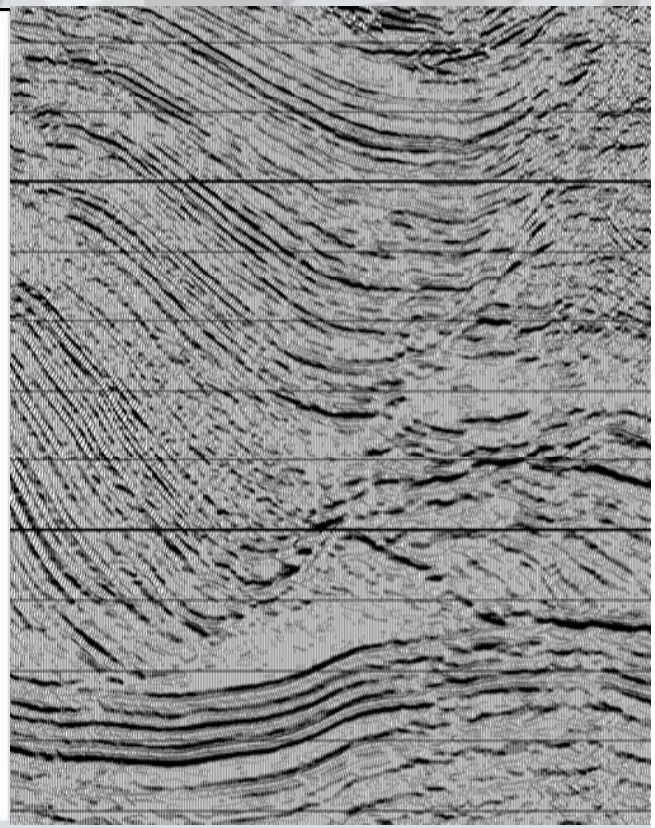
TIKIM

"Kirchhoff pre-stack time migration"

Overview



(Jean-Claude LANCELOT)

*Meeting **EGEODE** Massy*

December 10th 2007

TIKIM overview

Limited to 2D Marine Processing

- ✓ **Part1:** Introduction to time imaging *(reminder)*
- ✓ **Part2:** Migration method (Kirchhoff)
- ✓ **Part3:** Kirchhoff PreSTM in real life: TIKIM
- ✓ **Part4:** Software / Hardware issues

TIKIM overview

TIKIM part 1

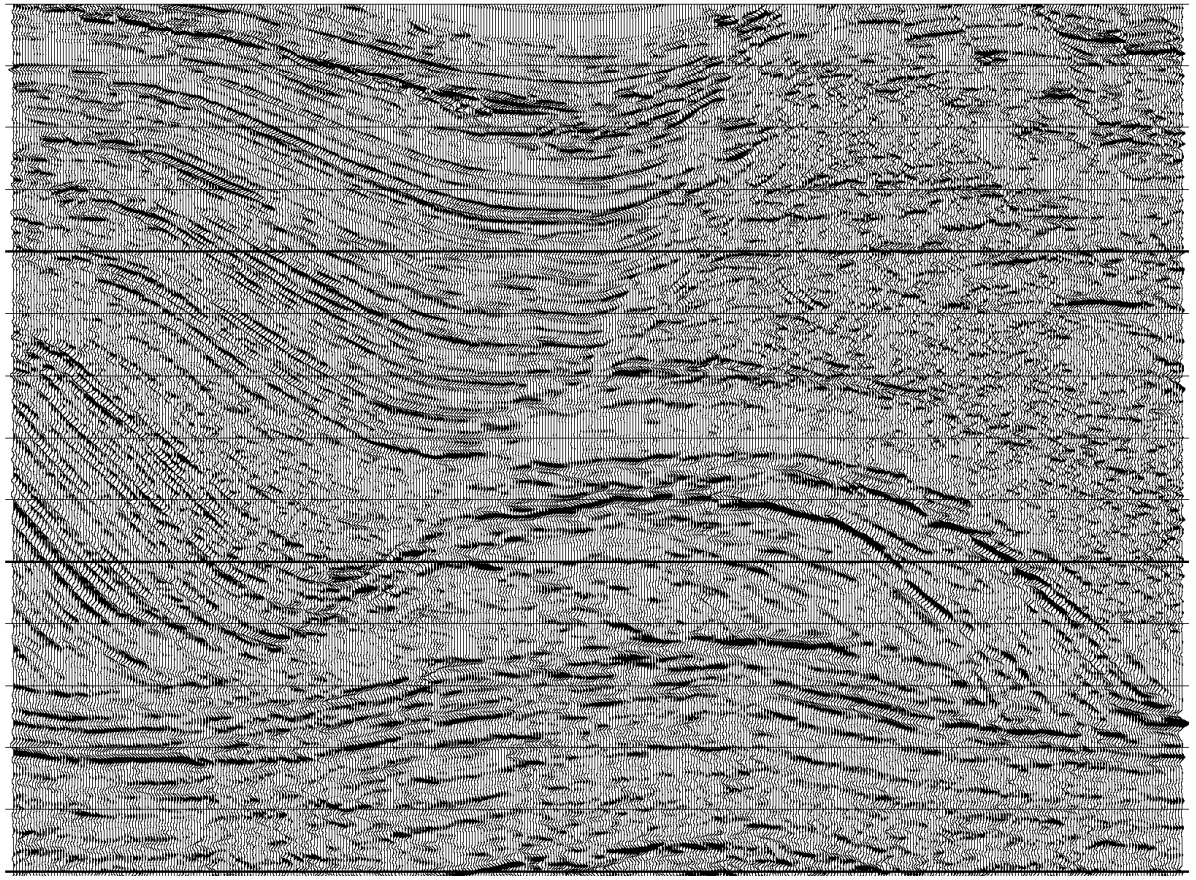
"Introduction to Time Imaging" Reminder

The need for pre-stack migration

- **“Transformation to Zero Offset” sequence does not provide optimum focusing**
  - ✓ **diffracted events** are **not preserved** in the stacking process
  - ✓ **crossing events** may generate **velocity conflicts**
  - ✓ **velocities** are **not picked at migrated position**

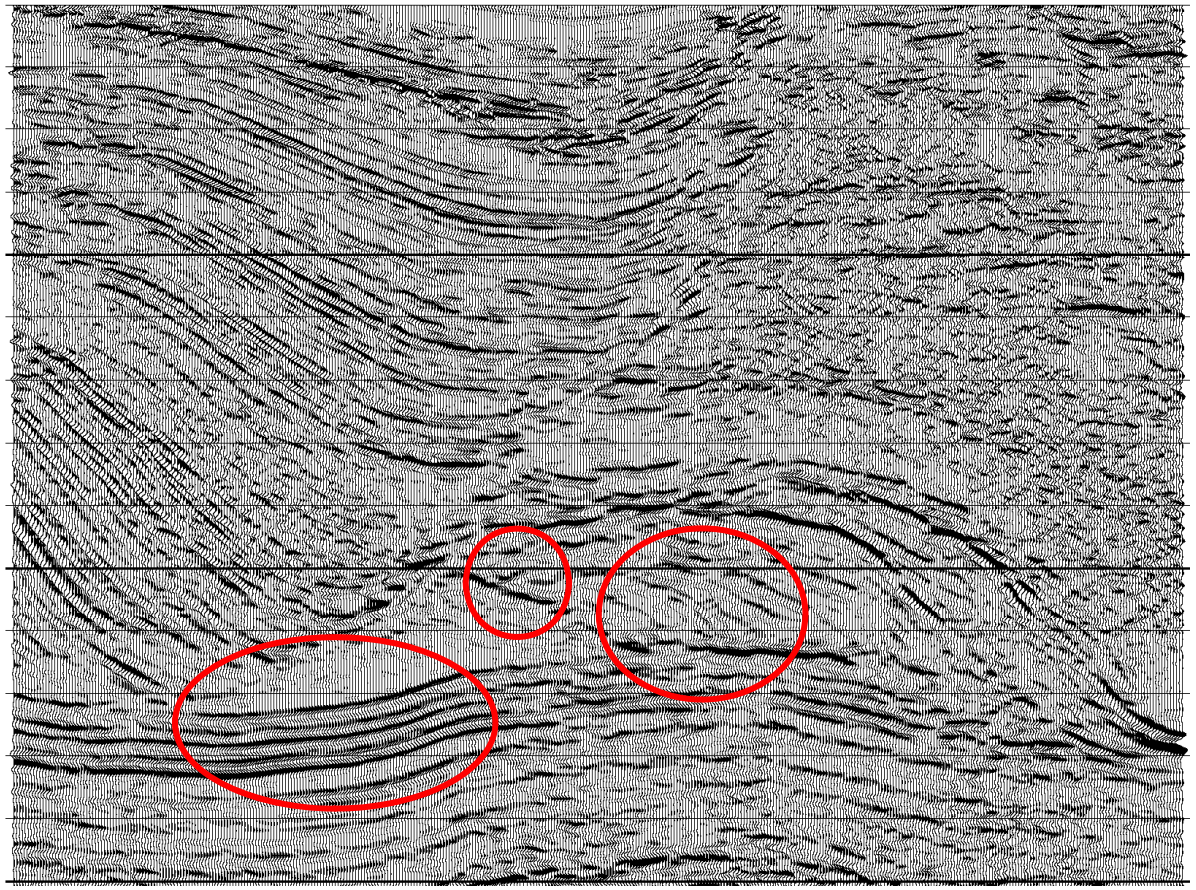
Migrating the data before stack is the best solution

