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New advances in the Common-Reflection-Surface Stack

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Overview

- Introduction
- 2-D examples
- Applications of the CRS attributes
  - stacking velocity
  - true amplitude analysis
  - model independent time migration
  - wavefield separation
- Conclusions

Can there be

anything better than

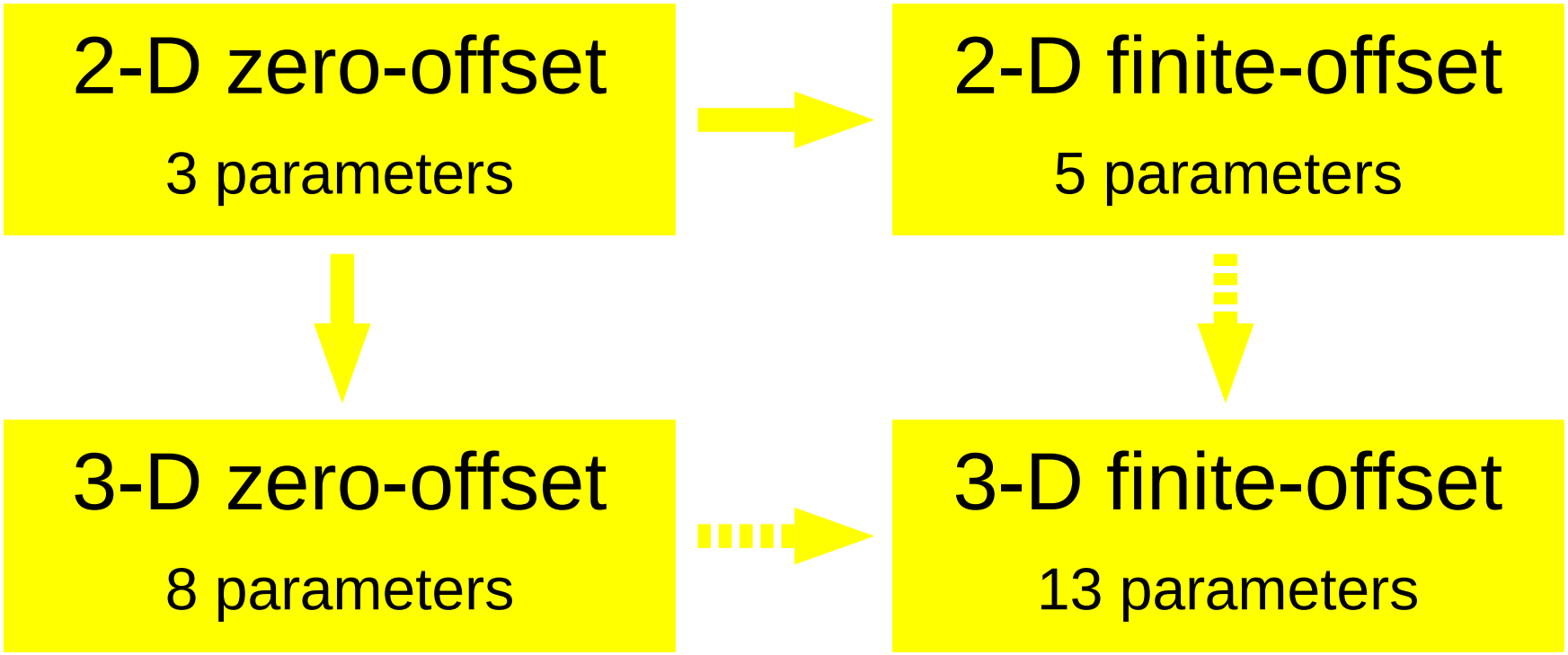
Pre-stack depth migration

or

NMO/DMO/Stack ?

Development of the CRS stack method

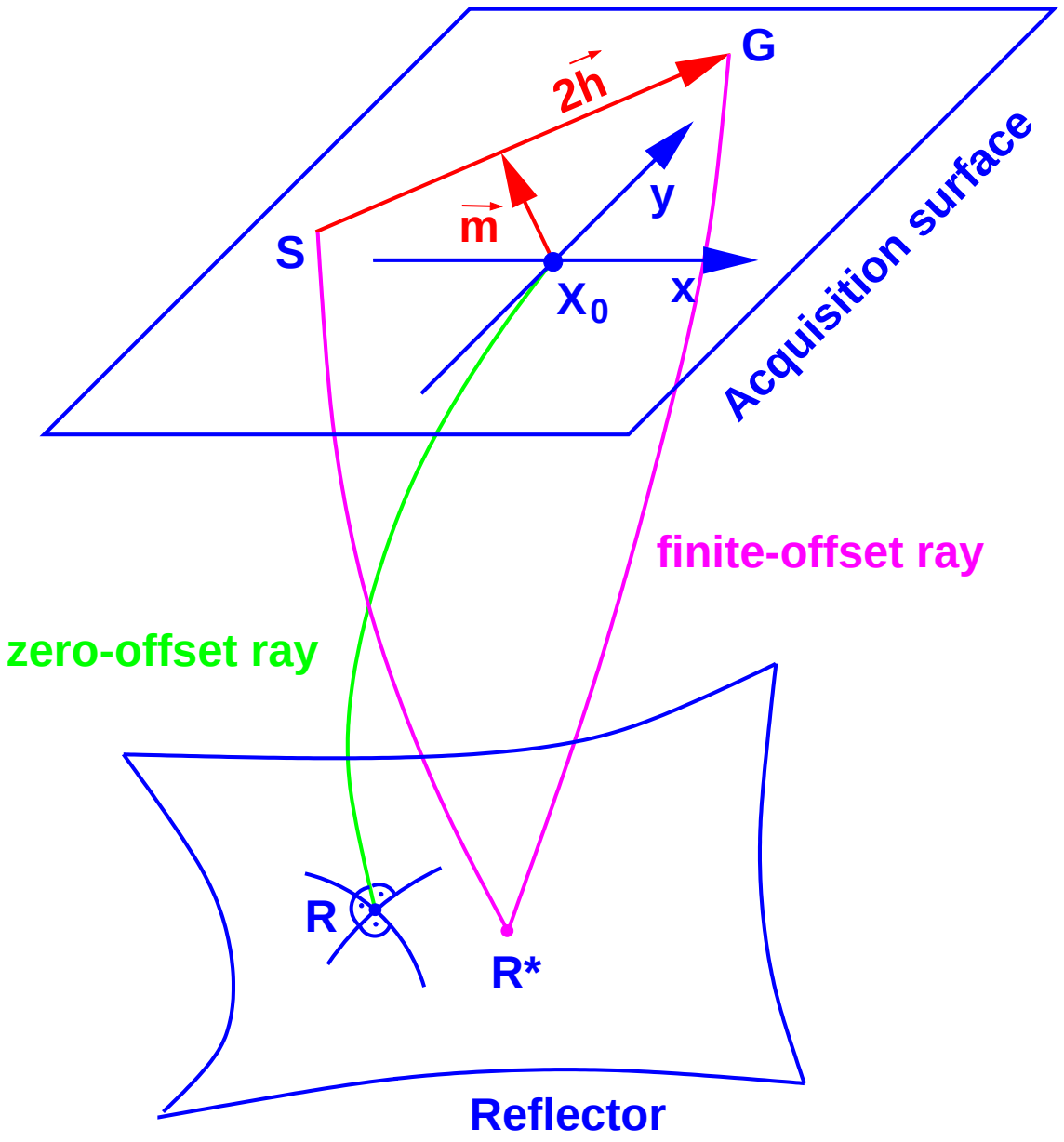
Multi-parameter moveout operators for model independent stacking



