David C. Henley

INTERFERENCE AND THE ART OF STATIC CORRECTION

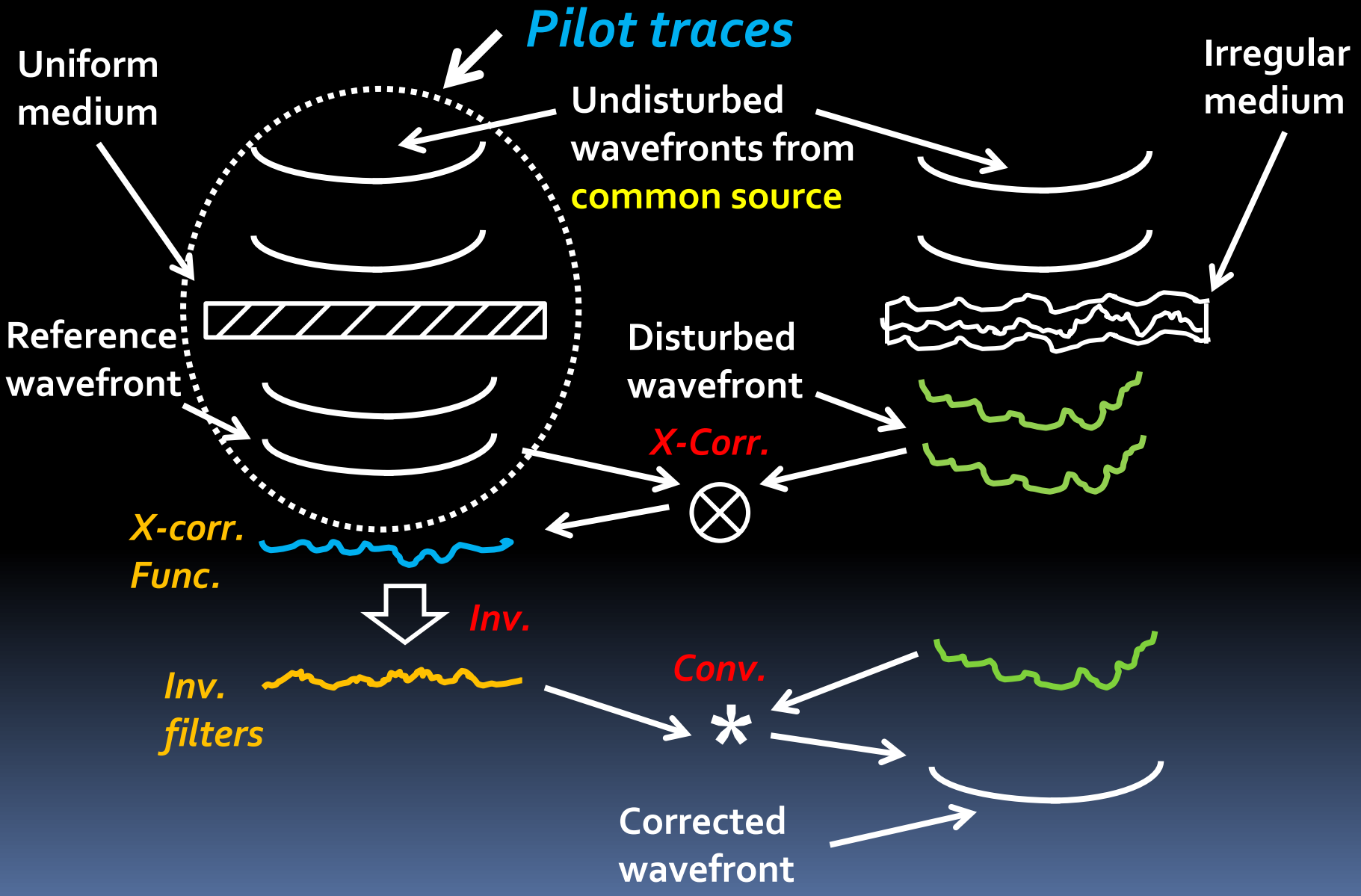
Outline

- Interferometry concept
- Raypath-consistency concept
- ***Raypath interferometry***
- Example—MacKenzie Delta
- Example—Hussar
  - PP dynamite Vectorseis data
  - PS dynamite Vectorseis data
- Observations

Interferometry

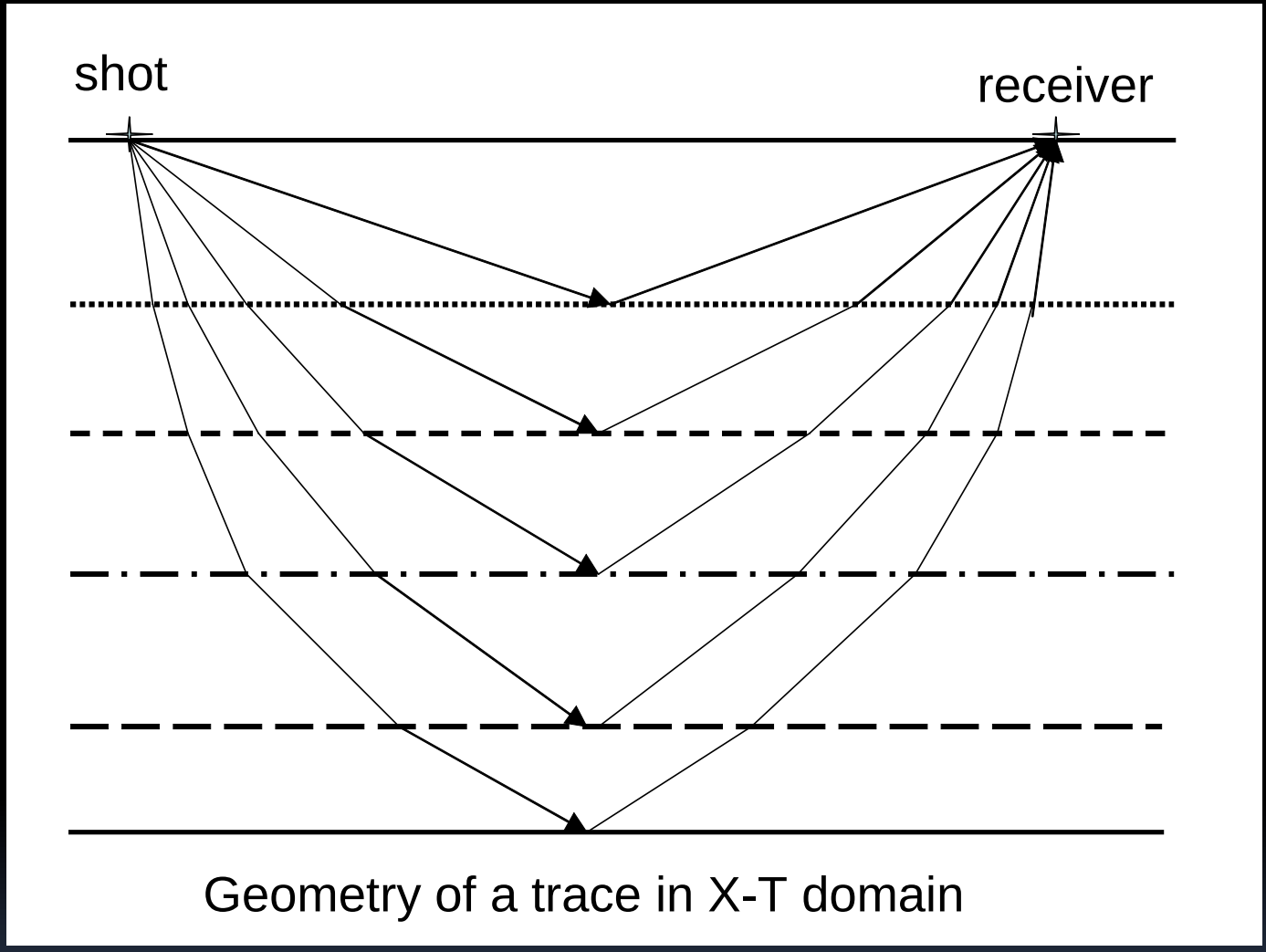
- ***Recorded*** wavefield compared with ***'reference'*** wavefield by ***cross-correlation***
- ***Inverse filters*** generated from ***cross-correlation*** functions
- ***Inverse filters*** applied to ***recorded*** wavefield to correct wavefront disturbances

Interferometry concept



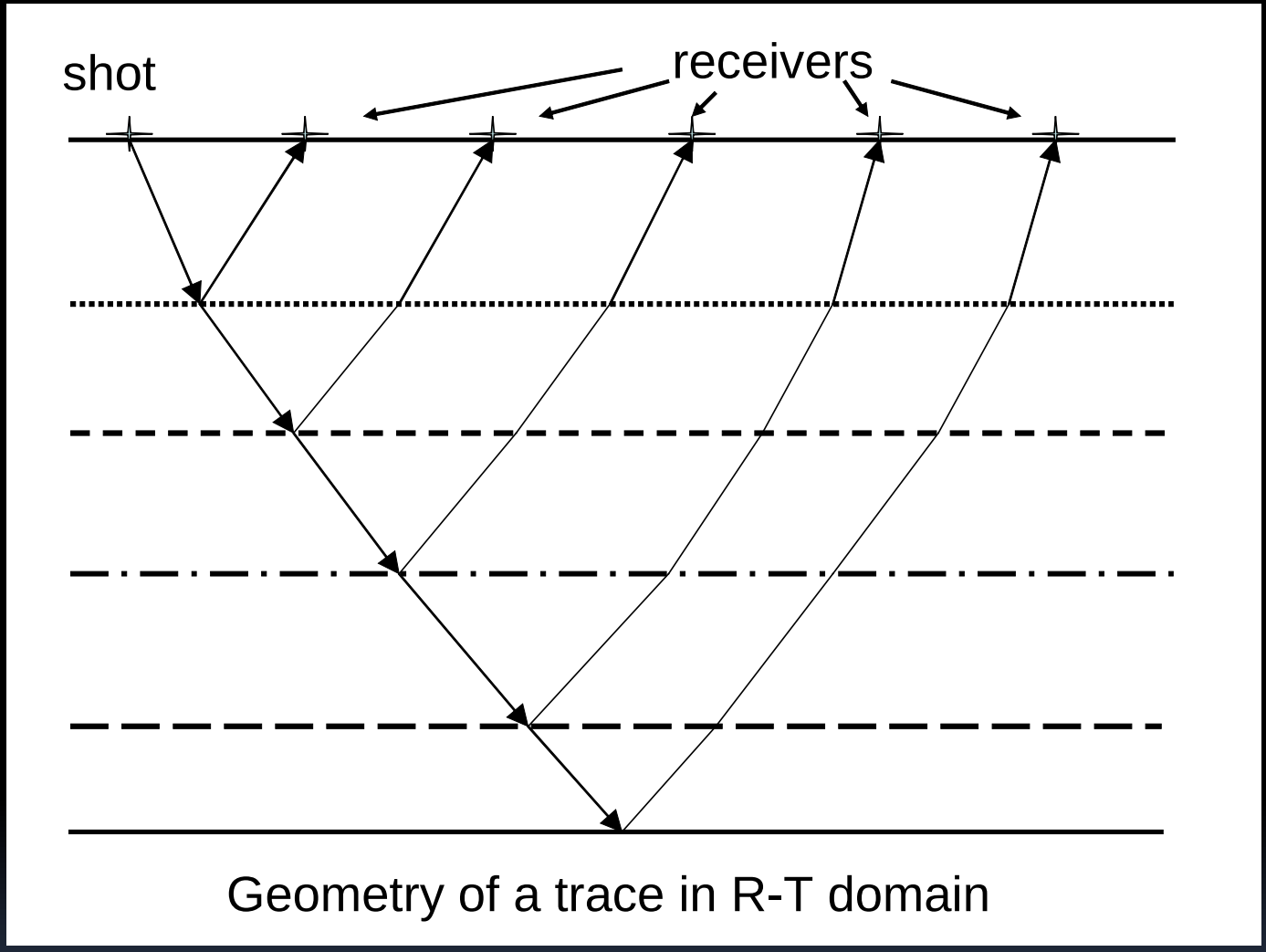
Raypath consistency concept

- One ***Surface function***, or ***'static'*** for all energy entering or emerging at a surface point at a ***specific raypath angle***
- ***Surface function*** at a surface location ***varies*** with surface ***raypath angle***
- ***XT data must be mapped to a domain with raypath angle as a coordinate (RT domain)***
- ***Surface consistency*** ***is a special case of raypath consistency (vertical-raypath assumption)***



