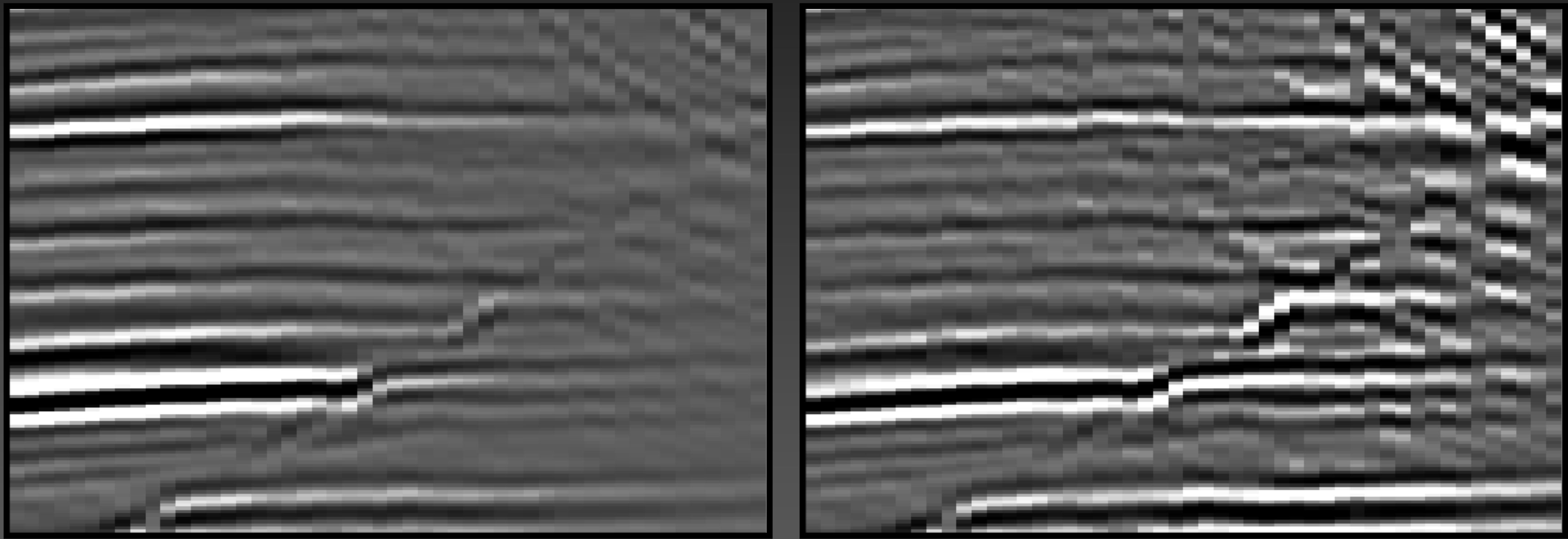
Angle-domain parameters computed via weighted slant-stack



Angle stacks

Claudio Guerra

SEP-131, p.59

Motivation

- **Post migration processes in the reflection-angle domain**
  - migration-velocity analysis
  - residual multiple attenuation
  - AVA
  - regularization of the least-squares inverse imaging
- **Compensate for illumination problems in ADCIGs**

Outline

- Introduction
- Weighted OFF2ANG
- Results
- Conclusions

Introduction

- **SEP125 - Valenciano and Biondi**
  - **Compute the Hessian in the angle domain by chaining operators T*, H and T.**

$$\mathbf{S(m)} = ½||\mathbf{Lm_h} – \mathbf{d_{obs}}||^2 = ½||\mathbf{LTm_\gamma} – \mathbf{d_{obs}}||^2$$

$$\partial^2\mathbf{S(m)}/\partial\mathbf{m}^2 = \mathbf{T^*L^*LT}$$

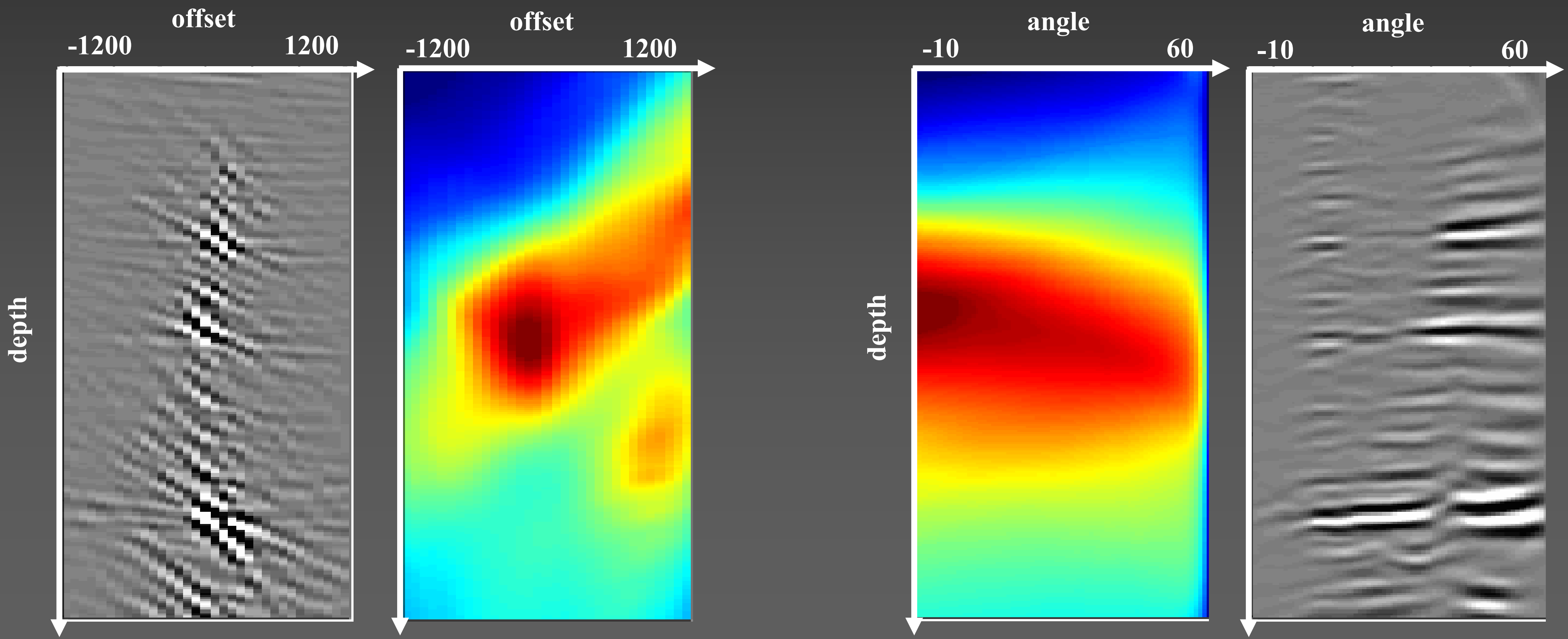
$$\mathbf{H}(\mathbf{x},\gamma;\ \mathbf{x}',\gamma') = \mathbf{T^*}(\gamma,h)\ \mathbf{H}(\mathbf{x},h;\ \mathbf{x}',h')\ \mathbf{T}(\gamma,h)$$