Post stack imaging



Post Stack Time Migration

Pre stack imaging



Pre Stack Time Migration

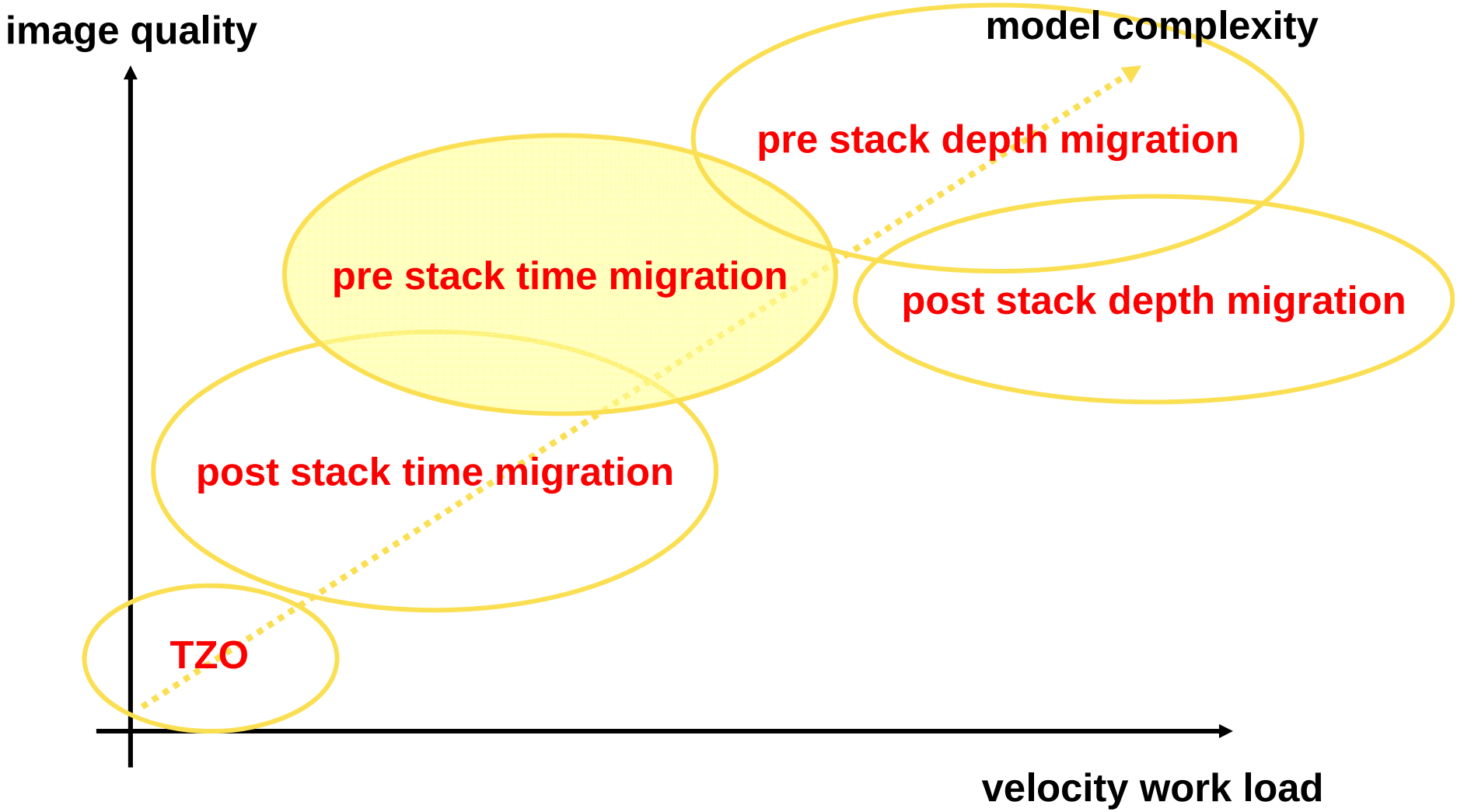


image quality
model complexity
pre stack depth migration
pre stack time migration
post stack depth migration
post stack time migration
TZO
velocity work load

TIKIM overview

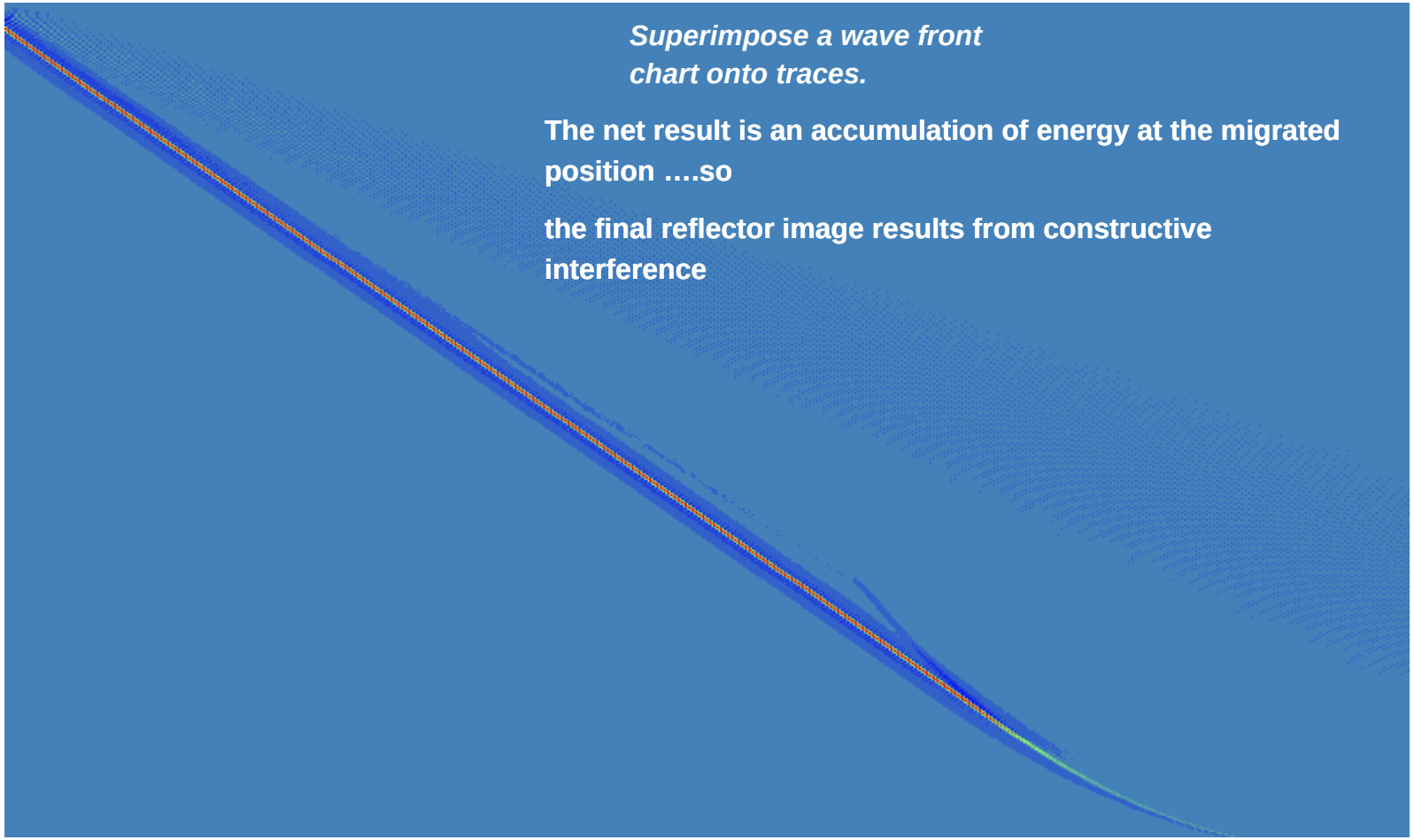
TIKIM part 2

“Migration Methods”

Kirchhoff Migration principle:

Constructive and destructive interferences will recreate the image

Superposition principle



TIKIM overview

TIKIM part 3

PSTM and TIKIM

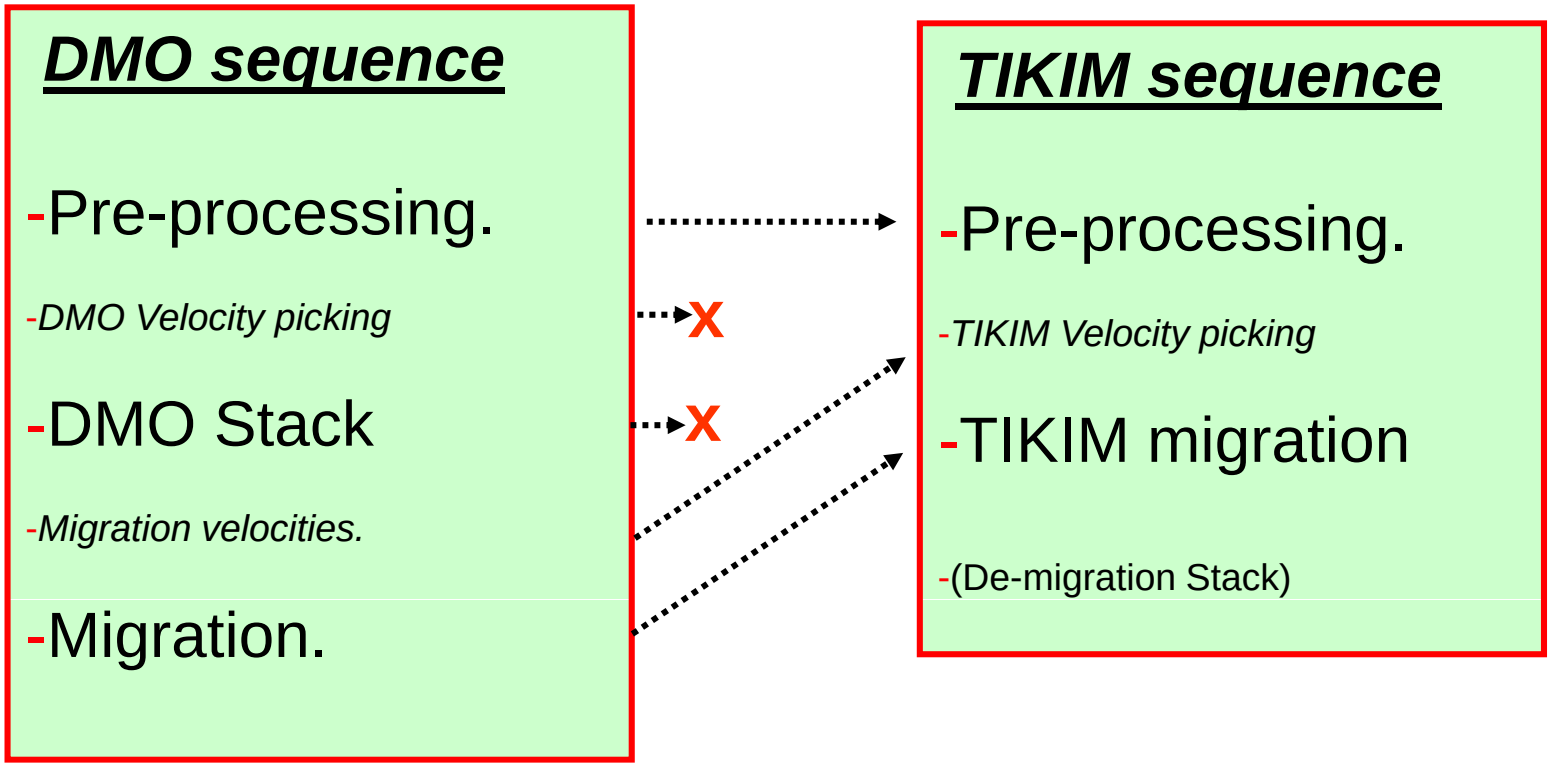
Warning: *Things to have in mind about TIKIM:*

- The **output** of TIKIM **is Migrated** data!
  - The **pickin**g of velocities after TIKIM is **on migrated data** (migrated gathers), i.e. direct picking of Migration velocities (very interpretative picking, so need of Client input).
  - There is no “Stack” output in the TIKIM sequence, but only the Migration. A De-migration can be proposed to obtain an un-migrated stack.

- ***Tikim:***
  - needs **only the output target** definition
  - **does not** care about the input geometry

- ***Tikim 2D:*** just **based on** Word 4 ***(CDP)*** and Word 20 ***(Offset)***

Schematic Comparison between DMO and TIKIM processing sequences:



Target definition - 2D

```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                 DCDP12.5
                                 IMAGE=(FCDP151,LCDP600)
                                 OFFSETS=(D150,ID100,XRM5800,XRP50)
                                 N0,
                                 LMU2,MUTE2
                                 APERCDP5000
                                 DIPLIM=(T400D20,T800D40,T4000D40,T4500D0)
                                 NOALIAS=(FMAX75)
                                 LVI1
```

Only definition of the **output** target!

