

Nº 179345

Tecnologia de interpretação aplicada e inteligência artificial

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Rio de Janeiro. 193 slides*

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PROIBIDO REPRODUÇÃO

I WORKSHOP PETROBRAS - IPT

TECNOLOGIA DE INTERPRETAÇÃO APLICADA E INTELIGÊNCIA ARTIFICIAL

05/10 A 07/10/24

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FELIPE SILVA SILLES

GUSTAVO TORRES CUSTÓDIO

NEY FERREIRA DE SOUZA GUERRA

THIAGO YUJI AOYAJI



INTERPRETAÇÃO SÍSMICA

I WORKSHOP PETROBRAS – IPT

05 DE NOVEMBRO DE 2024

SUMÁRIO

1 Introdução

2 Pré-processamento dos dados

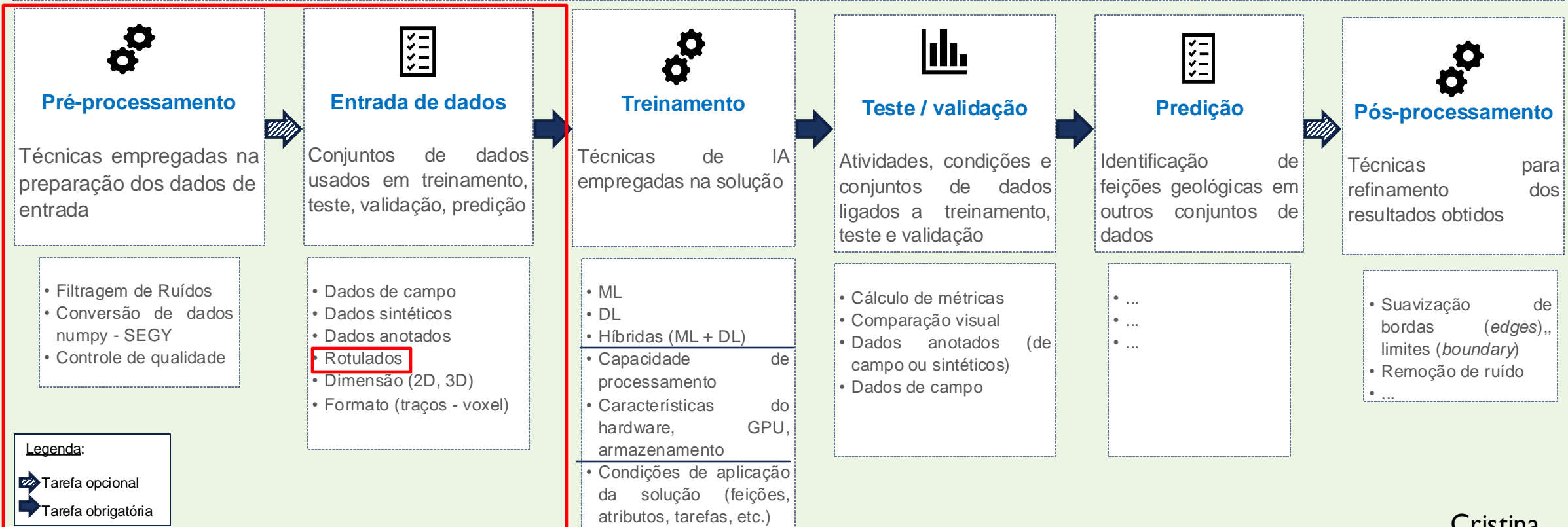
3 Datasets

INTRODUÇÃO

Pipeline associado à identificação de feições geológicas em dados sísmicos por meio de inteligência artificial

Interface com o usuário

• Visualização dos dados | Seleção de parâmetros | ...



Geração de Dados Sintéticos

Junho/2024

Cubo Sísmico
ejemplo_0.sgy

Dado Sísmico “exemplo_0.sgy”

128 in-lines

128 cross-lines

Tempo de registro – 0 a 508 ms

Amostragem de 4 ms

Dados de amplitude [-4 a 4]

Import 3D Seismic Data

Input file *=wildcard

Coordinate System

	Quick scan result	Source	Actually use
SEG-Y revision	0		User defined
Data format	1 - Floating point		From file header
Number of samples	128 (16384 traces)	From header	128
Z range	0 - 0.508 - 0.004 (s or m)	From header	Start <input type="text" value="0"/> Step <input type="text" value="0.004"/>
In-line range	1 - 128	From header	Inline (byte 189) - "Inline number of C" <input type="text" value="4 bytes"/>
Cross-line range	1 - 128	From header	Crossline (byte 193) - "Crossline num" <input type="text" value="4 bytes"/>
X-coordinate range	1.00 - 128.00	Calculated	tracr (byte 5) - "trace sequence num" <input type="text" value="4 bytes"/>
Y-coordinate range	1.00 - 128.00	Calculated	tracr (byte 5) - "trace sequence num" <input type="text" value="4 bytes"/>

1000 Use (X,Y)

0.1% Zeros

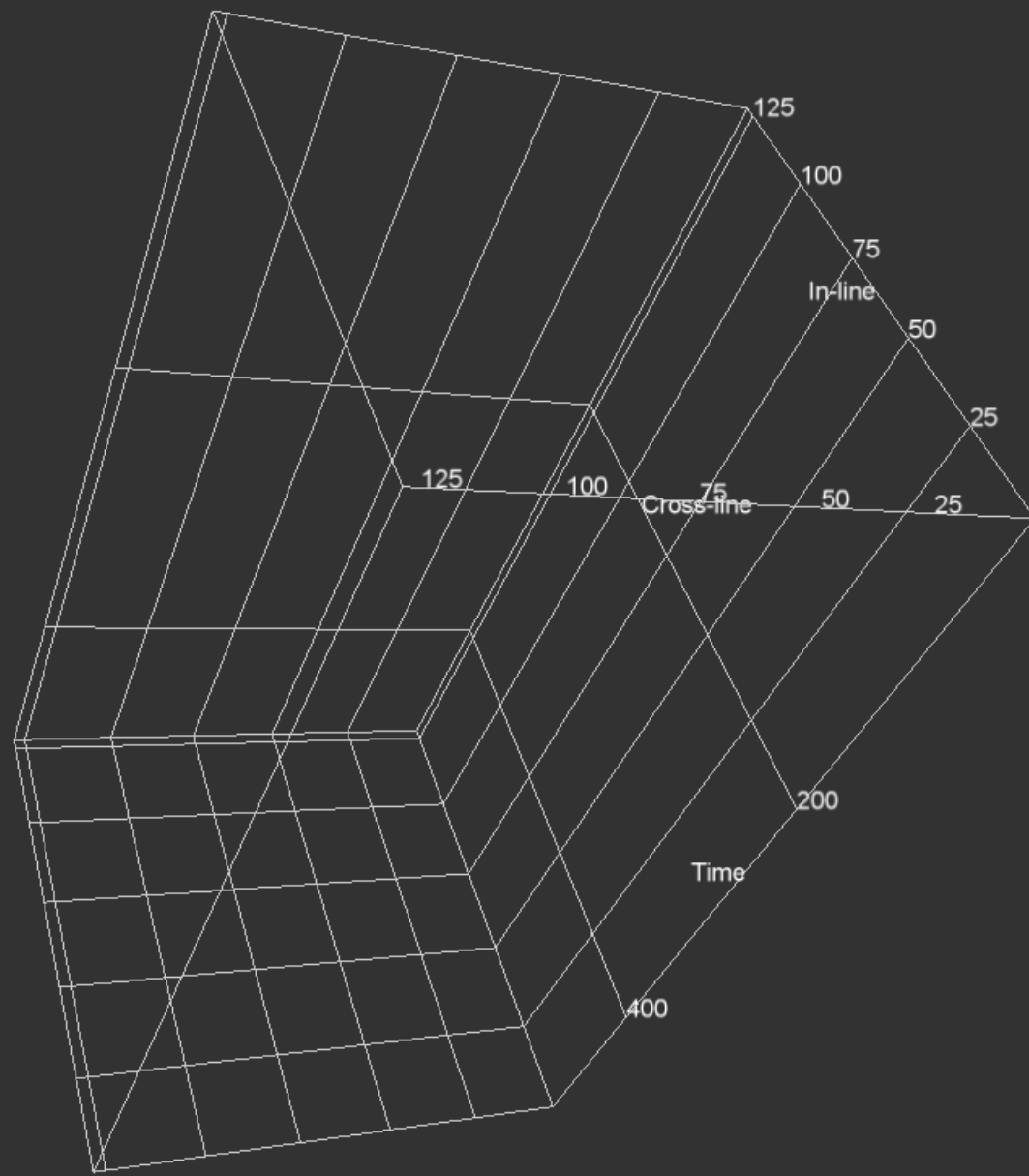
Geometria do cubo 3D

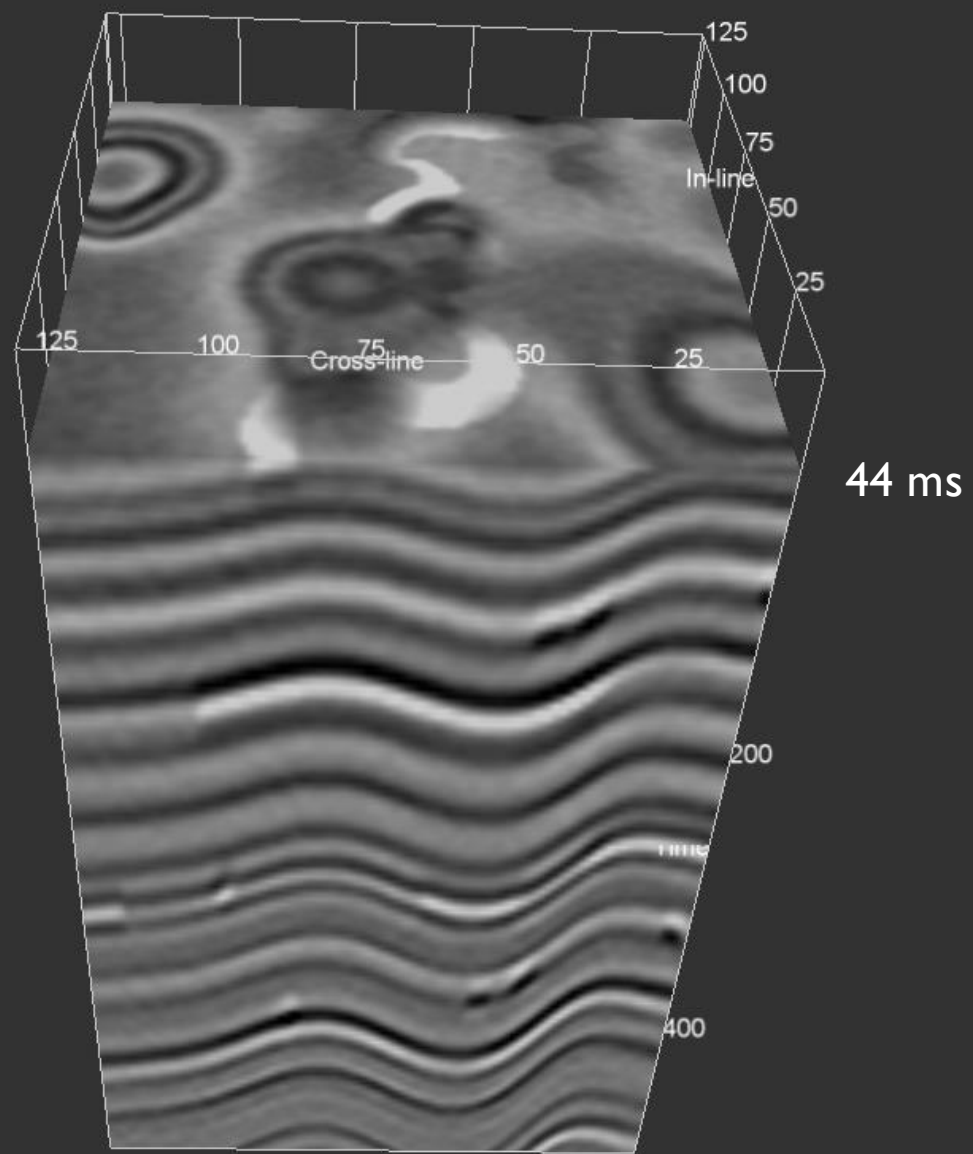
128 in-lines

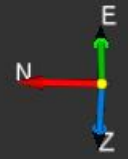
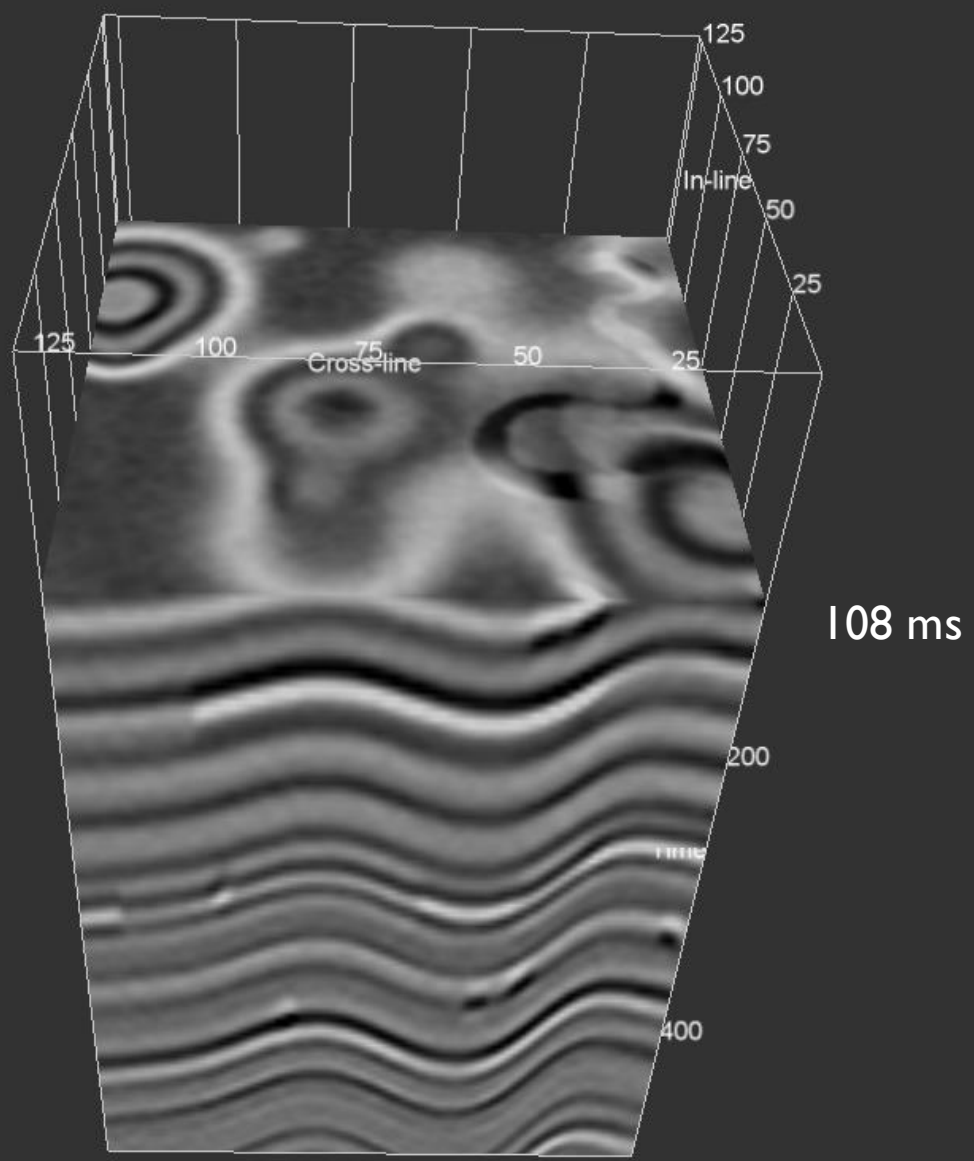
128 cross-lines

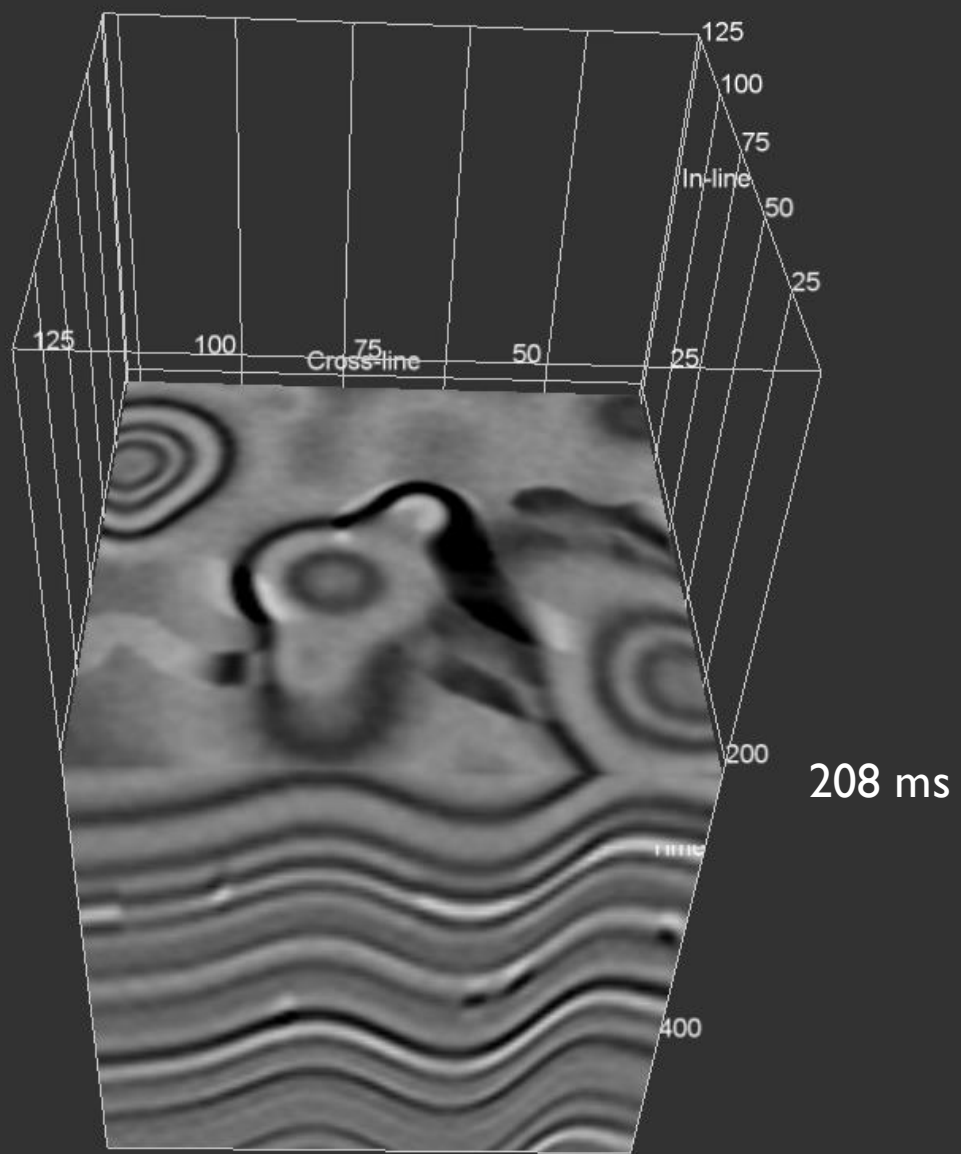
Tempo de registro – 0 a 508 ms

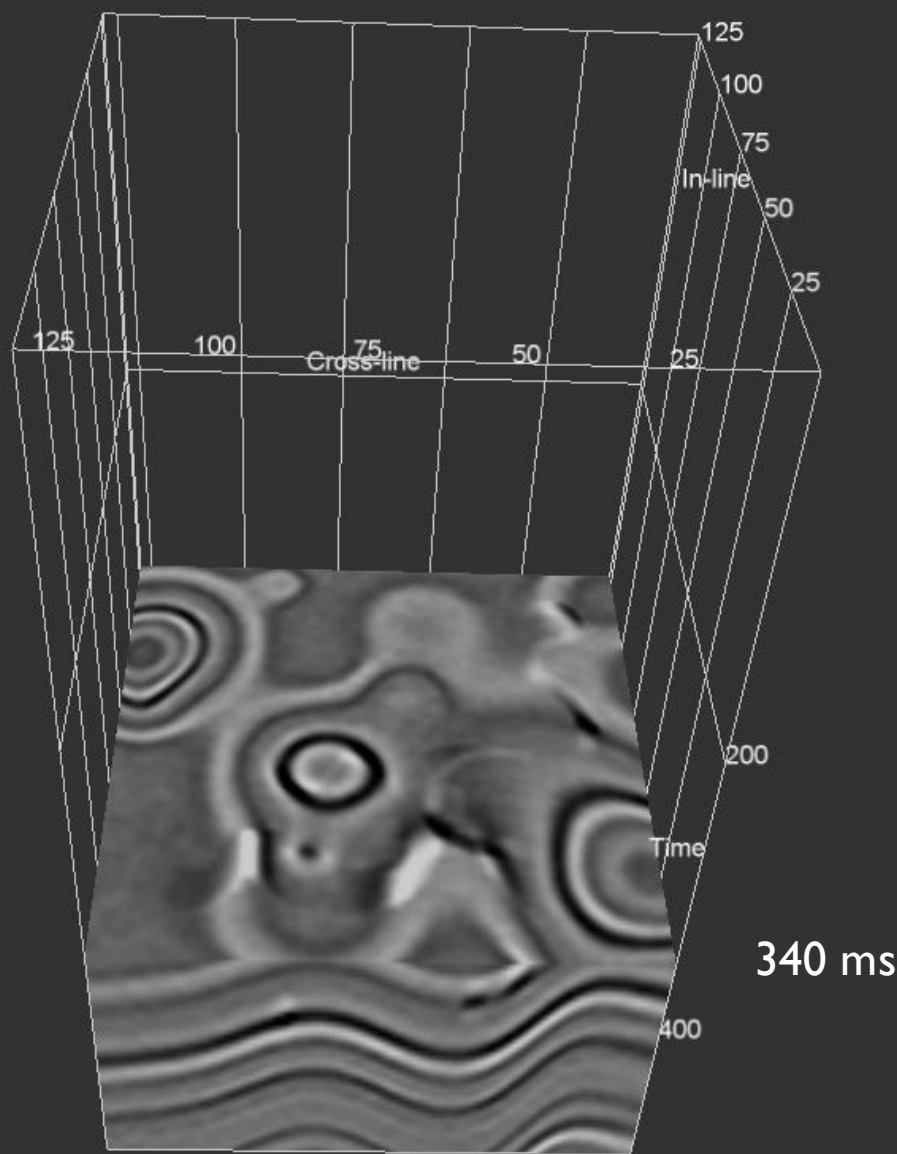
Amostragem de 4ms











Semblance & Coerência

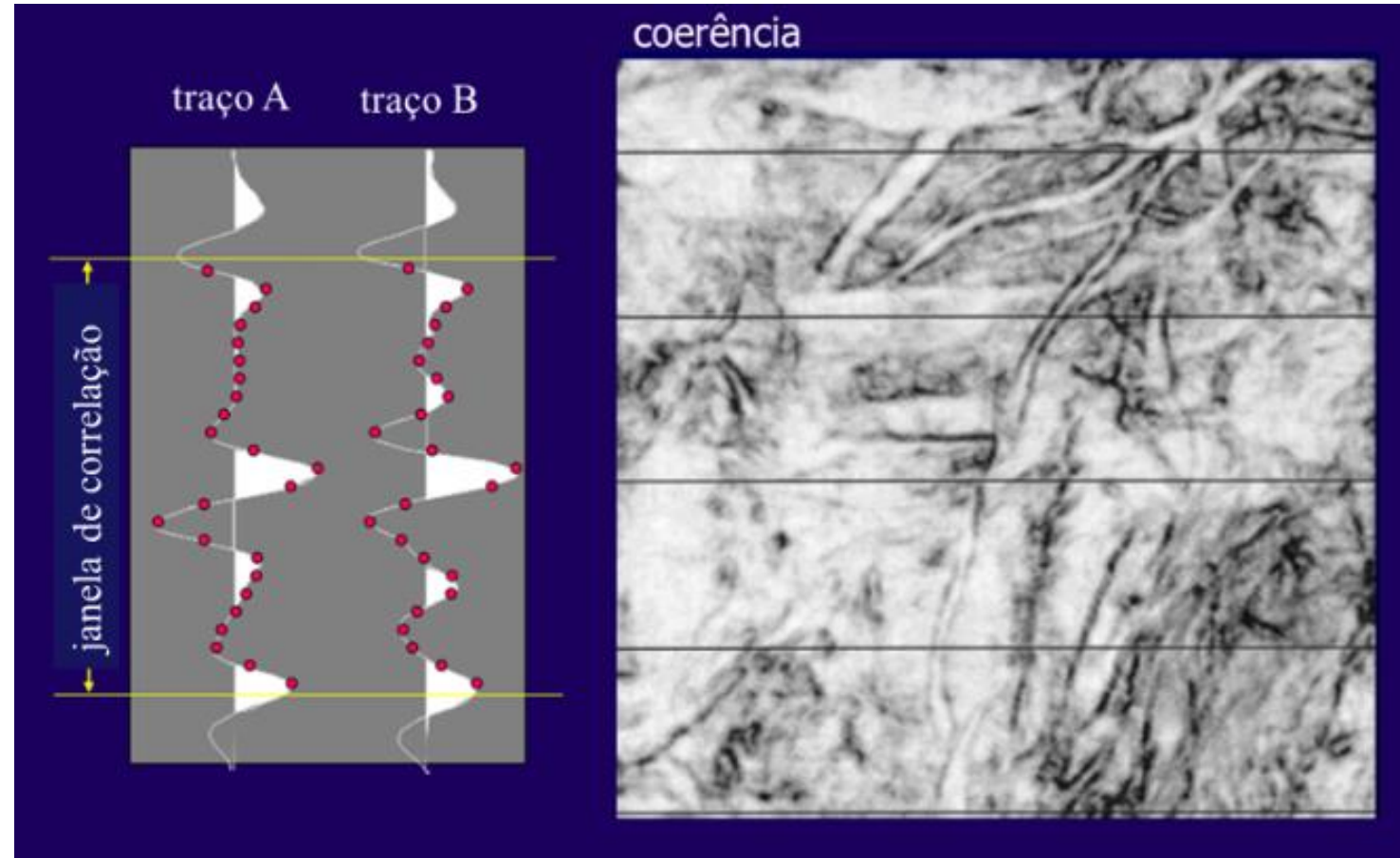
Junho/2024

Coerência ou Similaridade

Similaridade é uma forma de medida de "coerência" que expressa o quanto dois ou mais segmentos de traços são parecidos.

Uma similaridade de 1 significa que os segmentos de traço são completamente idênticos em forma de onda e amplitude.

Uma similaridade igual a 0 significa que eles são completamente diferentes.



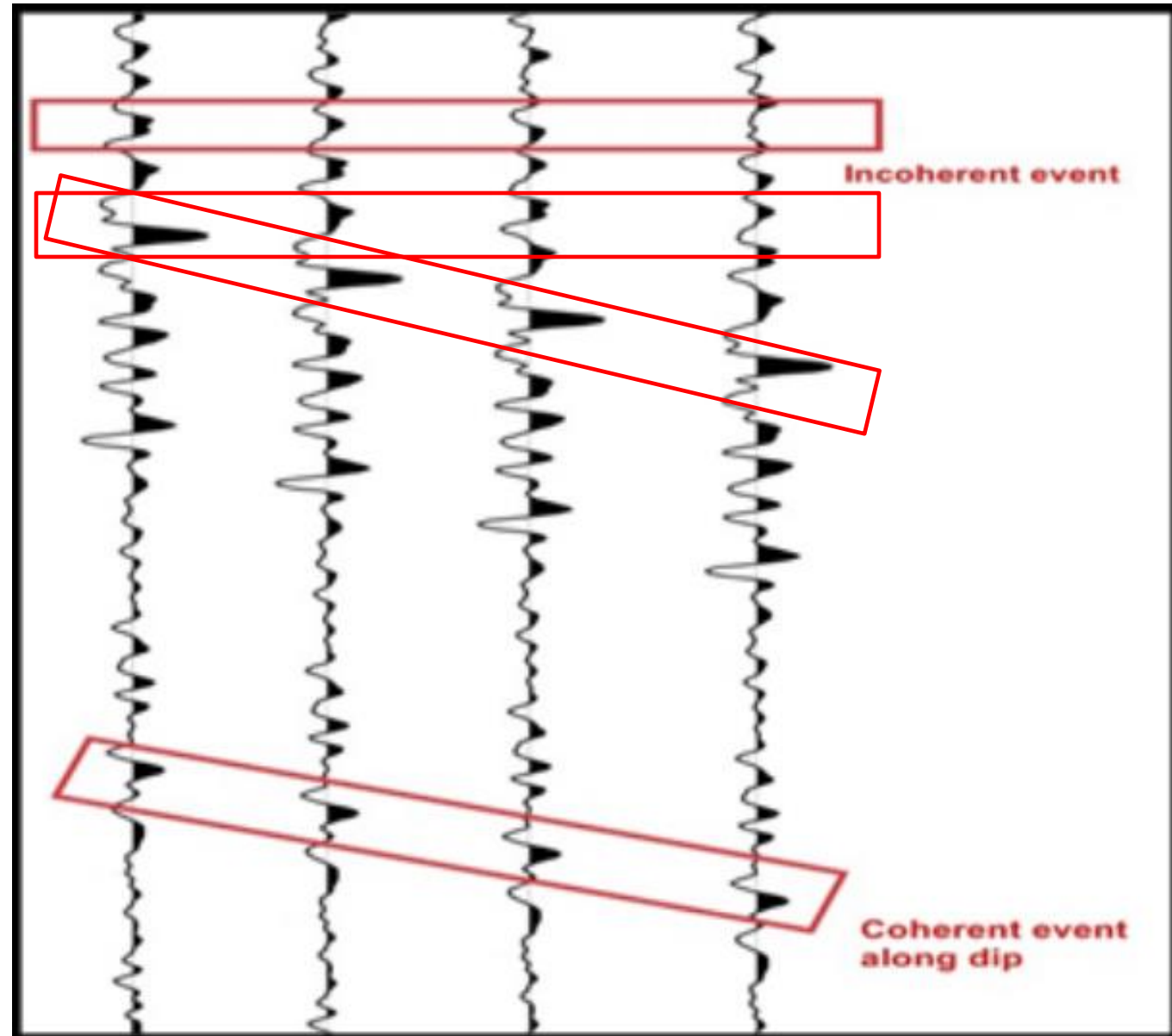
A **similaridade** entre dois segmentos de traço é calculada subtraindo do valor 1 a distância entre os vetores dos segmentos de traço, normalizada pela soma do comprimento dos vetores. Esta medição fornece o valor 1 se os segmentos do traço forem idênticos e zero se tiverem uma mudança de fase de 180°

Coerência ou Similaridade

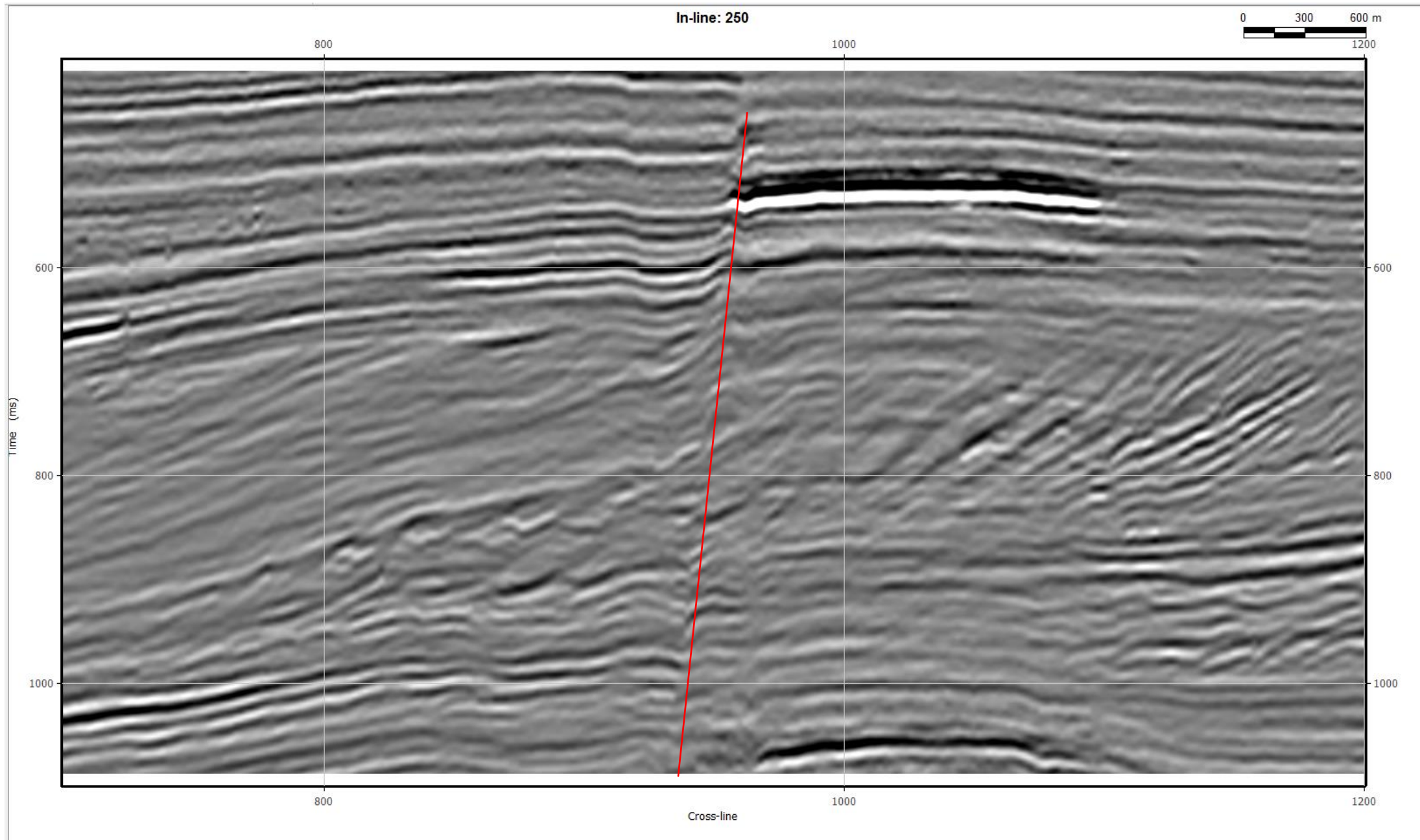
Traços semelhantes normalmente apresentam altos valores de coerência

Descontinuidades apresentam baixos valores de coerência

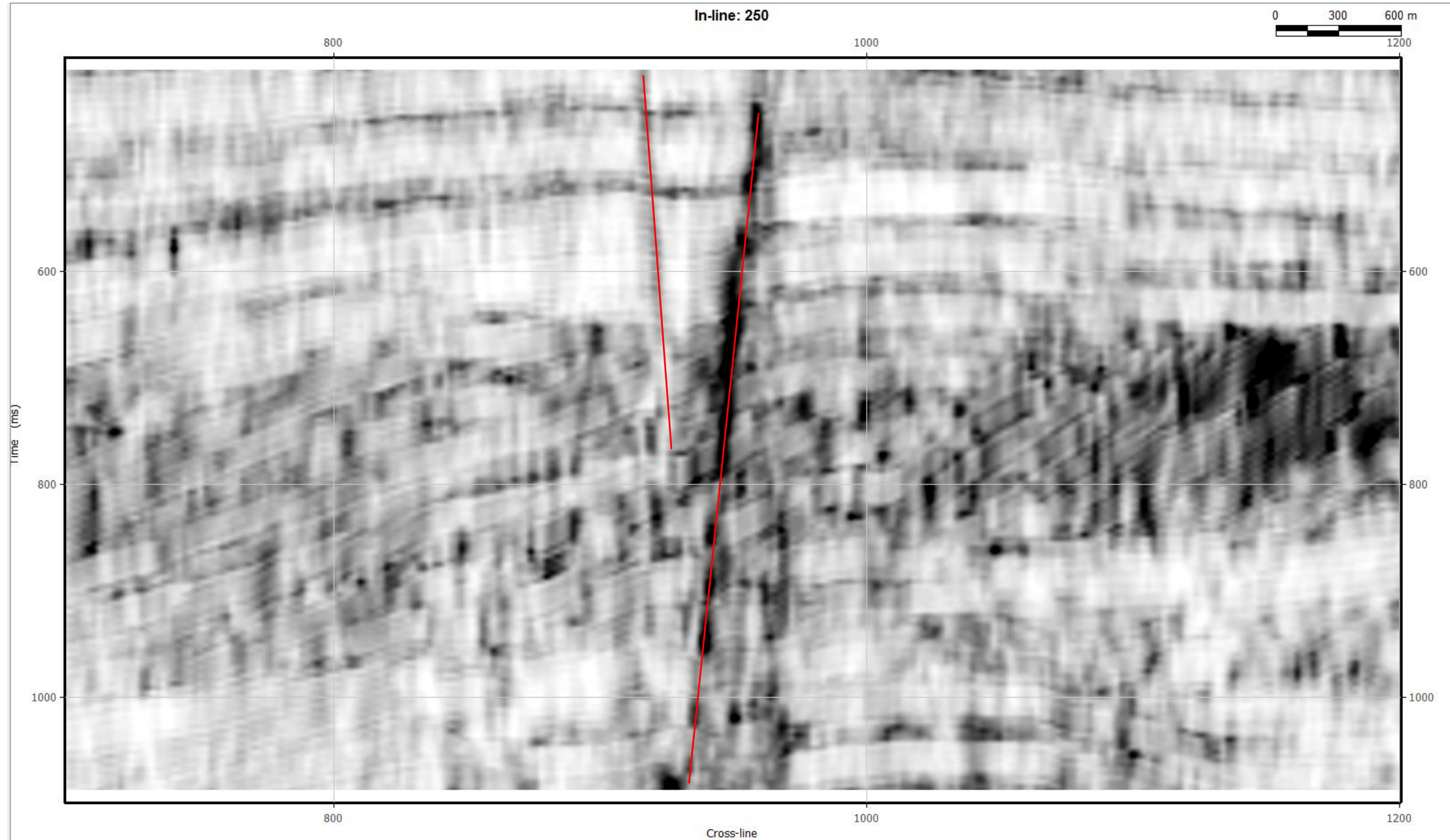
Regiões de traços sísmicos cortados por falhas, por exemplo, resultam em descontinuidades acentuadas na coerência traço a traço, produzindo um delineamento de valores de baixa coerência ao longo dos planos de falha.



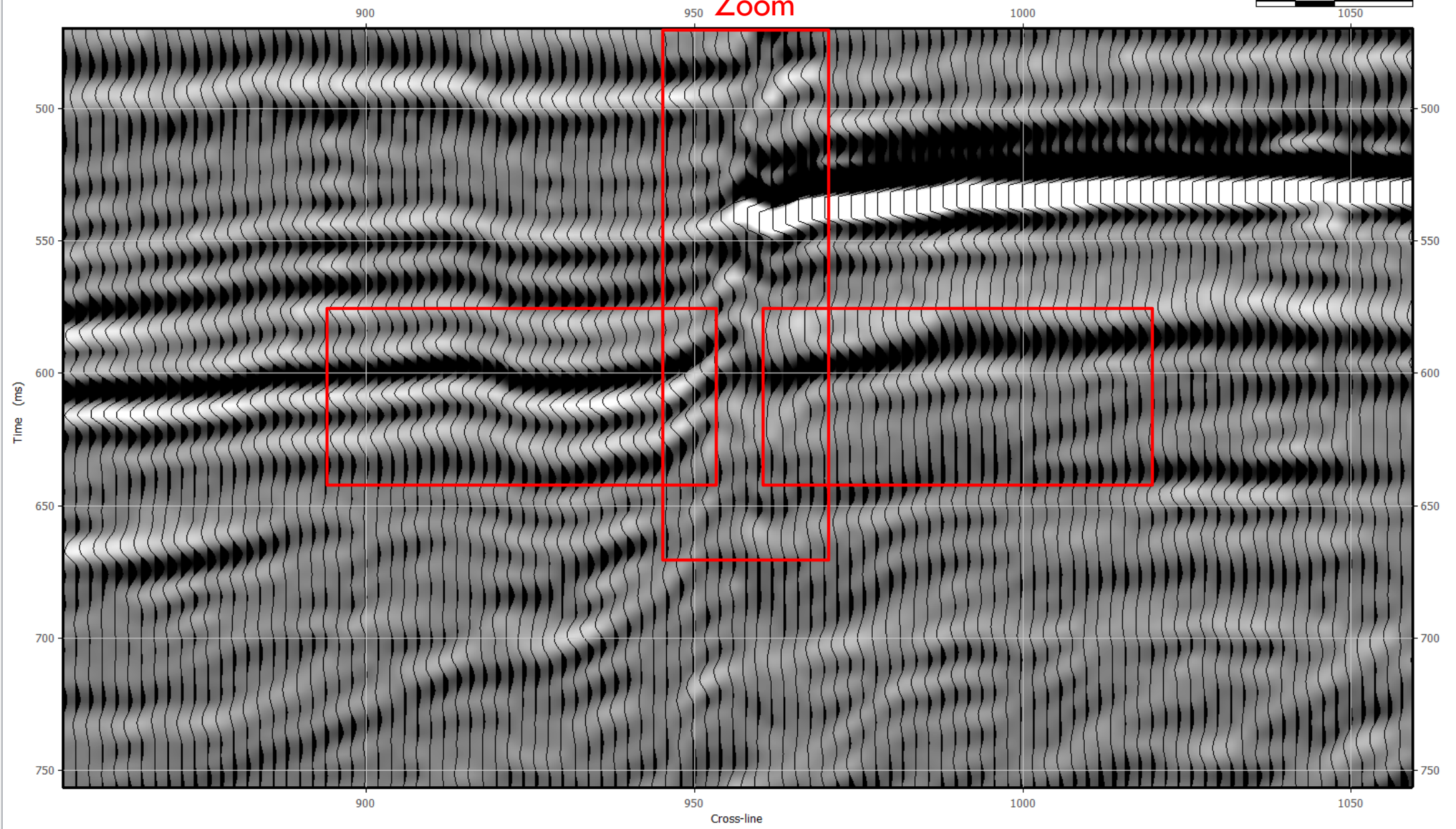
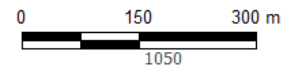
F3 (Densidade Variável)



Coerência (ou Similaridade) no F3



In-line: 250
Zoom



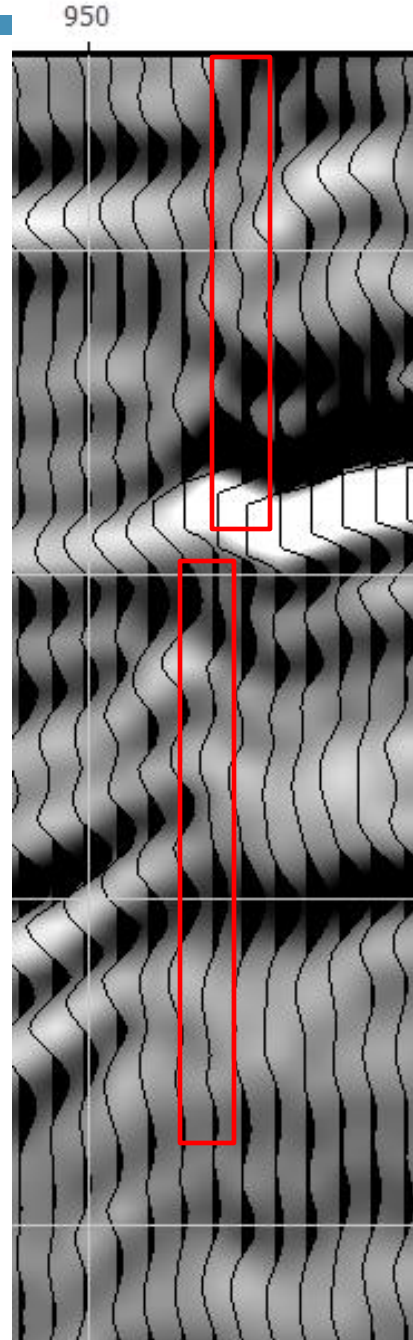
950

Zonas de falha com rejeito costumam colocar lado a lado rochas com diferentes litotipos, e diferentes coeficientes de reflexão, e por isso geram regiões de incoerência entre os traços sísmicos.

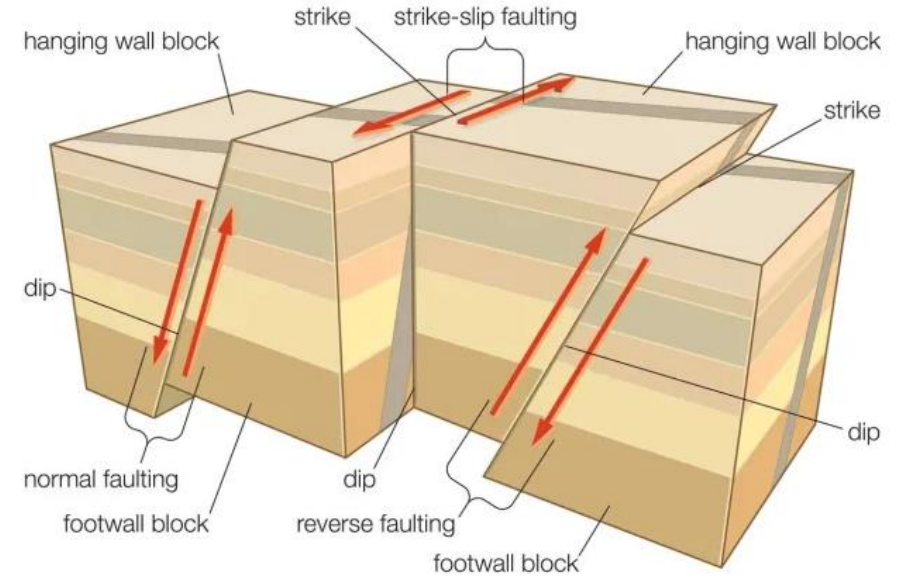
Falhas são locais onde a amplitude sísmica costuma apresentar um valor de amplitude mais baixo do que as camadas ao seu redor.

Canais erodem o substrato, sendo preenchidos com outro tipo de sedimento e, devido ao seu formato em “V” costumam colocar lado a lado rochas com diferentes litotipos, (e diferentes coeficientes de reflexão), gerando regiões de incoerência sísmica em suas bordas.

O **atributo de coerência** ou similaridade **realça as zonas coerentes** e, por isso, acabam por **revelar as zonas incoerentes**, como falhas, canais, bordas em geral e, (infelizmente) os ruídos.

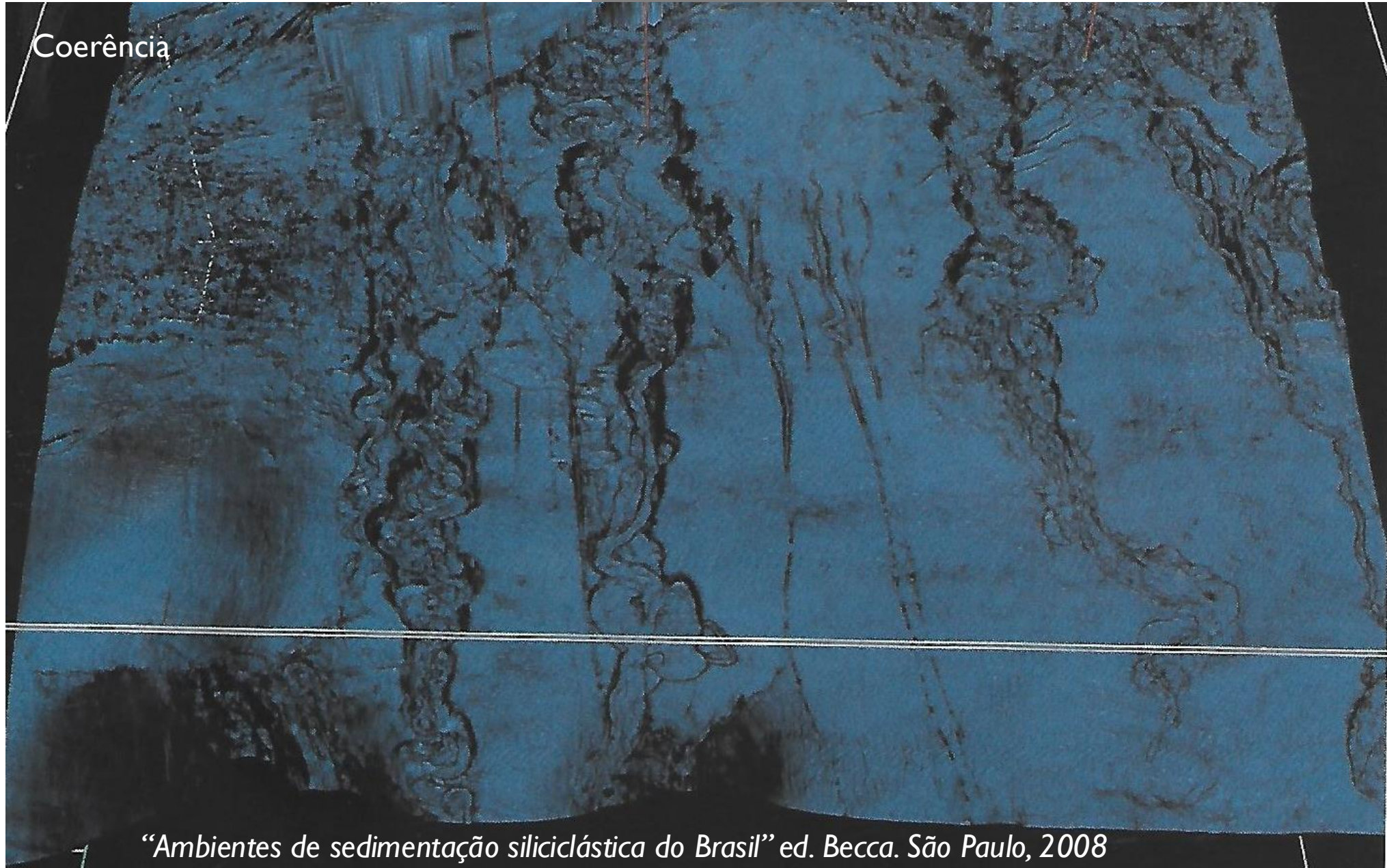


Características das Falhas



Sísmica
(Bacia de Santos)

Coerência



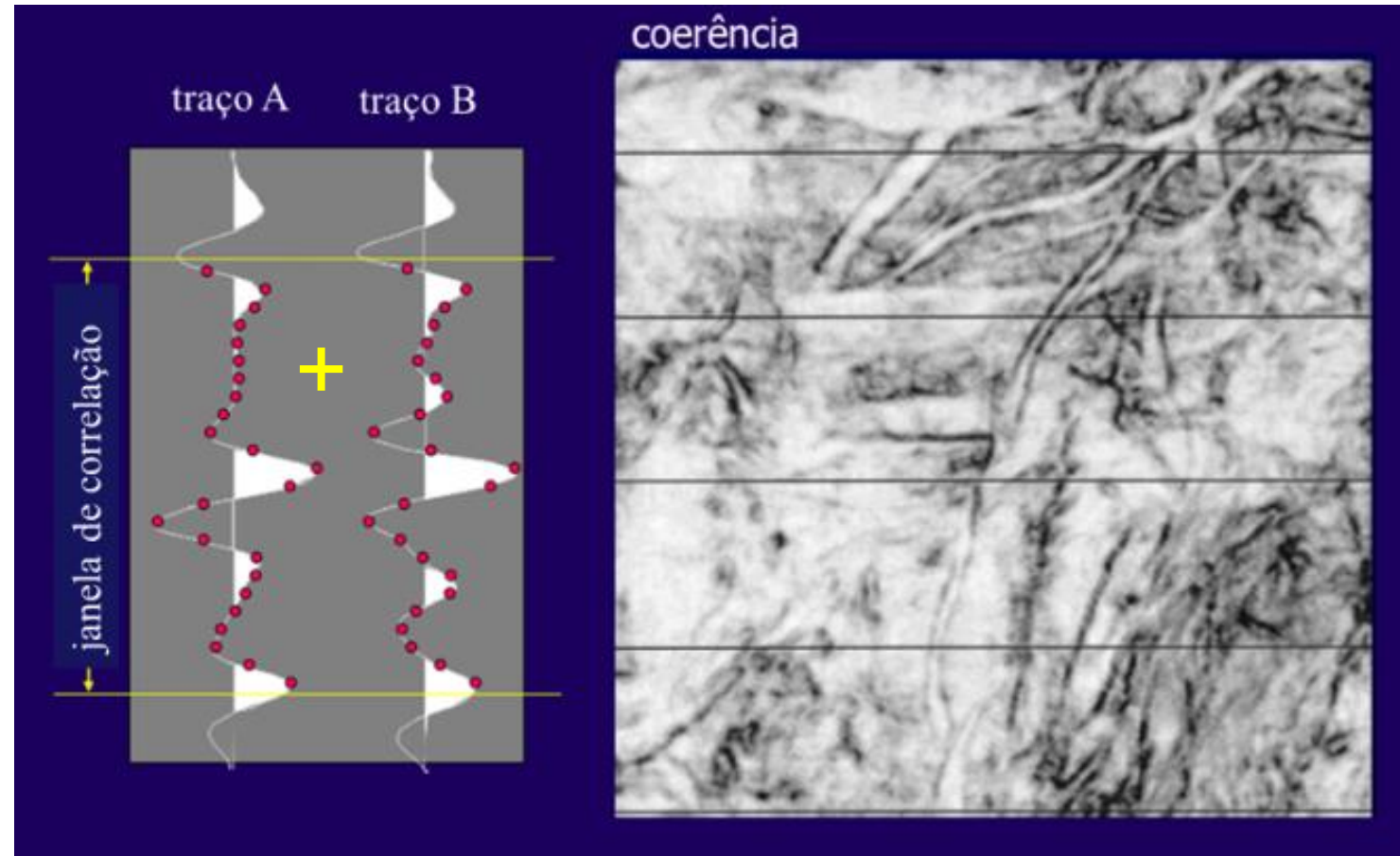
“Ambientes de sedimentação siliciclástica do Brasil” ed. Becca. São Paulo, 2008

SLEMBANCE

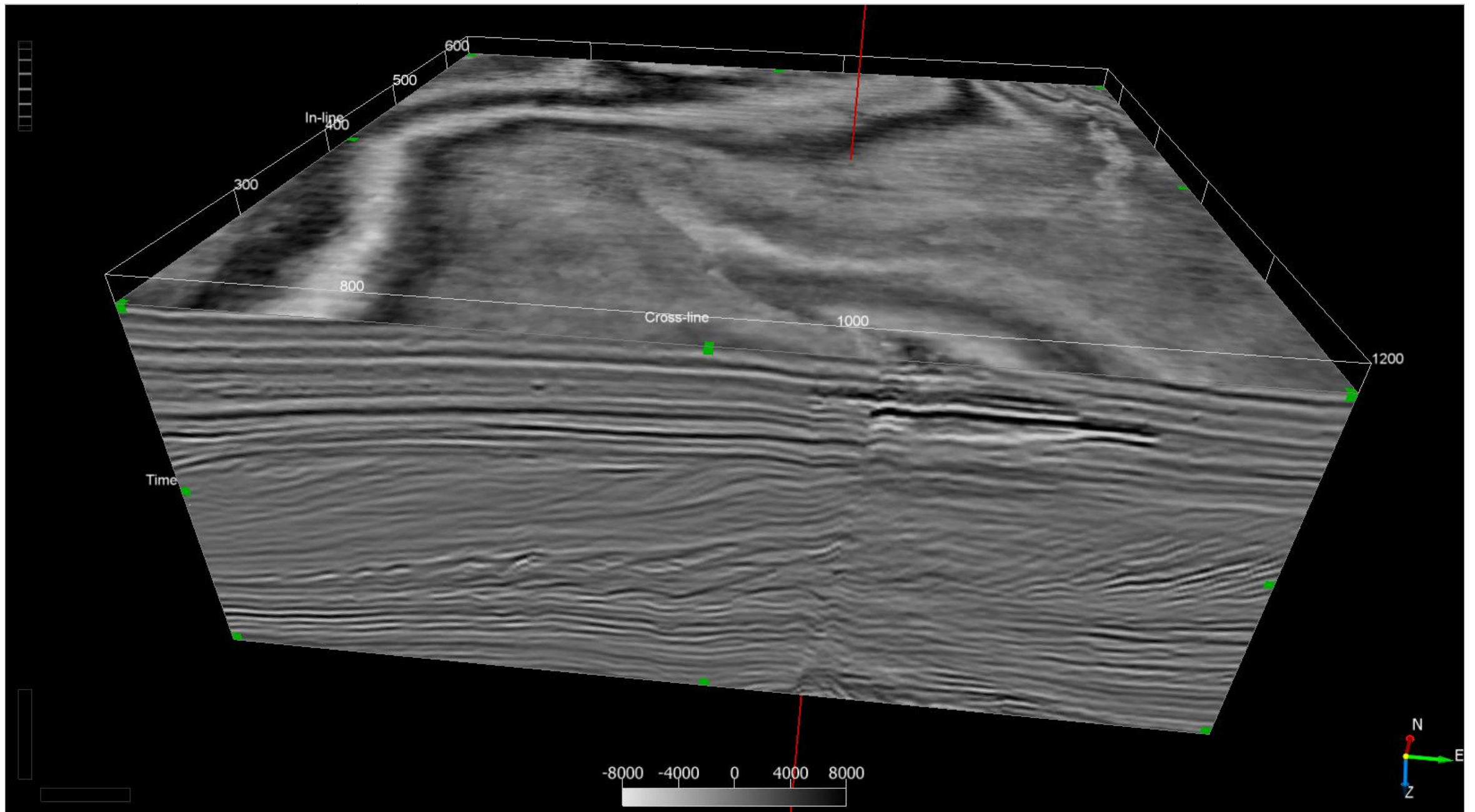
O Semblance se baseia na **soma de traços adjacentes**.

Traços sísmicos são dados oscilatórios; **se os traços estão alinhados e são semelhantes, então a soma tem um efeito construtivo**.

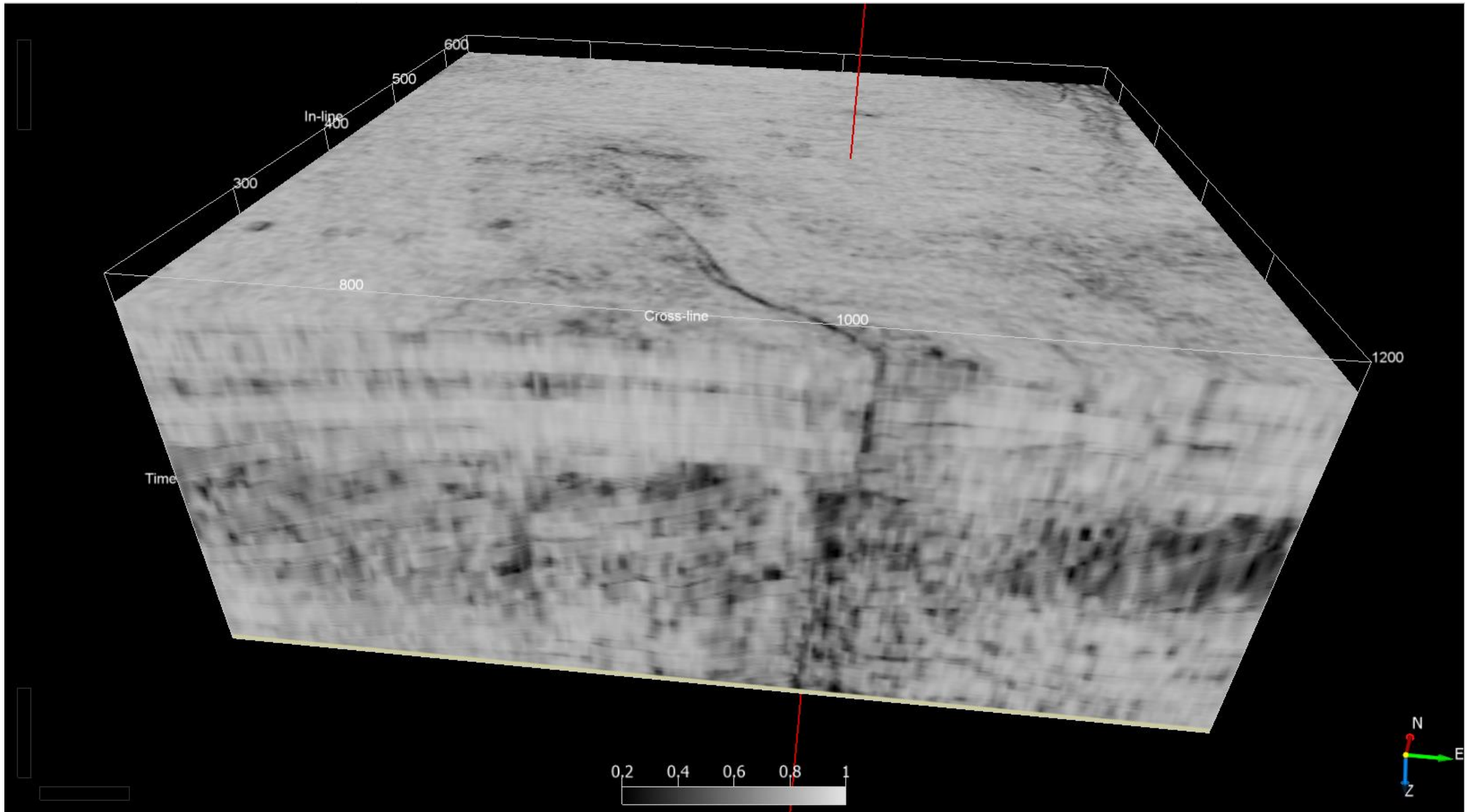
O Semblance é então uma medida de continuidade do horizonte e gera valores entre zero, no caso em que a defasagem entre traços vizinhos gera um efeito destrutivo, e o valor de um, para o caso de continuidade ideal do horizonte.