$\mathbf{H}(\mathbf{x},\gamma;\ \mathbf{x}',\gamma')$ – angle-domain Hessian
$\mathbf{m}_\gamma$ – ADCIG
$\mathbf{T}(\gamma,h)$ – angle-to-offset transformation
L – modeling operator

$\mathbf{H}(\mathbf{x},h;\ \mathbf{x}',h')$ – offset-domain Hessian
$\mathbf{m}_h$ – SODCIG
$\mathbf{T^*}(\gamma,h)$ – offset-to-angle transformation
L* - migration

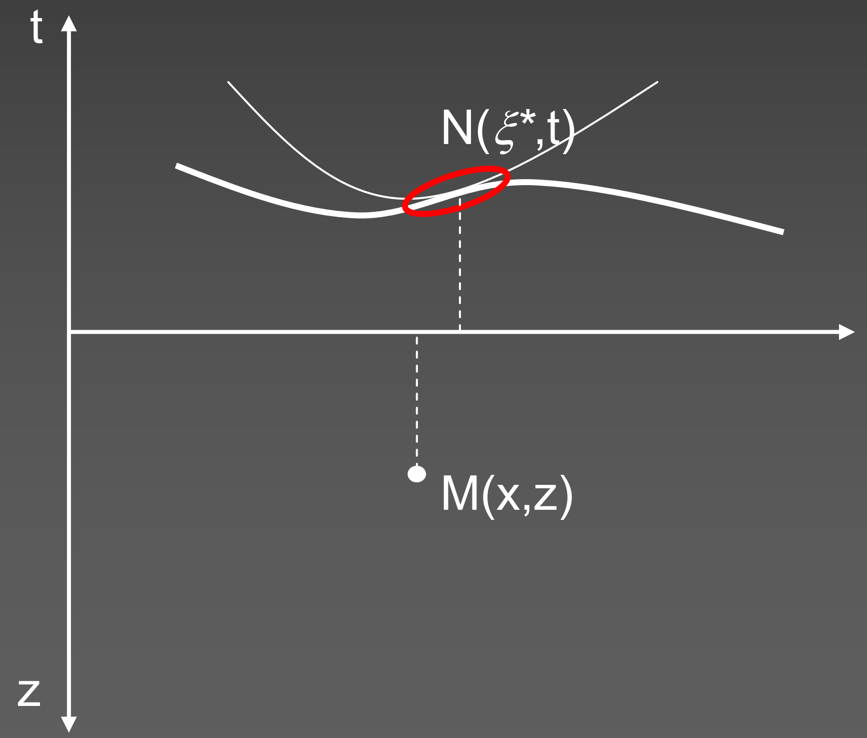
Introduction

- **SEP125 - Valenciano and Biondi**
  - **“The Hessian ... in the angle dimension lacks of resolution to be able to interpret which angles get more illumination.”**

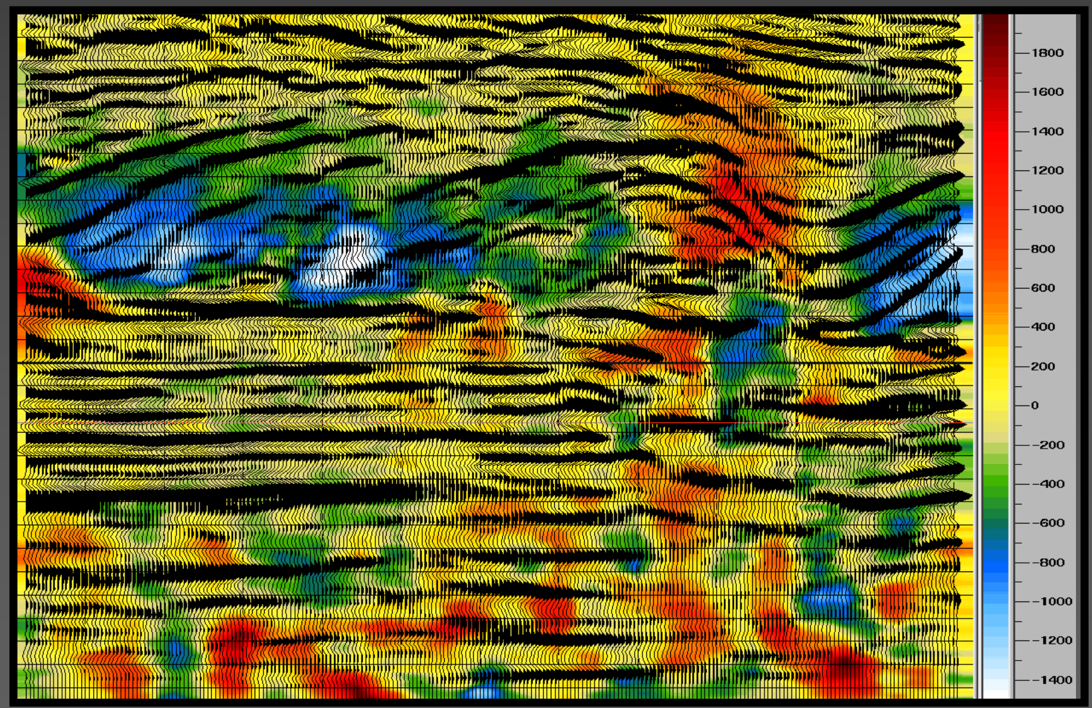


Weighted OFF2ANG

- **Assymptotic approximation of Kirchhoff Migration**
  - Main contribution comes from the vicinity of the stationary point
- **Bleistein(1987) and Tygel et.al(1993)**
  - migration with two different weights
  - division of the migrated images



$x - \xi^*$



Weighted OFF2ANG – phase behavior

Slant – stack

$$Q(z,\gamma) = \int_A \varrho[P(z,h)]dh|_{z=\zeta(\gamma,h)}$$

$$\zeta(\gamma,h) = z_0 + h\tan\gamma \qquad P(z,h) = A(h)f(z - z_r(h))$$

Q – ADCIG
$f(z)$ – wavelet
h – subsurface offset

P – SODCIG
z_r – reflector
γ – reflection angle

ζ – stacking line
A – amplitude
ϱ- rho filter

Weighted OFF2ANG – phase behavior

Slant – stack

$$Q(z,\gamma) \sim \frac{A(h^\star)}{\sqrt{|\Phi''(h^\star)|}} F(z - \Phi(\gamma, h^\star))$$

Q – ADCIG
$f(z)$ – wavelet
$h^\star$ – stationary offset

Φ – phase function
A – amplitude
γ – reflection angle

Weighted OFF2ANG

Weighted Slant – stack

$$\tilde{Q}(z,\gamma) \sim H(z,h^\star)\frac{A(h^\star)}{\sqrt{|\Phi''(h^\star)|}}F(z-\Phi(\gamma,h^\star))$$