Arbitrary acquisition configuration

$$\vec{h} = \frac{1}{2}\begin{pmatrix} x_G - x_S \\ y_G - y_S \end{pmatrix}$$

$$\vec{m} = \frac{1}{2}\begin{pmatrix} x_G + x_S \\ y_G + y_S \end{pmatrix}$$



CRS stacking operators for zero-offset

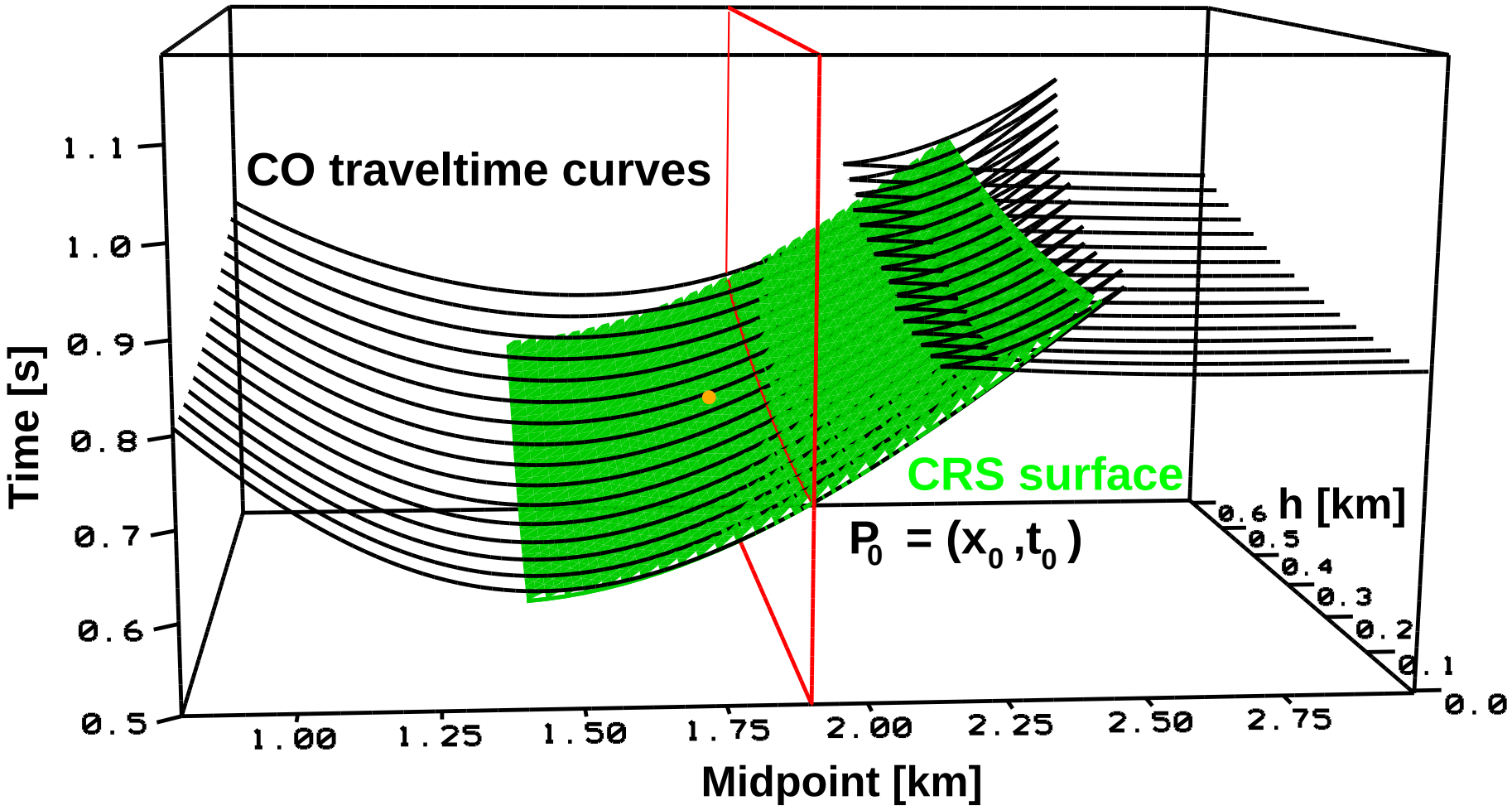
3-D case:

$$t_{hyp}^2 = \left(t_0 - \frac{2}{v_0}\vec{c}\cdot\vec{m}\right)^2 + \frac{2t_0}{v_0}\left(\vec{m}^T\underline{A}\vec{m} + \vec{h}^T\underline{B}\vec{h}\right)$$

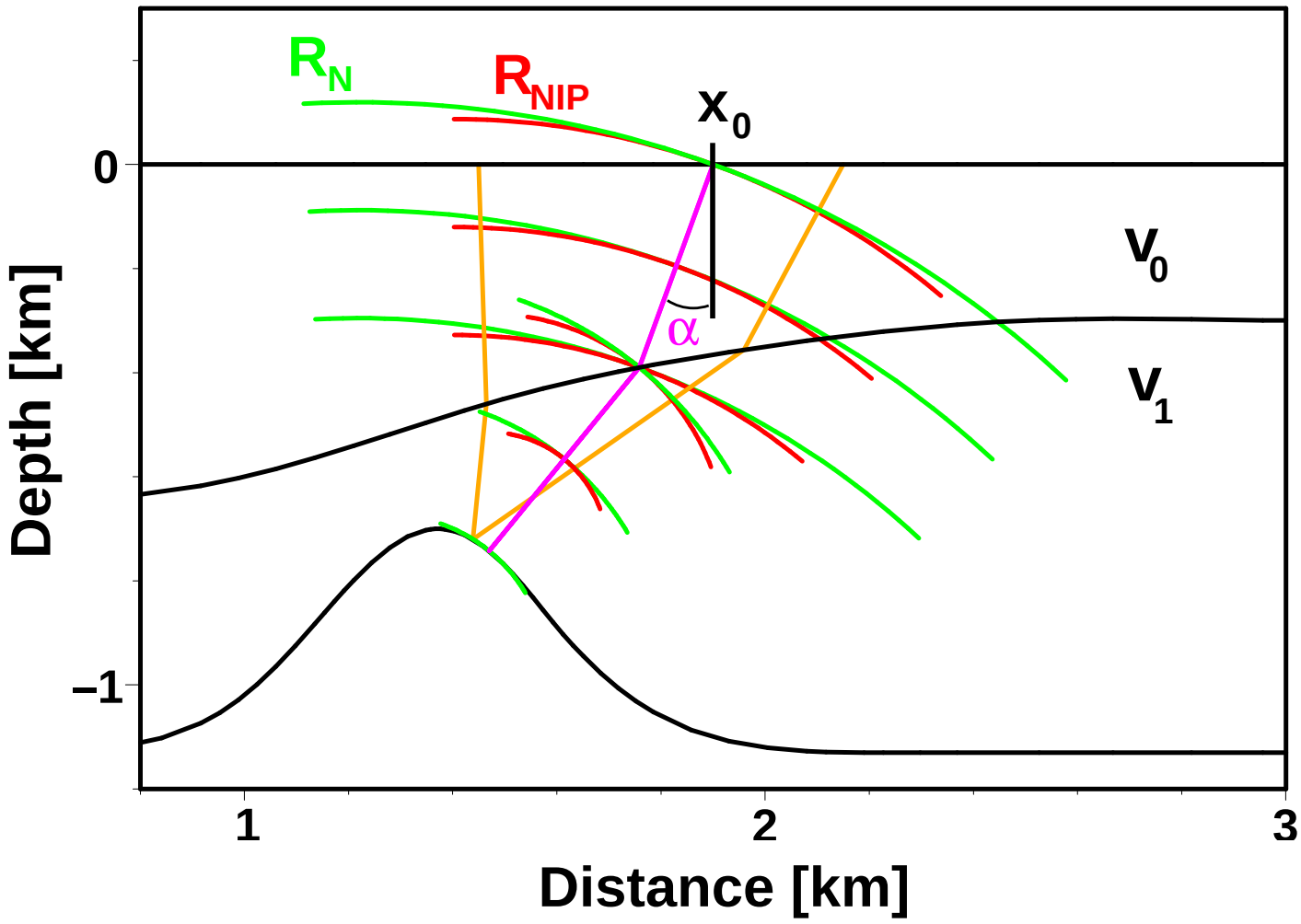
2-D case:

$$t_{hyp}^2 = \left(t_0 - \frac{2\sin\alpha}{v_0}m\right)^2 + \frac{2t_0\cos^2\alpha}{v_0}\left(\frac{m^2}{R_N} + \frac{h^2}{R_{NIP}}\right)$$