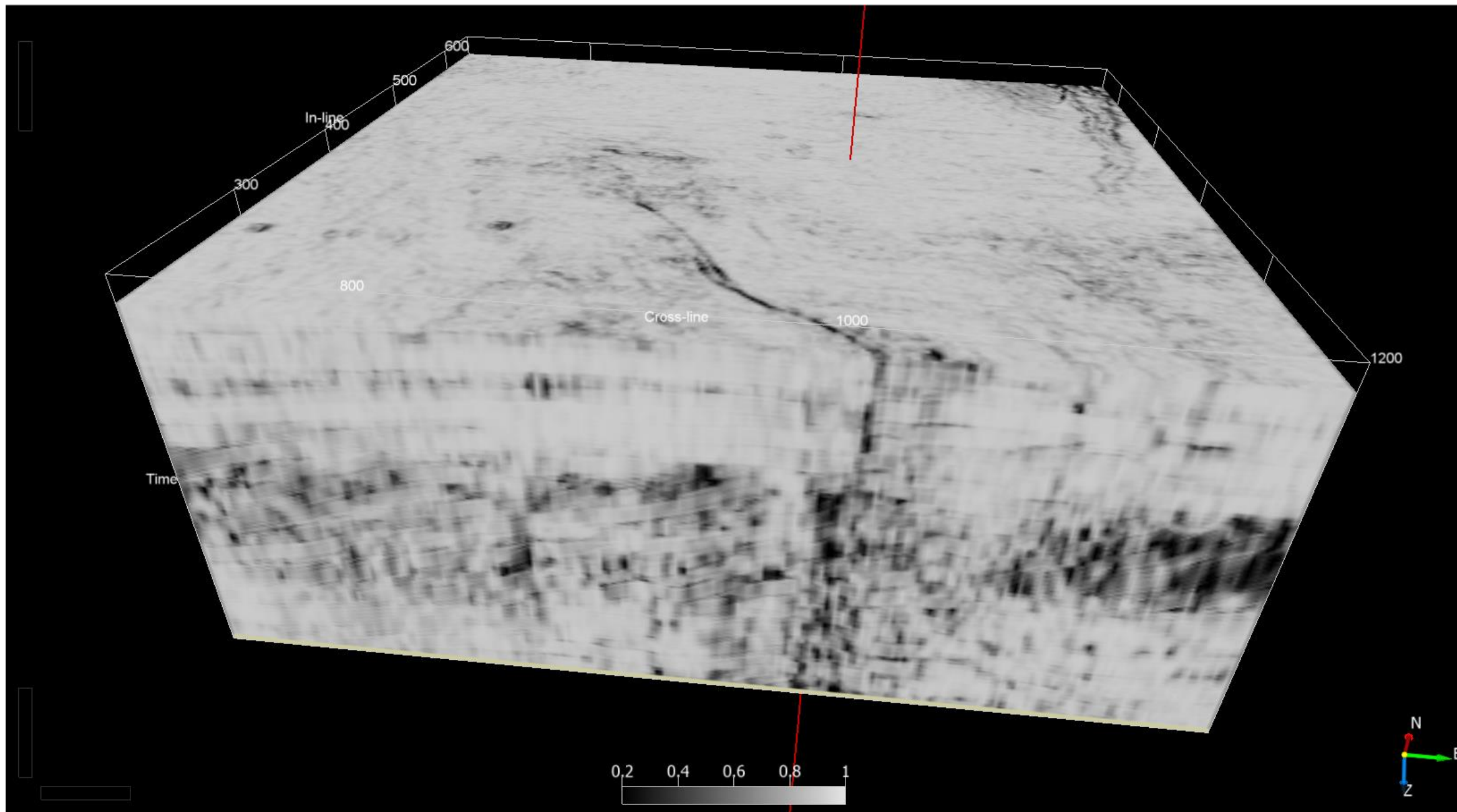
Cubo Sísmico F3



SIMILARIDADE



SLEMBANCE



Cubo Sísmico
coerencia_0.sgy

Informações do Header

Dado Sísmico “Coerencia_0.sgy”

128 in-lines

128 cross-lines

Tempo de registro – 0 a 508 ms

Amostragem de 4 ms

Dados de amplitude [0 a 1]

Extract Survey Setup from SEG-Y

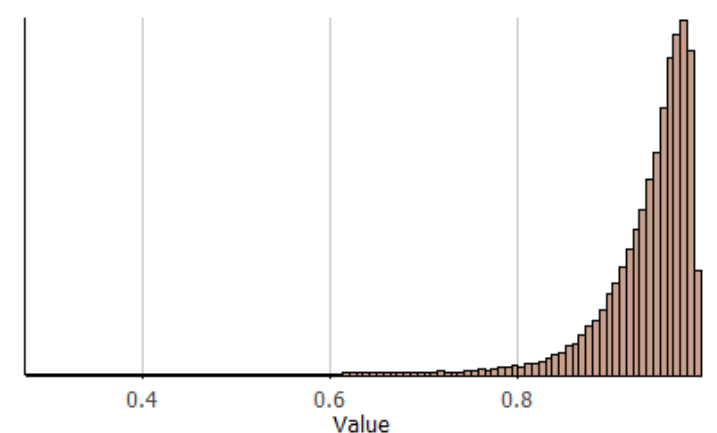
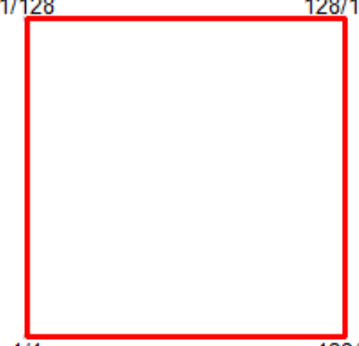
Input file *=wildcard C:\Users\hugosaar\Desktop\coerencia_0.sgy Select ... Edit ...

Data type 3D Seismic Data

Coordinate System Unlocated XY Select ...

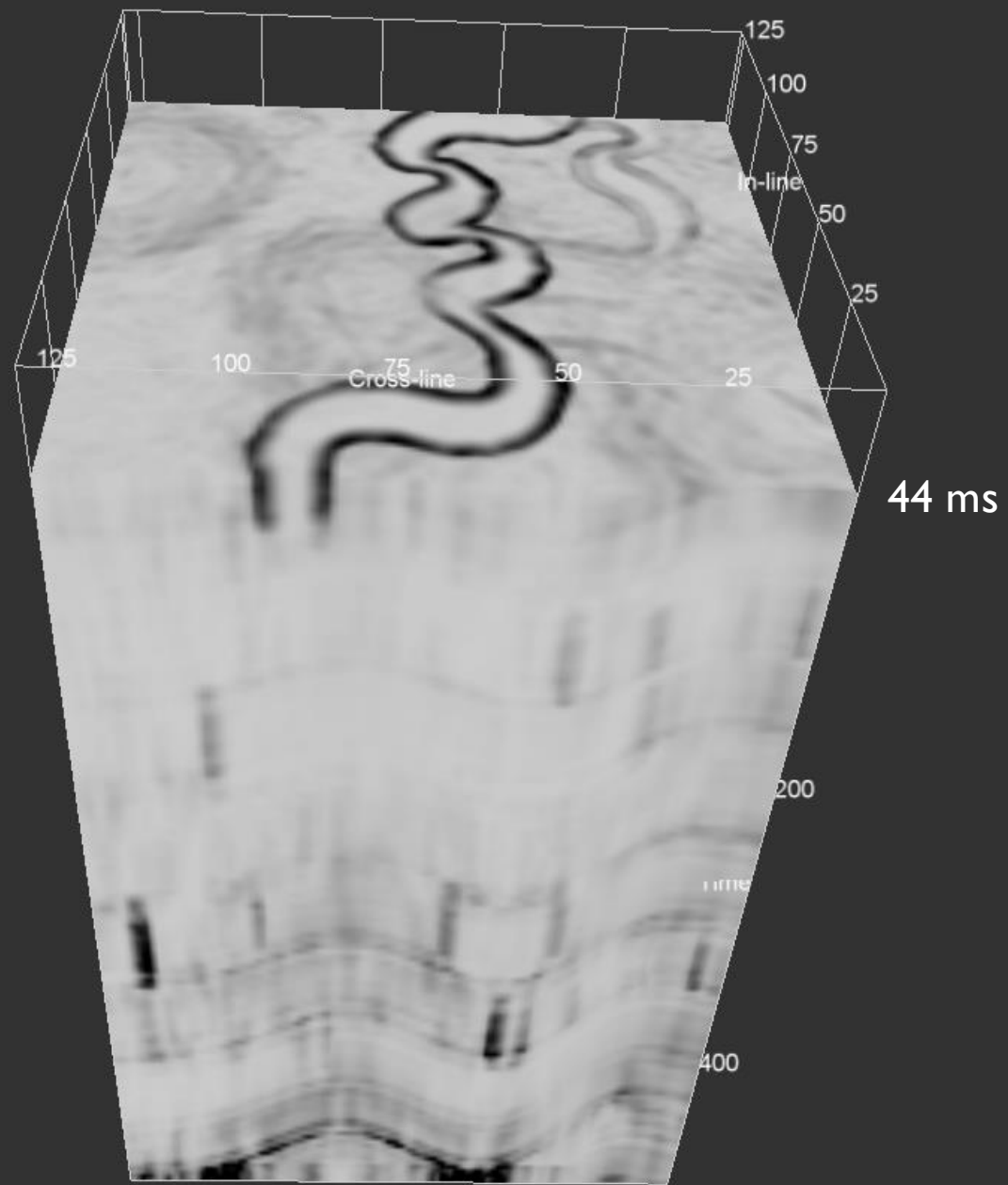
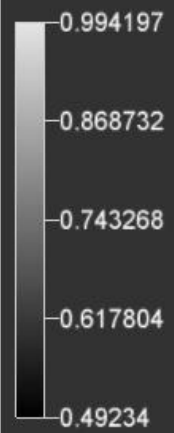
	Quick scan result	Source	Actually use
SEG-Y revision	0		User defined
Data format	1 - Floating point		From file header
Number of samples	128 (16384 traces)	From header	128
Z range	0 - 0.508 - 0.004 (s or m)	From header	Start 0 Step 0.004
In-line range	1 - 128	From header	Inline (byte 189) - "Inline num" 4 bytes
Cross-line range	1 - 128	From header	Crossline (byte 193) - "Crossl" 4 bytes
X-coordinate range	1.00 - 128.00	From header	Inline (byte 189) - "Inline num" 4 bytes
Y-coordinate range	1.00 - 128.00	From header	Crossline (byte 193) - "Crossl" 4 bytes

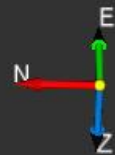
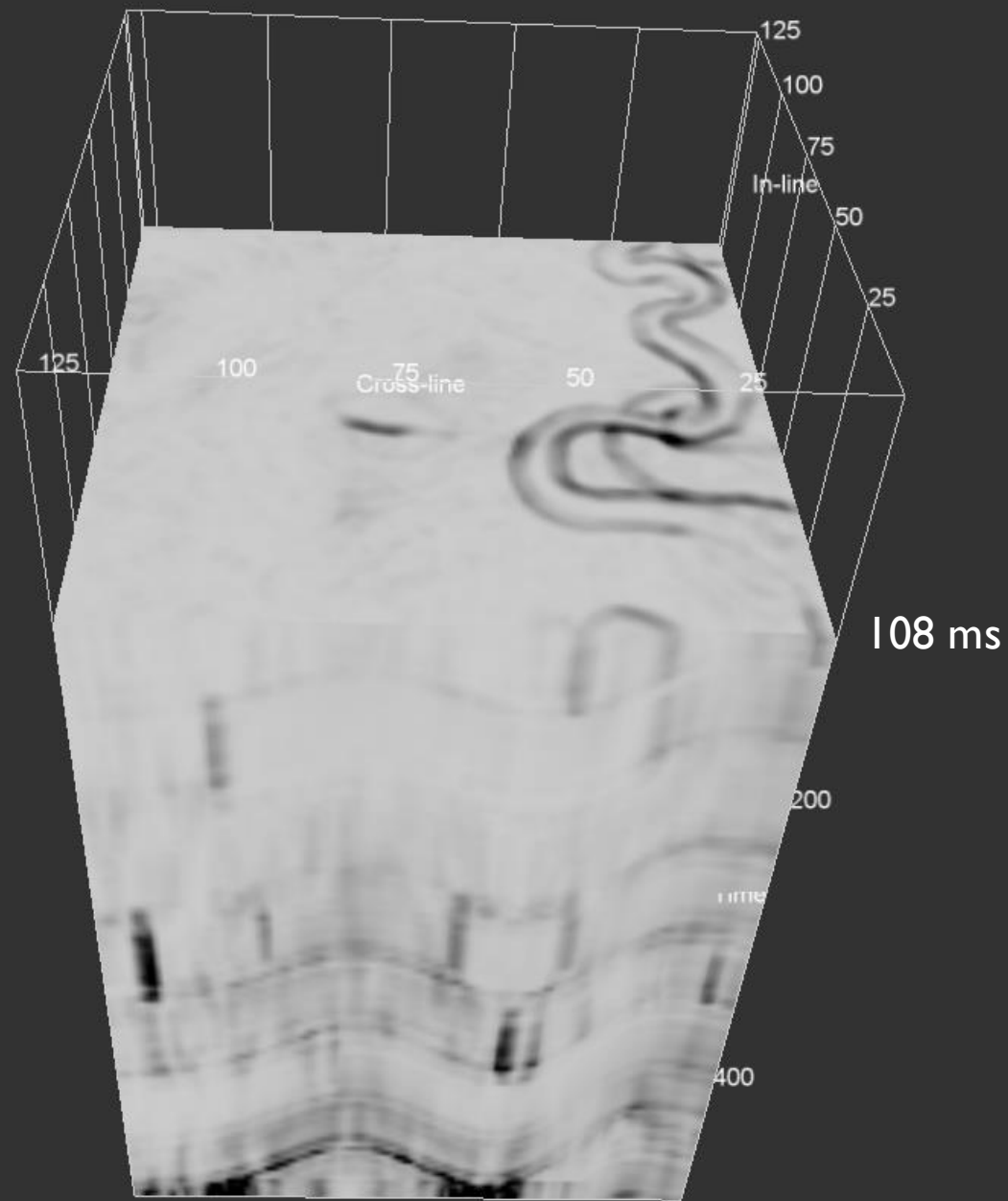
Resulting survey setup

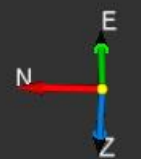
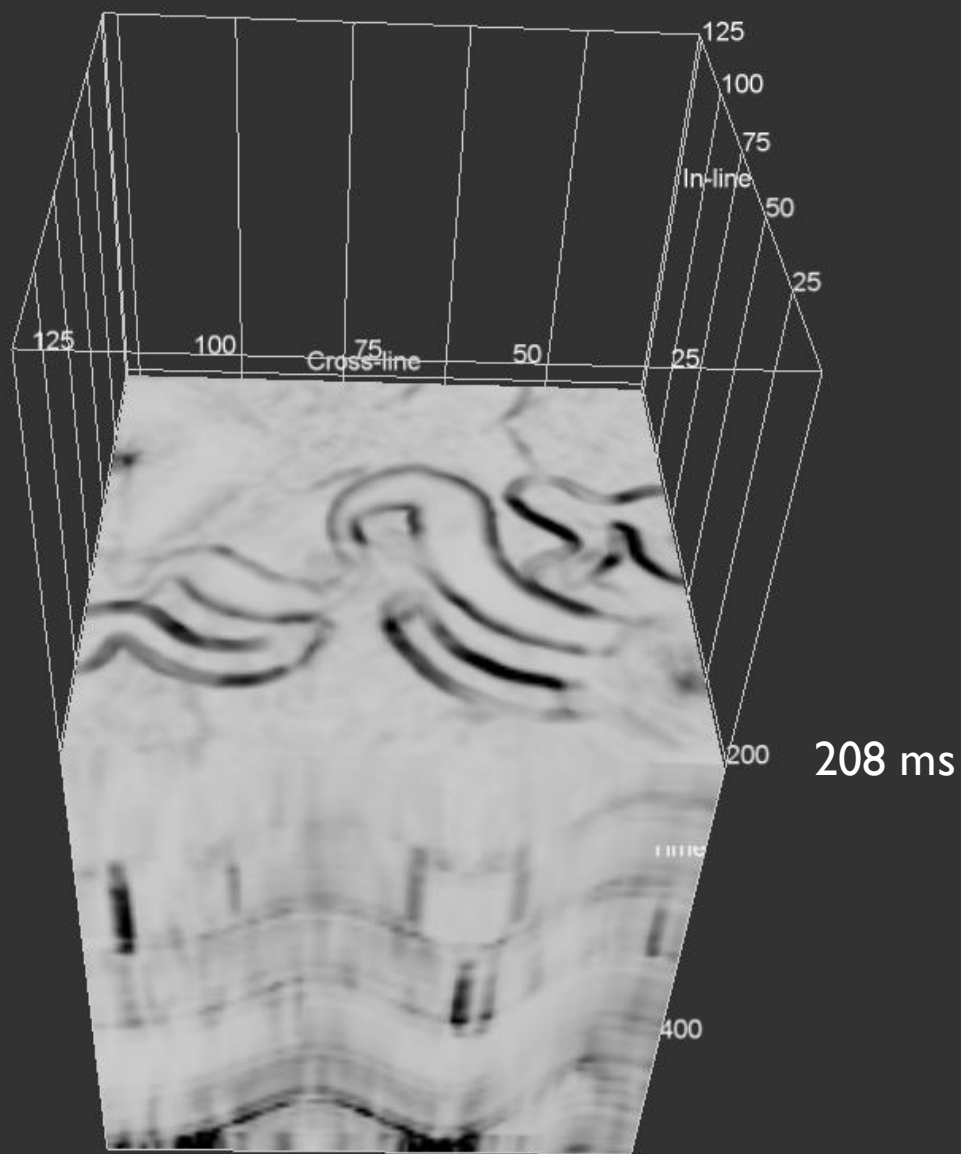


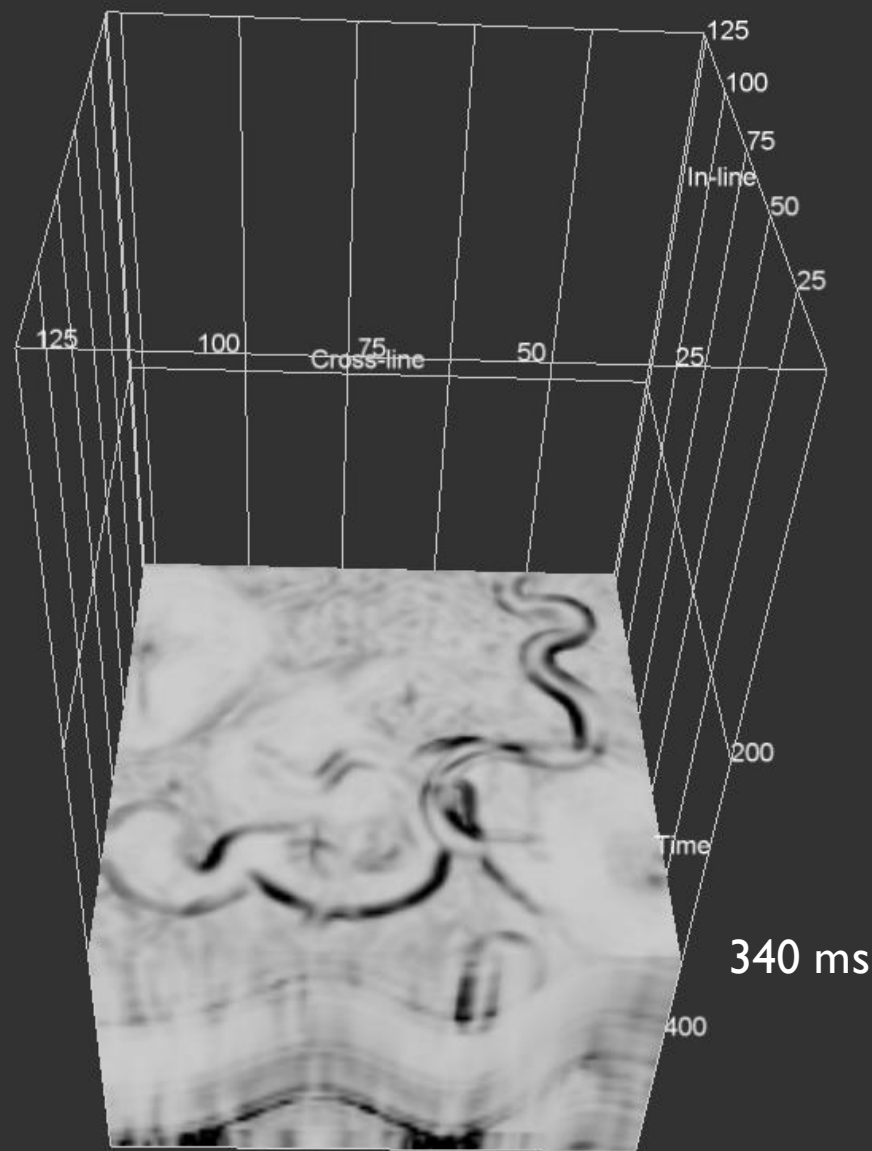
0.1% Zeros

OK Cancel ?









Observações

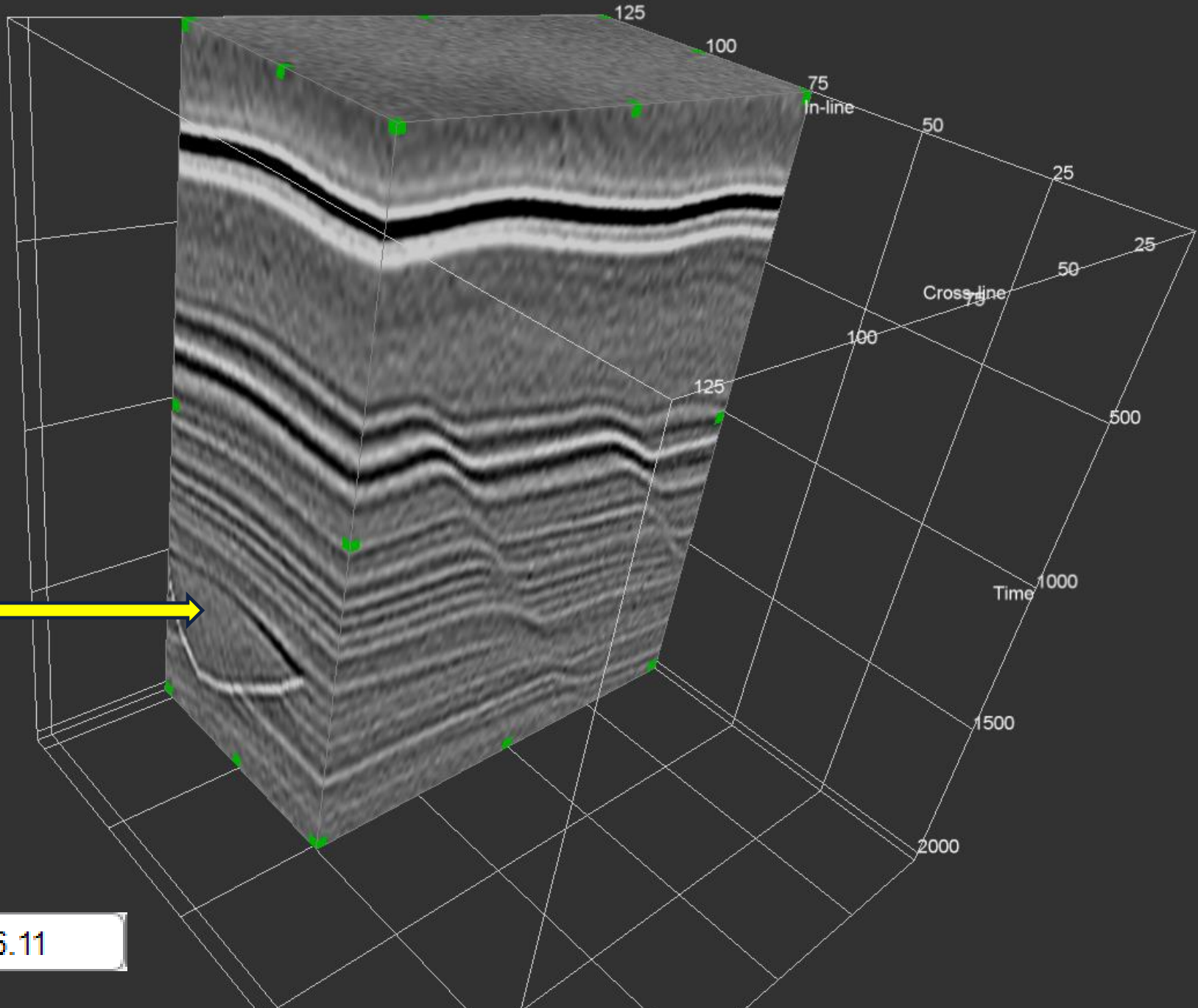
- 1- O Cubo de dados sísmicos sintéticos “exemplo_0.sgy” tem caráter geológico, apresentando canais diversos, que podem ser vistos em alguns slices de tempo, aqui separados nos tempos de 44 ms, 108 ms, 208 ms e 340 ms (há outros canais em tempos diversos).
- 2 – Os cubos de atributos sísmicos de Coerência e Semblance apresentam excelente correlação com o dado sintético que os originou.
- 3 – Os canais são melhor visualizados nos cubos de atributos sísmicos, seja no de Semblance ou no de Coerência.
- 4 – Uso dessa ferramenta de geração de cubos sintéticos em Python parece atender perfeitamente aos requisitos do projeto.

Cubo Sísmico Sintético

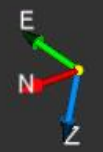
Canais e Falhas

Dado Sísmico
Cubo Teste3

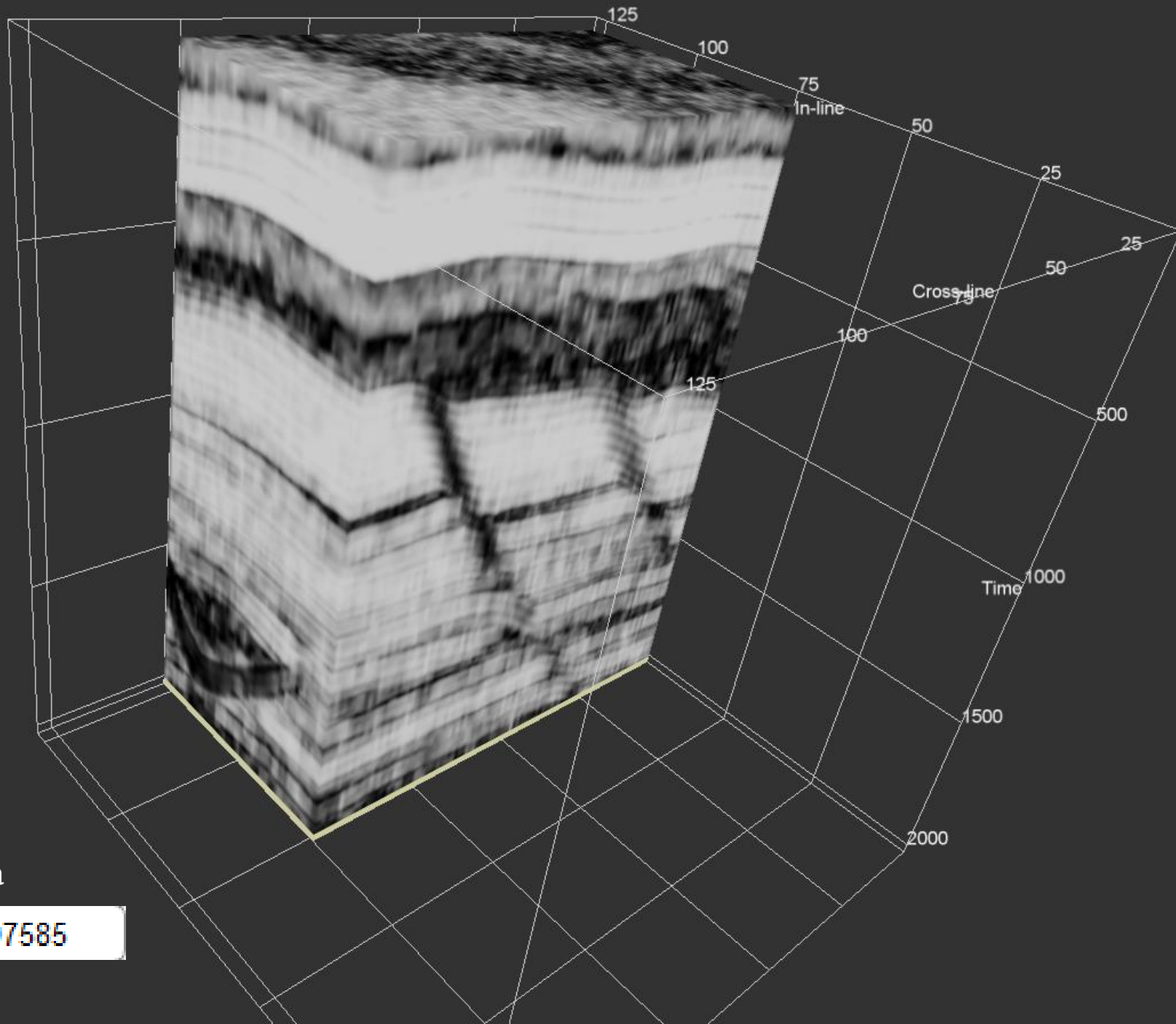
Canal



Amplitude



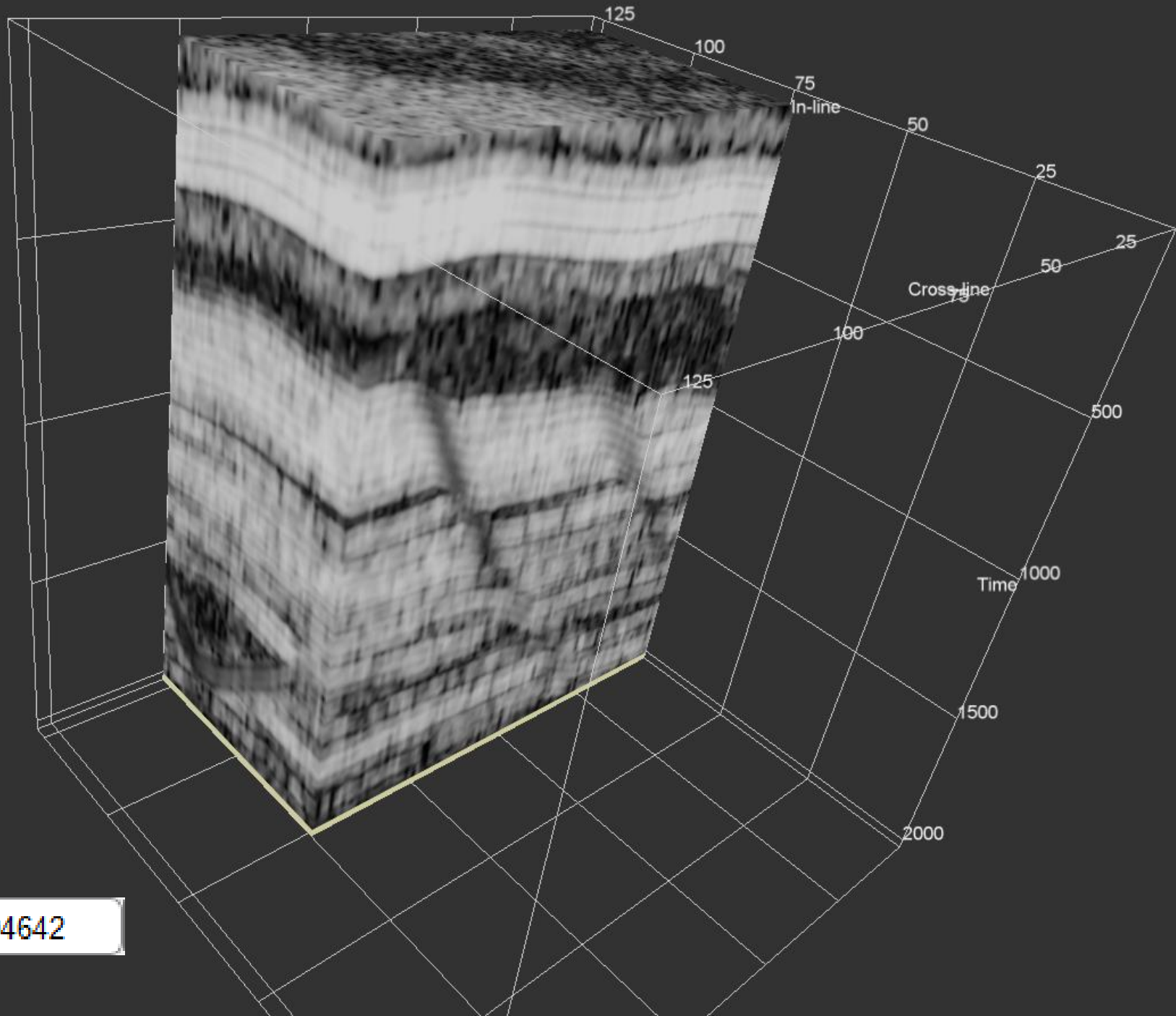
Semblance
Cubo Teste3



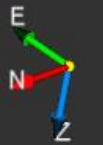
Amplitude Sísmica



Similaridade
Cubo Teste3

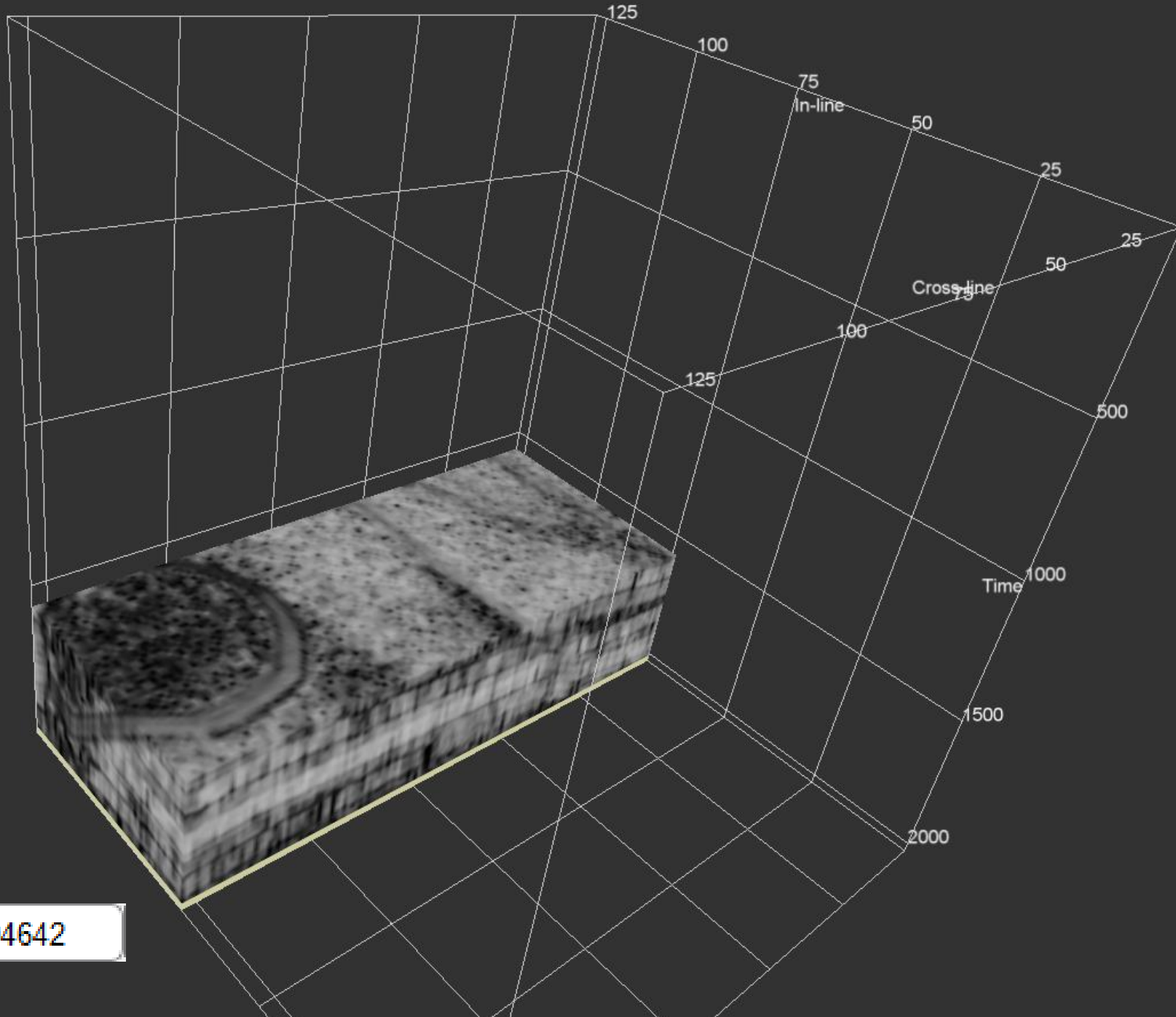


Amplitude

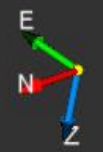
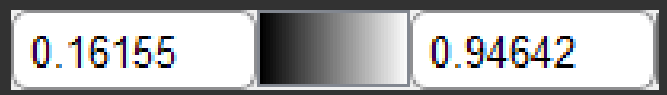


Similaridade Cubo Teste3

Canal
(visto em slice)



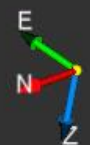
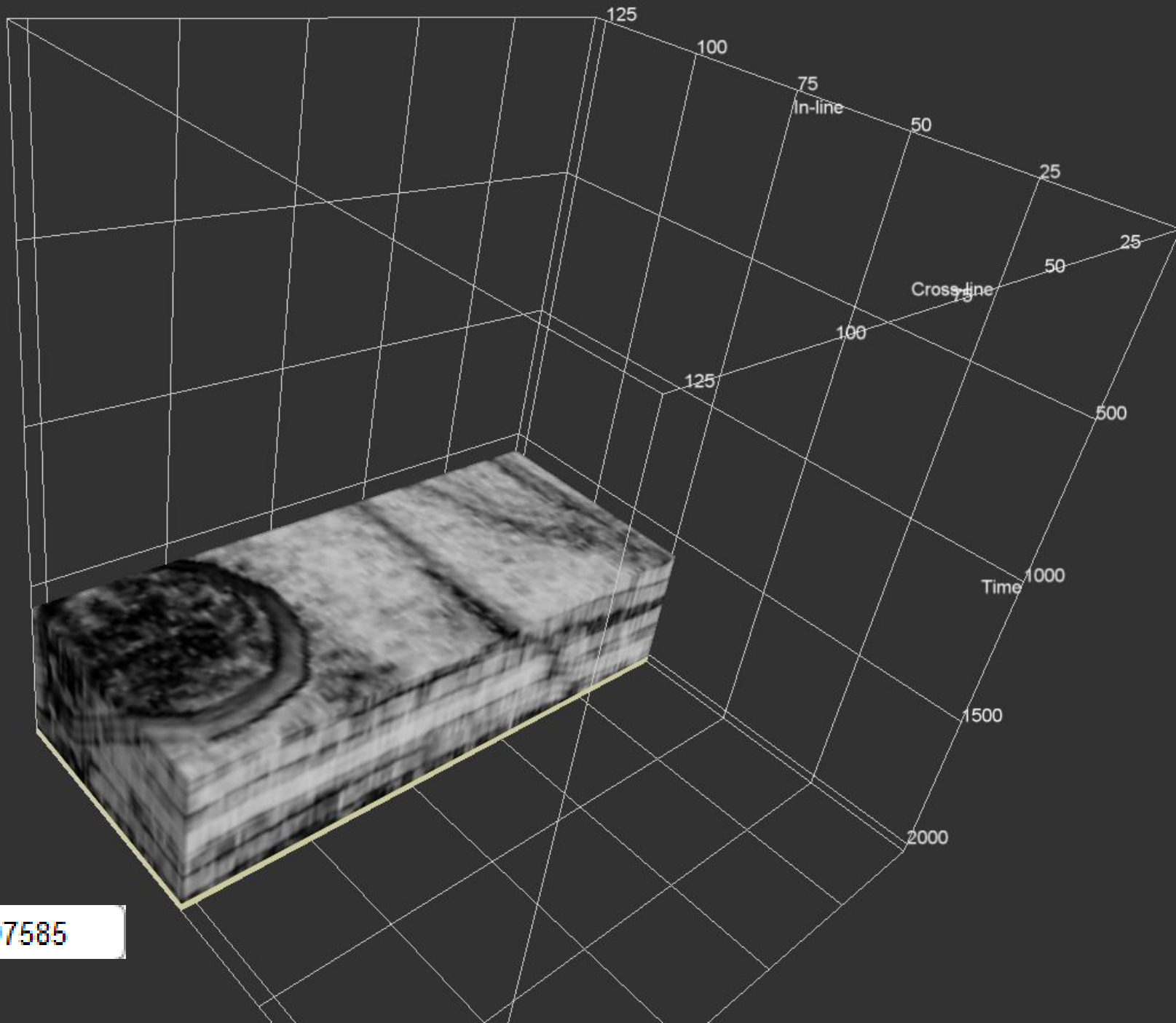
Amplitude



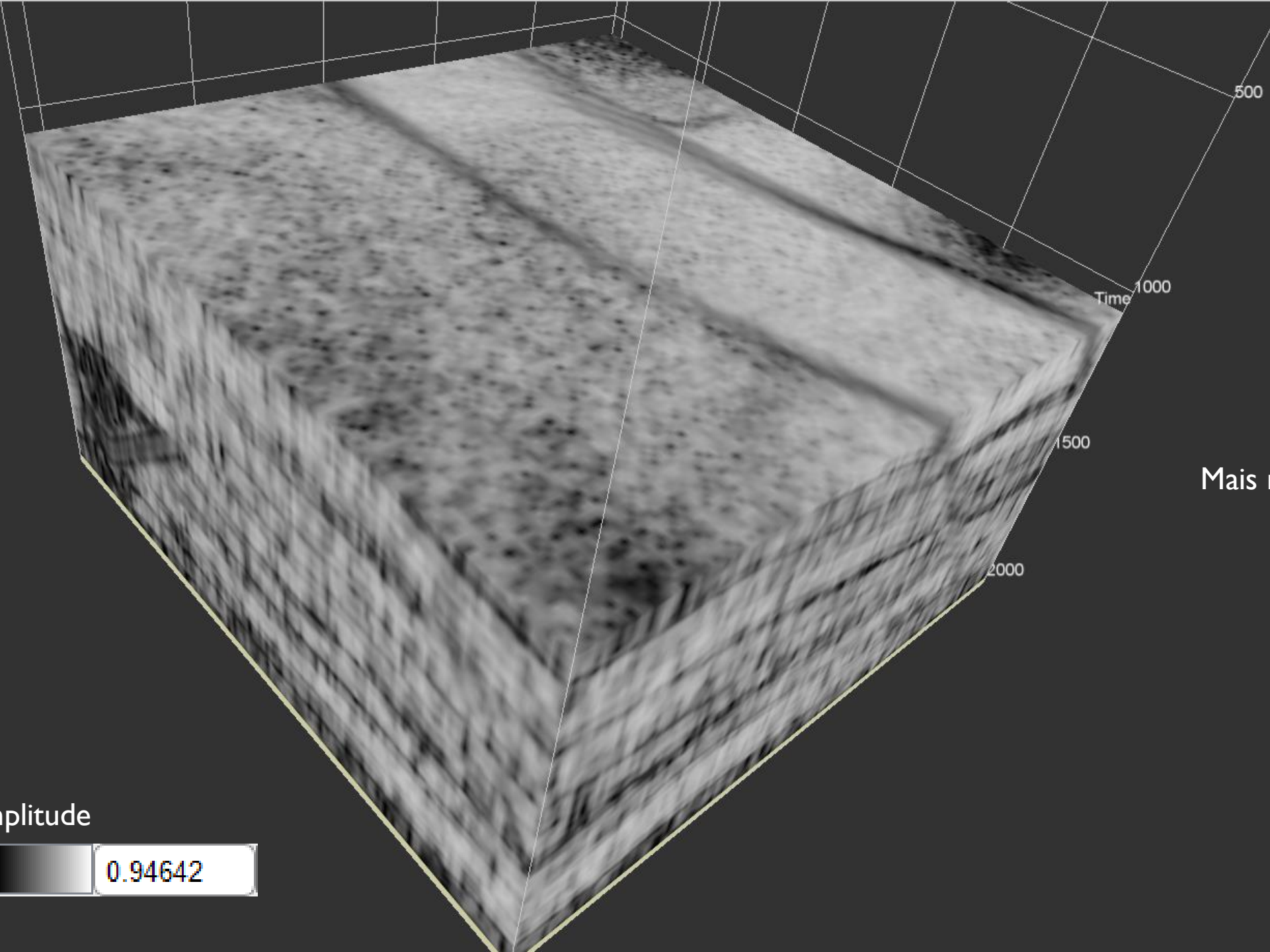
Semblance
Cubo Teste3

Canal
(visto em slice)

Amplitude

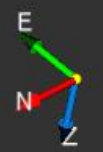


Similaridade
Cubo Teste3

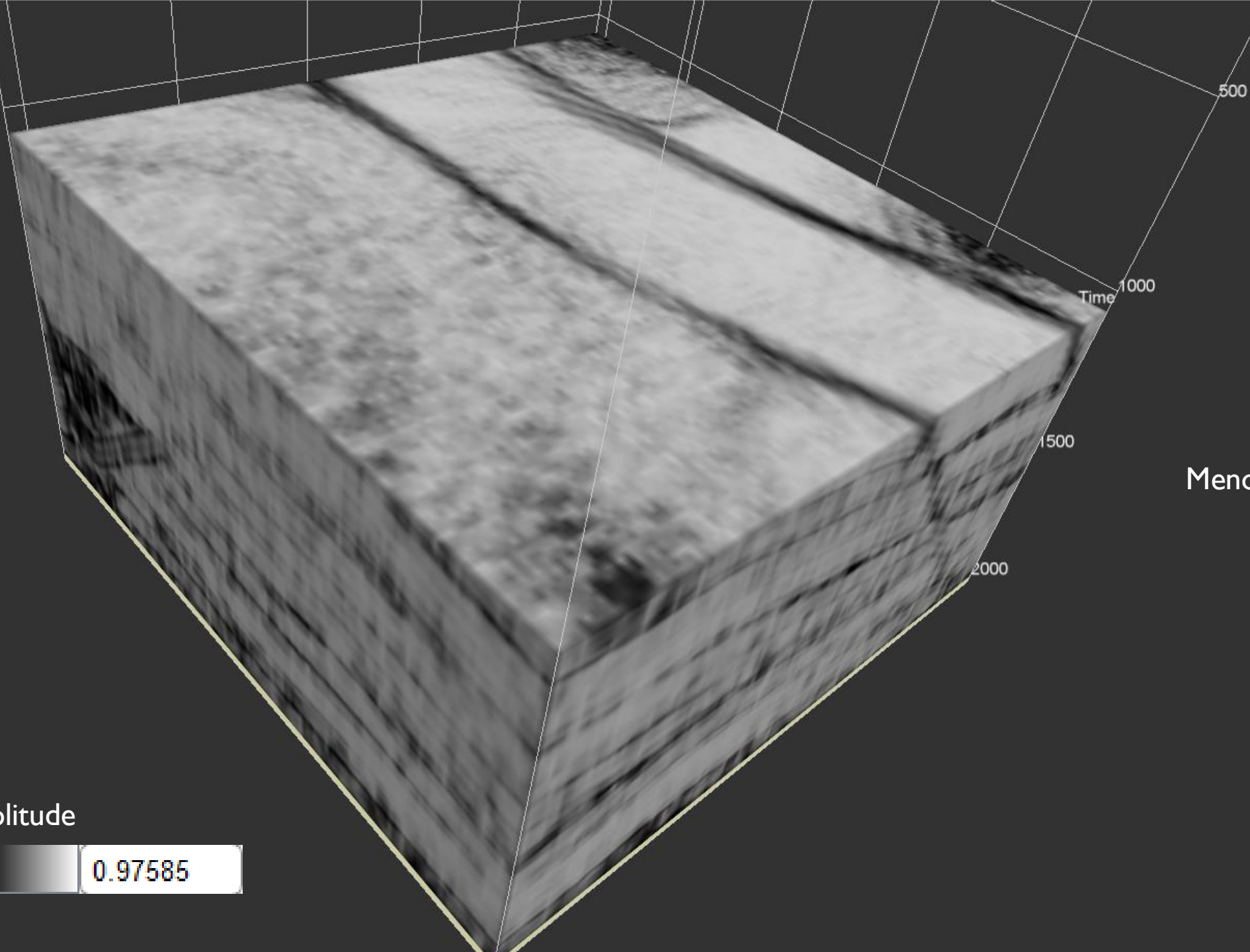


Mais ruidoso

Amplitude



Semblance
Cubo Teste3



Menos ruidoso

Amplitude

0.046903

0.97585



Observações

- 1 – Os cubos de atributos Semblance e Similaridade são gerados por análise de coerência traço a traço, em todas as direções.
- 2 – O cubo de similaridade foi gerado utilizando-se uma janela de busca de coerência entre -12 a 12ms, com análise direcional (steering) de mergulho máximo (browse dip) de 250 $\mu\text{s}/\text{m}$ e uma variação de mergulho (delta dip) de 10 $\mu\text{s}/\text{m}$.
- 3 – O cubo de Semblance foi gerado com a mesma janela de coerência [-12 a 12 ms].
- 4 – O atributo de Similaridade ficou mais ruidoso do que o atributo de Semblance, um ponto a ser estudado para definir sua utilização como input.
- 6 - Fica a questão sobre quais cubos servirão melhor para os testes com as técnicas de IA (?)

WORLDWIDE OPEN SEISMIC DATASETS

O ESFORÇO MUNDIAL PARA O AVANÇO DAS TÉCNICAS DE IA APLICADAS PARA DO DADOS SÍSMICOS

Avaliação dos Datasets

Feições Geológicas


Avaliação dos Datasets





REATE CPRM (Onshore)

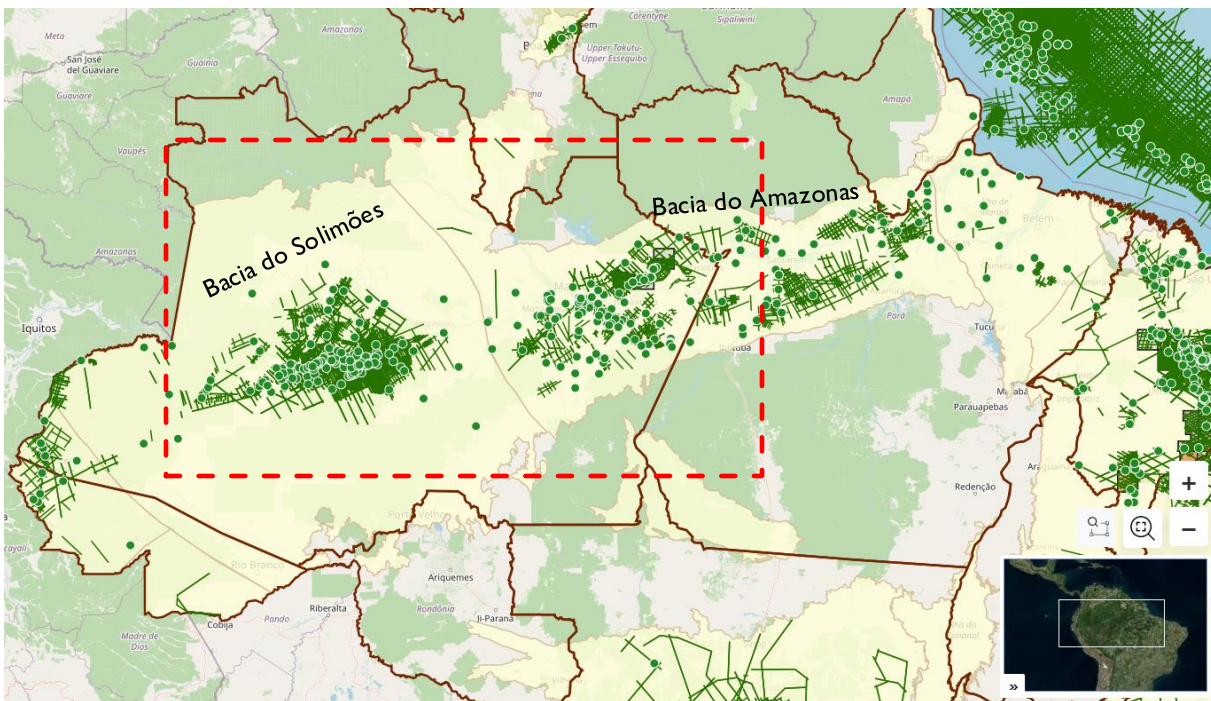
<https://reate.cprm.gov.br/anp/TERRESTRE>

 <p>BACIA DO ACRE - MADRE DE DIOS ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DE ALAGOAS ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO AMAZONAS ATUALIZADO EM: 05/05/2021</p> 
 <p>BACIA DO ARARIPE ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DE BARREIRINHAS ATUALIZADO EM: 16/05/2022</p> 	 <p>BACIA DE BRAGANÇA - VIZEU ATUALIZADO EM: 05/05/2021</p> 
 <p>BACIA DO ESPÍRITO SANTO ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DE JATOBÁ ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO MARAJÓ ATUALIZADO EM: 05/05/2021</p> 
 <p>BACIA DO PANTANAL ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO PARANÁ ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO PARECIS - ALTO XINGÚ ATUALIZADO EM: 05/05/2021</p> 
 <p>BACIA DO PARNAÍBA ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA POTIGUAR ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO RECÔNCAVO ATUALIZADO EM: 27/05/2021</p> 
 <p>BACIA DO RIO DO PEIXE ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DE SÃO FRANCISCO ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DE SÃO LUÍS ATUALIZADO EM: 05/05/2021</p> 
 <p>BACIA DE SERGIPE ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO SOLIMÕES ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO TACUTÚ ATUALIZADO EM: 05/05/2021</p> 
 <p>BACIA DO TUCANO CENTRAL ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO TUCANO NORTE ATUALIZADO EM: 05/05/2021</p> 	 <p>BACIA DO TUCANO SUL ATUALIZADO EM: 05/05/2021</p> 

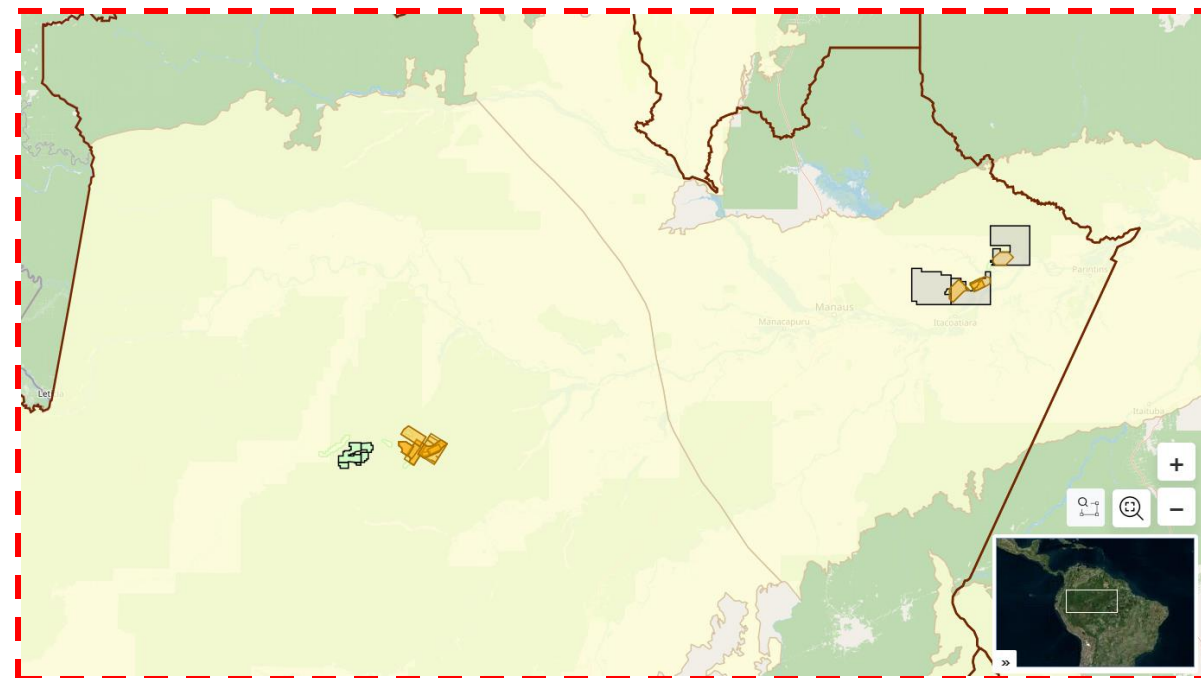


LOCALIZAÇÃO DA SÍSMICA DA SOLIMÕES

<https://geomaps.anp.gov.br/>



- Poços
- Sísmica 2D





Dados Disponíveis

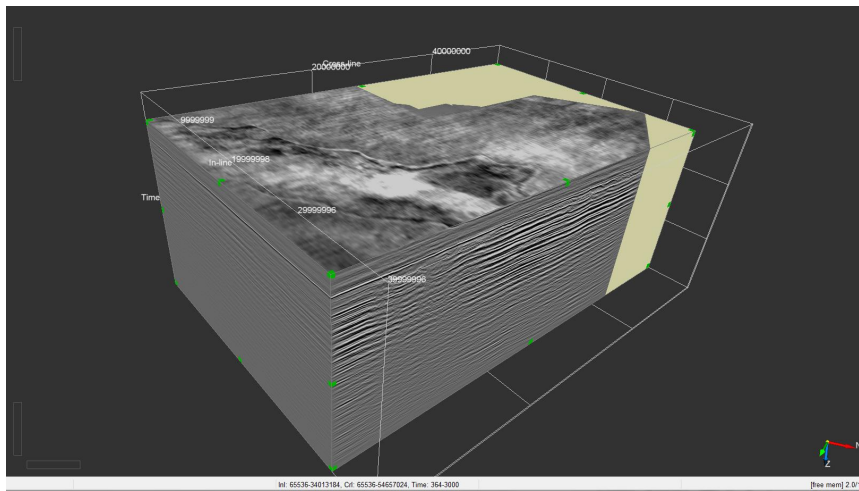


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NAO_SISMICOS	5.9 GB	4 years ago
POCO	92.3 GB	4 years ago
SISMICA_2D	23 GB	4 years ago
SISMICA_3D	20.5 GB	4 years ago
md5_catalogo_18-Bacia_do_Solimoes_1618632407.txt	1.2 MB	4 years ago

6 folders and 1 file

Name
0233_LESTE_URUCU
0237_AEROPORTO
0237_IGARAPE_MARTA
0300_3D_LUC_II
R0300_3D_CHIBATA
R0300_3D_SOL_AEROPORTO_II



141.8 GB

1-BRSA-984-AM_PC (2).pdf

BR

PERFIL COMPOSTO

1-BRSA-984-AM
(1-AUC-1-AM)

NOME DO POÇO ANP (PREFÍXO): **PETROBRAS - 984**

DESIGNAÇÃO: **PETROBRAS - 984**

ELEVACÕES: **WR= 85.0 m BAP= 78.9 m**

LOCALIZAÇÃO: BLOCO: SOL-T-171, ÁREA DO CAMPO: RIO URUCU, BACIA: SOLIMÕES

COORDENADAS DO FUNDO: LATITUDE: -4° 52' 35.275", LONGITUDE: -65° 21' 32.328", UTM: N: 8460331.1 m, E: 238374.1 m, WC: -63°

COORDENADAS DA BOCA: LATITUDE: -4° 52' 35.275", LONGITUDE: -65° 21' 32.328", UTM: N: 8460331.1 m, E: 238374.1 m, WC: -63°

DATUM: SAD-69

PERFUNDIDADE: 2885.0 m, PERFILAGEM: 2885.0 m

FORMAÇÃO: DATAS: INICIO POÇO: 20/09/2011, TERMINO PERFURAÇÃO: 05/01/2012, CONCLUSÃO POÇO: 02/02/2012

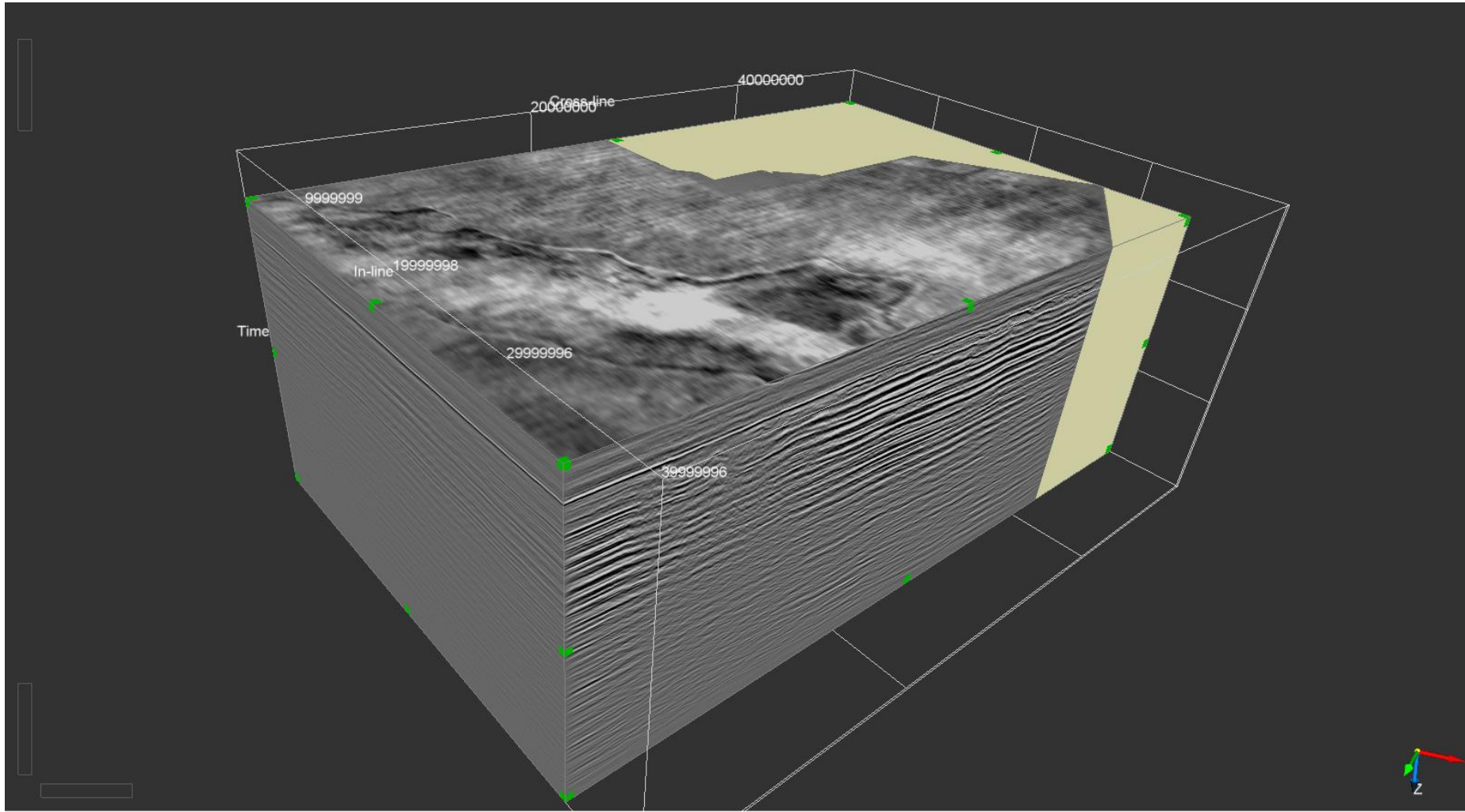
EQUIPAMENTO: Sonda No.: CES-761 OPERADOR: LINHA SISMICA: PONTO DE TIRO:

DATA DE ATUALIZAÇÃO: 04/04/2012, AUTOM: RECLASSIFICAÇÃO: DATA:

OCORRÊNCIAS DE PETRÓLEO	TESTES DE FORMAÇÃO	REVESTIMENTOS CANHÕES	SONAS PALEONTOLOGICAS
INDÍCIOS	20045 POTENCI	PERFURAÇÃO E SATORRADO MEDIAL	PERDAS DE CIRCULAÇÃO
		TESTEMUNHOS	INGENHEIRIA/ESTRUTURAS
			CONTATOS



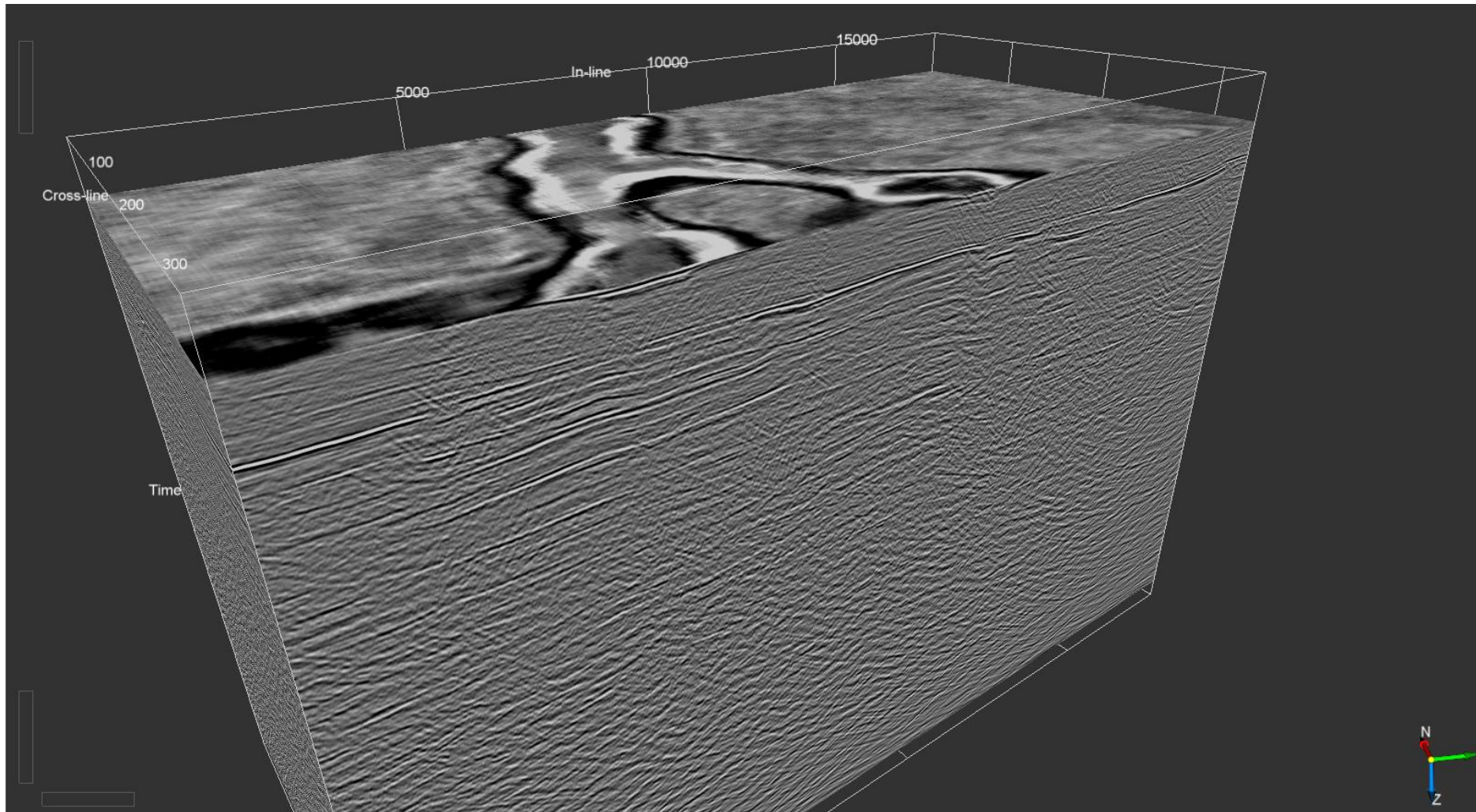
BACIA DO SOLIMÕES – AM (3D AEROPORTO)