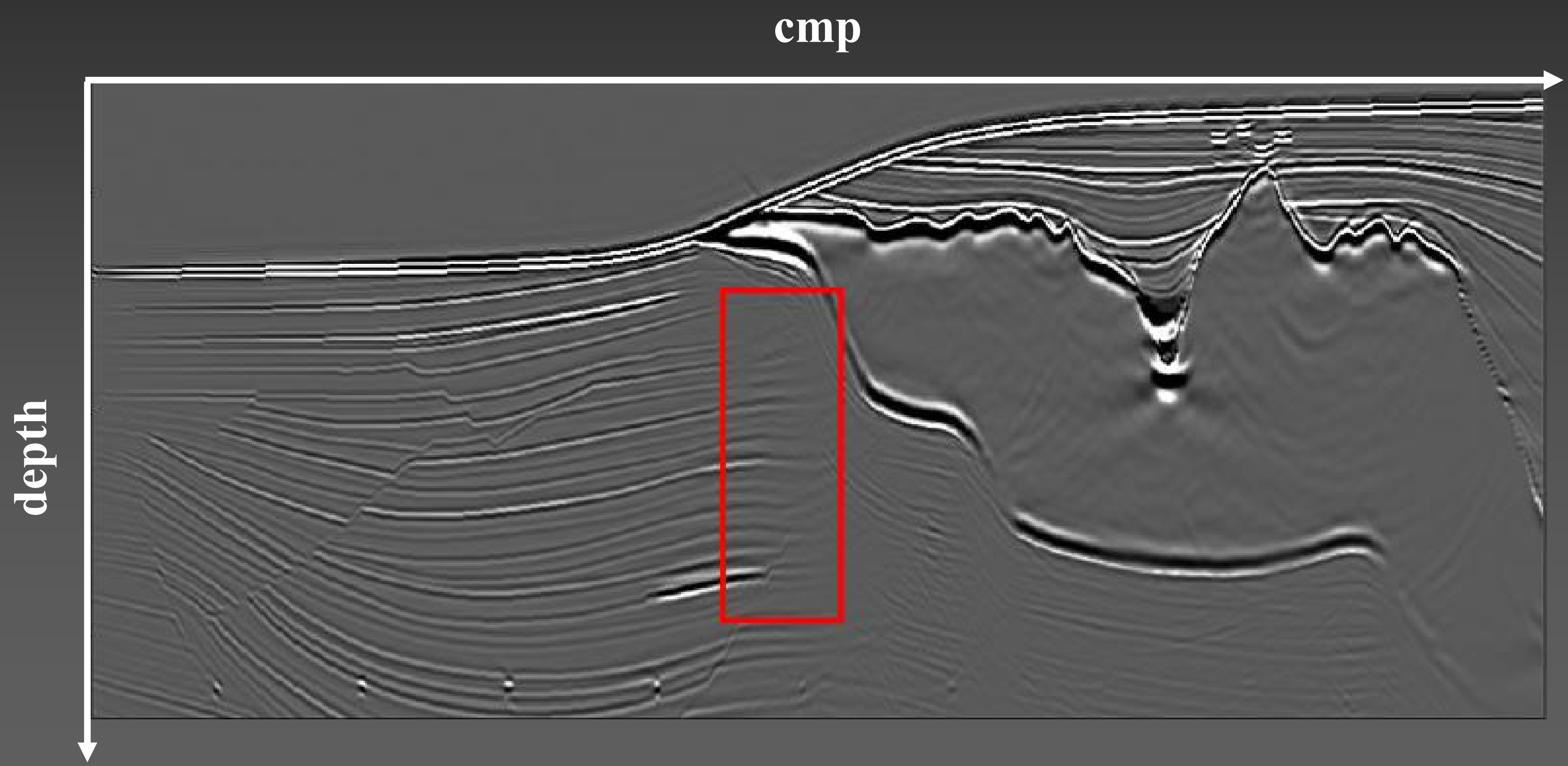
$$\widehat{H}(z,\gamma) \sim \langle \frac{\tilde{Q}Q}{Q^2+\epsilon} \rangle$$

$\tilde{Q}$ – ADCIG
$f(z)$ – wavelet
$h^\star$ – stationary offset

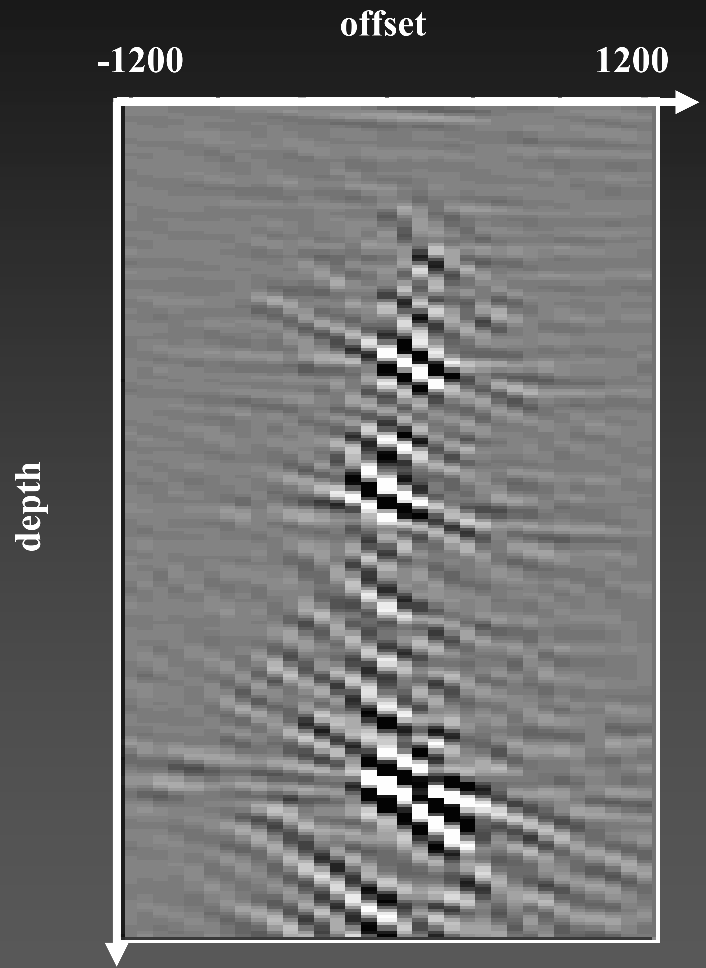
Φ – phase function
A – amplitude
γ – reflection angle