Offset class definition

```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                 DCDP12.5
                                 IMAGE=(FCDP151,LCDP600)
                                 OFFSETS=(D150,ID100,XRM5800,XRP50)
                                 N0,
                                 LMU2,MUTE2
                                 APERCDP5000,
                                 DIPLIM40
                                 NOALIAS=(FMAX75)
                                 LVI1
```

- **migration parameters**

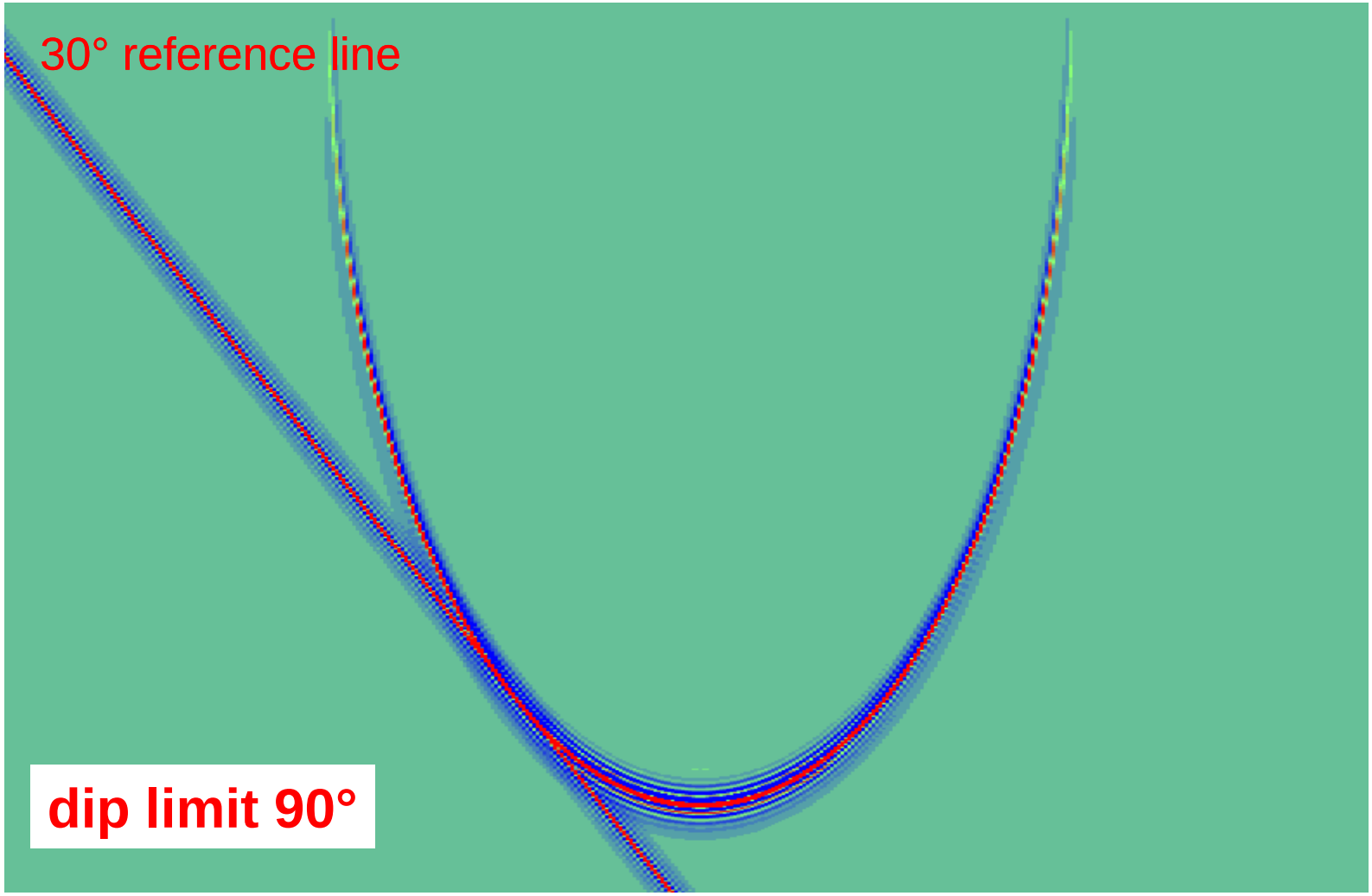
geological dip in degrees

```
* TIKIM        ==          02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                    NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                    DCDP12.5
                                    IMAGE=(FCDP151,LCDP600)
                                    OFFSETS=(D150,ID100,XRM5800,XRP50)
                                    N0,
                                    LMU2,MUTE2
                                    APERCDP5000,
                                    DIPLIM40
                                    NOALIAS=(FMAX75)
                                    LVI1
```

Time variant dip limit

```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                 DCDP12.5,
                                 IMAGE=(FCDP151,LCDP600)
                                 OFFSETS=(D150,ID100,XRM5800,XRP50)
                                 N0
                                 LMU2,MUTE2
                                 APERCDP5000,
                                 DIPLIM=(T40D15,T300D45,T6000D20,T8000D30)
                                 NOALIAS=(FMAX75)
                                 LVI1
```

Dip limit value

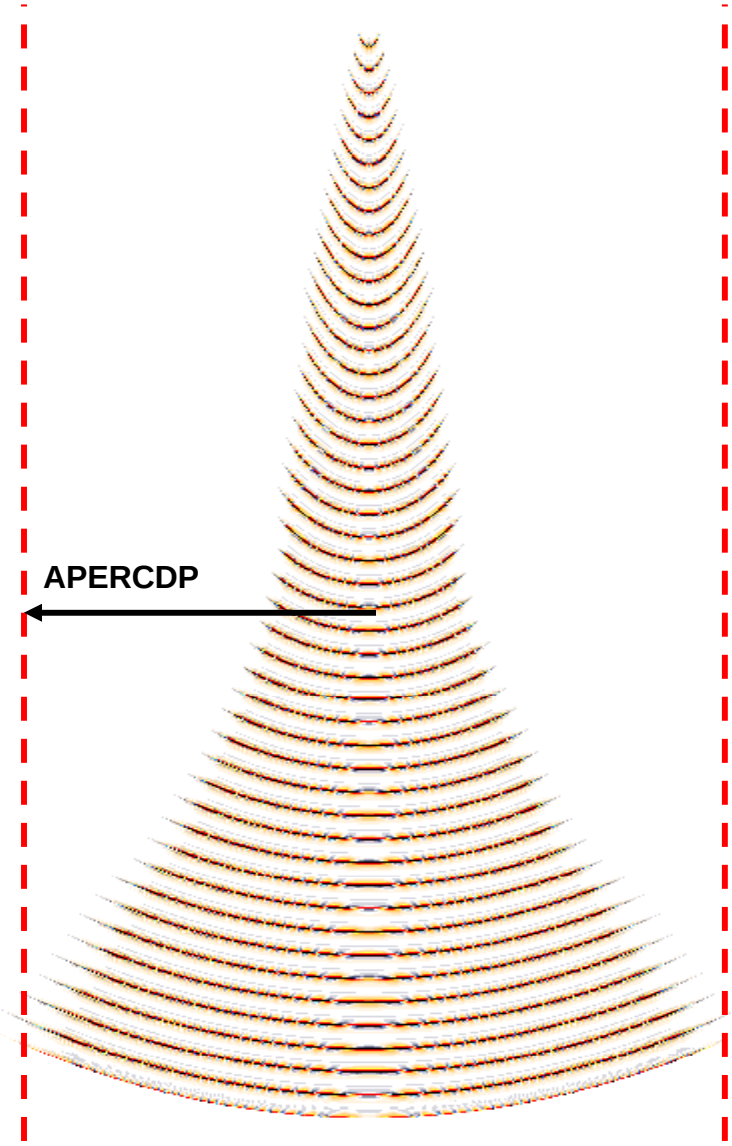


half-width of the migration smile

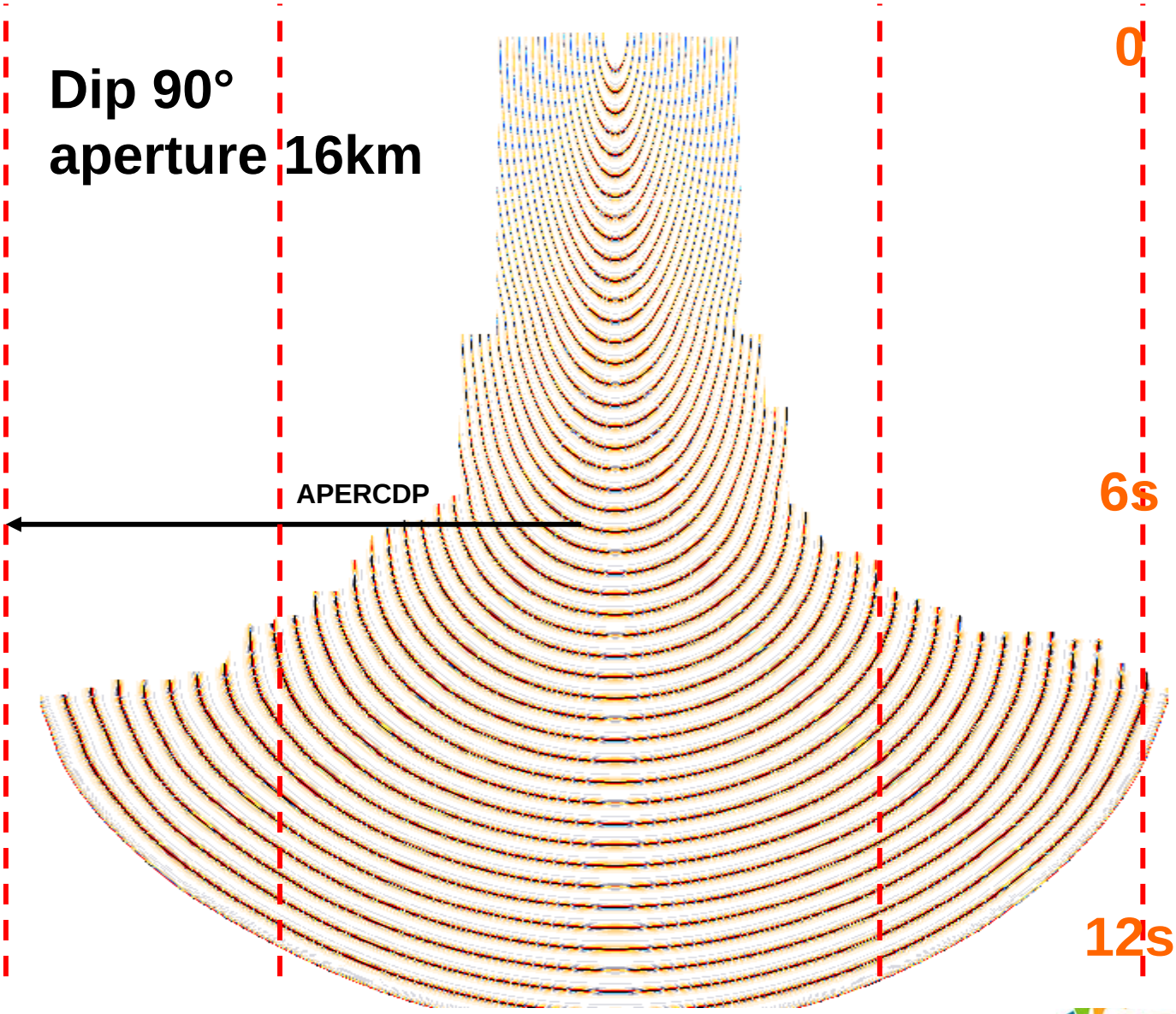
```
* TIKIM        ==          02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                    NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                     DCDP12.5,IMAGE=(FCDP151,LCDP600)
                                    OFFSETS=(D150,ID100,XRM5800,XRP50)
                                    N0,
                                    LMU2,MUTE2
                                    APERCDP5000
                                    DIPLIM40
                                    NOALIAS=(FMAX75)
                                    LVI1
```