Survey type:	3D
Inline range and step:	1,612, 1
Crossline range and step:	1, 834, 1
Z range and step:	0 – 3.000ms, amost. 4ms



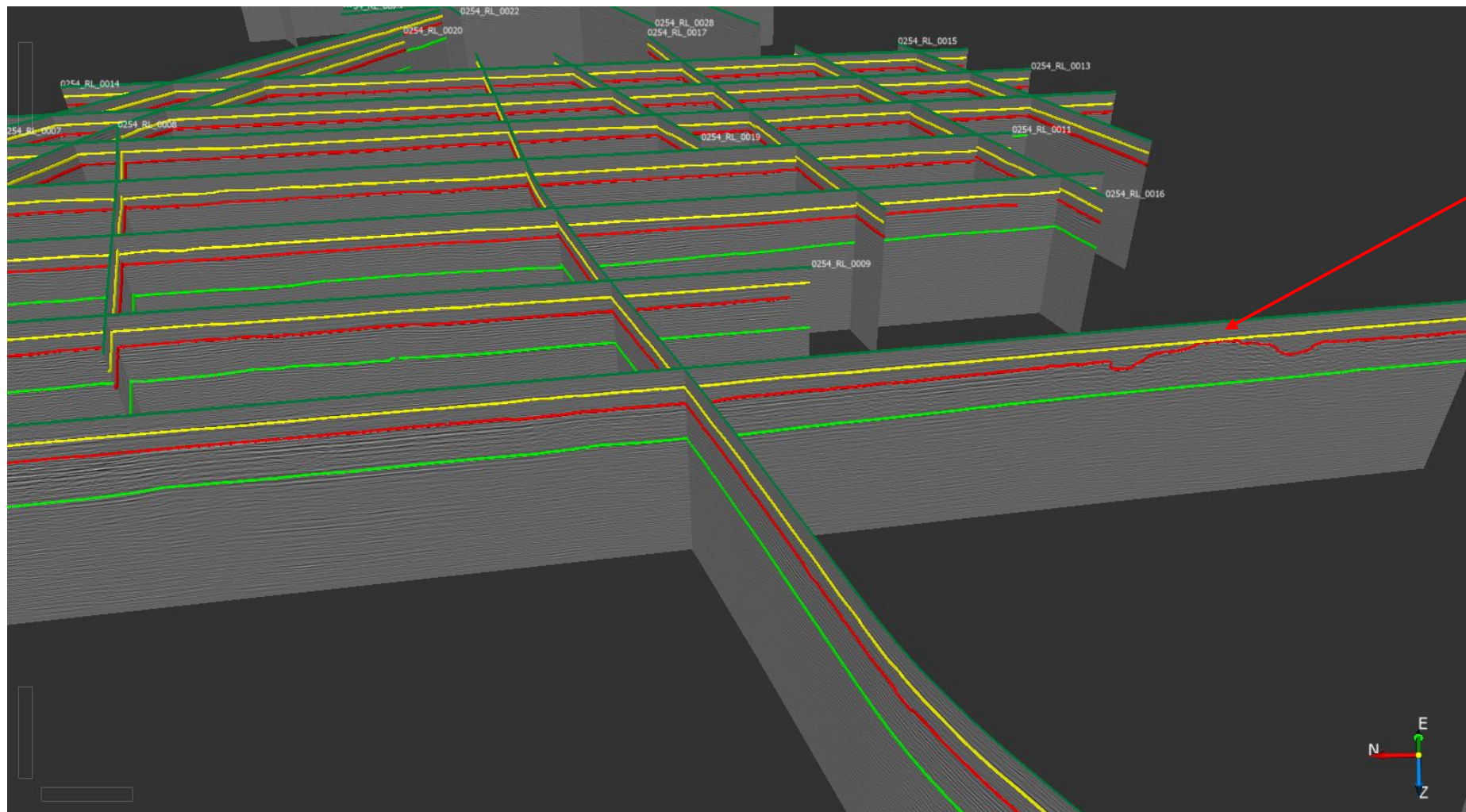
BACIA DO SOLIMÕES – AM (3D IGARAPÉ MARTA)



Survey type:	3D
Inline range and step:	1, 721, 1
Crossline range and step:	1, 327, 1
Z range and step:	0 – 4.000ms, amost. 2ms

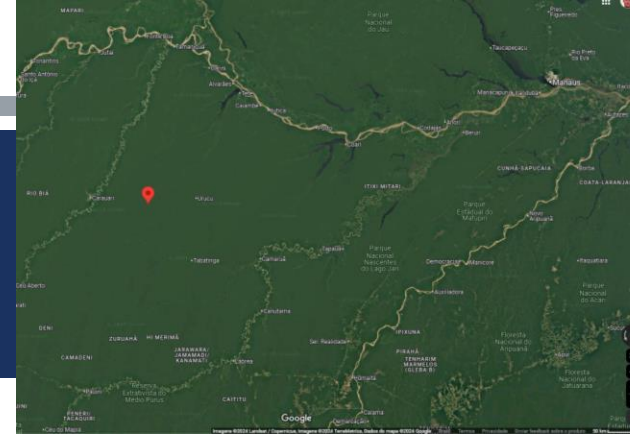


BACIA DO SOLIMÕES – AM (SÍSMICA 2D)

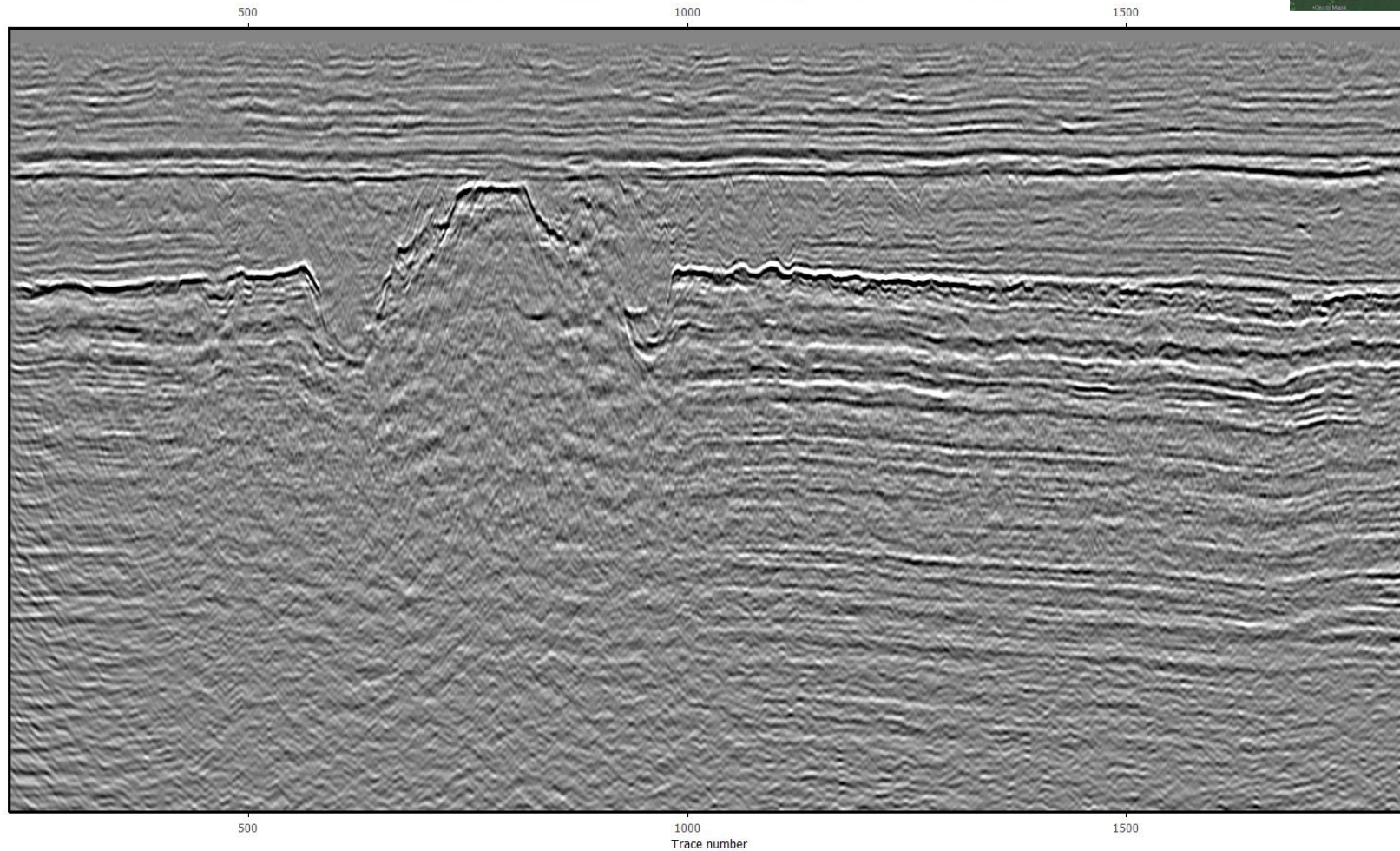




BACIA DO SOLIMÕES – AM (LINHA 2D 0254-RL-006)

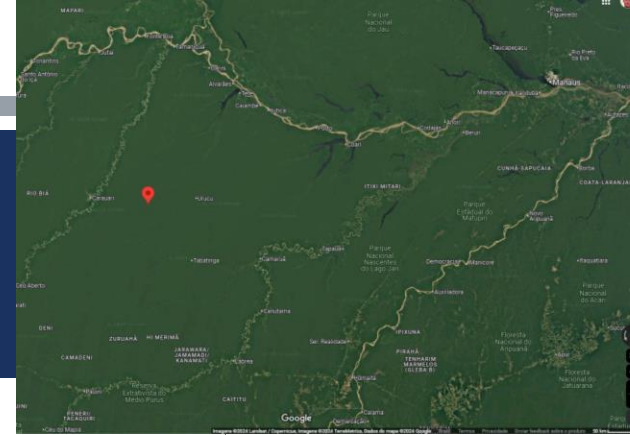


Line: 0254_JURUA_URUCU_PSTM_FOMENTO.2D.PSTM.0254-0006.0000228.0003160

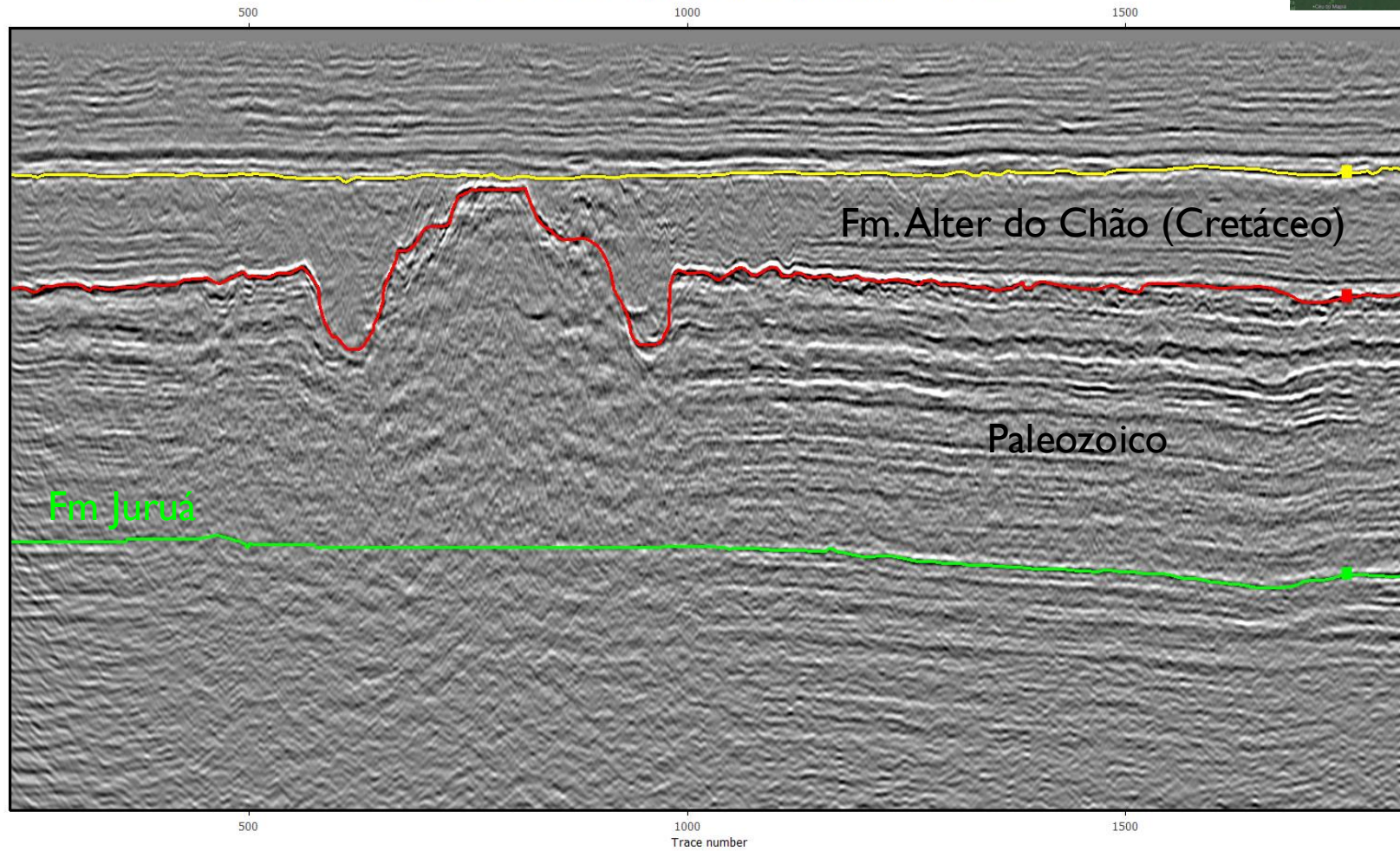




BACIA DO SOLIMÕES – AM (LINHA 2D 0254-RL-006)



Line: 0254_JURUA_URUCU_PSTM_FOMENTO.2D.PSTM.0254-0006.0000228.0003160





LOCALIZAÇÃO DA “CRATERA DO RIO TEFÉ



SBGF22099

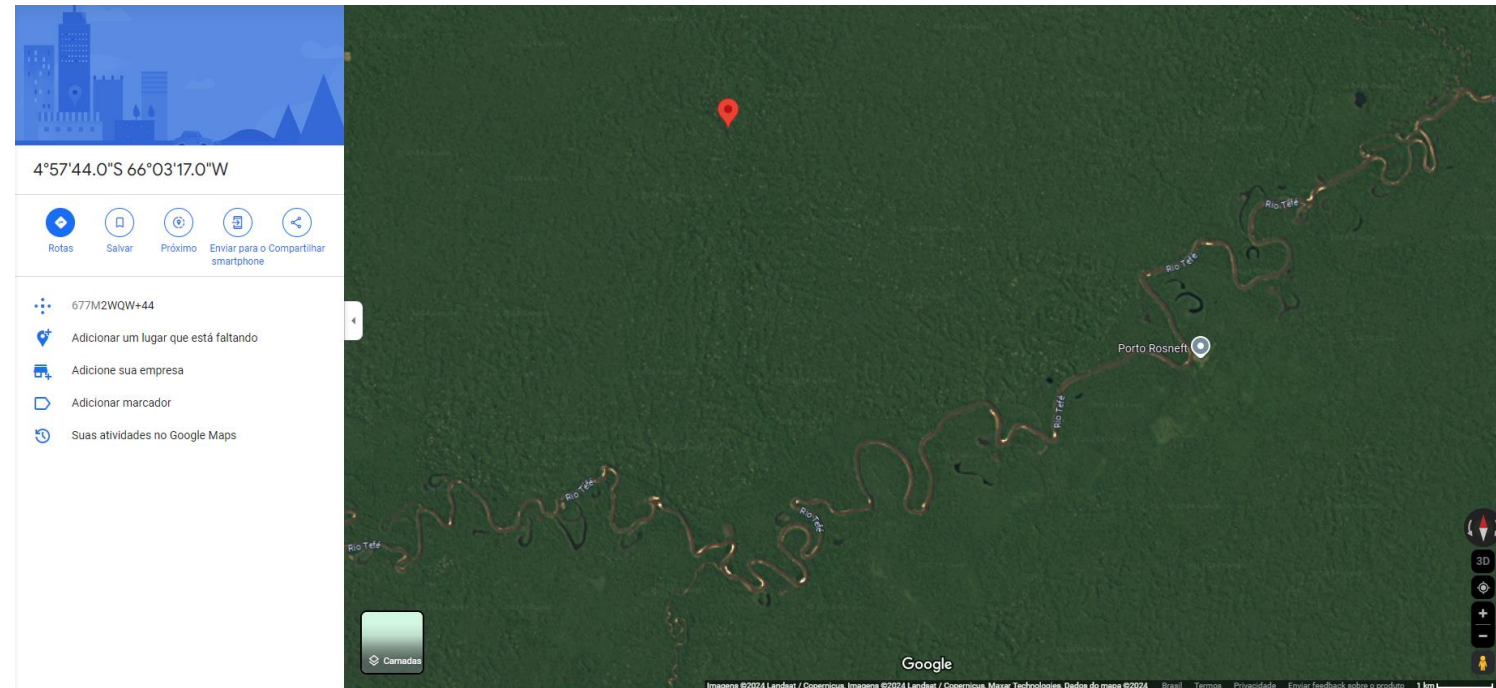
Geophysical evidence of a possible impact structure at the K-T boundary of the Solimões basin, Brazil

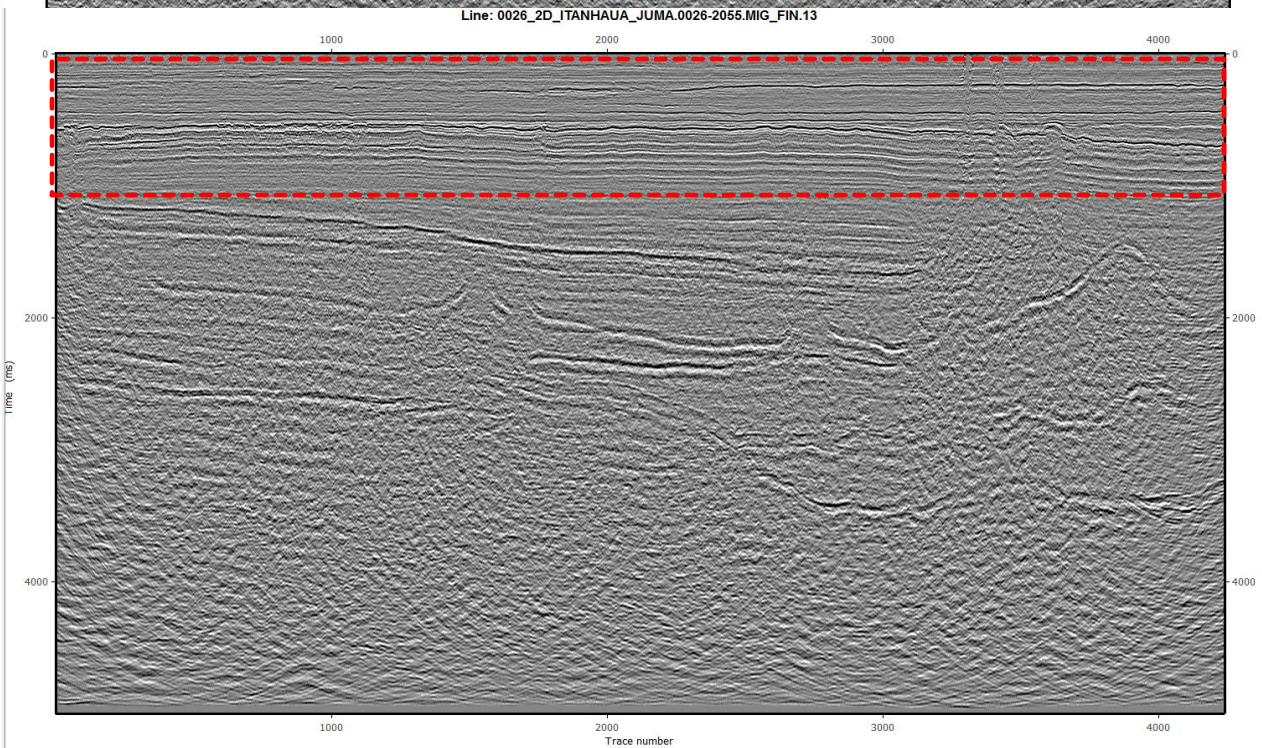
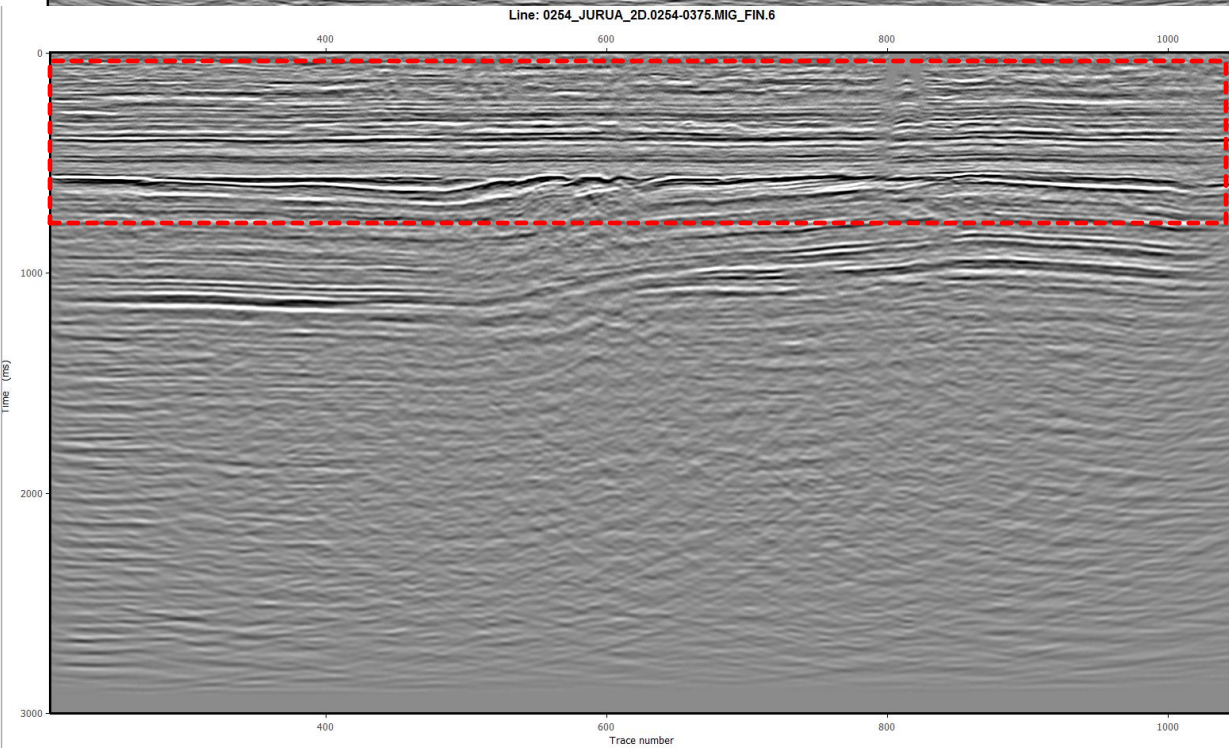
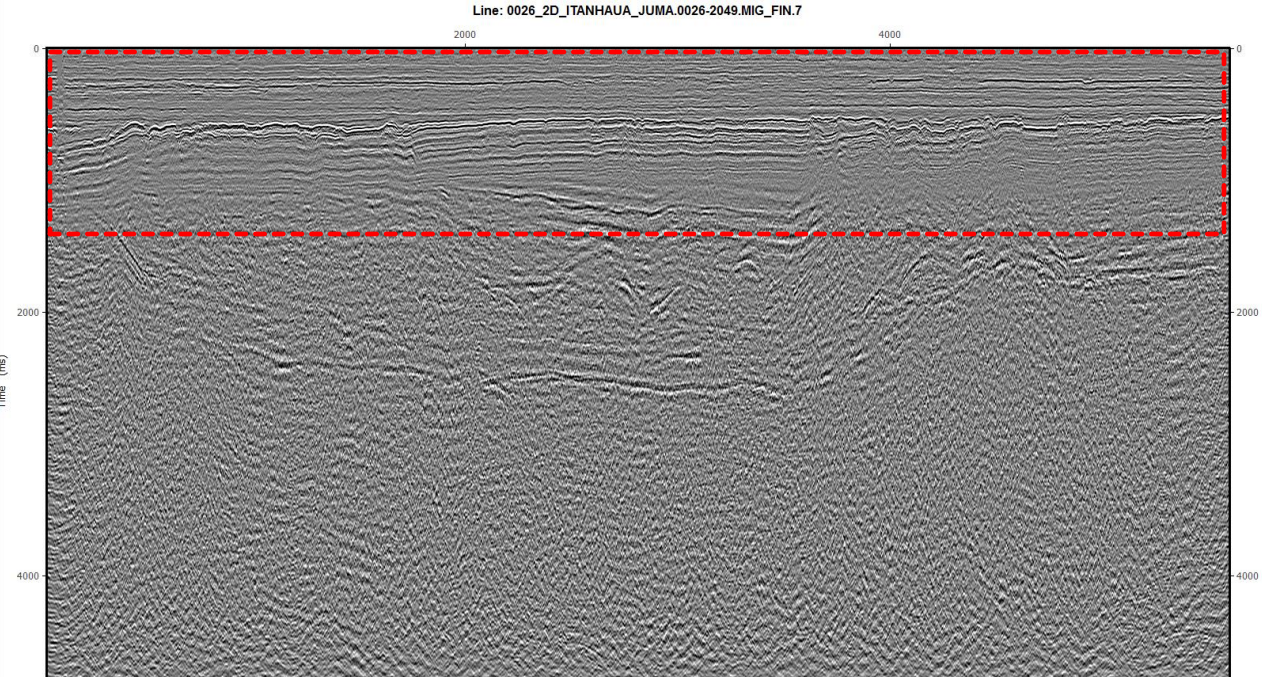
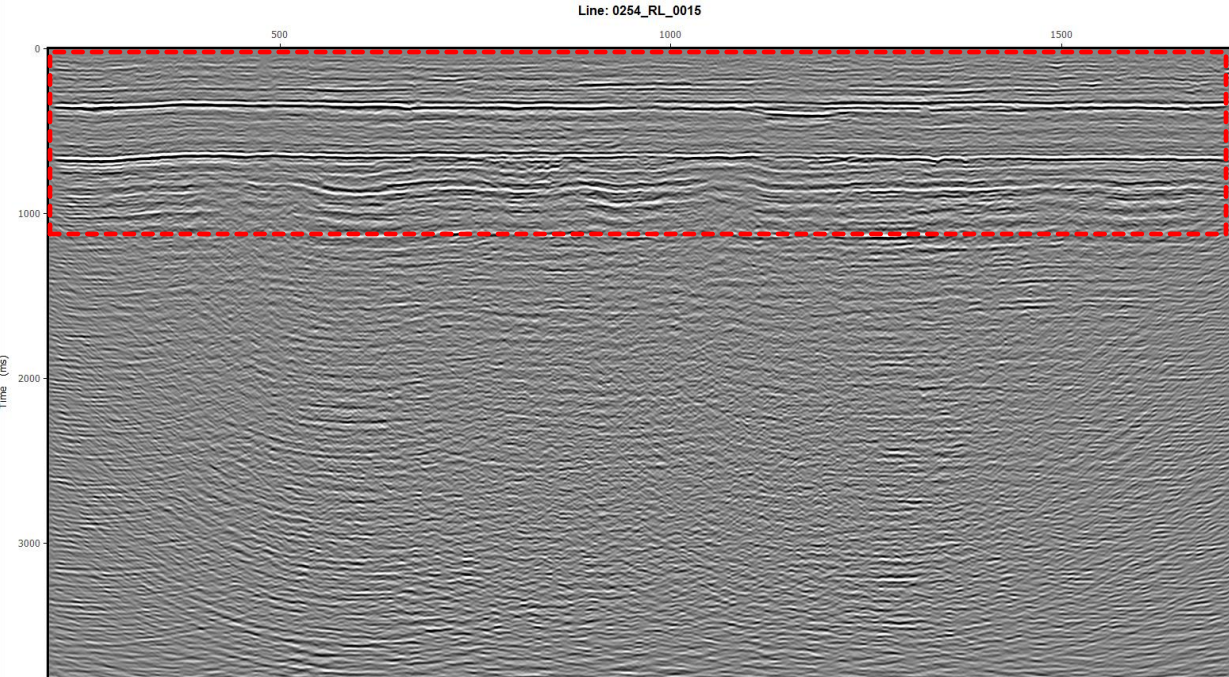
Jorge Rui C. de Menezes, Cleomar F. de Souza, Fernando P. Fortes* and Coaracy Barbosa Filho

PETROBRAS S/A, Brazil (* retired)

Abstract

The Tefé River possible impact structure (4°57'44"S, 66°03'17"W) was formed in the Late Cretaceous of Solimões Basin, Brazil. The target rocks are Cretaceous continental sandstones underlain by Paleozoic siliciclastic, carbonate and evaporitic rocks, which were intruded by thick diabase sills in the Mesozoic. The overburden is a 350 m-thick Tertiary (Miocene to Pliocene) sequence. A 2D reflection seismic lines dataset allowed the identification of a complex-type impact structure with a 2 km in diameter central uplift which consists of a chaotic arrangement of thrust faults, moderate- to steep-dipping beds and with slump-slided borders. A 5 km in diameter ring depression forms a syncline or graben around the central high, which was probably produced by normal listric faulting and by rotational block movement associated to the uplift of the central high. The outer rim is eroded by the Tertiary lower sequence boundary and its original diameter could reach more than 15 km. The infill of the crater is probably composed of slumped and fluidized Cretaceous sandstones, suggesting the presence of high water level and unconsolidated sediments, thus showing a very contrasting mechanical behavior in relation to Paleozoic rocks and diabase sills, which collapsed at steeper fault angles. Modelling of ground gravimetry and magnetometry measurements supports the presented structural interpretation, both leading to the hypothesis of a low-angle northeast-to-southwest bolide trajectory. As the structure remains undrilled, impact origin confirmation by means of shock-metamorphic features identification is to be done, as well accurate dating. Available dating based mostly on palinomorphs indicate a tens-of-million-years hiatus between Cretaceous and Tertiary sequences.





QUESTÃO

- Alguma técnica de IA seria capaz de identificar essa feição nas linhas sísmicas 2D da bacia do Solimões e Amazonas?



DADOS SÍSMICOS (OFFSHORE) ANP

www.gov.br/anp/pt-br/assuntos/exploracao-e-producao-de-oleo-e-gas/dados-tecnicos/acesso-aos-dados-tecnicos#:~:text=Os%20dados%20técnicos%20públicos%20disponibilizados.gov.br%2F&np=2F

gov.br Ministério de Minas e Energia

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Agência Nacional do Petróleo, Gás Natural e Biocombustíveis

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- **Cientes eventuais** - têm acesso aos dados mediante pagamento por cada solicitação de dado público, com os preços unitários definidos de acordo com o estabelecido no [Termo de Adesão](#);

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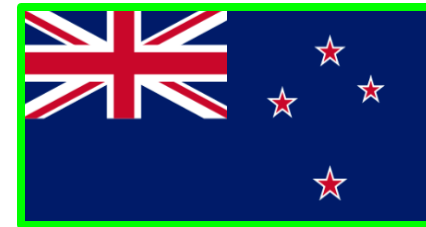
Os dados adquiridos serão disponibilizados majoritariamente por download por meio de uma ferramenta de acesso FTP (WinSCP, Filezilla, etc). Dados robustos serão entregues via HD ou, caso necessário, fitas IBM 3592. Instruções para a retirada dos dados serão enviadas pelo Help Desk (helpdesk@anp.gov.br) ao fim do pedido.

A conferência dos arquivos é de responsabilidade do solicitante. Reclamações sobre a integridade dos arquivos recebidos somente serão aceitas até 30 dias a contar da data do recebimento dos dados.

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Futuramente, a ANP deverá disponibilizar gratuitamente esses dados (exceto sísmica pre-stack) via internet, a exemplo do que ocorre com os dados técnicos públicos terrestres.

Avaliação dos Datasets



Terra Nubis



My account



Maps

Commercial Projects

- Survey Boundaries
- 2D Seismic
- 3D Seismic

Reports

- Report Boundaries
- Wells

Free Projects

- Survey Boundaries
- 2D Seismic
- 3D Seismic
- Wells

Blocks

Other Data

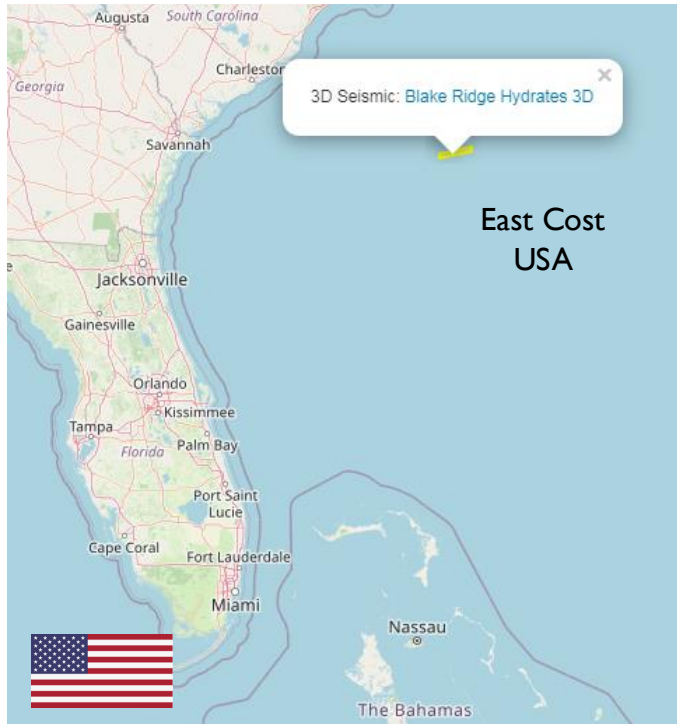
Show as list: Recently added ▾

SEARCH

WGS84 70.493108° / 15.117188°
UTM zone 33W X=504367m, Y=7820869m

Terra Nubis 3D (Free)

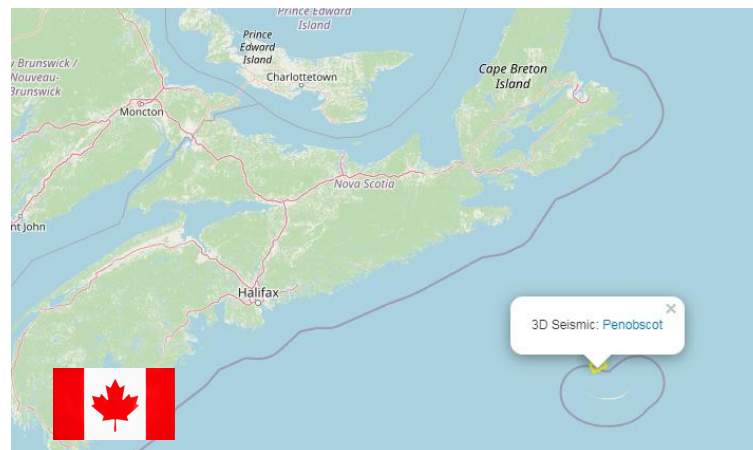
3D Black Ridges
(Hidratos de gás)



3D NW Australia Shelf



3D Penobscot



3D Seismic: F3 Demo 2020
3D Seismic: F3 Demo 2023

F3
Nederlands
North Sea

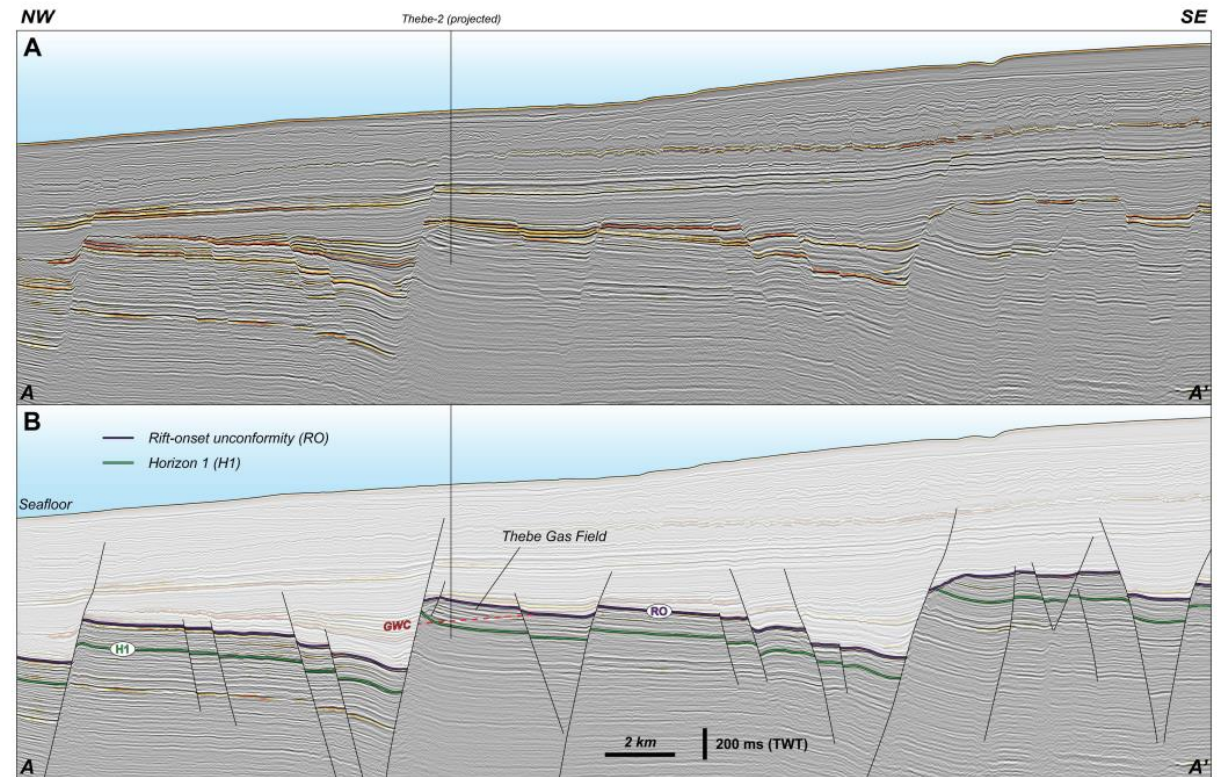
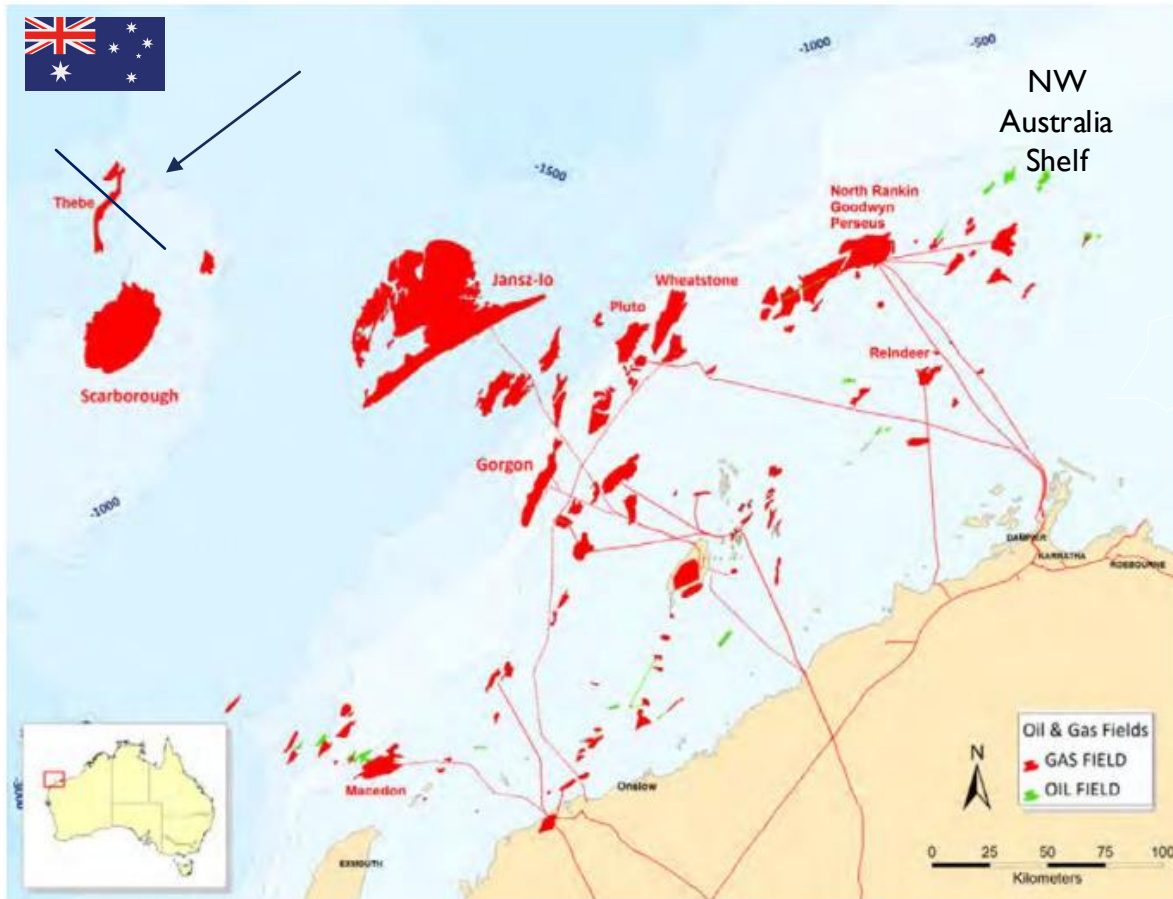


Avaliação dos Datasets





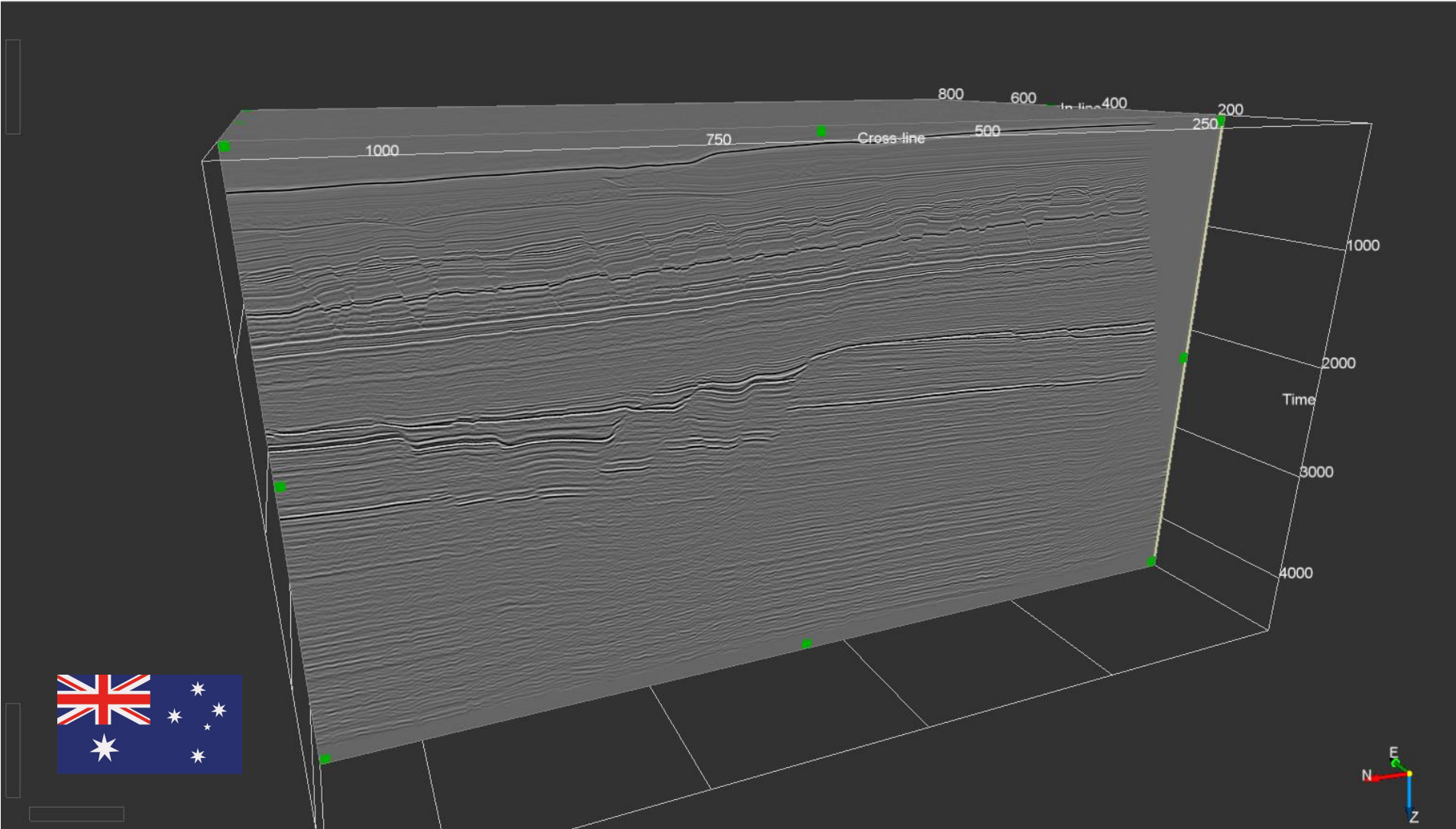
3D NW Australia Thebe



https://www.researchgate.net/publication/337210622_Imaging_past_depositional_environments_of_the_North_West_Shelf_of_Australia_Lessons_from_3D_seismic_data

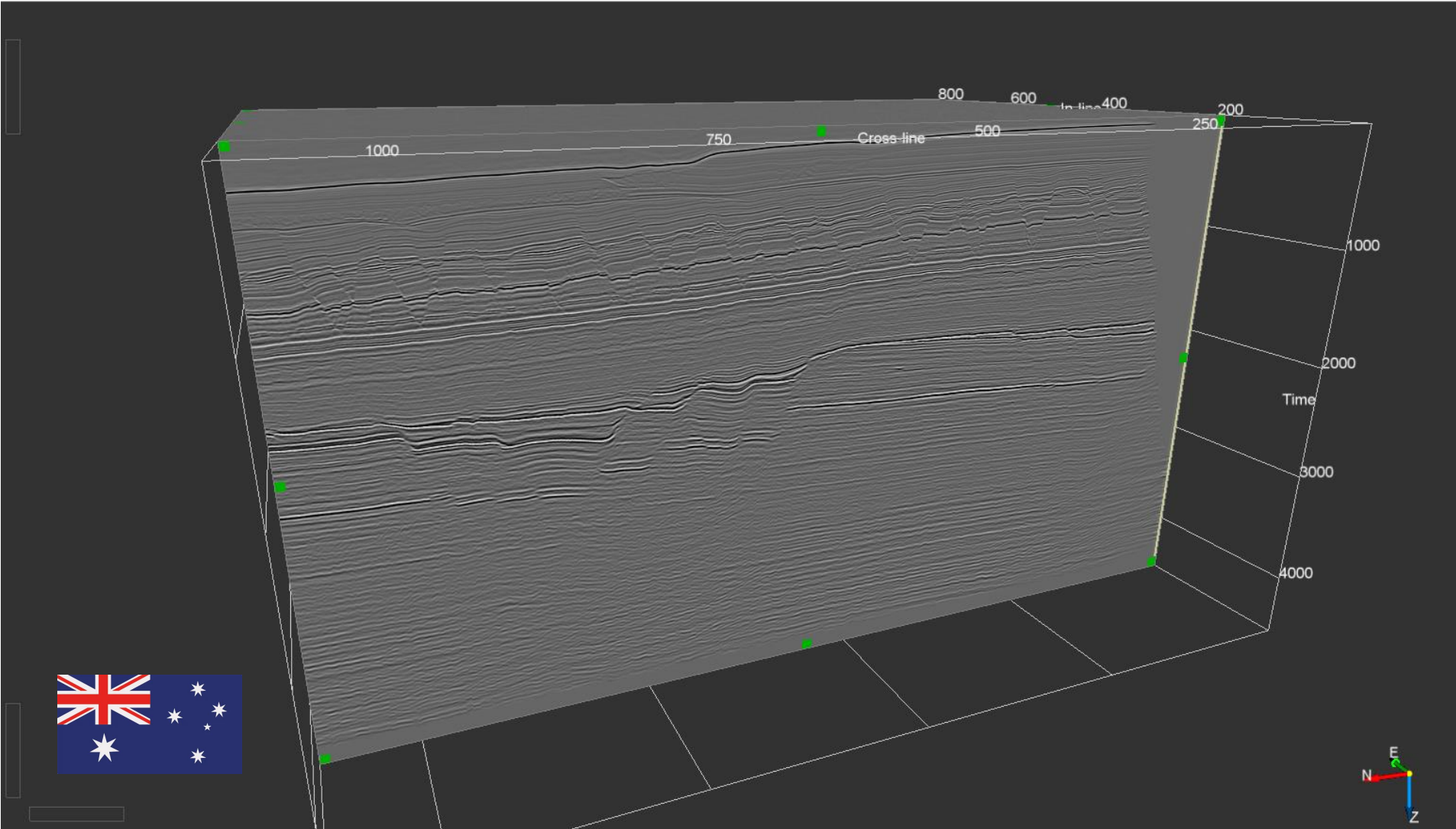
<https://www.pipeliner.com.au/woodside-becomes-scarborough-operator/>

3D NW Thebe Gas Field



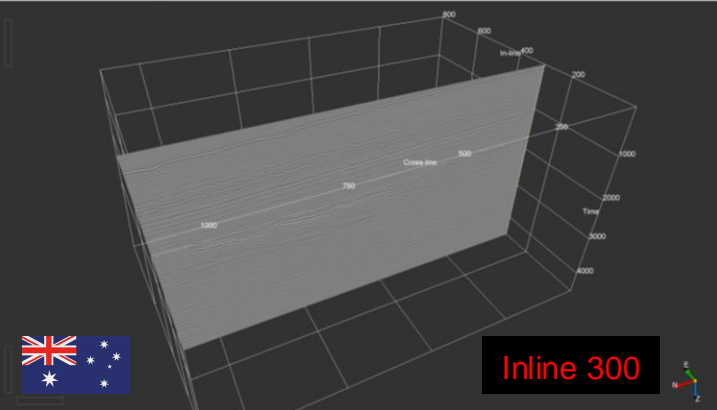
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Inline range and step:	983, 4419, 1
Crossline range and step:	504, 5556, 1
Z range and step:	0 – 6.000ms, amost. 4ms
Inline bin size (m/line):	18.75
Crossline bin size (m/line):	12.5
Area (sq km):	3376.71

3D NW Thebe Gas Field



Survey type:	3D
Inline range and step:	983, 4419, 1
Crossline range and step:	504, 5556, 1
Z range and step:	0 – 6.000ms, amost. 4ms
Inline bin size (m/line):	18.75
Crossline bin size (m/line):	12.5
Area (sq km):	3376.71

NW Australia - Inline 300



Inline 300

Anticlinais

Domos de Sal

Fácies Sísmicas

Bright Spots (DHI)

Flat Spots (DHI)

Falhas

Canais

Estratigrafia de Sequências

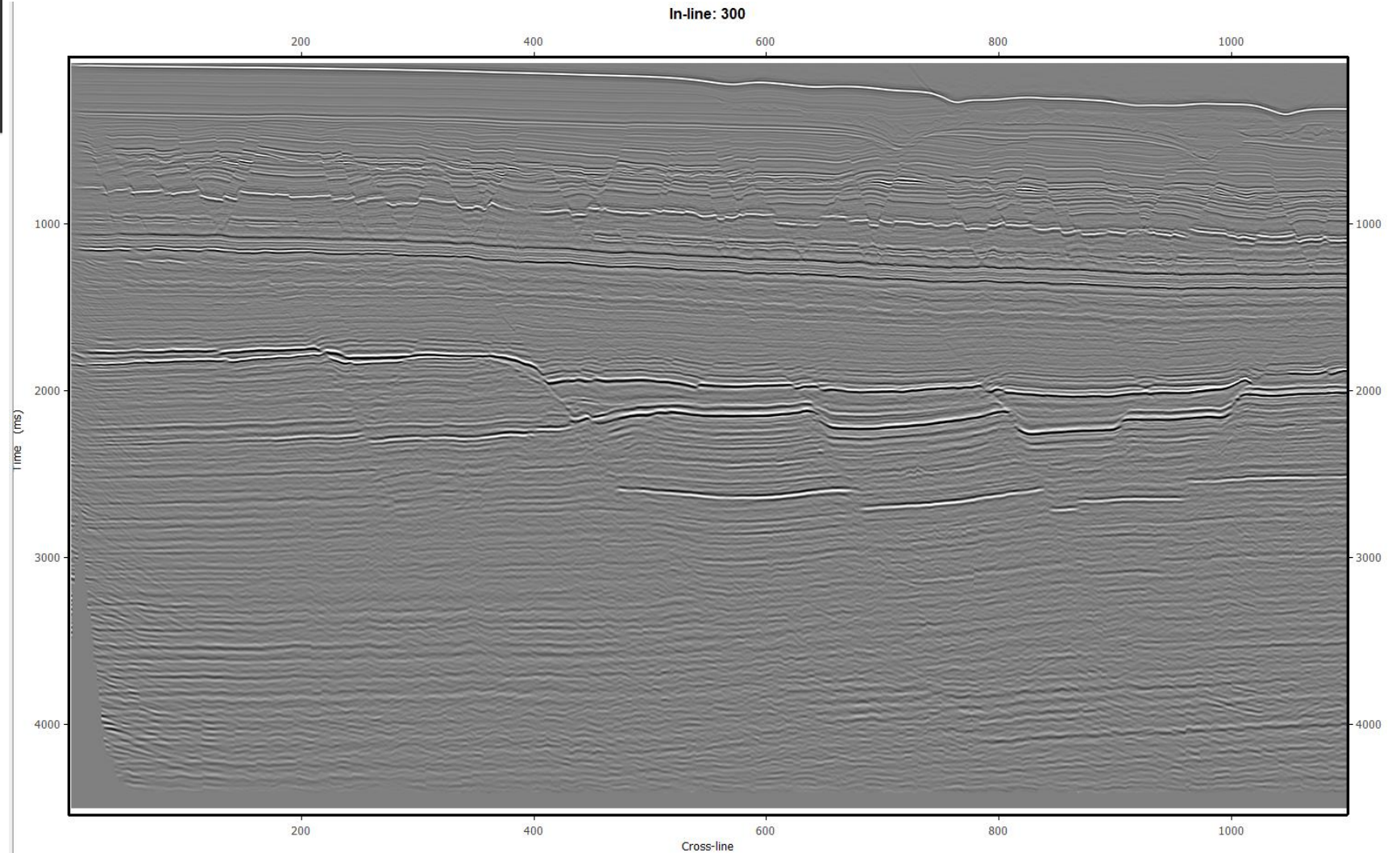
Chaminé de gás

Feições de Build up carbonático

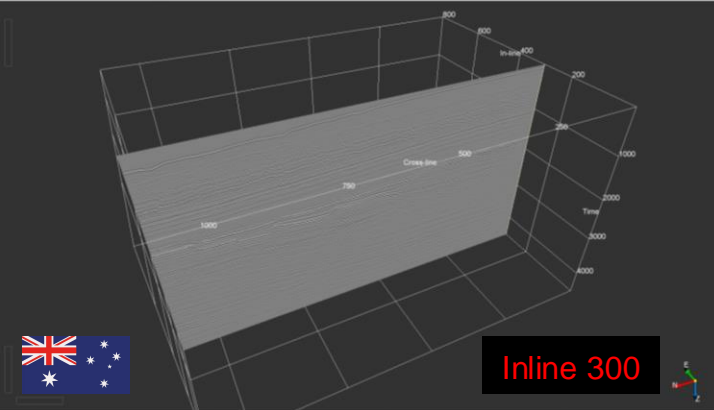
Turbiditos

Ruídos

Fácies caóticas

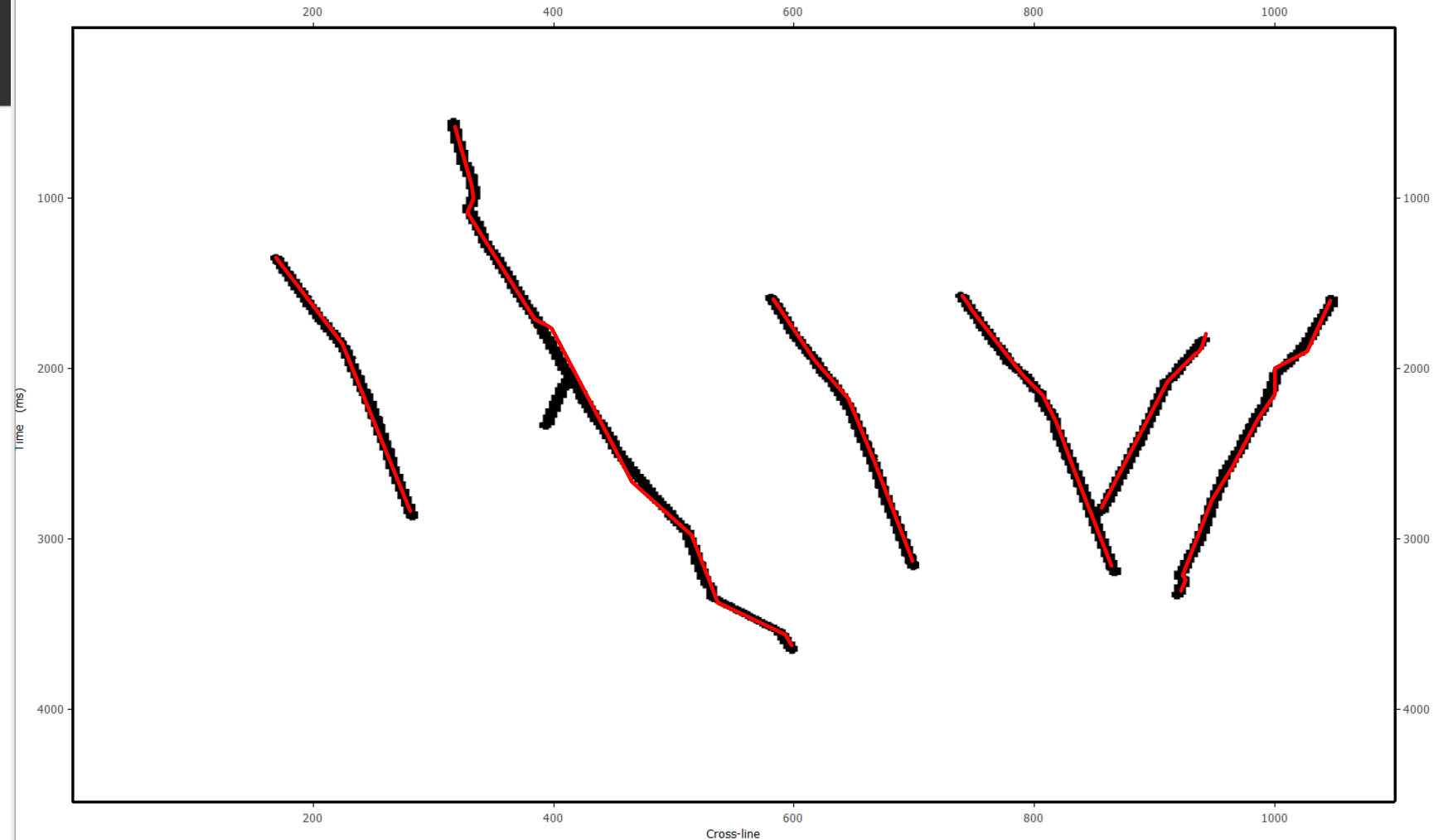


3D NW Thebe Gas Field (inline 300)



Rótulo

In-line: 300



Inline 300

Anticlinais

Domos de Sal

Fácies Sísmicas

Bright Spots (DHI)

Flat Spots (DHI)