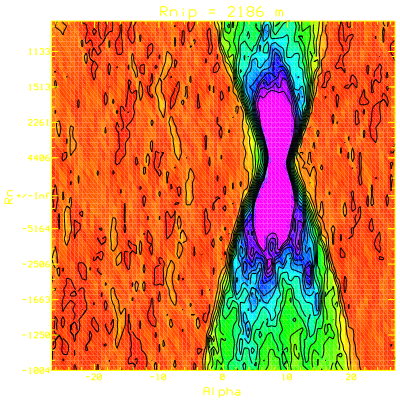
2-D zero-offset case

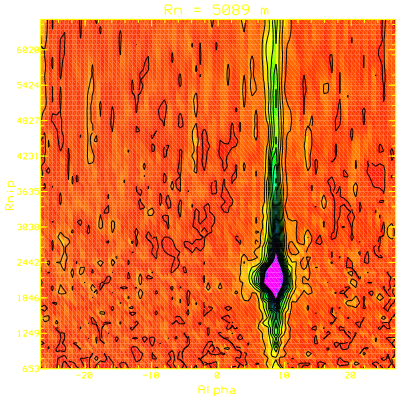


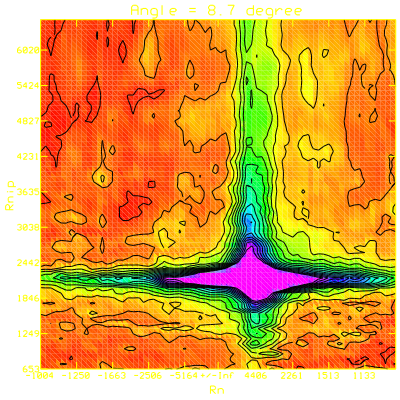
2-D zero-offset case

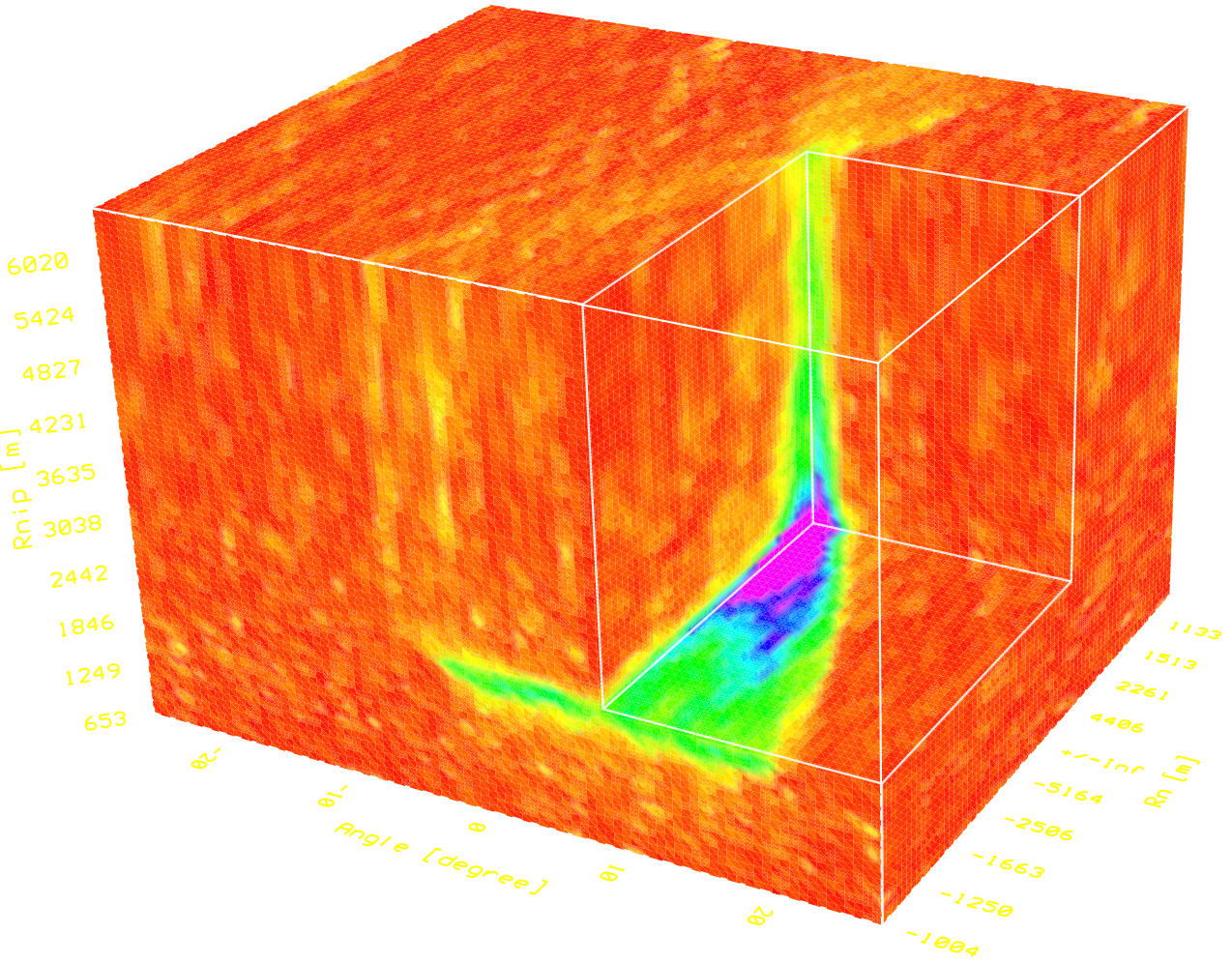


Coherence in the attribute domain