Geometry of a trace in X-T domain

Near-surface raypath angle *increases* with *reflection time* for a trace in the X-T domain

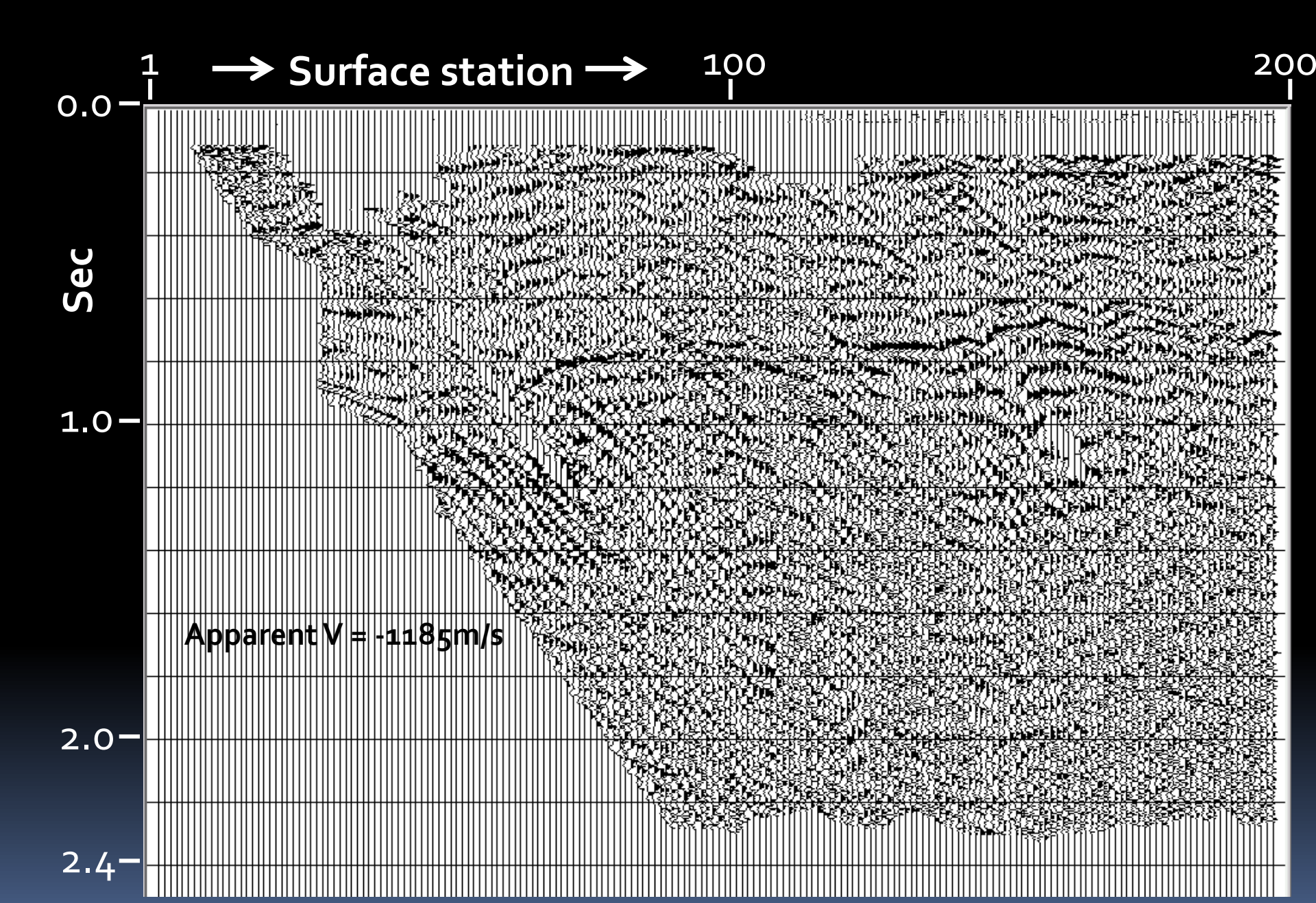


Geometry of a trace in R-T domain

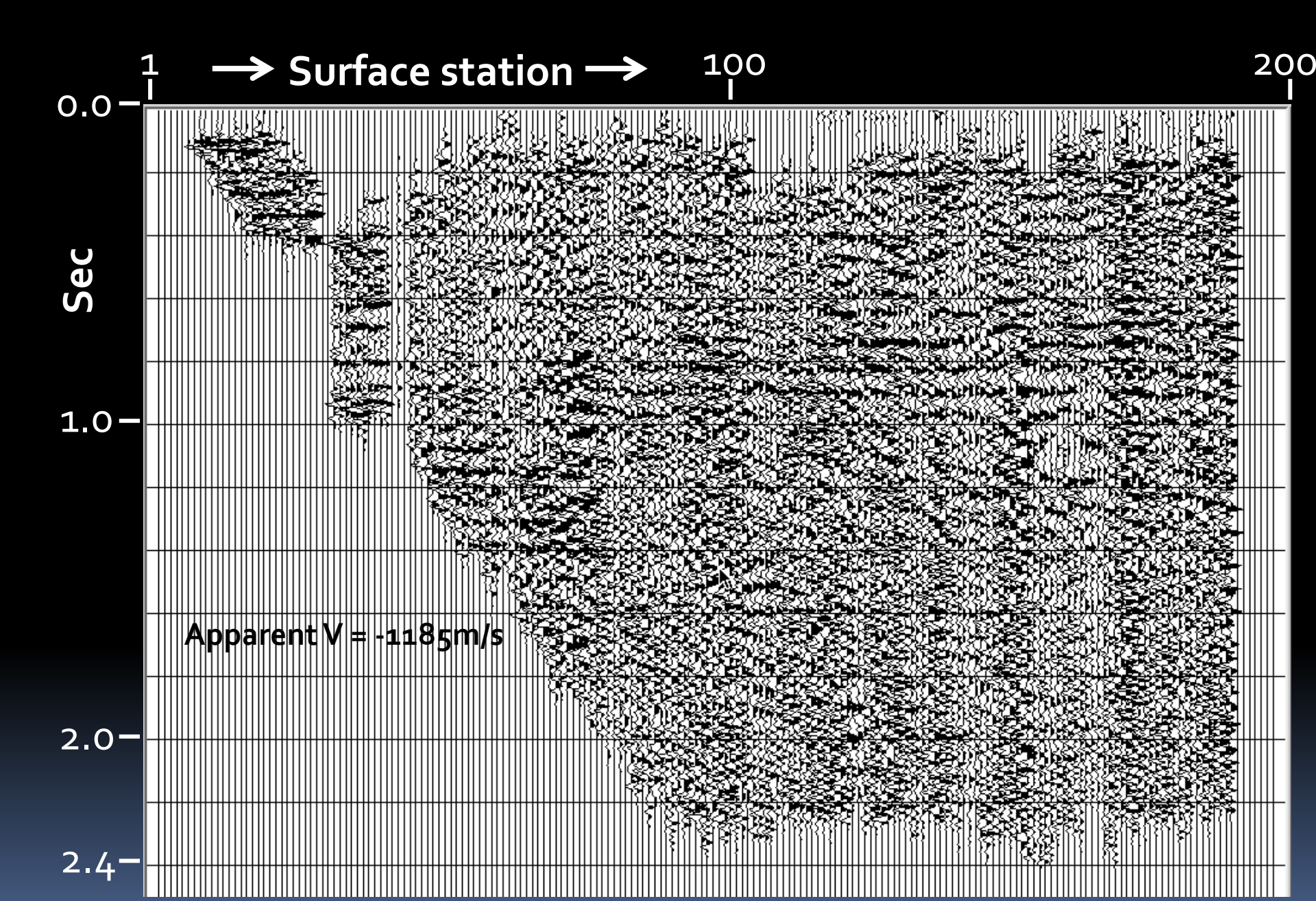
Near-surface raypath angle is *constant* for all *reflection times* for each trace in the RT domain

Raypath interferometry

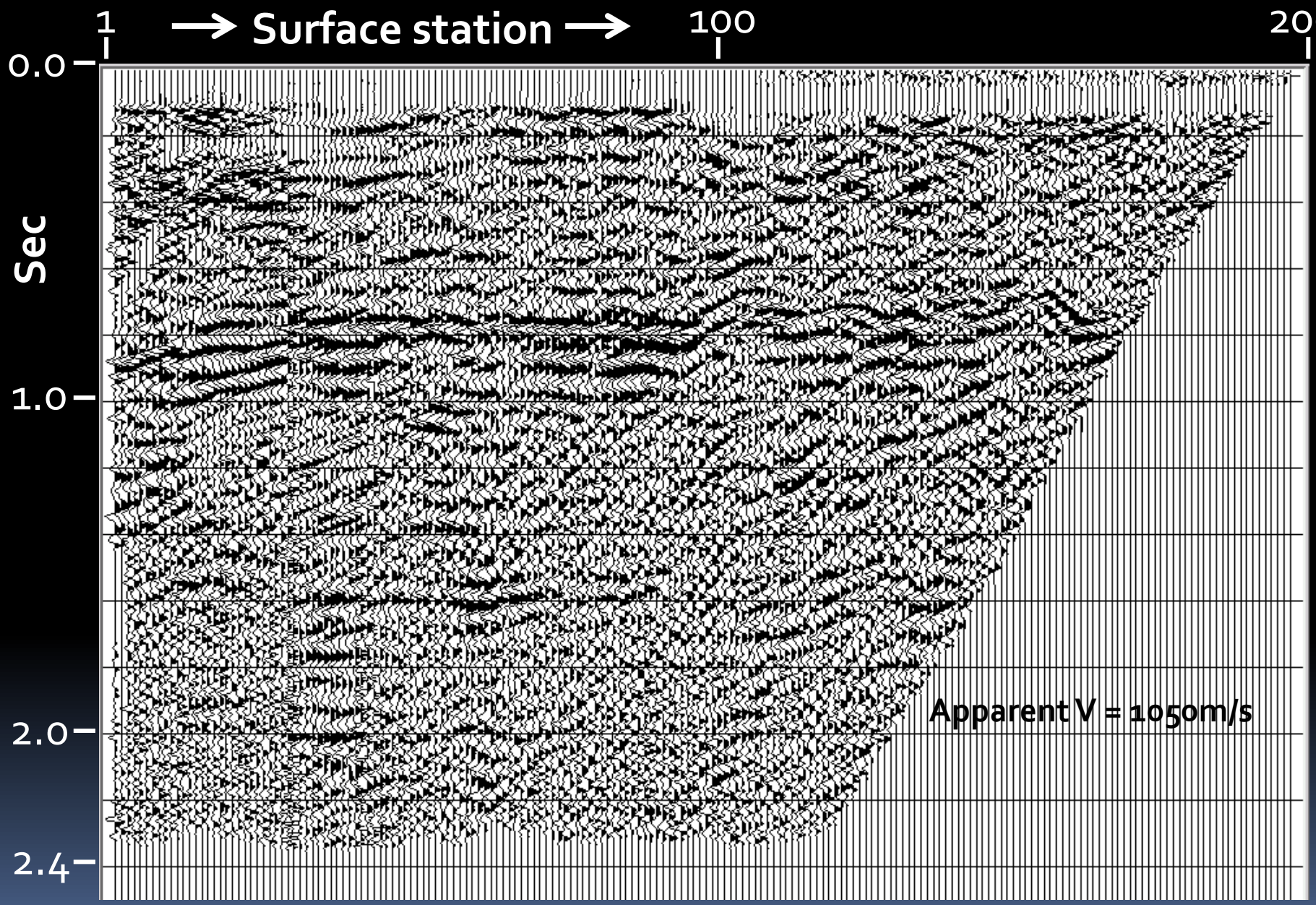
- Map raw ***XT gathers*** to ***RT gathers***, sort traces to ***common-angle gathers***
- Create ***reference*** wavefield ***common-angle gathers*** (pilot traces) ←
- Apply ***interferometry*** between ***reference angle gathers*** and ***raw angle gathers***
- Sort ***corrected common-angle gathers*** to ***RT gathers***, map to ***corrected XT gathers***