Results

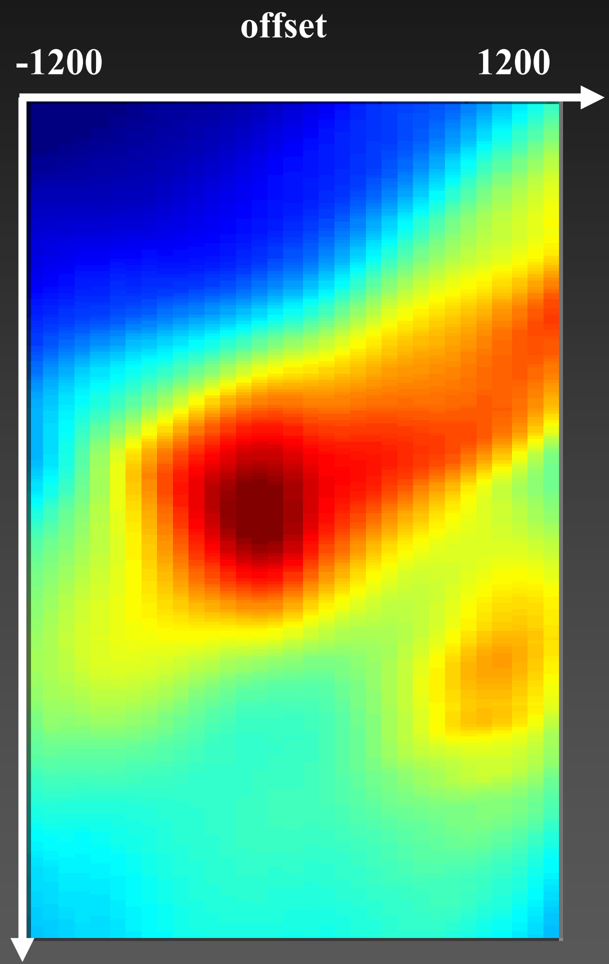
Sigsbee2b



Results – Input data

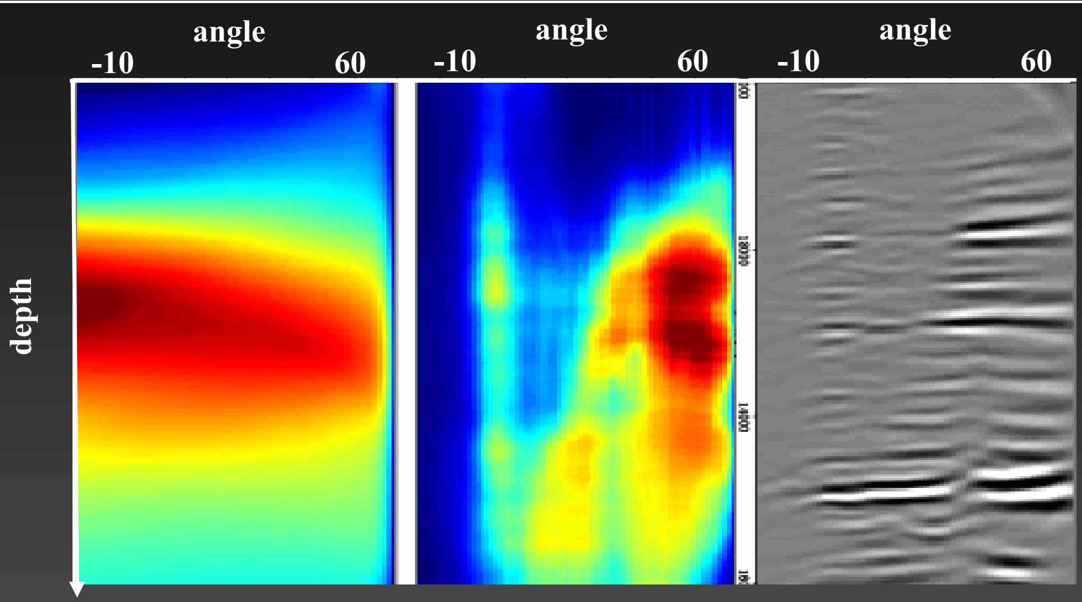


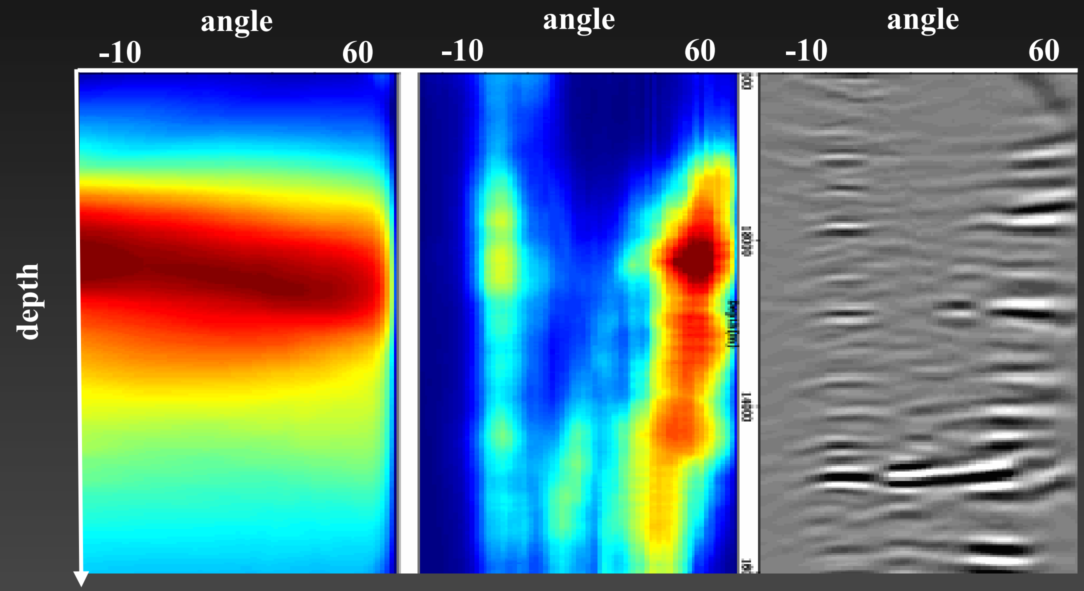
SODCIG



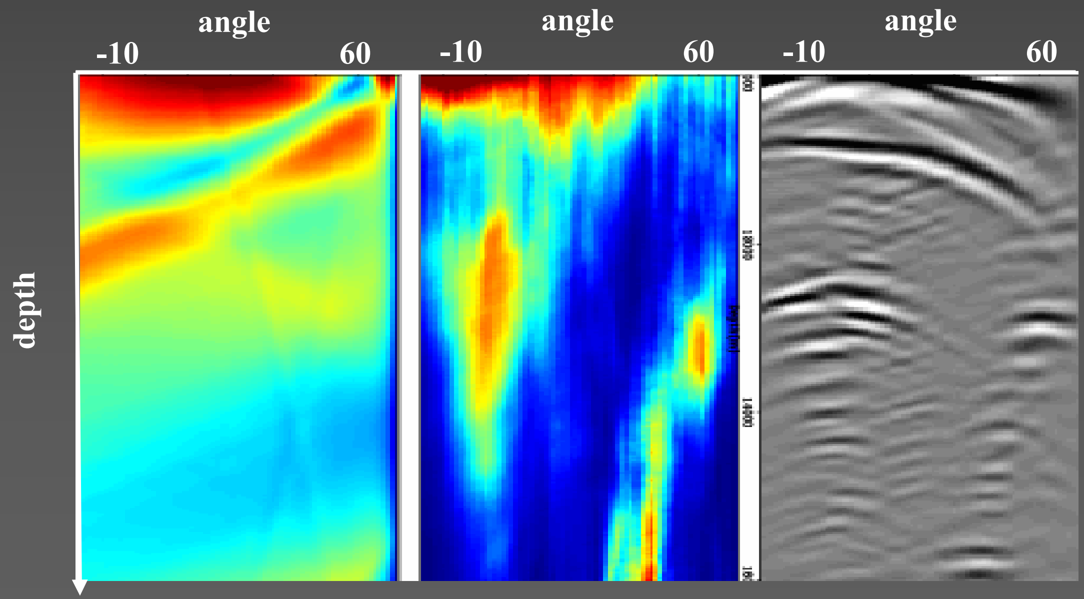