Aperture limitation

Dip 30°
aperture 9km



Aperture limitation

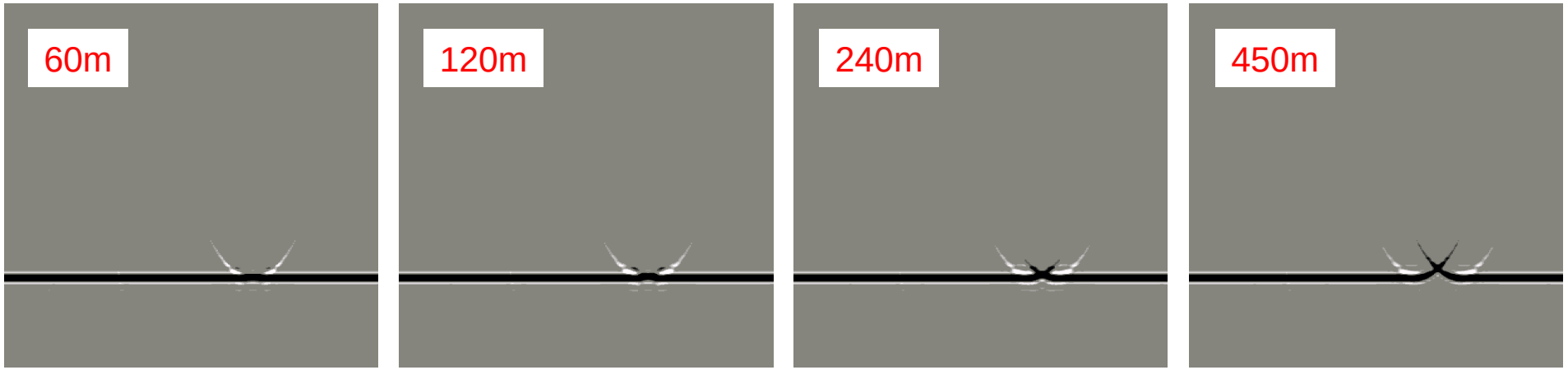


- **noise attenuation**

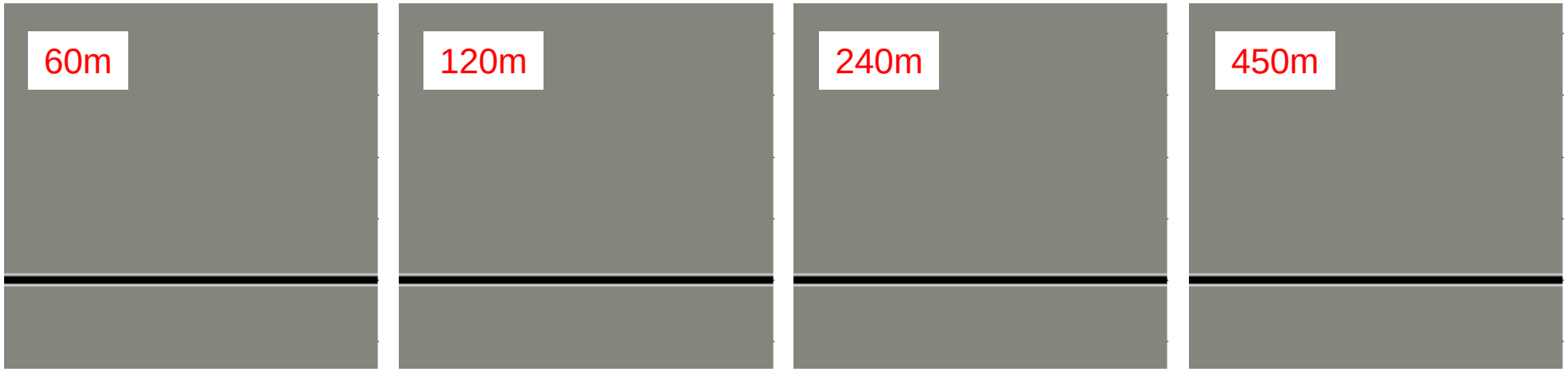
- **input noise** *(addressed by the Pre-Processing)*
  - ✓ coherent noise
  - ✓ random noise
  - ✓ irregular amplitudes
- **acquisition irregularities** *(addressed by the regularization)*
  - ✓ offset/fold
- **migration noise** *(addressed by the Migration Parameters)*
  - ✓ operator muting
  - ✓ aliasing

Regularization: missing traces on event

Missing or irregular data

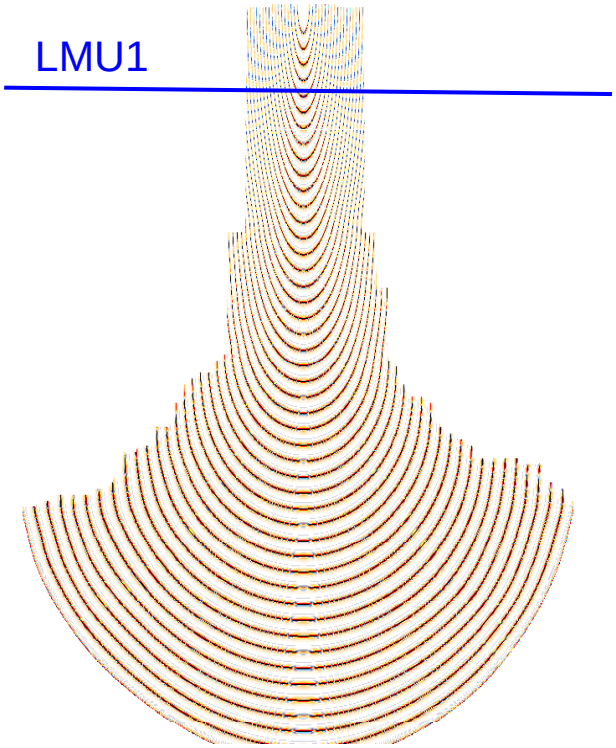


Regularized data



Migration operator mute coding

```
* TIKIM        ==          02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                  NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                   DCDP12.5
                                  IMAGE=(FCDP151,LCDP600)
                                  OFFSETS=(D150,ID100,XRM5800,XRP50)
                                  N0
                                  MUTE1,LMU1,
                                  APERCDP5000,
                                  DIPLIM40
                                  NOALIAS=(FMAX75)
                                  LVI1
```

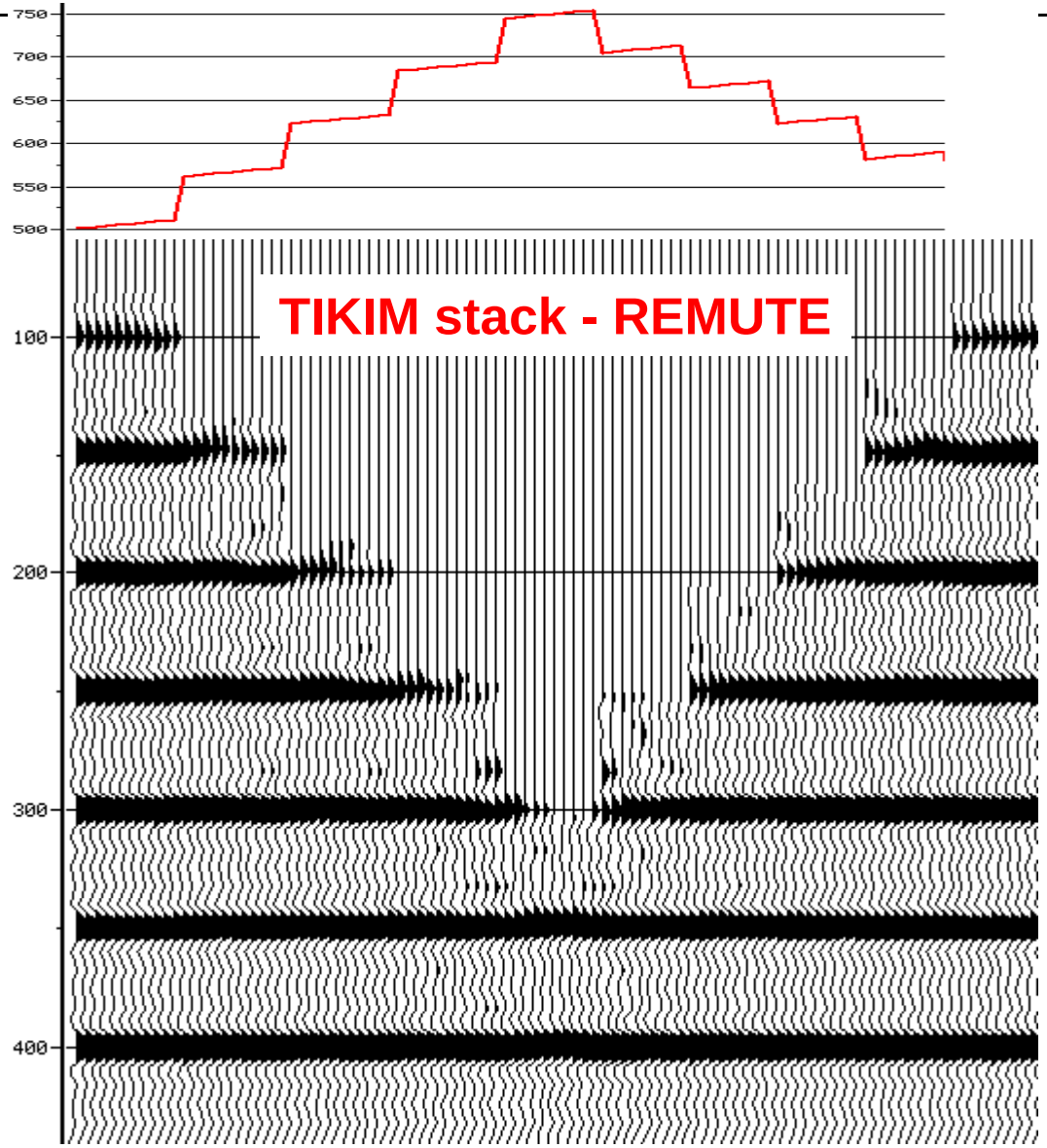


Post-migration mute

```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                 DCDP12.5
                                 IMAGE=(FCDP151,LCDP600)
                                 N0
                                 LMU2,MUTE2
                                 APERCDP5000,
                                 DIPLIM40
                                 NOALIAS=(FMAX75)
                                 LVI1
                                 REMUTE
```