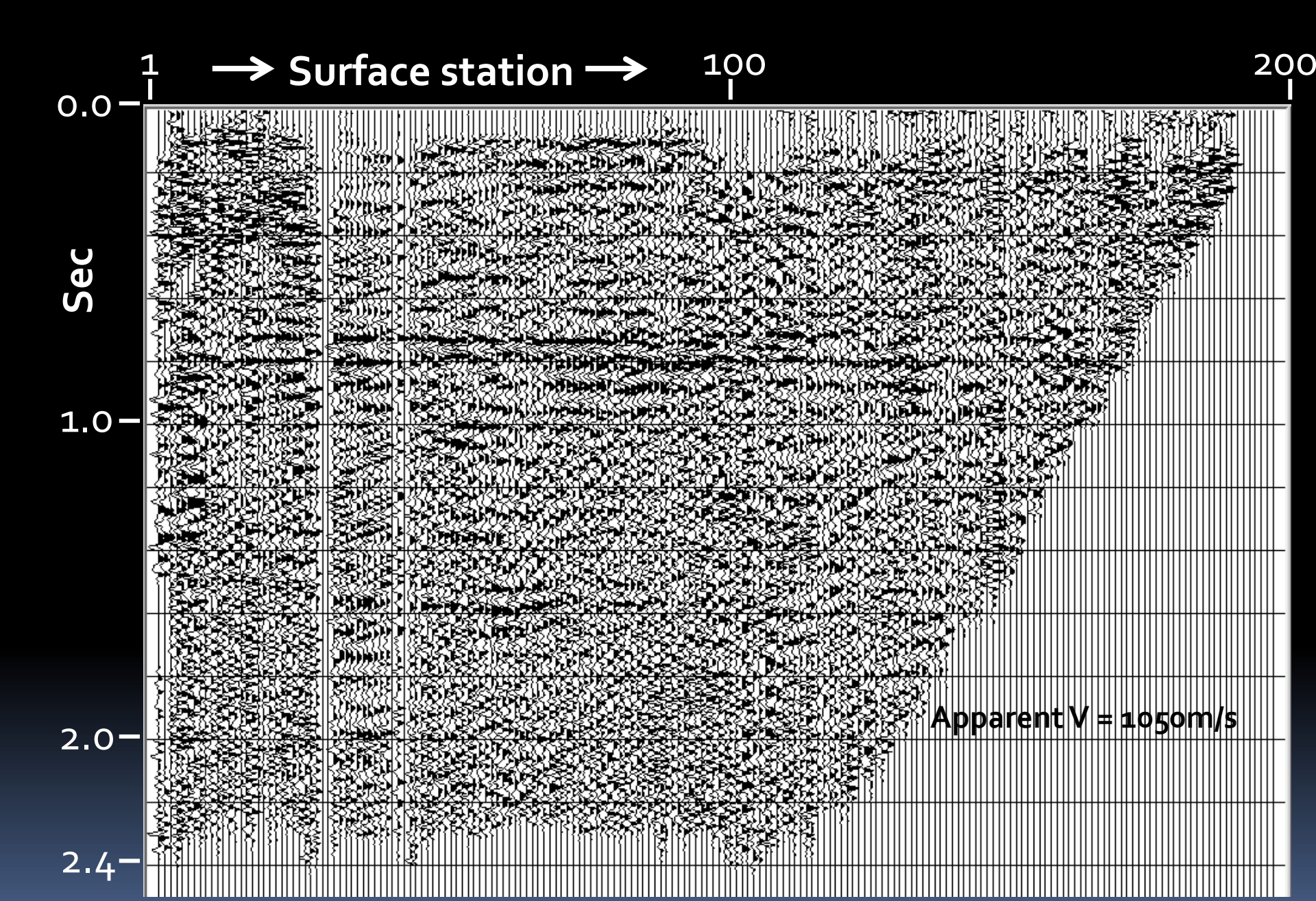
Typical *common-angle gather* before *interferometry*