Diagonal of the Hessian

Results –ADCIGs

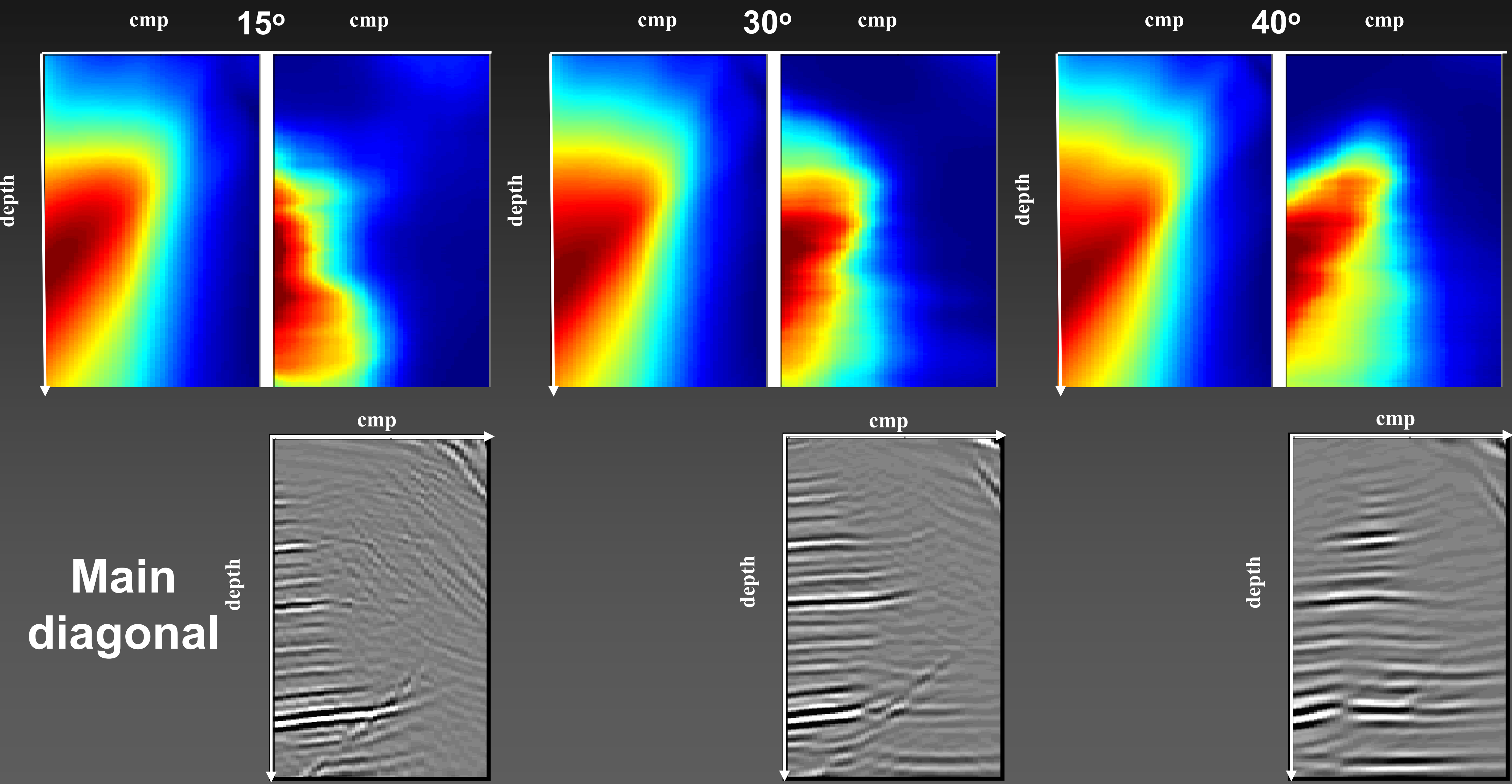




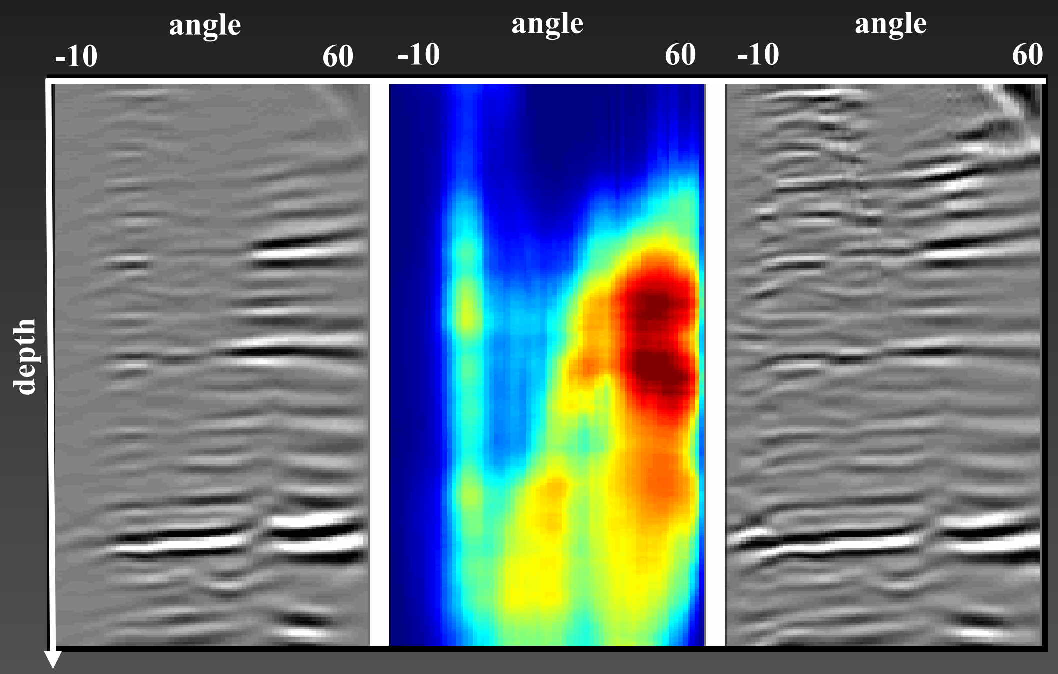
Main diagonal

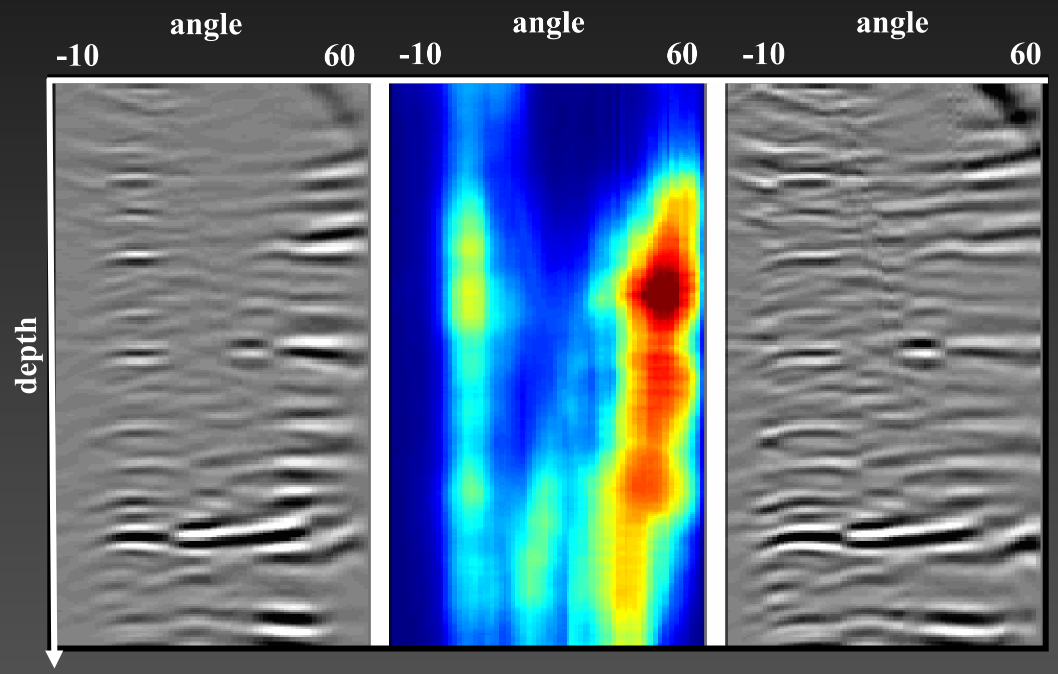


Results – Angle sections



