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PROCESSING EFFECTS ON REFLECTION AMPLITUDES

Outline

- Physical modeling and ***AVO***
- Event ***amplitude*** attributes
- ***"Cosmetic"*** processing
- Effects of three ***"cosmetic"*** processes on amplitude measurement
- A ***'pathological'*** example
- Conclusions

Physical modeling: *AVO*

- ***Theory*** tested using ***real materials***
- ***Acquisition*** parameters readily ***controlled***
- ***Surveys*** reliably ***repeated***
- Data affected by the ***same measurement issues*** as field data

- ***AVO*** studied by measuring ***amplitudes*** along ***single events*** on single-fold trace ensembles

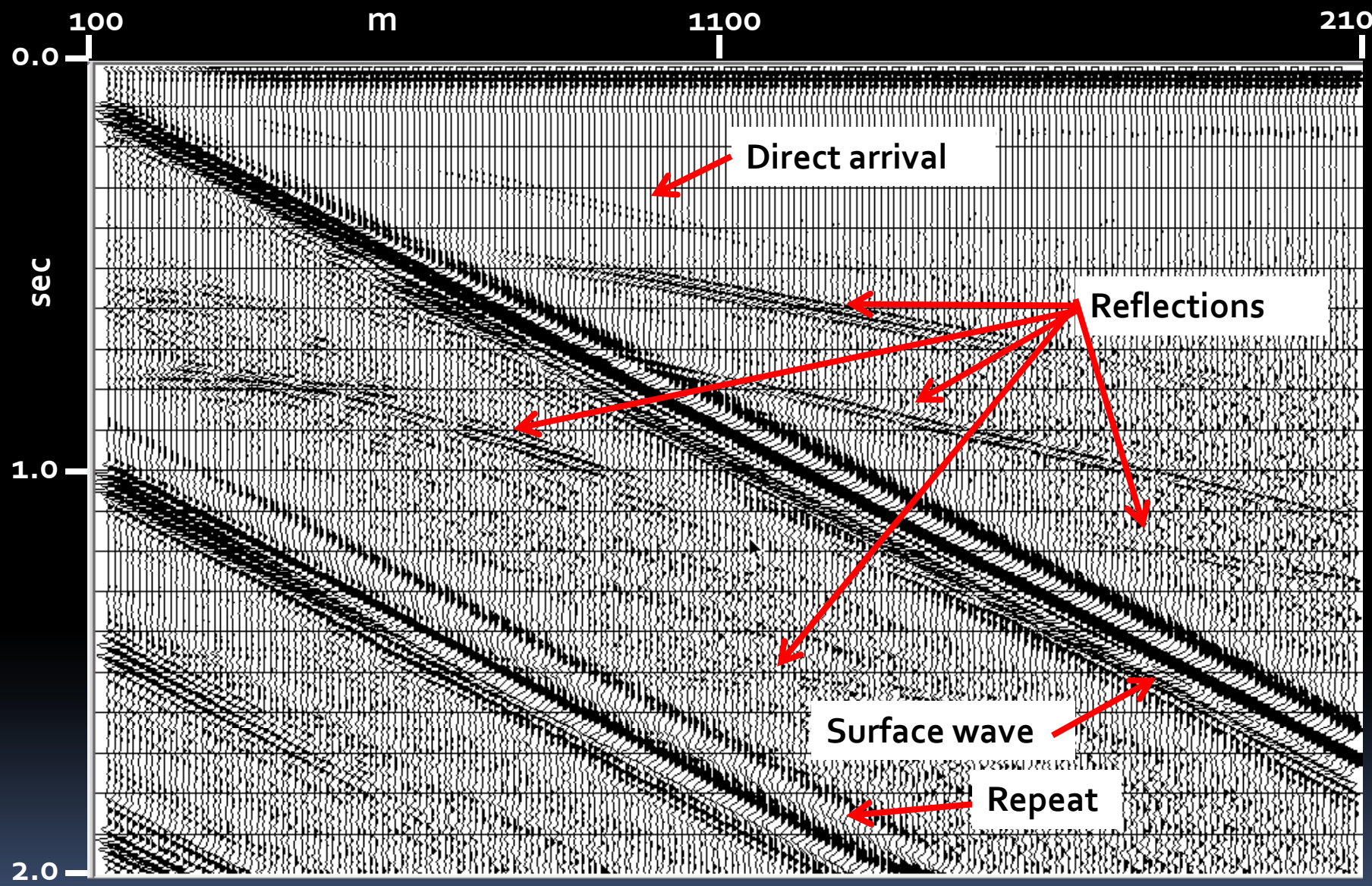
Possible *amplitude attributes*

- ***Maximum*** value of waveform in a window
- ***Minimum*** value of waveform in a window
- ***Maximum*** minus ***minimum*** in a window ←
- ***Sum of samples*** between two points
- ***Other—many attributes possible***

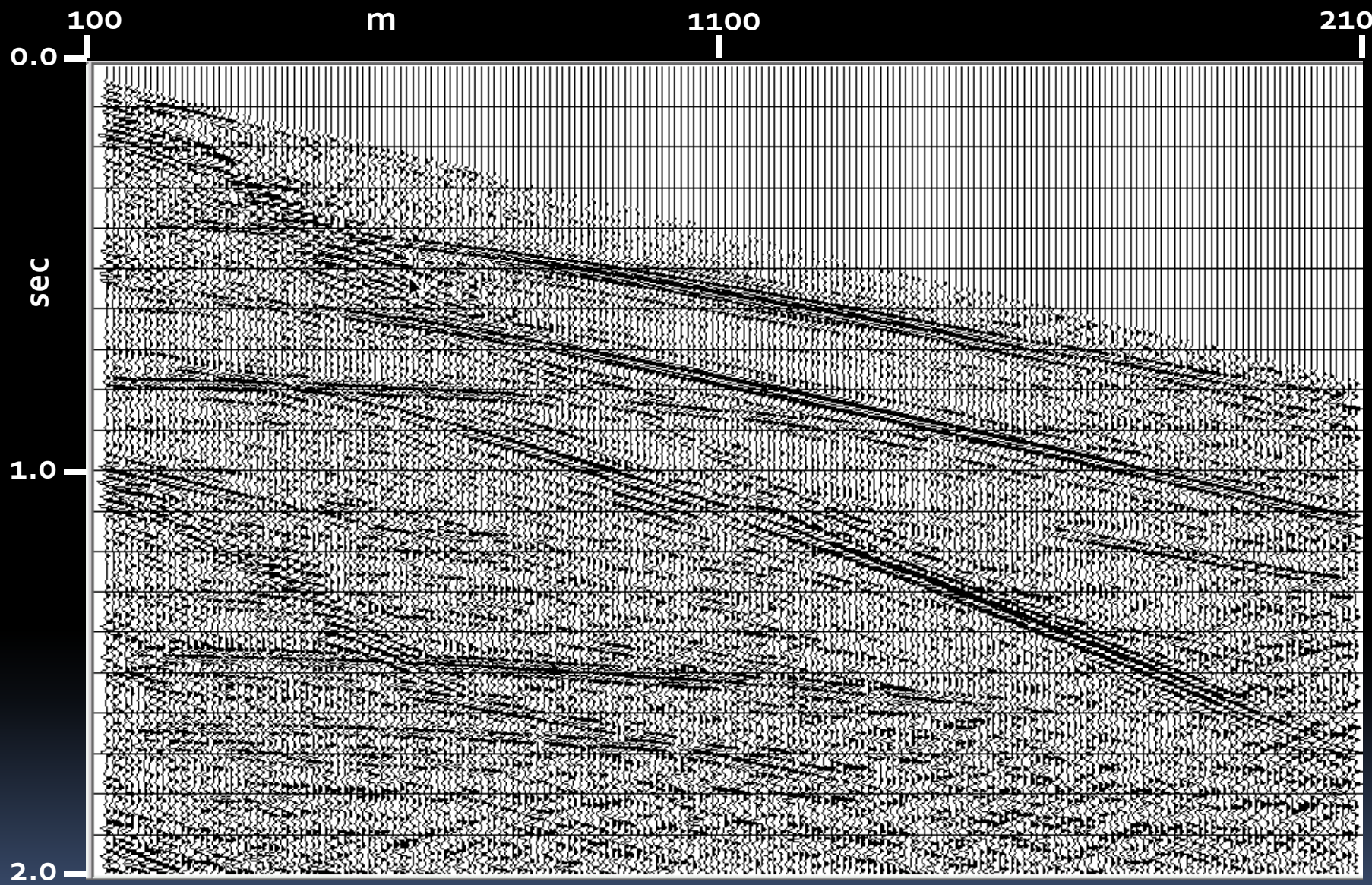
"Cosmetic" processing

- ***Often necessary*** to improve event amplitude measurement—includes:

- Coherent noise attenuation—
  R-T filtering
- Random noise attenuation—
  F-X deconvolution
- Event wavelet shortening—
  Gabor deconvolution



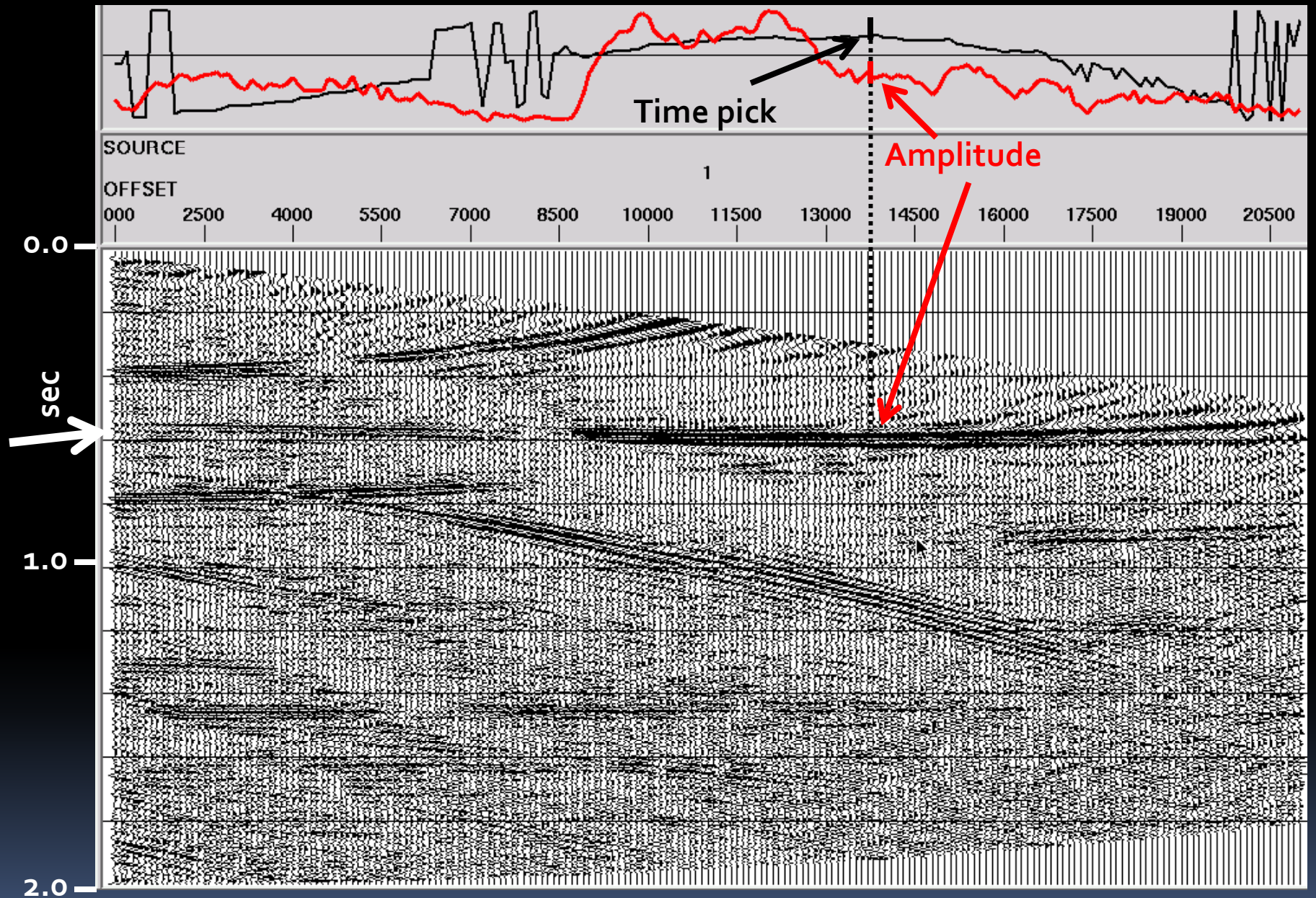
Source gather from physical model: reflection amplitudes obscured by *coherent* and *random* noise.



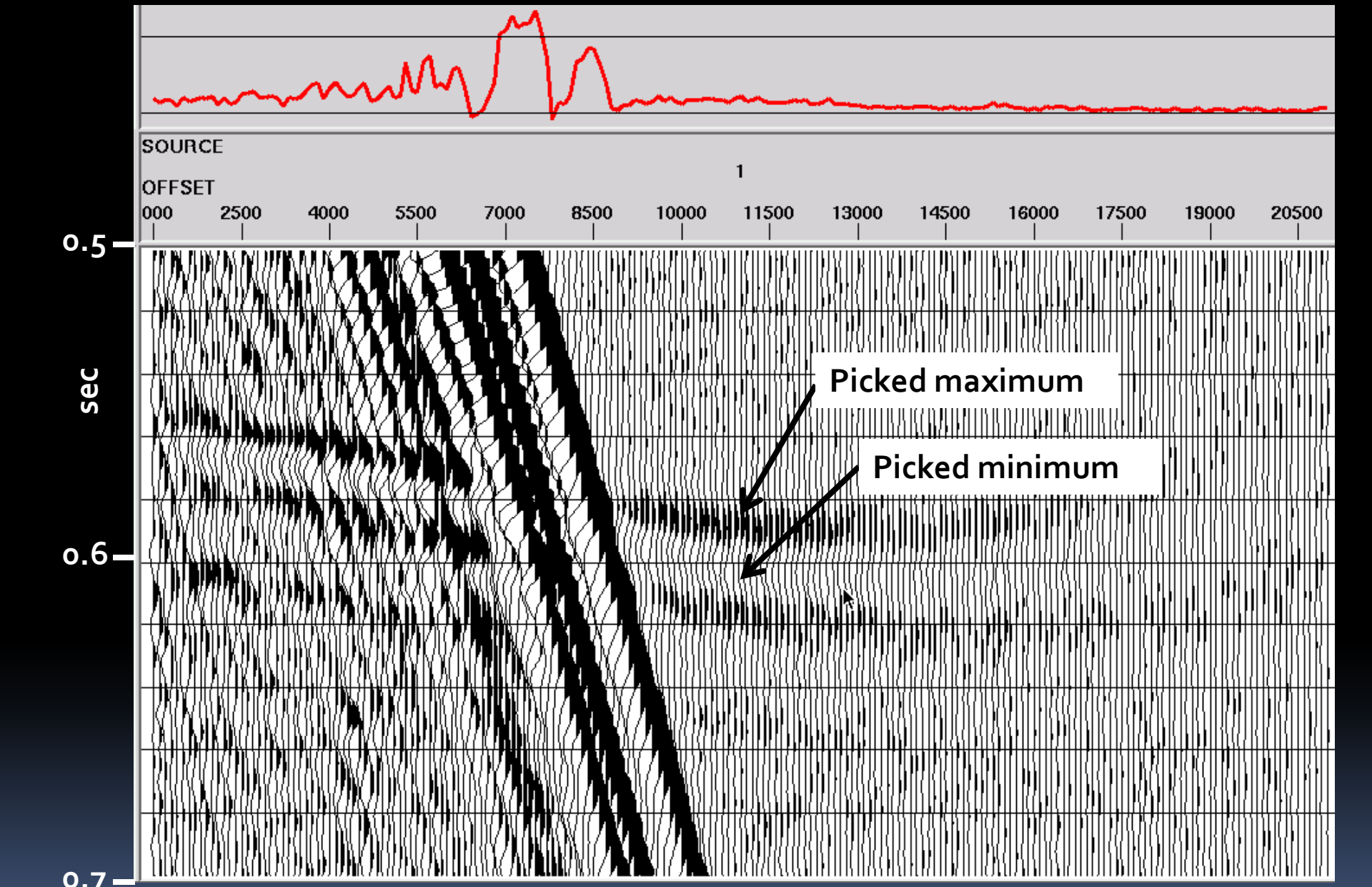
Source gather from physical model after extensive *cosmetic* processing. *Are original AVO relationships intact?*

