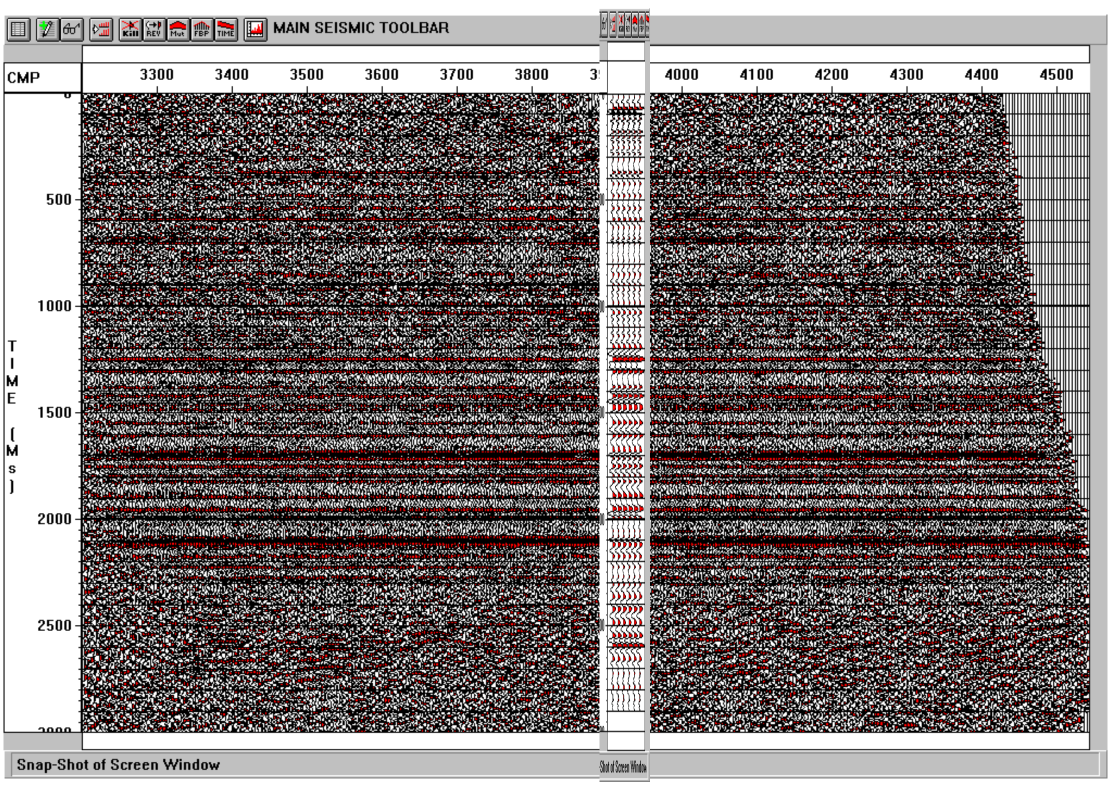

Figure 4. Trim static using pilot trace from Alberta, Canada. Window 0.3 to 2.3 sec, correlation time shift ±250ms.