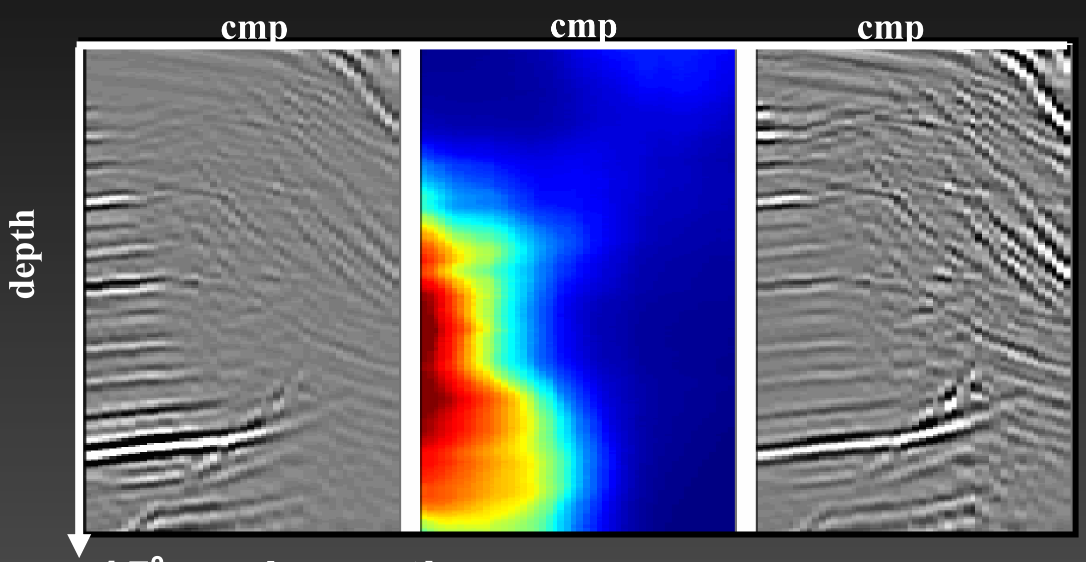
Results – Amplitude correction



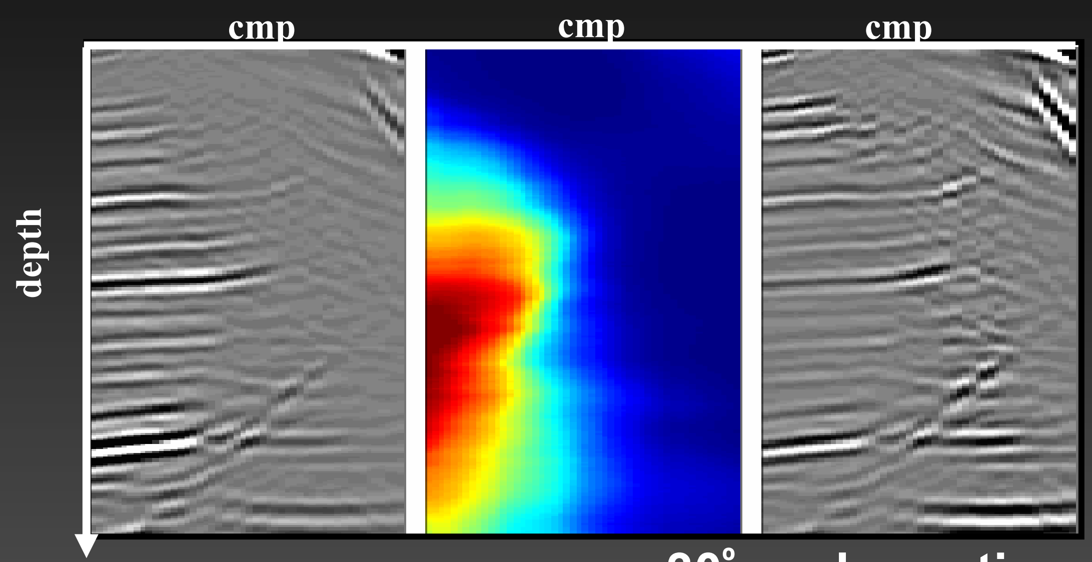


Main diagonal

Results – Amplitude correction

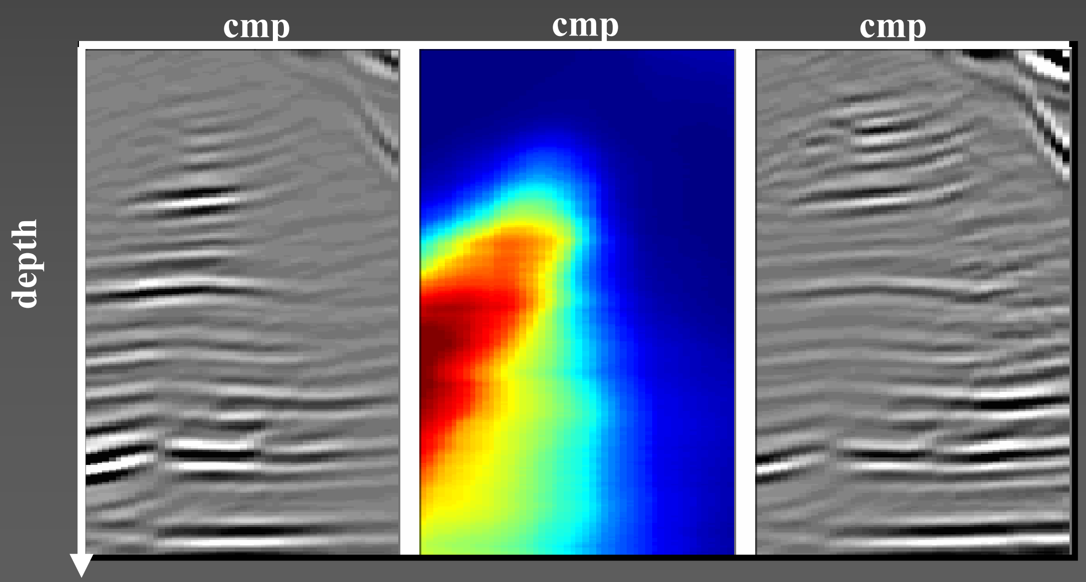


15° angle section



30° angle section