Procedure:

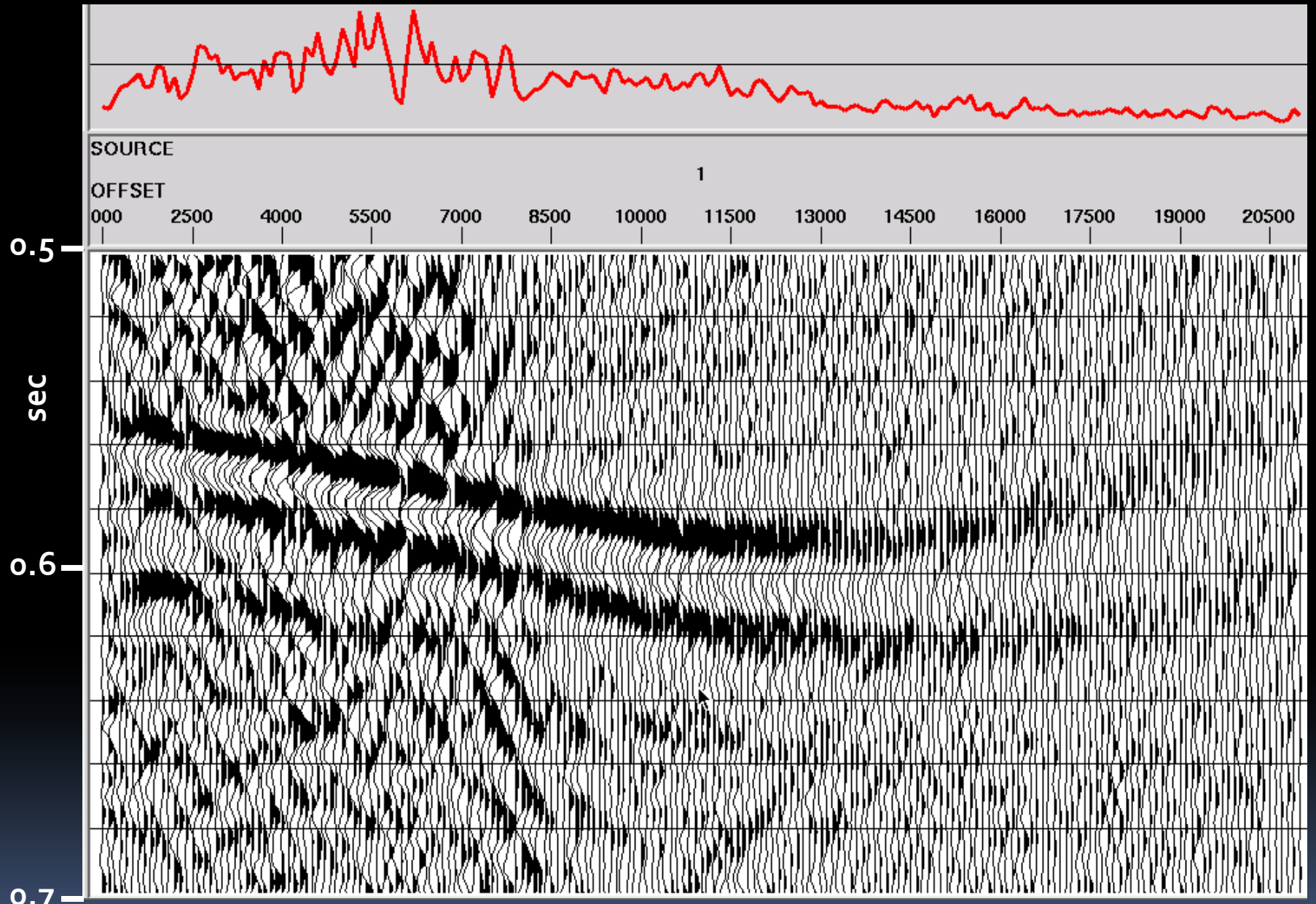
- Apply ***cosmetic*** procedures
- Flatten target event by ***NMO*** correction
- Pick ***maximum*** and ***minimum*** trace amplitudes in a window on each trace
- Create new ***AVO*** trace header containing ***Max minus min*** value for each trace
- Plot ***AVO*** trace headers