Falhas

Canais

Estratigrafia de Sequências

Chaminé de gás

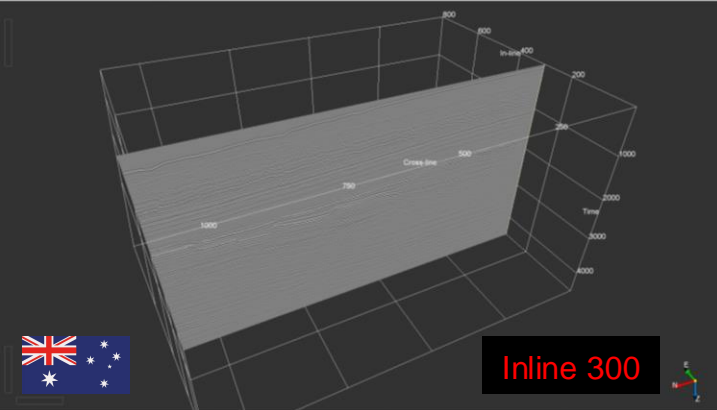
Feições de Build up carbonático

Turbiditos

Ruídos

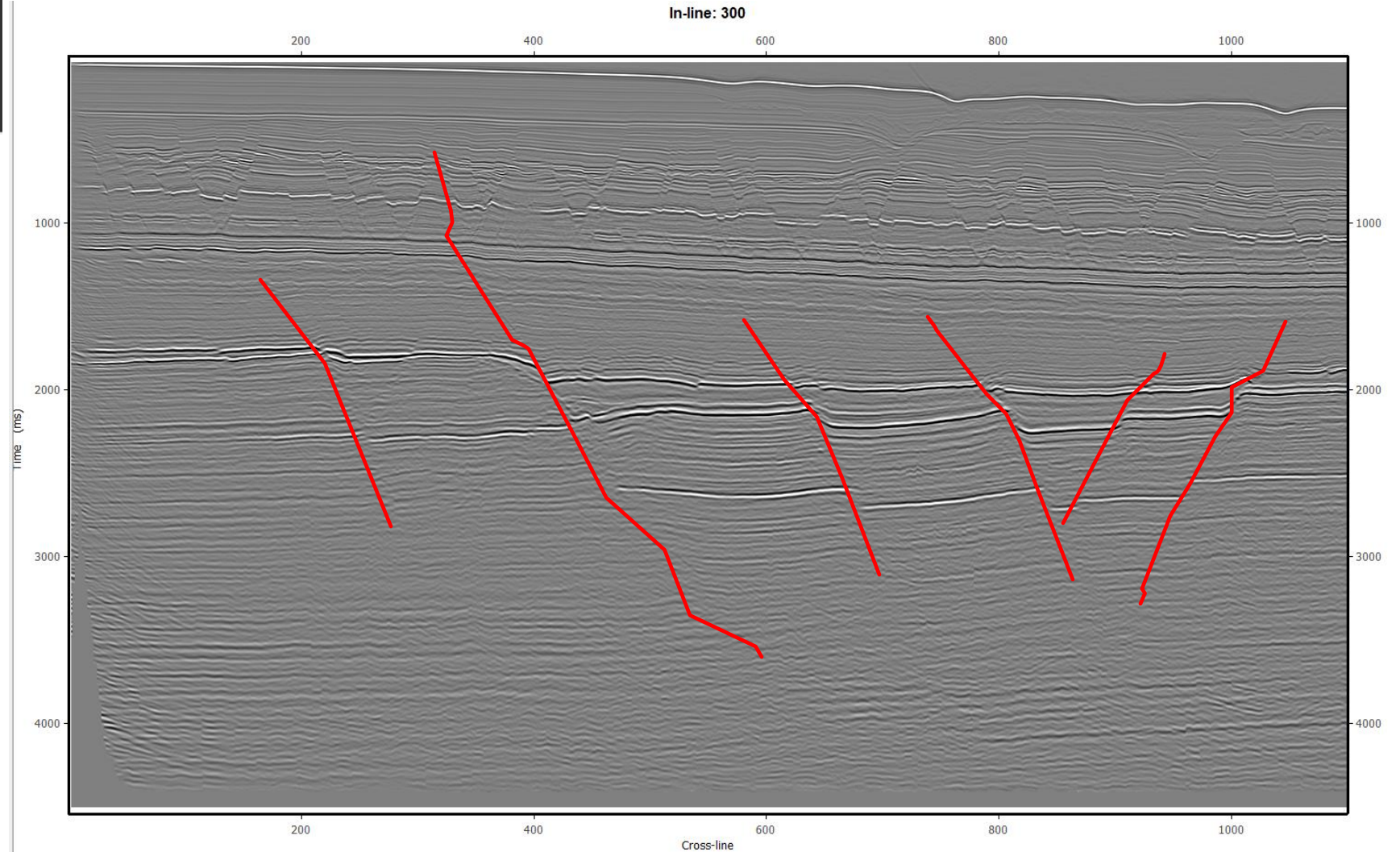
Fácies caóticas

NW Australia - Inline 300

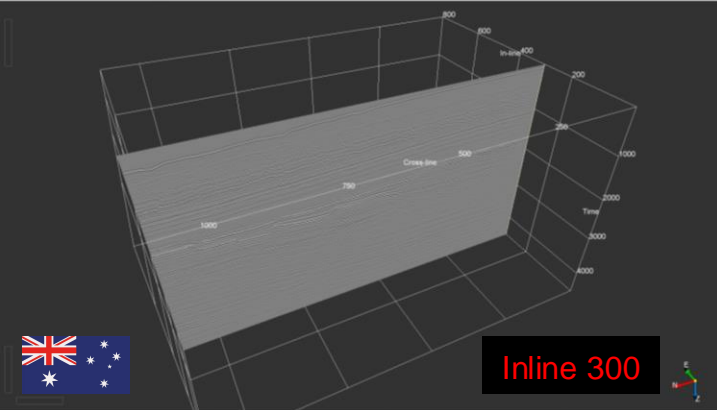


Inline 300

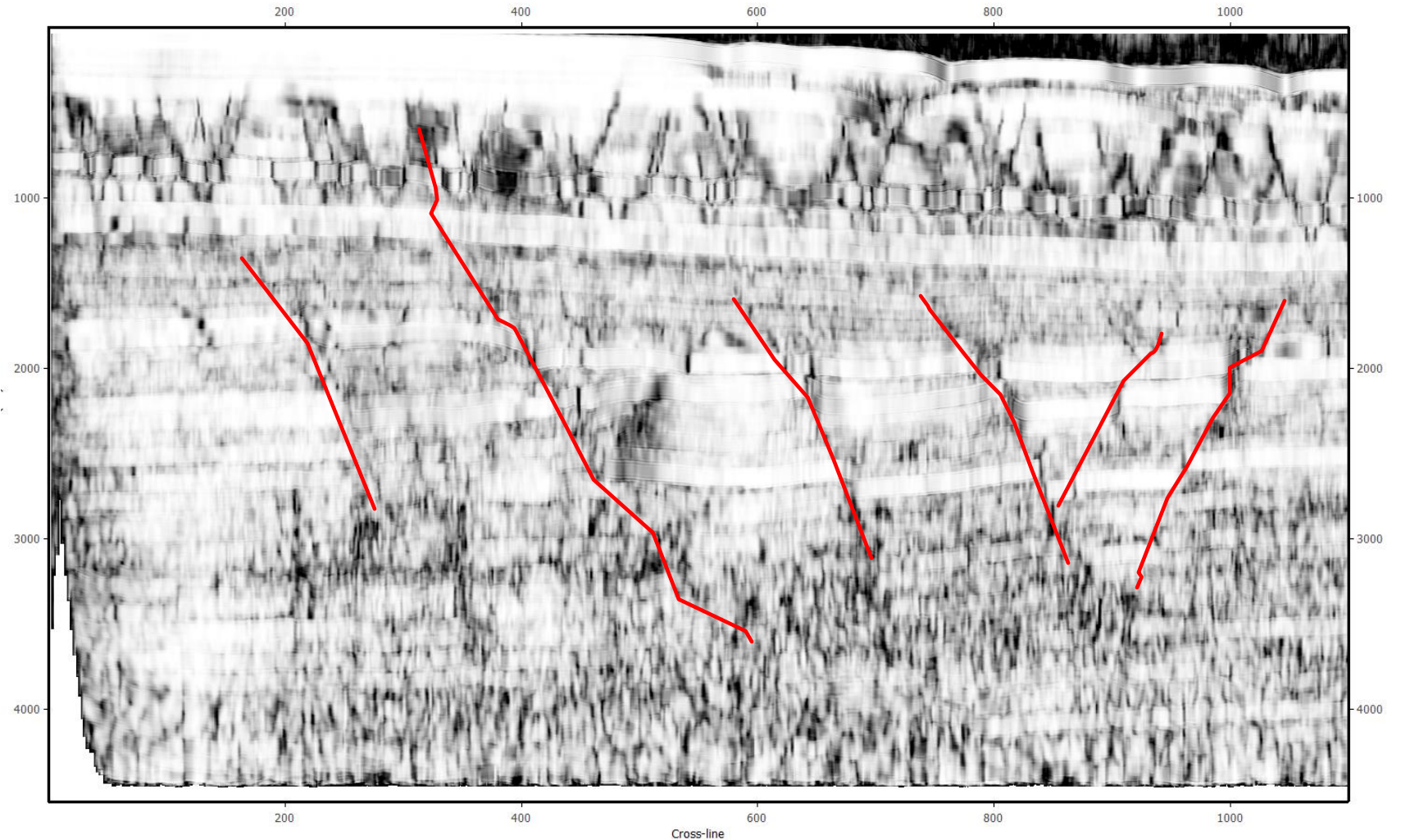
- Anticlinais*
- Domos de Sal*
- Fácies Sísmicas*
- Bright Spots (DHI)*
- Flat Spots (DHI)*
- Falhas*
- Canais*
- Estratigrafia de Sequências*
- Chaminé de gás*
- Feições de Build up carbonático*
- Turbiditos*
- Ruídos*
- Fácies caóticas*



3D NW Thebe Gas Field



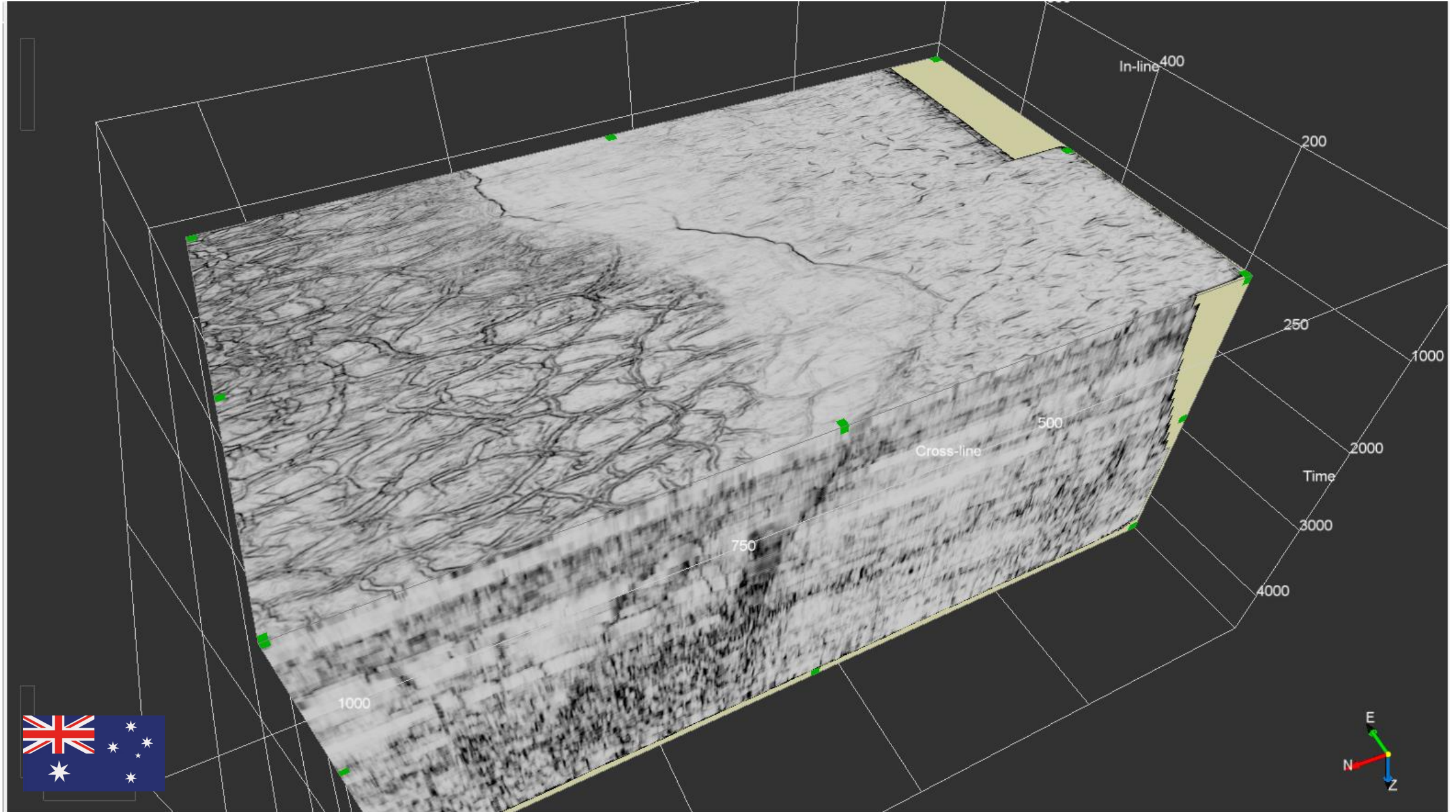
Semblance



Inline 300

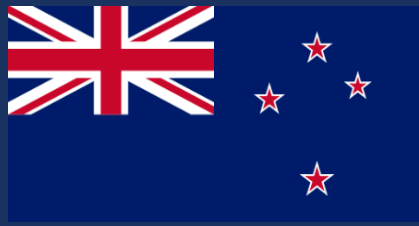
- Anticlinais*
- Domos de Sal*
- Fácies Sísmicas*
- Bright Spots (DHI)*
- Flat Spots (DHI)*
- Falhas*
- Canais*
- Estratigrafia de Sequências*
- Chaminé de gás*
- Feições de Build up carbonático*
- Turbiditos*
- Ruídos*
- Fácies caóticas*

3D NW Thebe Gas Field



Avaliação dos Datasets





NEW ZEALAND PETROLEUM AND MINERALS

geodata.nzpam.govt.nz/dataset/?ext_date_facet=&q=KAHU-3D+PR3177&sort=score+desc%2C+metadata_modified+desc

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NEW ZEALAND
PETROLEUM & MINERALS

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Datasets

The Geodata Catalogue contains datasets and reports collected by petroleum and minerals permit holders, and the New Zealand Government.

Kahu 3D

KAHU-3D


Advanced search

15 datasets found for "KAHU-3D PR3177" Sort by: Relevance

KAHU-3D : PR3177

Permit	Type	Start Date	Formats	Data Type
38479	Seismic	07 March 2005	ZIP SGY	Survey

Region

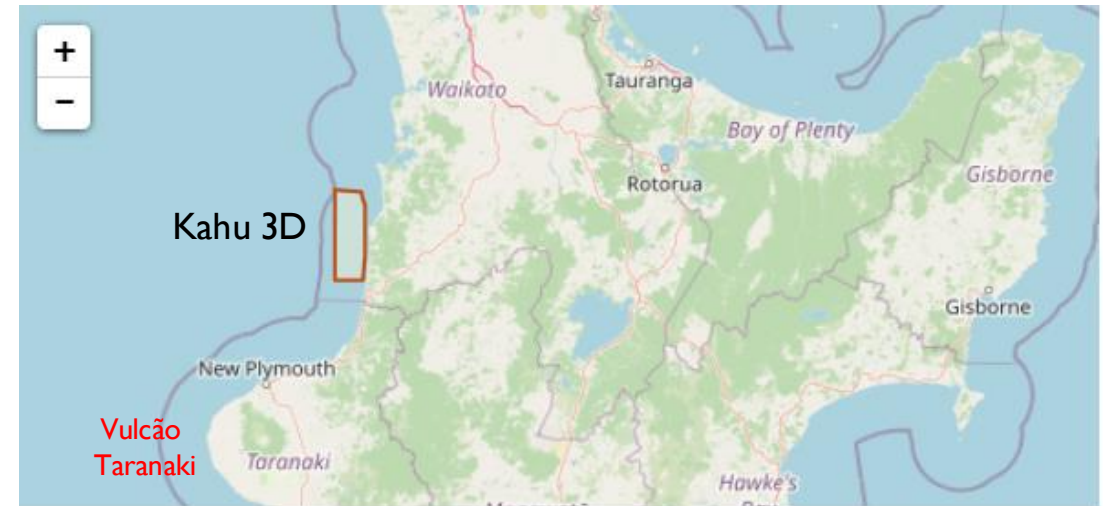


New Zealand / Aotearoa
South Island / Te Waiapouamu

Filter by location

Data Types **AND**

<input type="checkbox"/> Report	14
<input type="checkbox"/> Survey	1



Files

Sort by: Name Ascending

298	Field Navigation (KAHU_3D Field Navigation)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (1.51 GB)"/>
301	Seismic Project - PSTM (KAHU-3D-PR3177-T-PSTM-FULL)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (3.78 GB)"/>
301	Seismic Project - Far Angle Stack (KAHU-3D-PR3177-T-RPSTM-FAS)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (3.78 GB)"/>
301	Seismic Project - Raw PSTM (KAHU-3D-PR3177-T-RPSTM-FULL)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (3.78 GB)"/>
301	Seismic Project - Mid Angle Stack (KAHU-3D-PR3177-T-RPSTM-MAS)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (3.78 GB)"/>
301	Seismic Project - Near Angle Stack (KAHU-3D-PR3177-T-RPSTM-NAS)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (3.78 GB)"/>
301	Seismic Project - PSDM (KAHU-3D-PR3177-T-PSDM)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (2.19 GB)"/>
301	Seismic Project - PSDM (KAHU-3D-PR3177-T-PSDM)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (1.62 GB)"/>
301	Seismic Project - Velocity (KAHU-3D-PR3177-T-PSDM-VBMS)	<input type="button" value="Add to downloads"/> <input type="button" value="Download (2.64 GB)"/>

<https://geodata.nzpam.govt.nz/dataset/>

Parque Egmont – Vulcão Taranaki



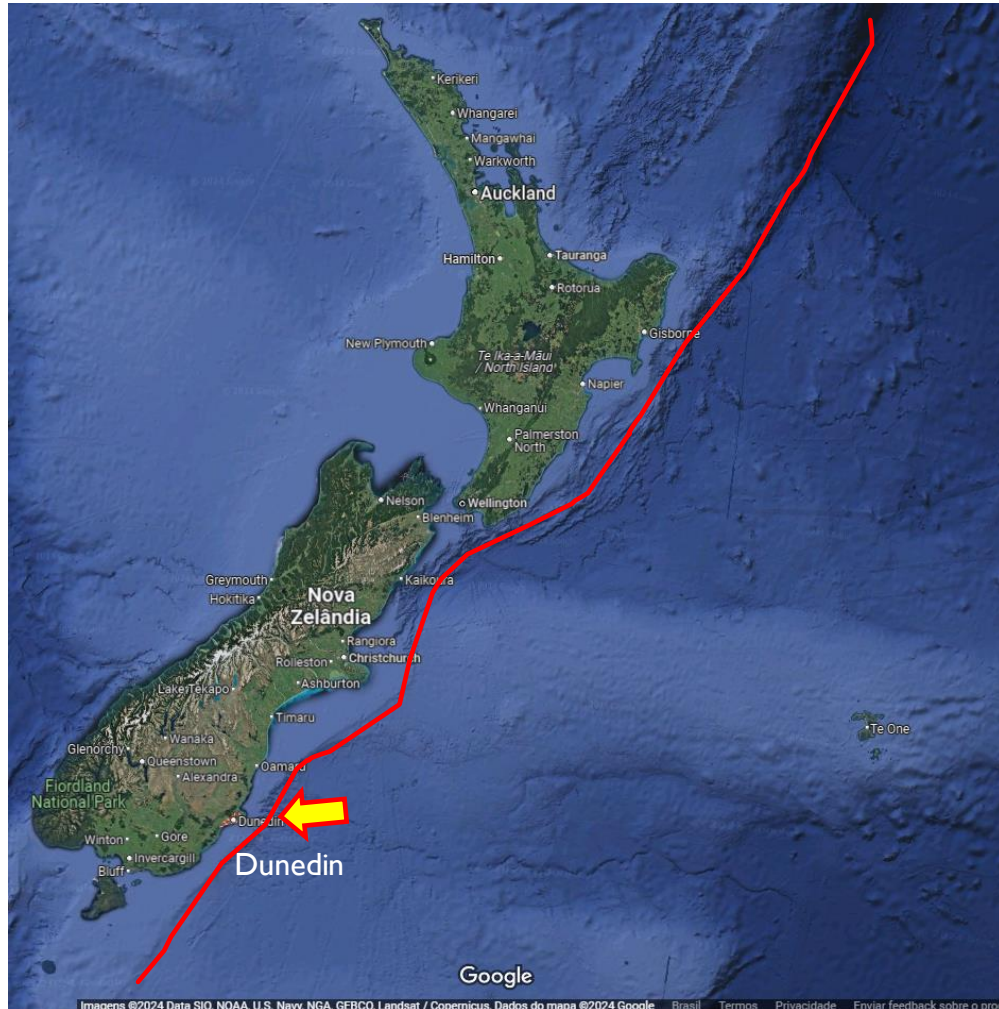
Última Erupção 1860



Looking out over the Tasman Sea from the summit of Taranaki.