Common-angle gather after *interferometry*



Typical *common-angle gather* before *interferometry*

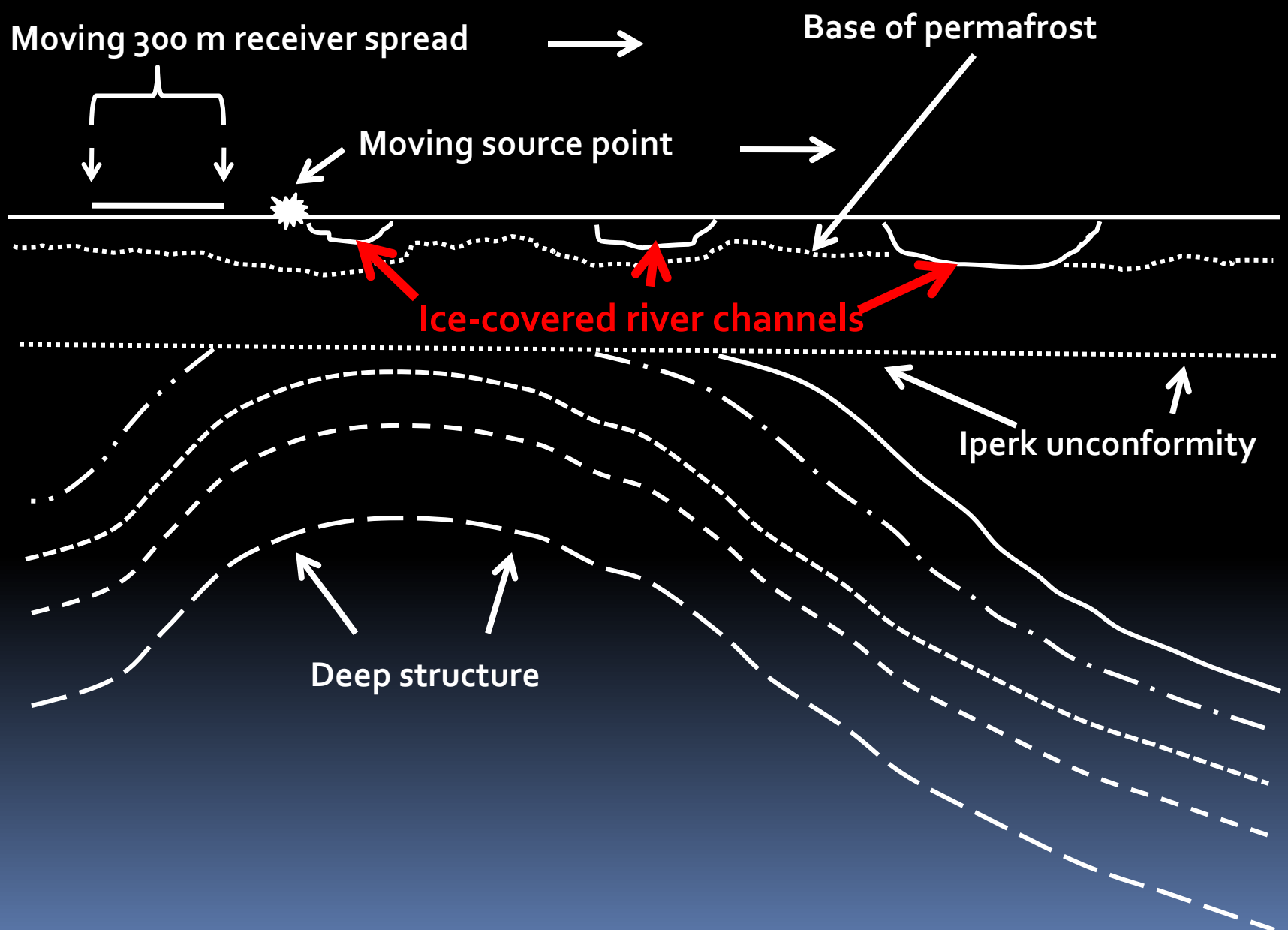


Common-angle gather after *interferometry*

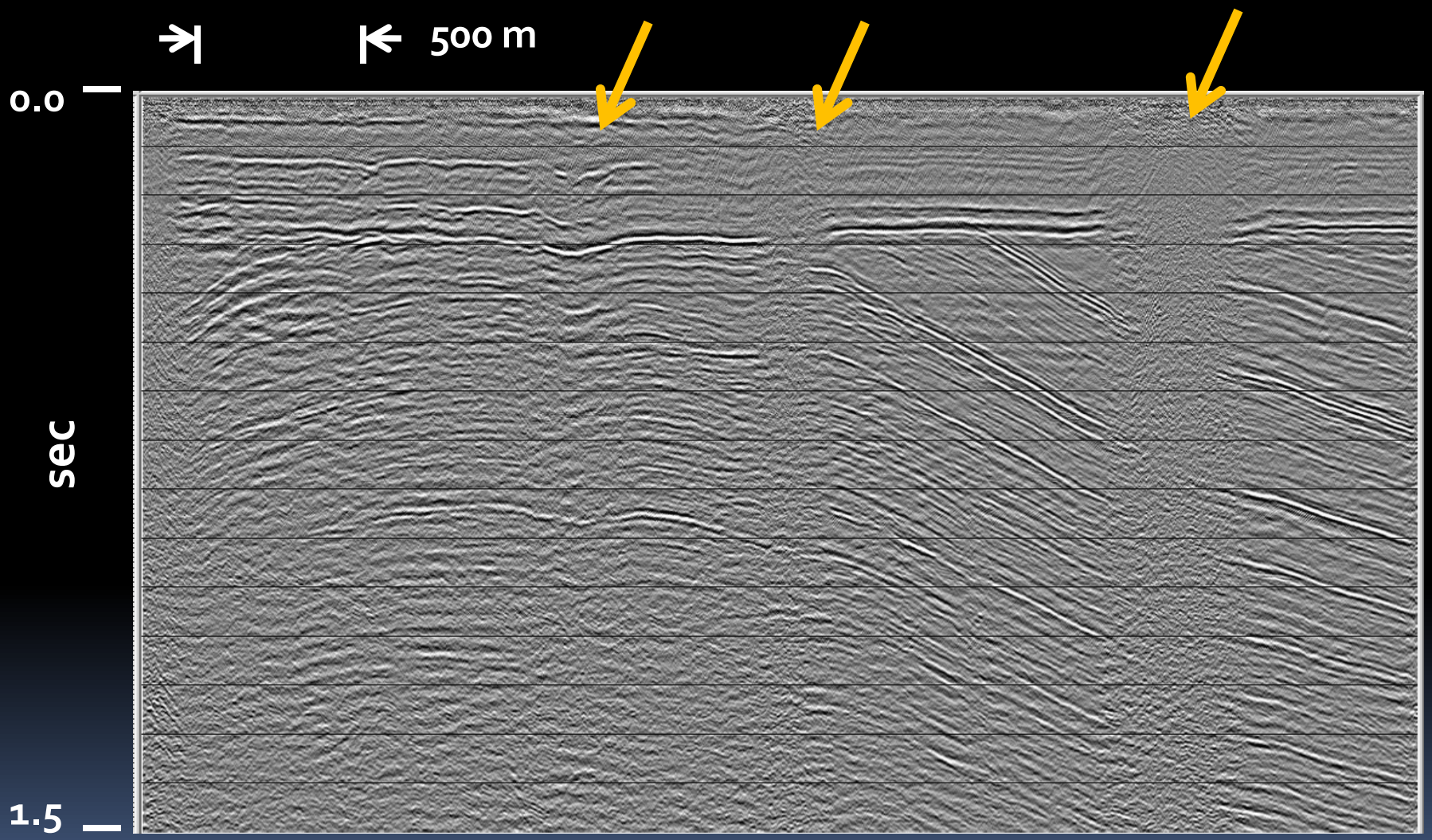
Examples

- MacKenzie Delta
  - High resolution survey from MacKenzie Delta—***large statics, surface-consistency violated***
  - ***Conventional statics inadequate***
- Hussar Low-frequency experiment
  - High quality 3C survey from Alberta plains
  - ***Conventional statics work well***