Amplitude analysis of reflection event at 550 ms

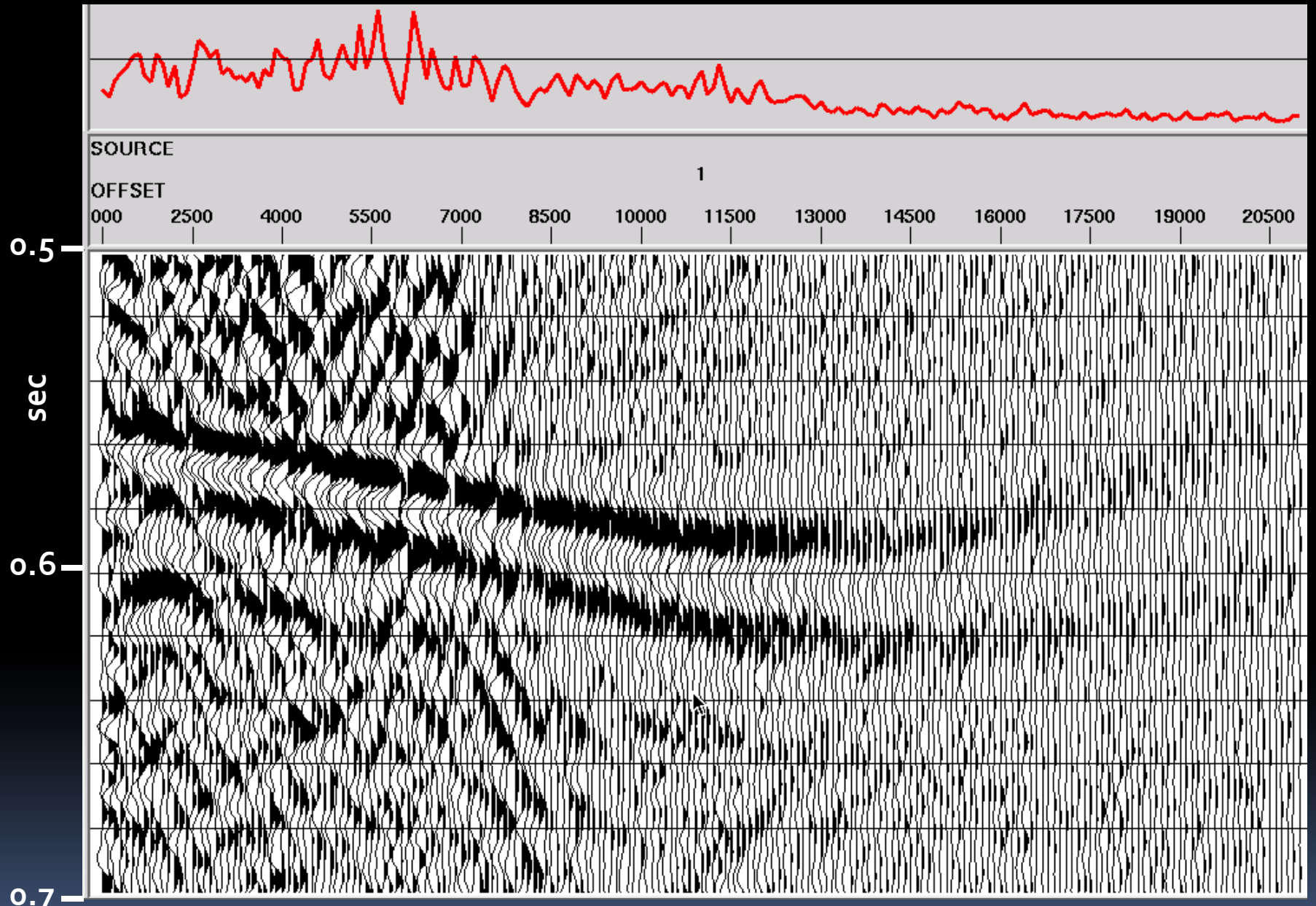


Reflection amplitudes measured along 550 ms event



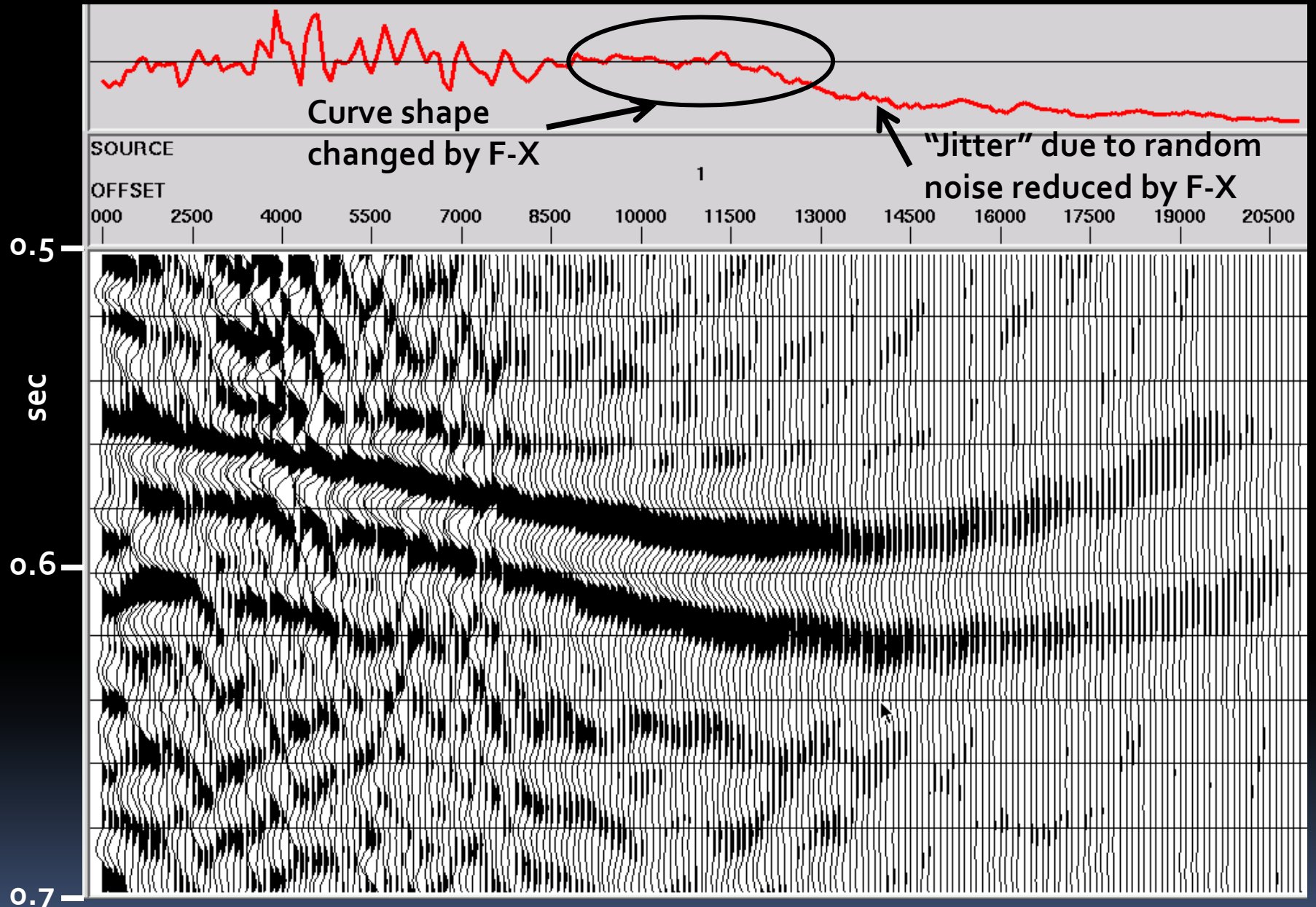
Reflection amplitudes measured along 550 ms event—