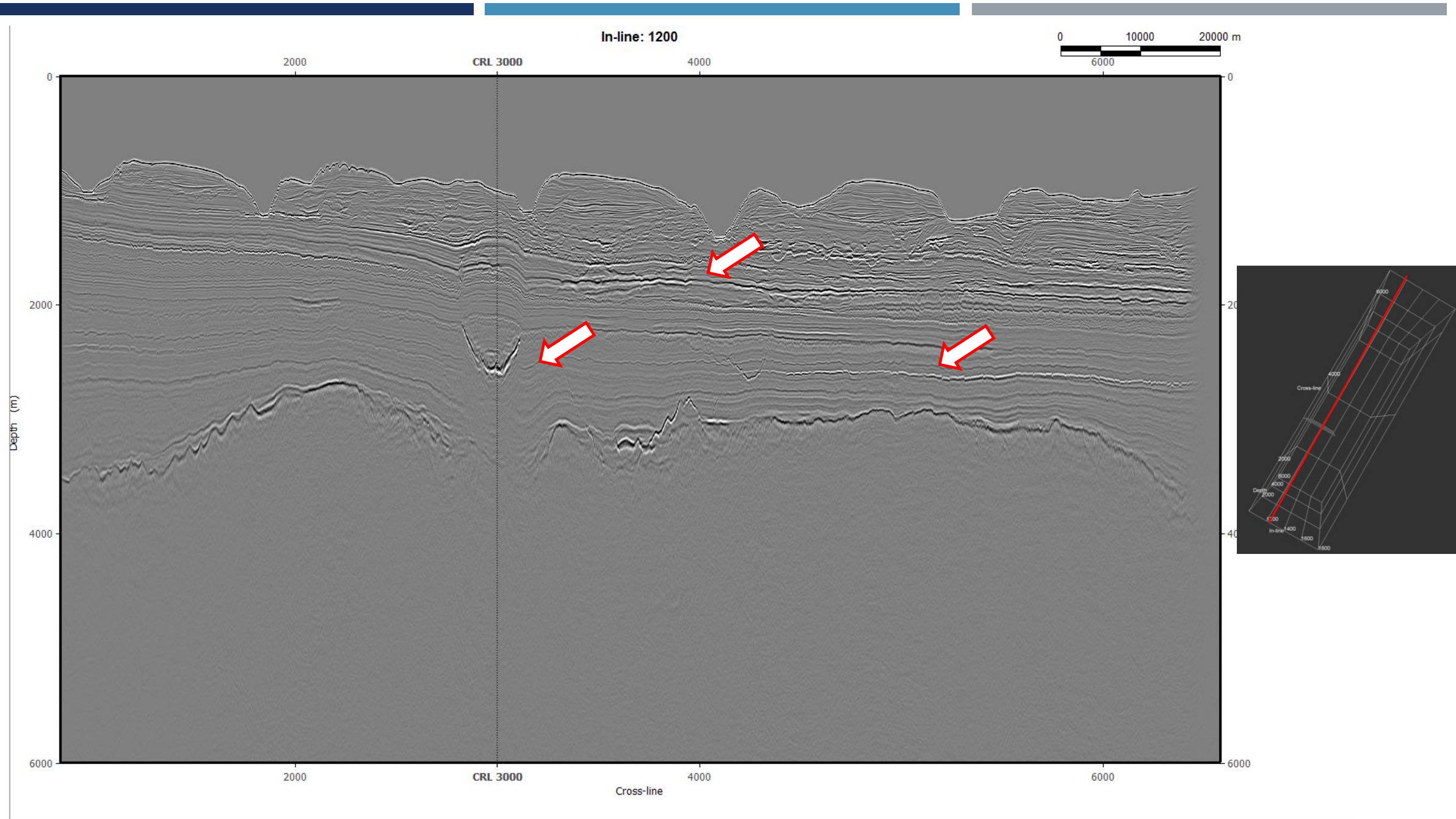


Waka 3D



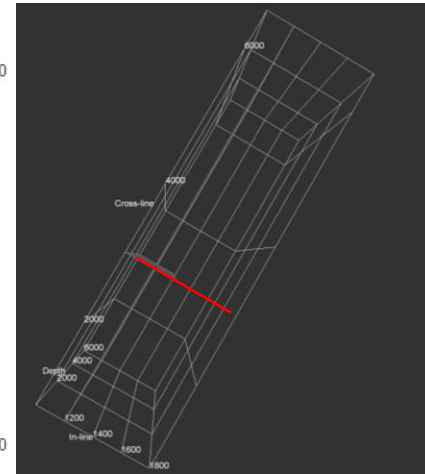
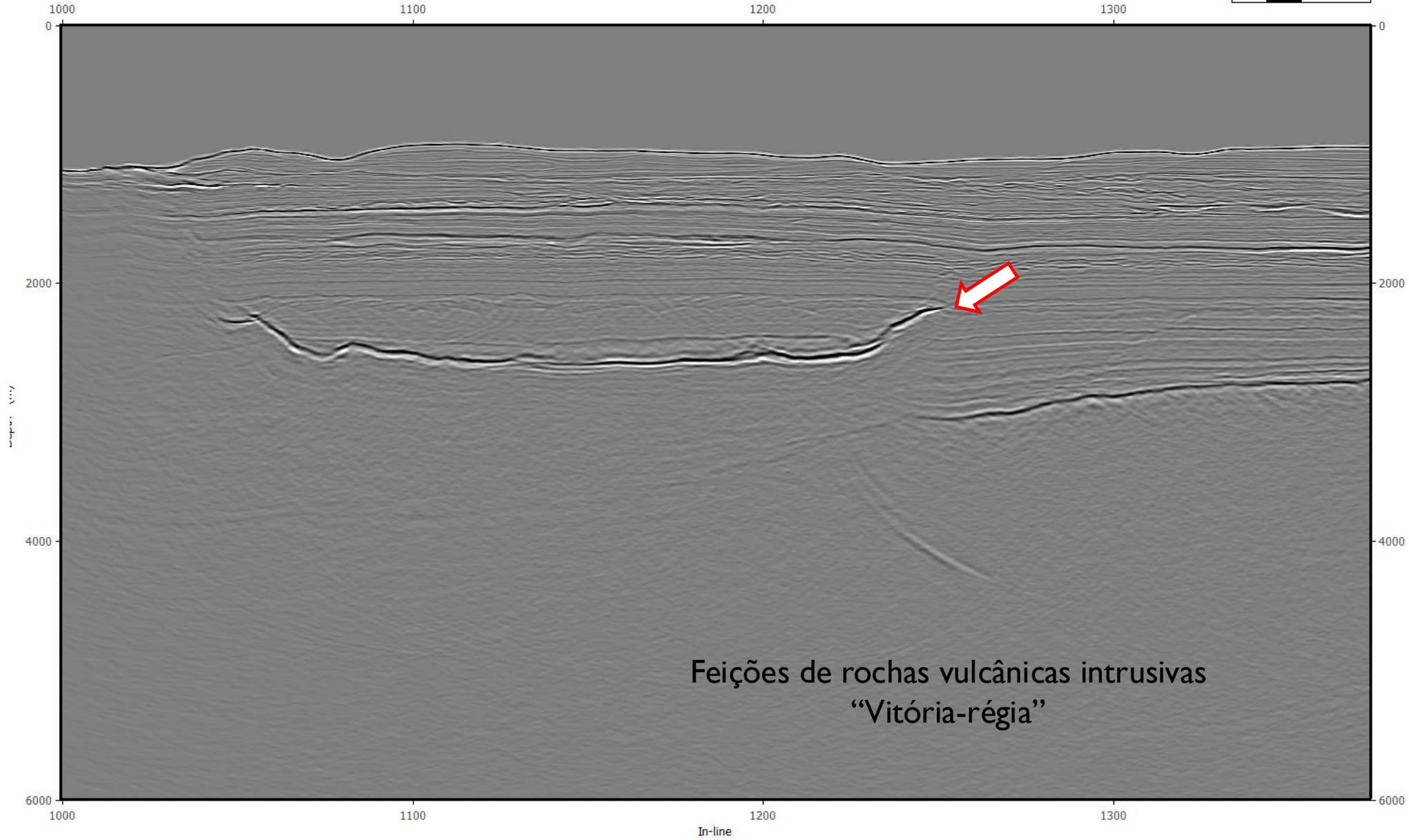
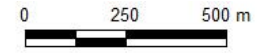
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In-line range : 1000 - 1800 [1]; Total: 801
Cross-line range : 840 - 6580 [1]; Total: 5741
Z range (m) : 0 - 6000 [5]; Total: 1201
Inl/Crl bin size : 25.00 / 12.50 (m/line)
CRS : Unlocated XY
Area : 1437.05 (sq km)
Survey type : Only 3D
In-line orientation : 31.42 Degrees from N
Location : C:\Users\hugosaar\Waka
```

3D Kahu – Inline 1200



3D Kahu – Crossline 3000

Cross-line: 3000



DATASETS (ARTIGOS)

Dataset	Feições Encontradas nos Artigos	Ids artigos
"A" Field 3D (Malay Basin)	Salt; Turbidite; Channel	203; 102; 207
2D seismic survey	Sequence Stratigraphy; Fault	483
3D seismic data from Saudi Arabia	Fault	031
3D survey in the South Atlantic Ocean	Salt	265
AN Field 3D	Sequence Stratigraphy; Turbidite; Channel	329
Arabian Basin 3D	Fault	100
Beatrice oil field	Fault	171
Blake Ridge 3D	Fault	014
Bonaventure 3D	Mass Transport	184
BroadseisTM 3D	Fault	390
Browse Basin	Channel	106
Buzios Field 3D	Build-up; Sequence Stratigraphy; Fault; Salt	445; 415; 472
Campos Basin 3D	Fault	228
Canning 3D	Fault	014; 263
Chengdao Oil Field	Channel	458
Coal Fields Shanxi Province	Sequence Stratigraphy; Fault	217
Costa Rica Margin 3D	Fault	229
Dangerous Grounds 3D (DG)	Sequence Stratigraphy; Turbidite; Channel	329
Delft 3D	Fault	014
Diskos 3D	Fault	218
Eugene Island 3D	Salt	450; 208
Four Gazprom Neft seismic cubes	Sequence Stratigraphy	202

Dados de Campo

- SEGY Disponível para download
- SEGY Dados do Brasil

DATASETS

Dataset	Feições Encontradas nos Artigos	Ids artigos
Great South Basin (GSB)	Salt; Fault; Channel; Stratigraphic Sequences; Sequence Stratigraphy; Gas Chimney	335; 003; 404; 455; 446; 269; 196
Groningen Gas field 3D	Fault	271
Gullfaks 3D	Sequence Stratigraphy	417
HC125 work area	Fault	079
Horda Platform 3D	Fault	164
Julia field	Salt	178
KG 3D (Krishna - Godavari Basin)	Fault	223; 222
Kahu-3D	Fault	014
Kerry 3D	Sequence Stratigraphy; Salt; Fault	229; 091; 210; 468; 230; 263; 267; 014; 135; 277; 226
Kokako 3D	Turbidite; Channel	380
Kora	Fault	157
LH Block	Fault	403
Laverda 3D	Sequence Stratigraphy; Fault	262
Maui 3D	Fault; Sand Gas; Turbidite; Channel	473; 380; 491; 228
Middle Pennsylvanian Red Fork Formation	Channel	290
NH 3D	Sequence Stratigraphy	417
NH0301 3D	Sequence Stratigraphy; Fault	262
NLOG	Fault; Salt	277
Netherlands Offshore F3 Block	Anticline; Salt; Seismic Facies; Bright Spot; Sand Gas; Fault; Channel; Stratigraphic Sequences; Sequence Stratigraphy; Gas Chimney	152; 233; 226; 433; 419; 191; 318; 407; 104; 232; 400; 077; 367; 004; 222; 243; 001; 444; 291; 120; 052; 255; 287; 455; 215; 202; 224; 405; 486; 014; 435; 021; 040; 392; 114; 062; 414; 135; 008; 427; 196; 070; 369; 391; 402; 010; 386; 151; 206; 401; 330; 229; 245; 397; 100; 324; 174; 363; 016; 131; 230; 123; 489; 418; 425; 201; 430; 424; 051; 216; 129; 416; 409; 446; 482; 091; 258; 410; 316

F3

Anticlinais
 Domos de Sal
 Fácies Sísmicas
 Bright Spots (DHI)
 Flat Spots (DHI)
 Falhas
 Canais
 Estratigrafia de Sequências
 Chaminé de gás
 Feições de Build up carbonático
 Turbiditos
 Ruídos

SEGY

Disponível para download

SEGY

Maior número de feições sísmicas

SEG WIKI



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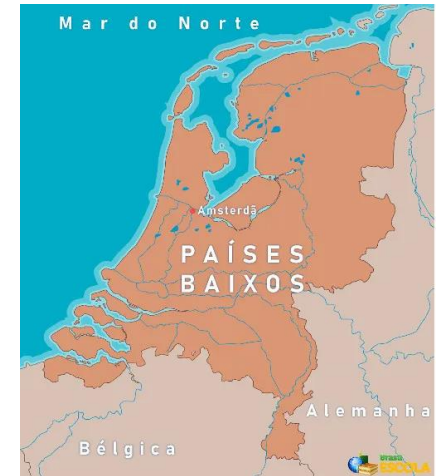
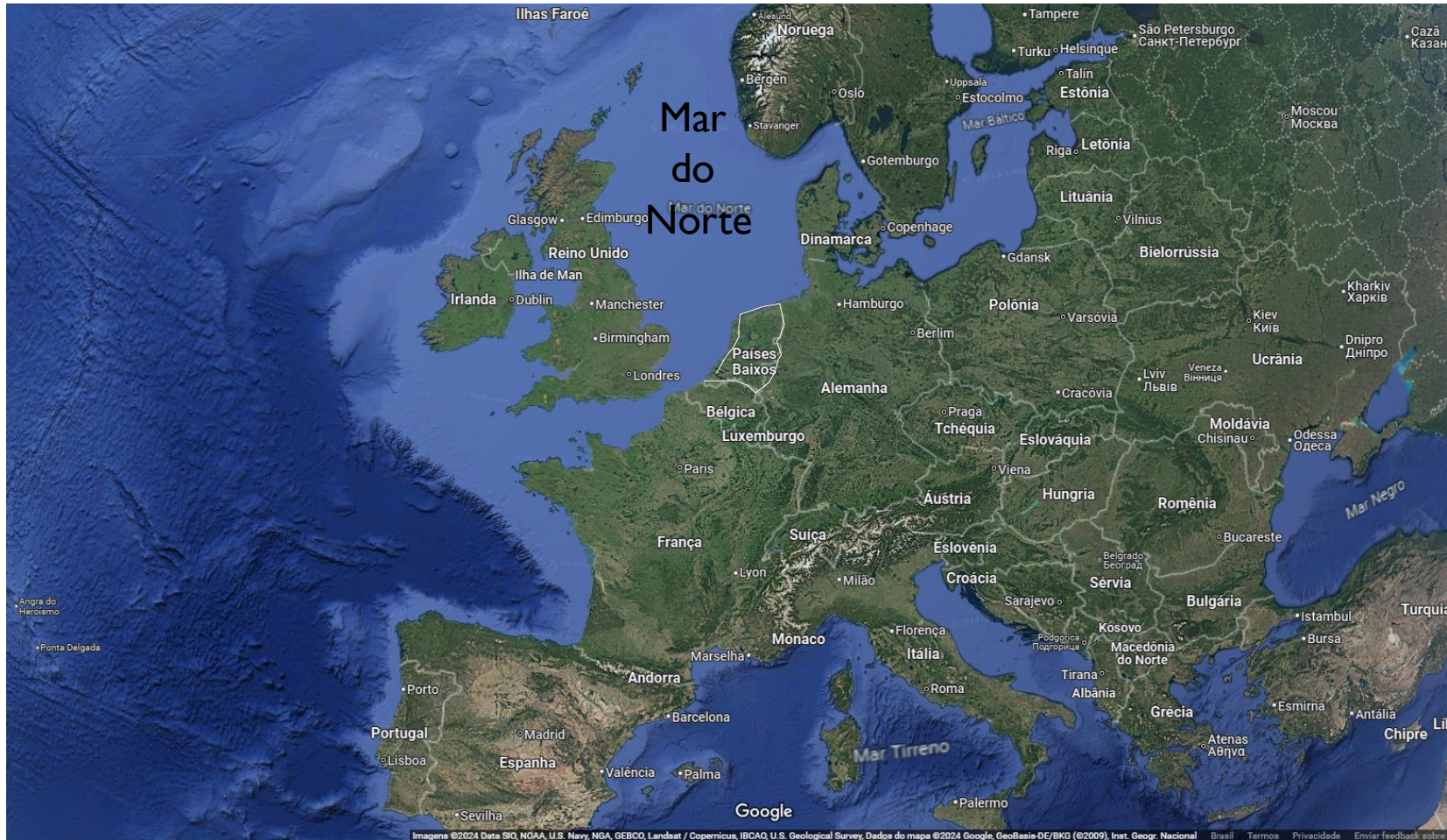
https://wiki.seg.org/wiki/Open_data

Avaliação dos Datasets





F3 Netherlands





Location of the F3 3D survey in the North Sea, Netherlands offshore.

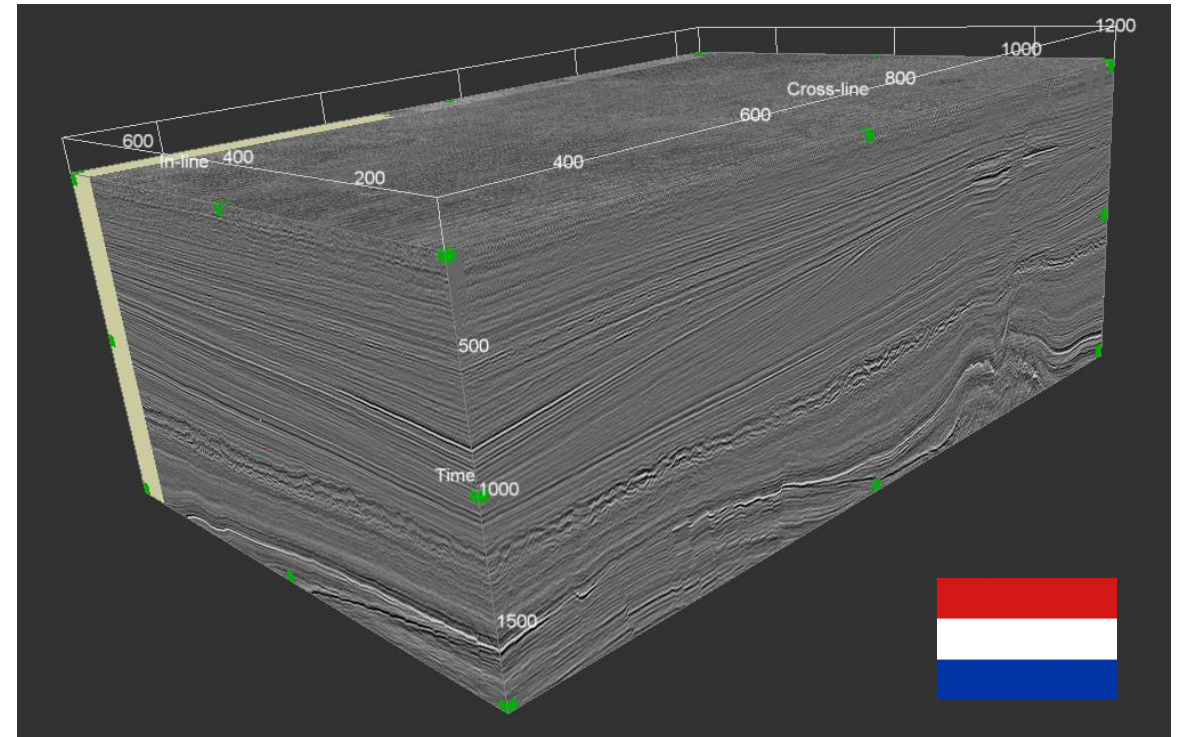
Volume Sísmico F3

O F3 é um bloco localizado no setor holandês do Mar do Norte.

O bloco é coberto por sísmica 3D que foi adquirida para explorar petróleo e gás nos estratos do Jurássico Superior e Cretáceo Inferior, **que se encontram abaixo do intervalo selecionado para este conjunto de demonstração** (Pré-Sal).

Os 1200 ms superiores do conjunto de demonstração consistem em refletores pertencentes ao Mioceno, Plioceno e Pleistoceno.

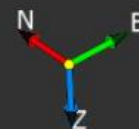
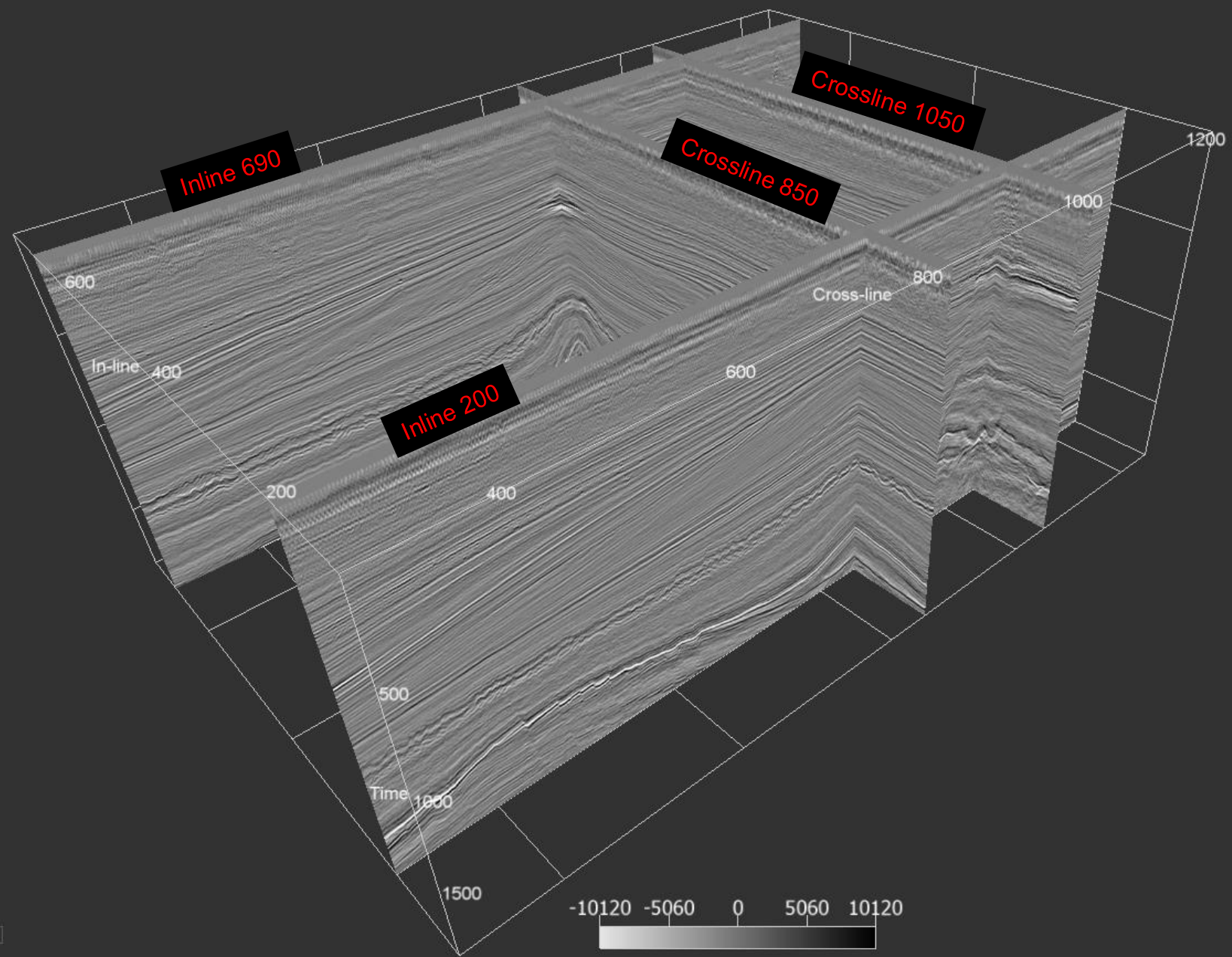
<https://terranubis.com/datainfo/F3-Demo-2020>



Survey type:	3D
Inline range and step:	100, 750, 1