MacKenzie Delta high-resolution survey

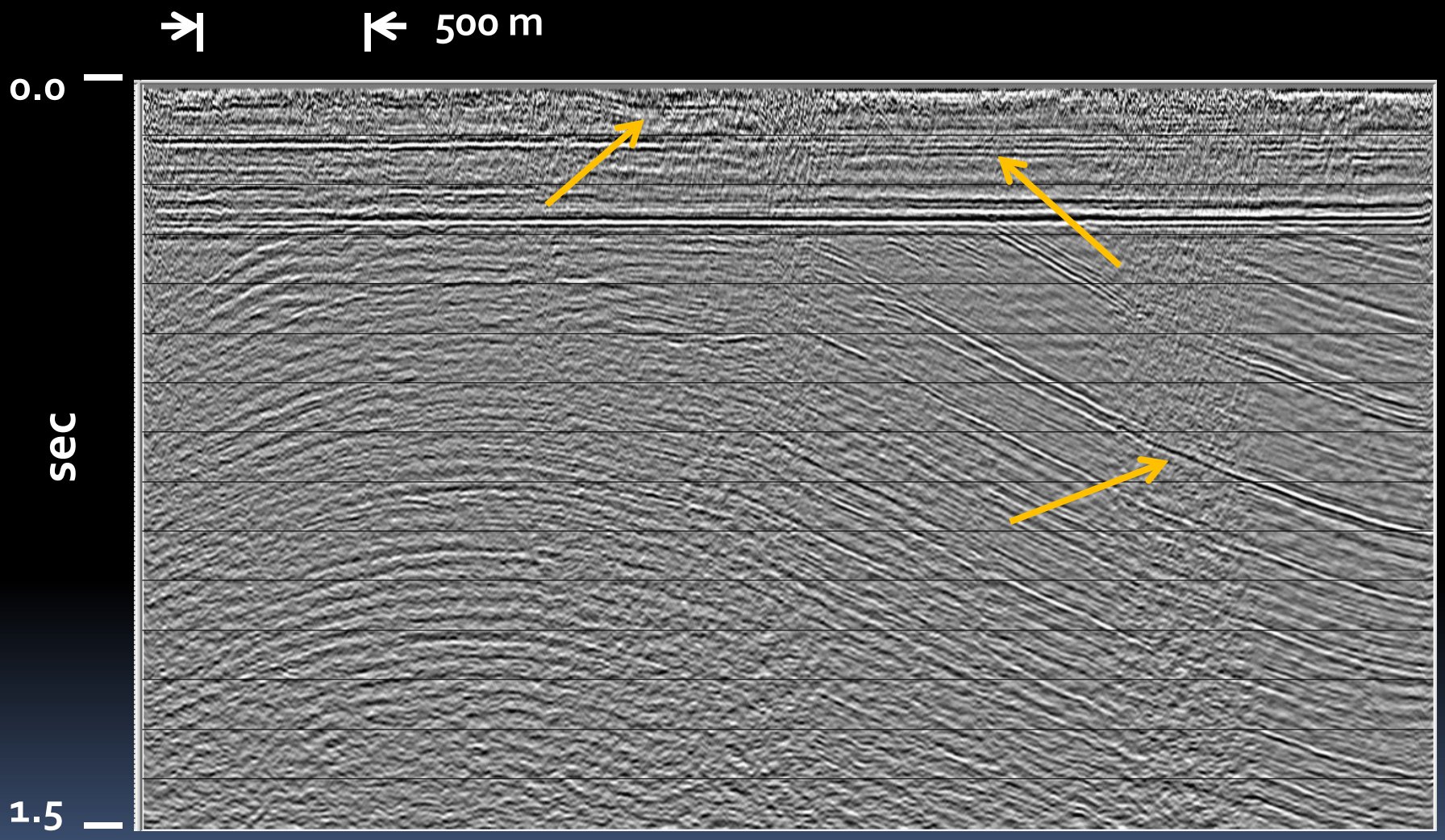


Example: MacKenzie Delta



CMP stack of MacKenzie Delta high resolution line

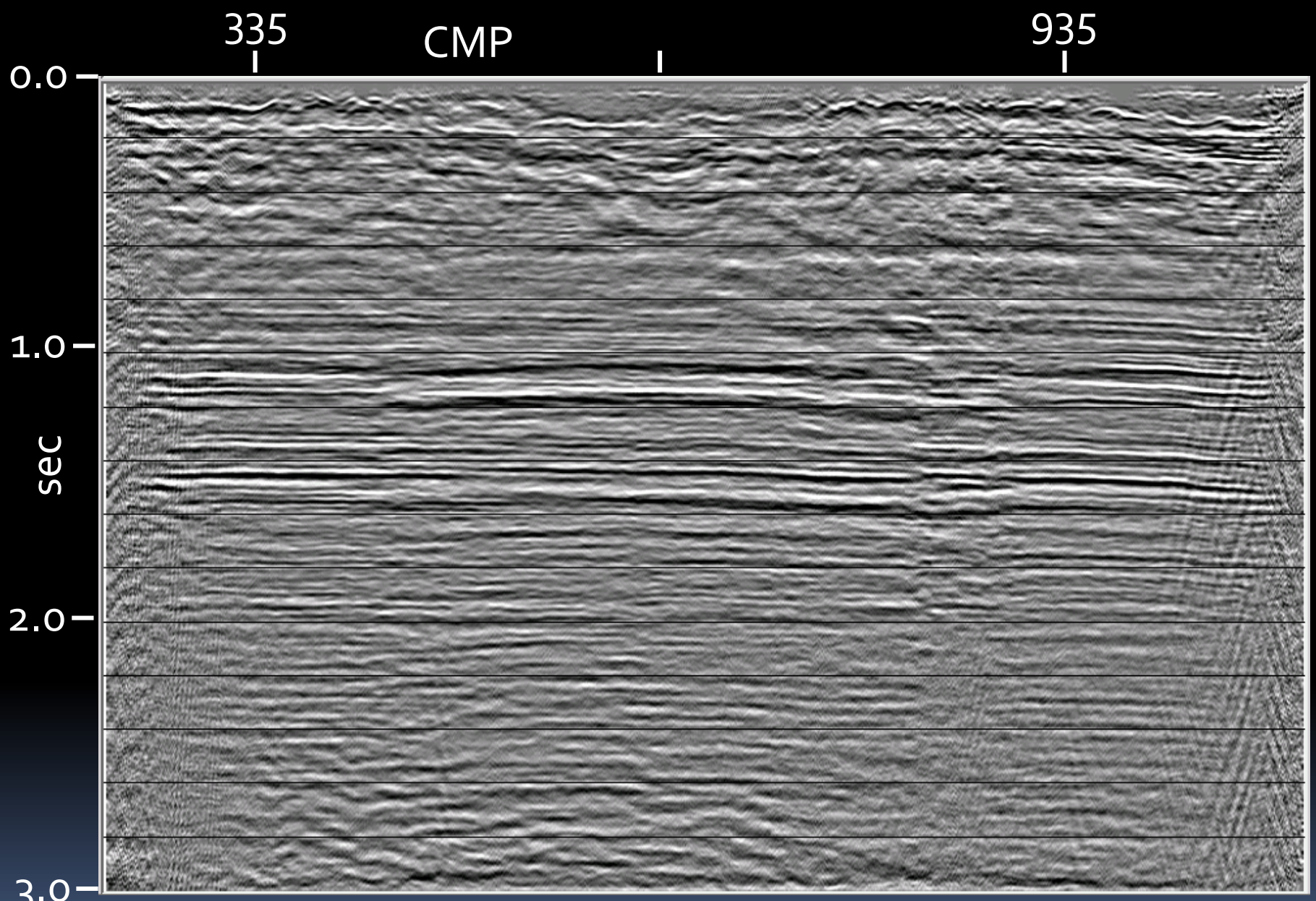
Example: MacKenzie Delta



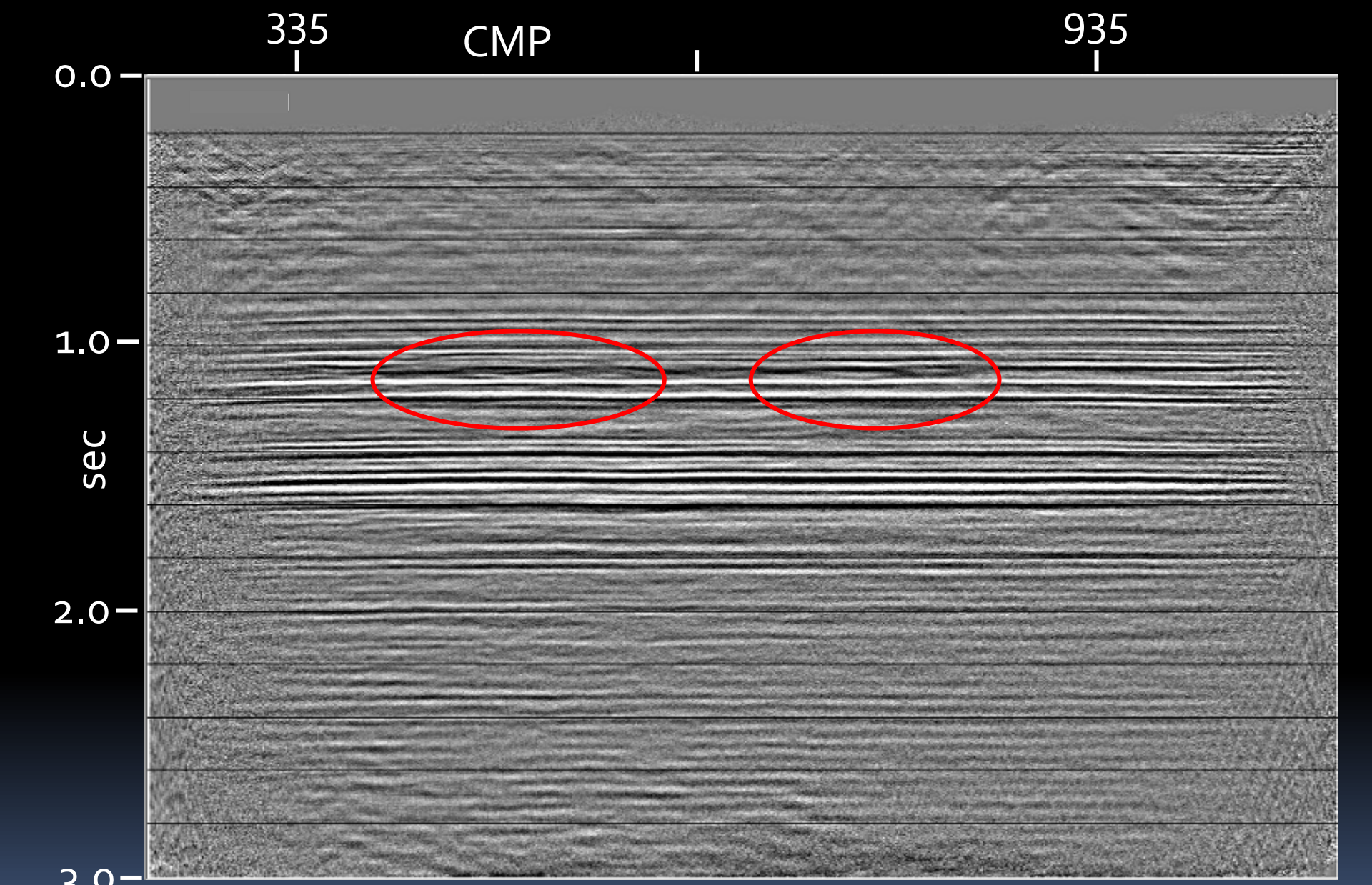
MacKenzie Delta line after raypath interferometry

Hussar PP statics comparison

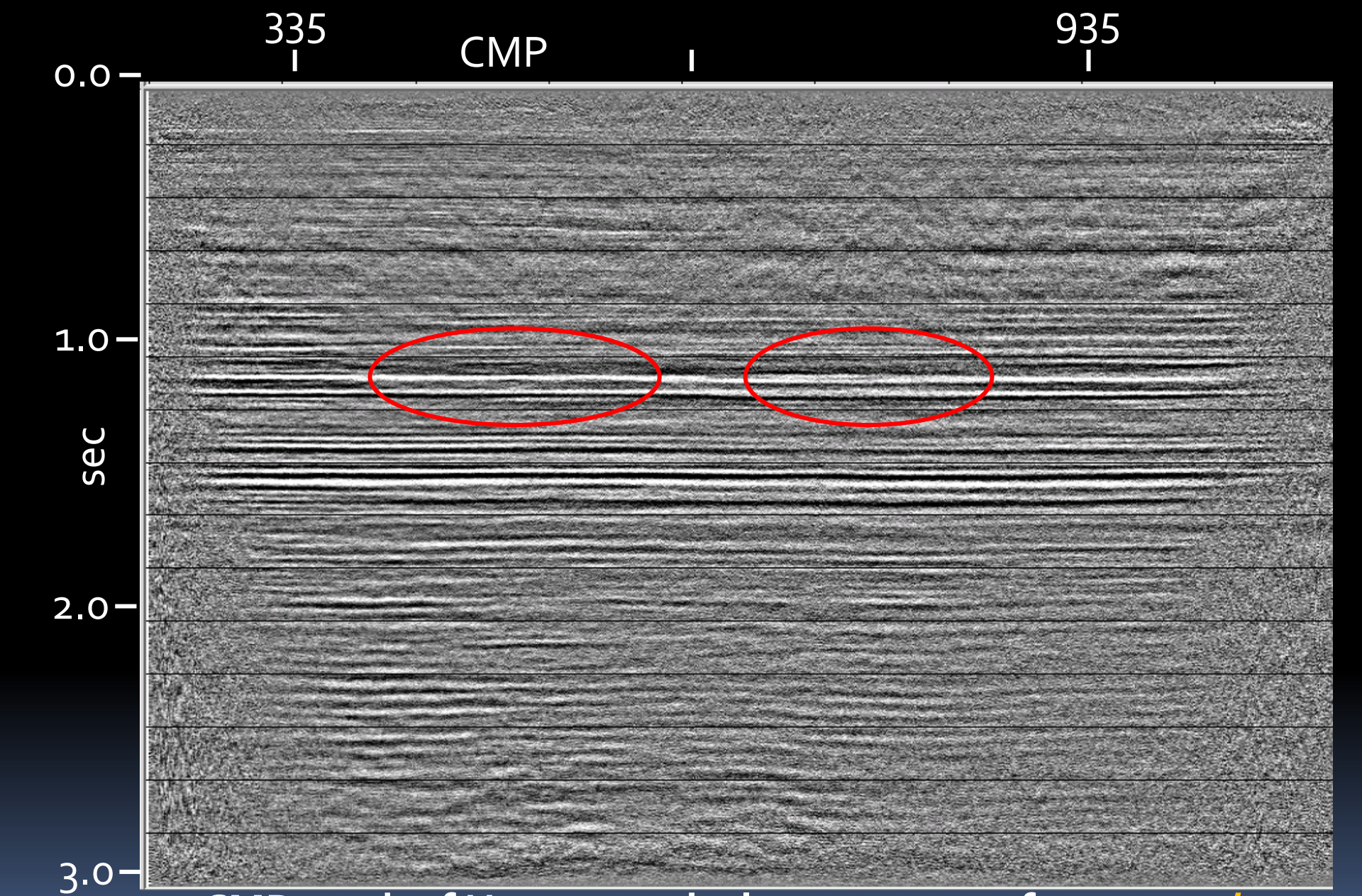
- ***Vectorseis*** vertical component ***dynamite***, ***10m receiver*** spacing
- ***RT filtering—Reflection frequencies above 3Hz untouched***.
- ***Gabor deconvolution***
- ***Static correction—two solutions for comparison***
  - ***Raypath interferometry*** (Henley)
  - ***Conventional NMO and residual statics*** (Isaac)



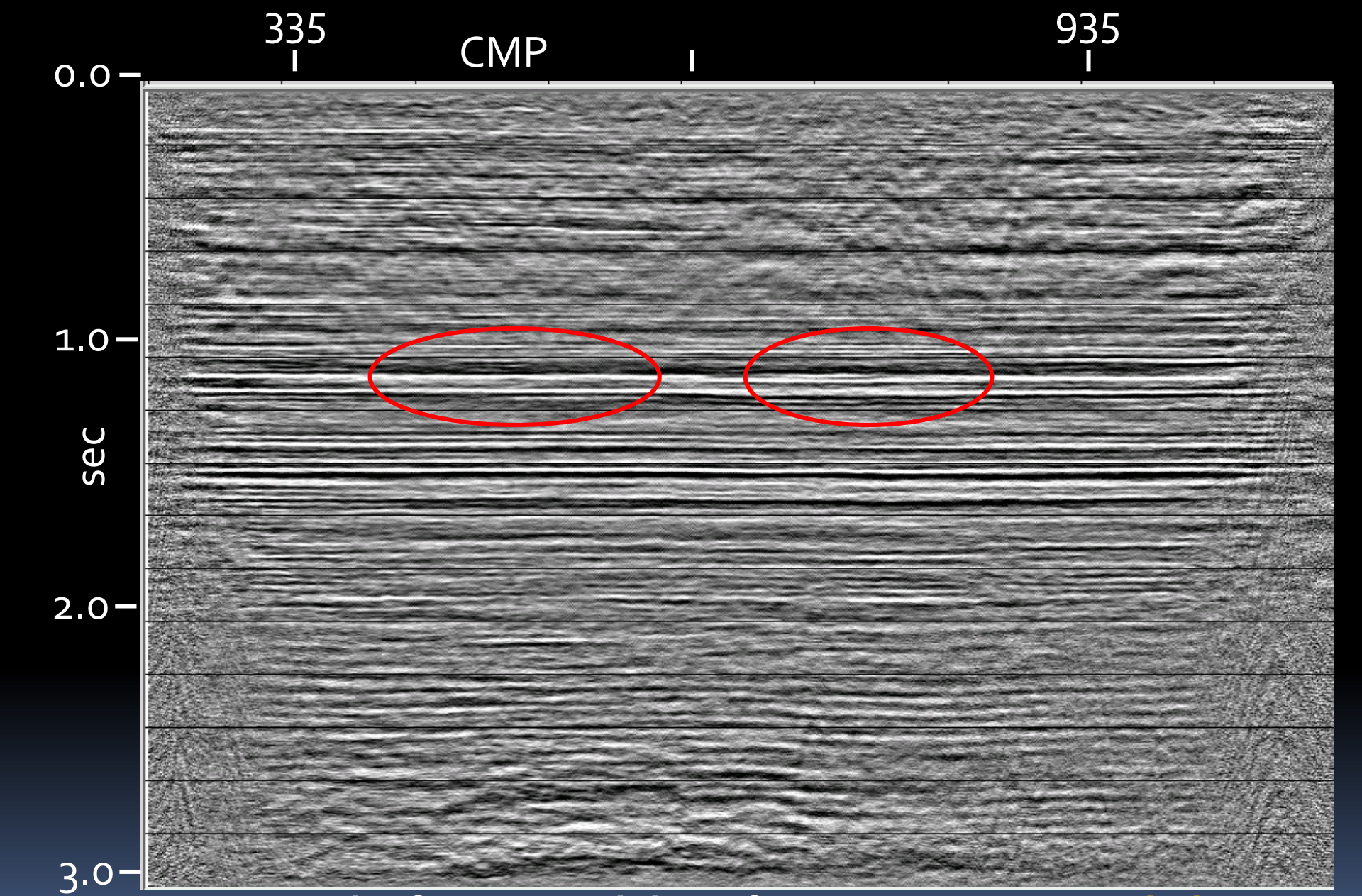
CMP stack of vertical component Vectorseis dynamite data, single NMO function, *no statics*