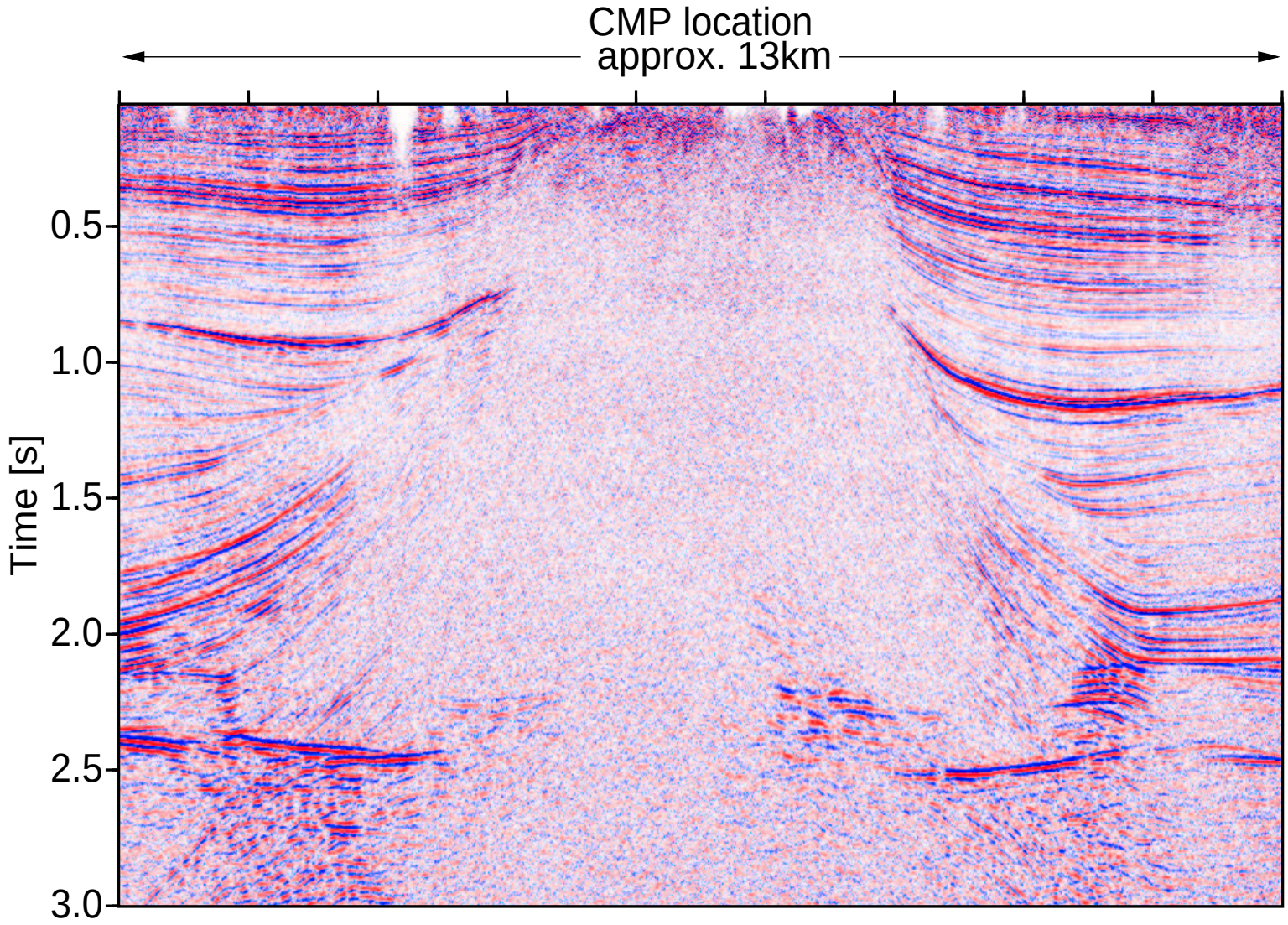




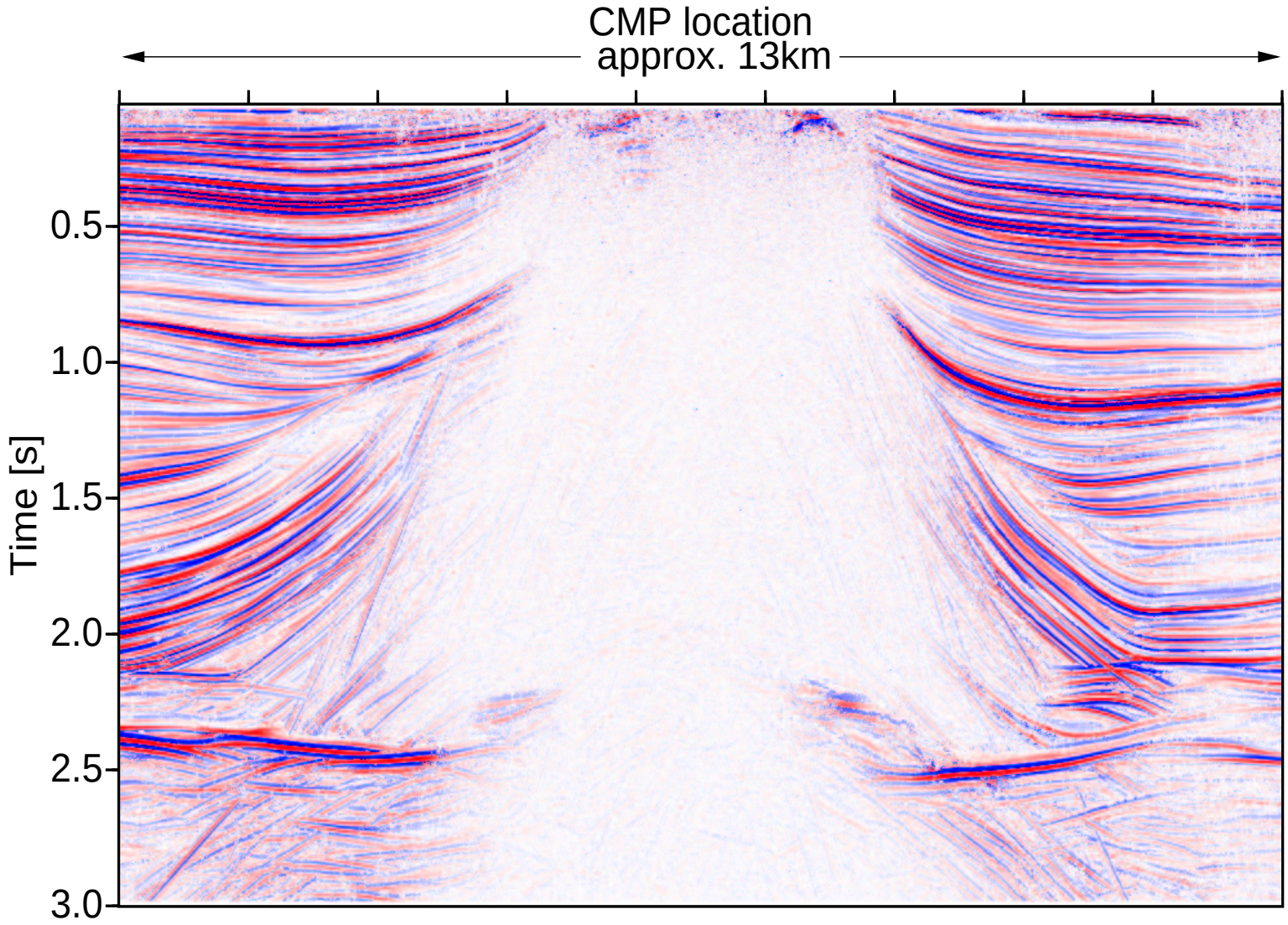




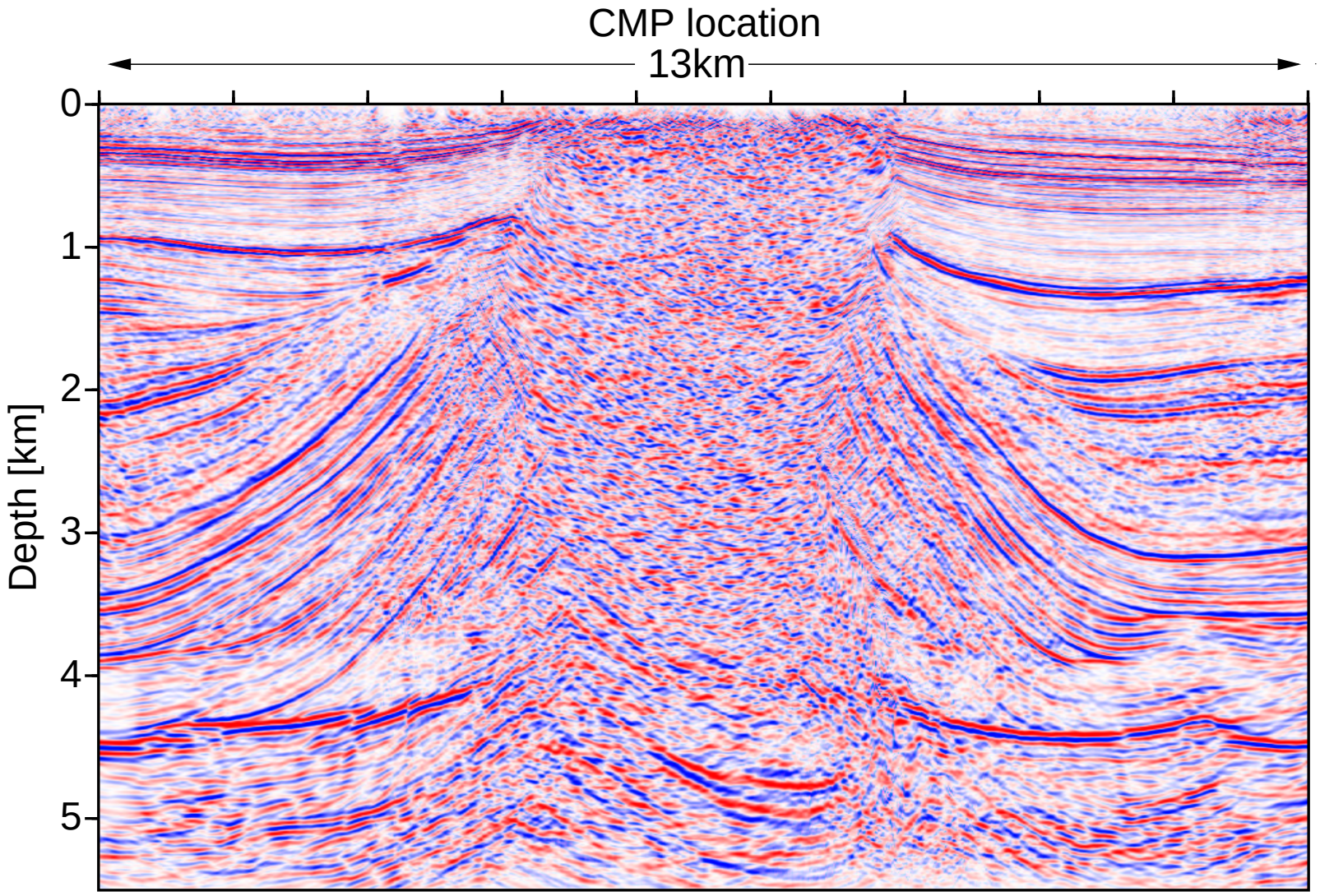
Result of NMO/DMO/Stack



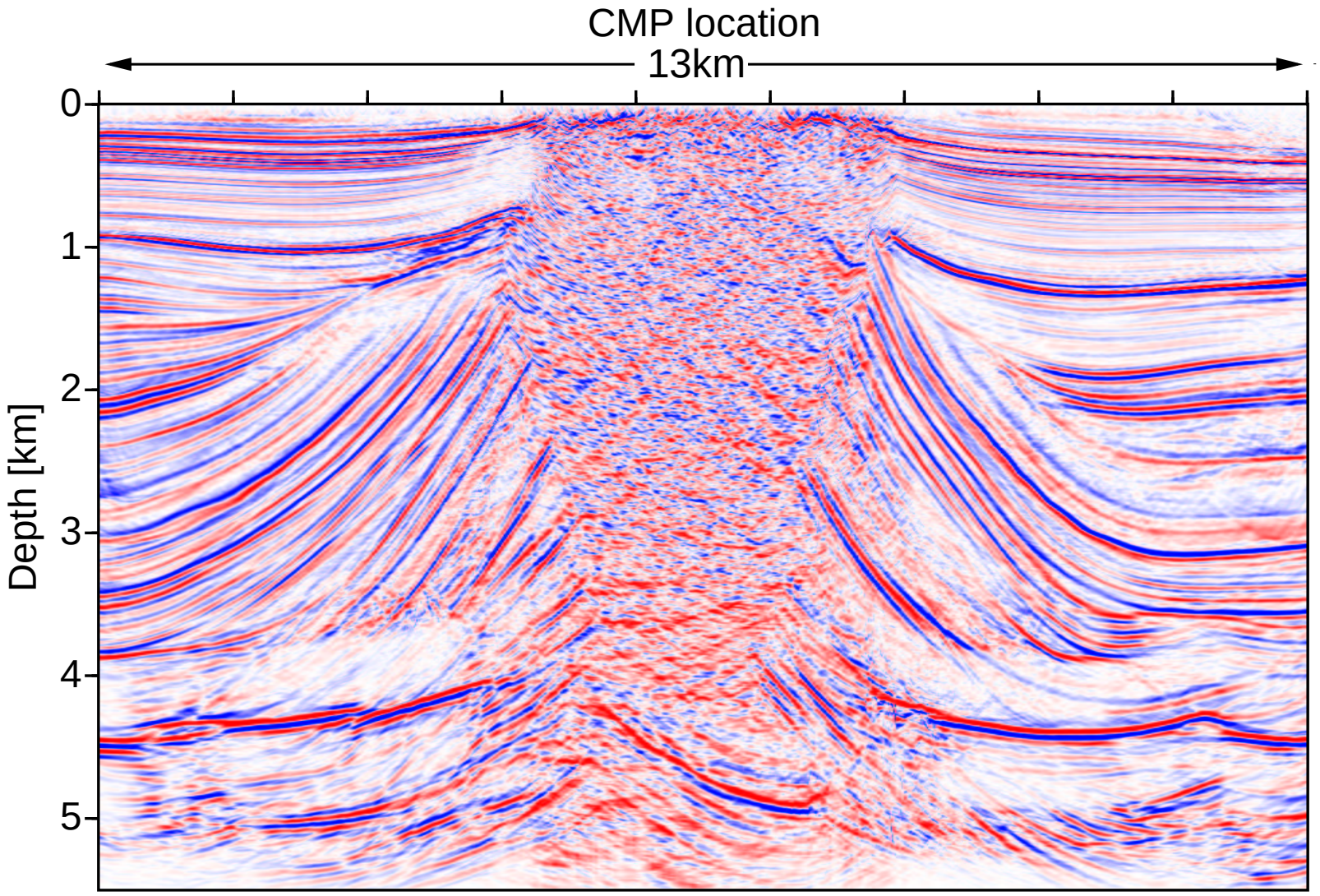
Result of CRS stack



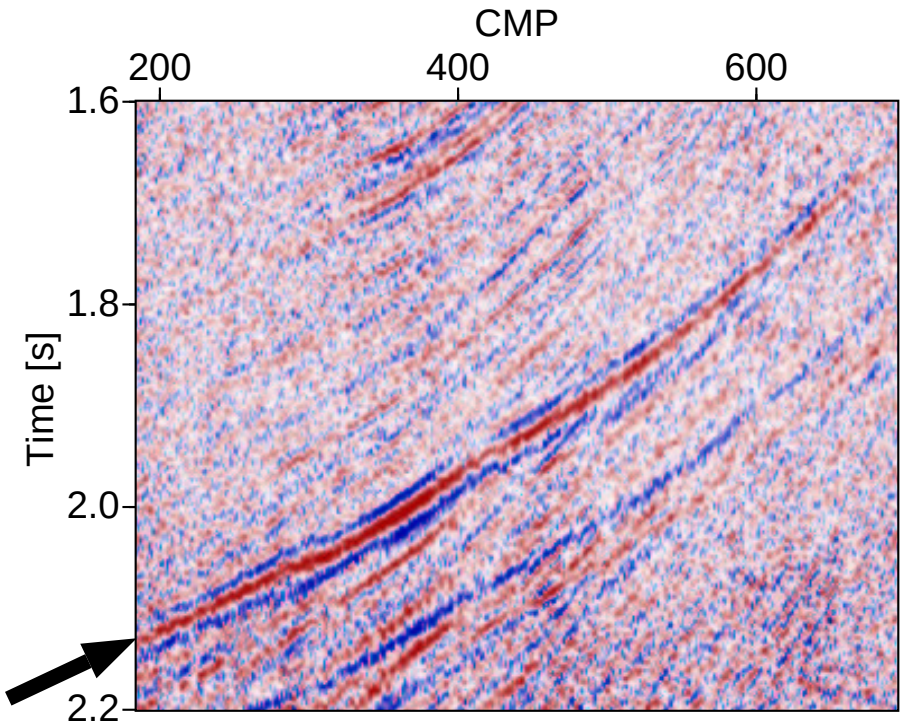
Depth migration of NMO/DMO/Stack