Based on Word6 input trace

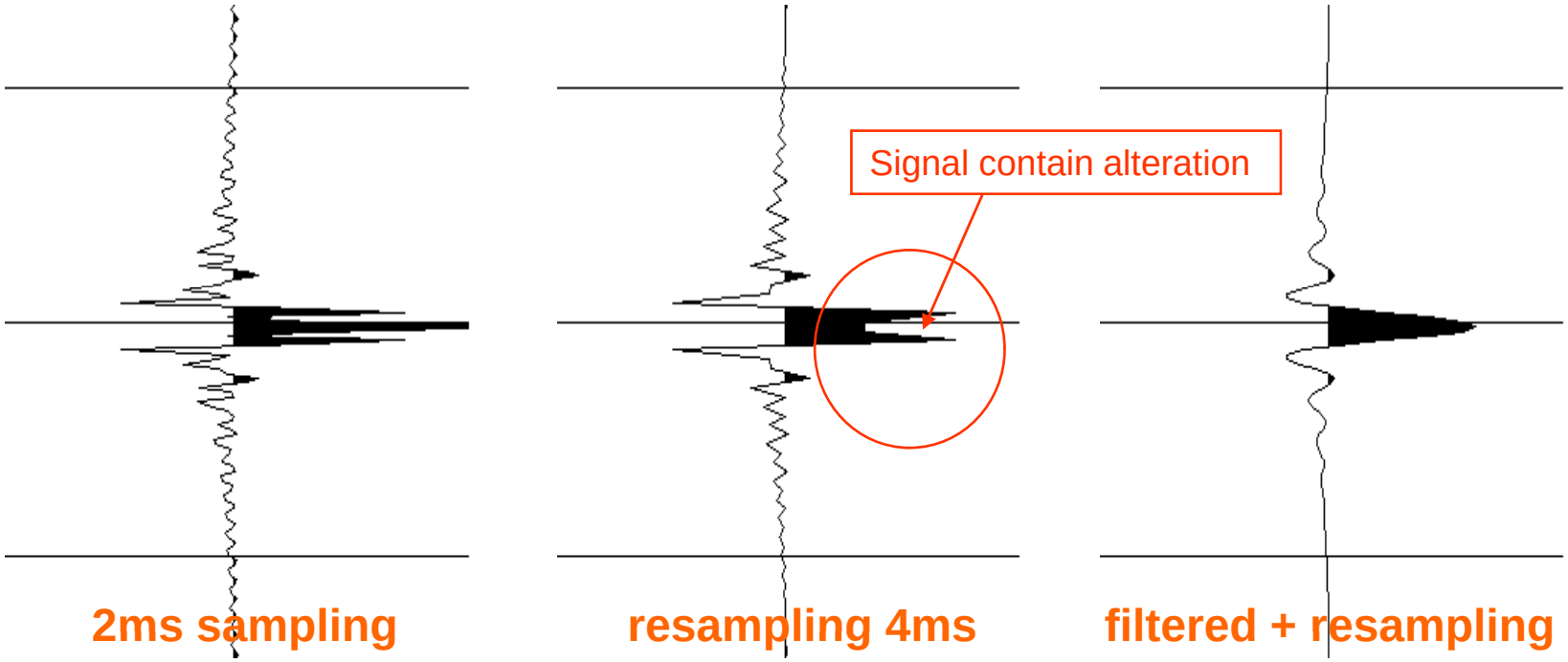
Poststack mute



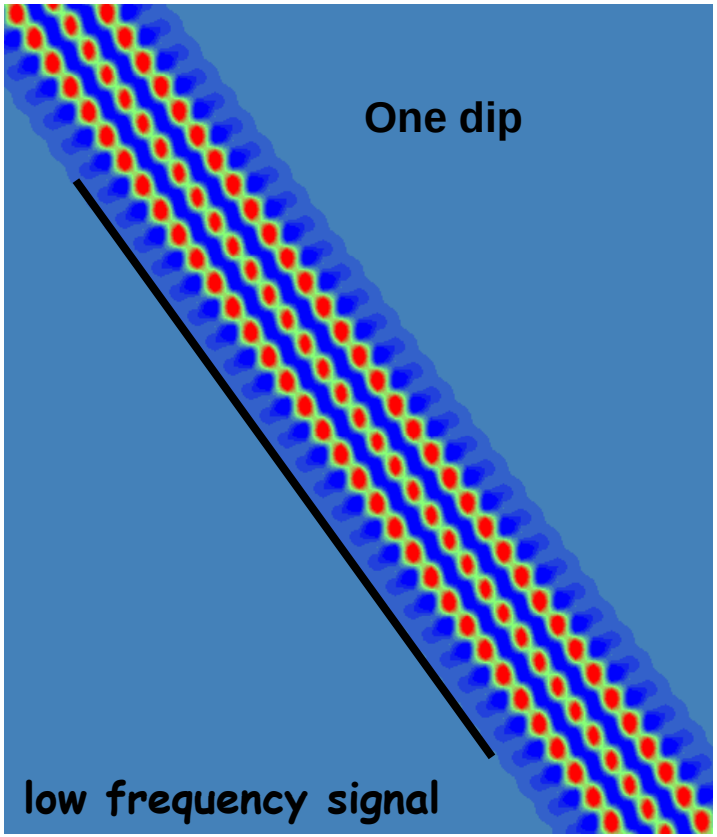
- what is aliasing ?
- dip aliasing
- aliasing noise in Kirchhoff migration