Crossline range and step:	300, 1250, 1
Z range and step:	0 - 1.848 ms, amost. 4 ms
Inline bin size (m/line):	25
Crossline bin size (m/line):	25
Area (sq km):	386.92

Avaliação da Qualidade

F3



In-line: 200

300

400

500

600

Zona Ruidosa

100 ms

Time (ms)

200

400

600

200

400

600

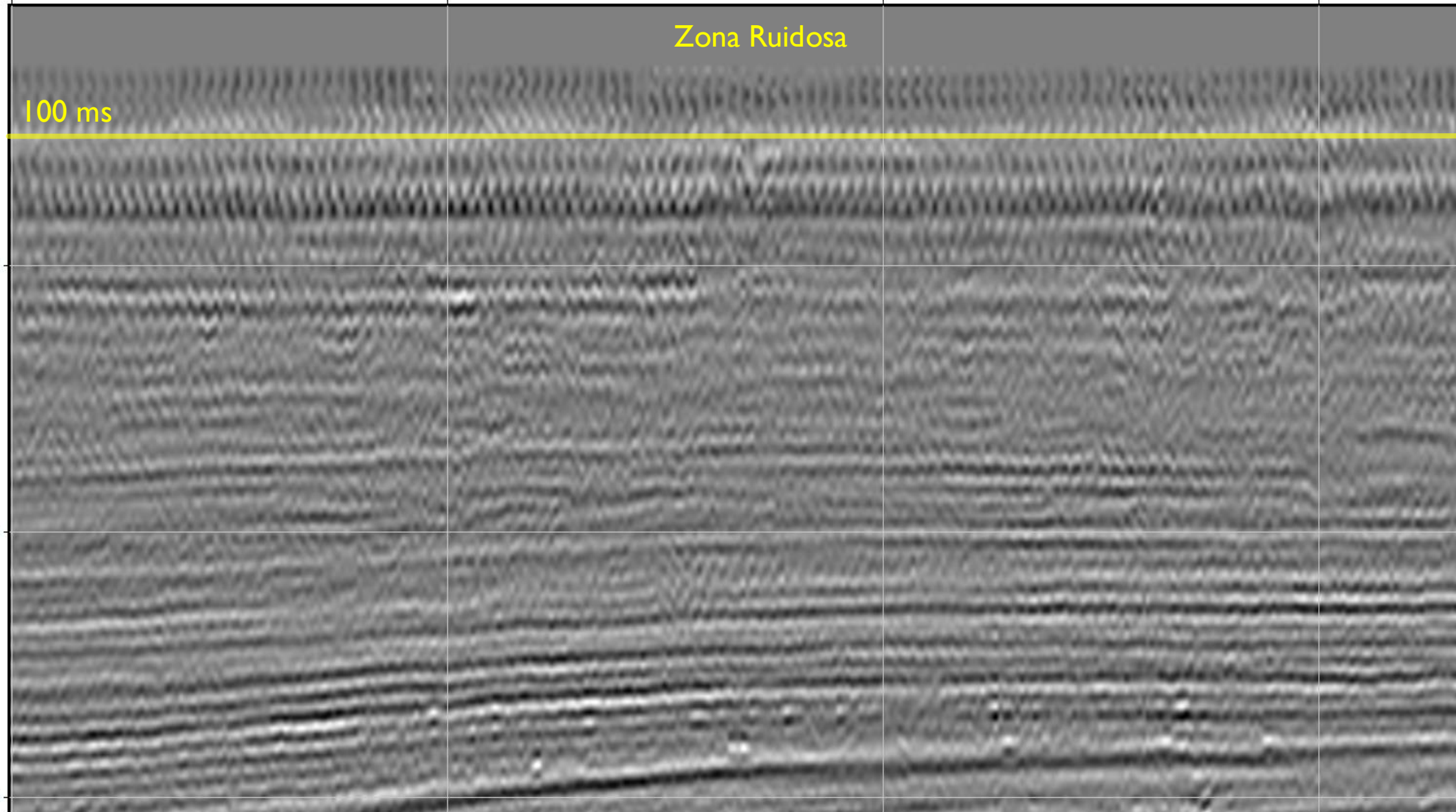
Cross-line

300

400

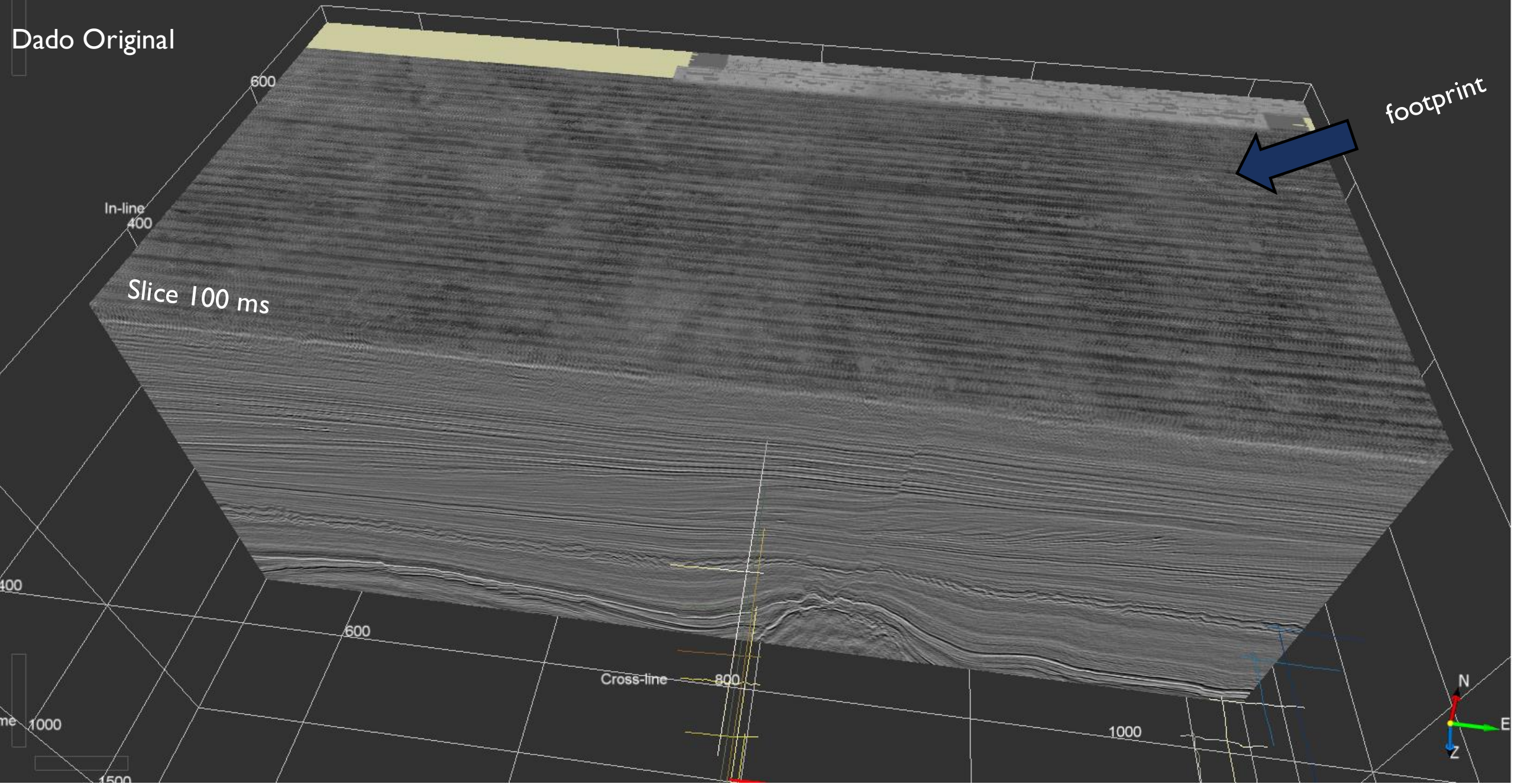
500

600



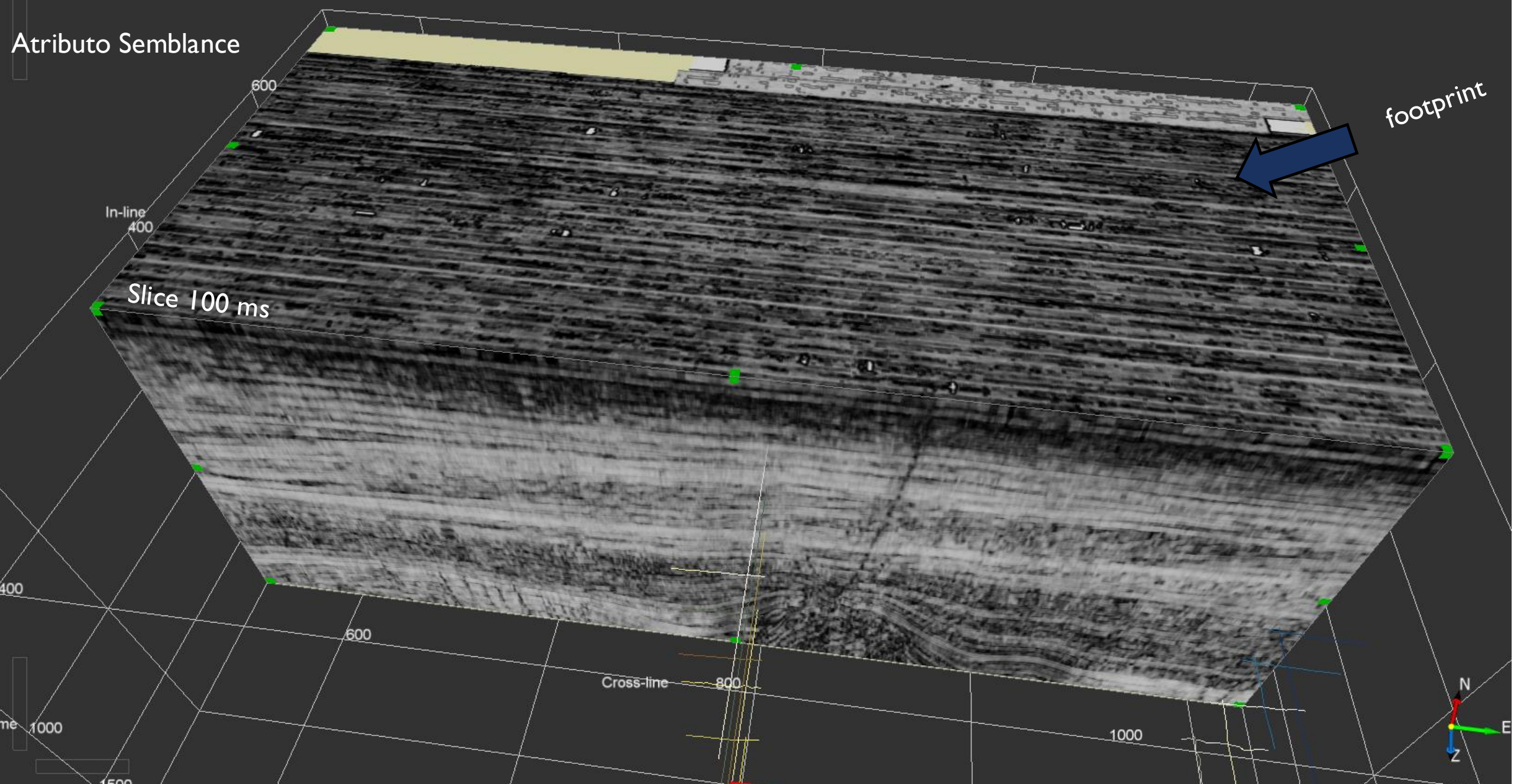
Cubo sísmico F3

Dado Original



Cubo sísmico F3

Atributo Semblance



footprint

In-line
400

Slice 100 ms

Cross-line
800

N
E
Z

1000

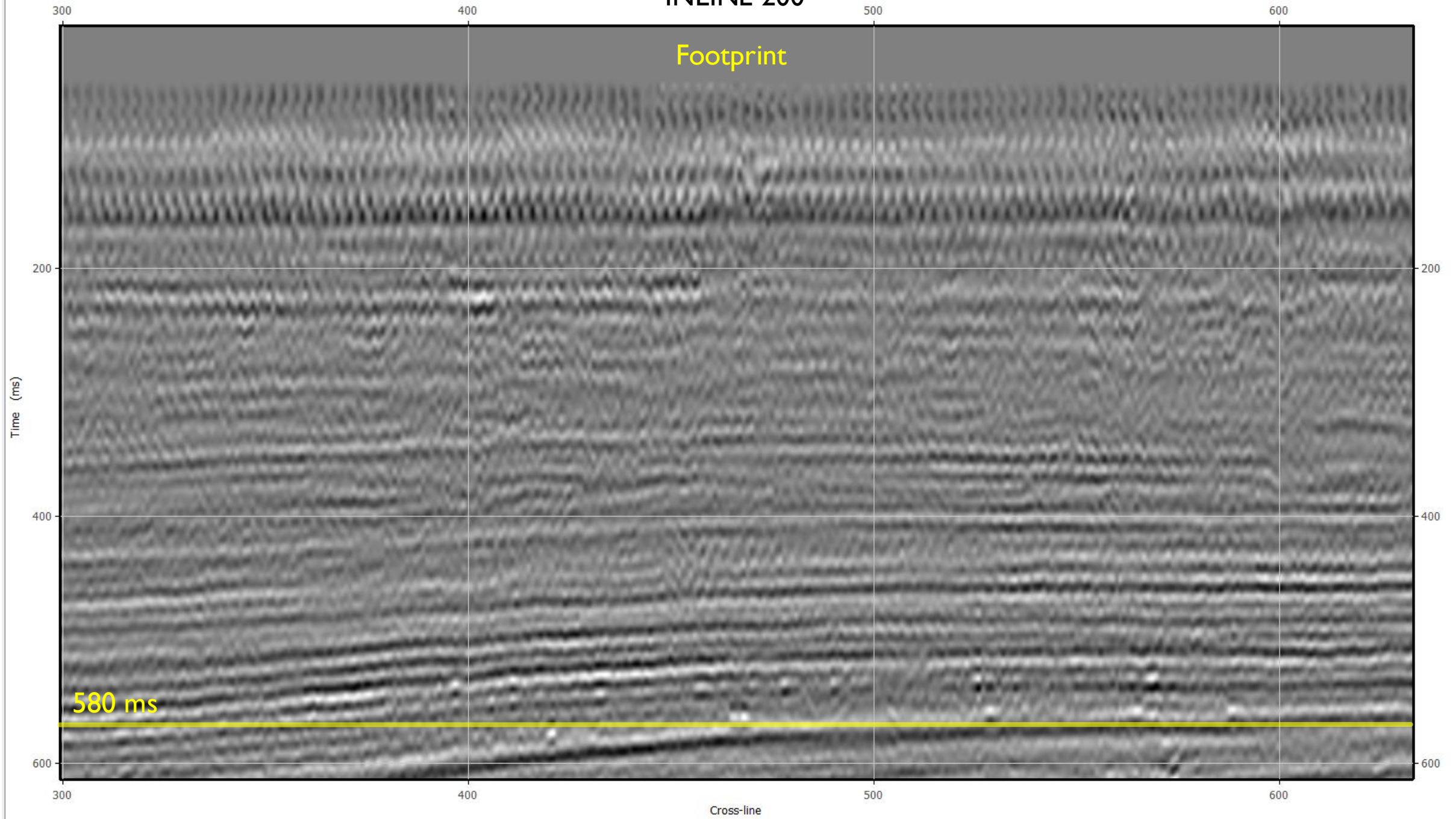
1500

1000

600

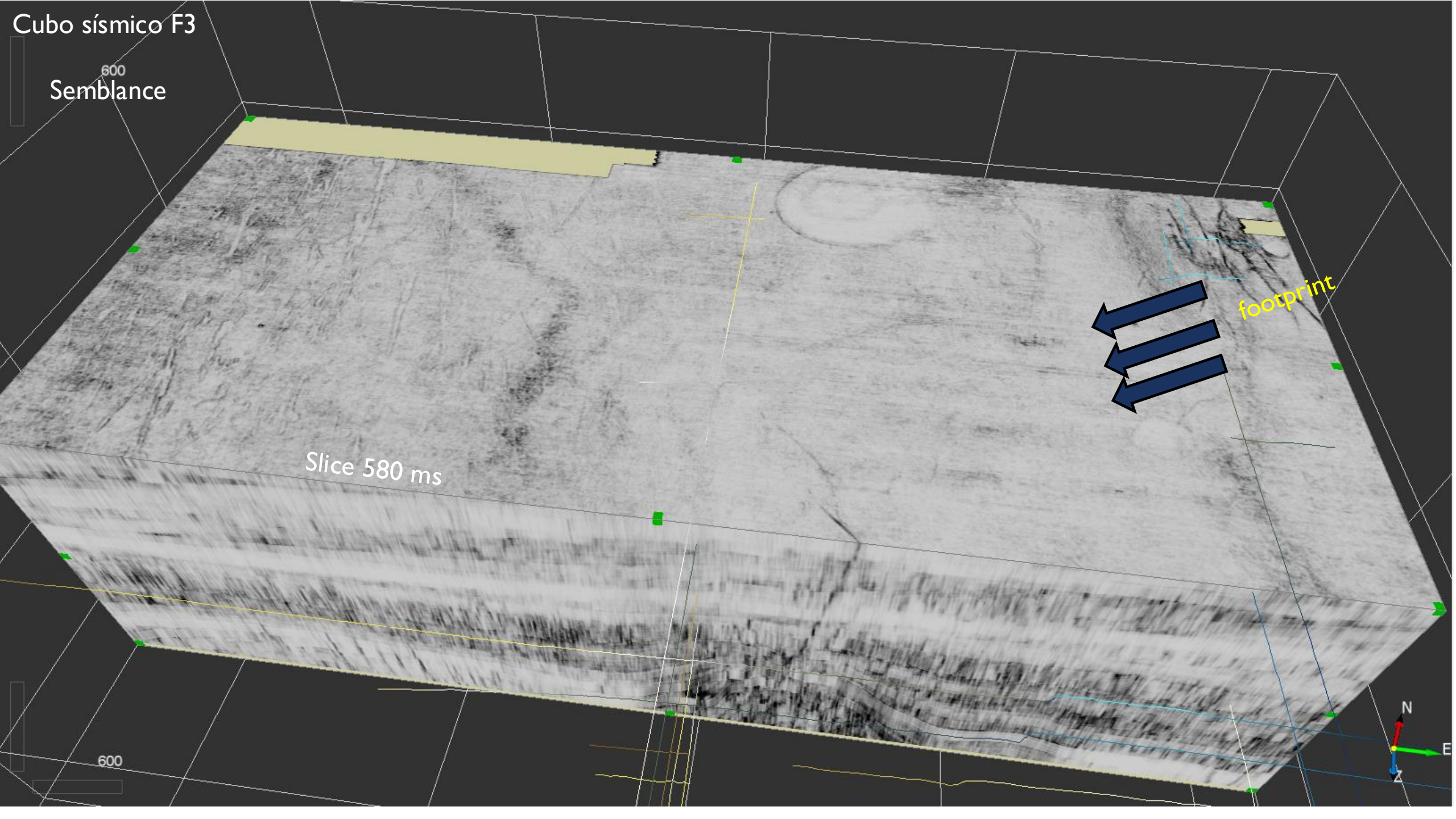
600

INLINE 200



Cubo sísmico F3

600
Semblance





Slice 580 ms

footprint

600



- 
- O *footprint* é bem visível nas altas frequências, na parte mais rasa.
 - O efeito diminui com o aumento da profundidade, ao que tudo indica, o dado sísmico F3 foi processado para valorizar as partes mais profundas, abaixo de 0,5 segundos (> 500 ms)
 - O cubo de atributo *Semblance* realça a ocorrência do *footprint*, cujo efeito aparece no *slice* como linhas horizontais.
 - Qualquer extração de atributos na parte rasa, vai ser influenciada por esse ruído.
 - Um filtro passa-baixa deve amenizar esse ruído.
- 



PRÉ-PROCESSAMENTO

05 DE NOVEMBRO DE 2024

Filtro
SOF

FILTRO ORIENTADO A ESTRUTURAÇÃO (SOF)

De acordo com Hale (2009), a filtragem orientada à estruturação é uma adaptação de filtros de difusão anisotrópica, que melhoram a coerência (Fehmers e Höcker, 2003), que assim é utilizado para melhorar a interpretação de imagens sísmicas.

Este filtro é uma operação de suavização, que ocorre paralelo às reflexões sísmicas, sendo restringido entre terminações, para que possa remover o ruído e simplificar as informações estruturais em dados sísmicos.

Conforme construído por Fehmers e Höcker (2003), o filtro orientado à estruturação tem três componentes importantes: orientação, detecção de bordas e suavização orientada (para preservação de bordas).

O filtro é basicamente um processo de difusão anisotrópica simulado (filtro passa-baixa), que difunde a amplitude sísmica paralelamente às reflexões. Para conseguir isso, o tensor de difusão (D), é calculado a partir da estrutura da imagem local, tendo por base a equação 1:

$$\frac{\partial u}{\partial \tau} = \nabla \cdot (\mathbf{D} \nabla u), \quad (1)$$

onde $u = u(x, y, t)$ são os dados sísmicos, τ é o tempo de difusão e D é o tensor de difusão.

FILTRO ORIENTADO A ESTRUTURAÇÃO

O filtro orientado à estruturação depende do tempo total de difusão τ e do fator de escala σ (raio do filtro - dimensão dos dados).

O efeito de considerar diferentes valores de τ e σ é ilustrado na Figura 2.

Para valores pequenos, as alterações nos dados são imperceptíveis

Para τ (tempo) grande, a filtragem elimina mais ruído, mas algumas estruturas não originalmente conectadas ou caóticas tornam-se conectadas por o processo de difusão.

Para σ (x,y,z) grande, grandes estruturas são preservadas, e a imagem começa a ficar desfocada.

Uma adequada escolha de ambos os parâmetros é fundamental na utilização deste tipo de Filtro.

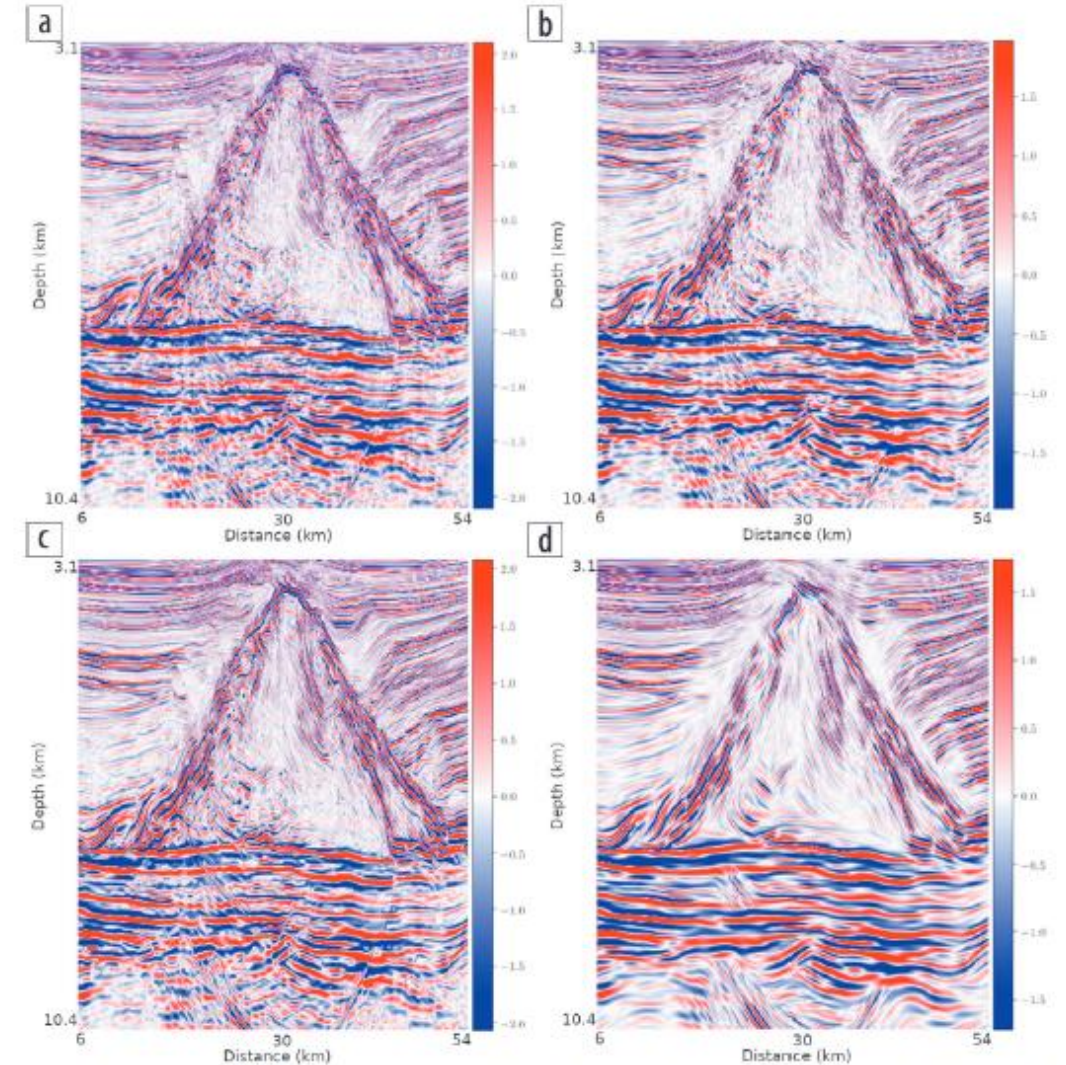
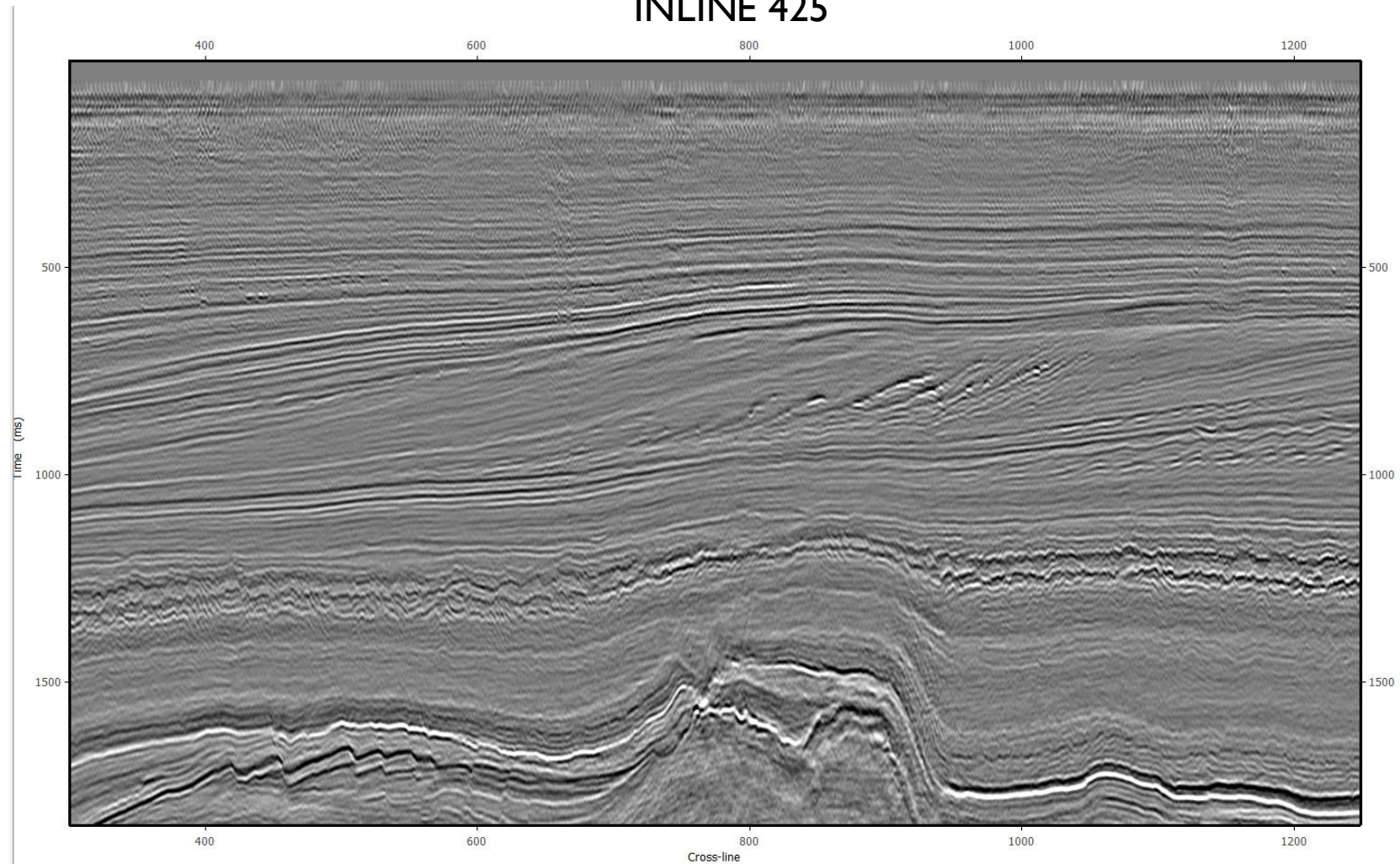


Figure 2. Structure-oriented filtering. (a) $\sigma=1$ and $\tau=100$. (b) $\sigma=20$ and $\tau=100$. (c) $\sigma=1$ and $\tau=1000$. (d) $\sigma=20$ and $\tau=1000$. For small σ and τ , the changes in data are imperceptible. For large τ , the filtering eliminates most noise from the data. However, some structures not originally connected or chaotic become connected by the diffusion process. For large σ only, large structures are preserved. When both parameters are large, the diffusion becomes severe and the picture looks blurry.

EFEITO DO FILTRO SOF NO F3

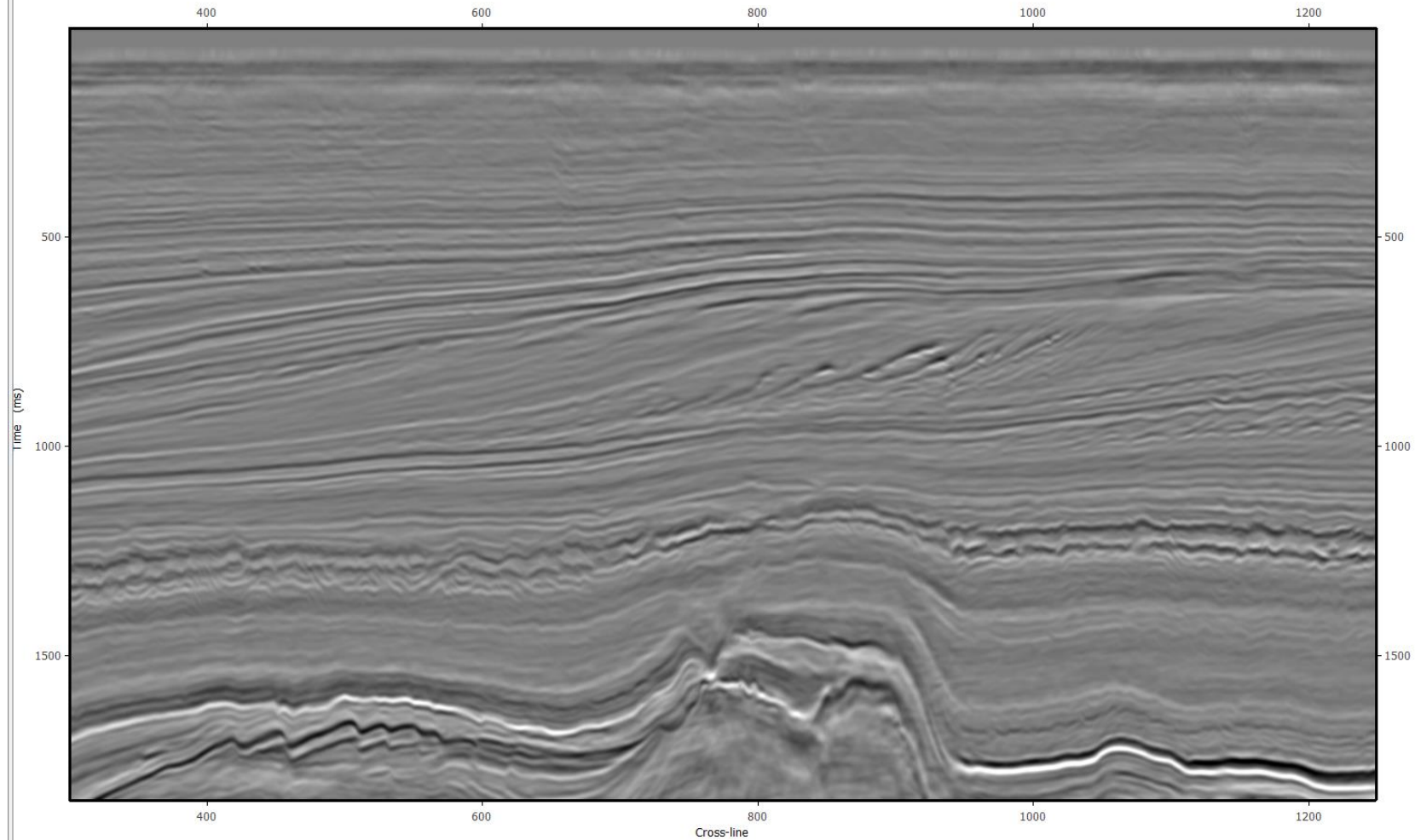
INLINE 425



Dado original

EFEITO DO FILTRO SOF NO F3

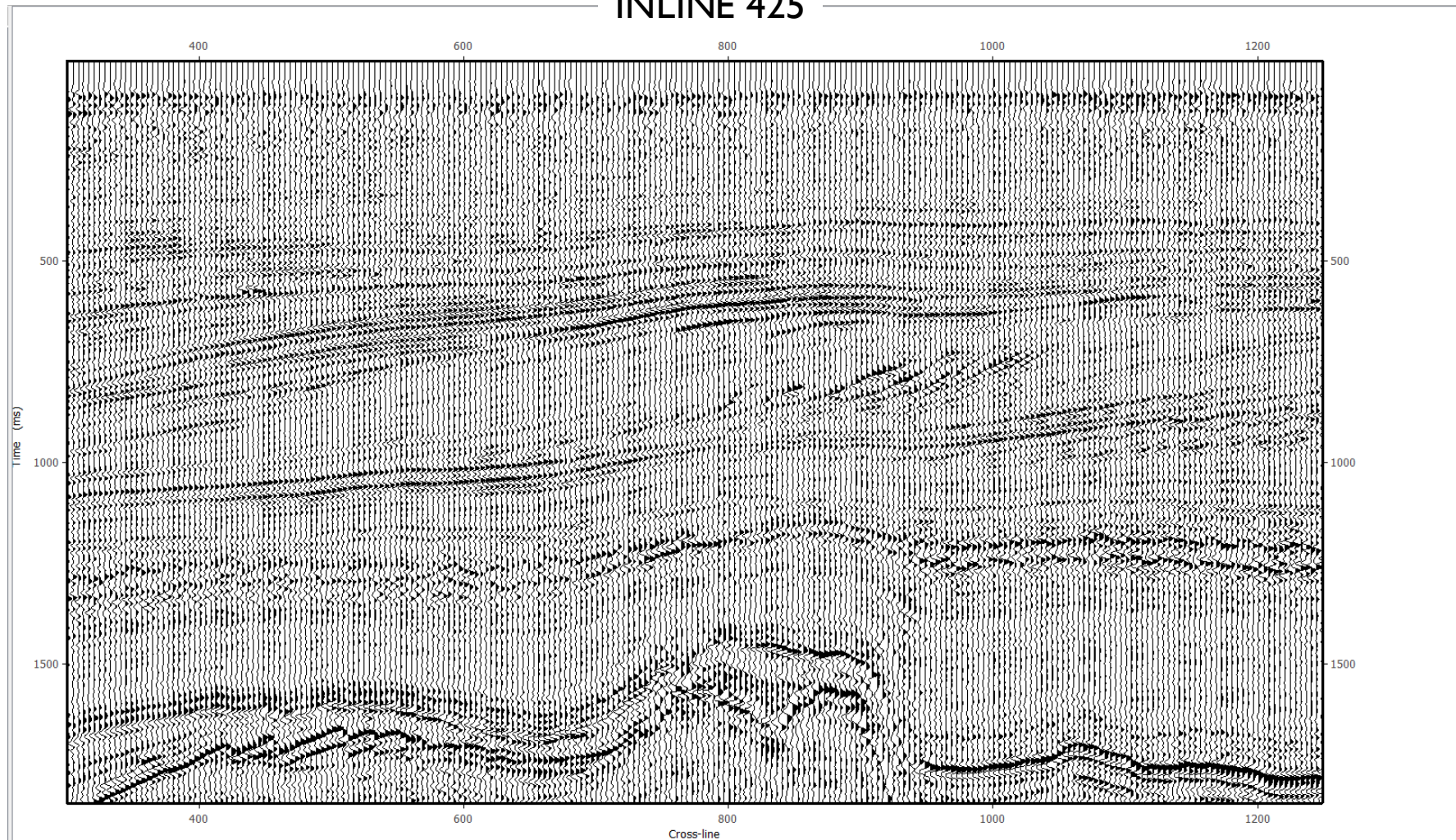
INLINE 425



Dado Filtrado

EFEITO DO FILTRO SOF NO F3

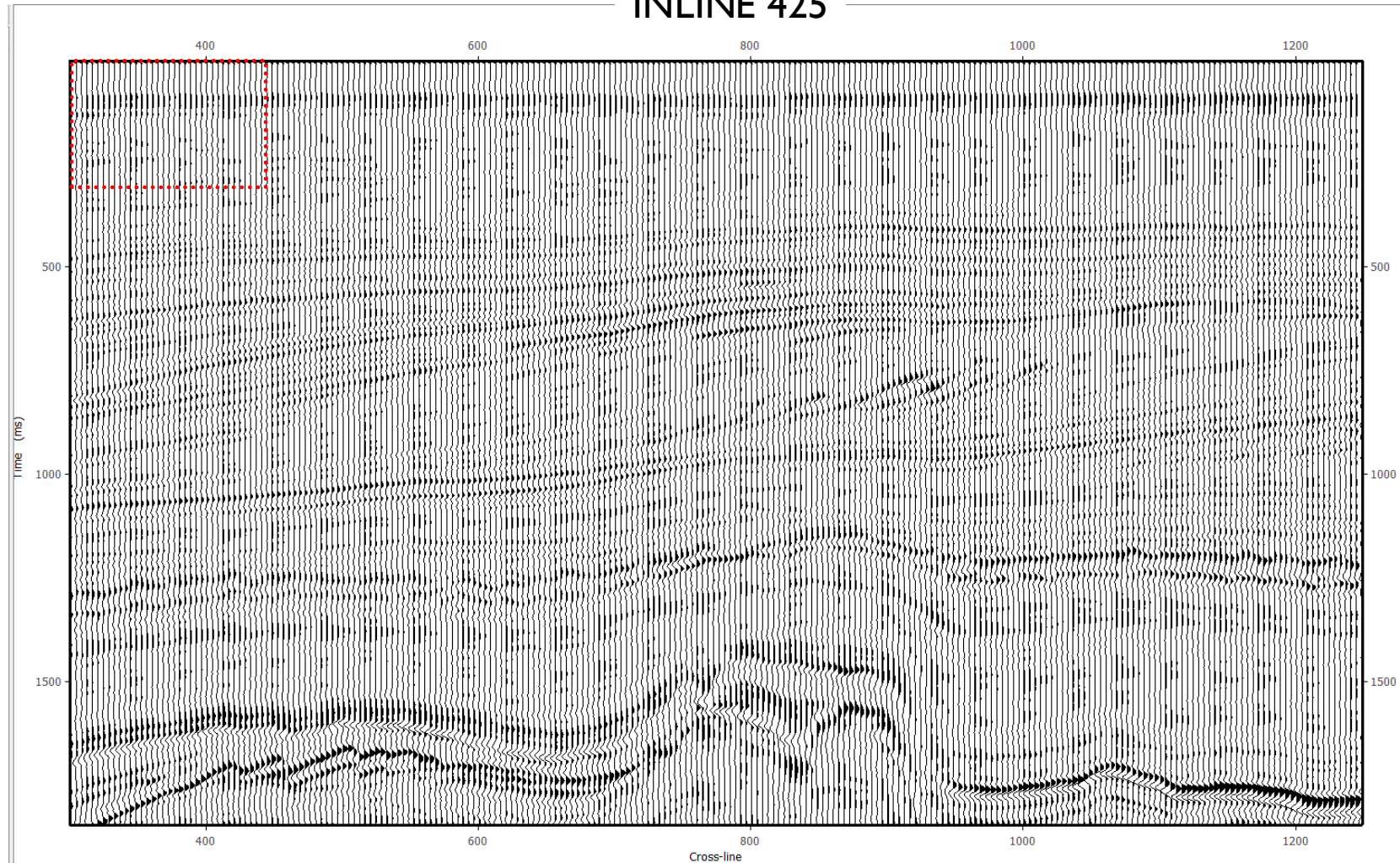
INLINE 425



Dado original
(Wiggle)

EFEITO DO FILTRO SOF NO F3

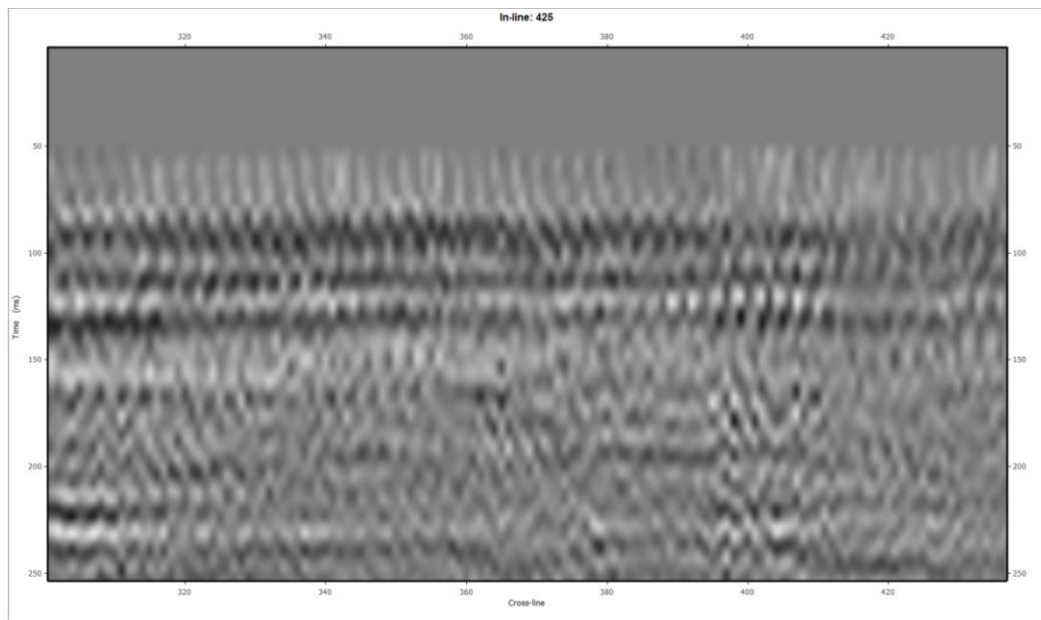
INLINE 425



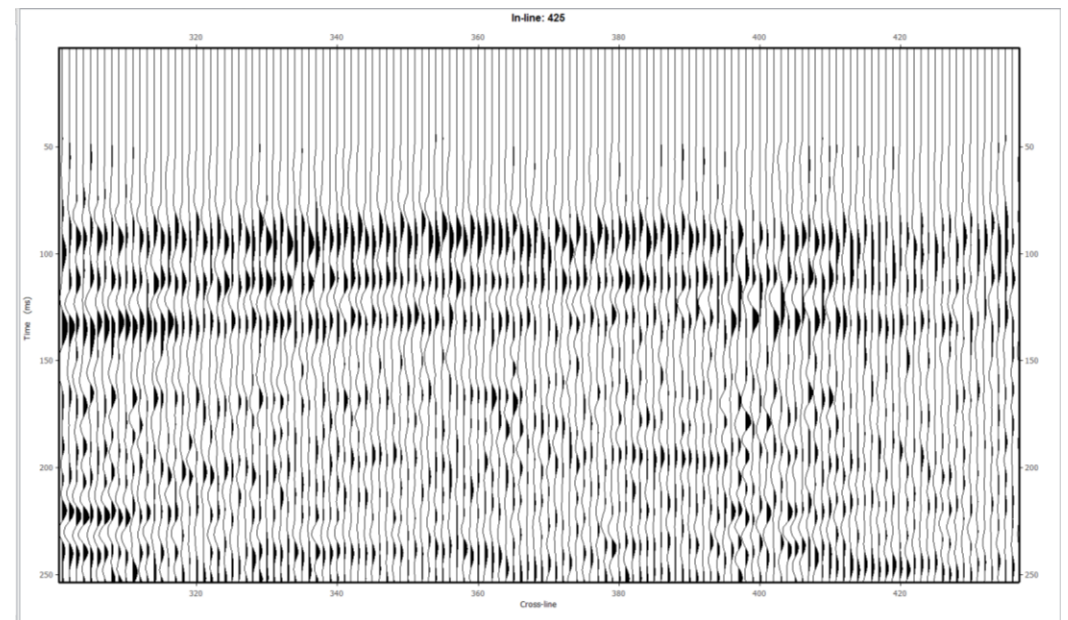
Dado Filtrado
(Wiggle)

EFEITO DO FILTRO SOF NO F3