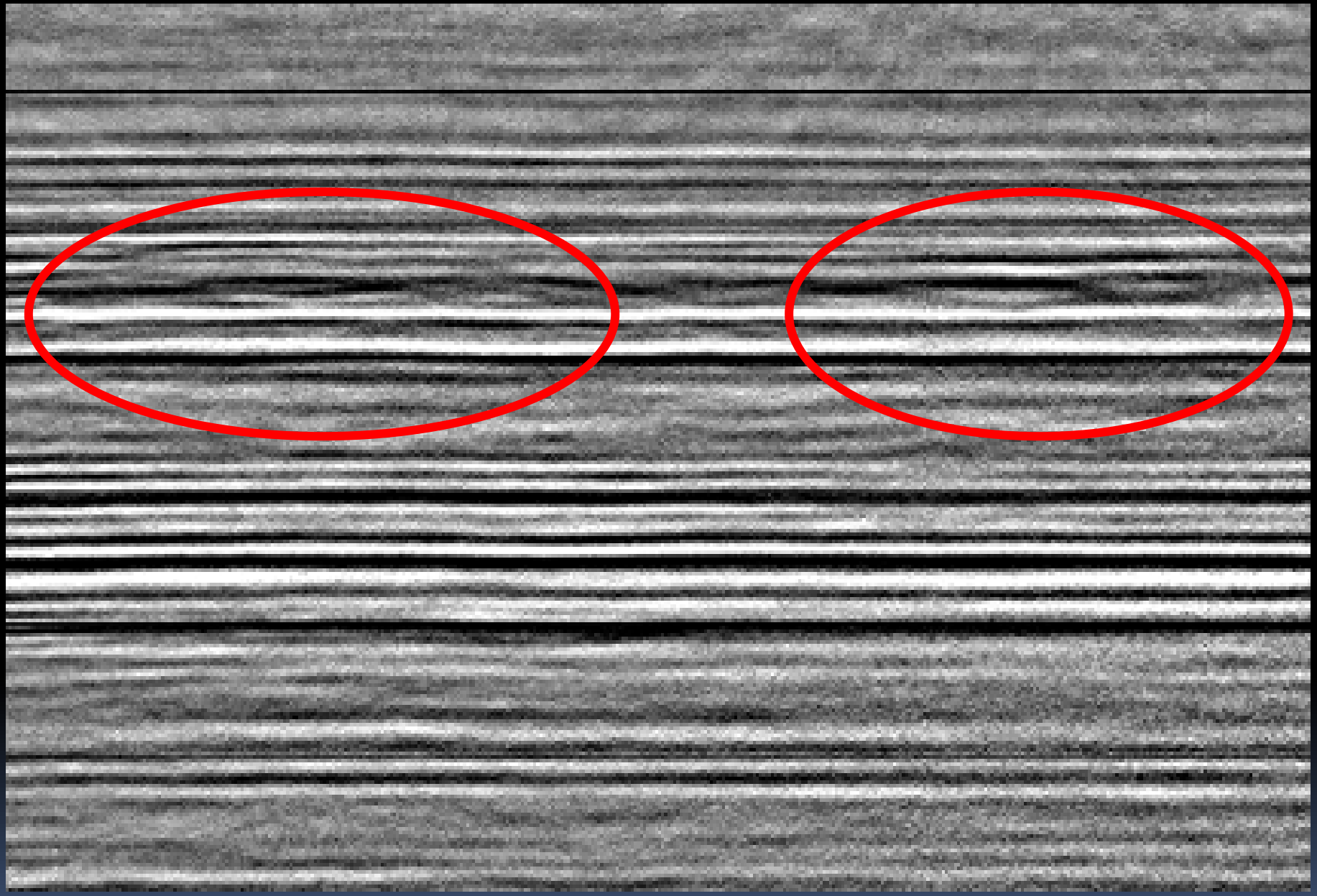
CMP stack of preprocessed data, after conventional NMO analysis, residual statics…*no post-stack processing*



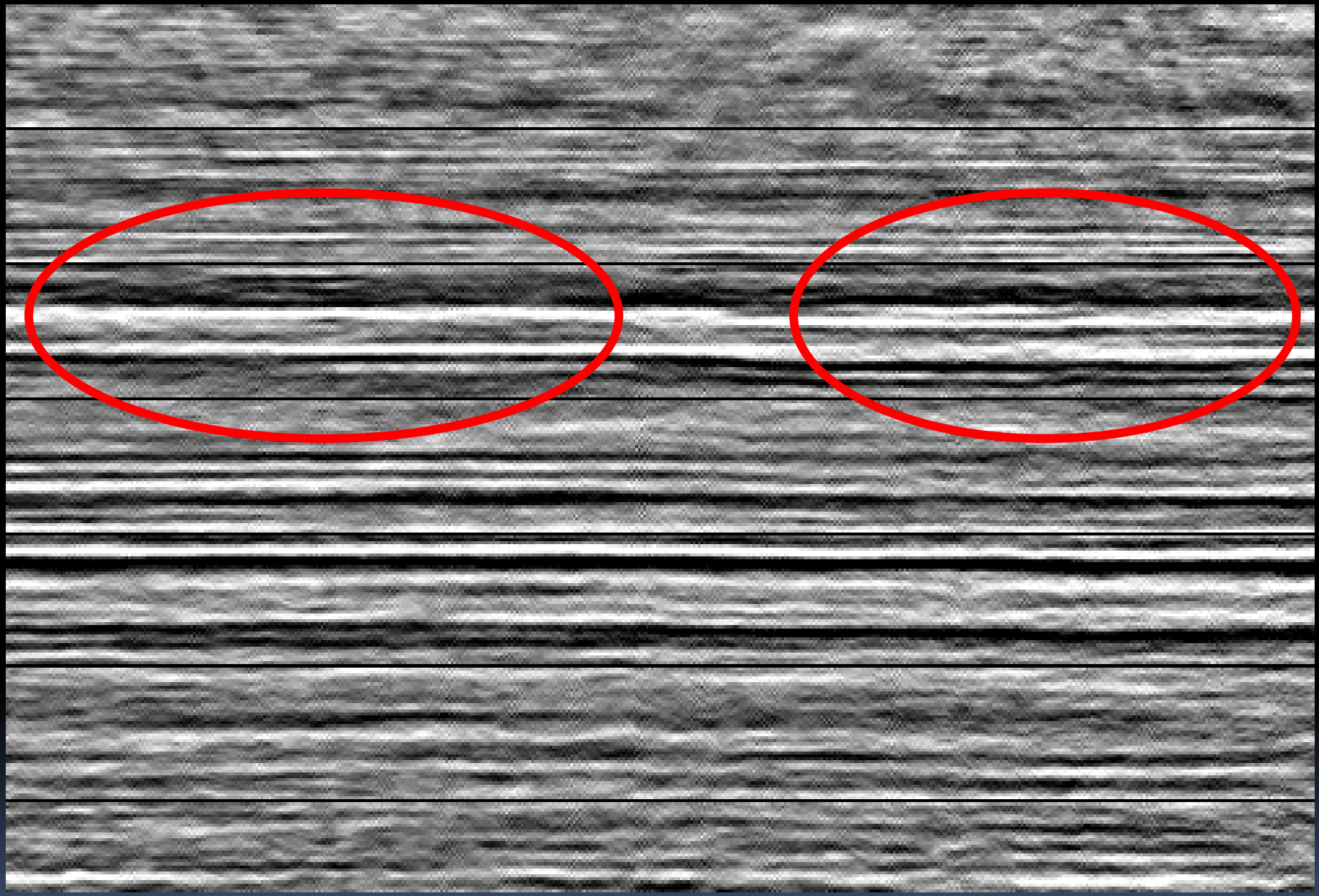
CMP stack of Hussar vertical component after *raypath interferometry*. Single NMO function used



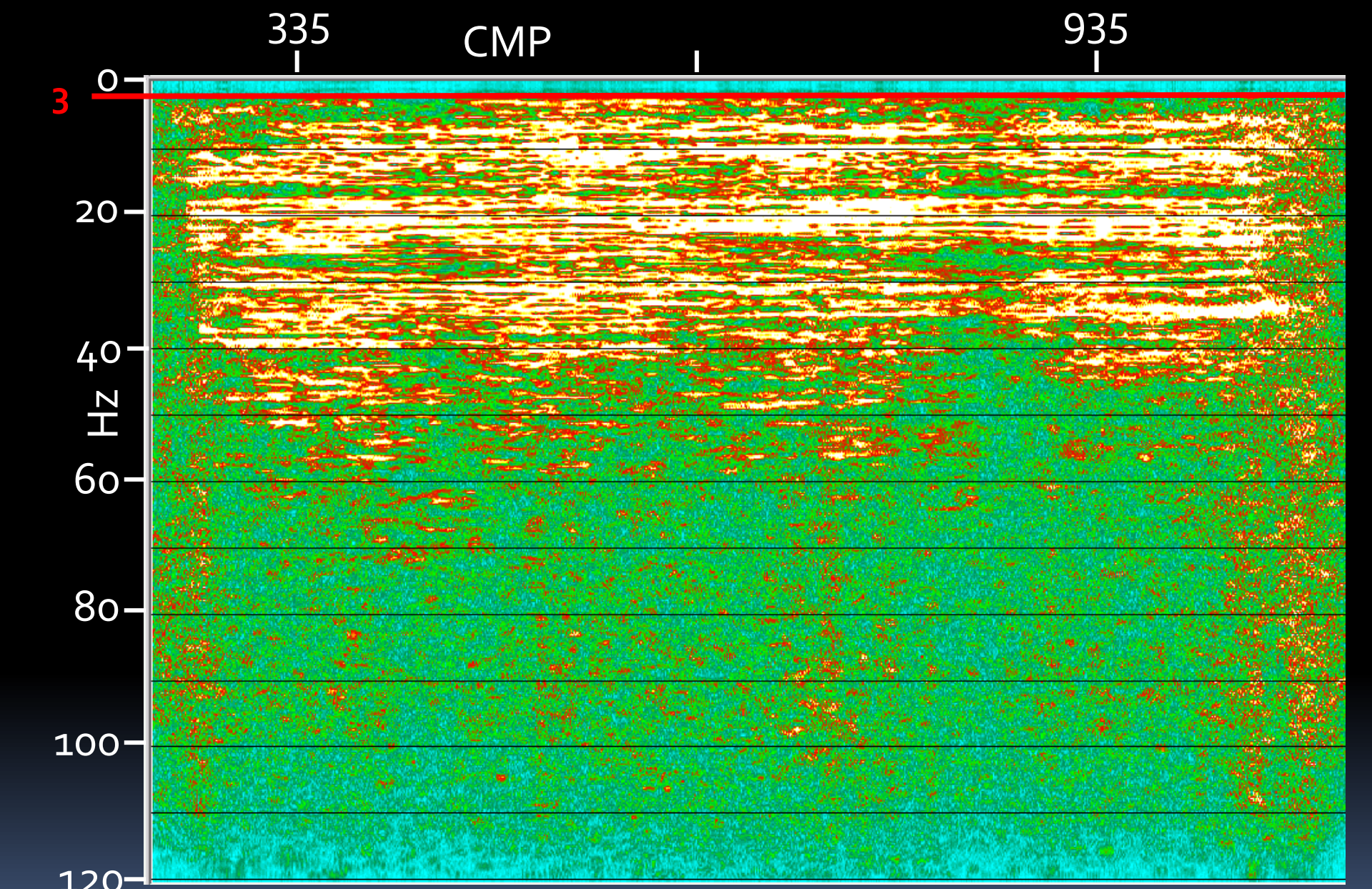
CMP stack after raypath interferometry, Post-stack decon applied to whiten, FX decon to reduce random noise