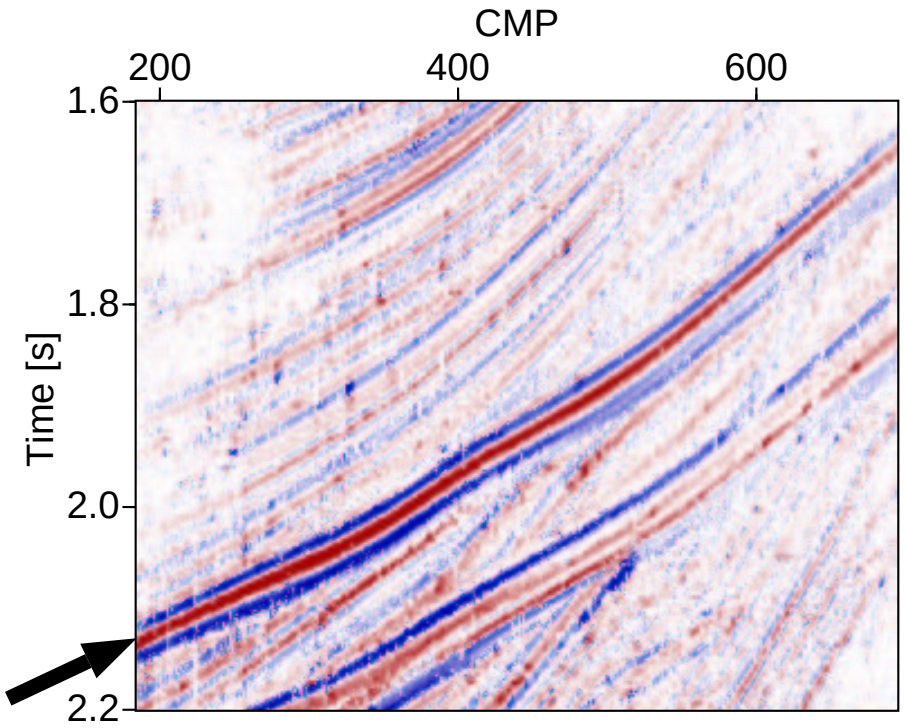
Depth migration of CRS stack



Applications of the attributes

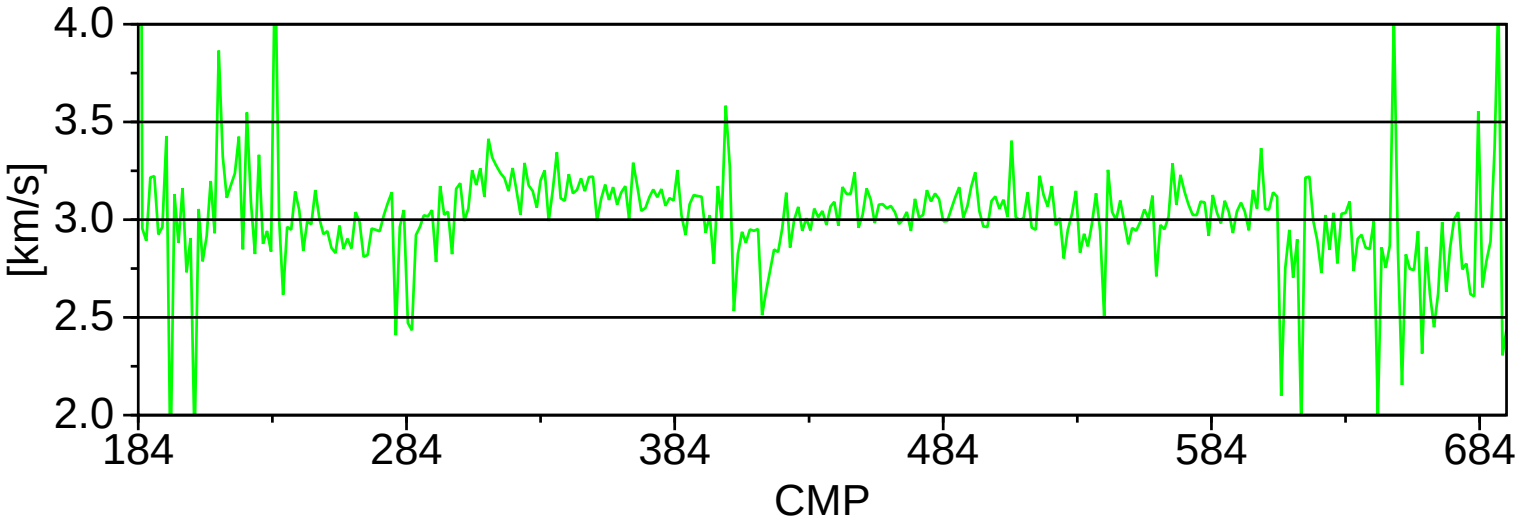


CMP stacked section

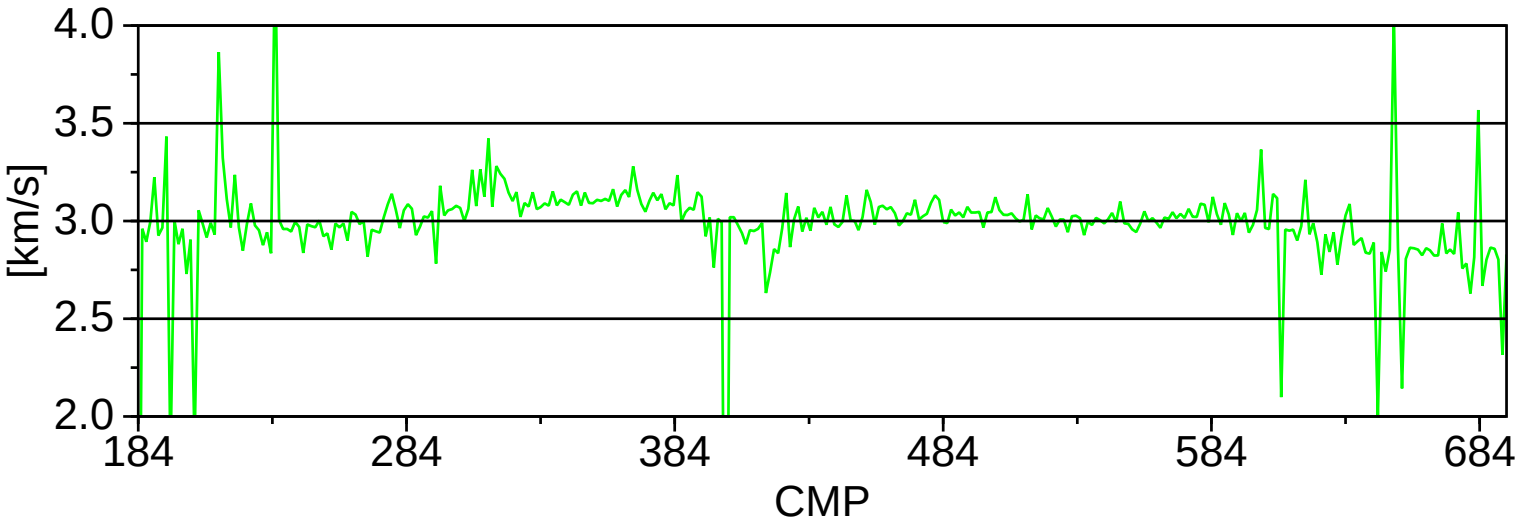


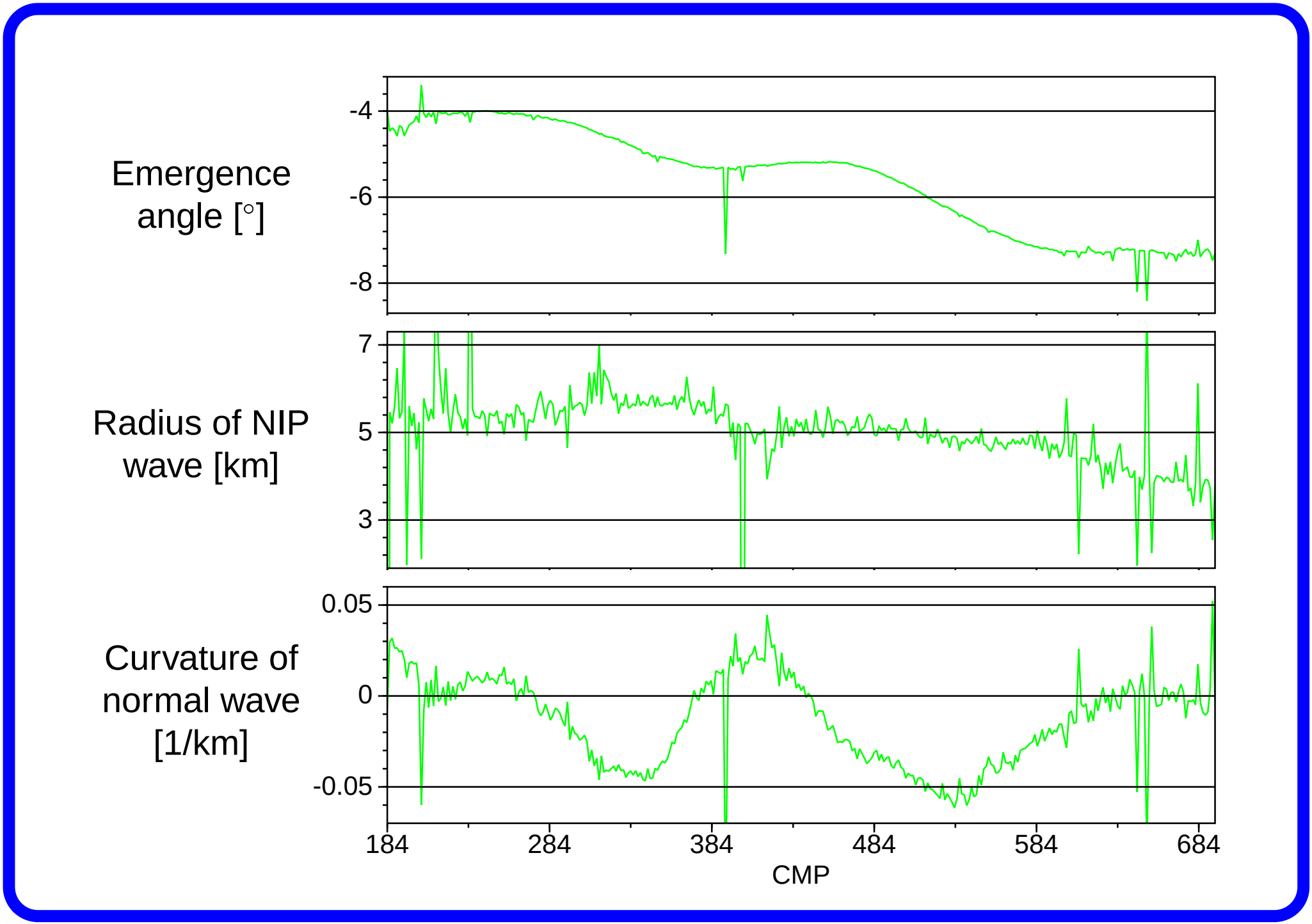