INLINE 425



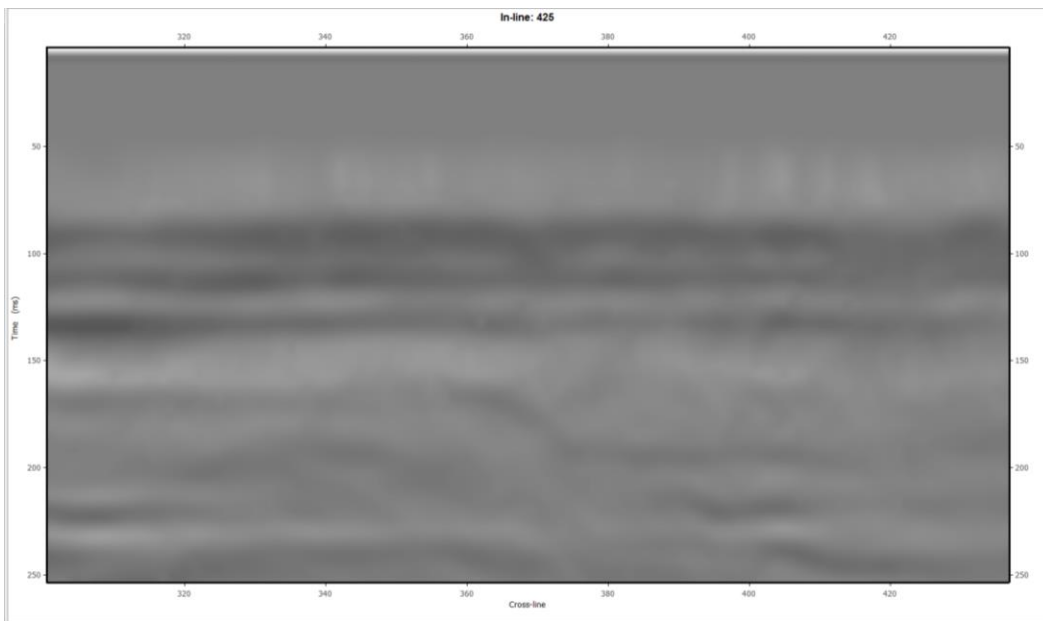
Dado original



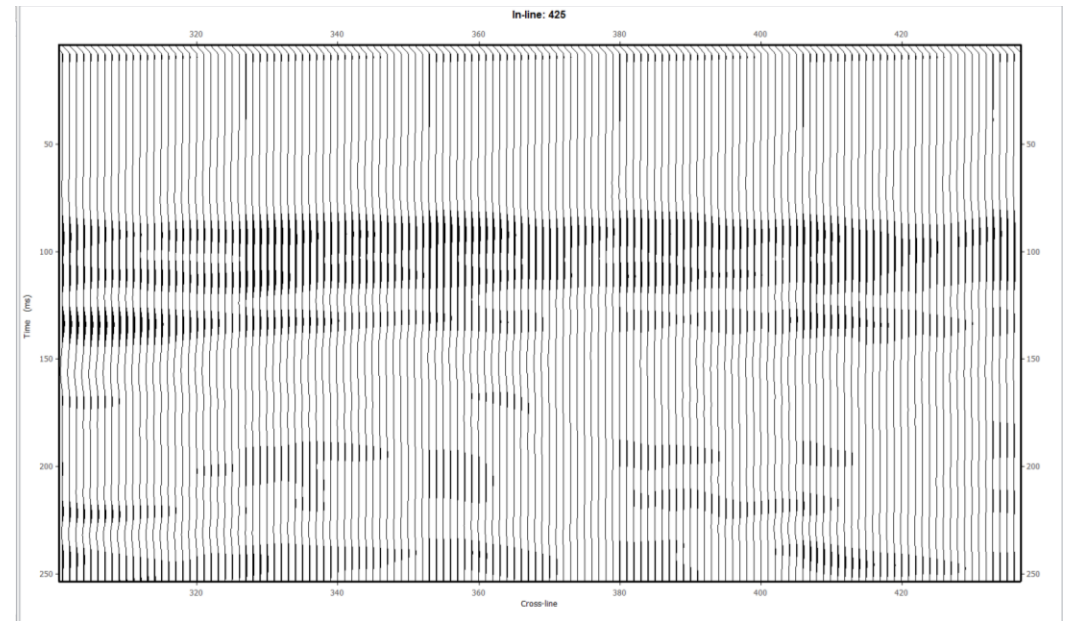
Dado original
(Wiggle)

EFEITO DO FILTRO SOF NO F3

INLINE 425



Dado Filtrado



Dado Filtrado
(Wiggle)

INTERPRETAÇÃO SÍSMICA



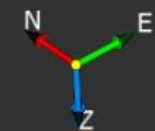
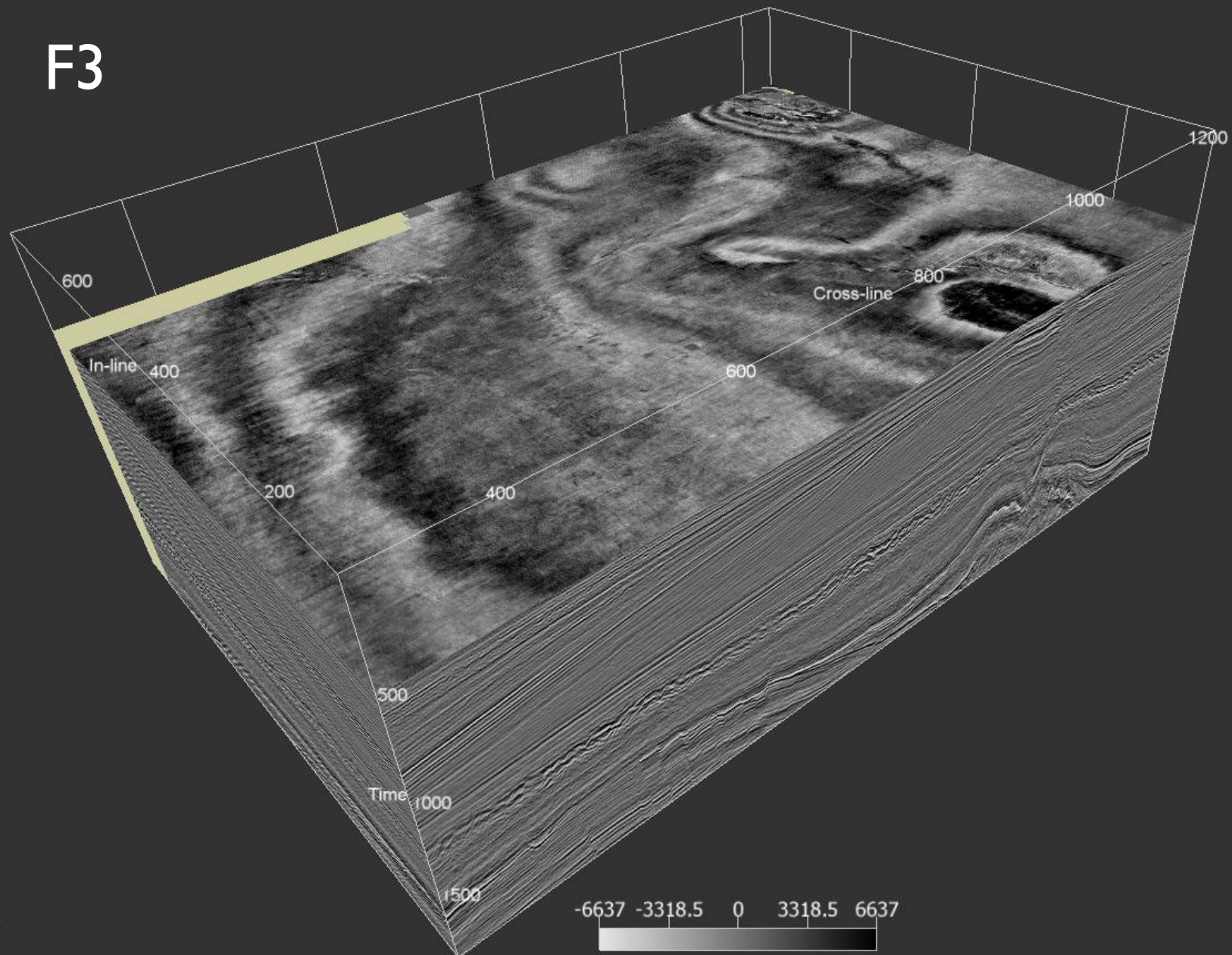
F3 Netherlands

Interpretação Sísmica

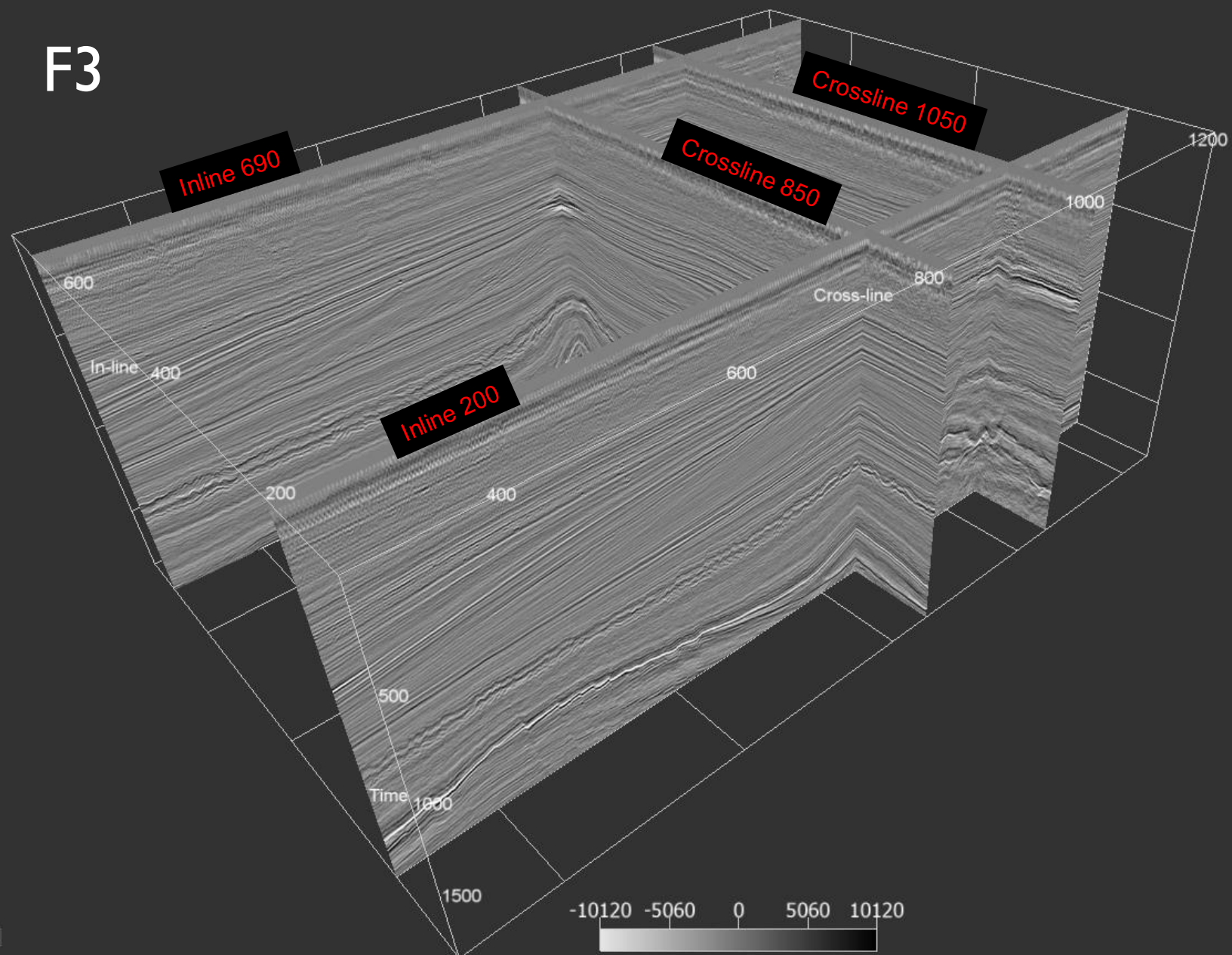
FEIÇÕES SÍSMICAS (ARTIGOS)

Grupo	Classificação
Carbonate	Build-up Karst Reef
DHI	Bright Spot Gas Chimney Sand Gas
Evaporite	Salt
Facies	Litofacies Seismic Facies Sequence Stratigraphy
Fault	Fault
Siliciclastic	Channel Mass Transport Turbidite
Stratigraphic	Stratigraphic Sequences
Structural	Anticline Fold

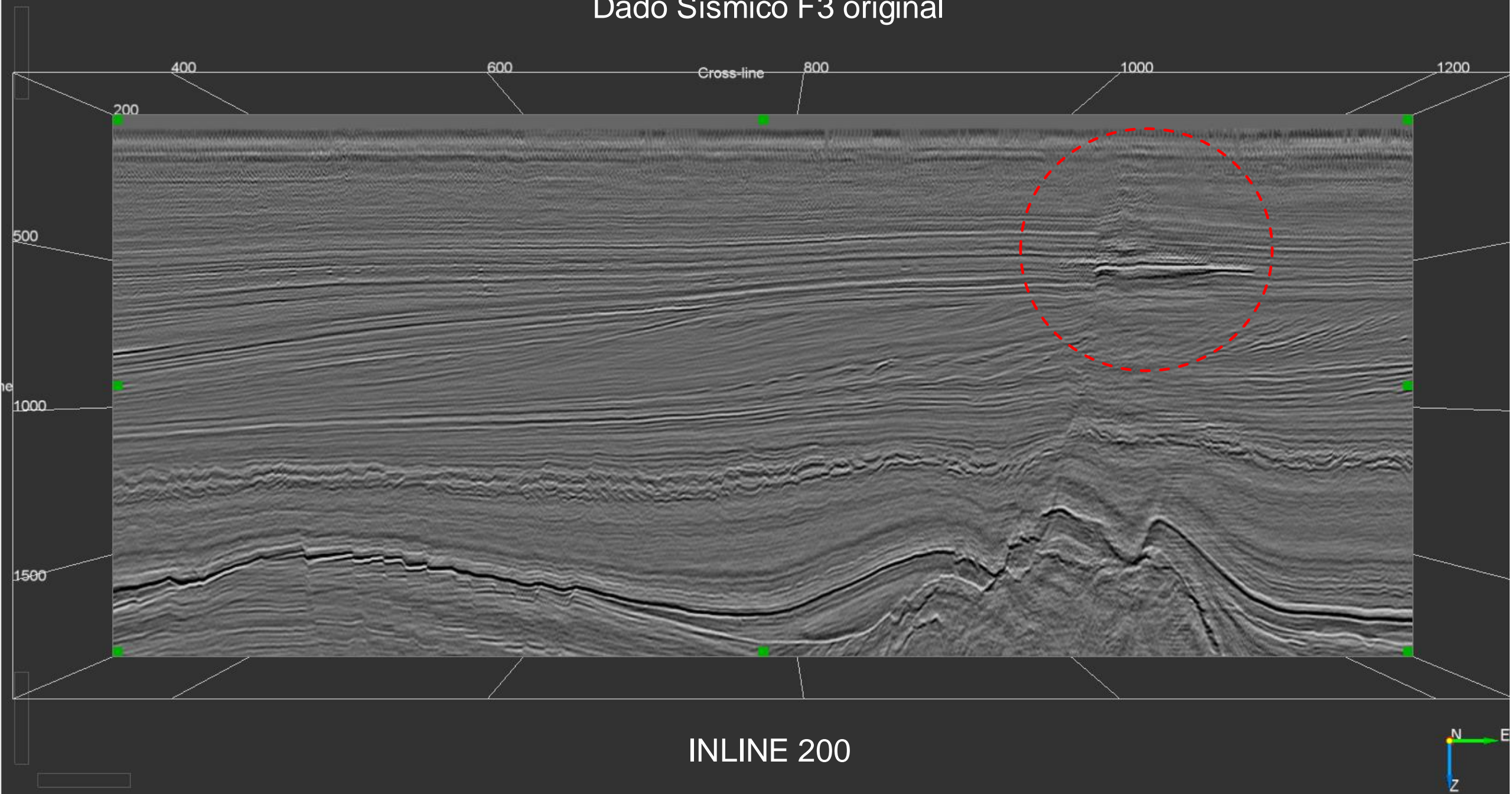
F3



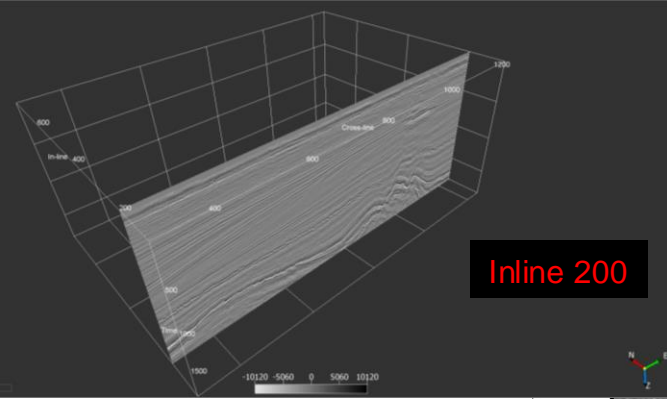
F3



Dado Sísmico F3 original

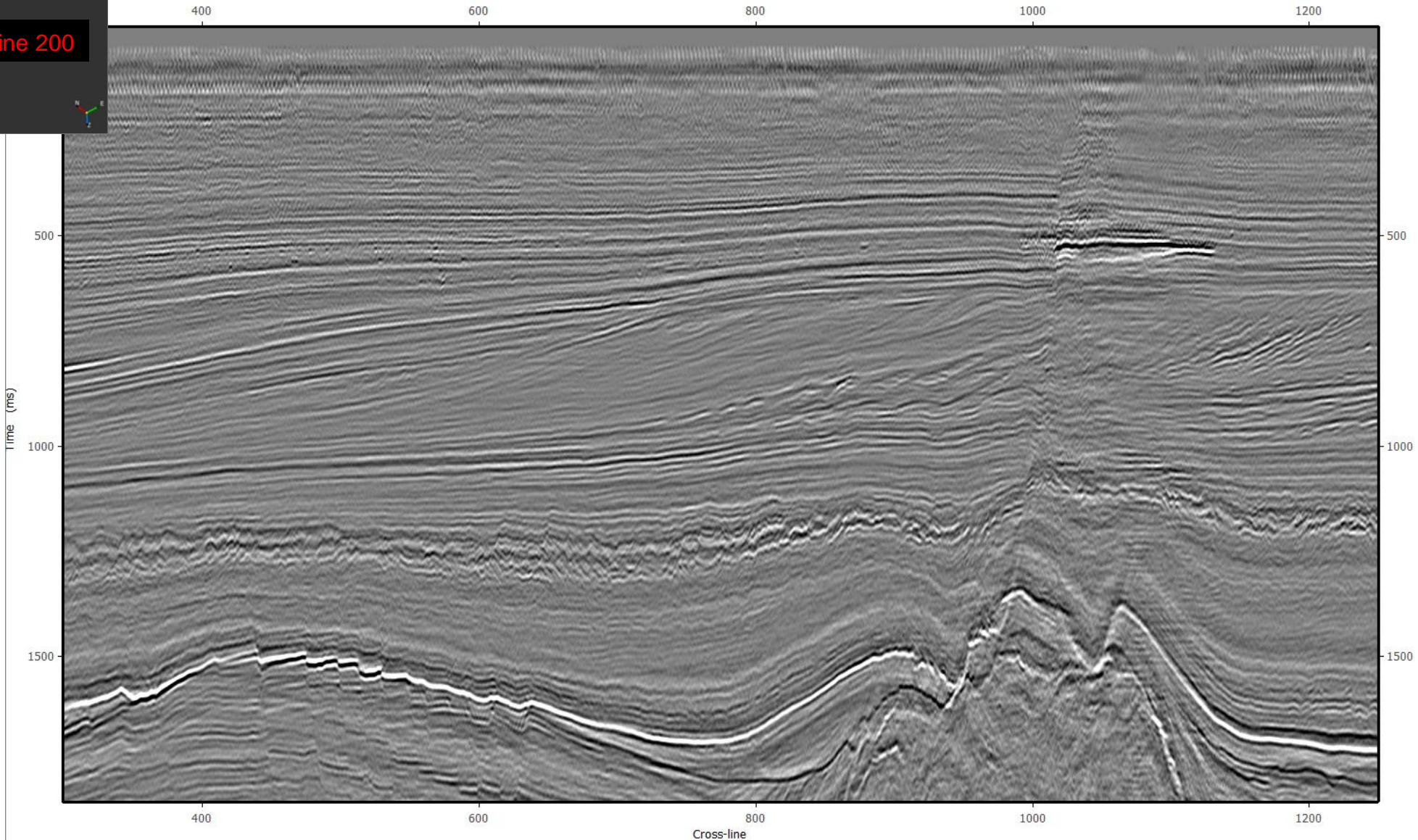


F3 - Inline 200



Inline 200

In-line: 200



Inline 200

Anticlinais
Domos de Sal
Fácies Sísmicas
Bright Spots (DHI)
Flat Spots (DHI)

Falhas

Canais ??

Estratigrafia de Sequências

Chaminé de gás

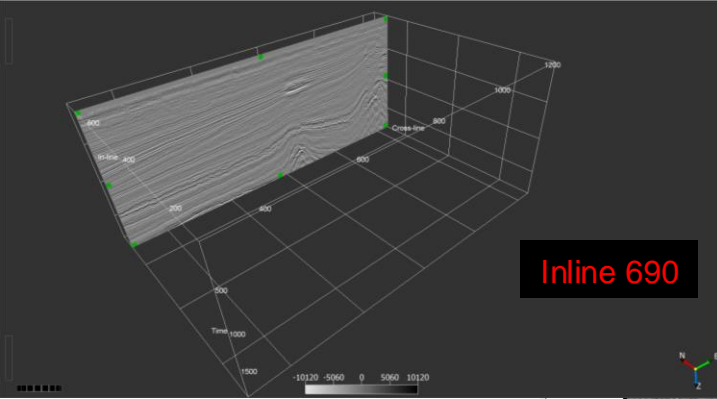
Feições de Build up carbonático

Turbiditos ??

Ruídos

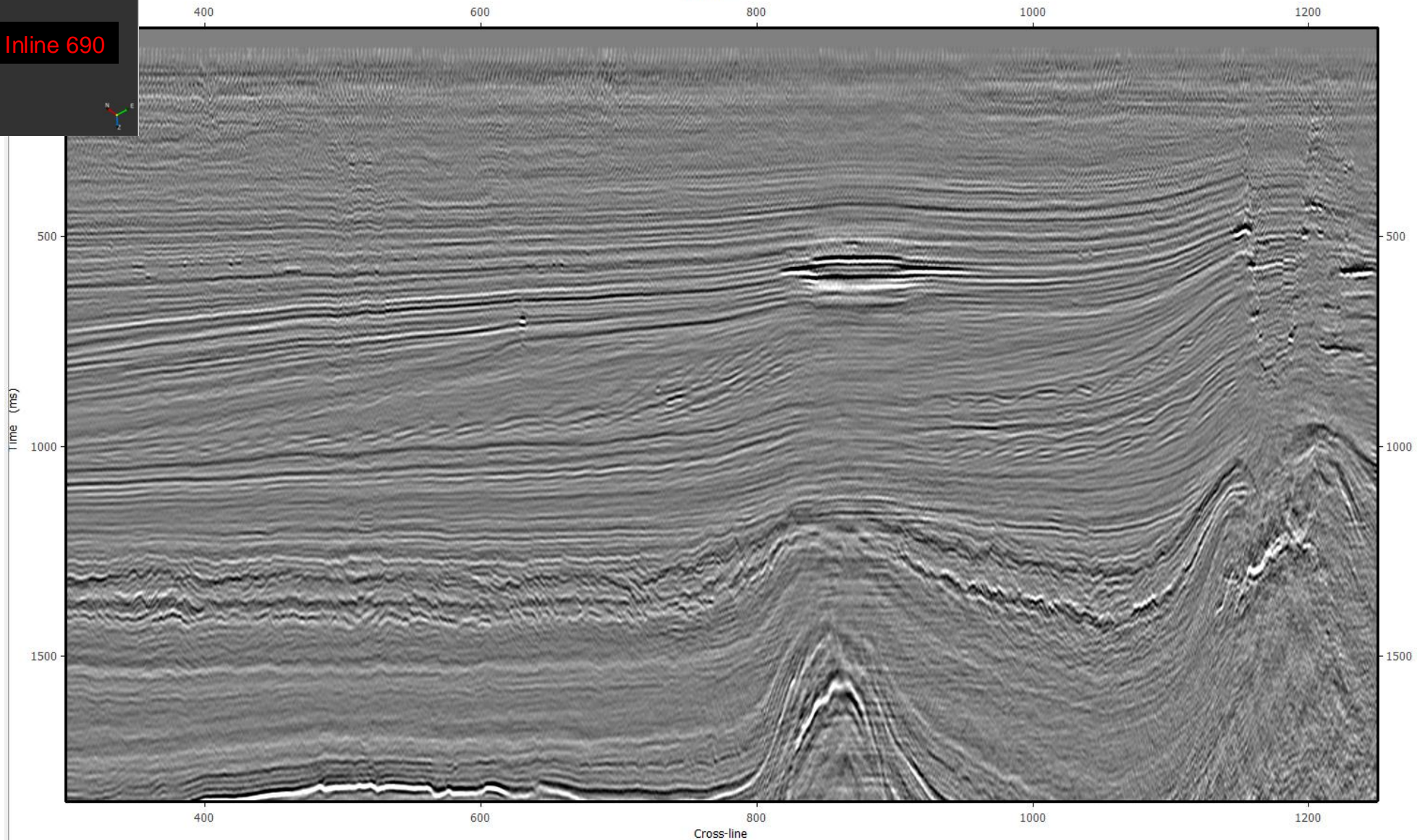
Fácies caóticas

F3 - Inline 690



In-line 690

In-line: 690



In-line 690

Anticlinais
Domos de Sal
Fácies Sísmicas
Bright Spots (DHI)
Flat Spots (DHI)
Falhas
Canais ??

Estratigrafia de Sequências
Chaminé de gás

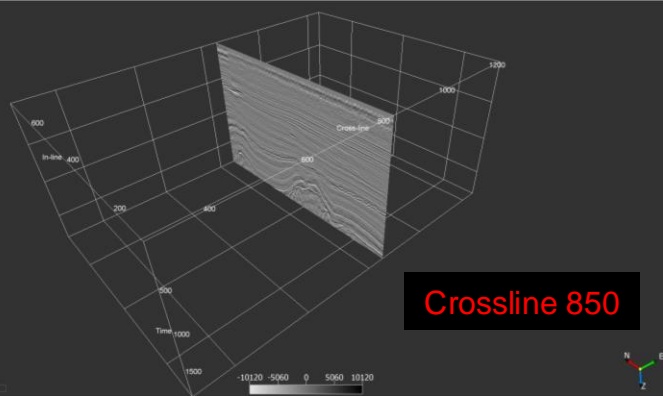
Feições de Build up carbonático

Turbiditos ??

Ruídos

Fácies caóticas

F3 - Crossline 850



Crossline 850

Cross-line: 850

200

400

600

Crossline 850

Anticlinais
Domos de Sal
Fácies Sísmicas
Bright Spots (DHI)
Flat Spots (DHI)
Falhas

Canais ??

Estratigrafia de Sequências

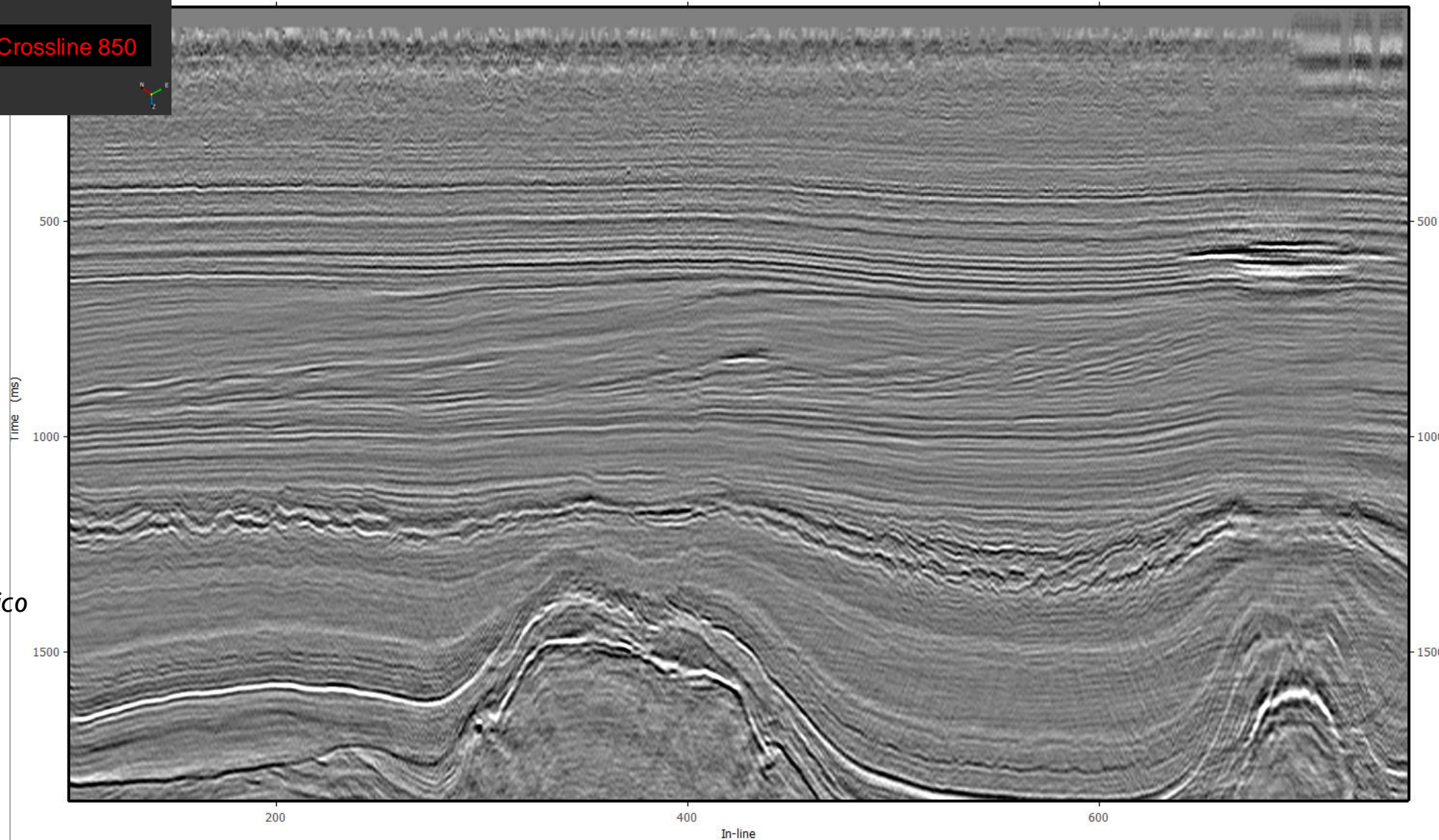
Chaminé de gás

Feições de Build up carbonático

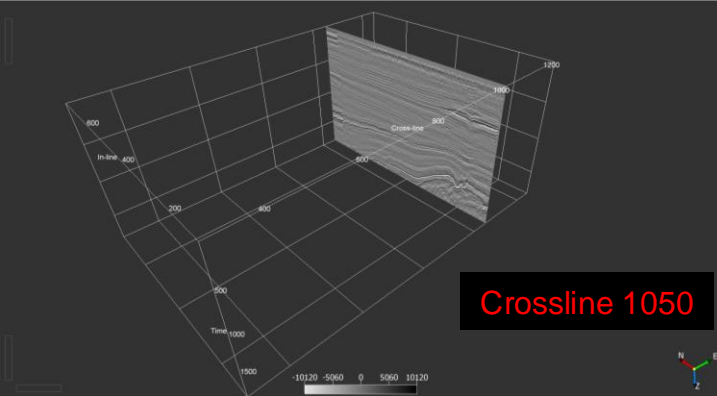
Turbiditos ??

Ruídos

Fácies caóticas



F3 - Crossline 1050



Cross-line: 1050

200

400

600

Crossline 1050

Anticlinais
Domos de Sal
Fácies Sísmicas
Bright Spots (DHI)
Flat Spots (DHI)

Falhas

Canais ??

Estratigrafia de Sequências

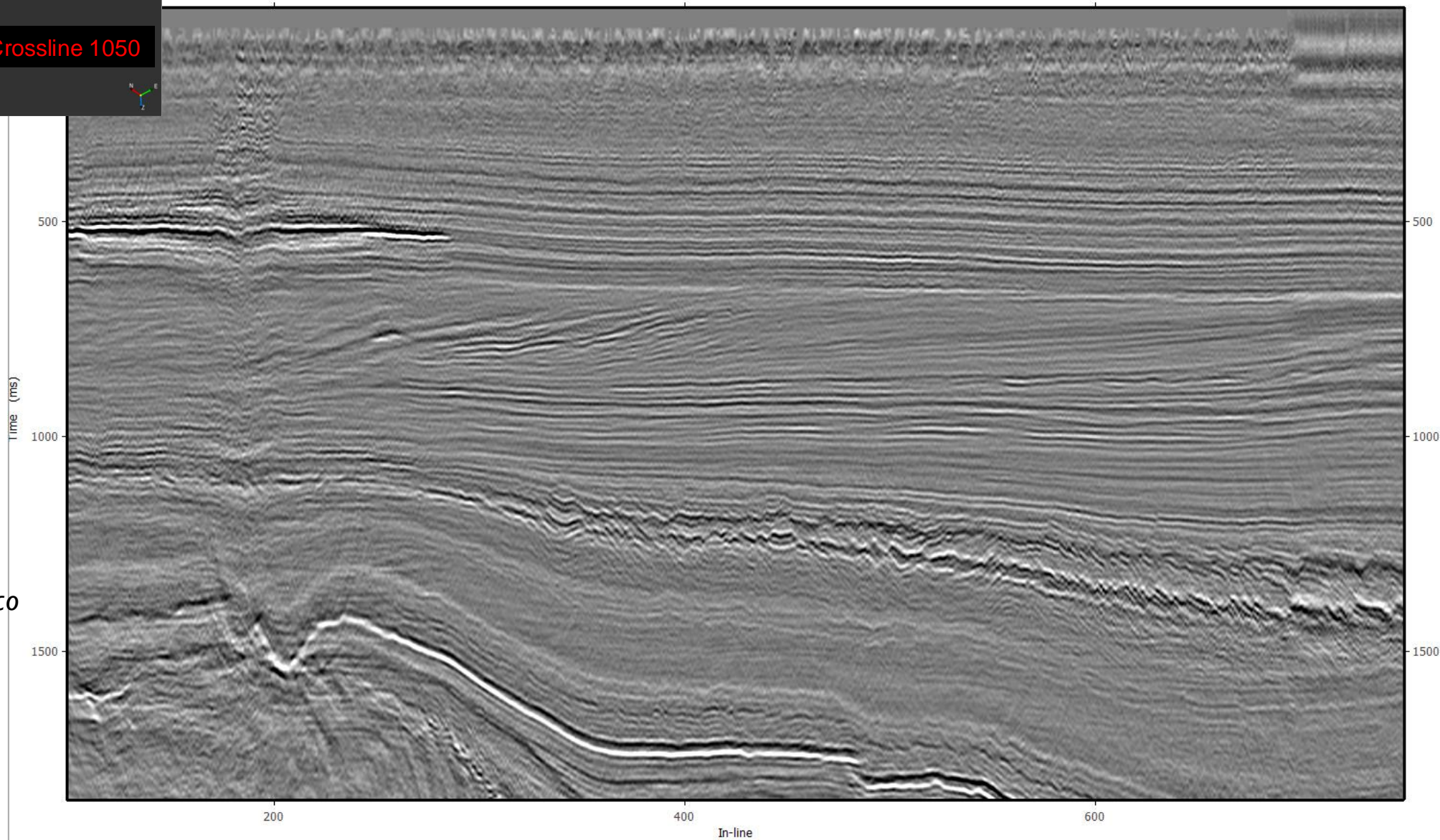
Chaminé de gás

Feições de Build up carbonático

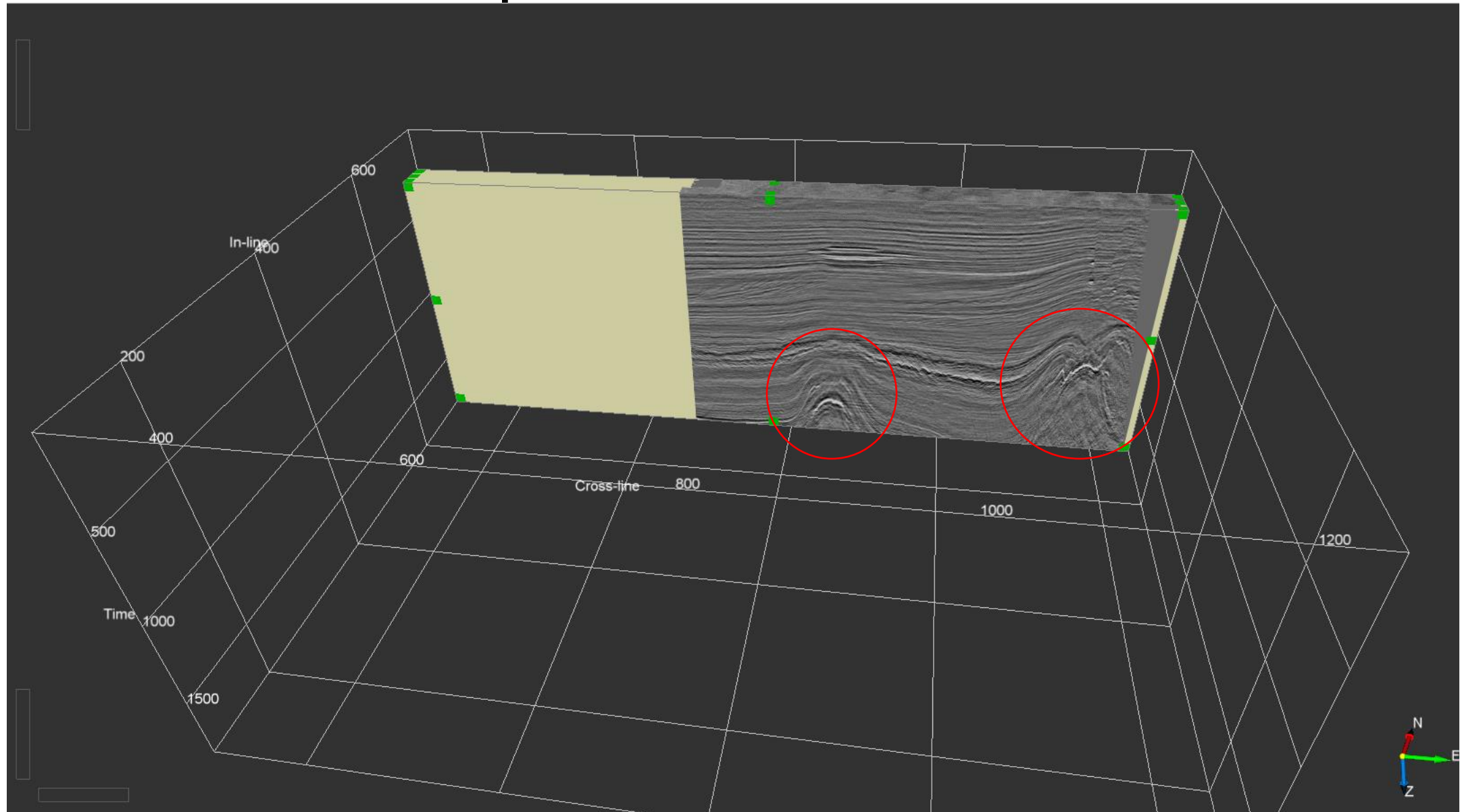
Turbiditos ??

Ruídos

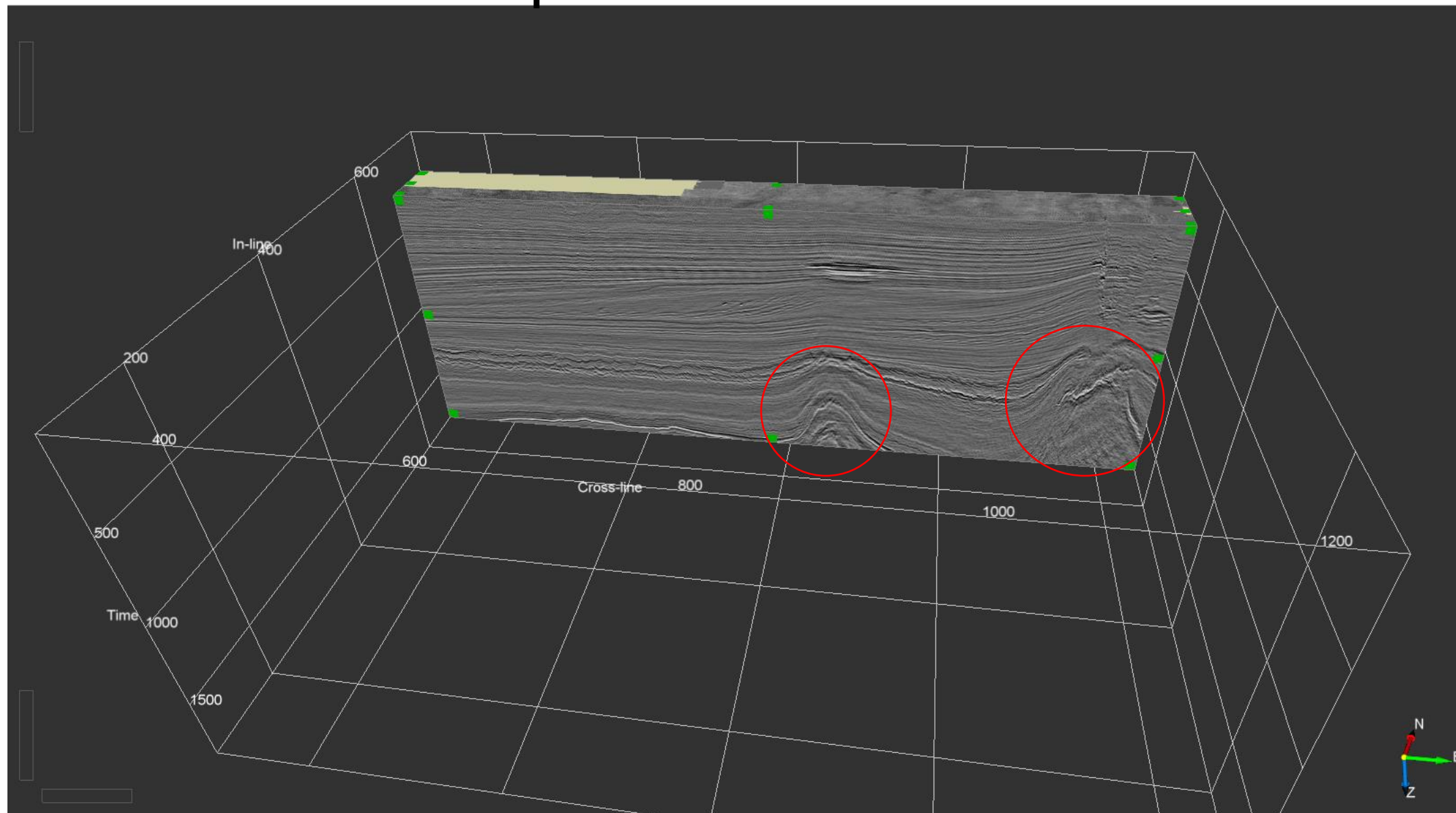
Fácies caóticas



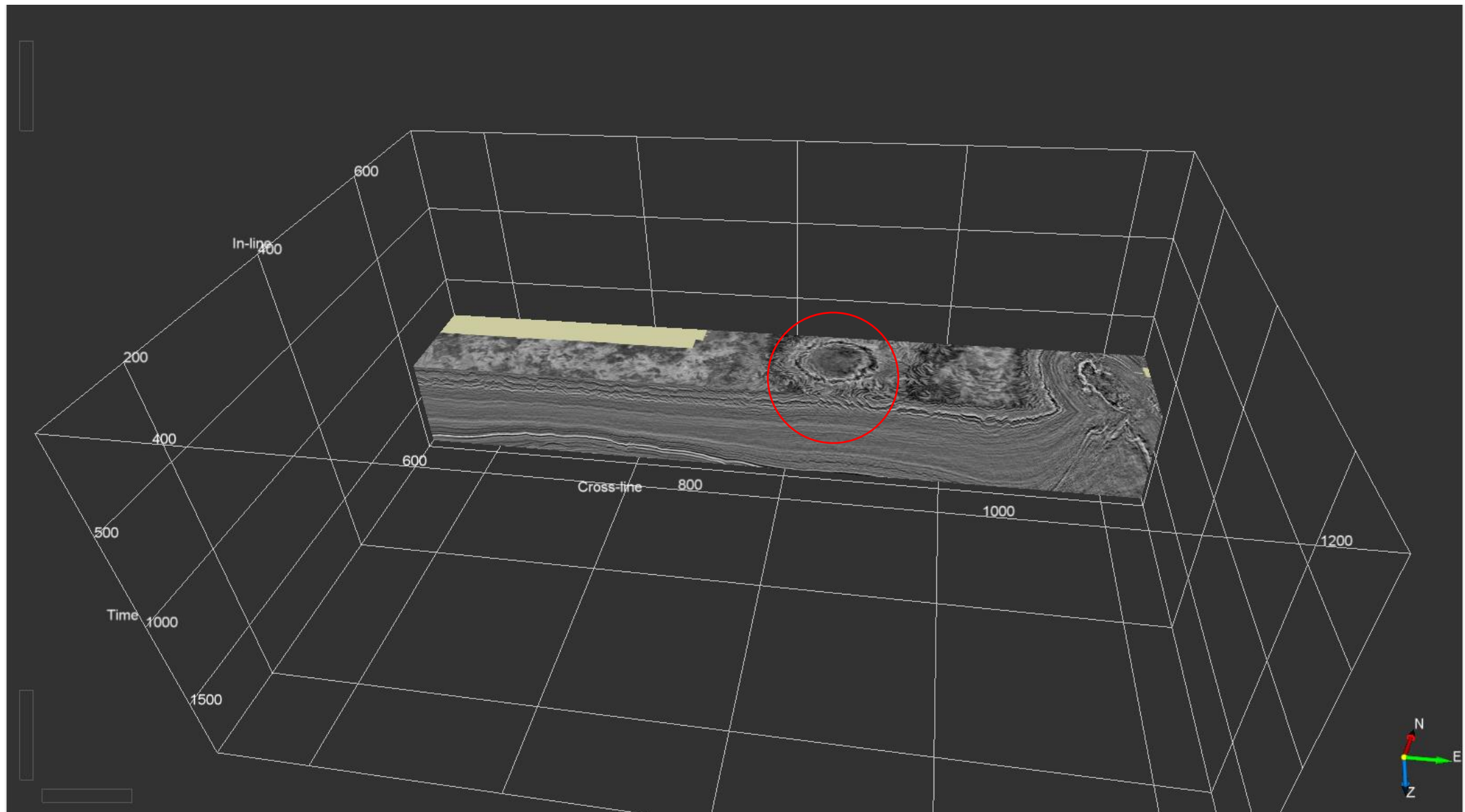
Busca por estruturas anticlinalis



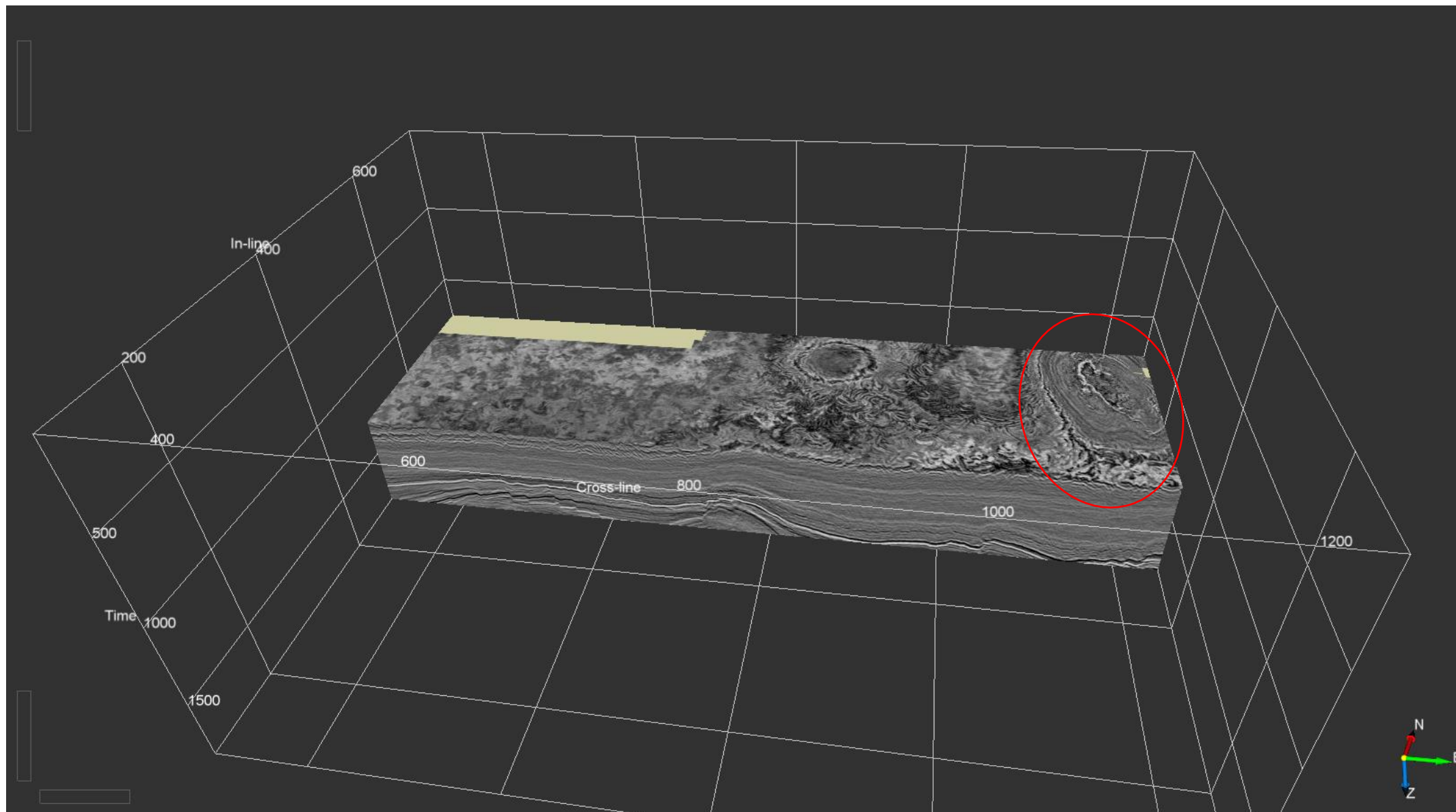
Busca por estruturas anticlinalis



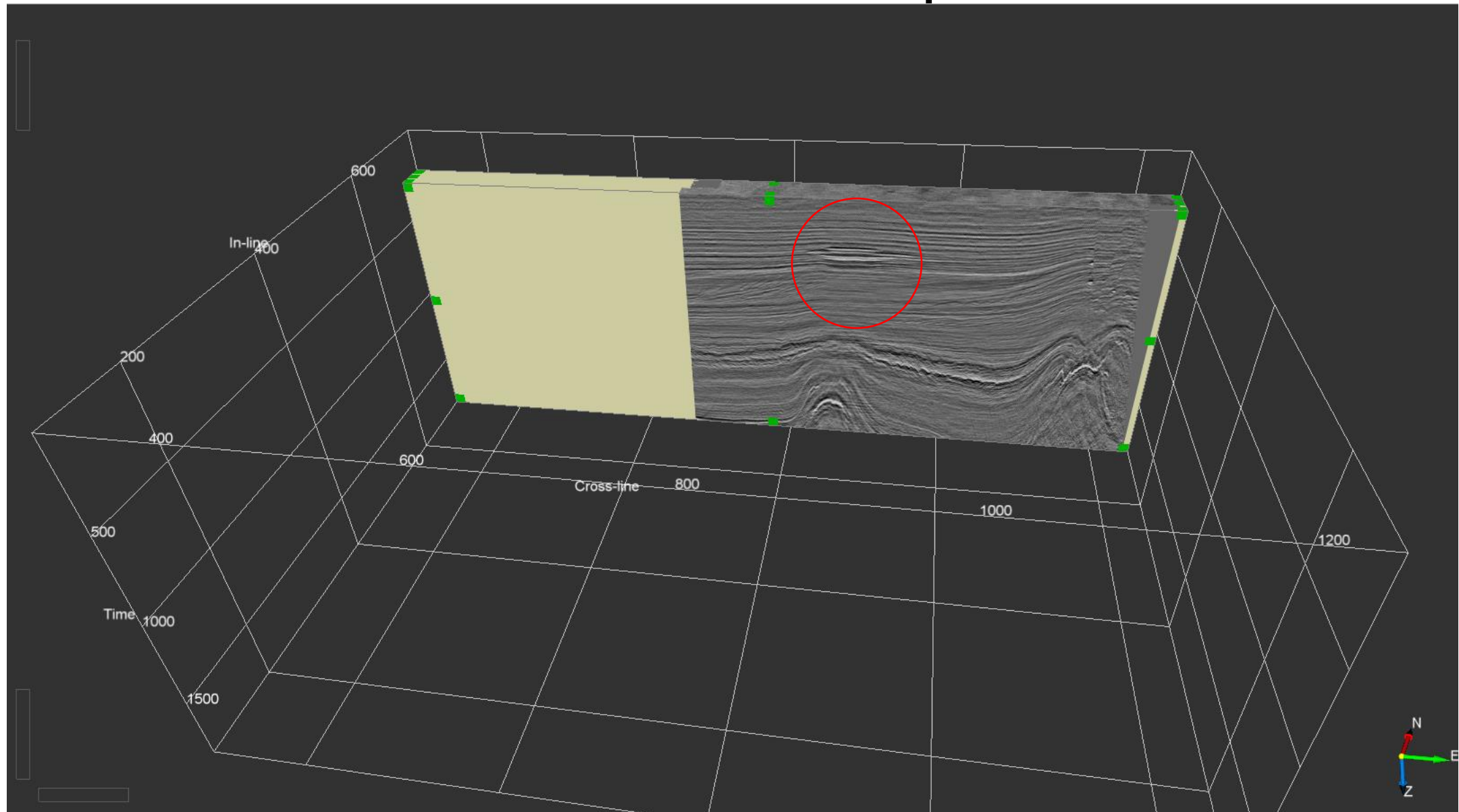
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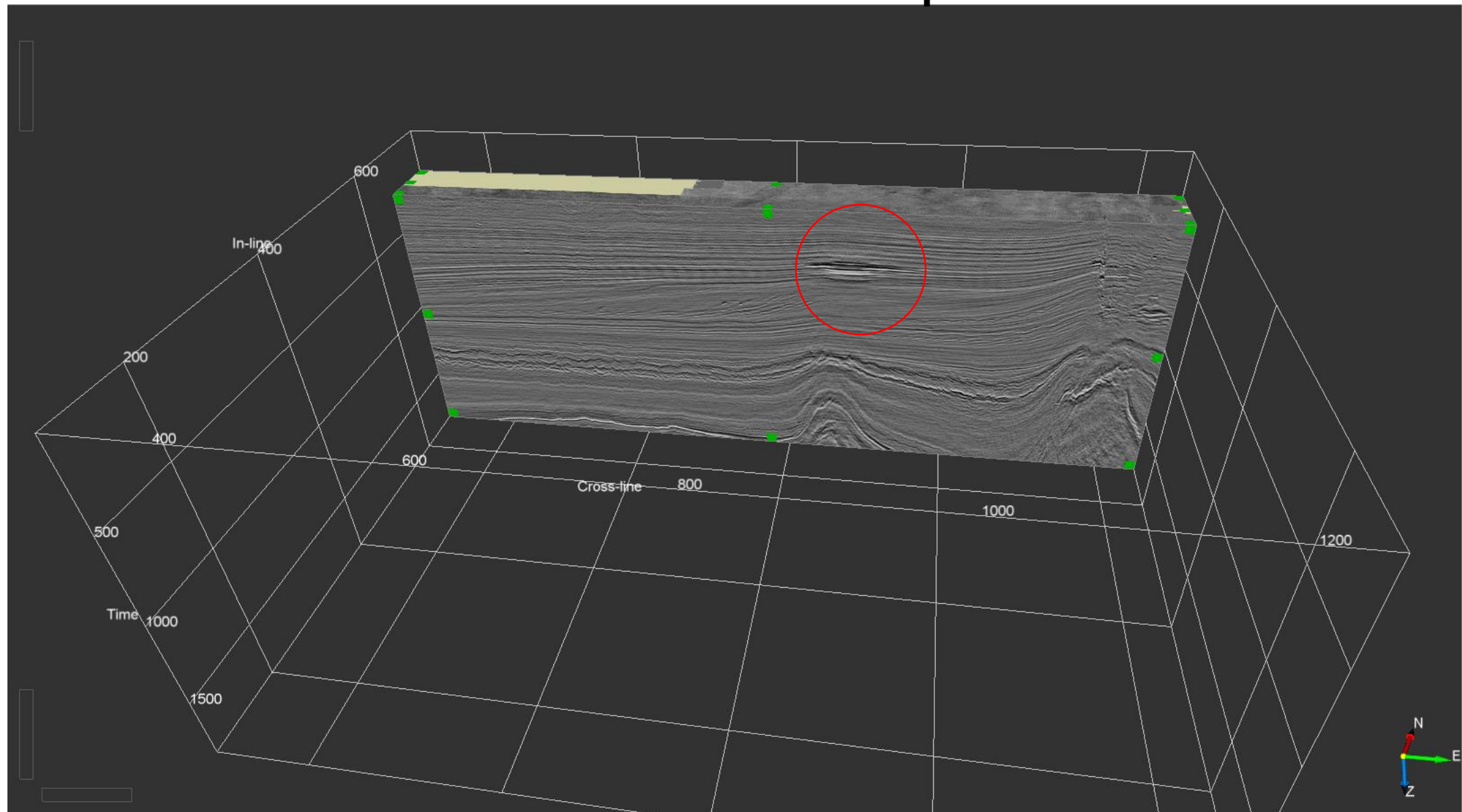
Busca por estruturas



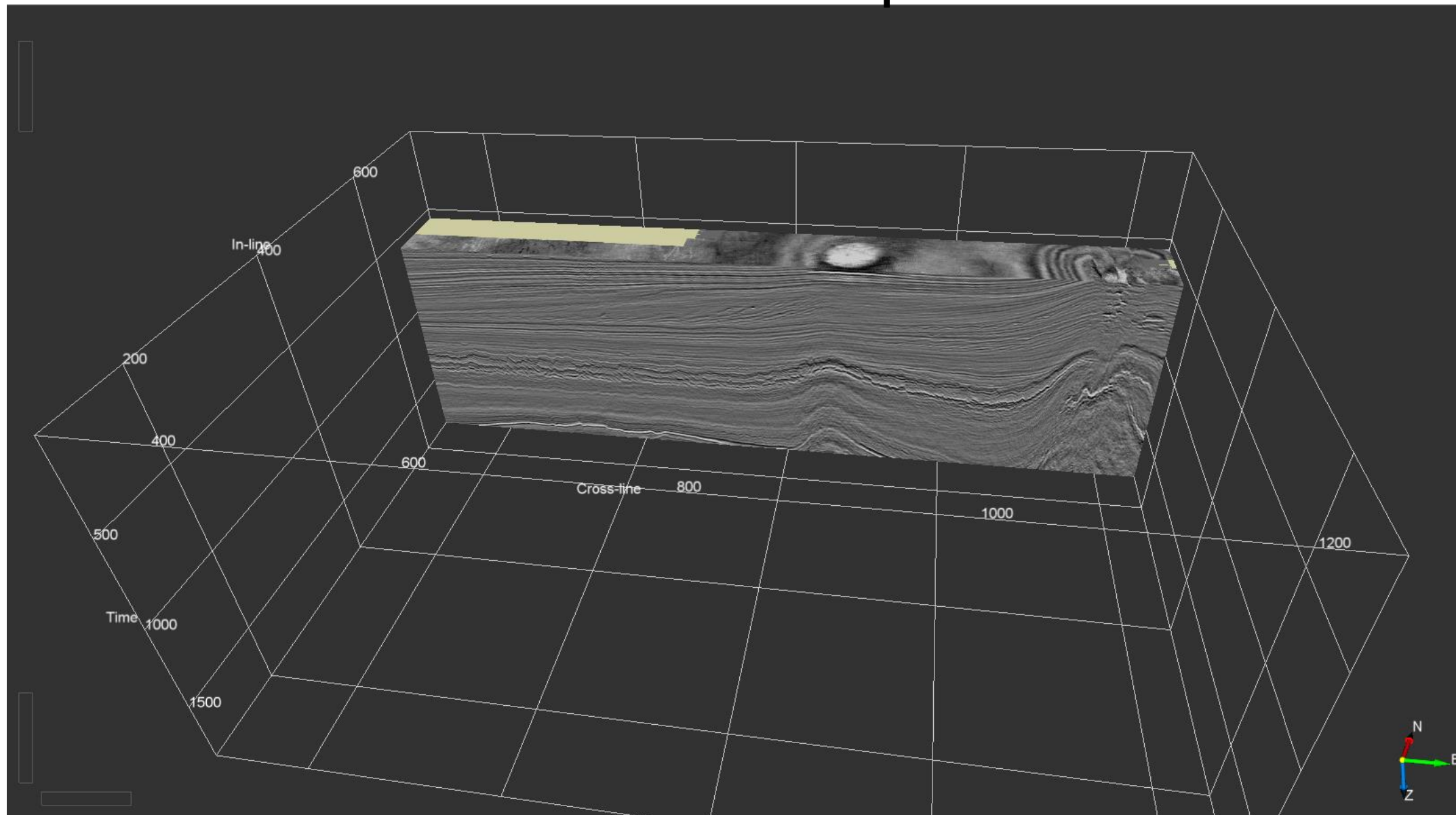
Anomalias de Amplitude



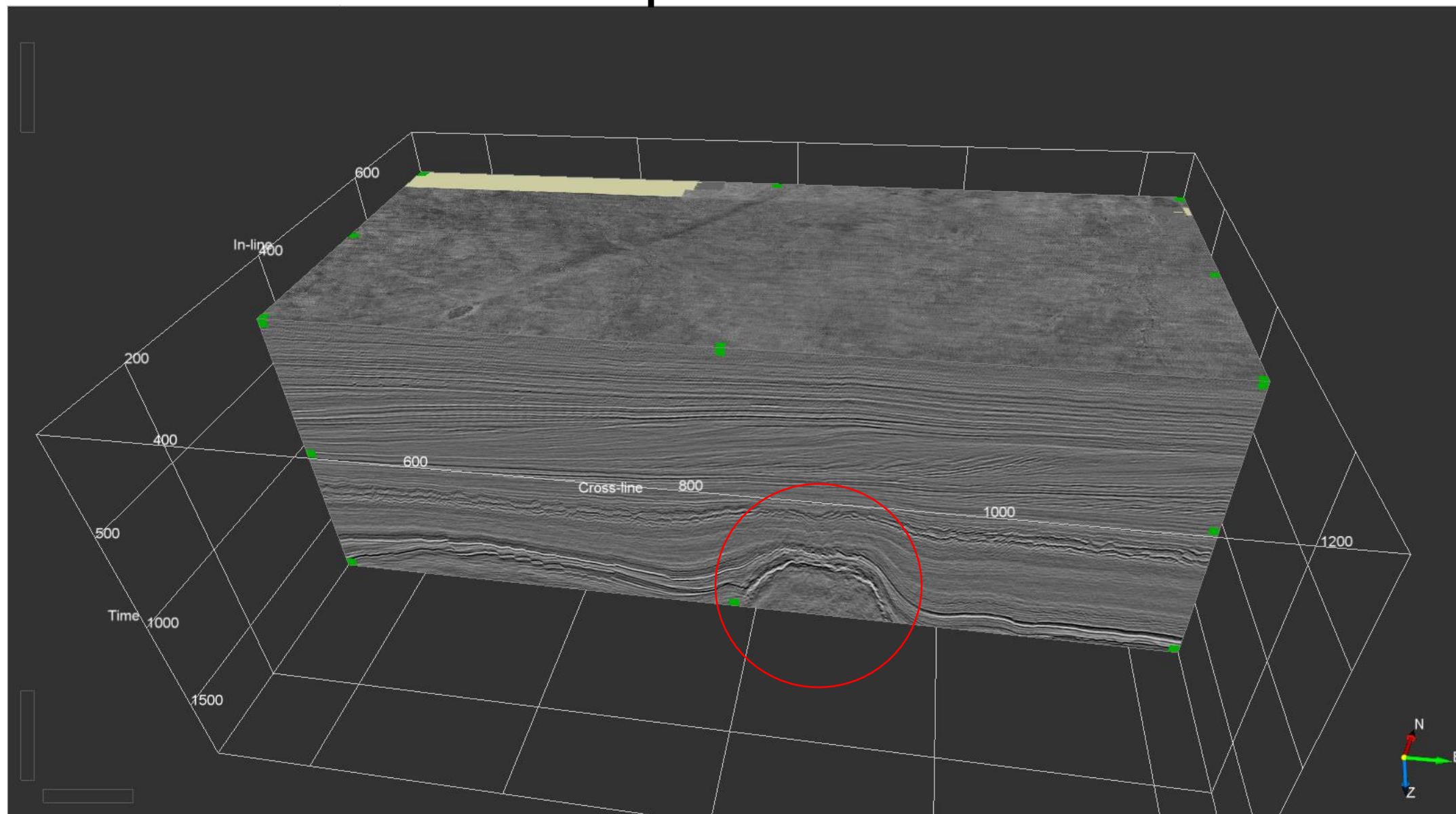
Anomalias de Amplitude



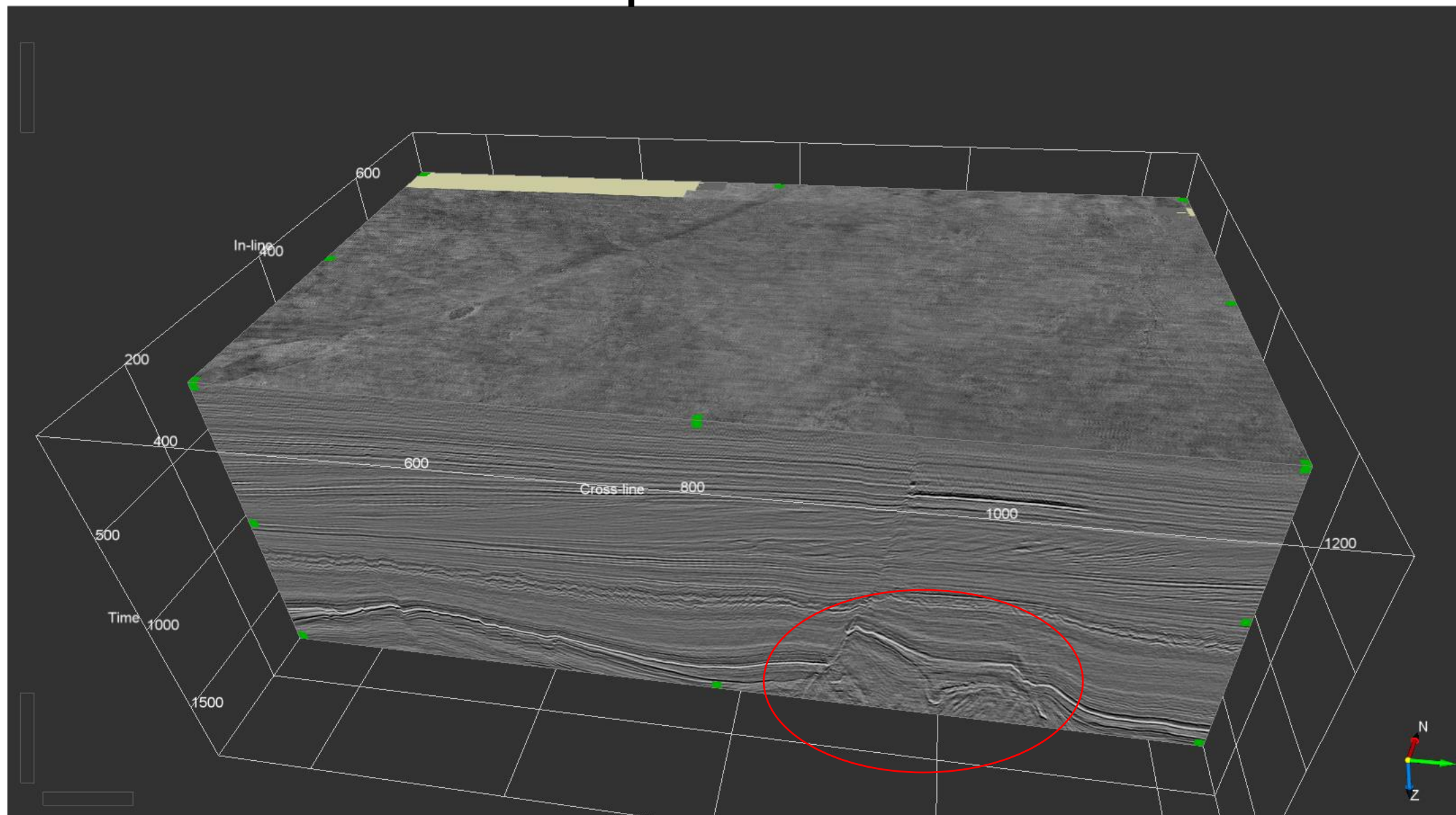
Anomalias de Amplitude



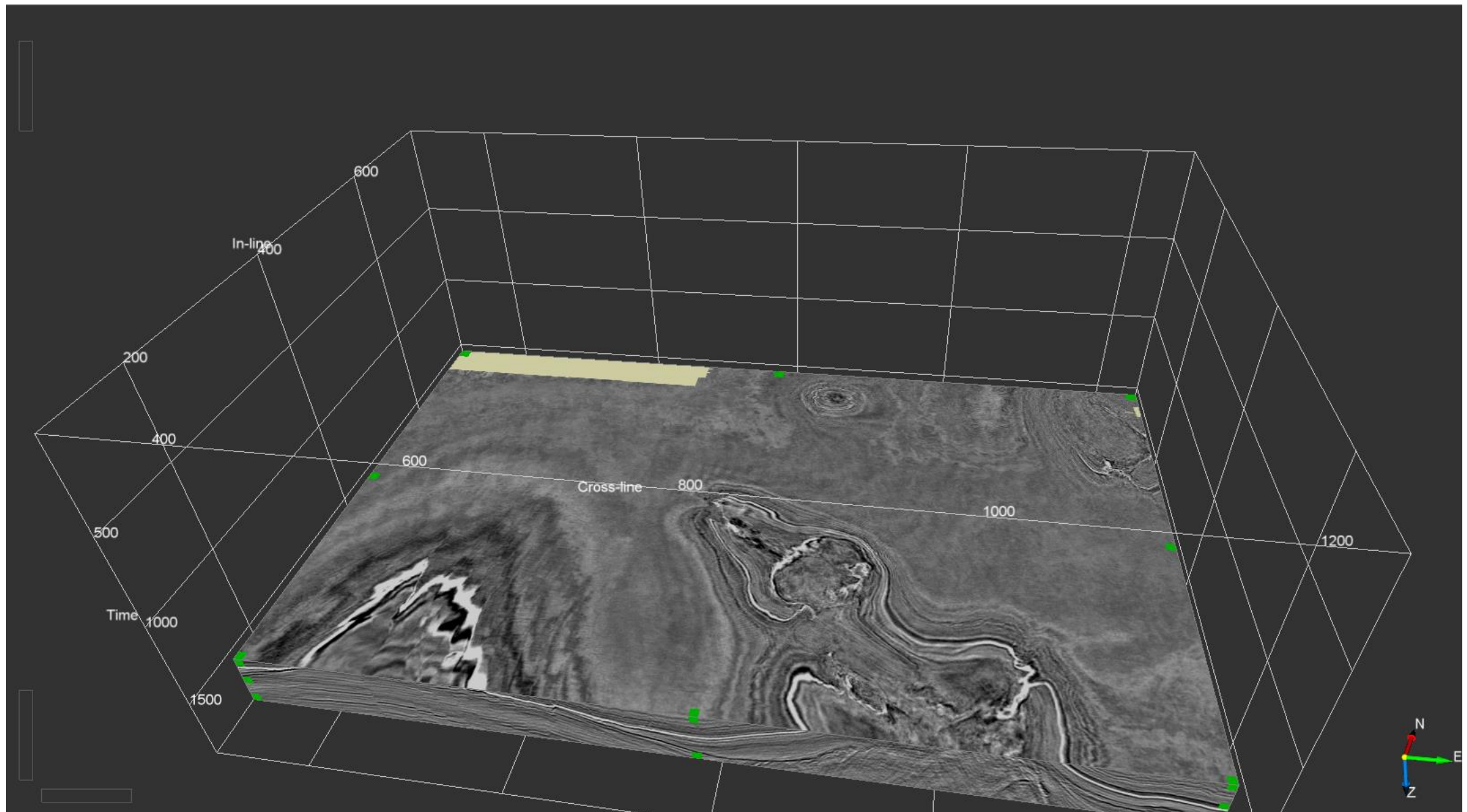
Busca por estruturas



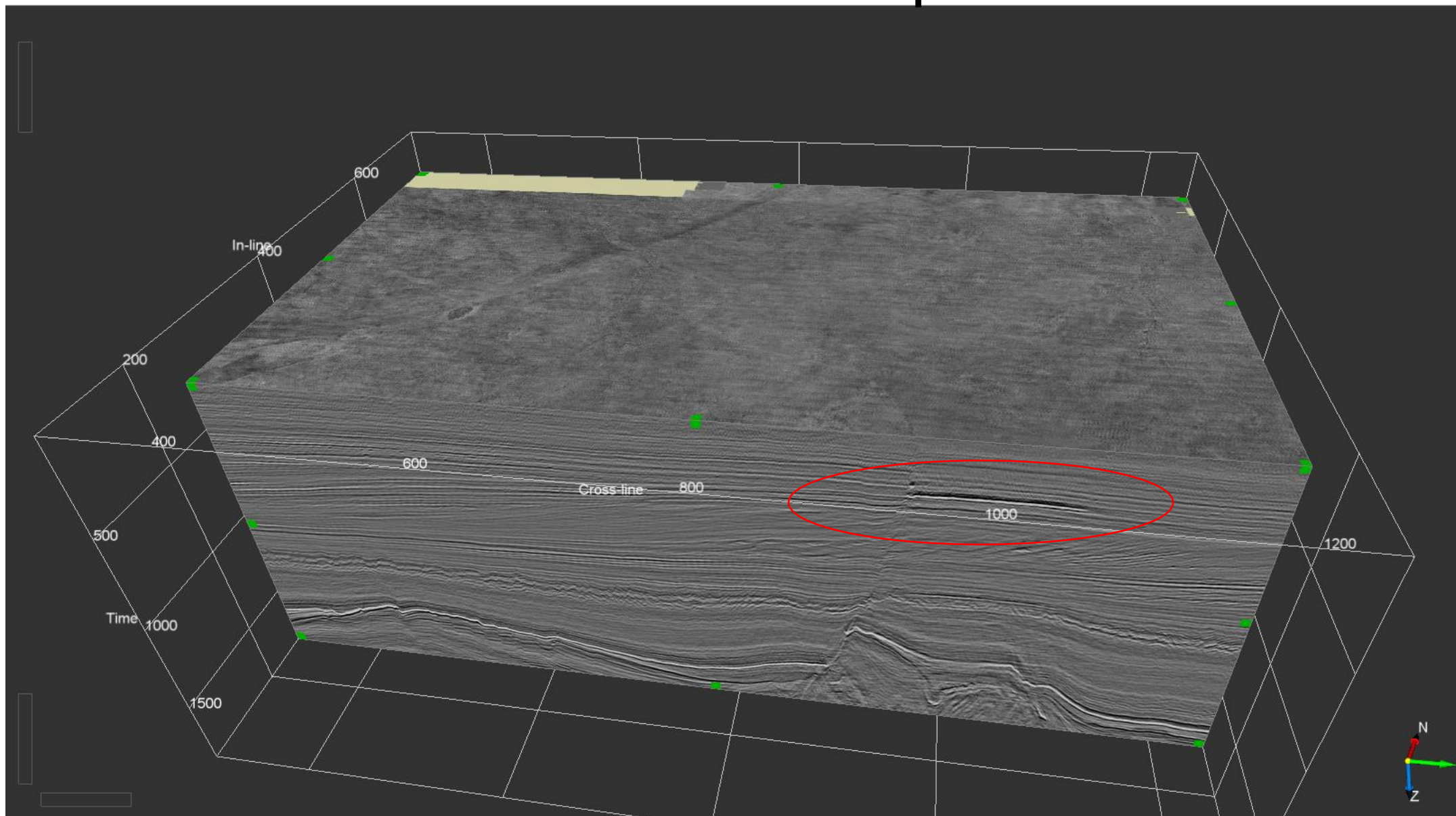
Busca por estruturas



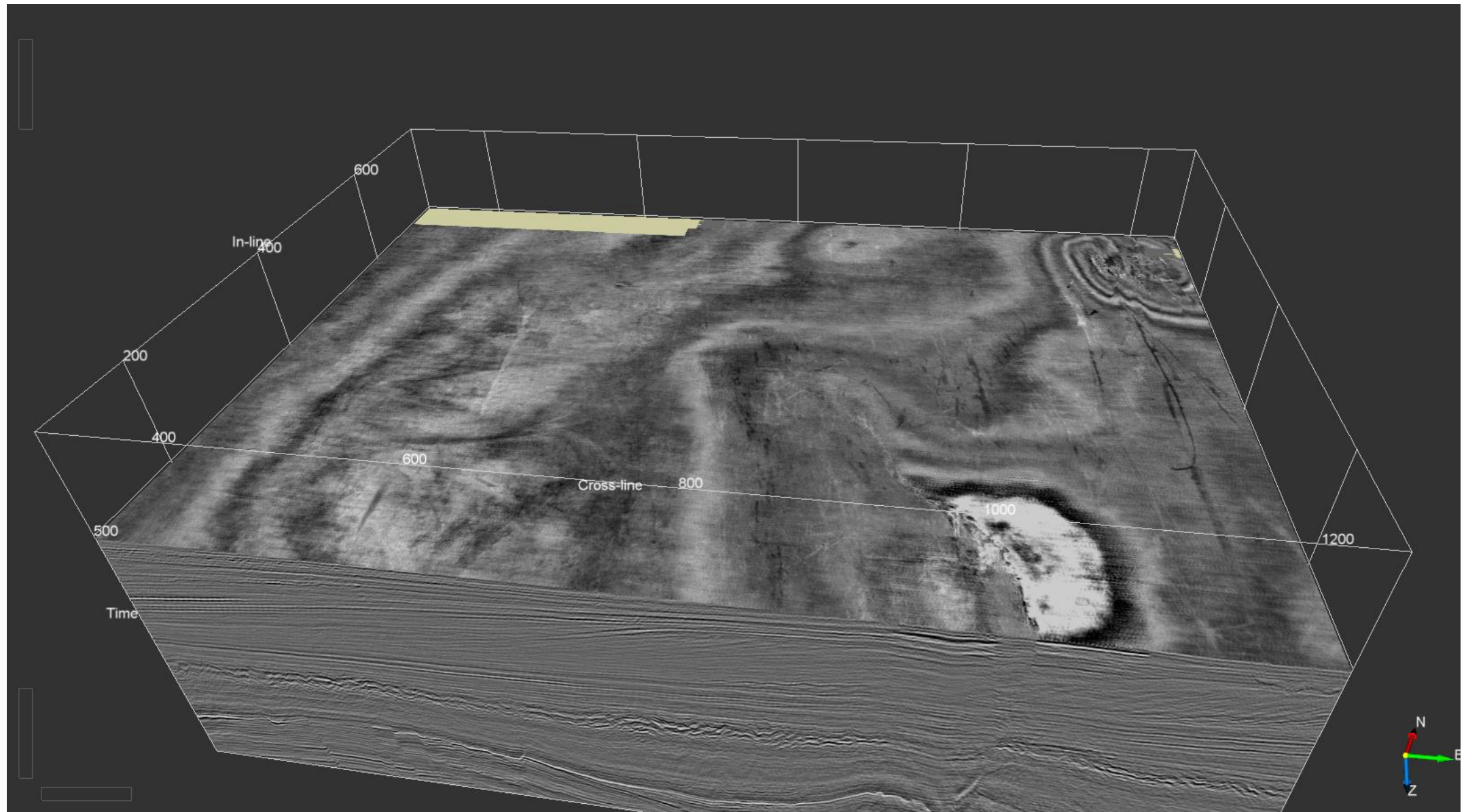
Busca por estruturas



Anomalias de Amplitude



Anomalias de Amplitude

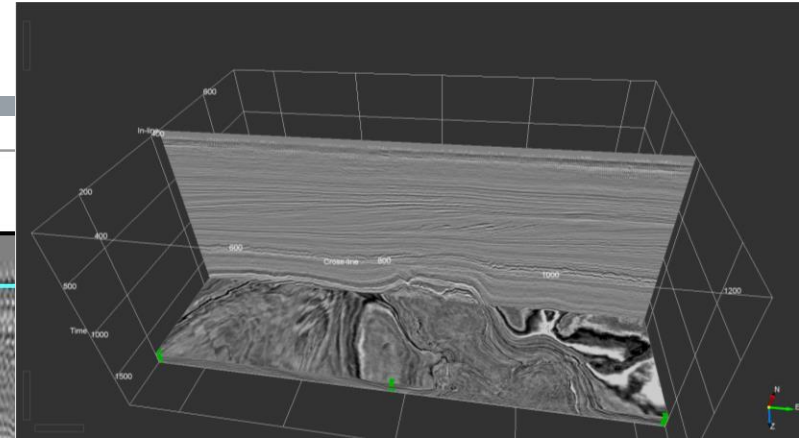
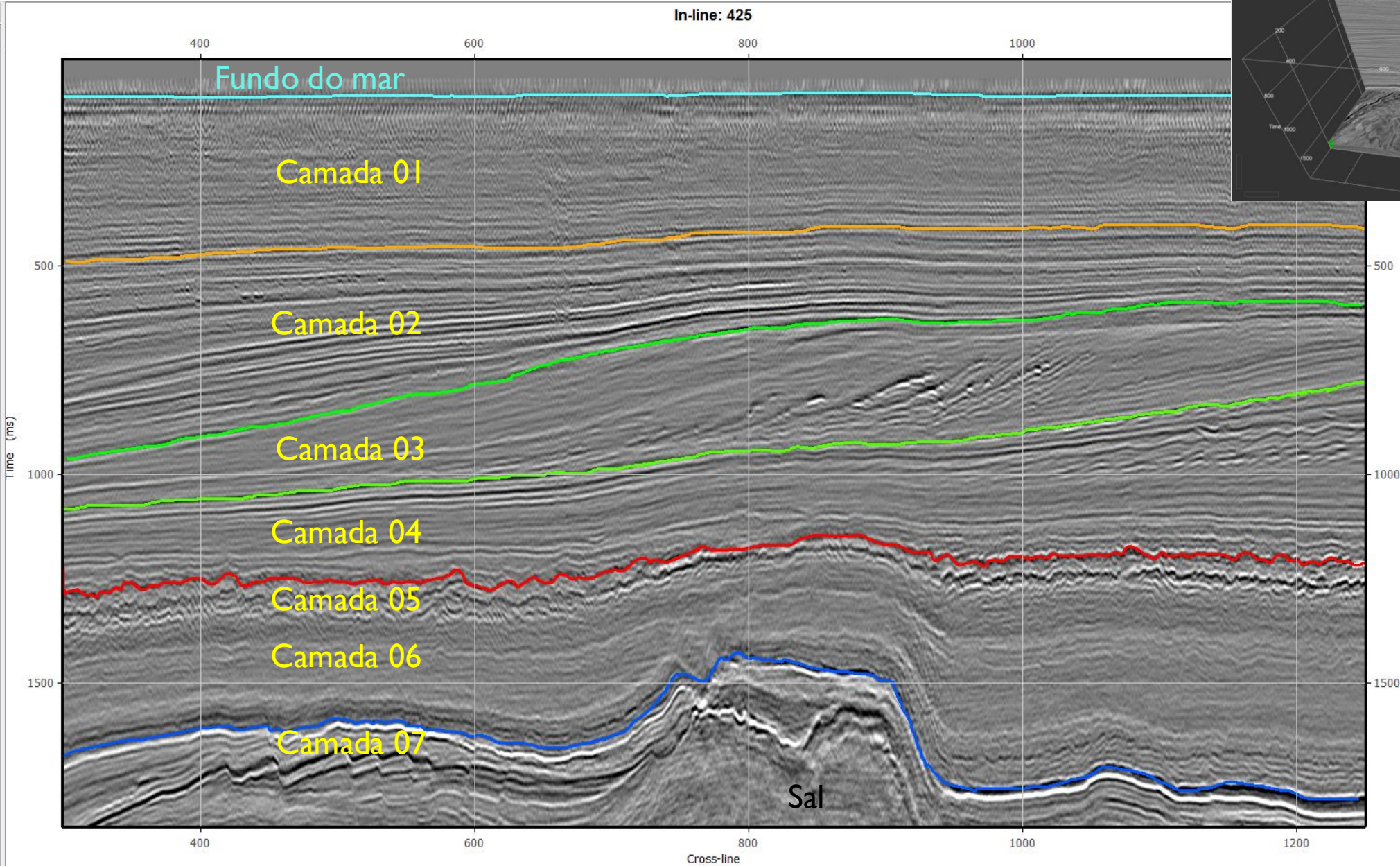




F3 Netherlands

Transporte de massa

Interpretação Sísmica 2D



Afogamento Crescente ?

Clima árido ?

7- Carbonatos
6 - Folhelhos e areias ?

5 - Caóticos

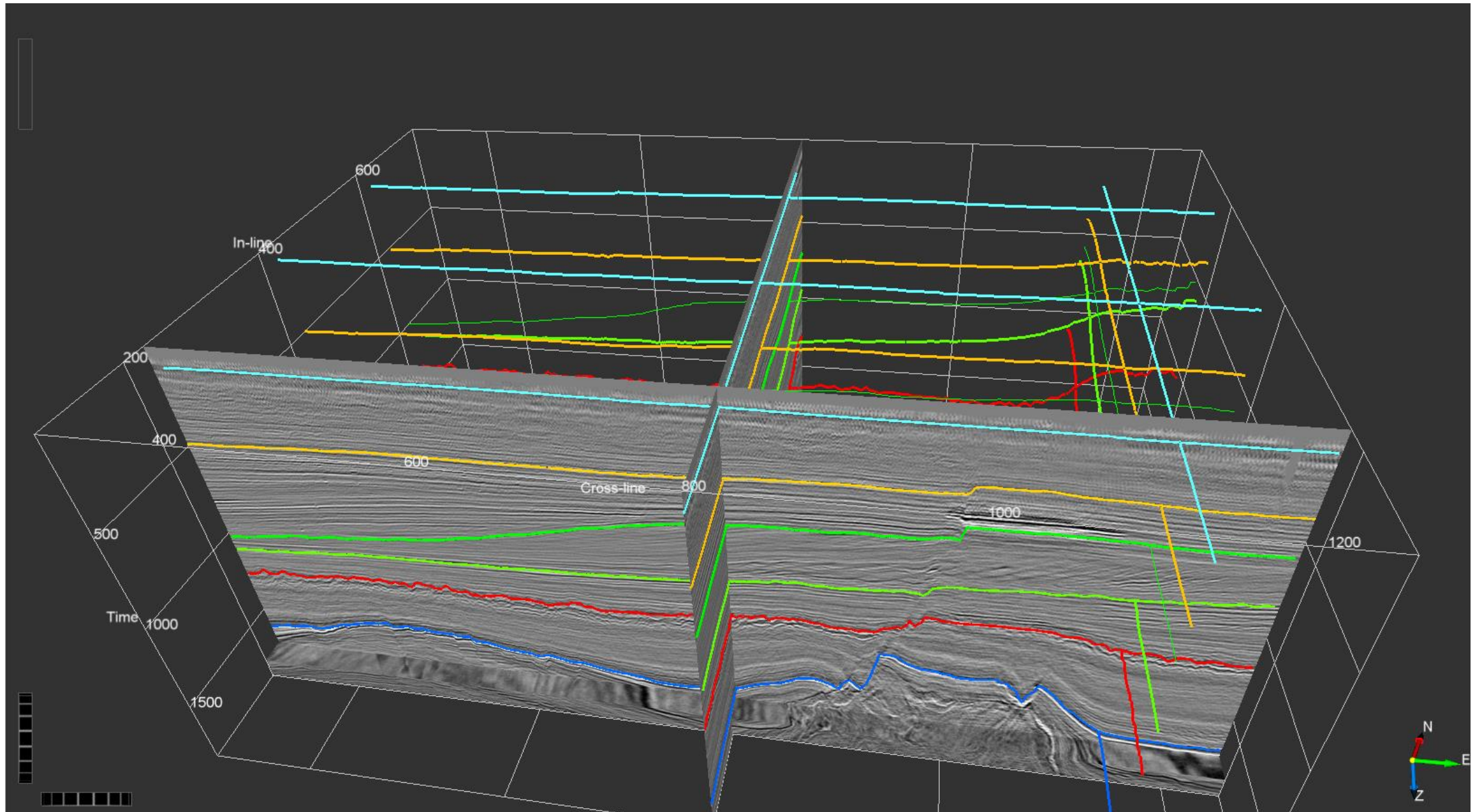
4 - Folhelhos e areias

3 - Clinoformas

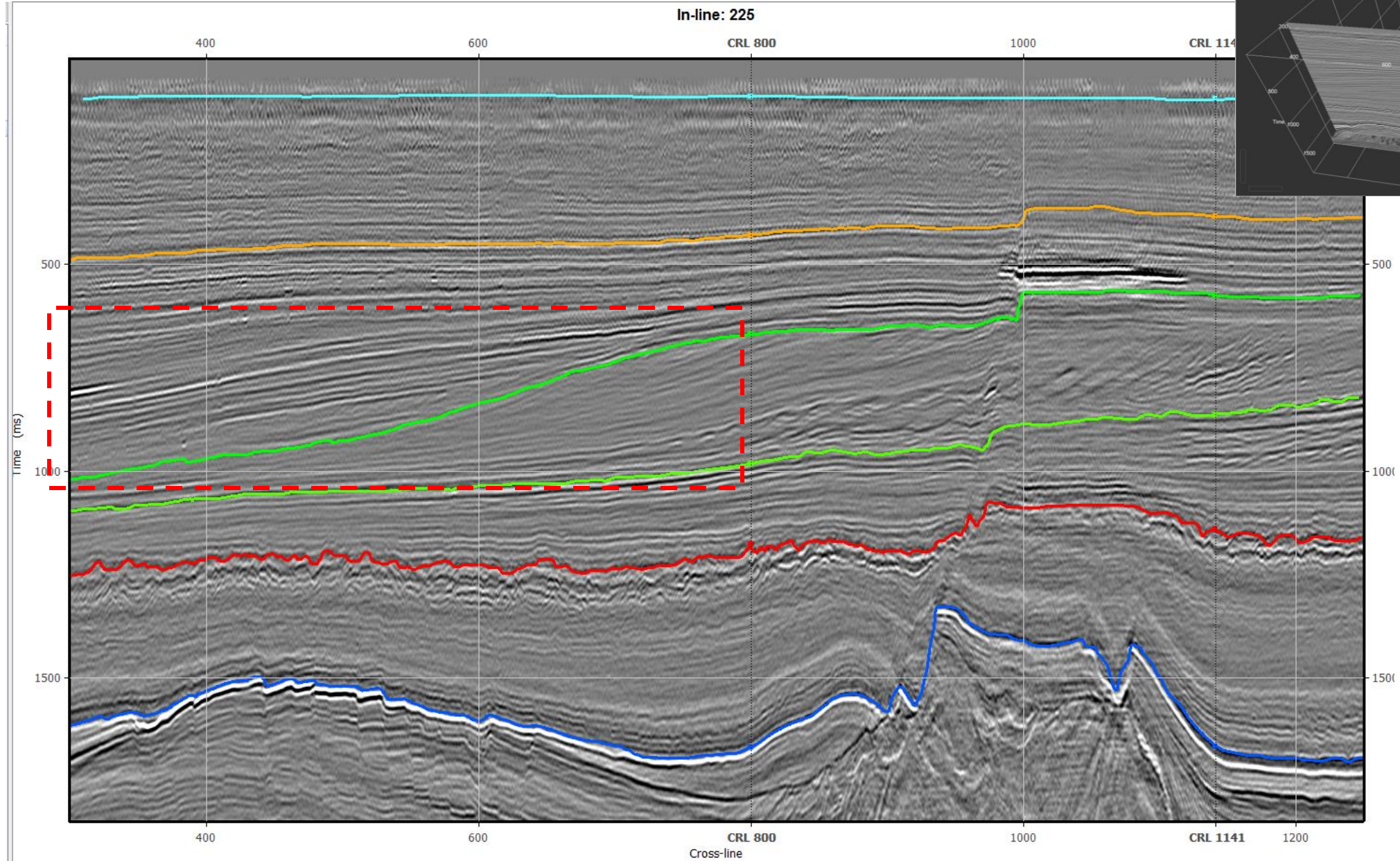
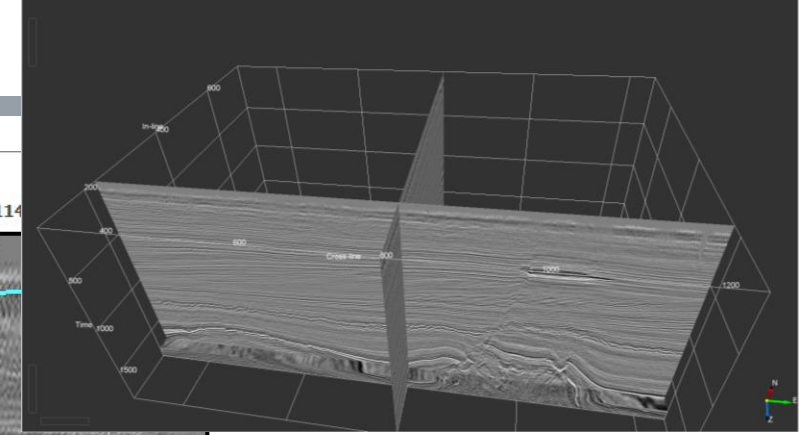
2 - Sub- paralelos

1 - Sedimentos finos siliciclásticos

Interpretação Sísmica 3D

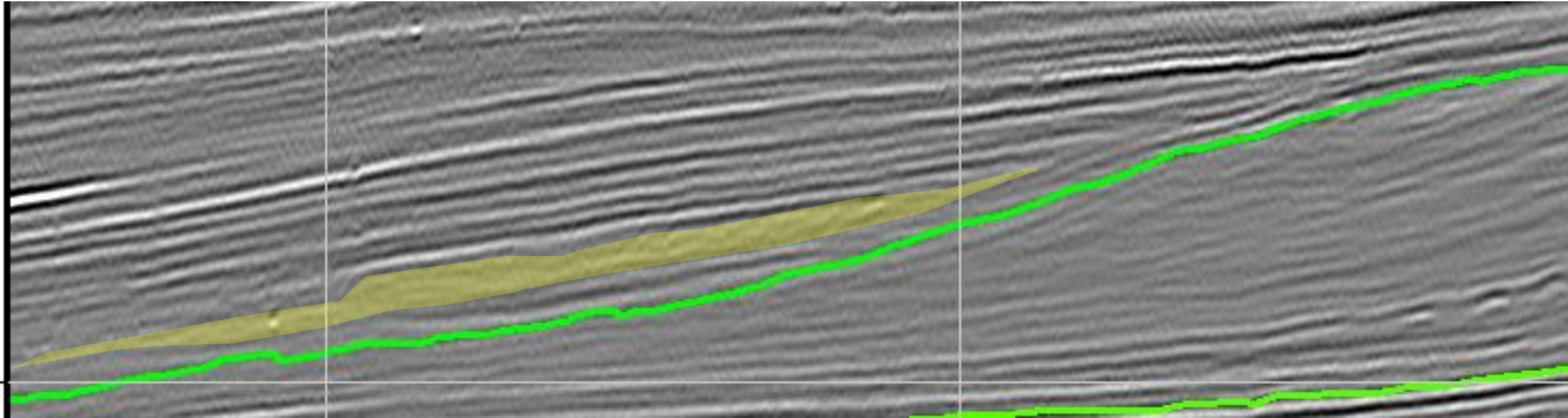


Interpretação Sísmica 2D (detalhe)



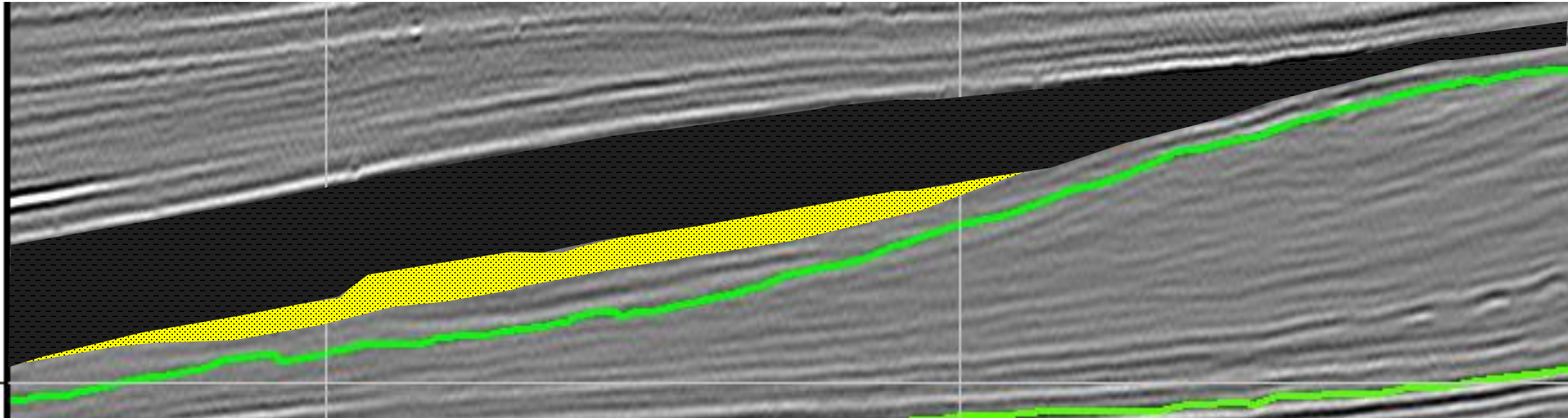
In-line 225

Turbidito ? Fan delta ?



Distância = 200 in-lines
~200 x 25m = 5 Km

A camada superior é selante ?



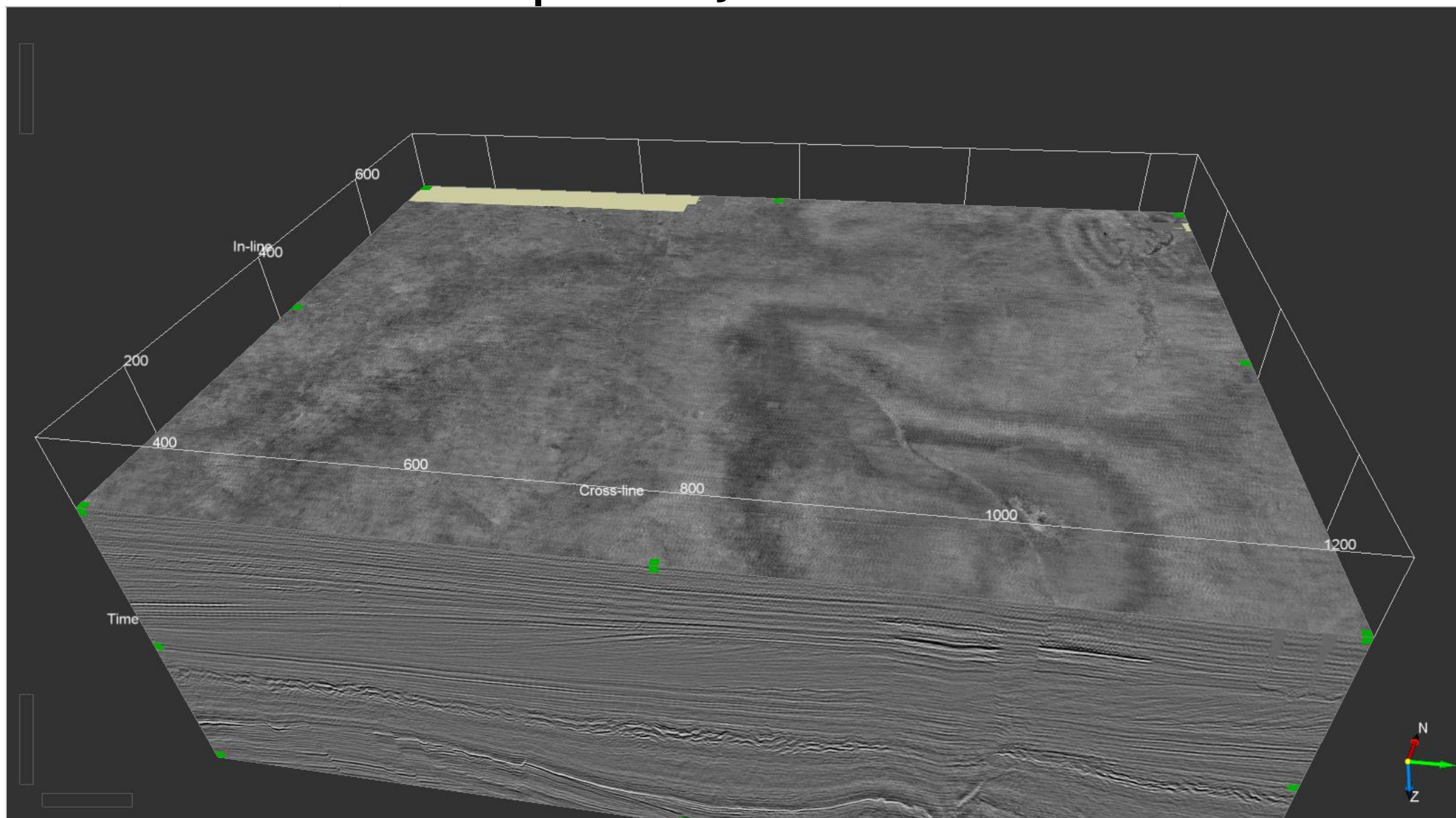
Distância de 200 in-lines
~200 x 25m = 5 Km



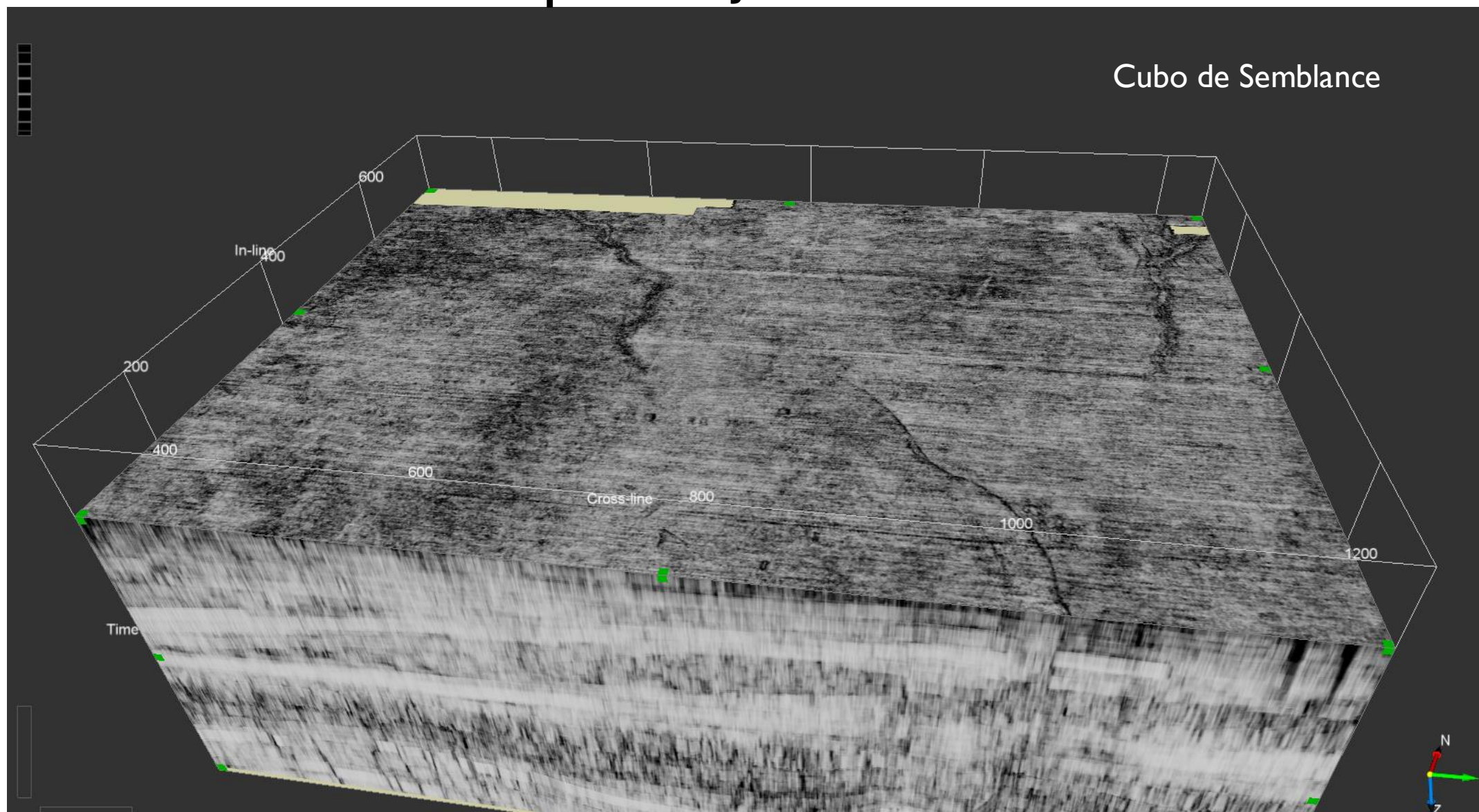
F3 Netherlands

Canais

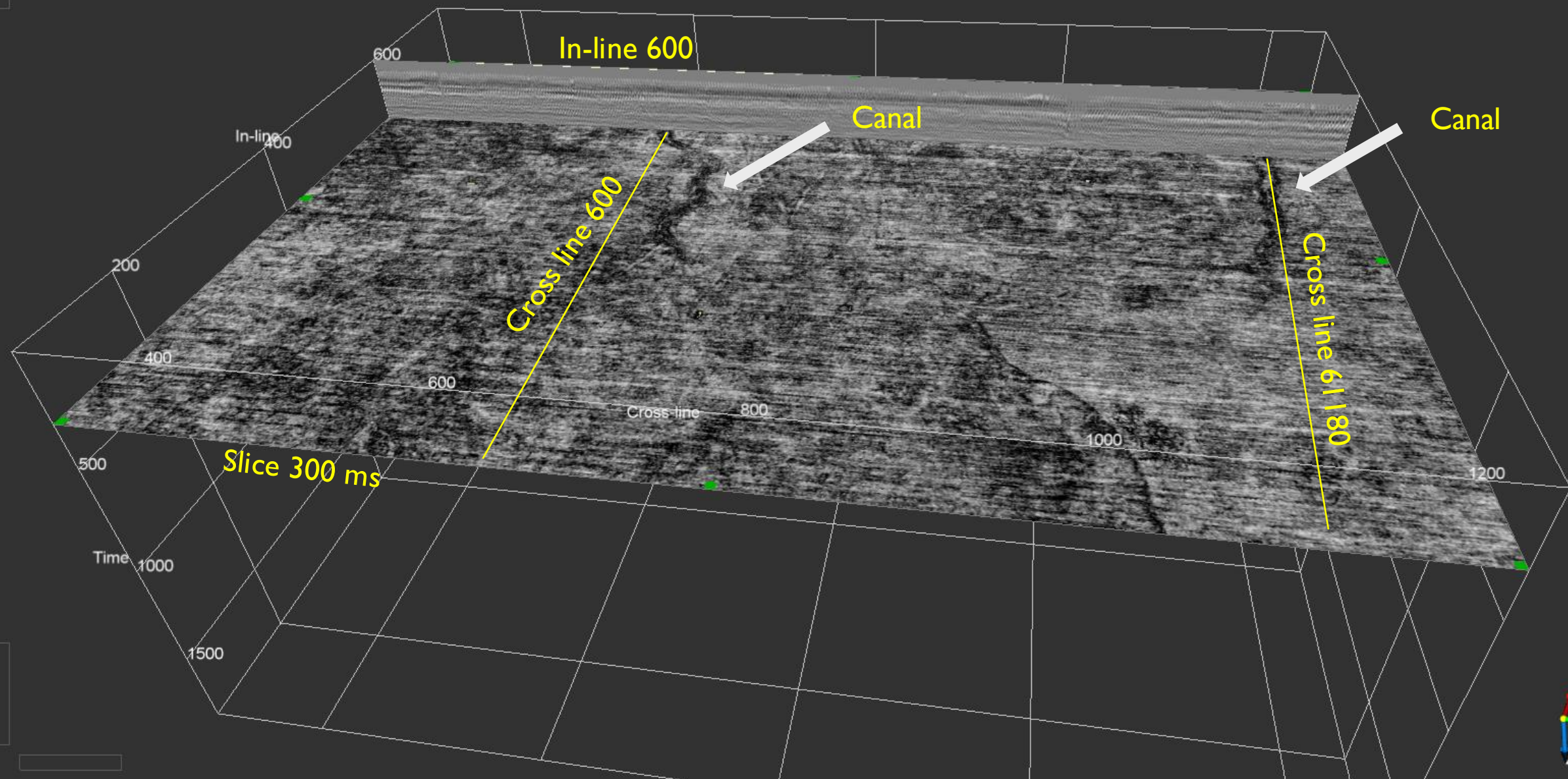
Busca por feições de canais



Busca por feições de canais



Canais



Canais

In-line: 600

600

CRL 800

CRL 885

1000

CRL 1181

Canal

Canal

300 ms

500

500

1000

1000

1500

1500

600

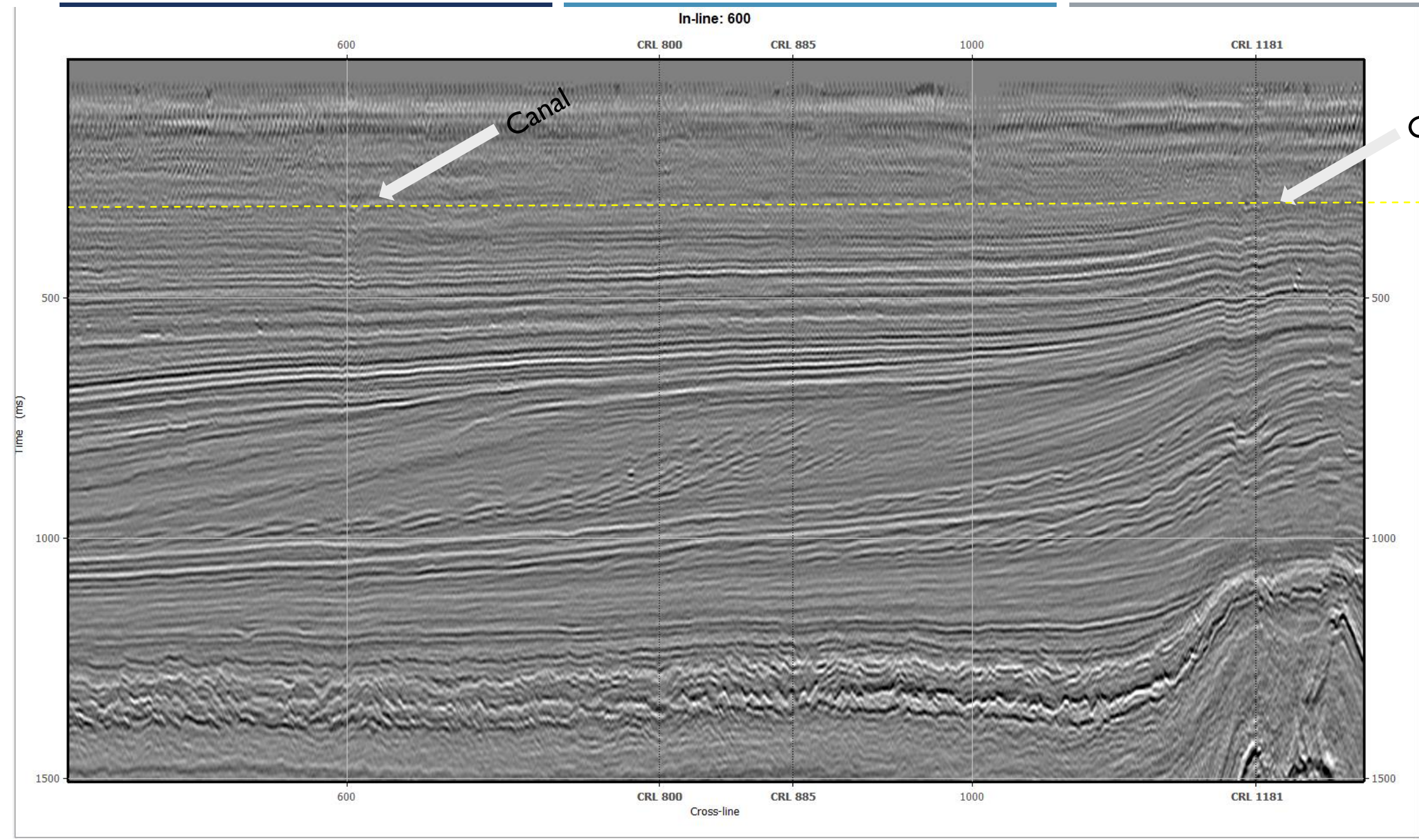
CRL 800