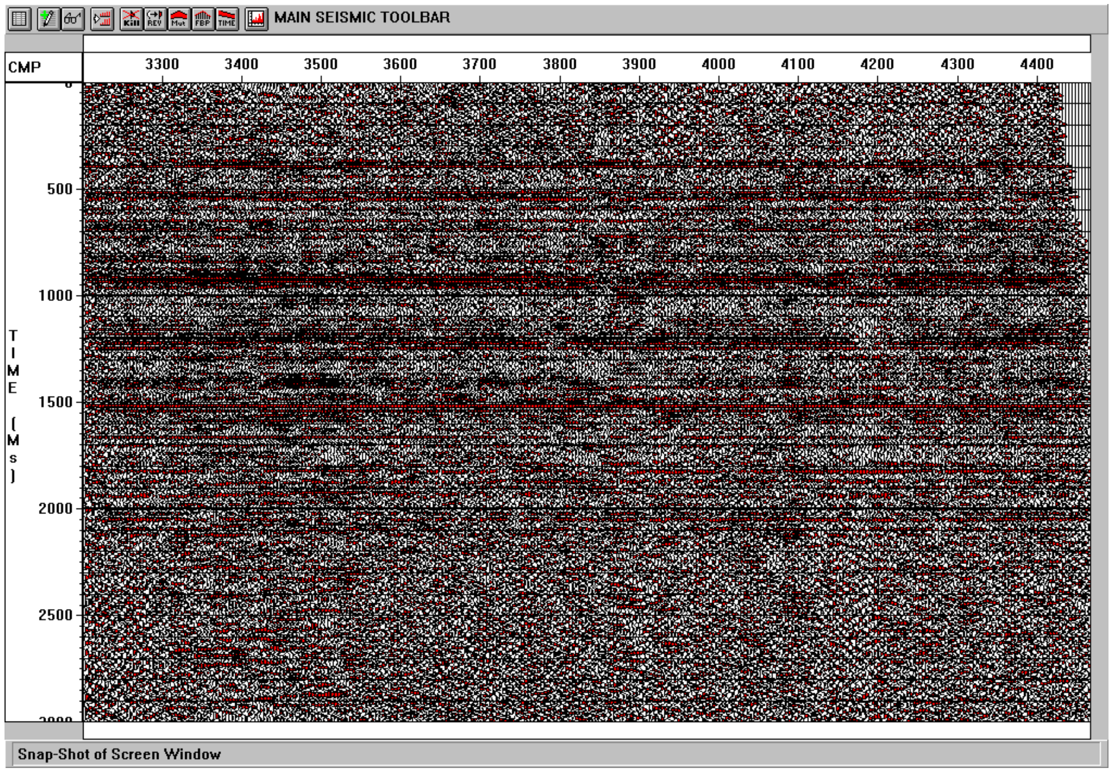

Figure 5. Trim static using pilot trace from data. Window 0.3 to 2.3 sec, correlation time shift ±250ms, offset limited to 1300m..