R-T filter sequence applied

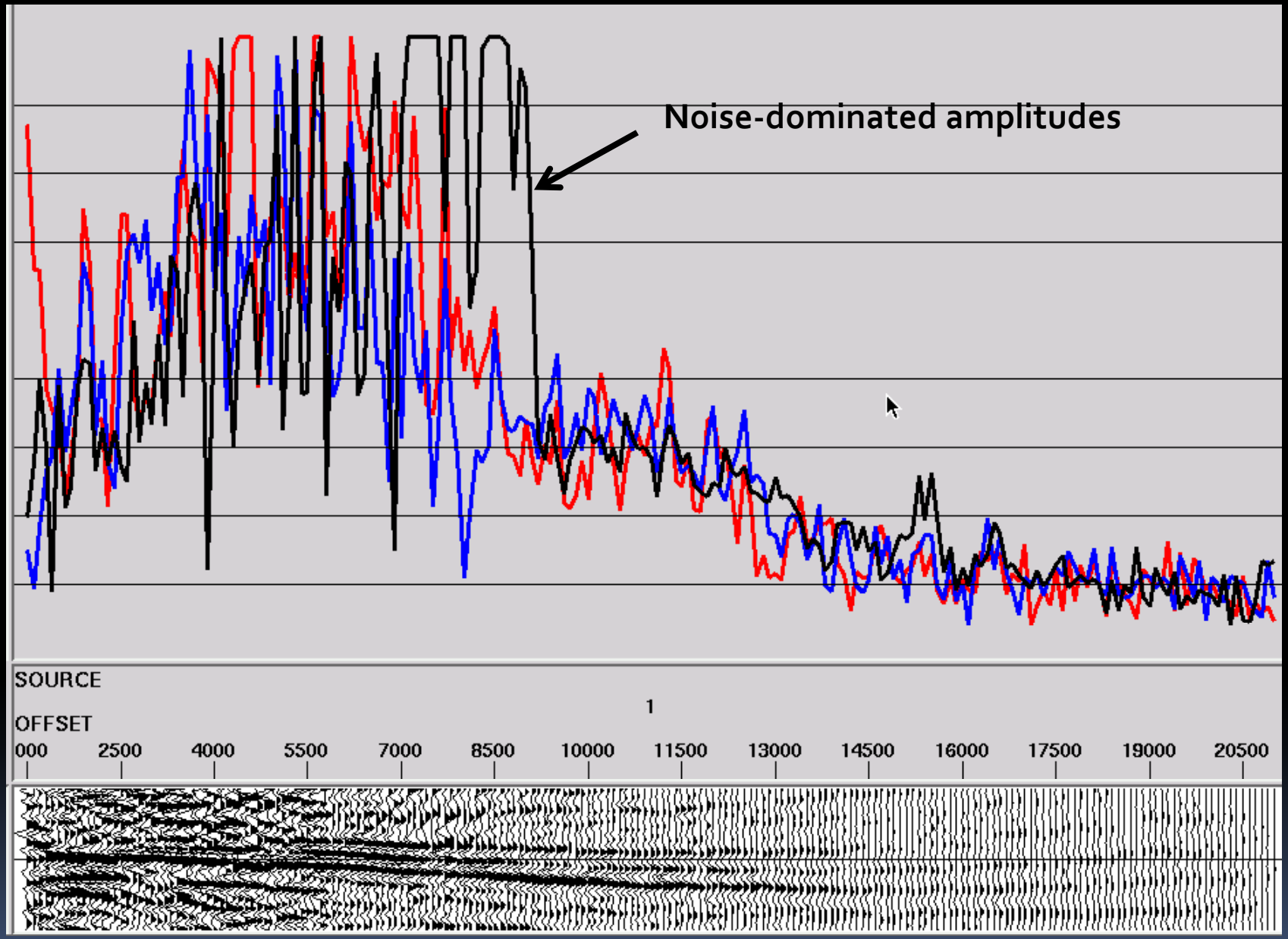


Reflection amplitudes measured along 550 ms event—

R-T filters and Gabor deconvolution applied



Reflection amplitudes measured along 550 ms *event*—*R-T filters, Gabor deconvolution, and F-X deconvolution applied*



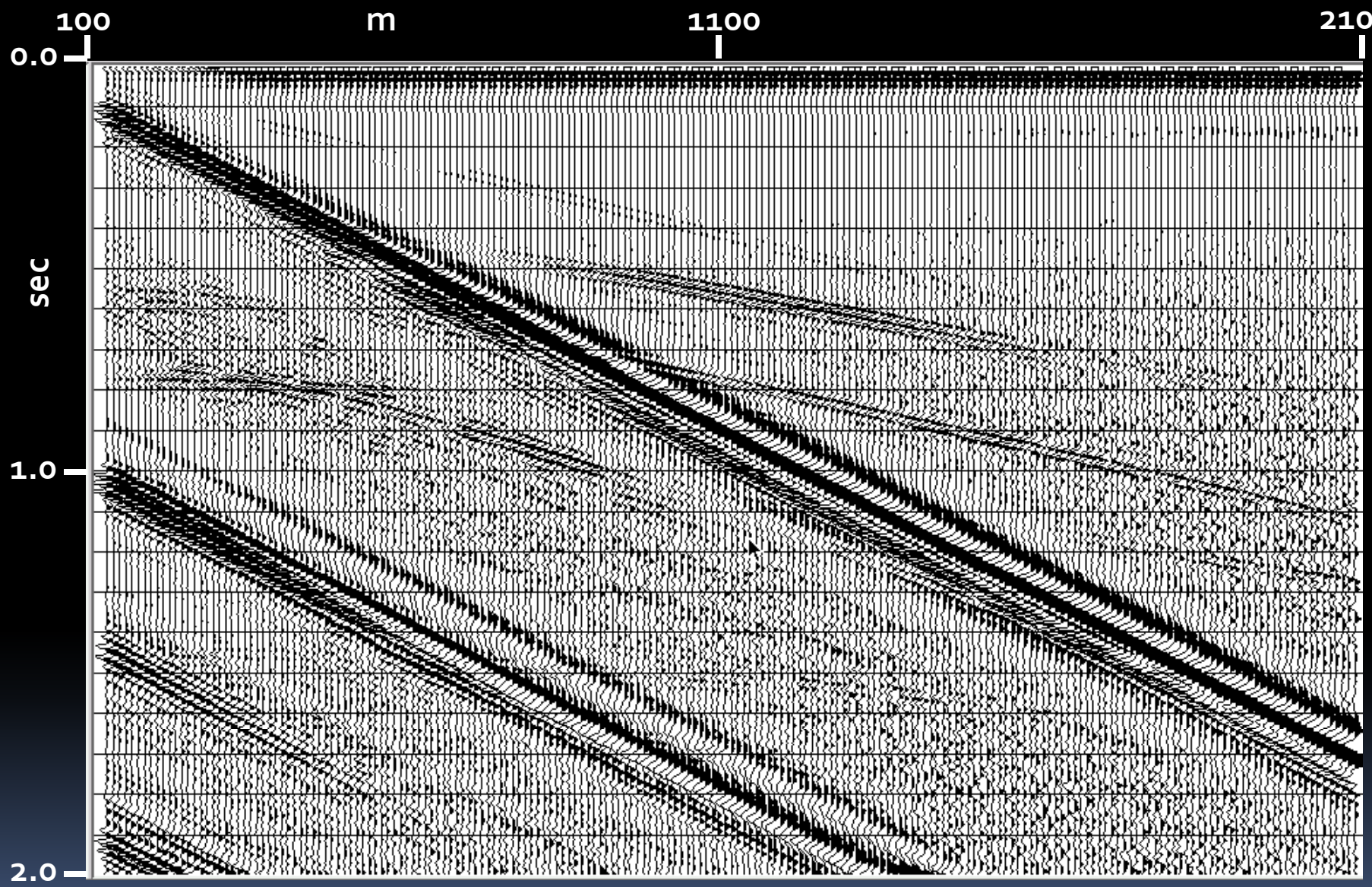
AVO comparison for 550 ms reflection. Black=raw; red=R-T filters; blue=R-T filters + Gabor deconvolution