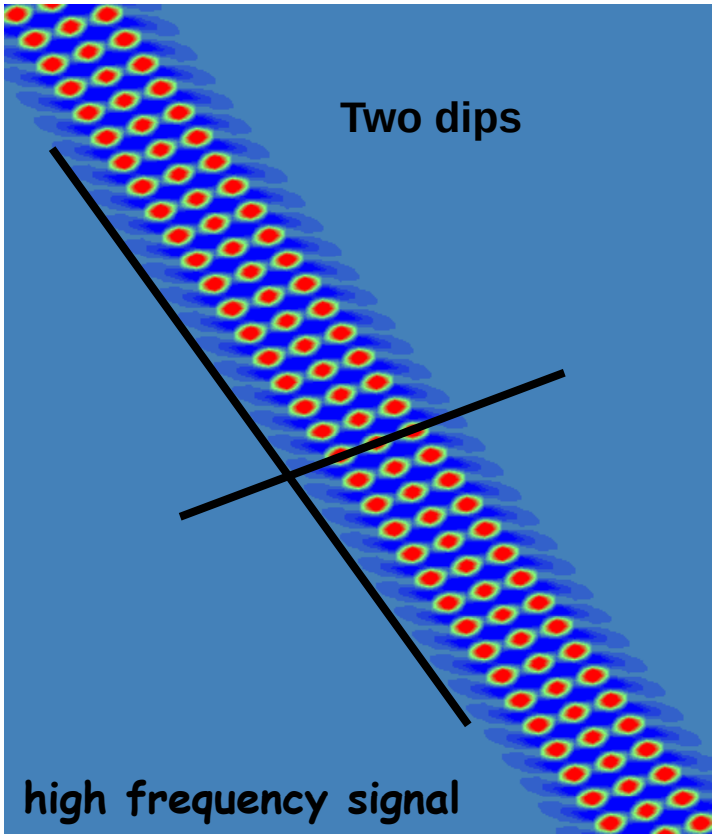
Aliasing

aliasing occurs when a signal is undersampled in time, or spatially



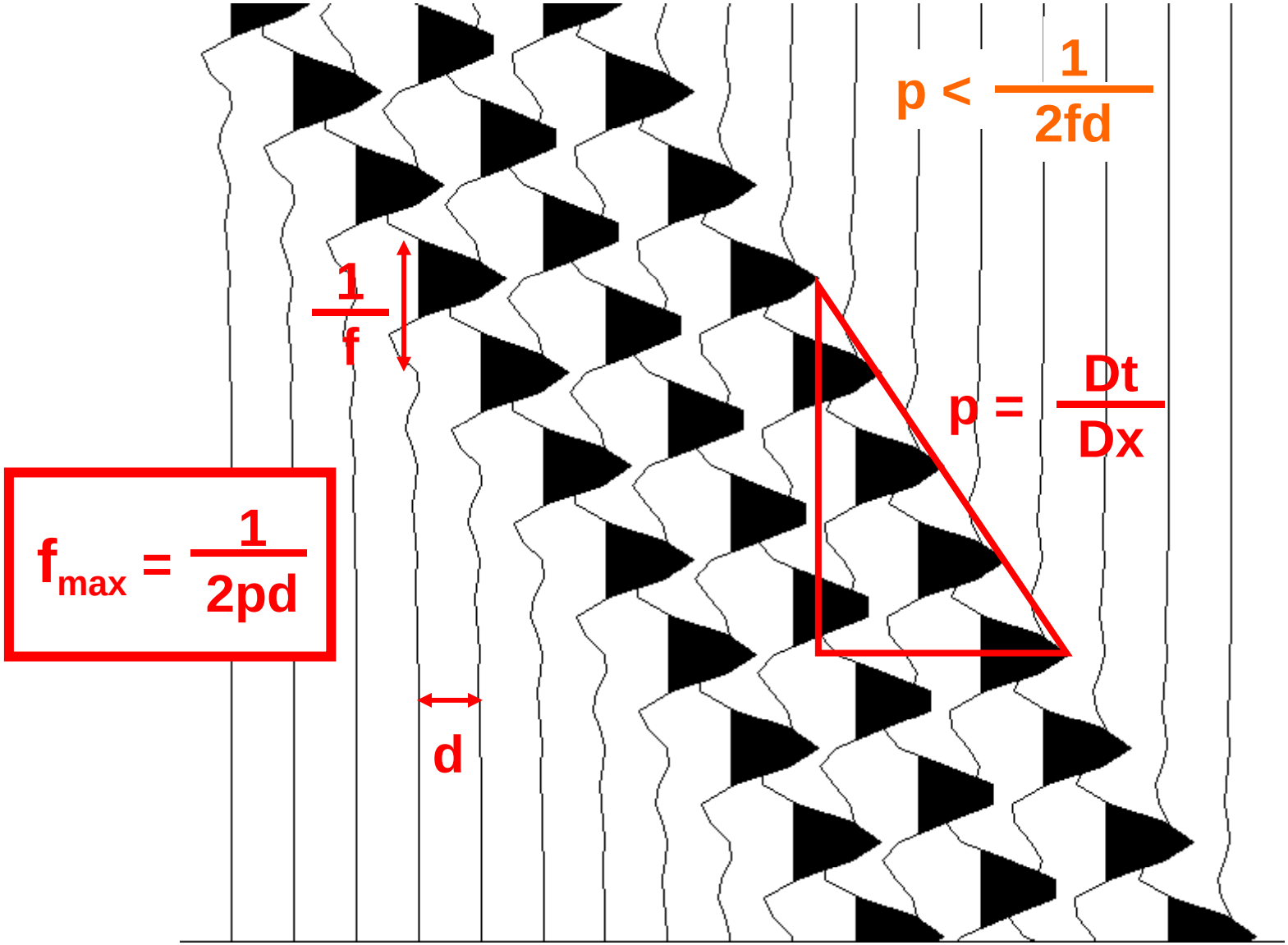
Dip aliasing





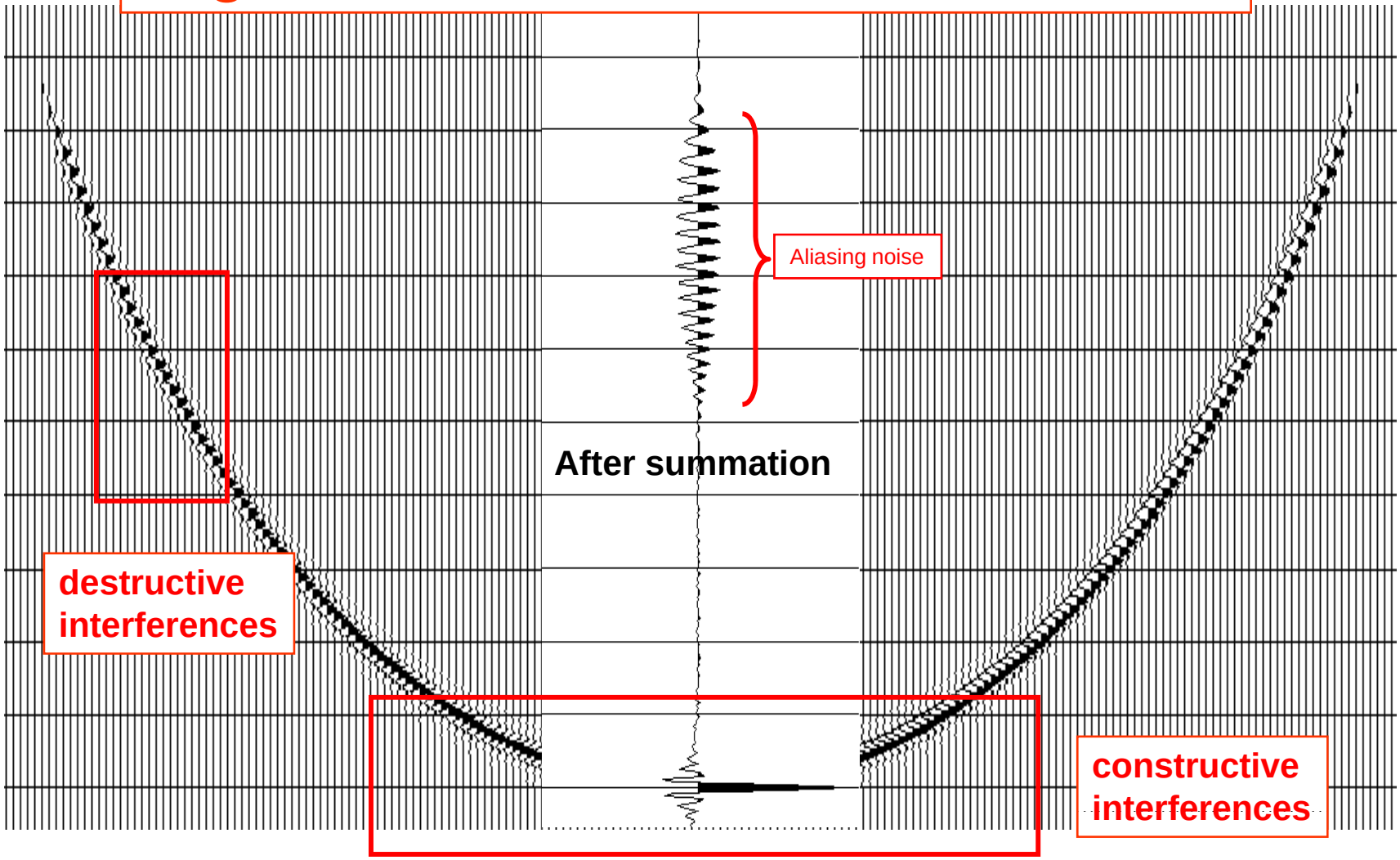
a dipping event will be aliased because of spatial undersampling

Aliasing condition in 2D



Aliasing noise in Kirchhoff migration

migration contributions to a flat event



Noalias coding

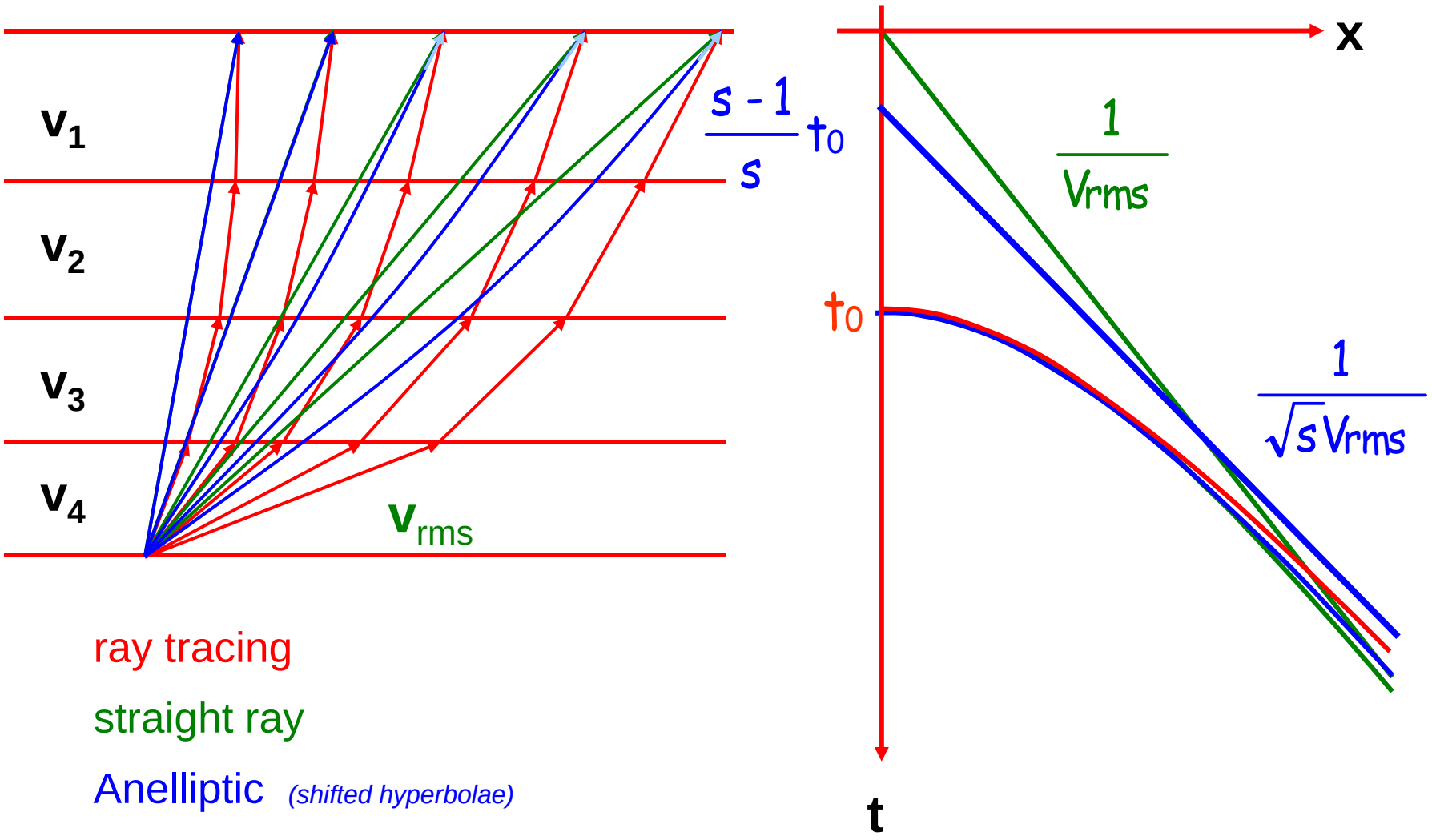
```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                  DCDP12.5
                                 IMAGE=(FCDP151,LCDP600)
                                 OFFSETS=(D150,ID100,XRM5800,XRP50)
                                 N0
                                 LMU2,MUTE2
                                 APERCDP5000,
                                 DIPLIM=(T400D20,T800D40,T4000D40,T4500D0)
                                 NOALIAS=(FMAX75)
                                 LVI1
```

- **3 options of TIKIM** ***(velocity definitions)***

➢ ***3 options in TIKIM*: kinematics:**

- ✓ **straight ray (default)**
- ✓ **anelliptic**
- ✓ **raytracing (standard processing)**

Ray kinematics



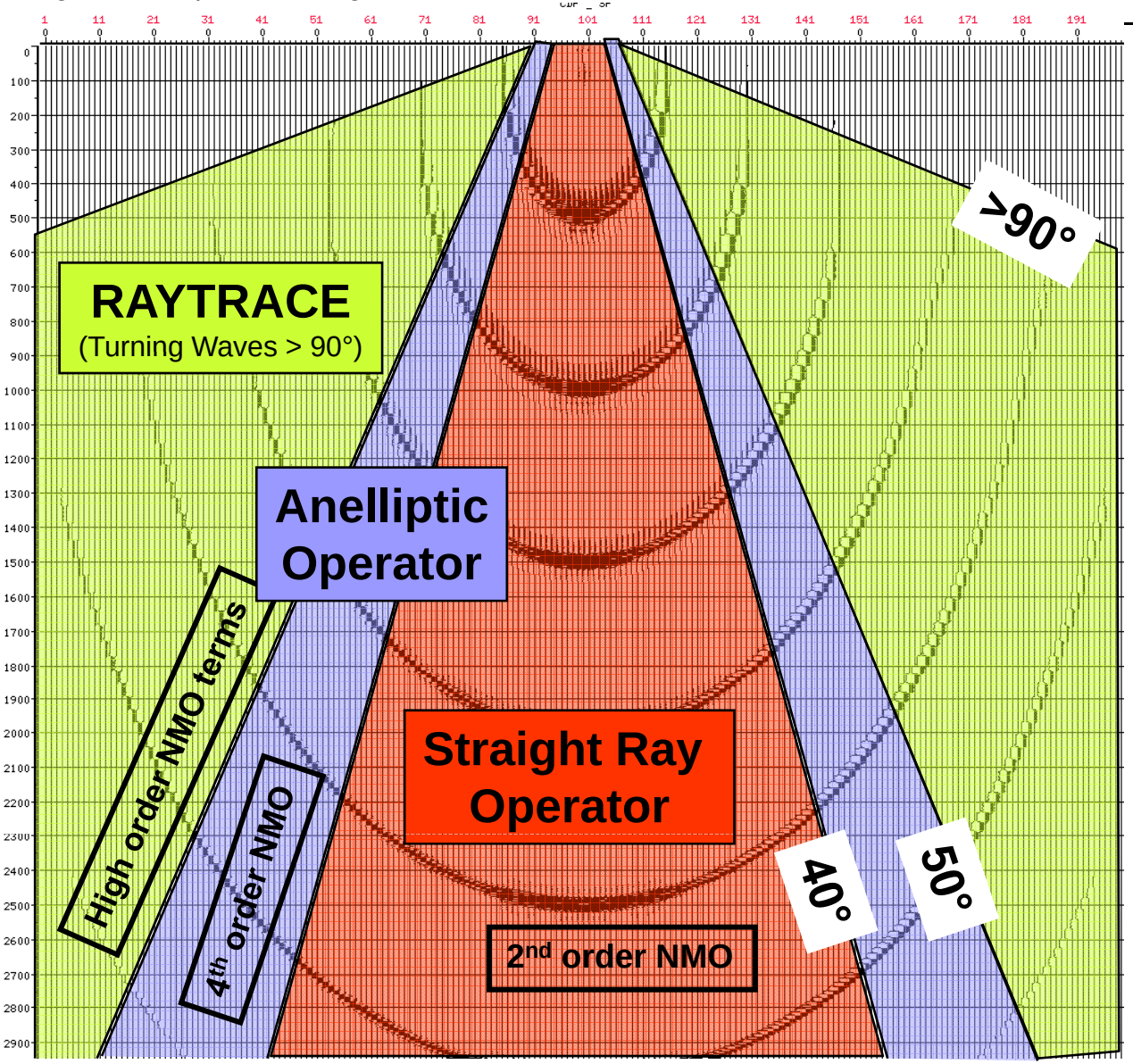
ray tracing

straight ray

Anelliptic *(shifted hyperbolae)*

New ray tracing : anisotropic & Turning-waves

Kinematics



Straight Rays *(up to 40 degrees)*

```
* TIKIM        ==          02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                    NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                     DCDP12.5
                                    IMAGE=(FCDP151,LCDP600)
                                    OFFSETS=(D150,ID100,XRM5800,XRP50)
                                    N0
                                    LMU2,MUTE2
                                    APERCDP5000,
                                    DIPLIM40
                                    NOALIAS=(FMAX75)
                                    LVI1
```