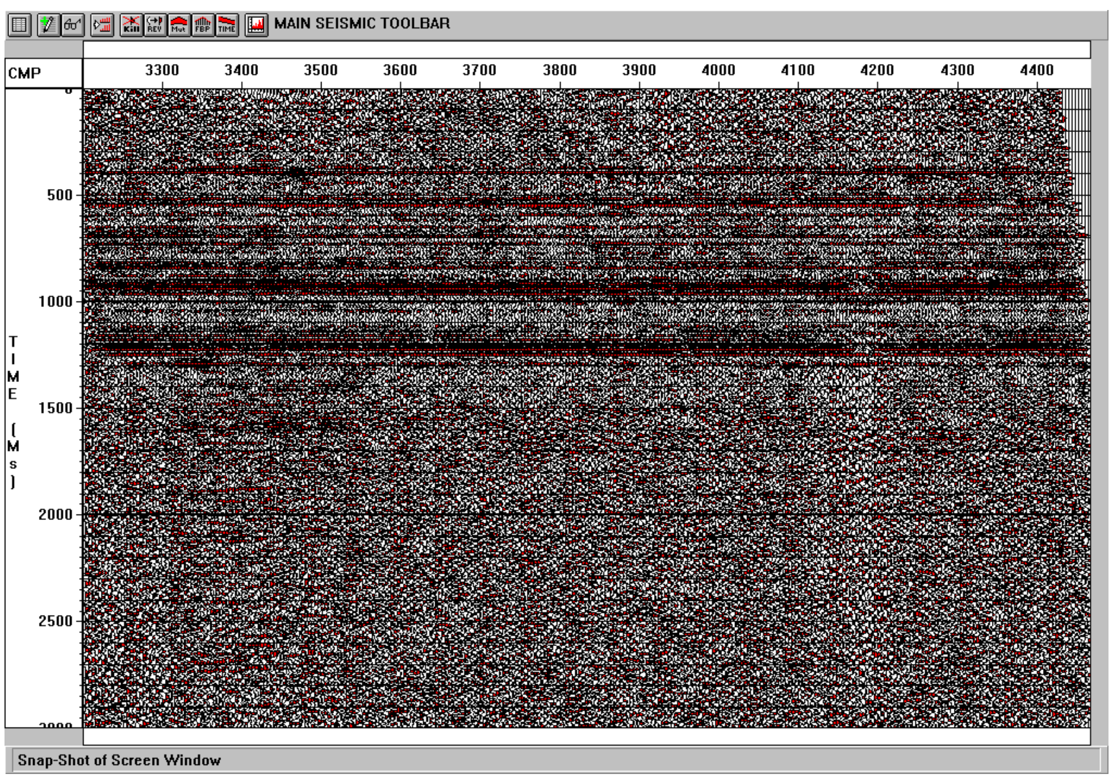

Figure 6. Trim static using pilot trace from data. Window 0.3 to 1.3 sec, correlation time shift ±250ms, offset limited to 1300m..

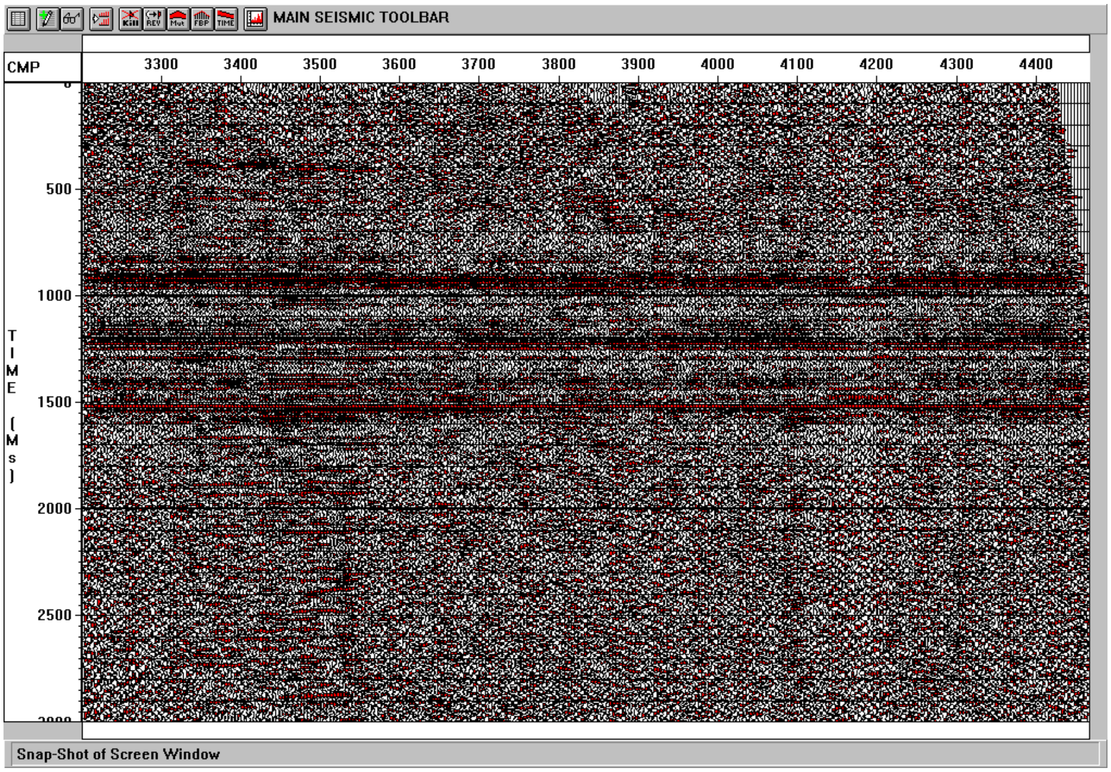

Figure 7. Trim static using pilot trace from data. Window <u>0.8 to 1.6 sec</u>, correlation time shift ±250ms, offset limited to 1300m..