CRS stacked section

CMP NMO velocity

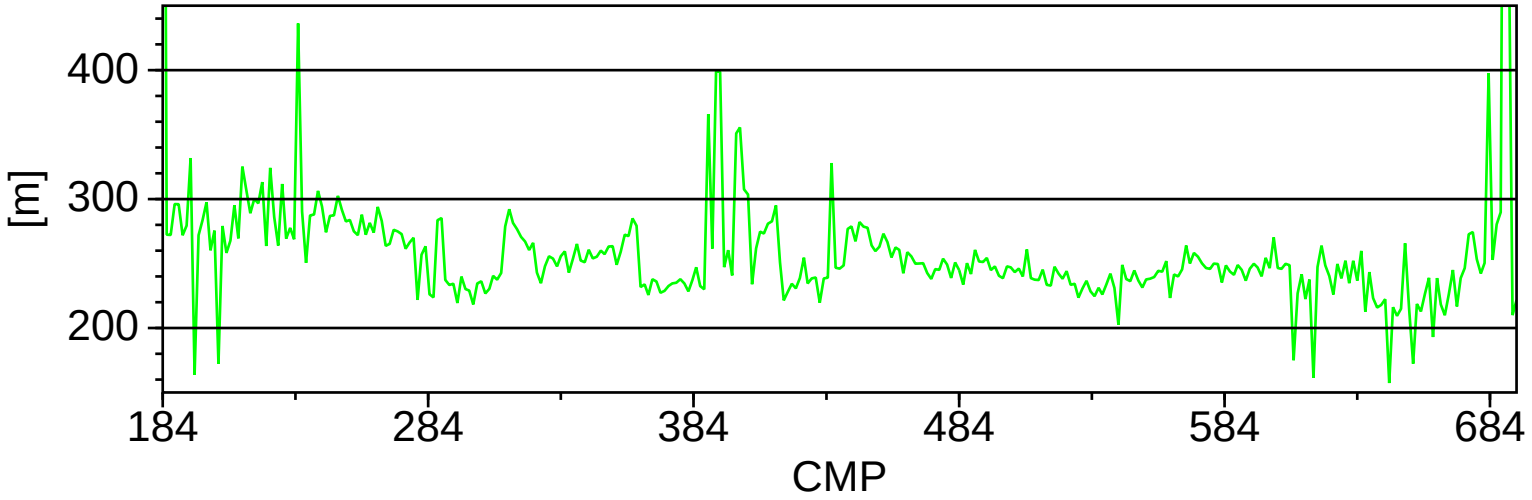


CRS NMO velocity

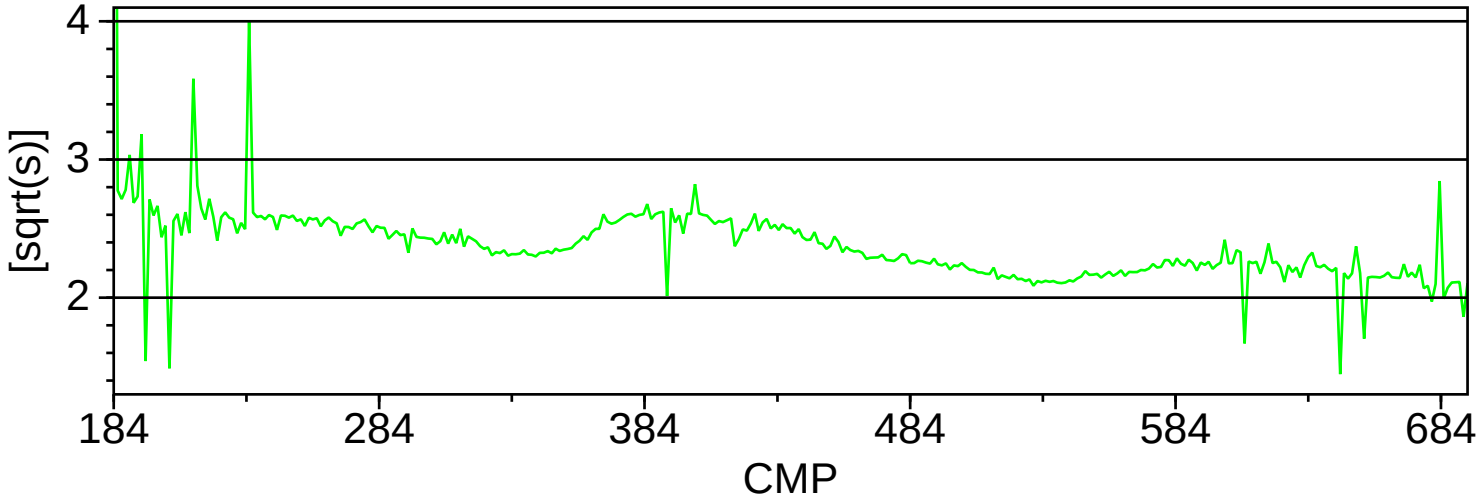



Emergence angle [°]
-4
-6
-8
Radius of NIP wave [km]
7
5
3
Curvature of normal wave [1/km]
0.05
0
-0.05
184
284
384
484
584
684
CMP