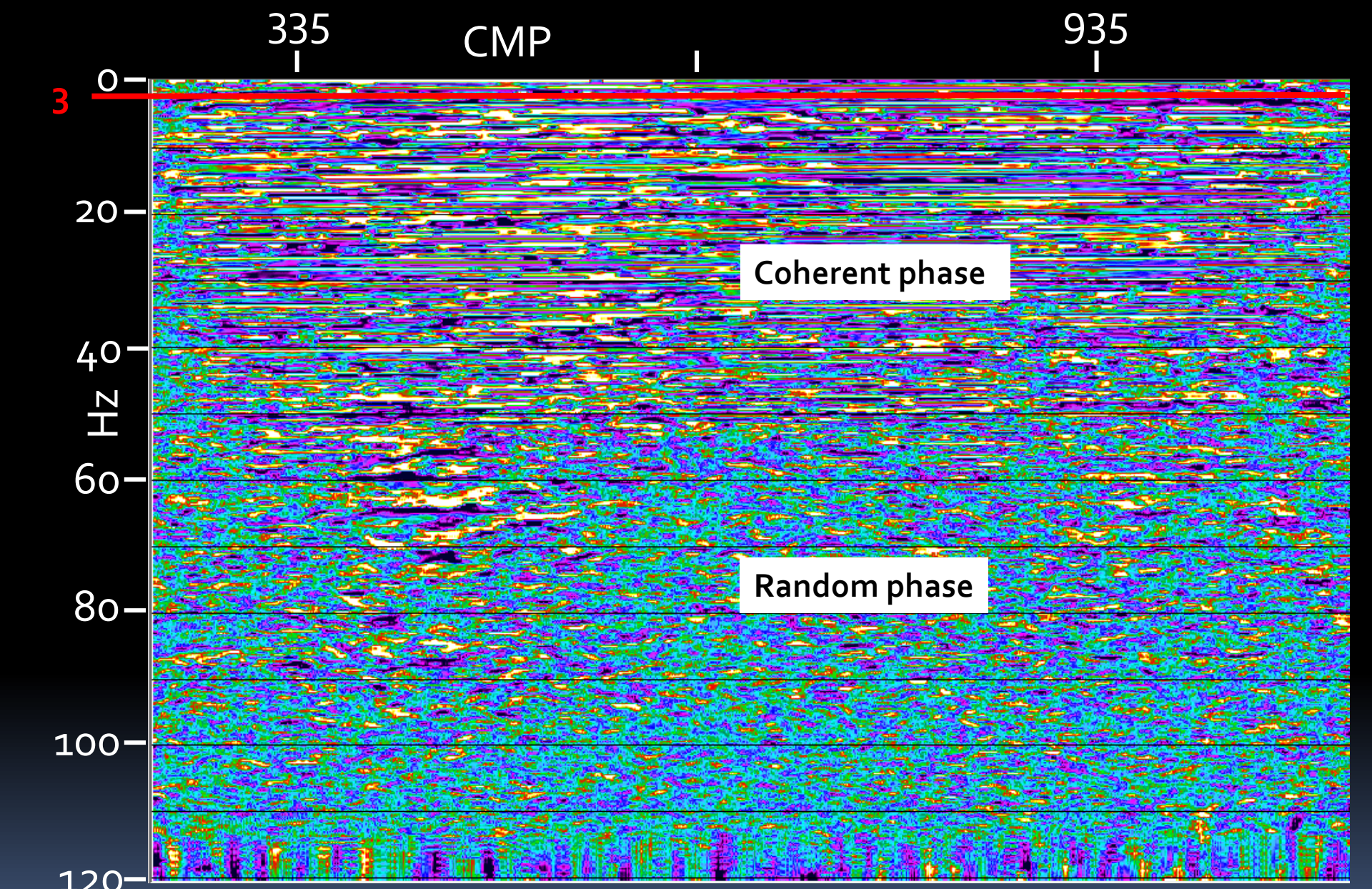
Zoom of CMP stack with *conventional statics*



Zoom of stack after *raypath interferometry*, post-stack decon and FX decon



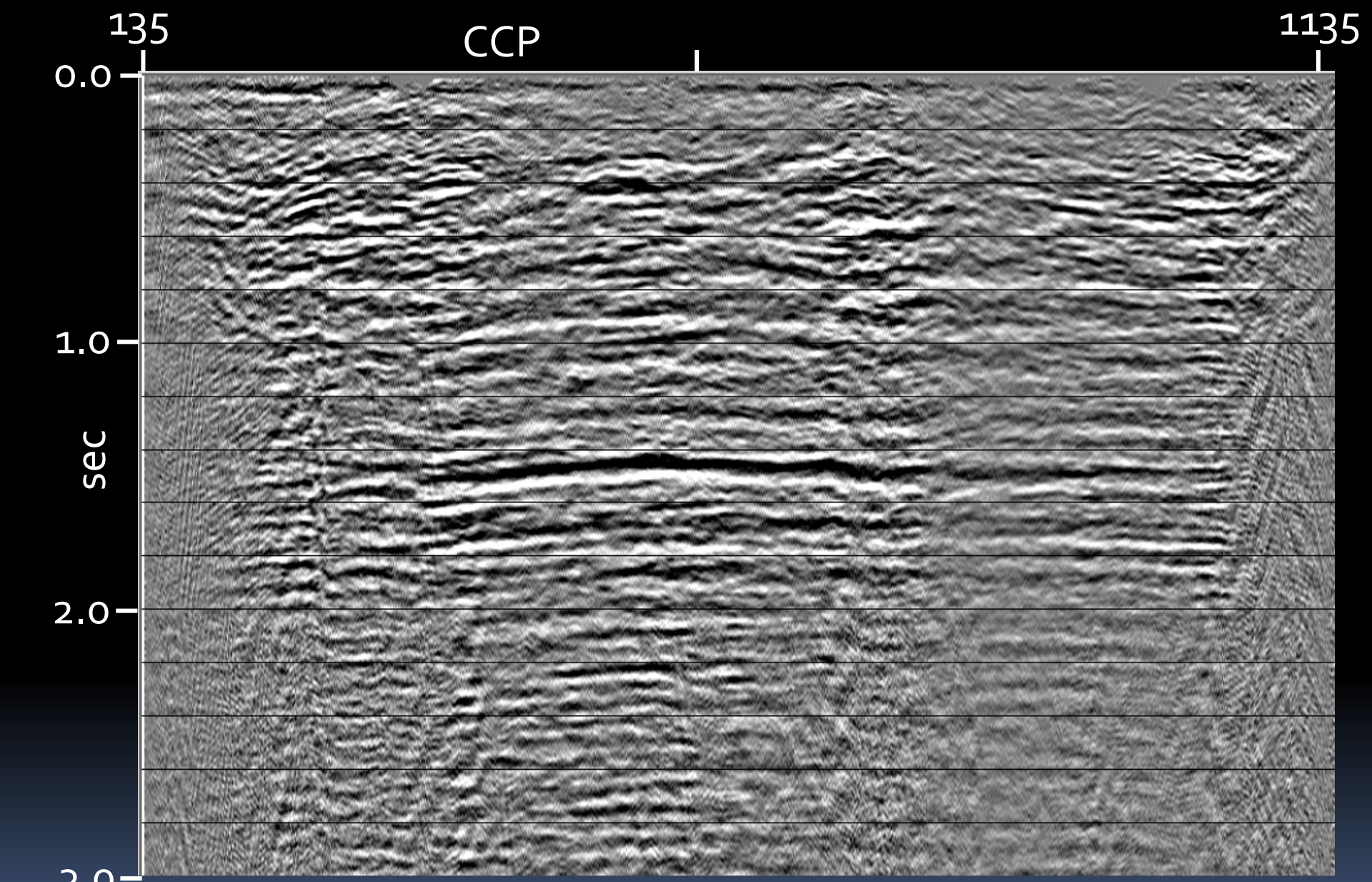
Amplitude spectra as a function of CMP for *Raypath interferometry* stack



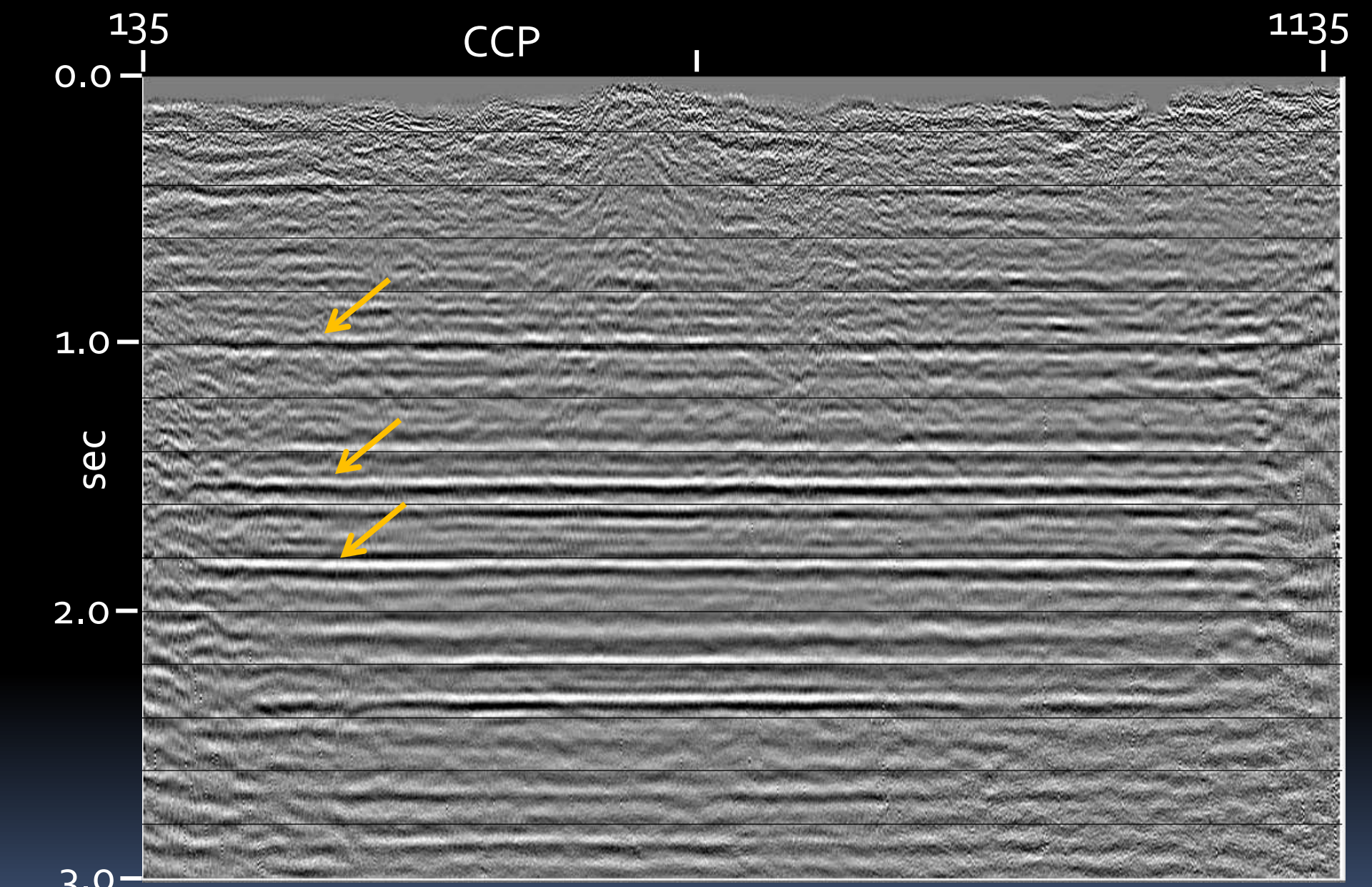
Phase spectra as a function of CMP for *Raypath interferometry* stack