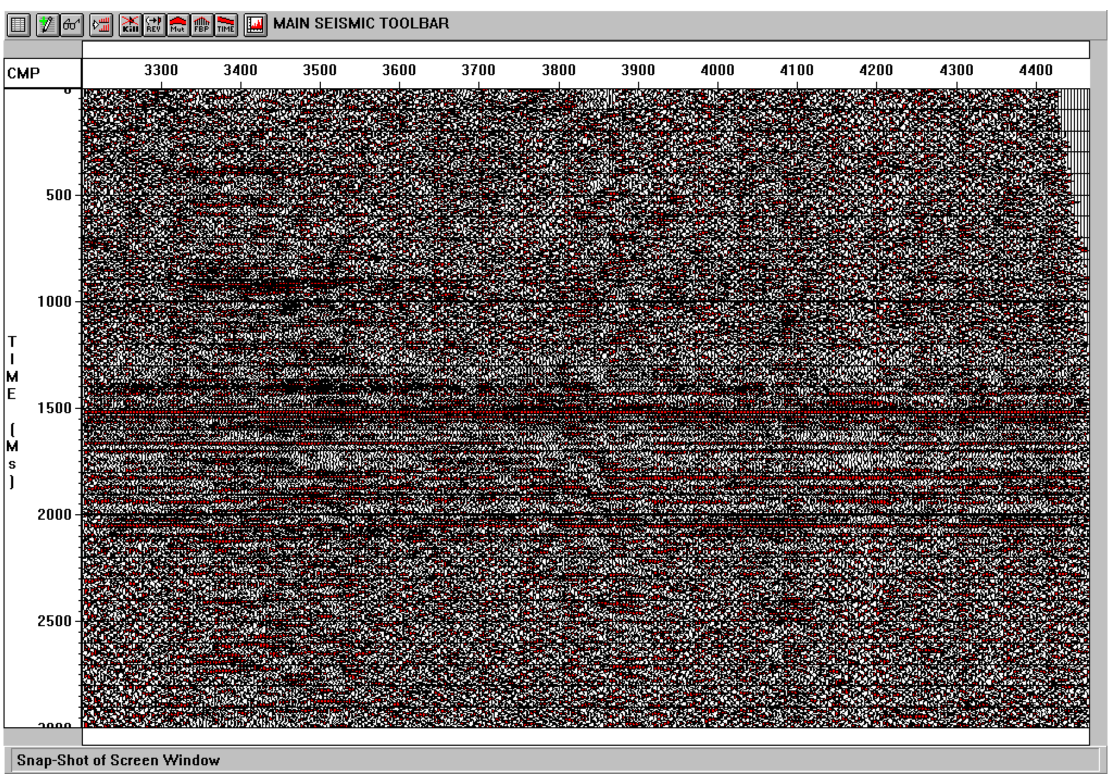

Figure 8. Trim static using pilot trace from data. Window <u>1.3 to 2.3 sec</u>, correlation time shift ±250ms, offset limited to 1300m..

COMMENTS

The companion paper (Ursenbach and Bancroft 2000) uses random noise to derive an equation to estimate or predict the cross-correlation coefficient between the trimmed data and the model trace. Thus, one may estimate a SNR that would result from the alignment of noise in real data. Using Equations (1) and (4) in the companion paper, and the trim parameters for Figure 2, along with an estimated wavelet length of .030s (based on frequency content), an expected SNR of 4.0 is estimated for the final stack within the correlation window. This is consistent with the appearance of Figure 2.

CONCLUSIONS

Careless application of trim statics can allow high fold input data to match any model trace.

ACKNOWLEDGEMENTS

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REFERENCES

Ursenbach, Charles P. and Bancroft, John C., Noise alignment in trim statics: CREWES Research Report, Volume 12, 2000