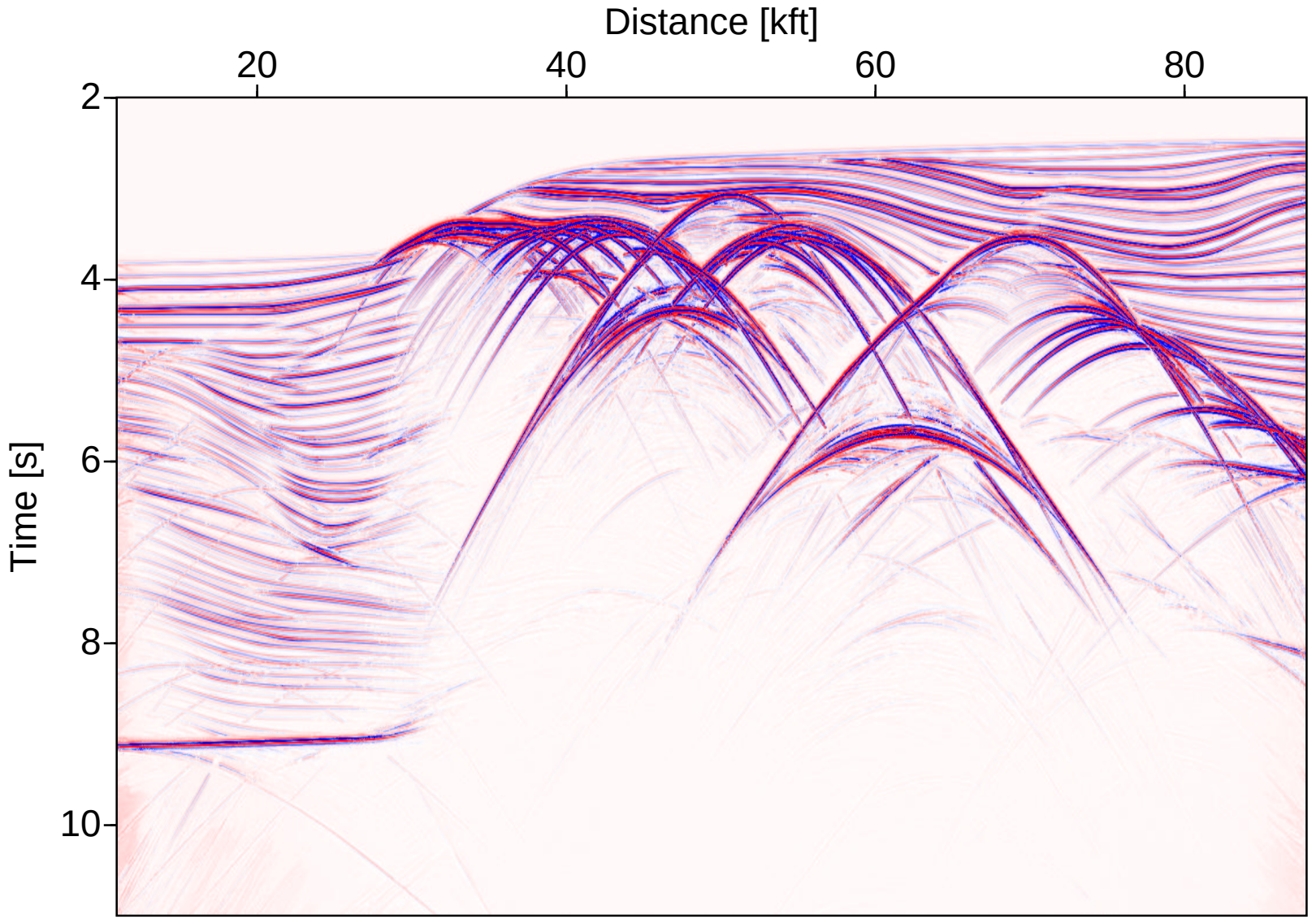
Projected Fresnel zone



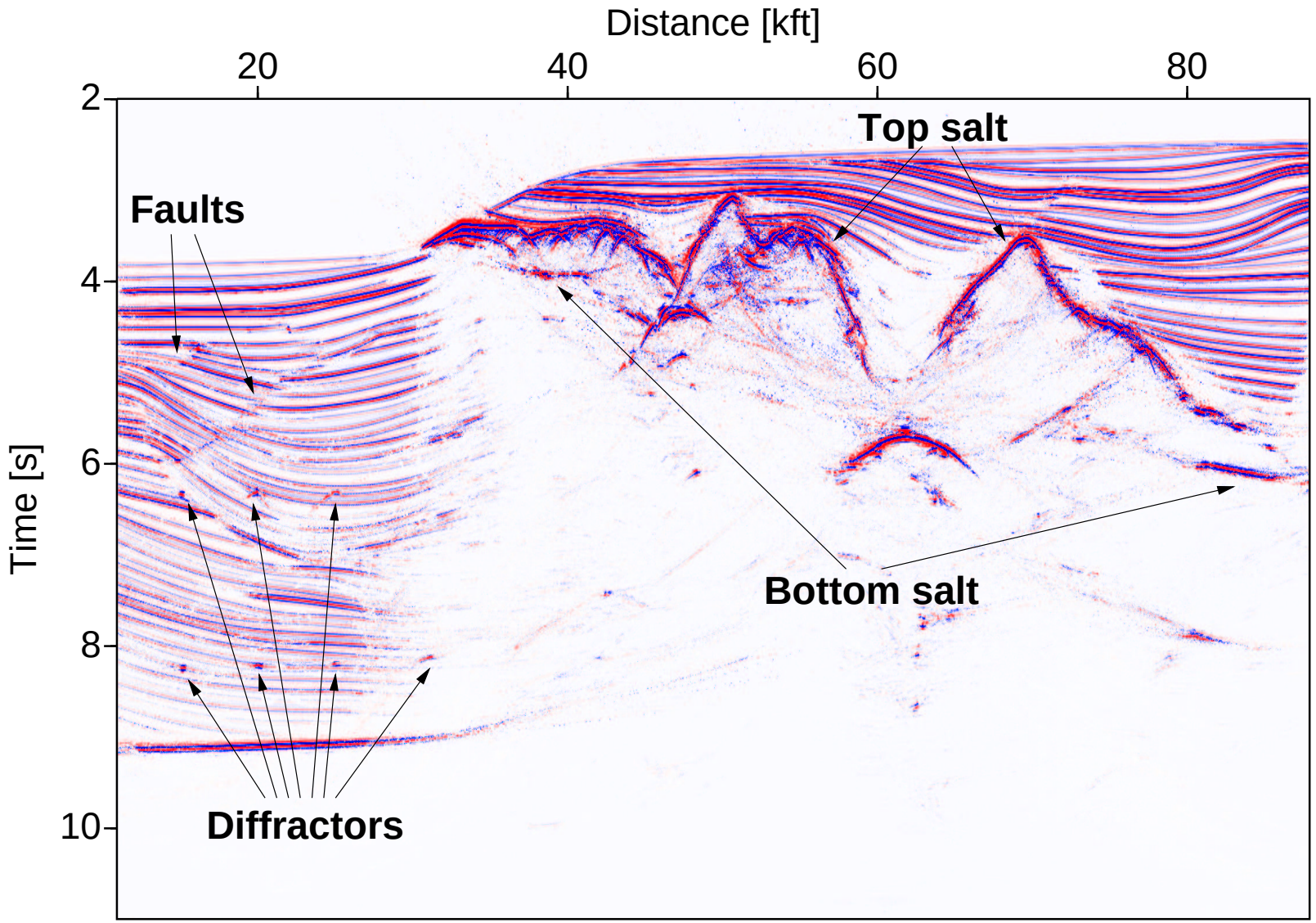
Normalized in-plane geometrical spreading