Hussar PS comparison

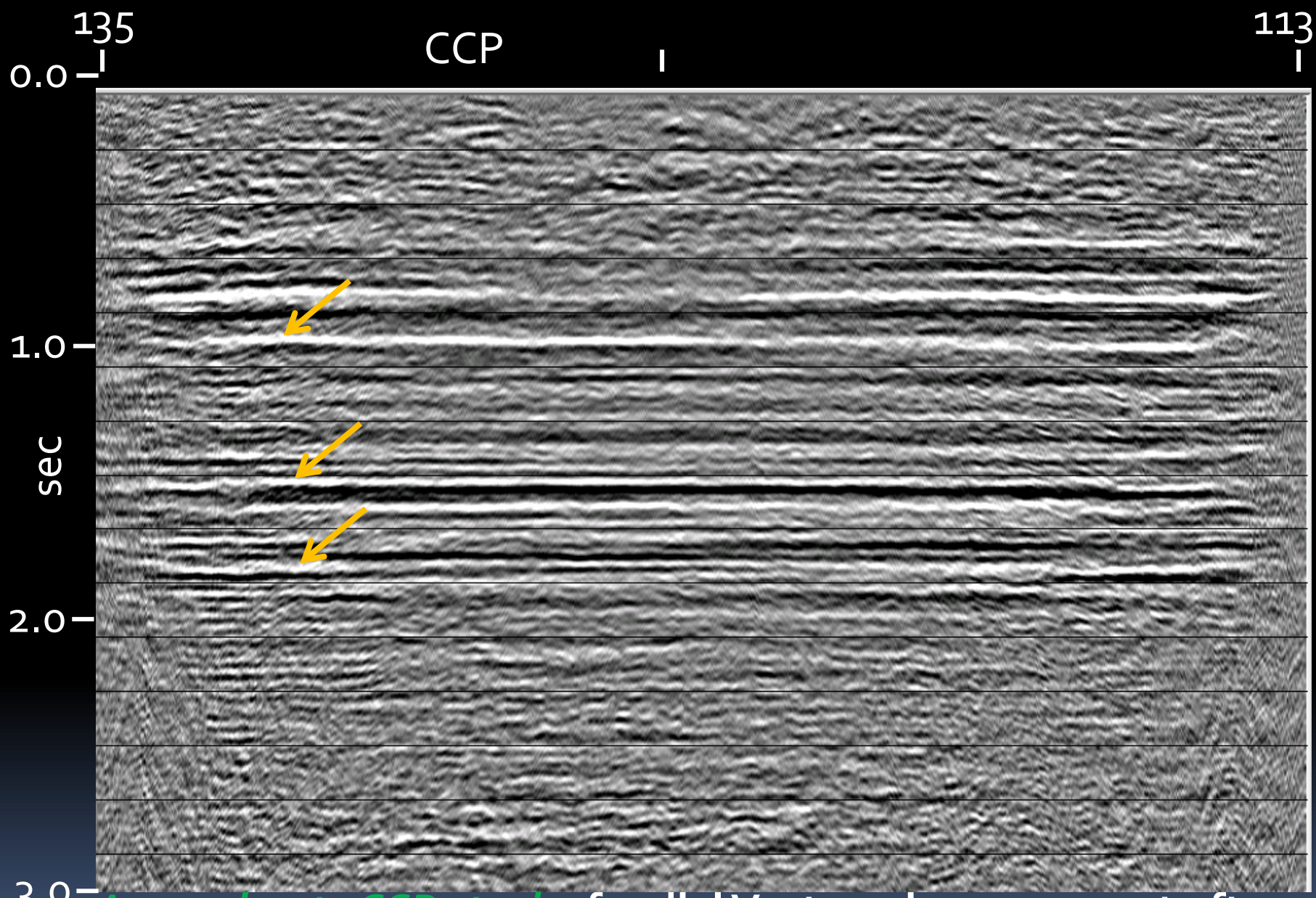
- ***Vectorseis*** radial component ***dynamite***, ***10m receiver*** spacing
- ***RT filtering—Reflection frequencies above 2Hz untouched***
- ***Gabor deconvolution***
- ***Static correction—raypath interferometry***
- ***Independently processed PS section provided by Isaac for comparison***



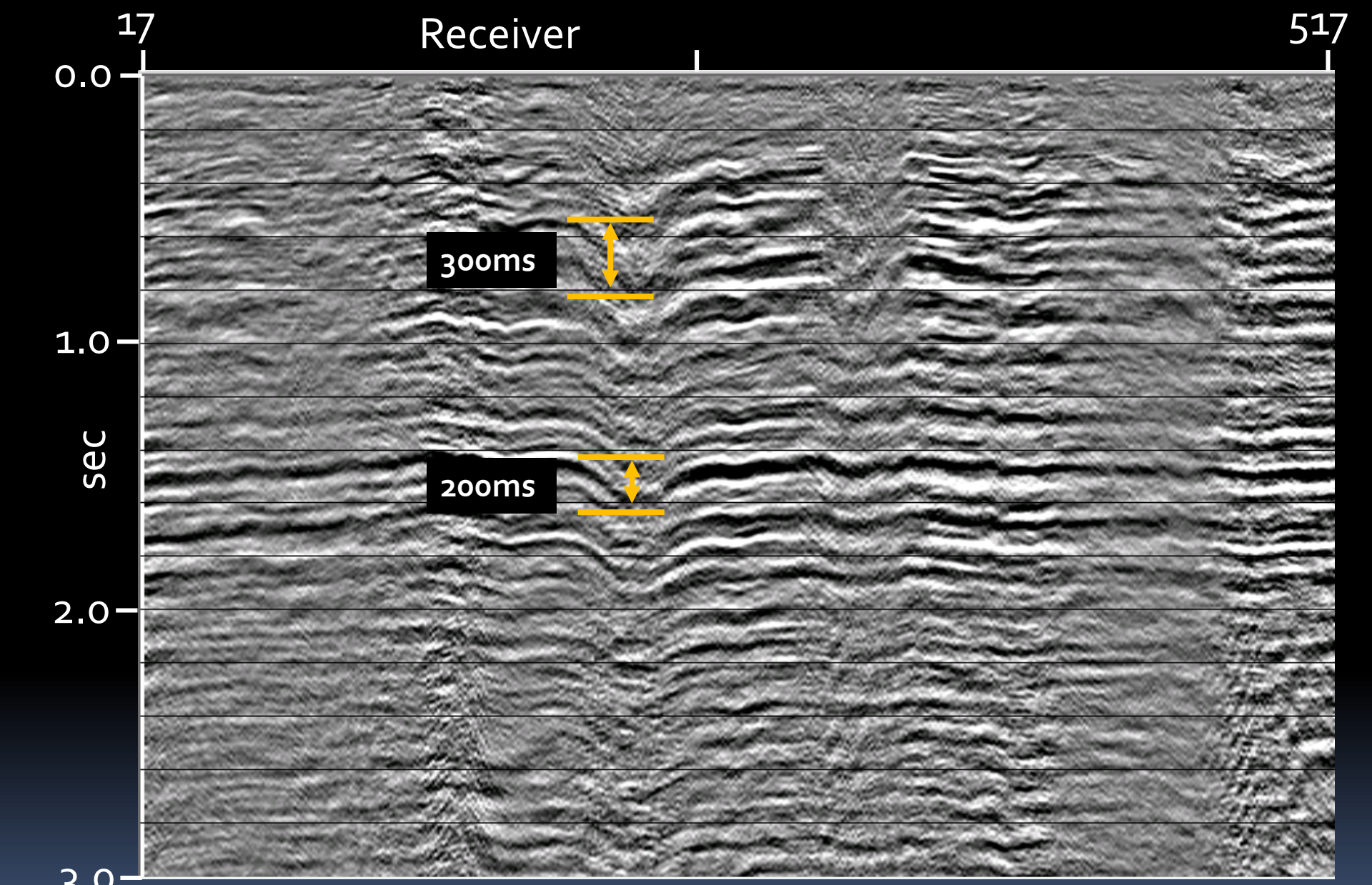
Approximate CCP stack of radial Vectorseis data, single NMO function, *no statics*



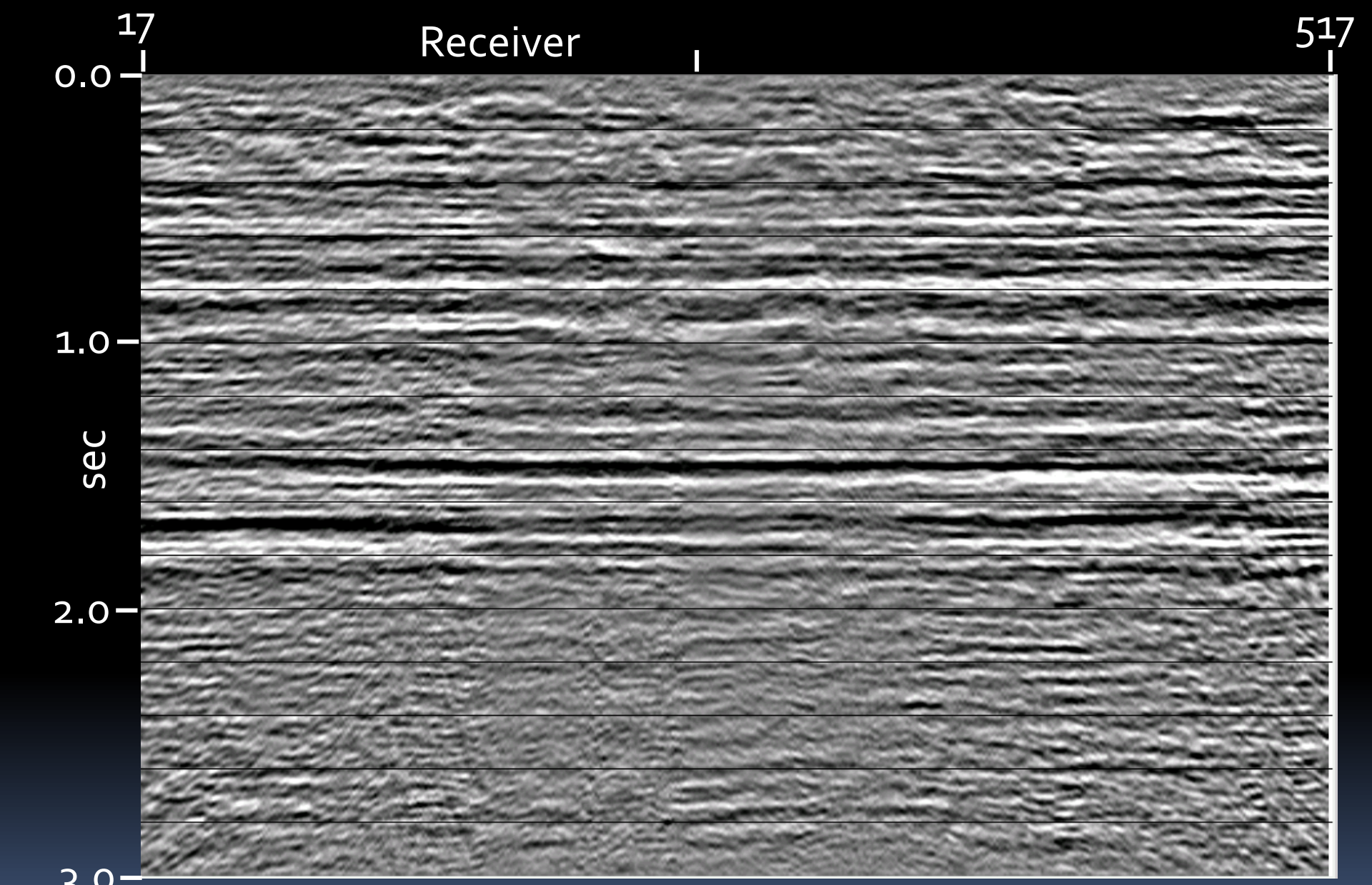
Correct CCP stack of radial Vectorseis component after *conventional NMO and PS statics* (courtesy of Helen Isaac)



Approximate CCP stack of radial Vectorseis component after *raypath interferometry*, single NMO function



Common-receiver stack of radial Vectorseis component showing apparent *nonstationary* statics



Common-receiver stack of radial Vectorseis component after *raypath interferometry*

Observations

- ***Raypath interferometry*** comparable to conventional ***residual statics*** on PP data…or ***better?***
- Comparison difficult on PS data because of ***different processing***, different velocities and CCP stack
- ***Raypath interferometry*** for PS data corrects apparent ***non-stationary statics***

Acknowledgements

- CREWES sponsors and NSERC, for funding
- Helen Isaac, for Hussar data preparation, and for processing comparison stacks
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