Cosmetic processing effects

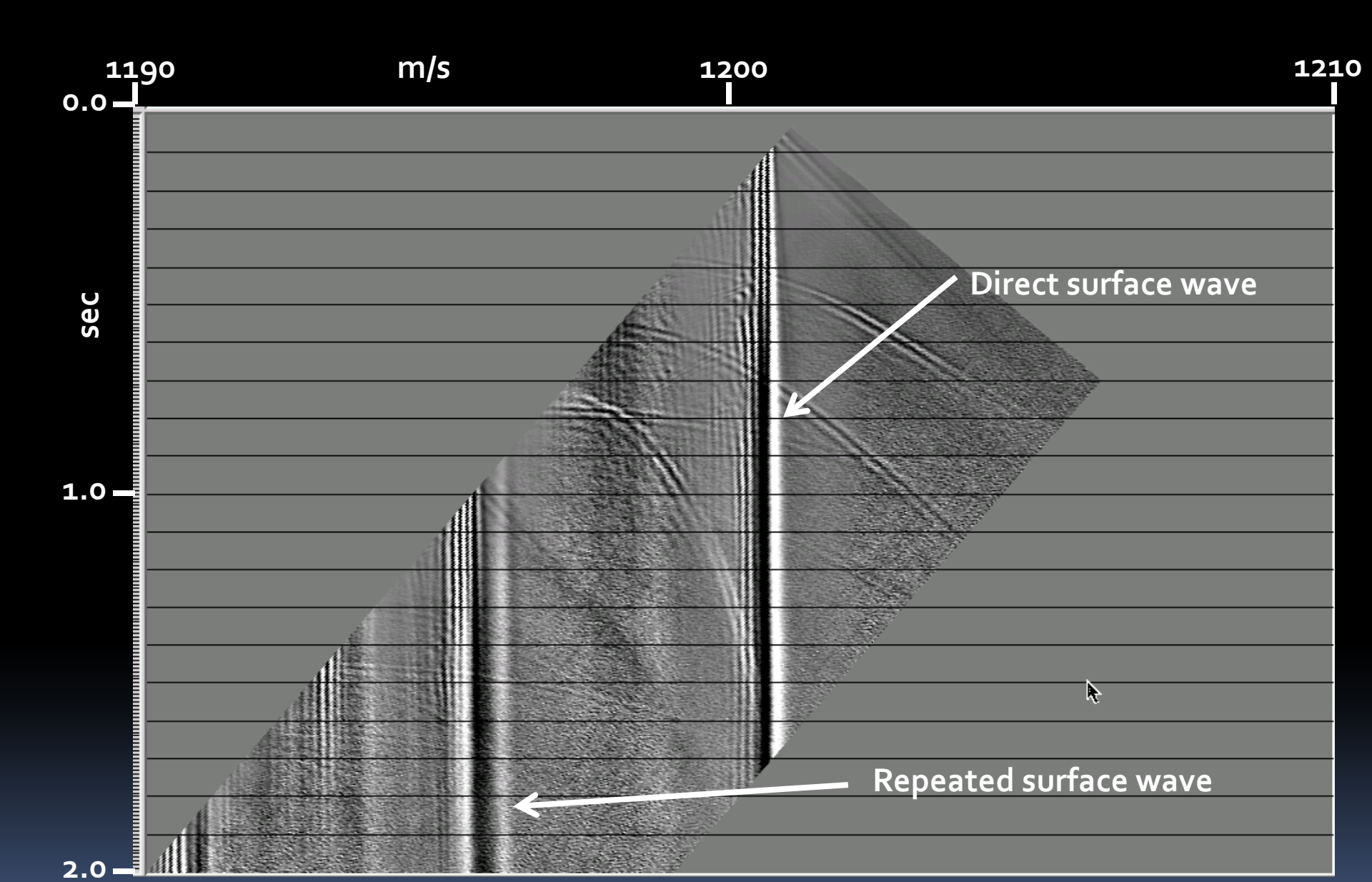
- ***R-T filtering***—multiple passes ***do not*** significantly affect ***AVO***
- ***Gabor deconvolution—does not*** significantly affect ***AVO***
- ***F-X deconvolution—affects AVO***, but also reduces amplitude jitter.

A pathological example

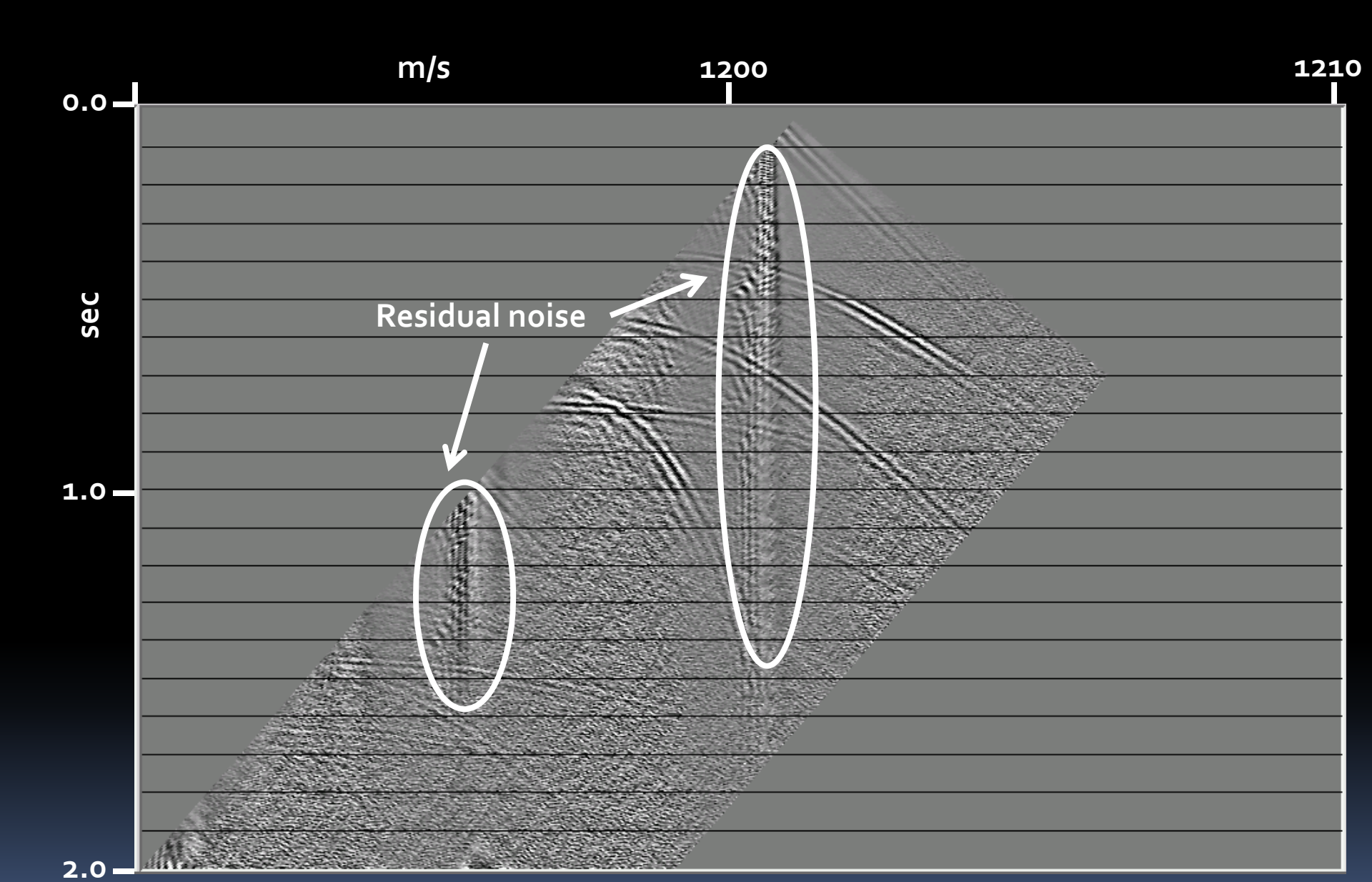
- Not all ***R-T domain*** operations are ***benign***
- For very strong coherent noises, ***AGC in the R-T domain*** can be very effective
- ***However***…trace-to-trace amplitude information is ***damaged***
- ***R-T domain AGC*** suitable for ***imaging***, ***not amplitude analysis***