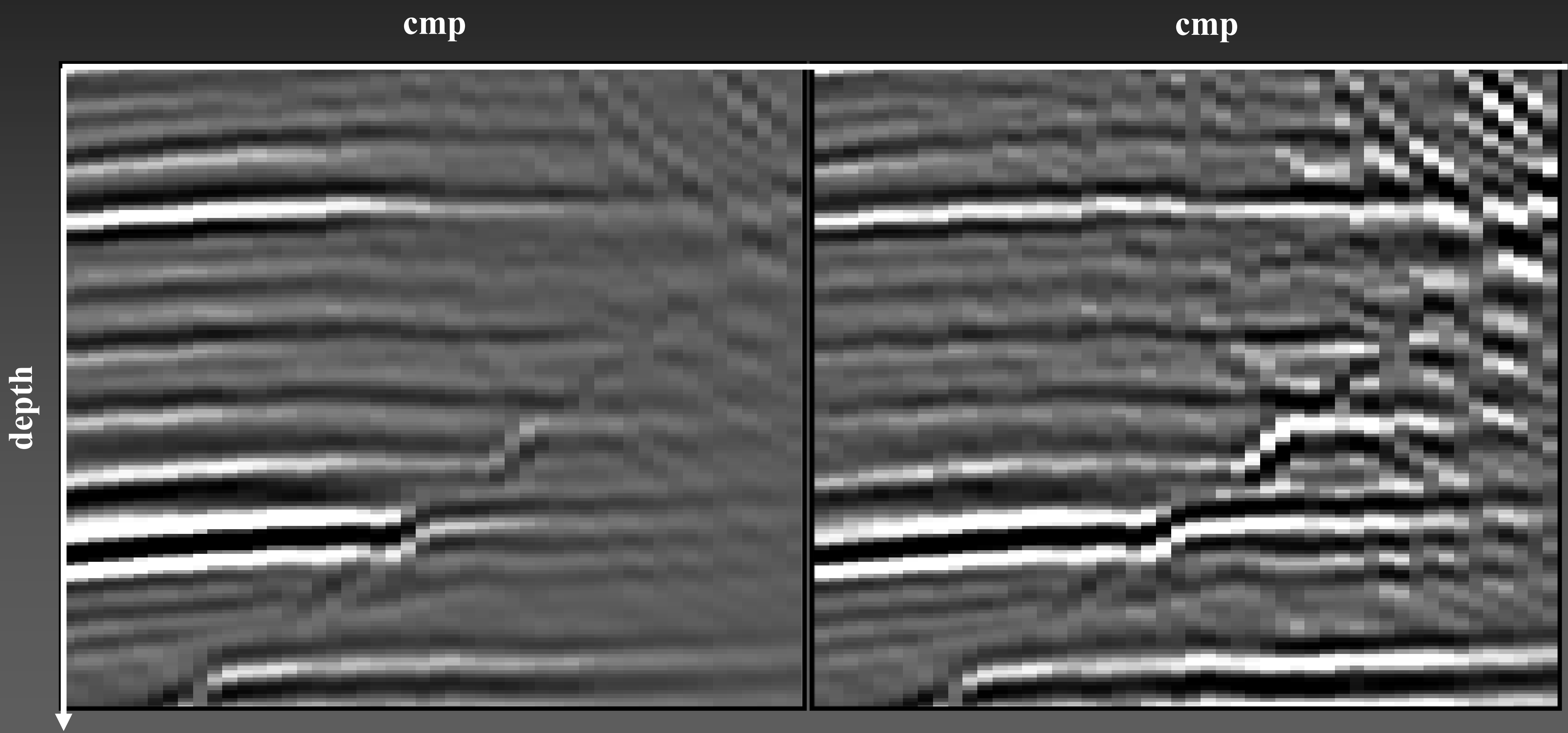
Main diagonal



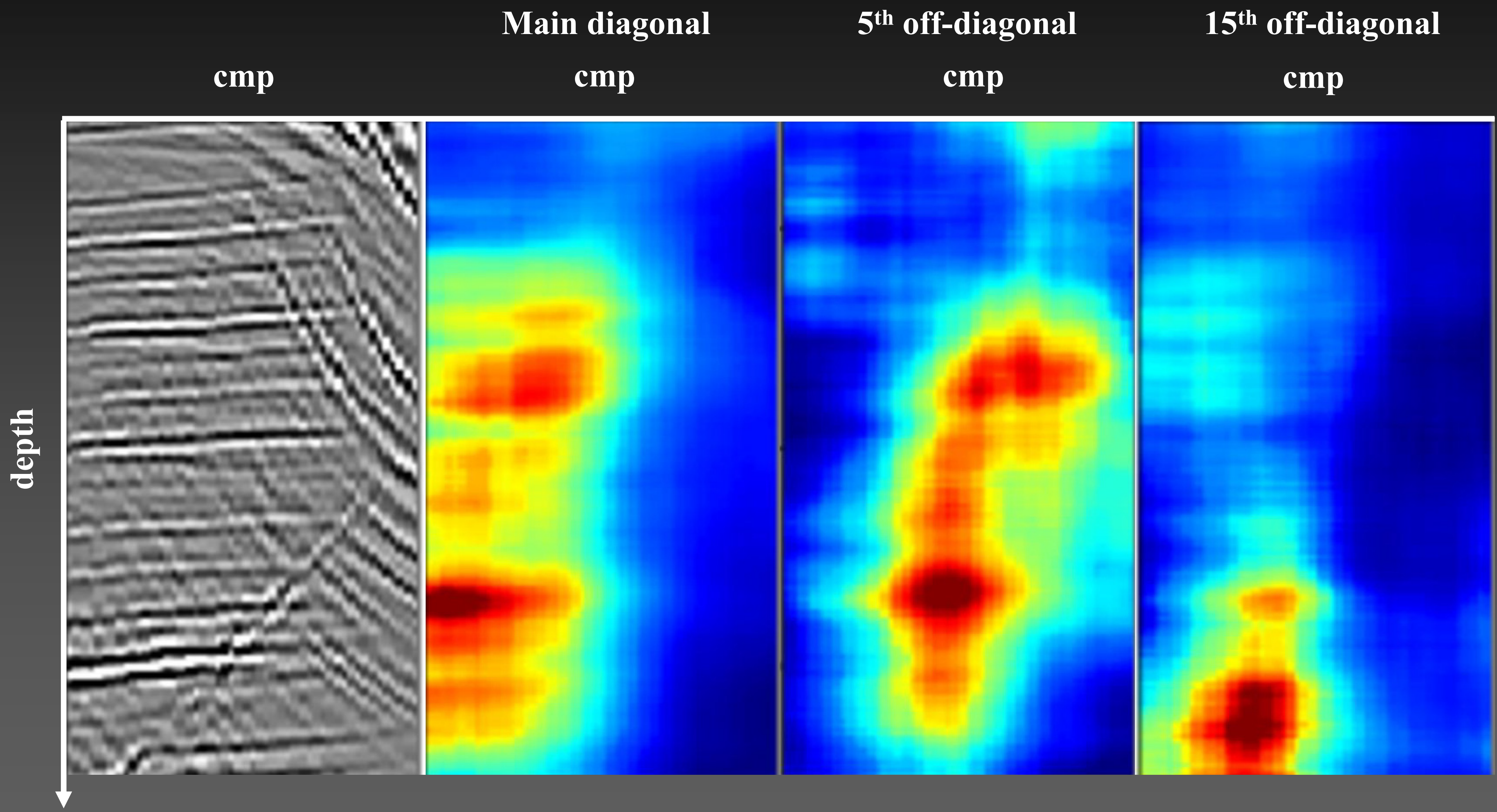
45° angle section

Results – Amplitude correction

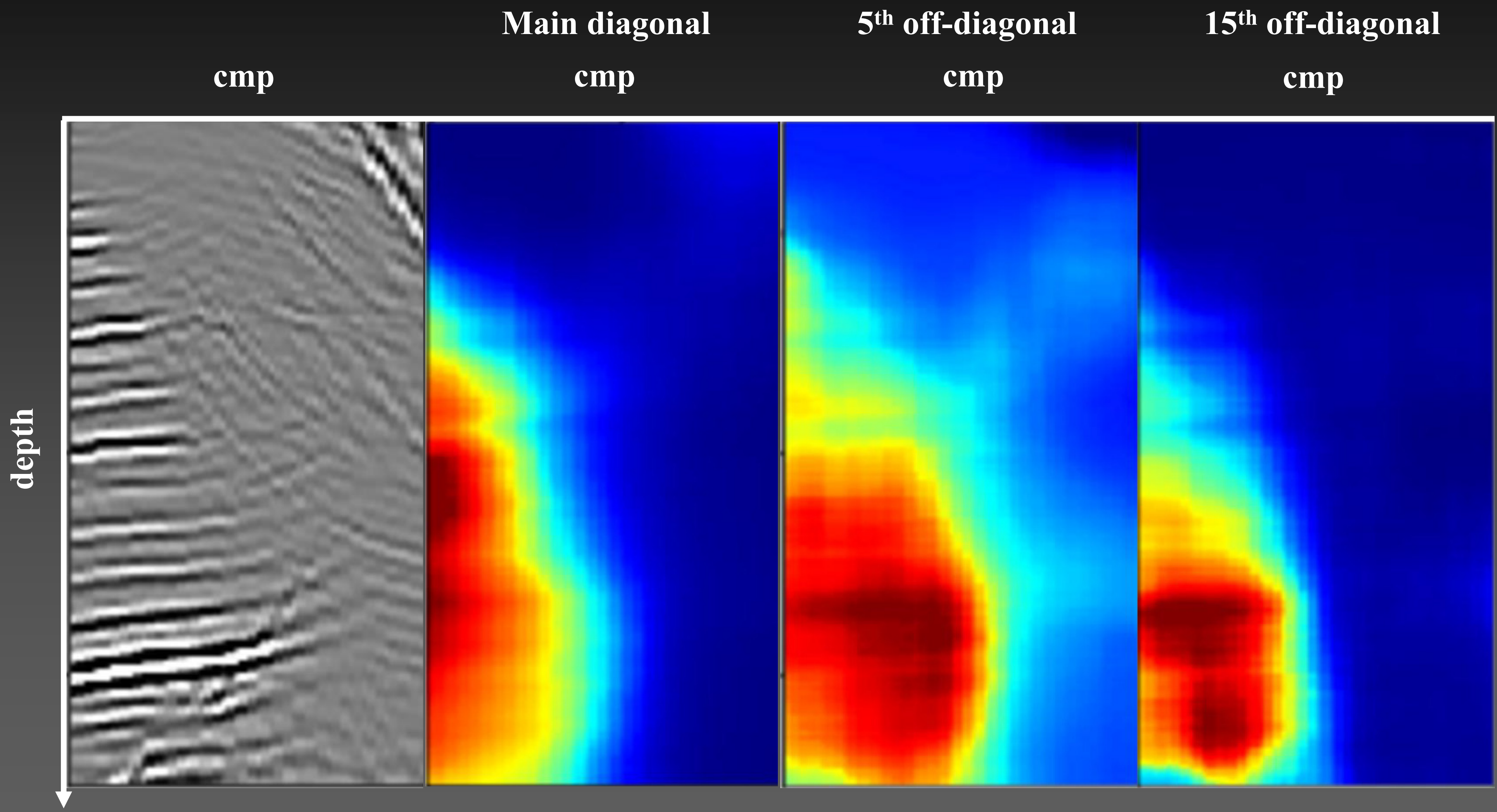
Angle stack



Results – 0° Off-diagonals



Results – 15º Off-diagonals



Conclusions

- Alternative approach to transform the Hessian to the angle domain
- Well balanced ADCIGs
  - Better angle-stack
- Off-diagonal terms
  - Still no direct application