Anelliptic *(up to 50 degrees)*

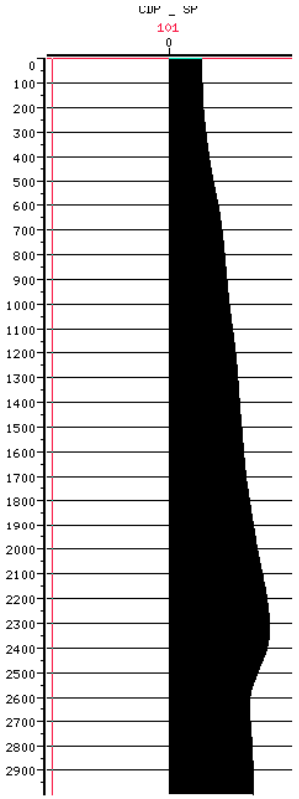
```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                 DCDP12.5
                                 IMAGE=(FCDP151,LCDP600)
                                 OFFSETS=(D150,ID100,XRM5800,XRP50)
                                 N0
                                 LMU2,MUTE2
                                 APERCDP5000,
                                 DIPLIM50
                                 NOALIAS=(FMAX75)
                                 LVI1,LSH1
```

Time shift library

Ray Tracing *(more than 50 degrees)*

(standard processing)

```
* TIKIM        ==        02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                 NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                  DCDP12.5
                                 IMAGE=(FCDP151,LCDP600)
                                 OFFSETS=(D150,ID100,XRM5800,XRP50)
                                 N0
                                 LMU2,MUTE2
                                 APERCDP5000,
                                 DIPLIM=(T0,D150,T3500,D120,T6000,D40),
                                 NOALIAS=(FMAX75)
                                 LVI1,LSH1,RAYTRACE,
                                 TREND=local:/trendfile.cst
```



Smoothed trend

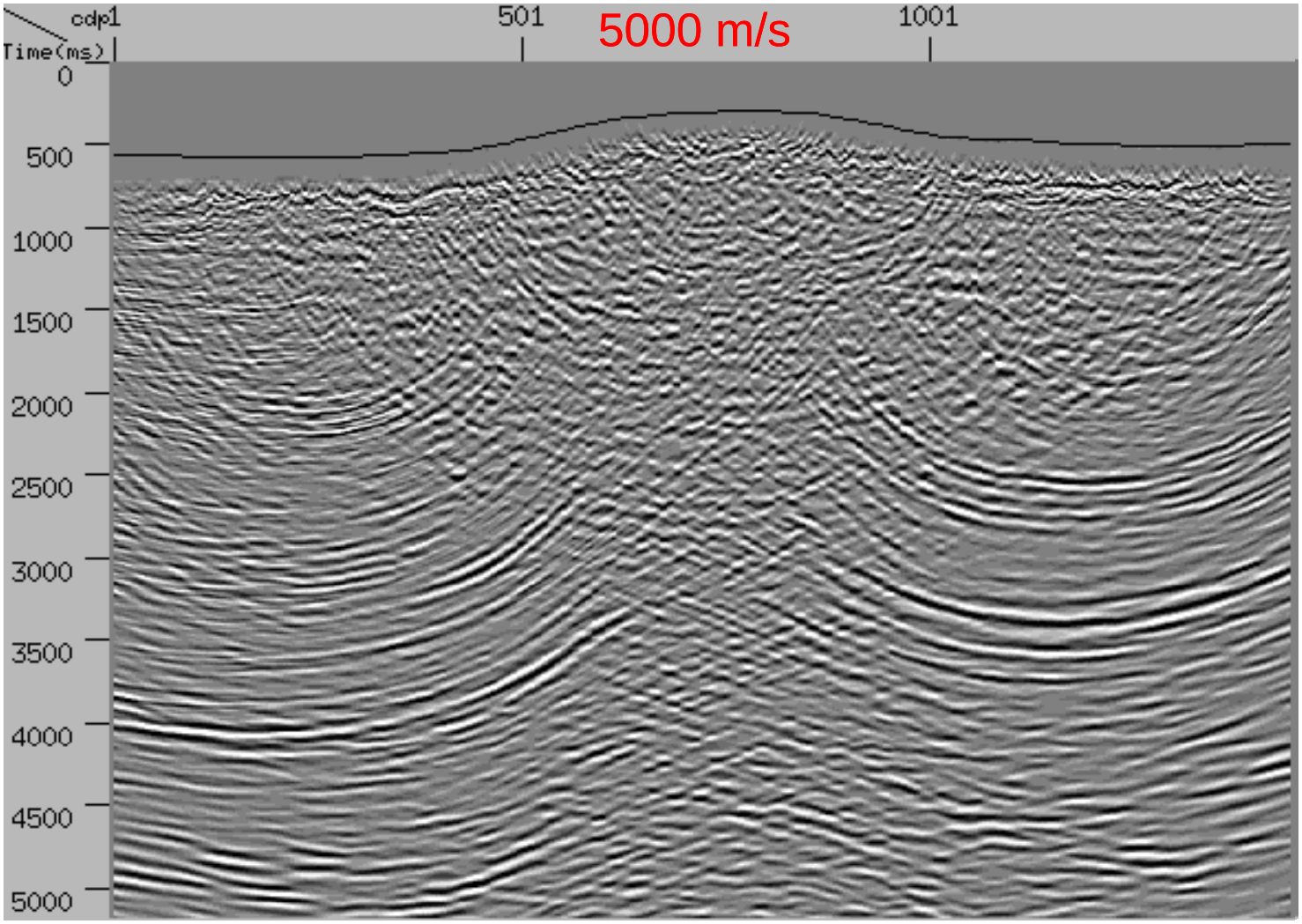
Velocities in TIKIM

- **velocity analysis**
  - ✓ **coding**
  - ✓ **methodology**

complex 2D geology with no velocity a priori

```
* TIKIM      ==      02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                            NPE64,MACHINE=PC,DISTRIB ,BIMG02
                            DCDP12.5
                            IMAGE=(FCDP151,LCDP600)
                            OFFSETS=(D150,ID100,XRM5800,XRP50)
                            N0
                            LMU2,MUTE2
                            APERCDP5000
                            DIPLIM=(T400D20,T800D40,T4000D40,T4500D0)
                            NOALIAS=(FMAX75)
                            ATTRIBUT=VELOCITY,
                            CSTSCAN=(3000,3400,…,4600,5000)
```