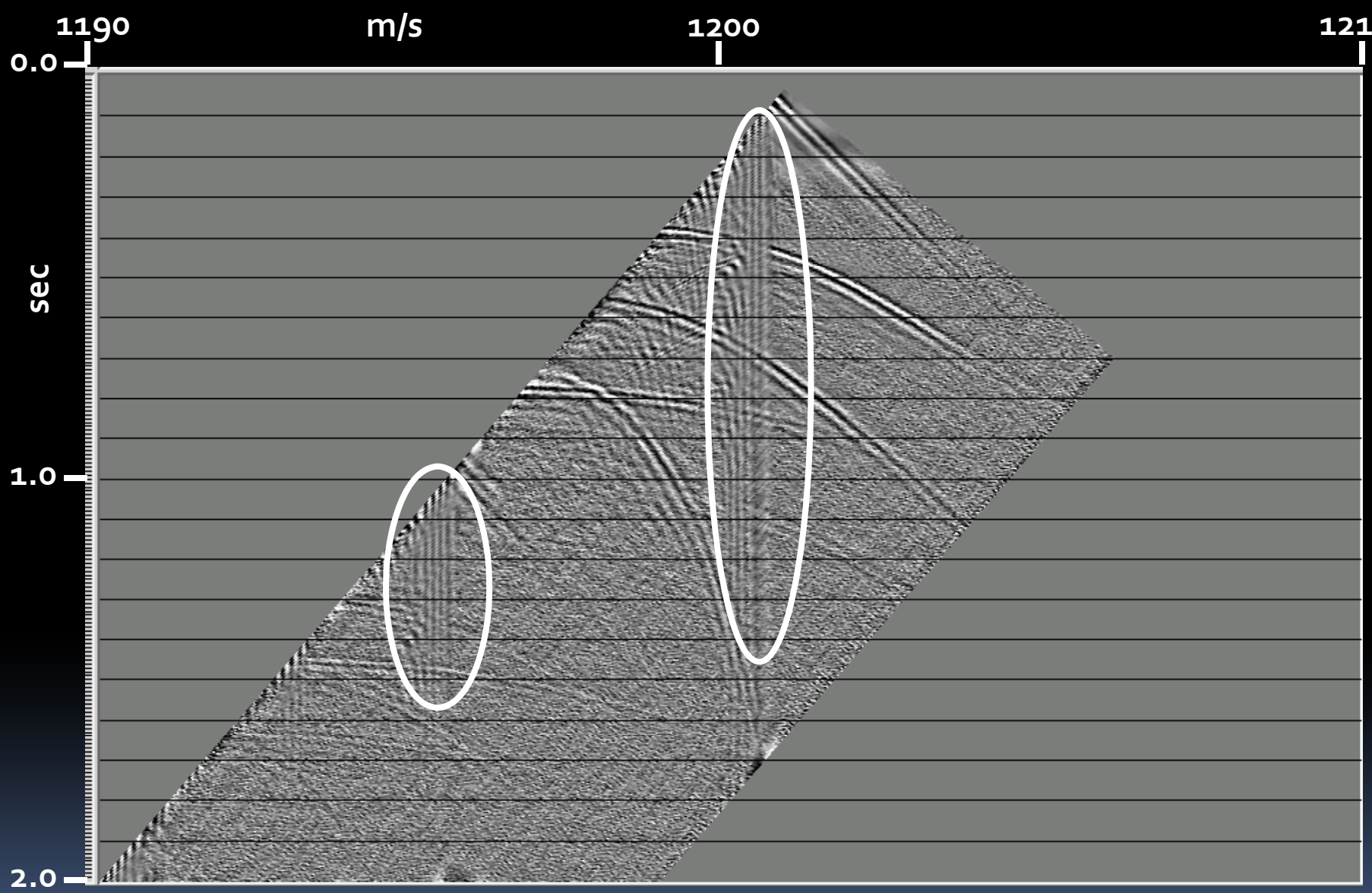
Original shot gather



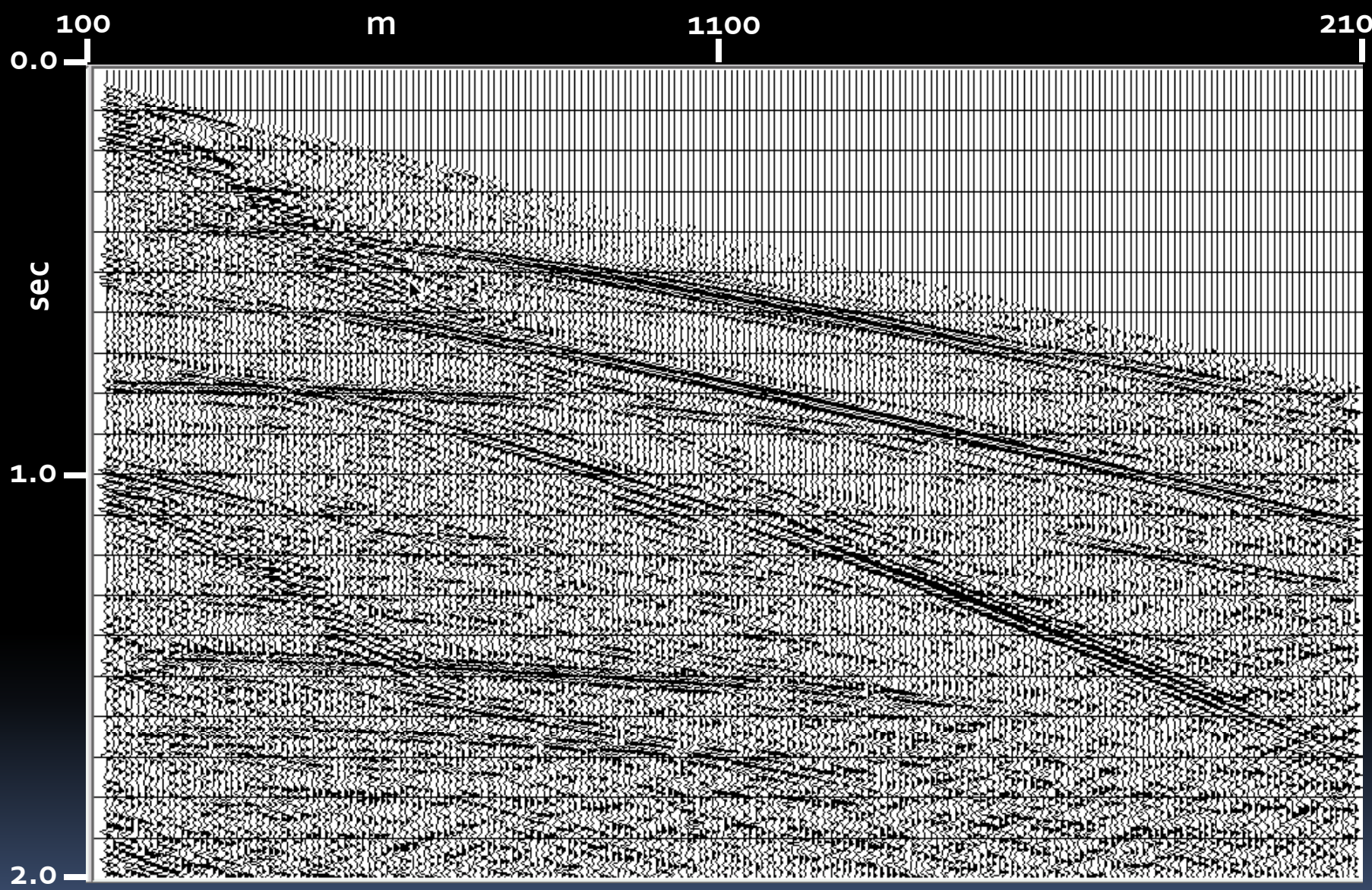
R-T *dip* transform of raw shot record—dip velocity=1200m/s