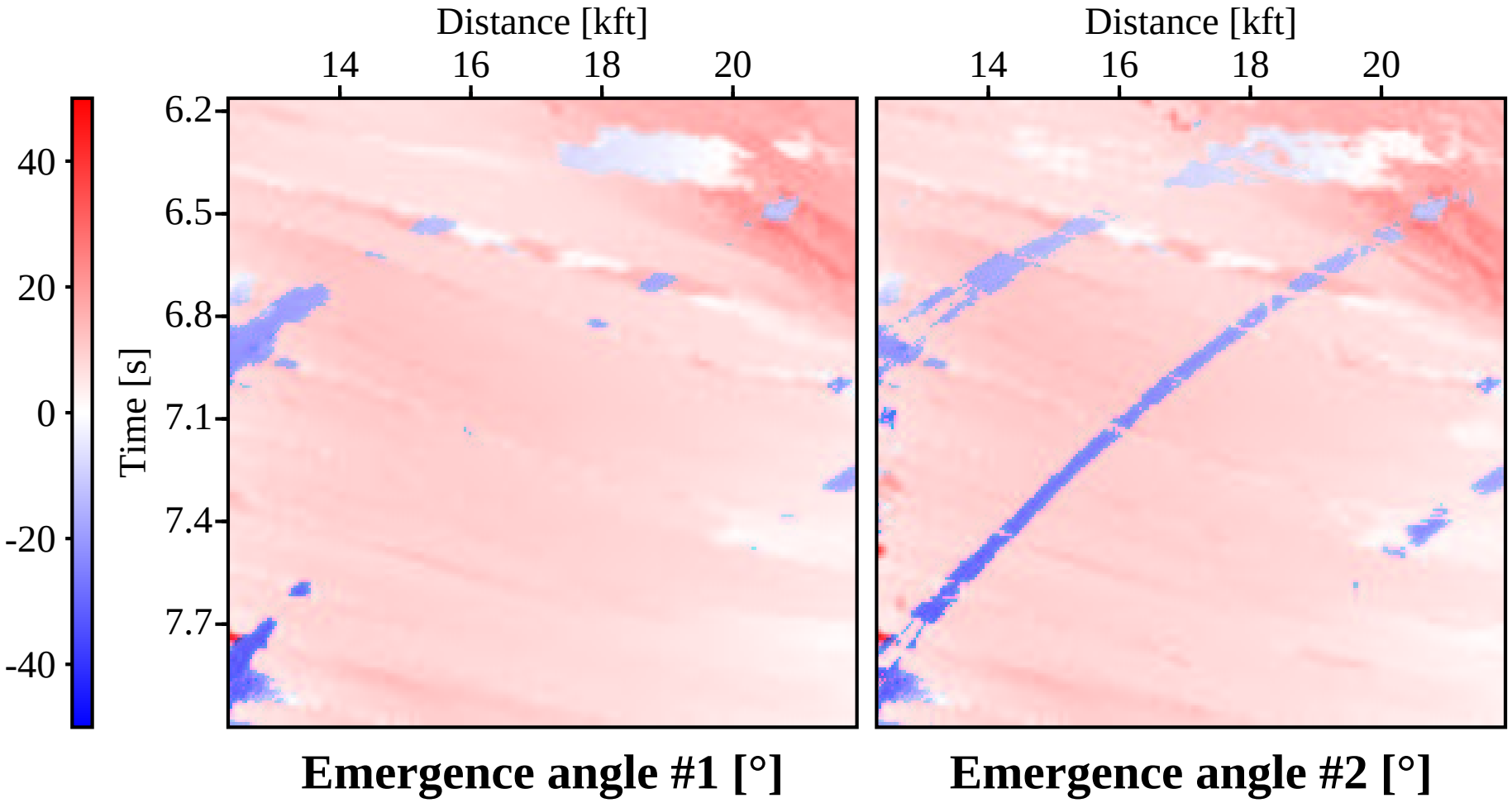
Sigsbee 2A data: CRS stacked section



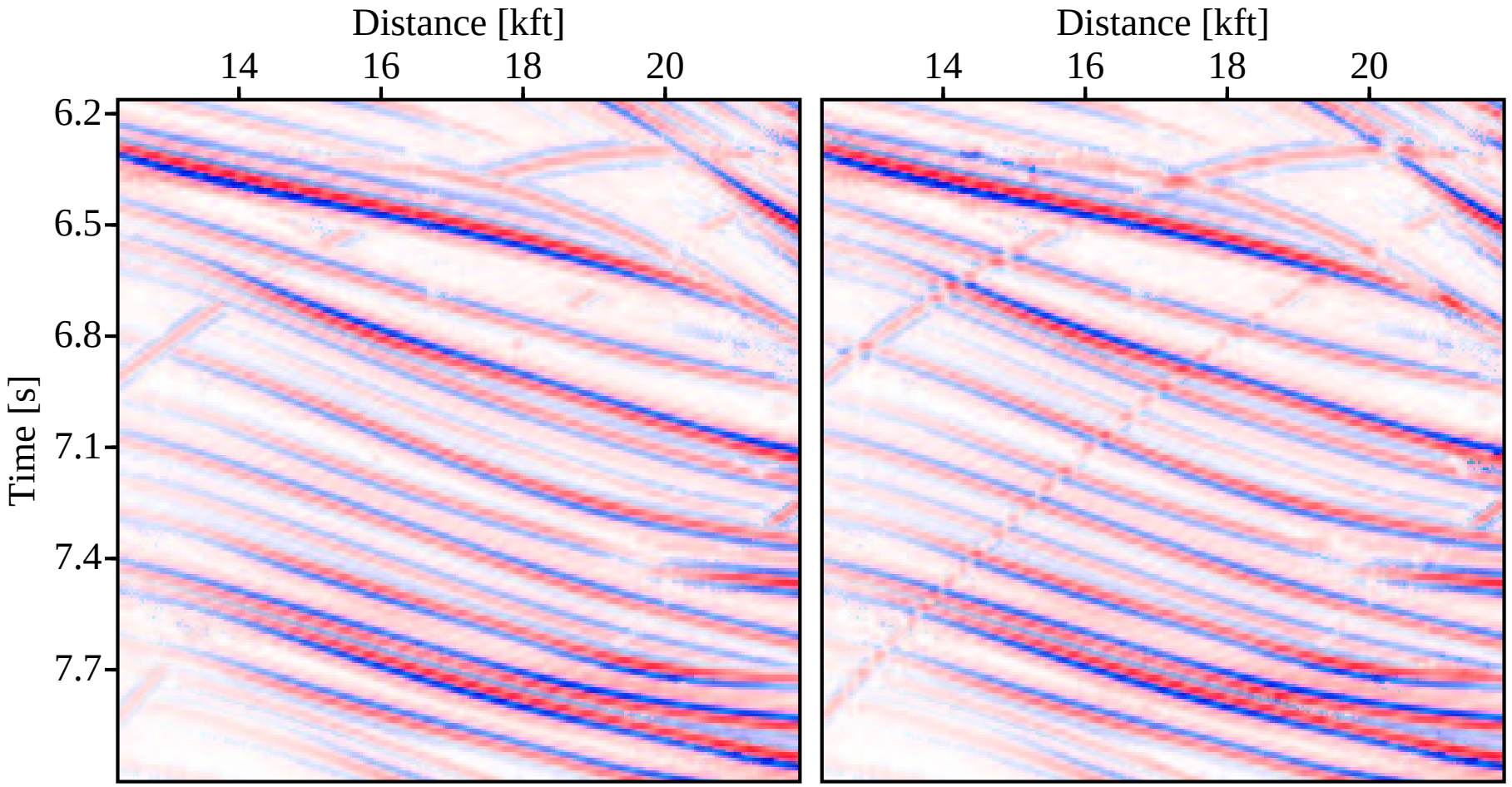
Model independent time migration



Wavefield separation

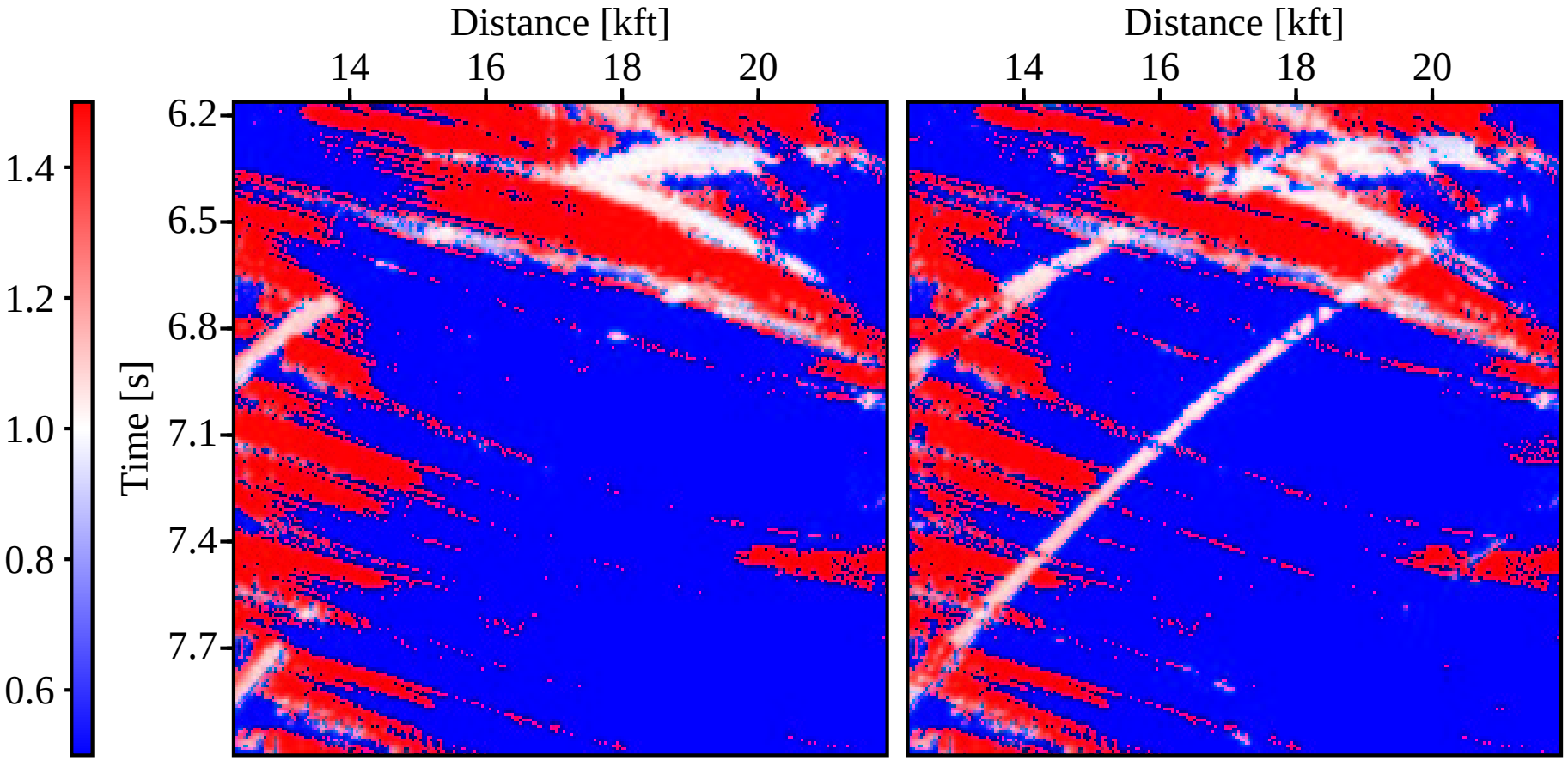


Conflicting dip handling



Pragmatic CRS stack **Extended CRS stack**

Wavefield separation



Ratio Rn/Rnip #1 **Ratio Rn/Rnip #2**

Conclusions (I)

CRS stacked section:

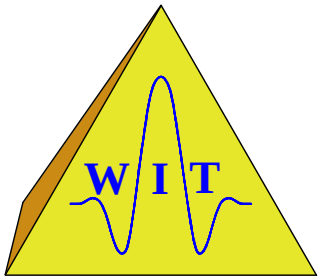
- completely data-driven method
- high signal-to-noise ratio
- high vertical resolution
- increased continuity of events

Conclusions (II)

Kinematic wavefield attributes:

- more accurate stacking velocity
- projected Fresnel zone for parsimonious migration
- geometrical spreading factor for
  - natural gain functions
  - true amplitude analysis
- model-independent time migration and inversion
- wavefield separation

Acknowledgments



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