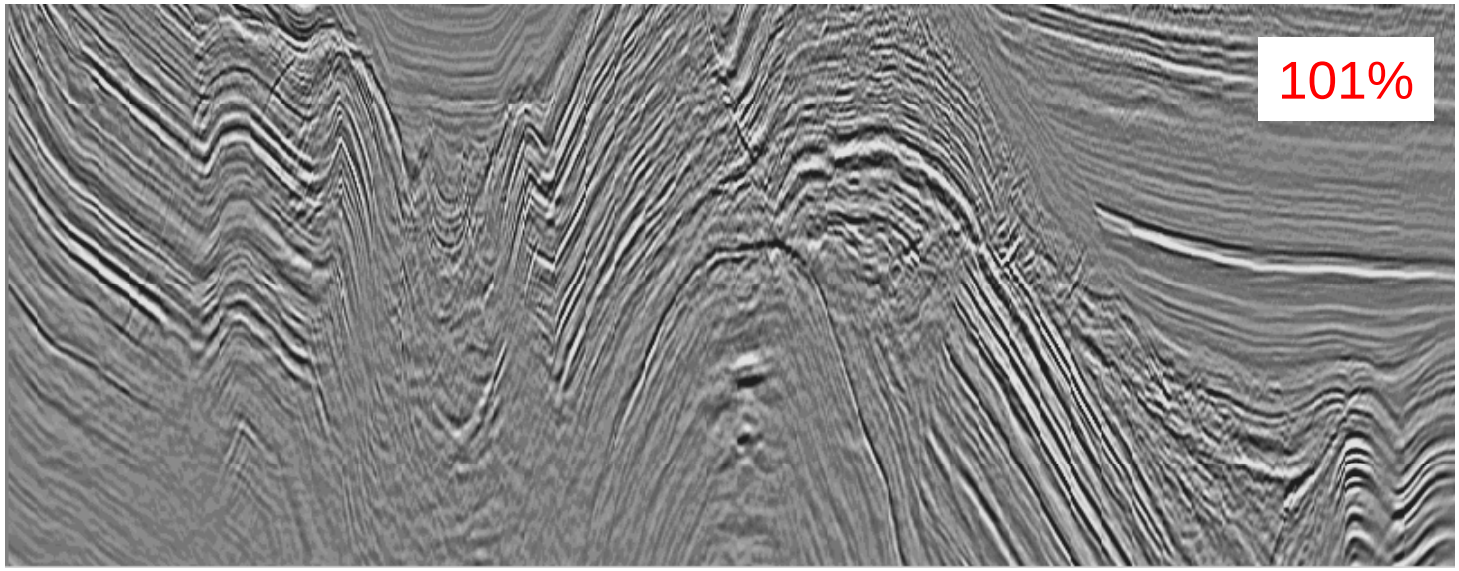
Constant velocity scan



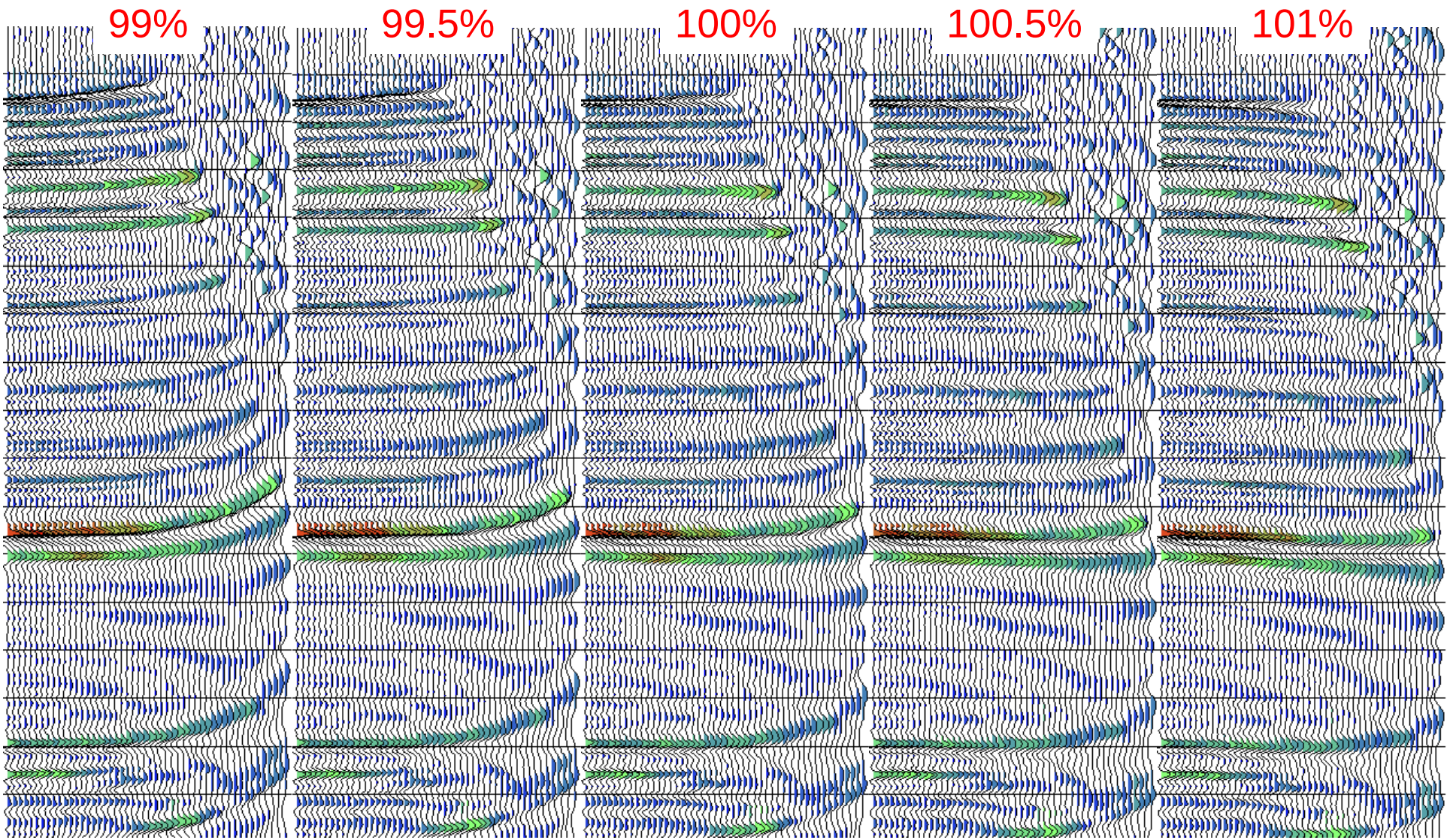
Percentage velocity scan

```
* TIKIM        ==          02    TRAFILE=2003,NUMTRA1,IDTRA=me,REWRITE
                                  NPE64,MACHINE=PC,DISTRIB ,BIMG02
                                   DCDP12.5
                                  IMAGE=(FCDP151,LCDP600,ICDP2)
                                  OFFSETS=(D150,ID100,XRM5800,XRP50)
                                  N0
                                  LMU2,MUTE2
                                  APERCDP5000,
                                  DIPLIM40
                                  NOALIAS=(FMAX75)
                                  LVI1
                                  ATTRIBUT=VELOCITY,
                                  PERSCAN=(91,94,97,100,103,106,109,112)
```

Percentage velocity scan on stack



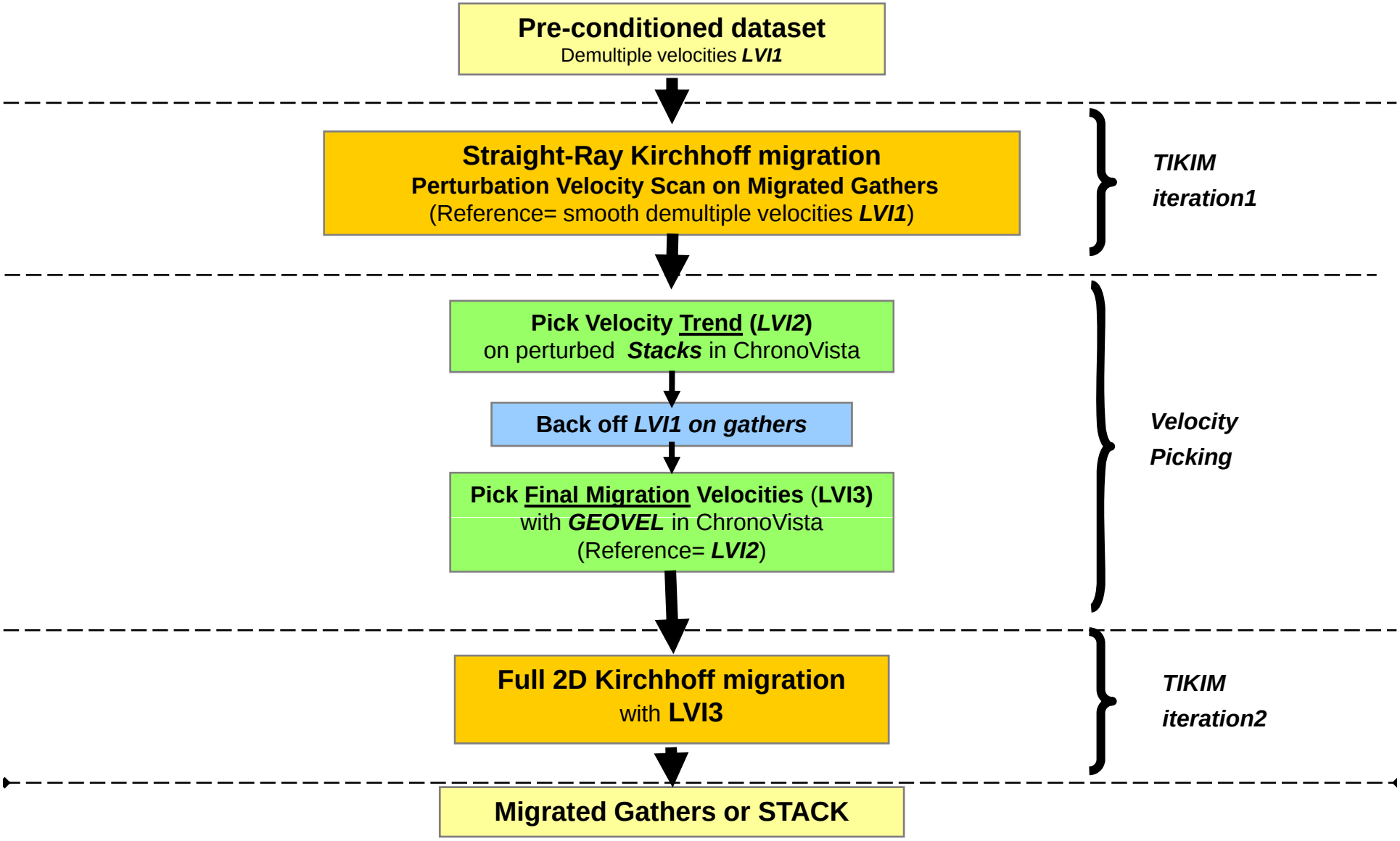
Velocity percentage scan on gathers



Velocity picking - a word of advice

- **Picking tool: ChronoVista**
  - **Start from a smooth model**
    - ✓ easier to pick the trends
    - ✓ Kirchhoff migrations like it smooth

TIKIM ISOTROPIC Simplified 2D Velocity Model Building Flow



TIKIM overview

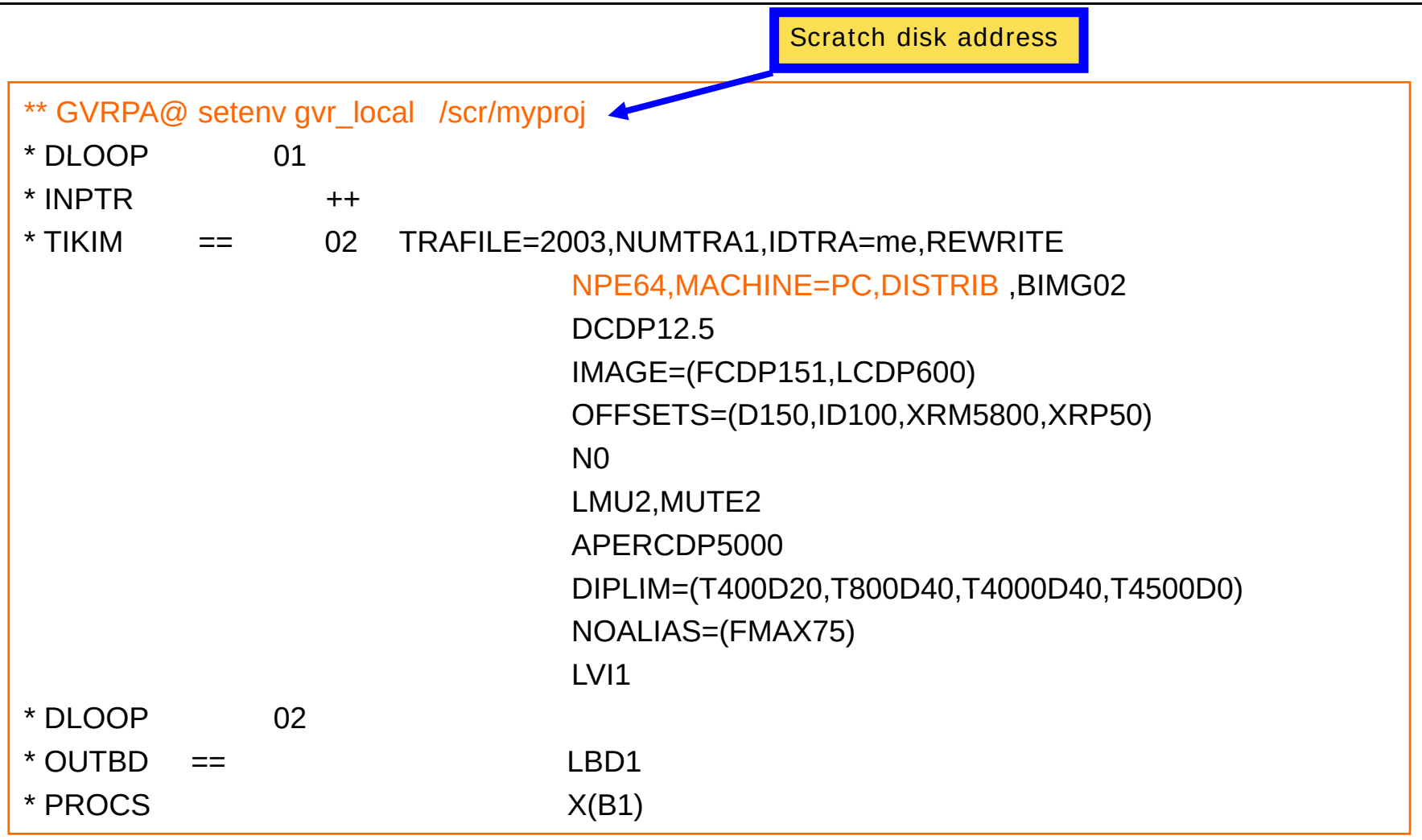
TIKIM part 4

Software / Hardware issues

Mandatory parameters (2D TIKIM – “blank option”):

- **TRAFILE=…, NUMTRA…, IDTRA=…,** ***Job run parameters***
- **DCDP** ***Gridding of the Image***
- **DIPLIM** ***Dip limitation***
- **N** or **NP** ***Weighting*** ***(fold compensation)***
- **(LVI)** ***Velocity Model***
- **NOALIAS=(FMAX)** ***Anti-aliasing filter***
- **IMAGE=(FCDP,LCDP)** ***Output Image***
- **BIMG** ***Output loop number***

Coding TIKIM on cluster *(“blank option”)*



End
of the presentation