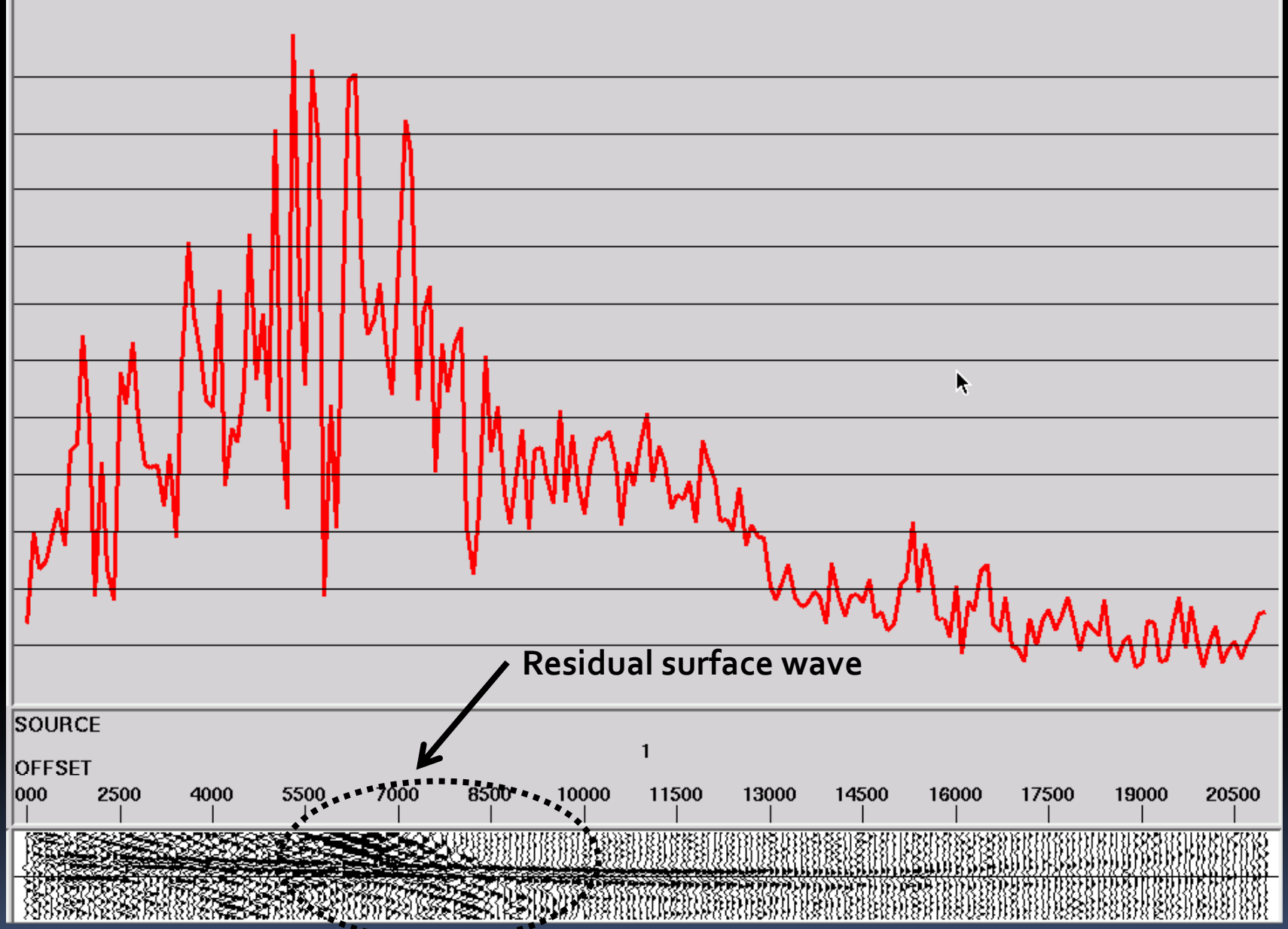
R-T *dip* transform of shot record—*R-T subtraction applied*



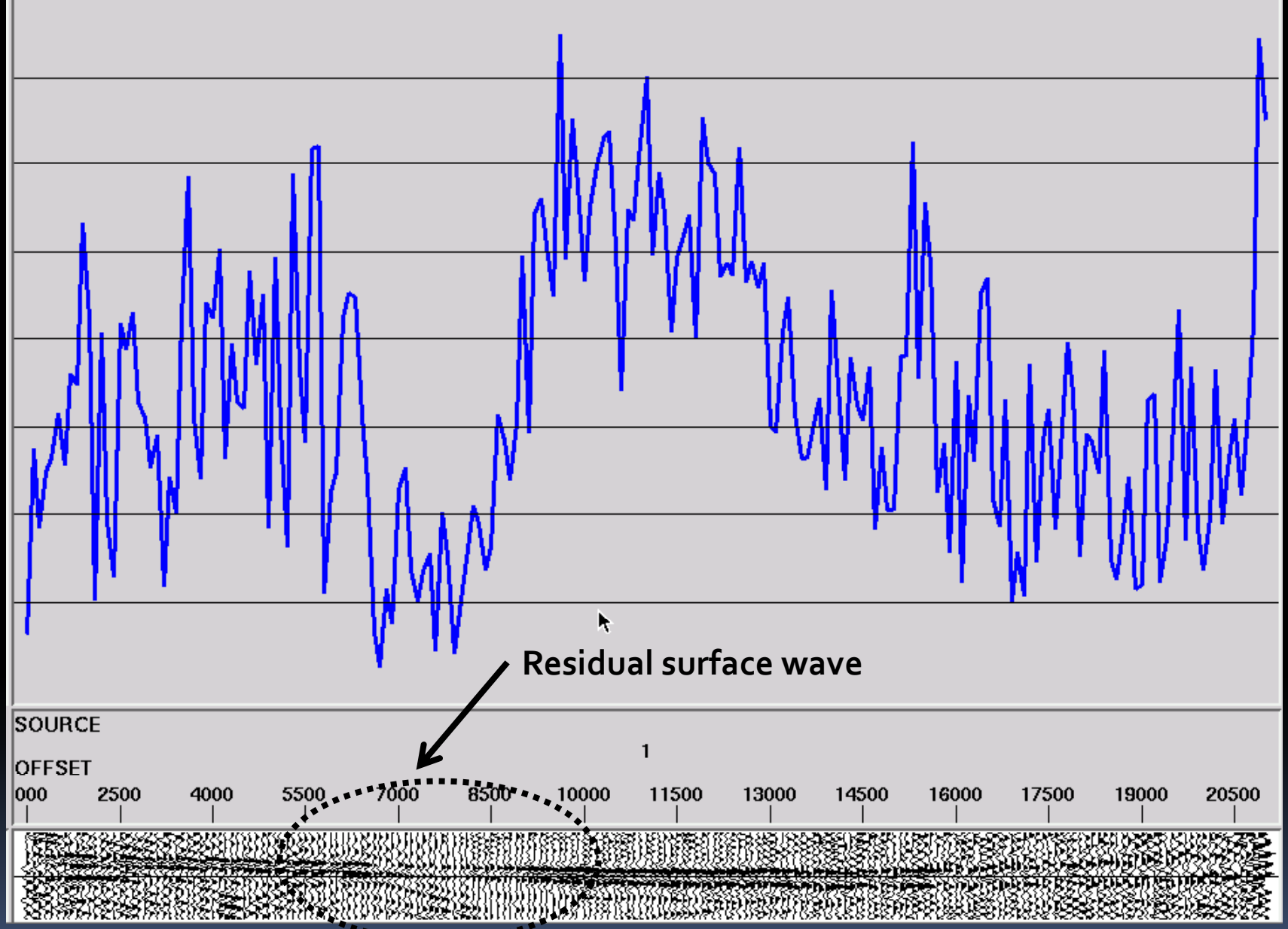
R-T *dip* transform of shot record—*R-T AGC applied*.



Physical model shot gather after cosmetic processing, including *R-T domain AGC*



Amplitudes along 550ms reflection after *R-T subtraction filter*



Amplitudes along 550ms reflection after *R-T domain AGC*

Conclusions

1. Physical model data may need ***"cosmetic"*** processing before ***amplitude measurement***
2. ***R-T filtering, Gabor deconvolution*** are ***"safe"***
3. ***F-X deconvolution*** affects amplitudes, should be used ***cautiously***
4. ***R-T domain AGC*** can dramatically reduce coherent noise, but also ***destroys AVO***
5. ***Points 1-4 directly applicable to field data***

Acknowledgements

- CREWES sponsors and staff