CRL 885

1000

CRL 1181

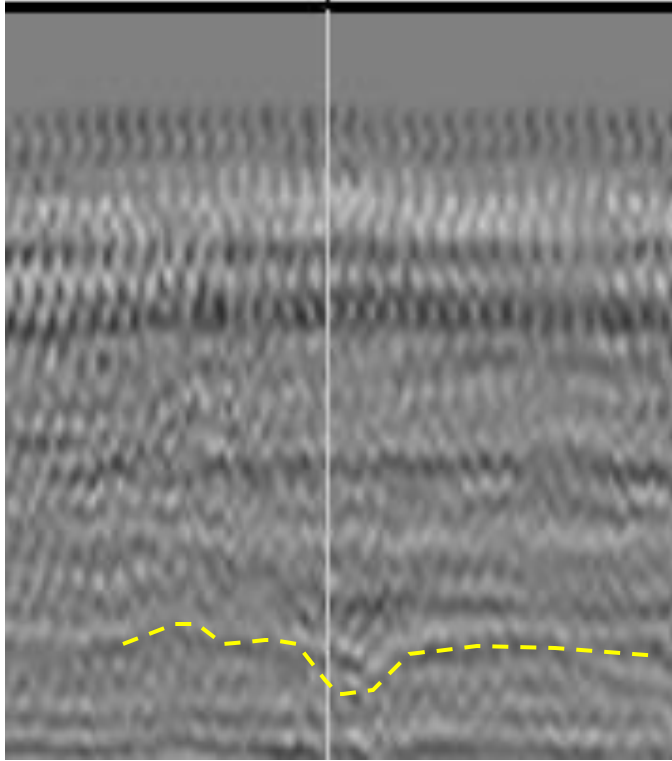
Cross-line



Canais

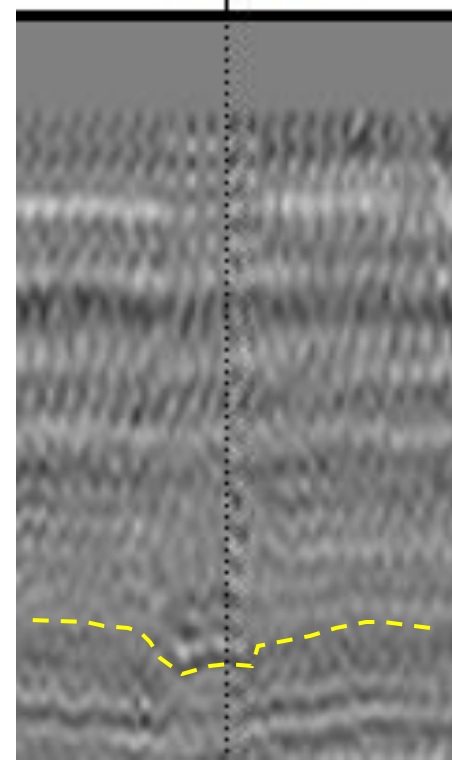
600

Inline 600



CRL 1181

Inline 600

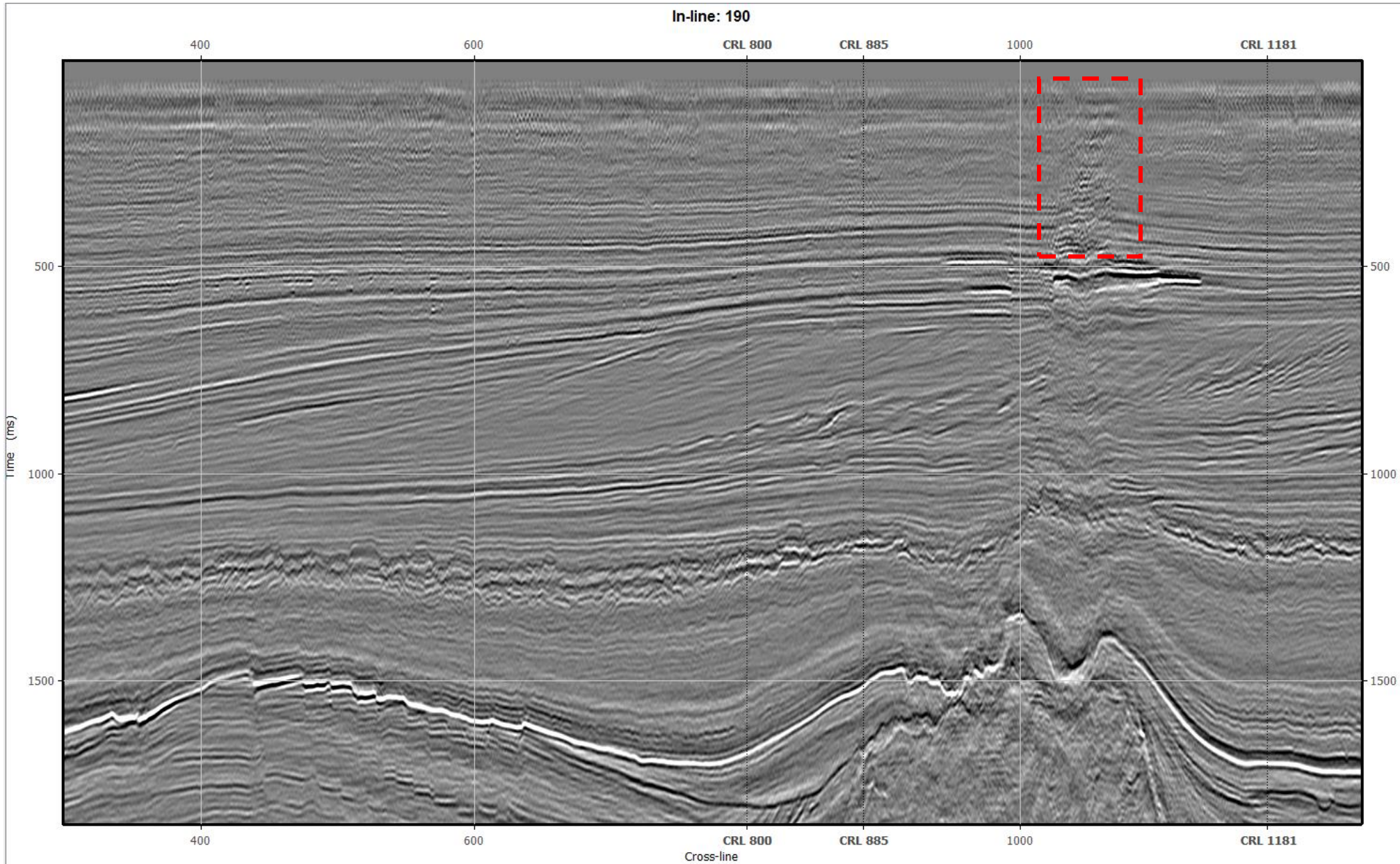




F3 Netherlands

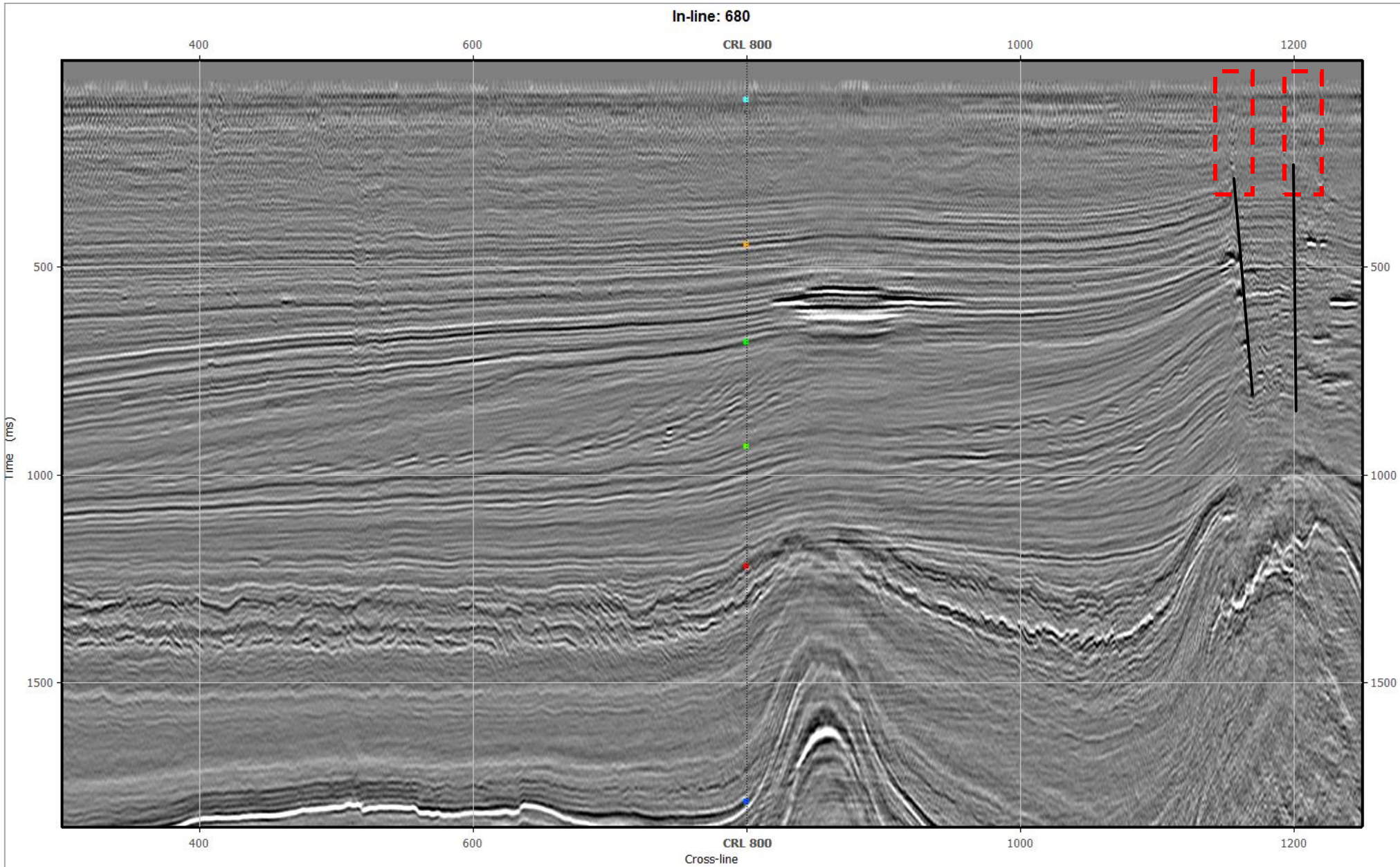
Chaminé de Gás

Chaminé de Gás



In-line 190

Chaminé de Gás



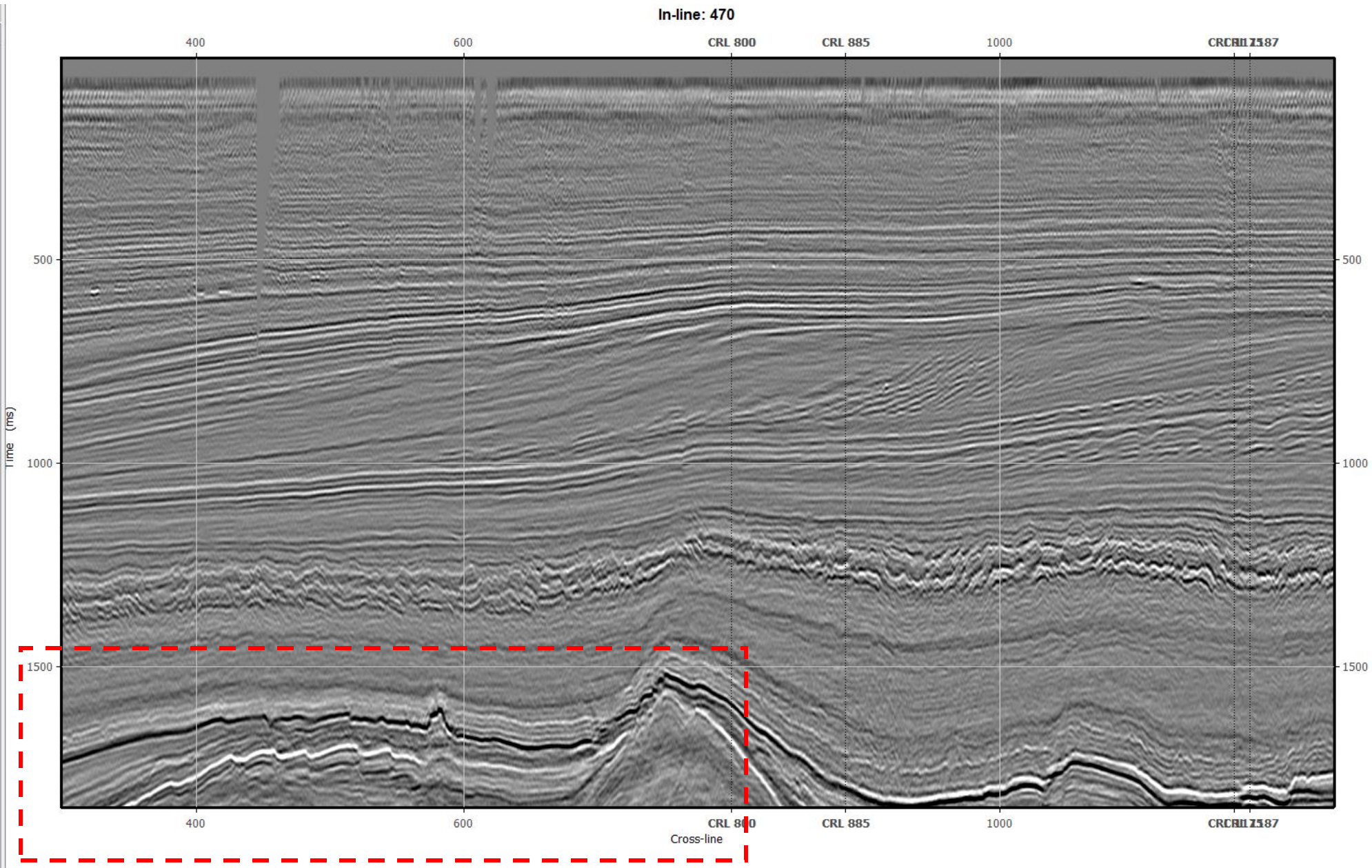
In-line 680



F3 Netherlands

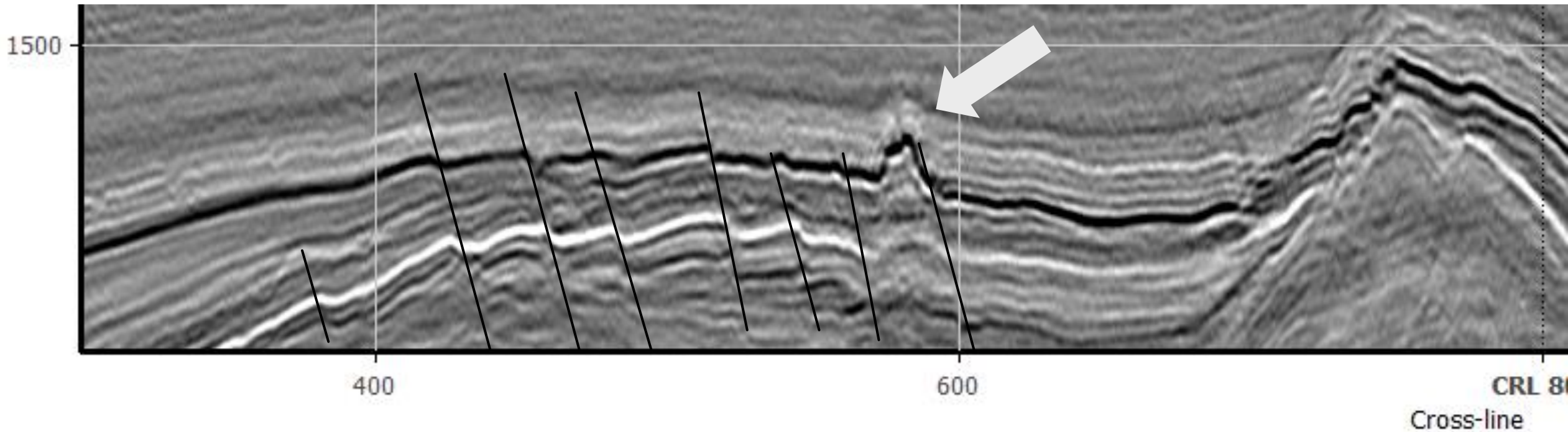
Build ups
Fácies Carbonáticas

Carbonatos

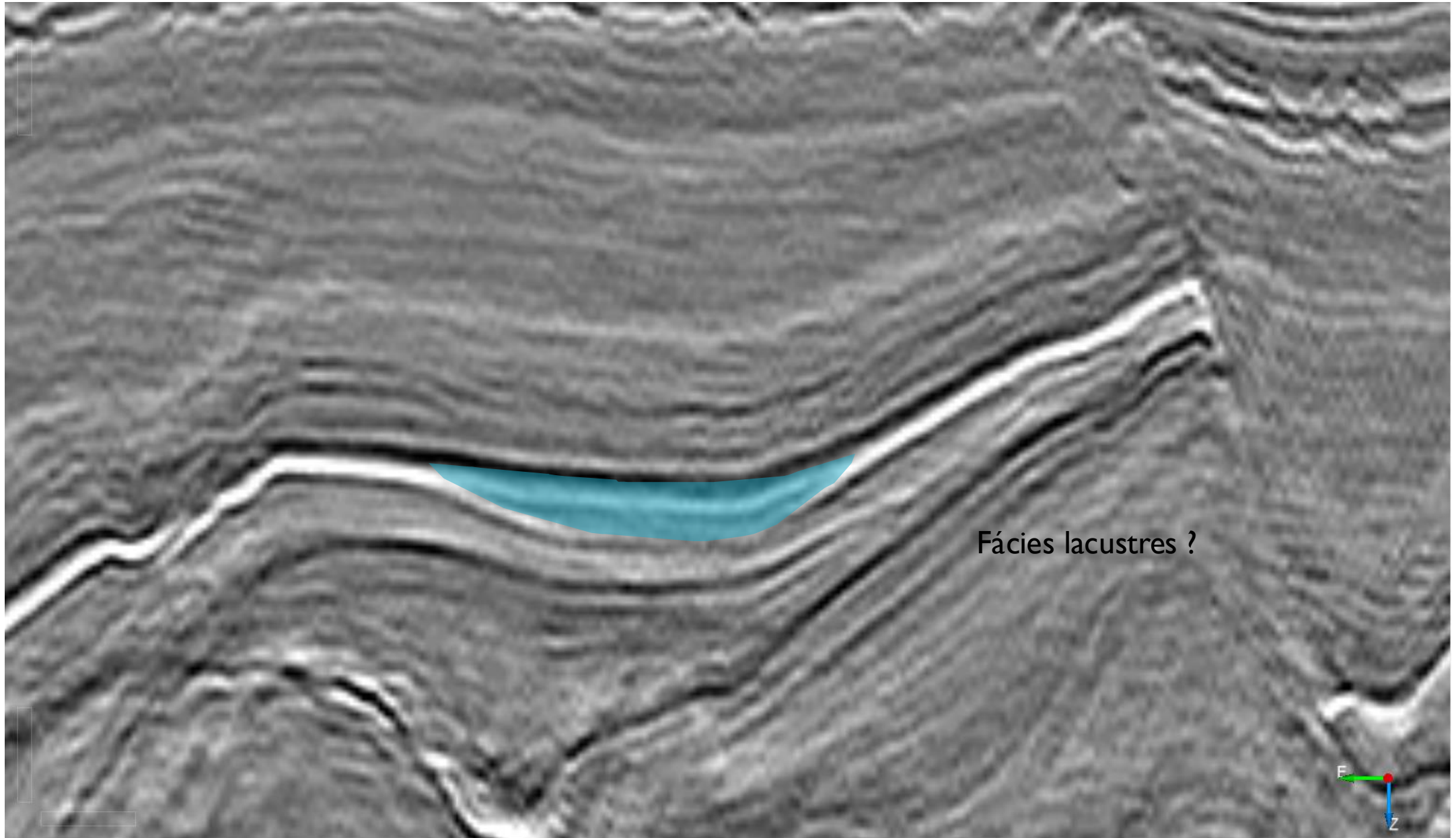


In-line 470

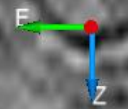
Build up carbonatico ?

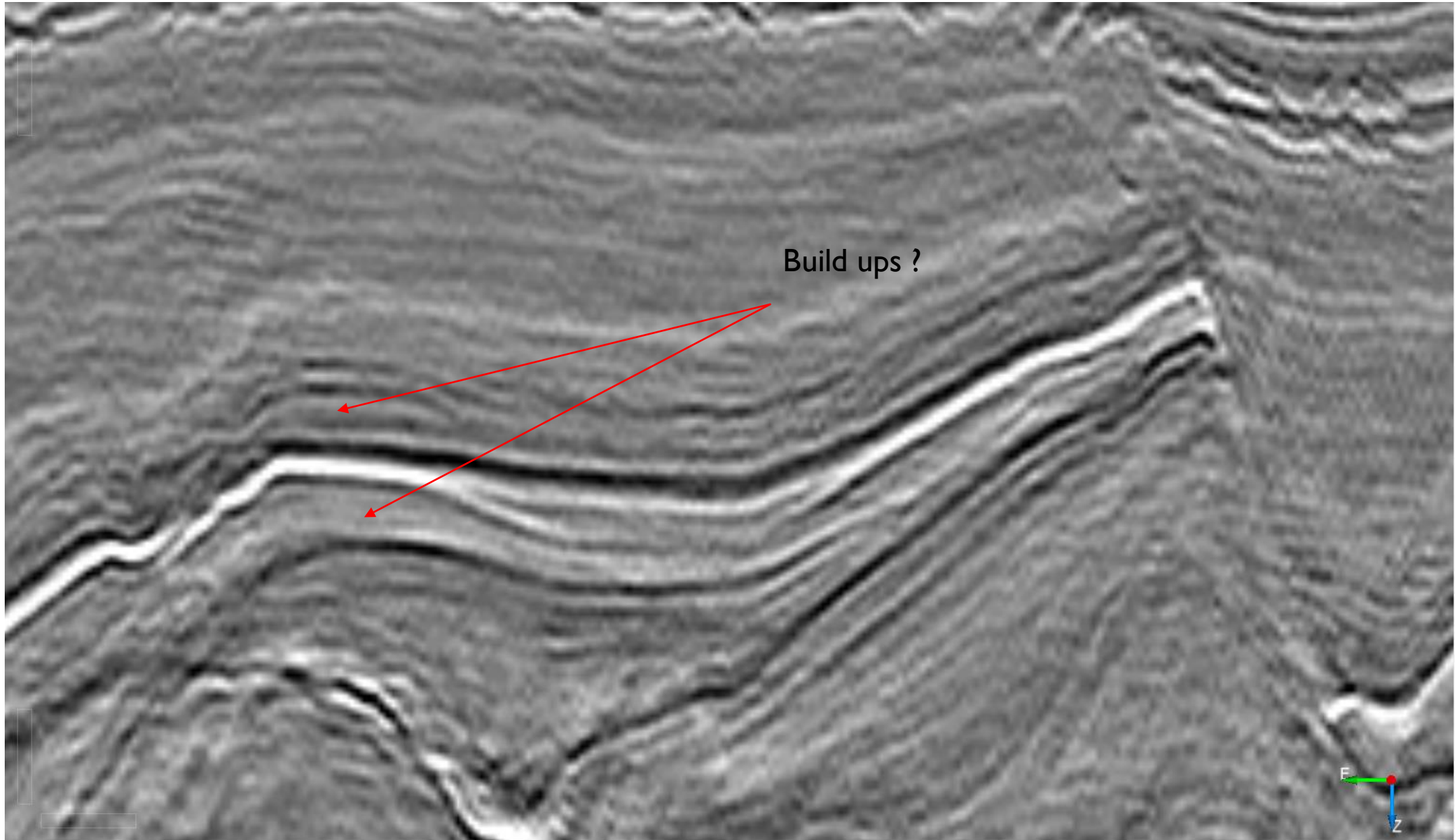


In-line 470



Fácies lacustres ?





Build ups ?

F
Z

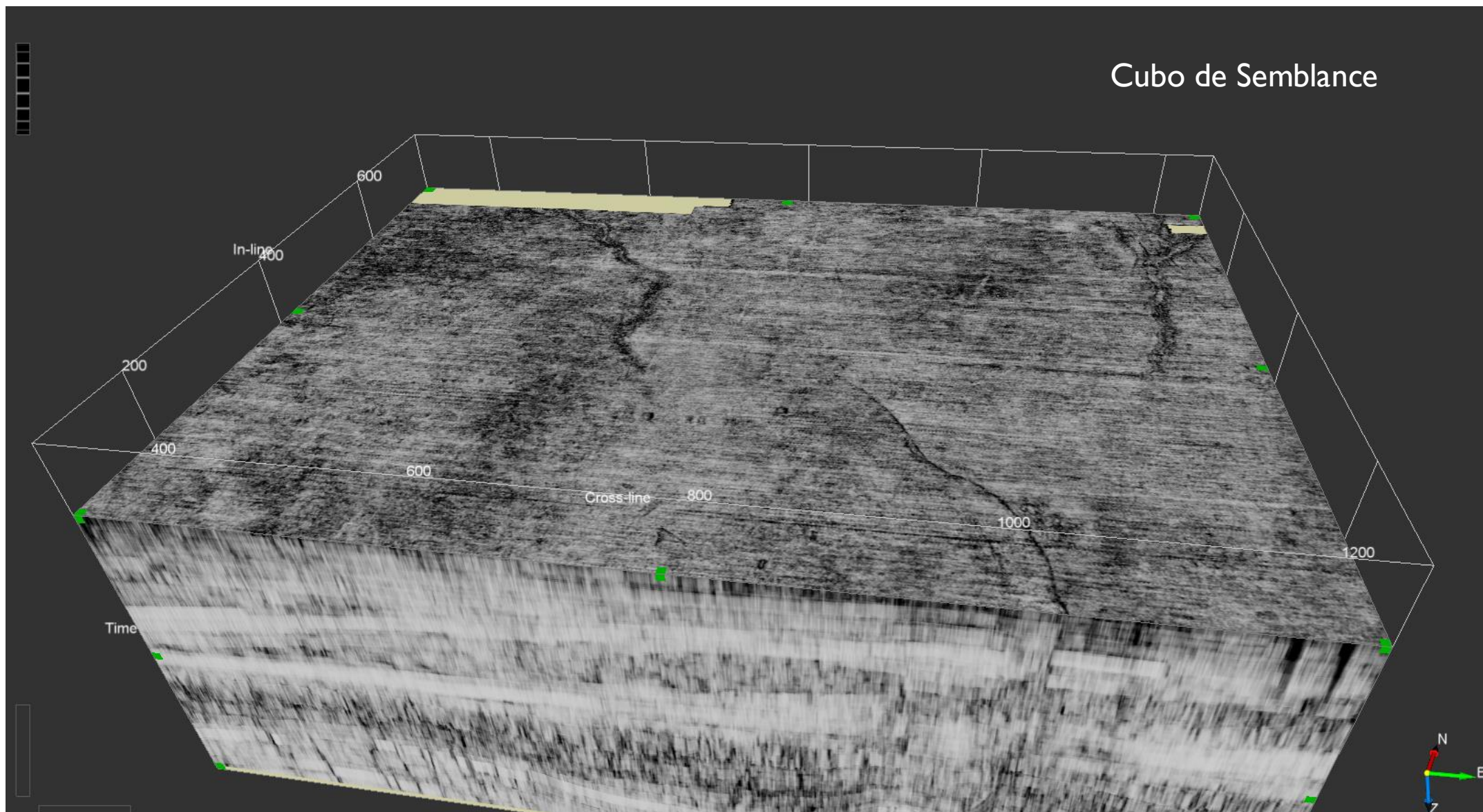


F3 Netherlands

Falhas

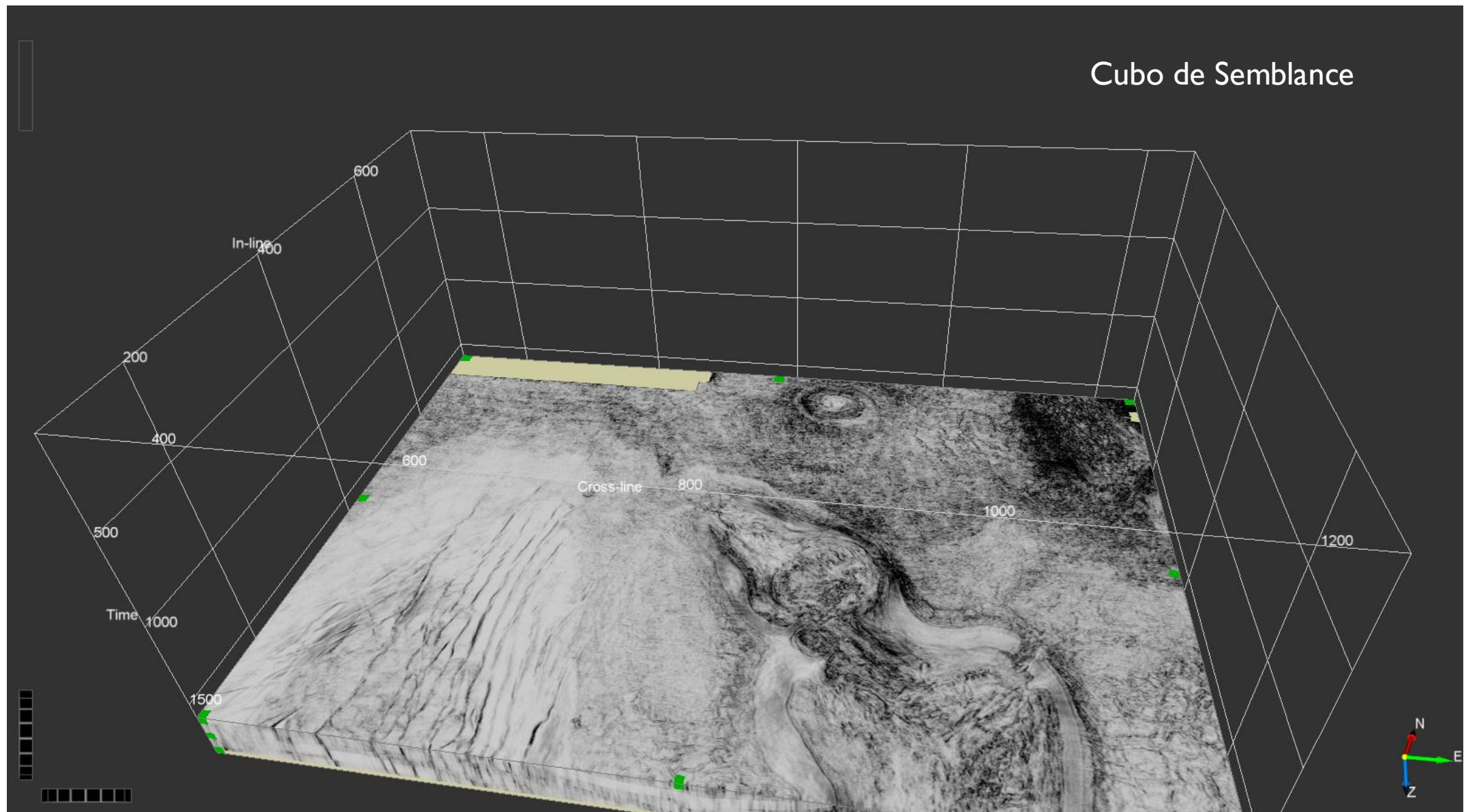
Falhas

Cubo de Semblance



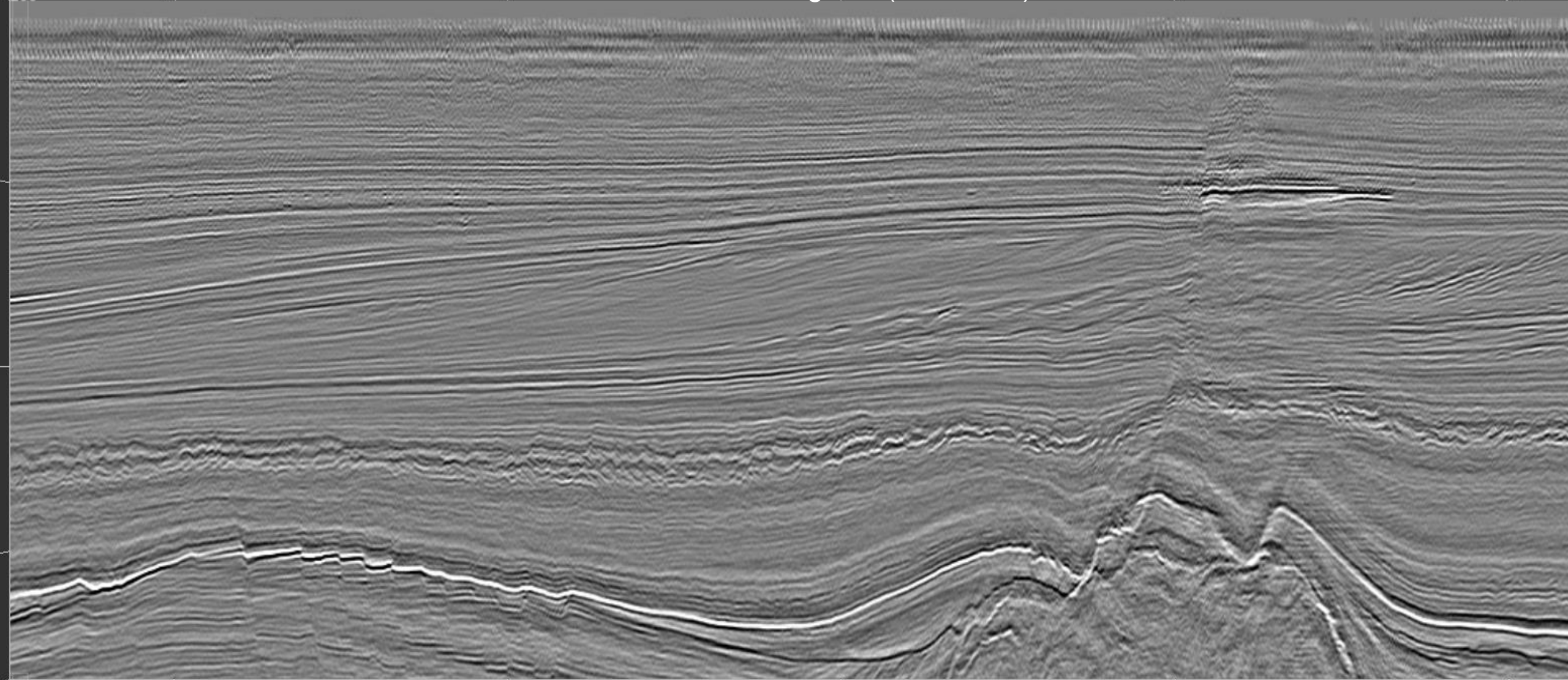
Falhas

Cubo de Semblance



F3
Cubo Sísmico Original (Inline 200)

200



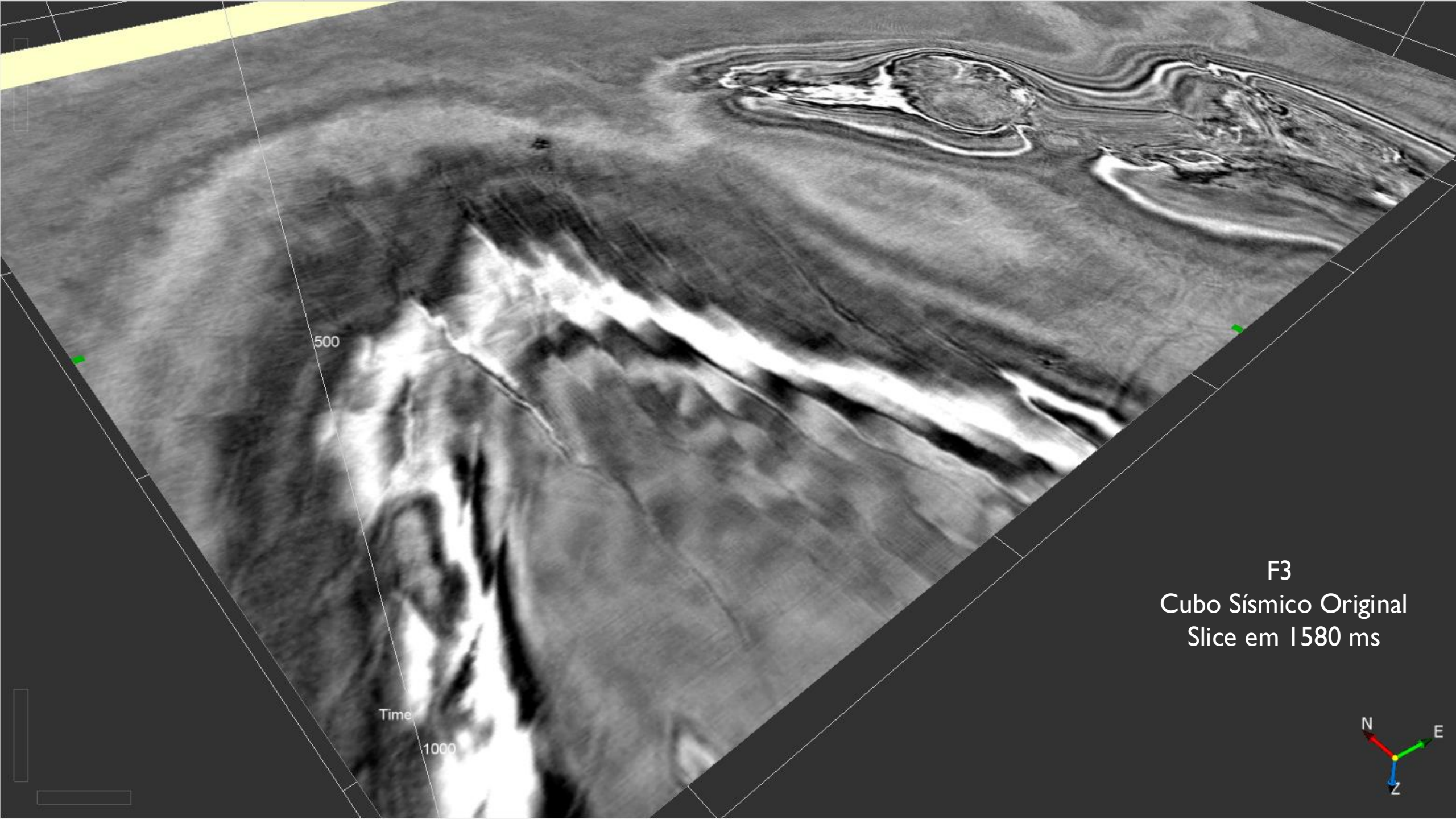
F3
Cubo Sísmico Original (Inline 200)

200

Falha A

Falha 01
Falha 02
Falha 03
Falha 04

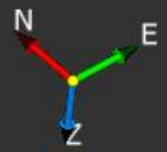


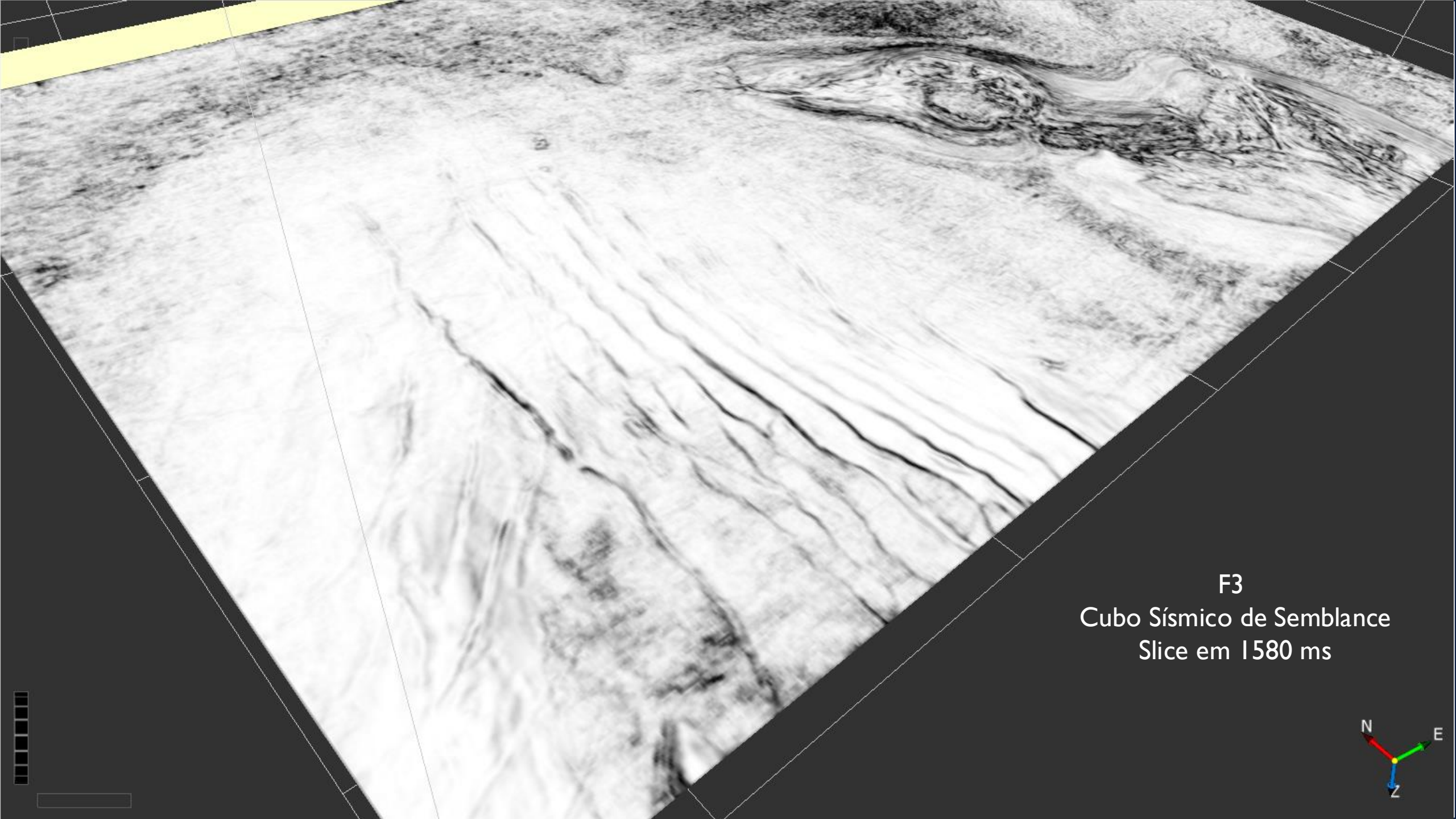


500

Time
1000

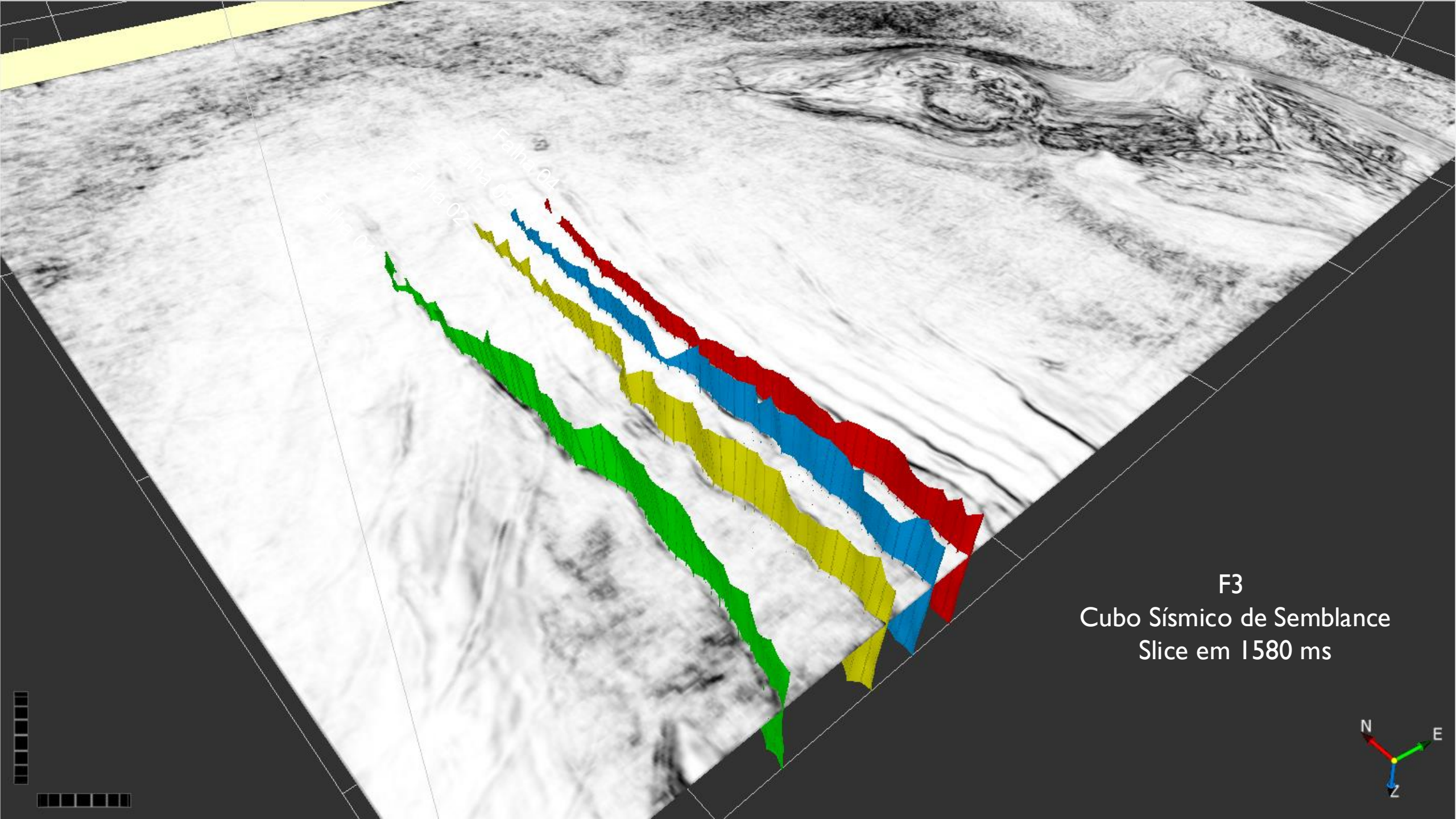
F3
Cubo Sísmico Original
Slice em 1580 ms





F3
Cubo Sísmico de Semblance
Slice em 1580 ms





F3
Cubo Sísmico de Semblance
Slice em 1580 ms



Tree items

Elements Color

- Wiggle
- VD
- 3D Horizon
- Fault
- FaultStickSet
- PointSet

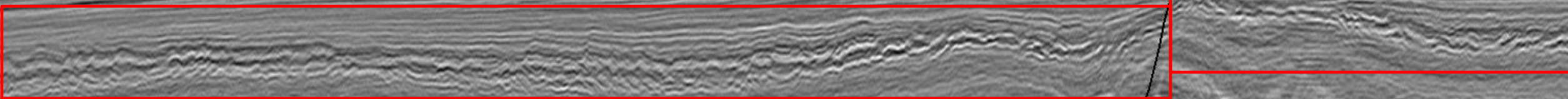
In-line: 188

Cubo de predição de falhas



F3
Cubo Sísmico Original (Inline 200)

Falha A



Falha 01
Falha 02
Falha 03
Falha 04

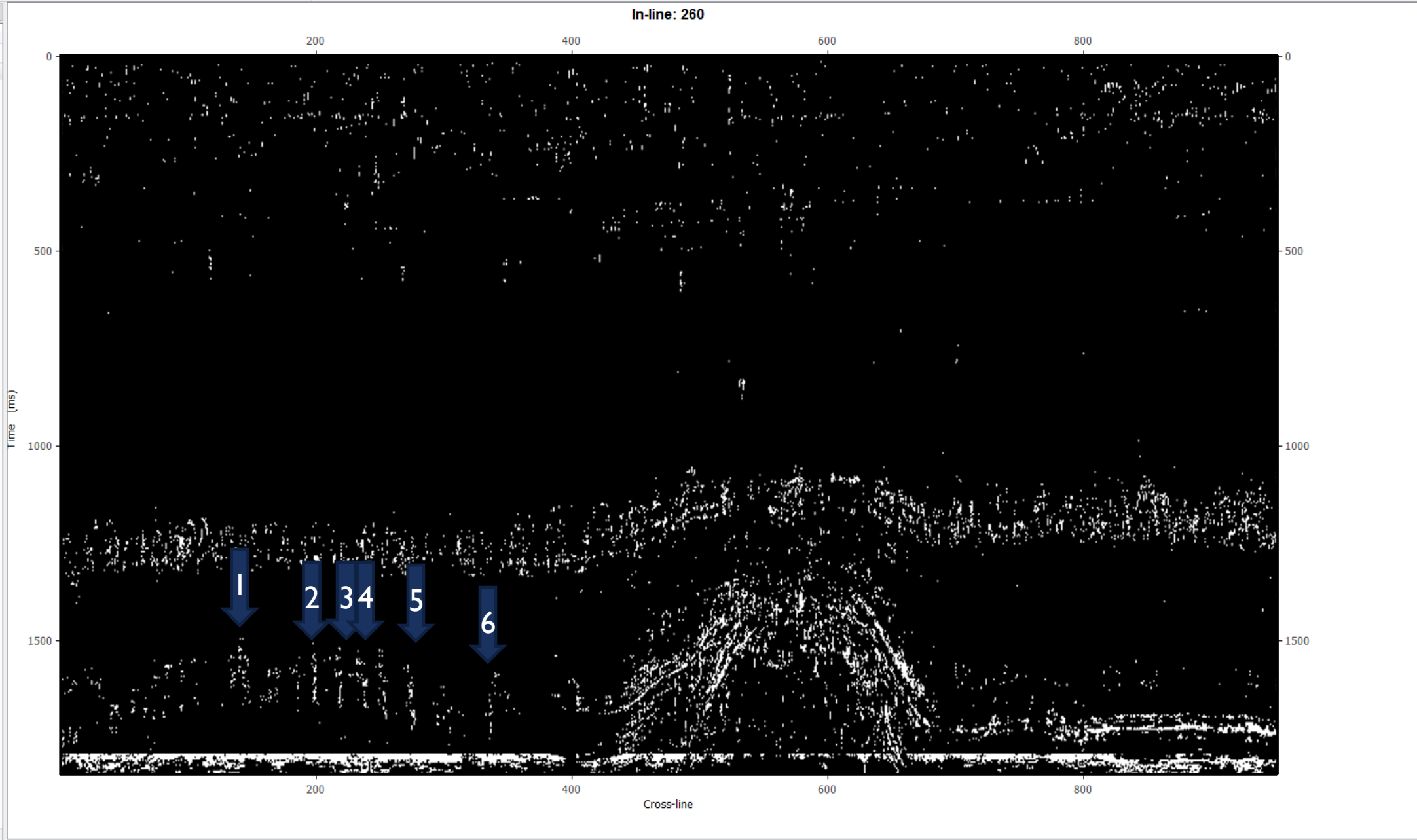
Refletores Caóticos



Tree items

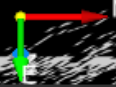
Elements Color

- Wiggle
- VD
- 3D Horizon
- Fault
- FaultStickSet
- PointSet



1500

- 1
- 2
- 3
- 4
- 5
- 6

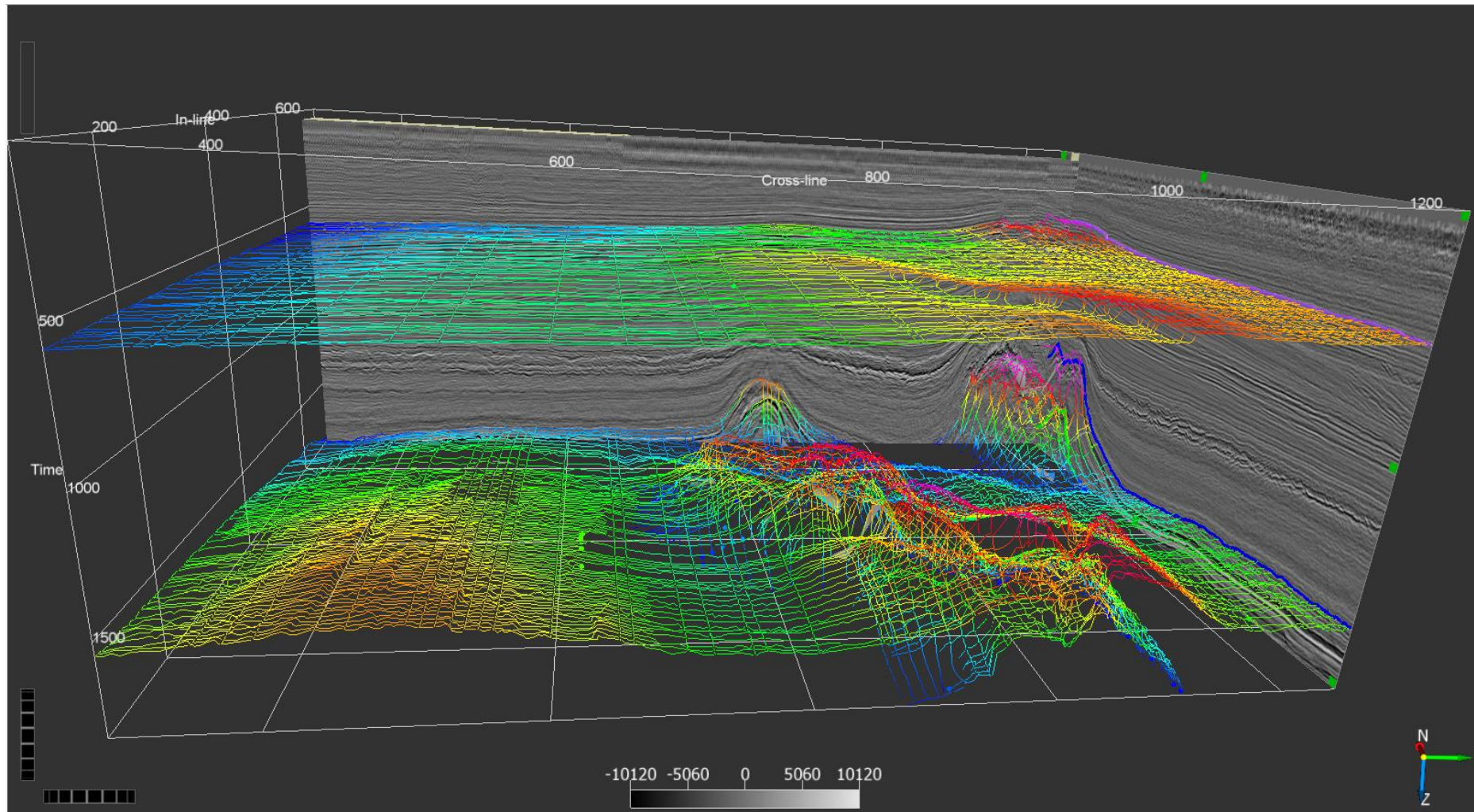




F3 Netherlands

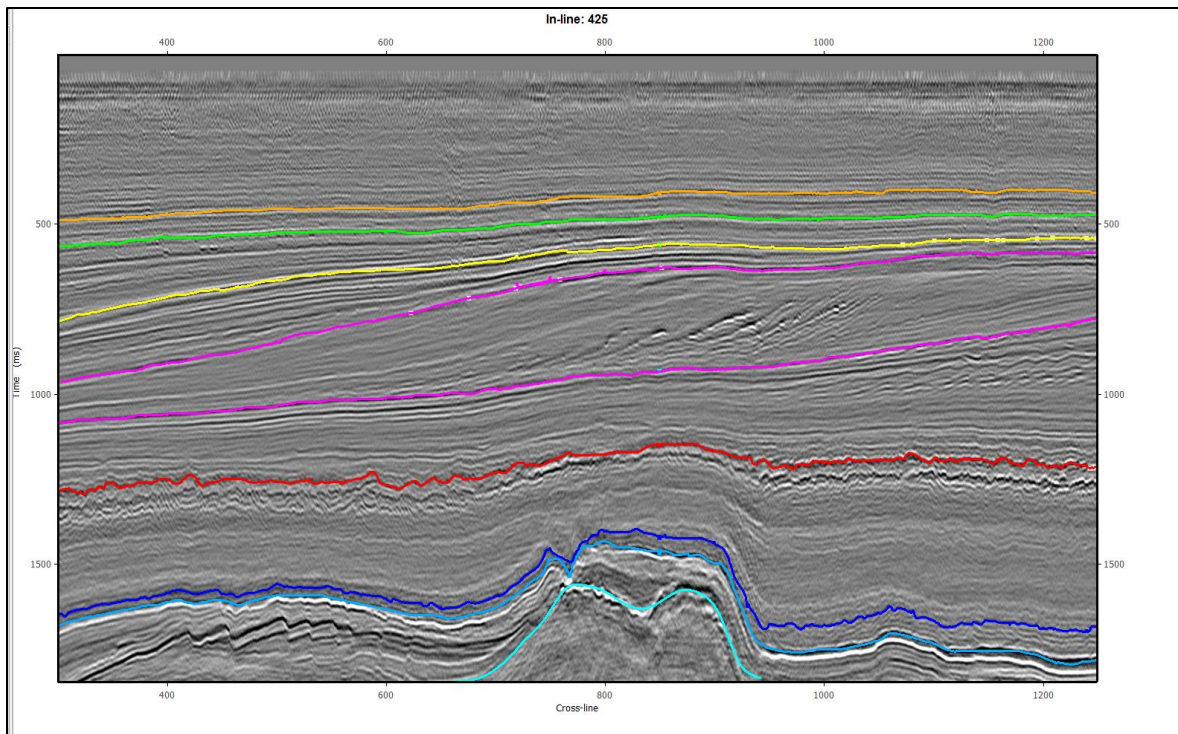
Horizontes

Visualização 3D

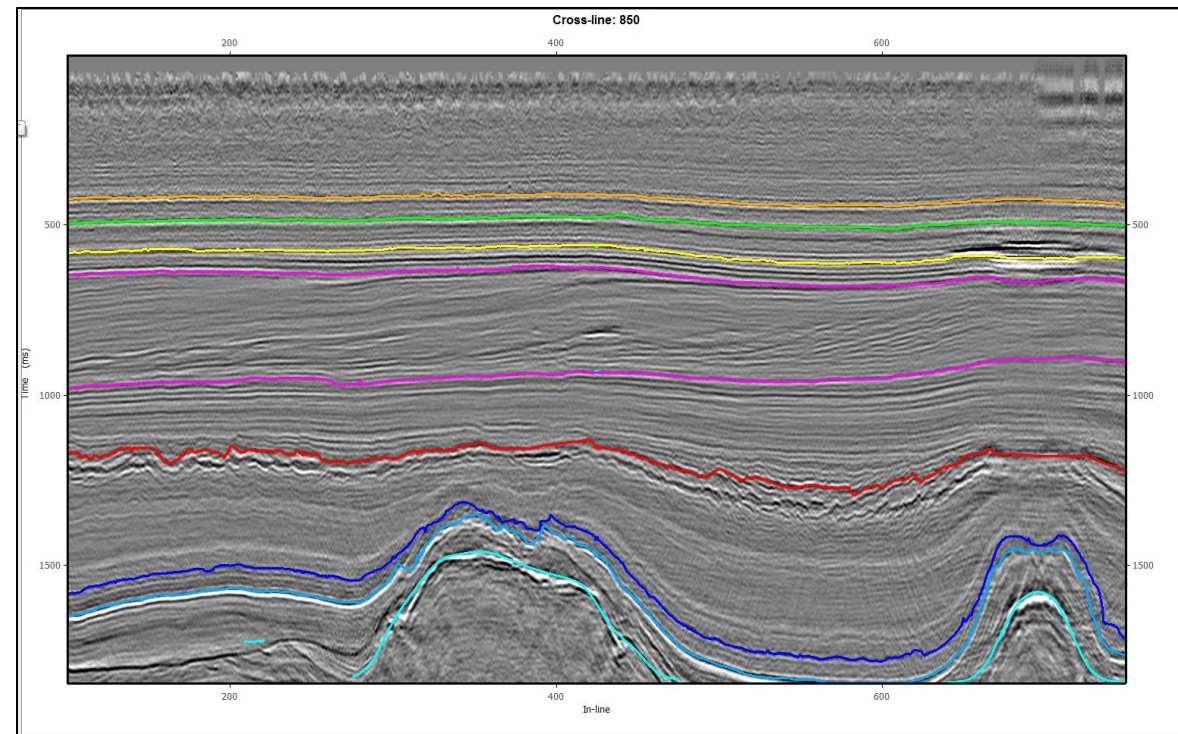






Lista de Horizontes





Inline 425



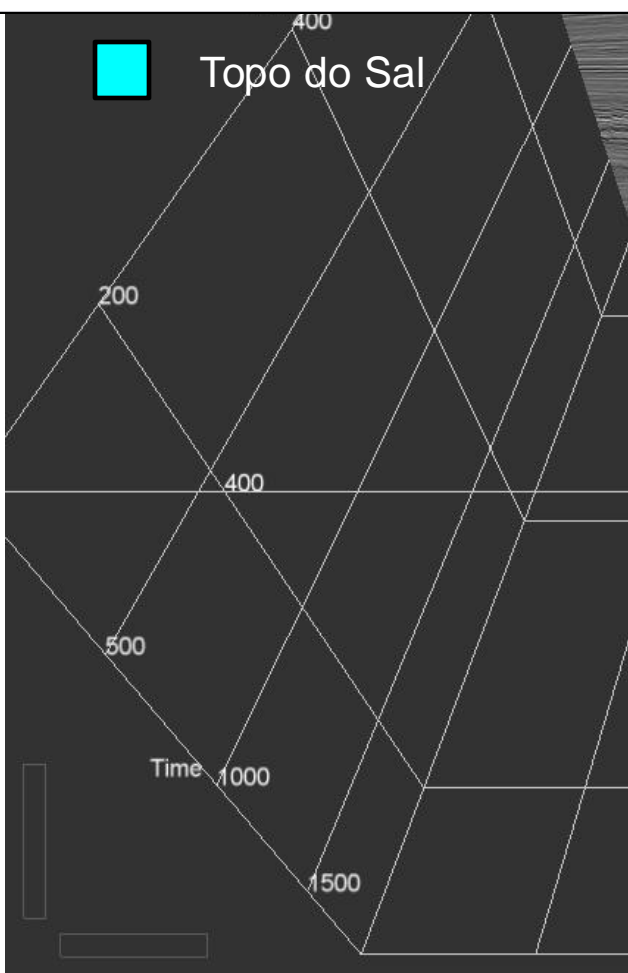
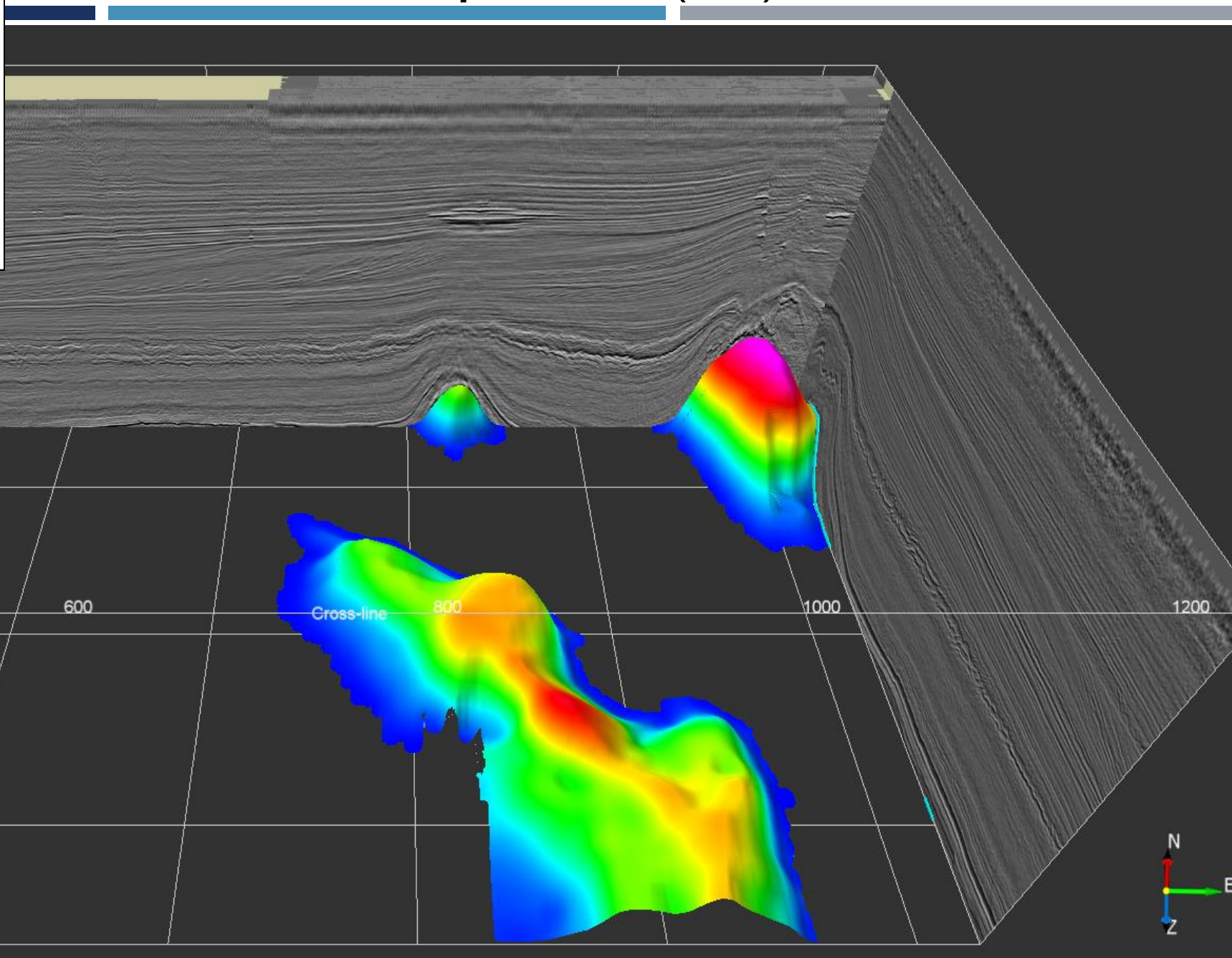
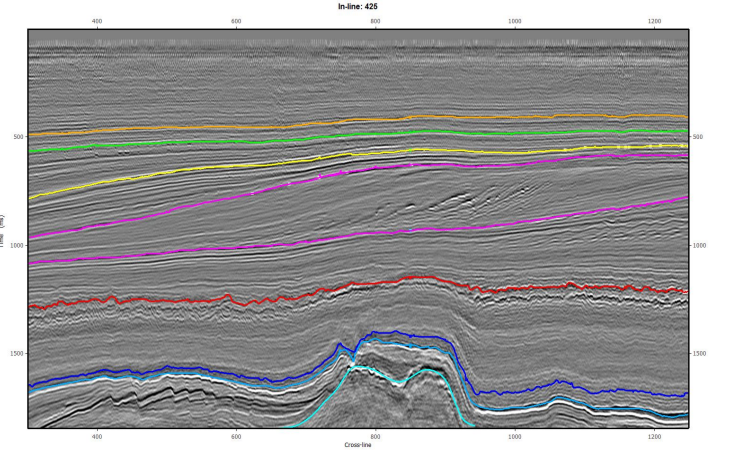
Crossline 850



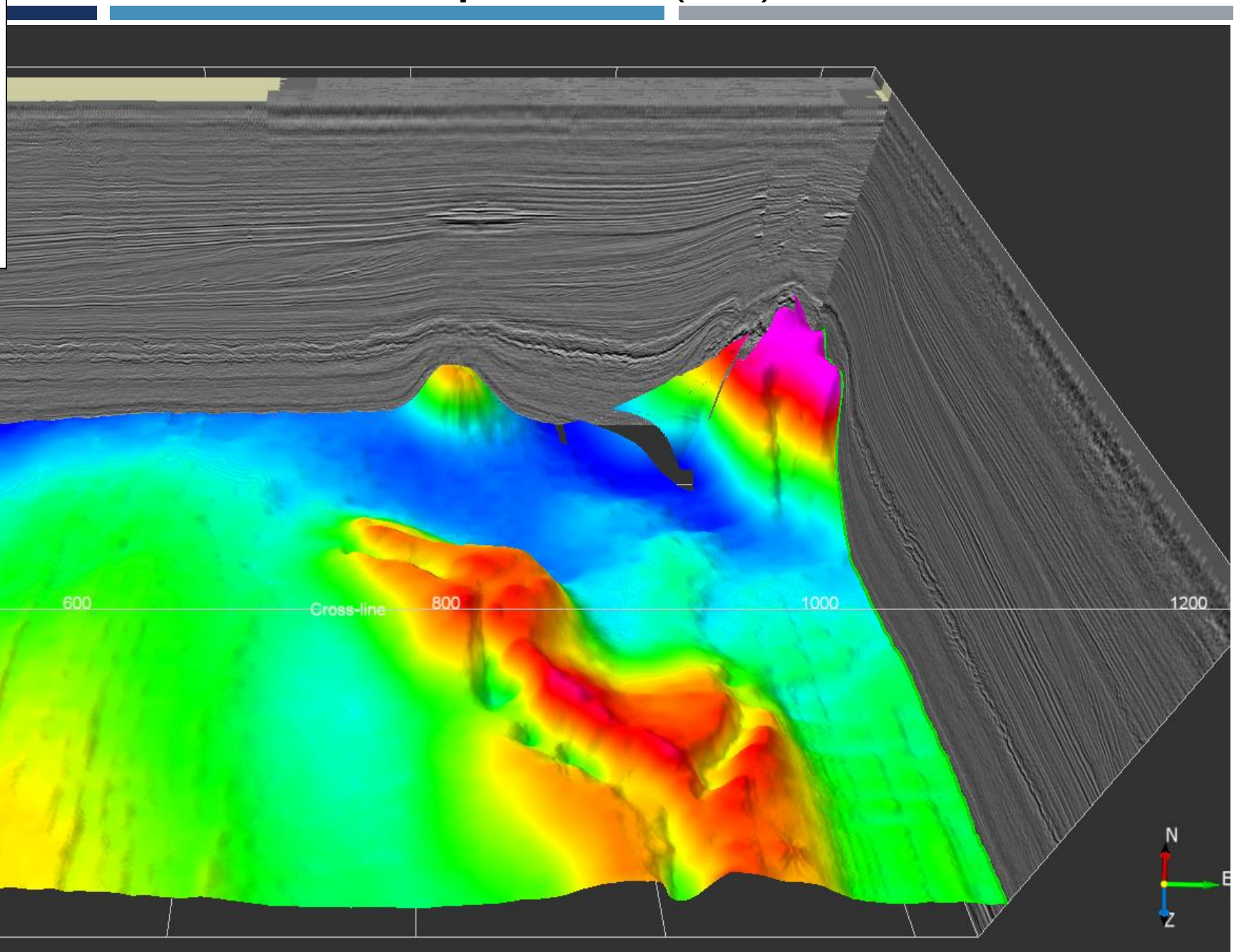
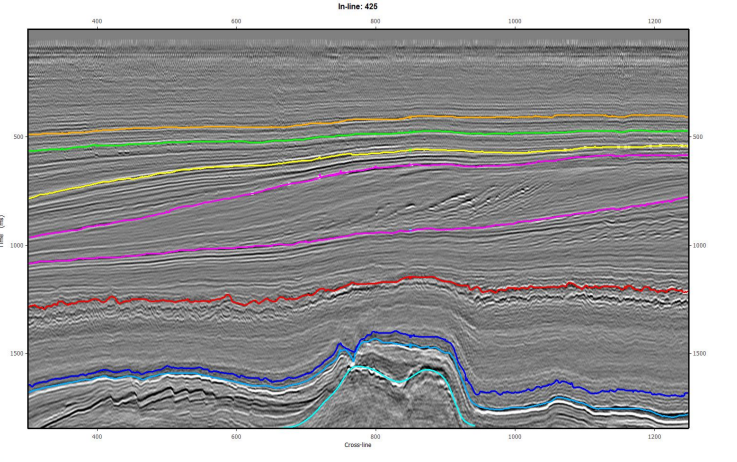
-  Sub Horizontal 01
-  Sub Horizontal 02
-  Sub Horizontal 03
-  Topo/base Clinoformas

-  Caóticos
-  Marco Azul Holândes
-  Topo dos Carbonatos
-  Topo do Sal

Horizontes Interpolados (3D)

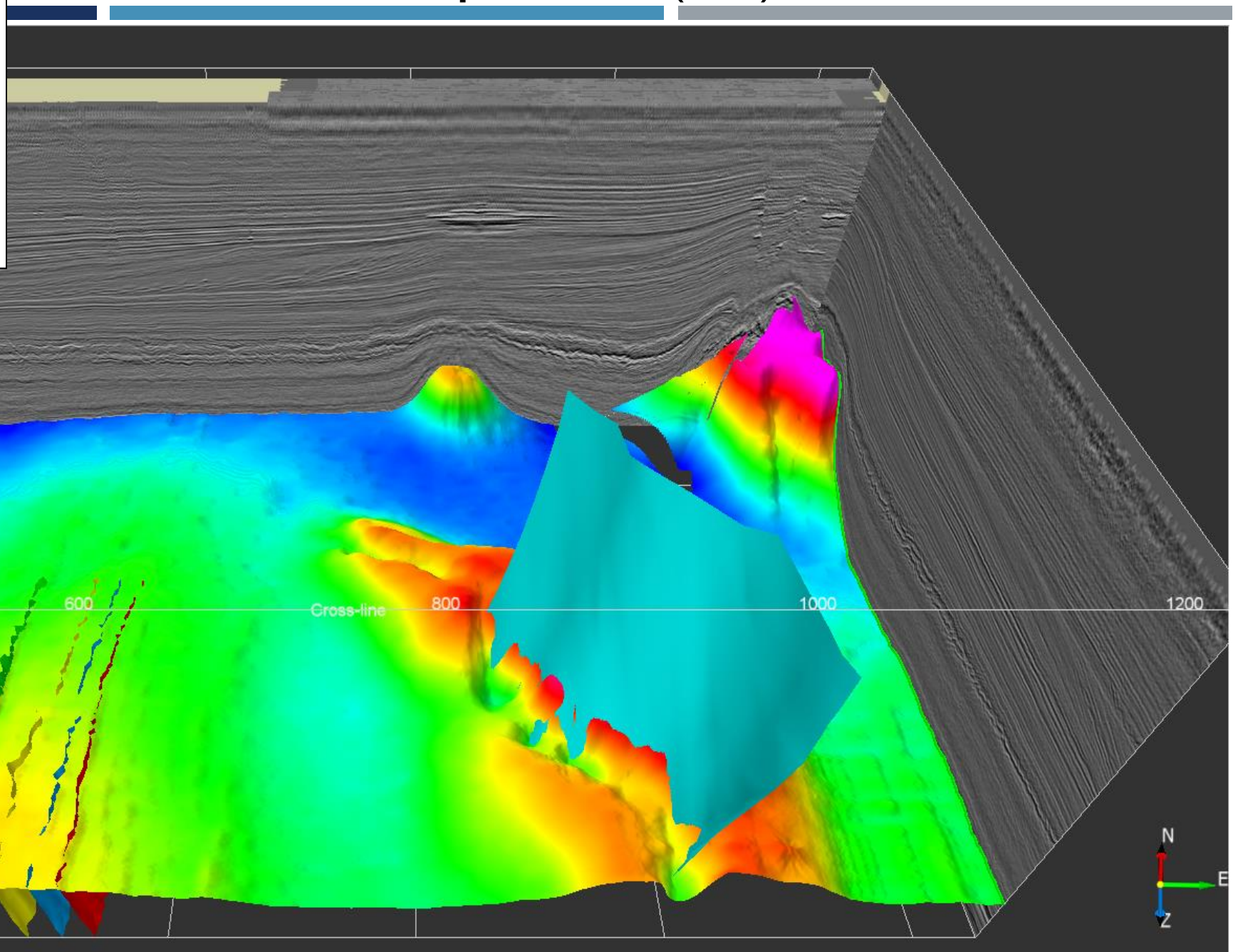
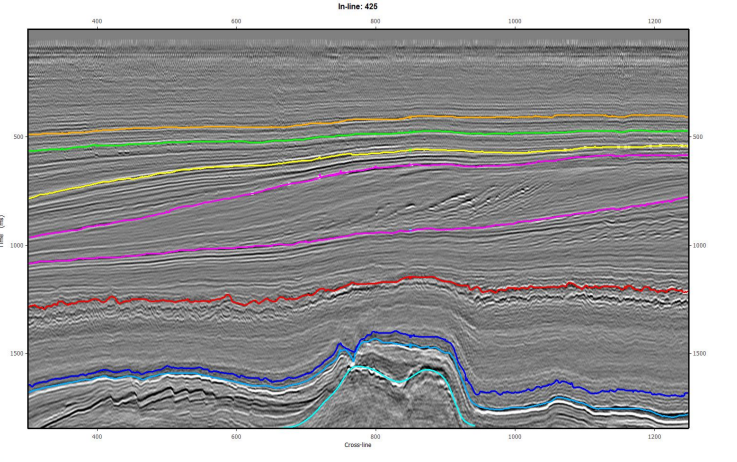


Horizontes Interpolados (3D)

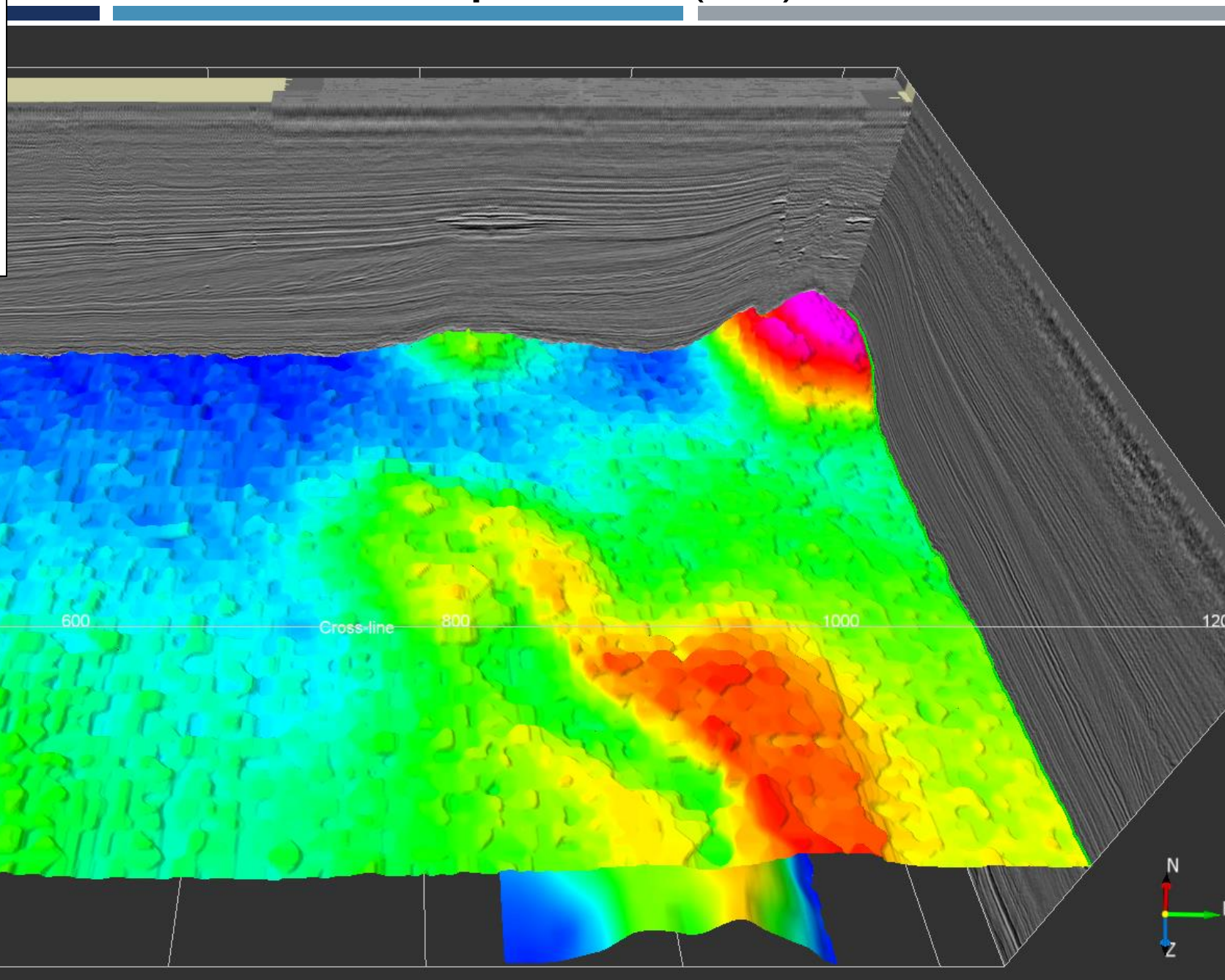
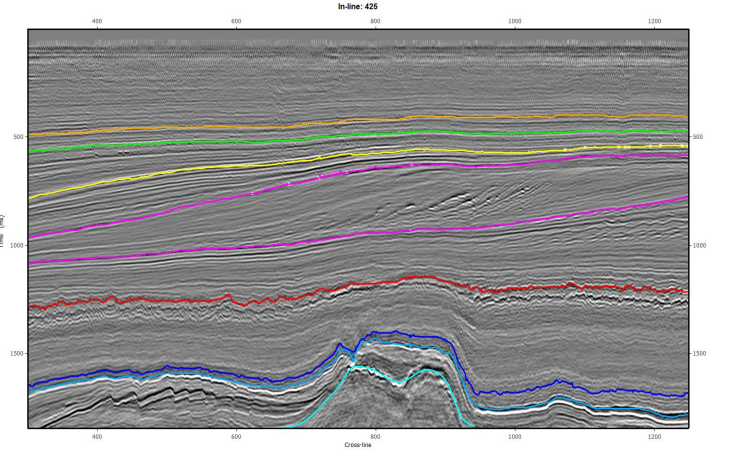


Marco Azul Holândes

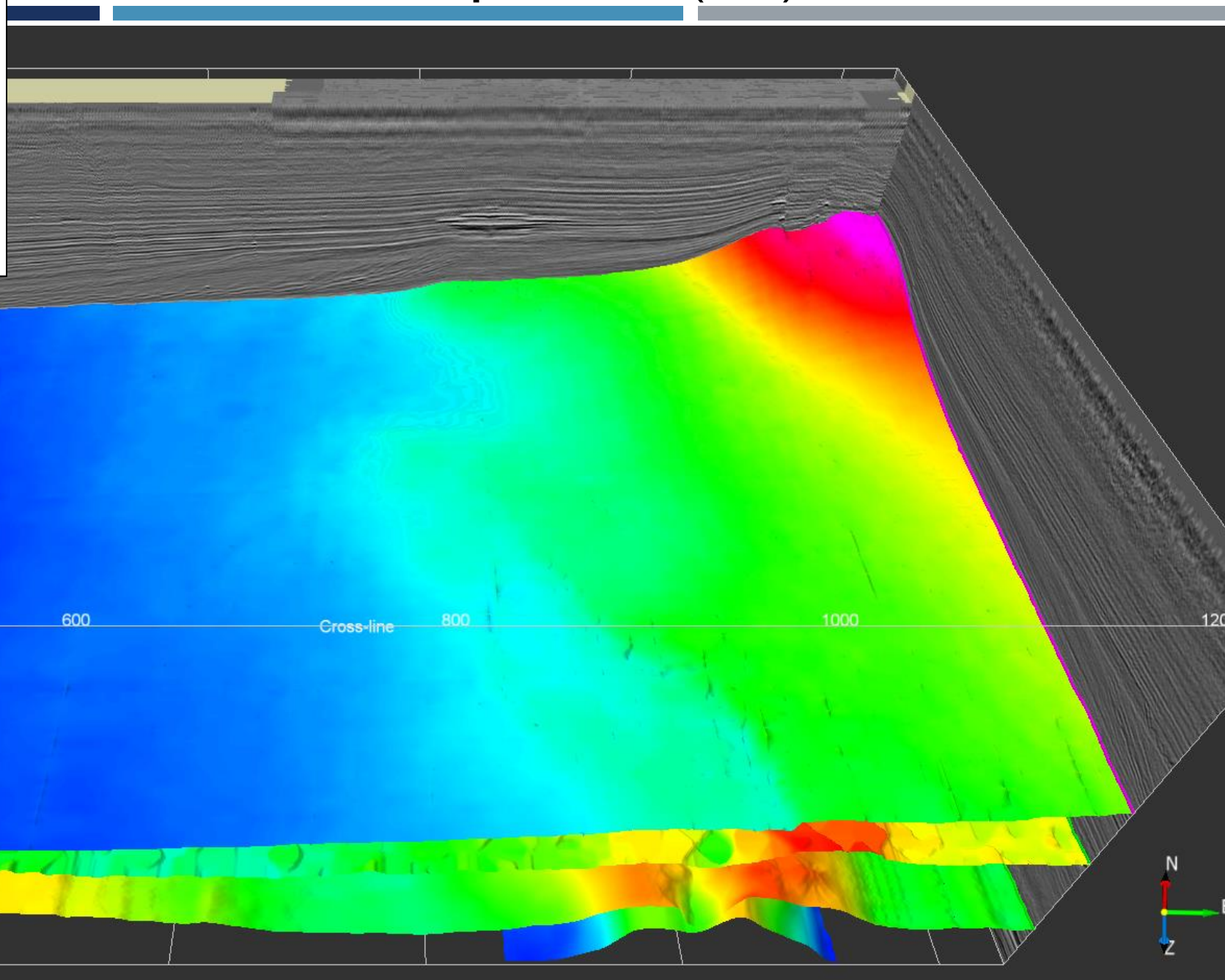
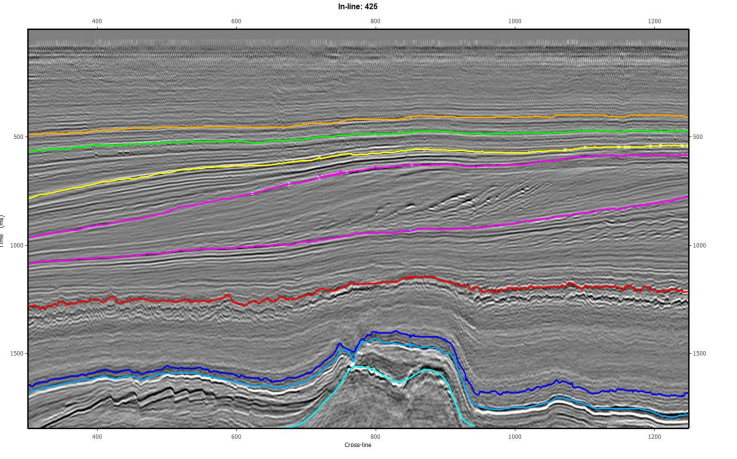
Horizontes Interpolados (3D)



Horizontes Interpolados (3D)



Horizontes Interpolados (3D)



base das
clinoformas

200

400

600

Cross-line

800

1000

1200

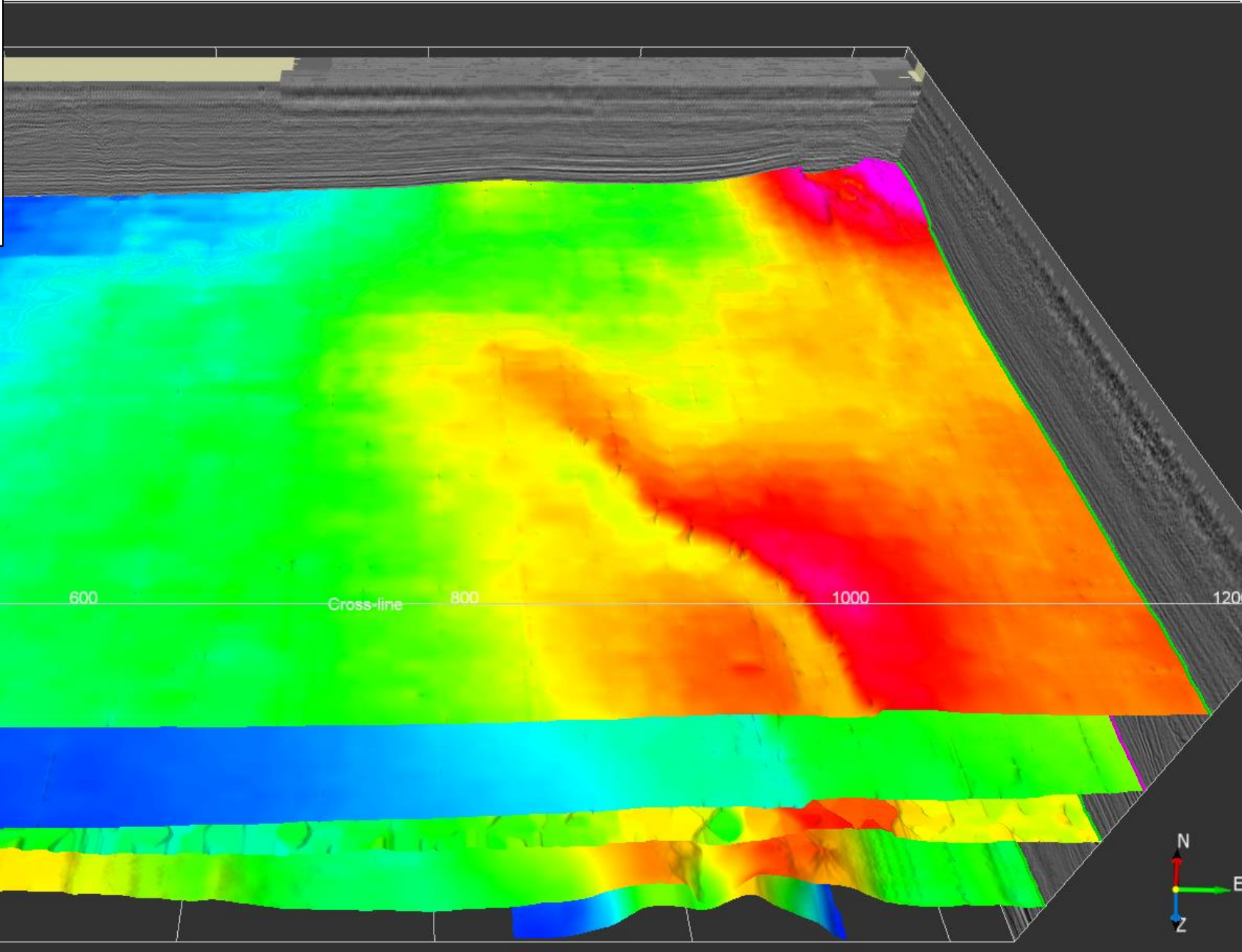
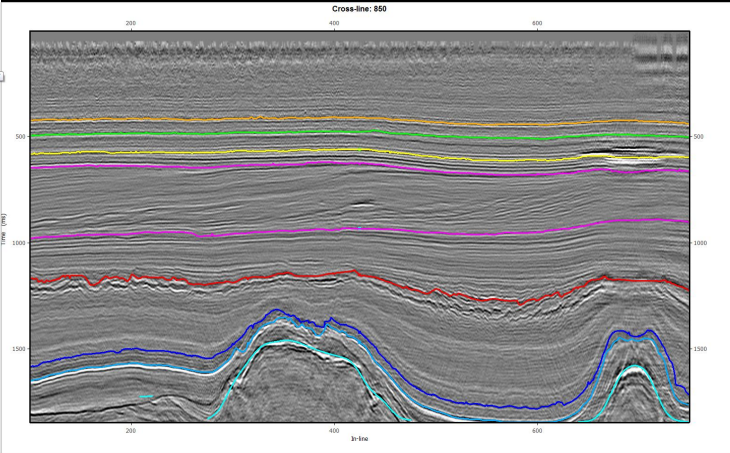
500

Time 1000

1500



Horizontes Interpolados (3D)



Sub
Horizontal 01

200

400

600

Cross-line

800

1000

1200

500

Time 1000

1500

N
E
Z



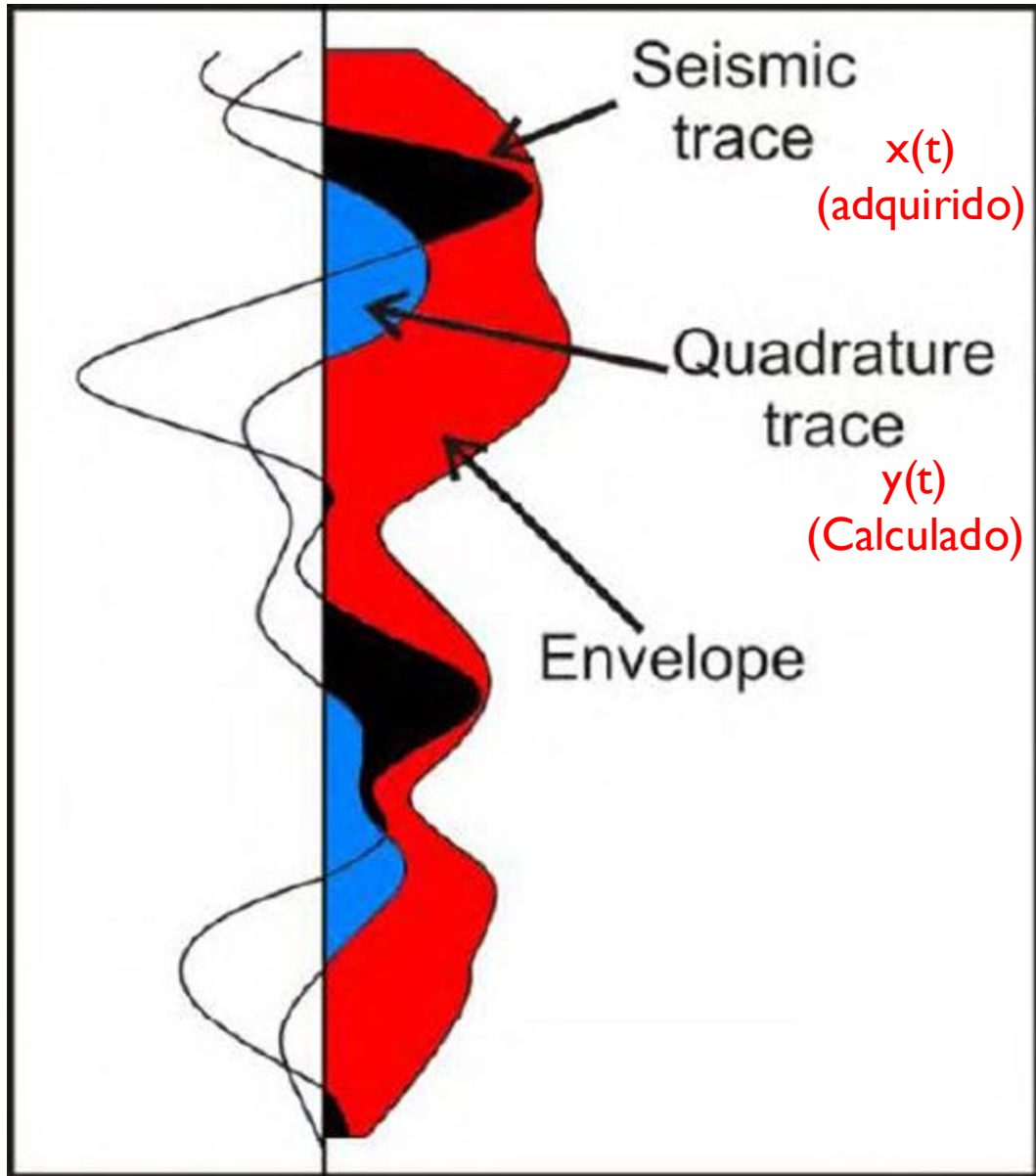
F3 Netherlands

Atributos Sísmicos



F3 Netherlands

RMS



$Envelope = \sqrt{x(t)^2 + y(t)^2}$
(Módulo do traço sísmico complexo)

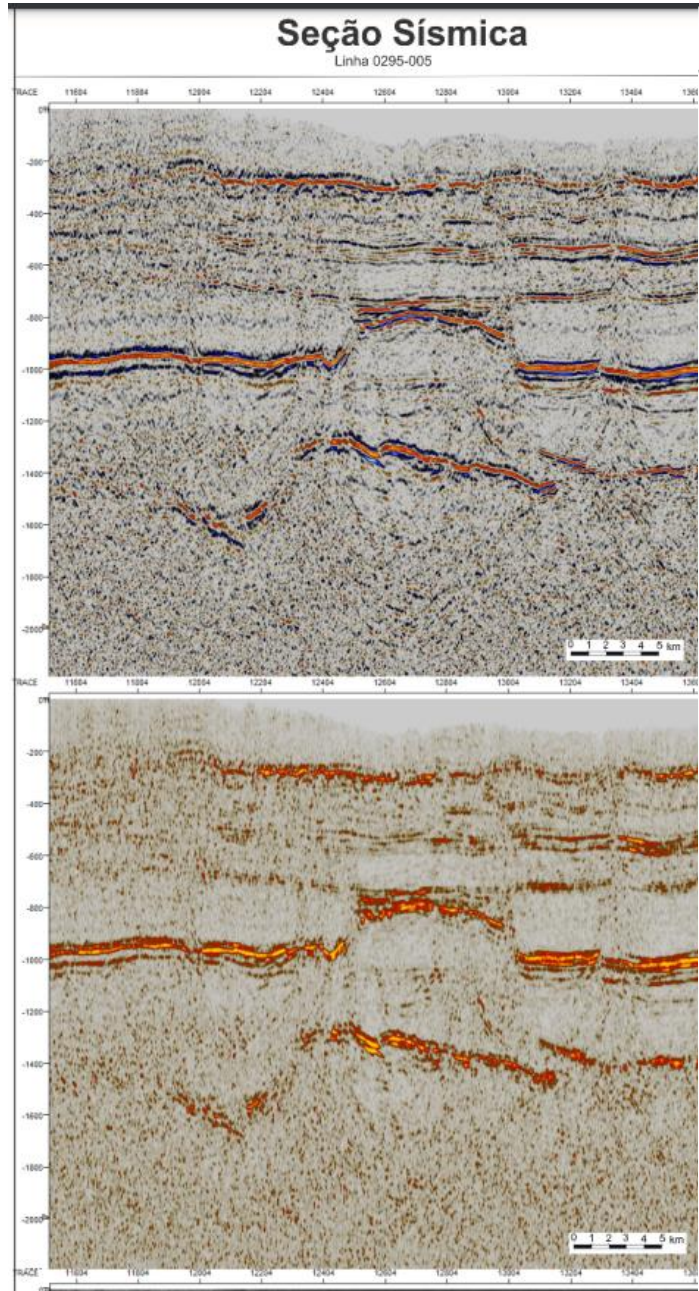
$$X_{rms} = \sqrt{\frac{1}{N} \sum_{n=1}^N w_n x_n^2}$$

X_{rms} = raiz da amplitude quadrática média
 w_n = Tamanho da janela
 N = número de amostras na janela
 x = valor da amplitude do Envelope

O atributo RMS representa a média quadrática do envelope (na prática significa uma versão suavizada do envelope)

Tanto o atributo Envelope, quanto o RMS são sempre positivos, e refletem a **quantidade de energia refletida na interface** das camadas

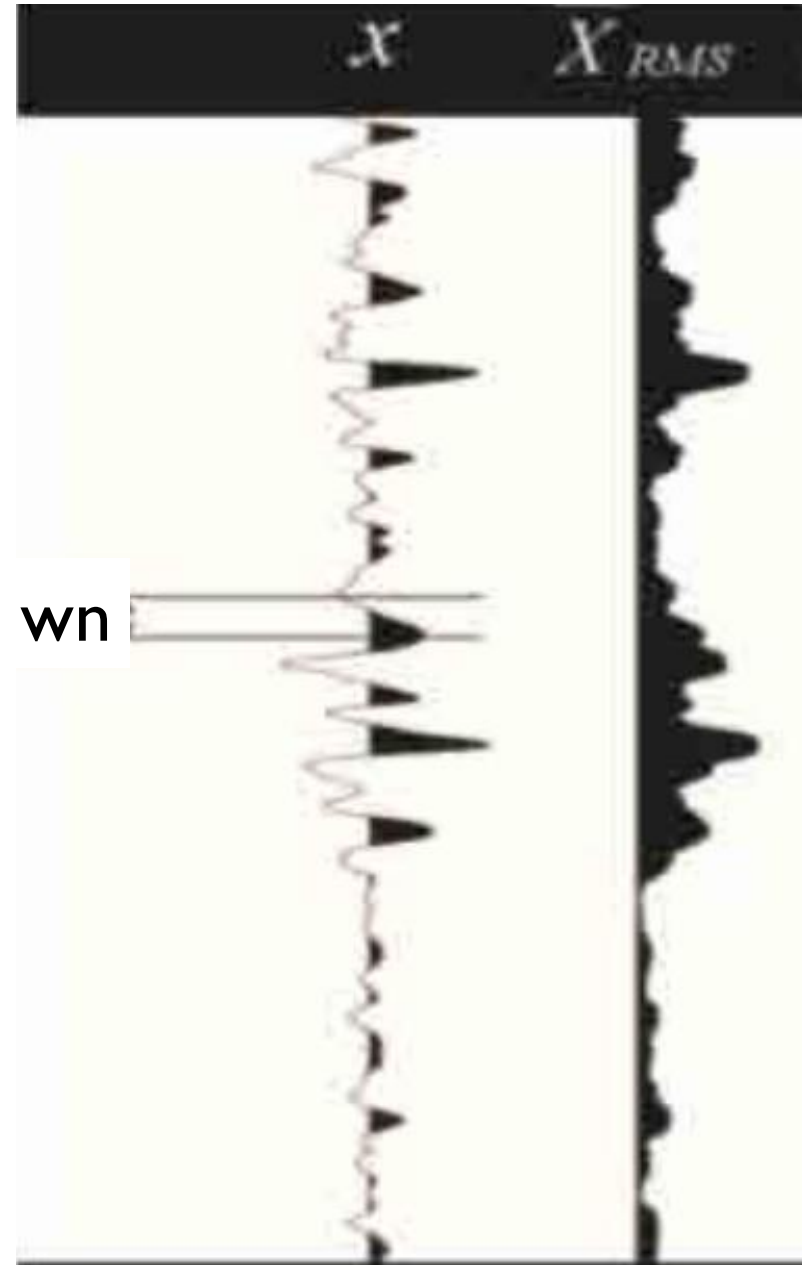
Exemplos



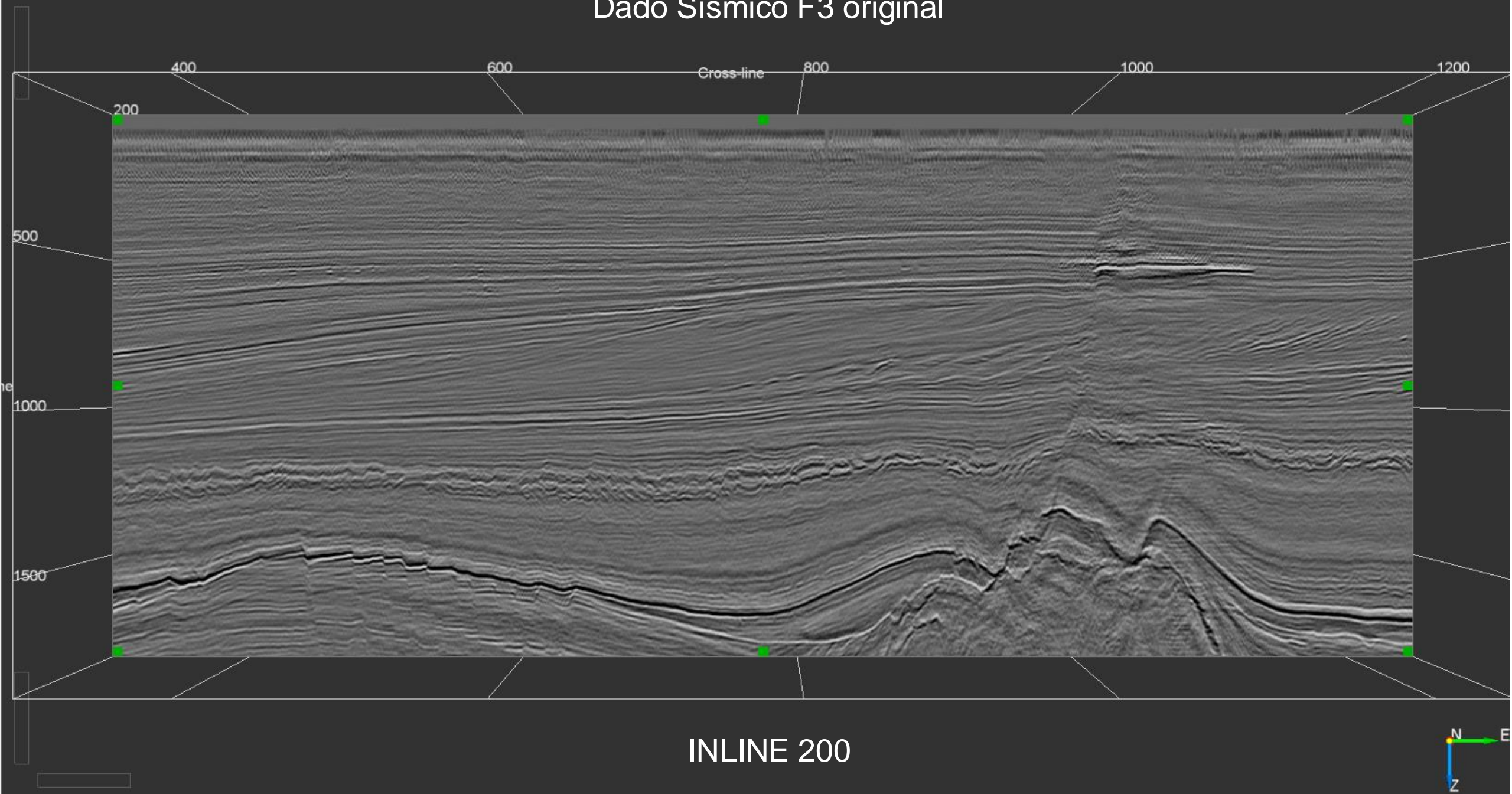
Atributo

Amplitude Padrão

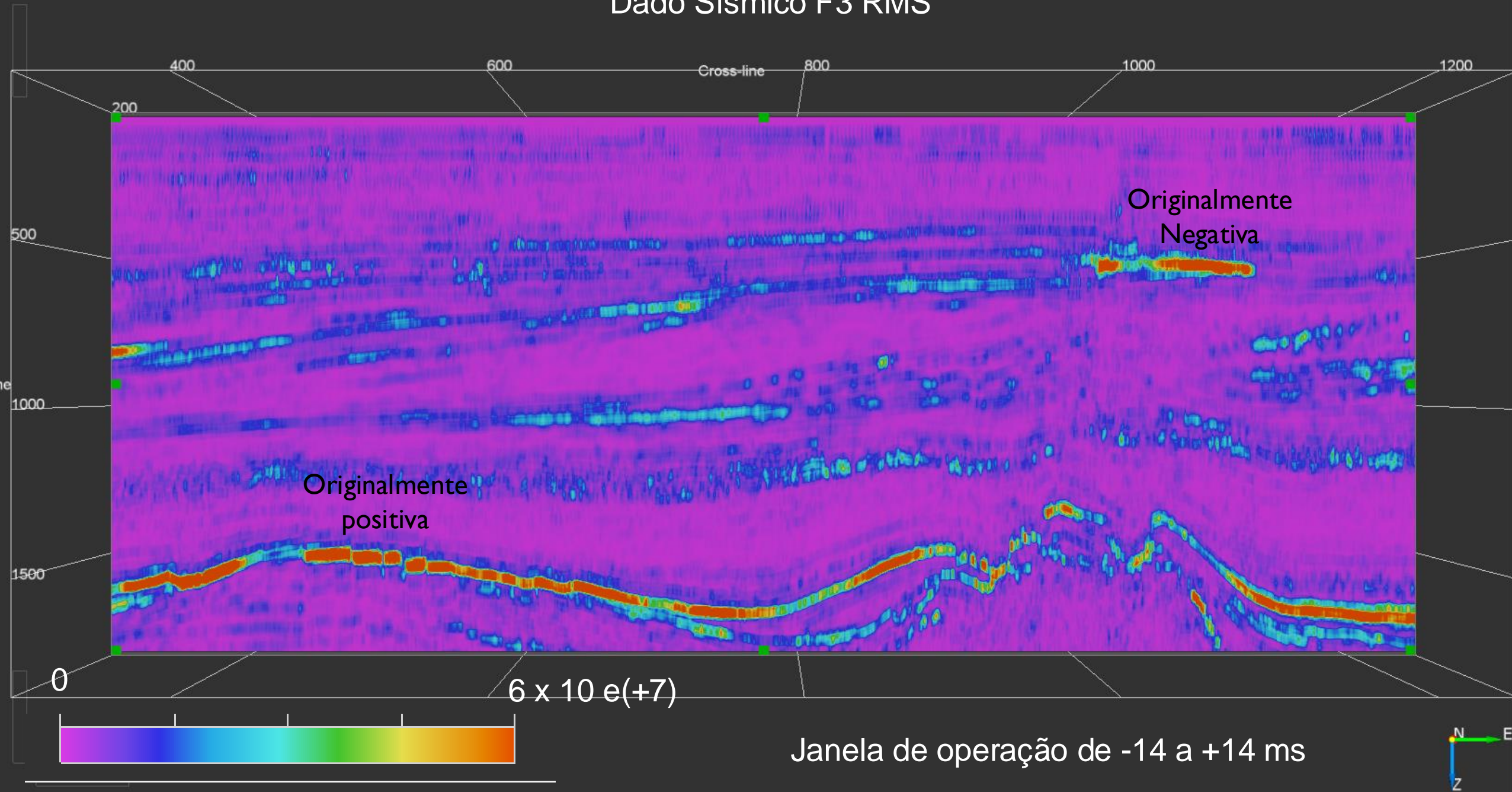
RMS Amplitude



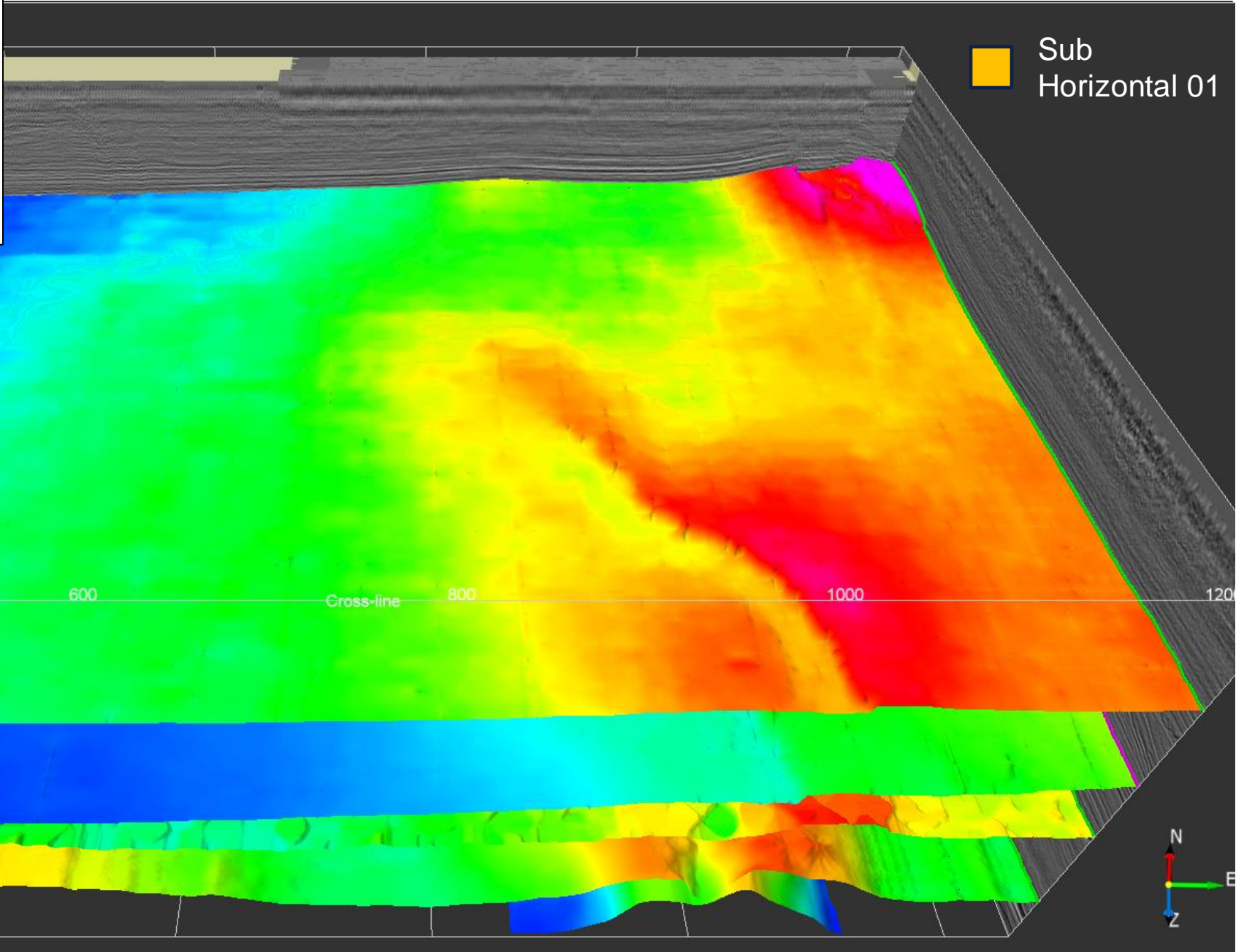
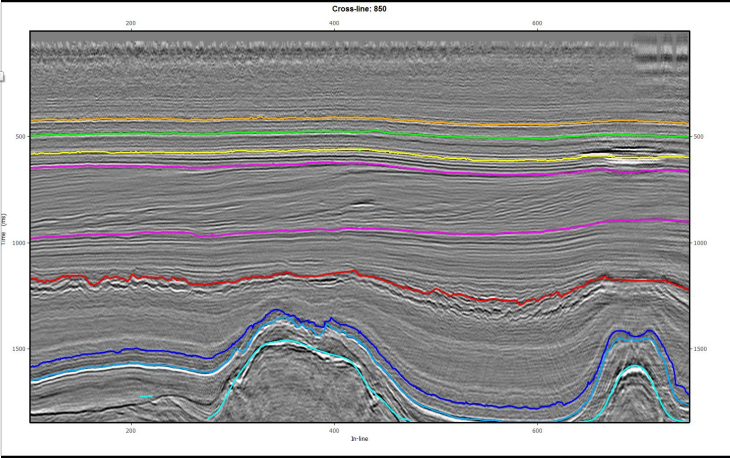
Dado Sísmico F3 original



Dado Sísmico F3 RMS



Horizontes Interpolados (3D)

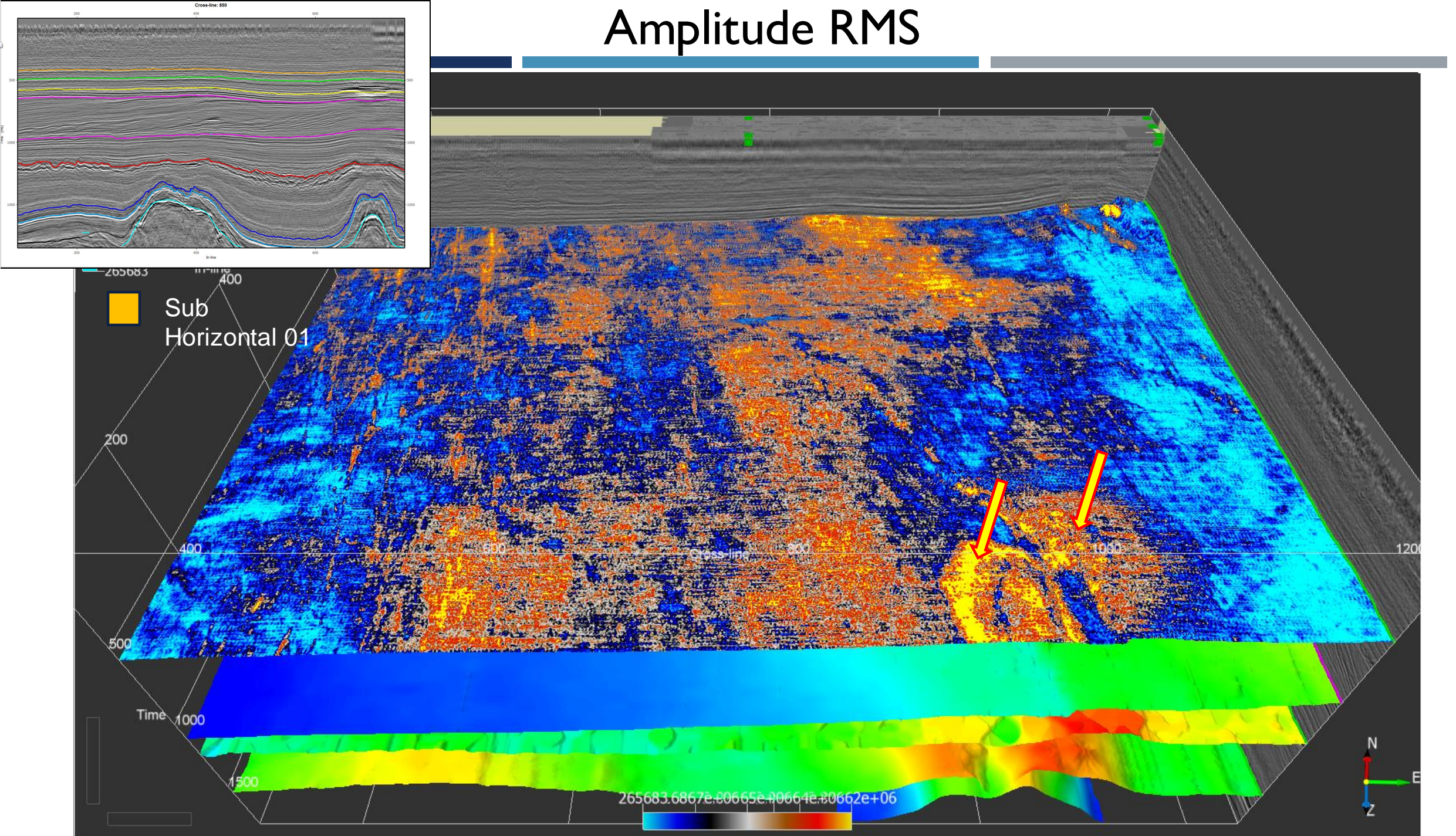


Sub Horizontal 01

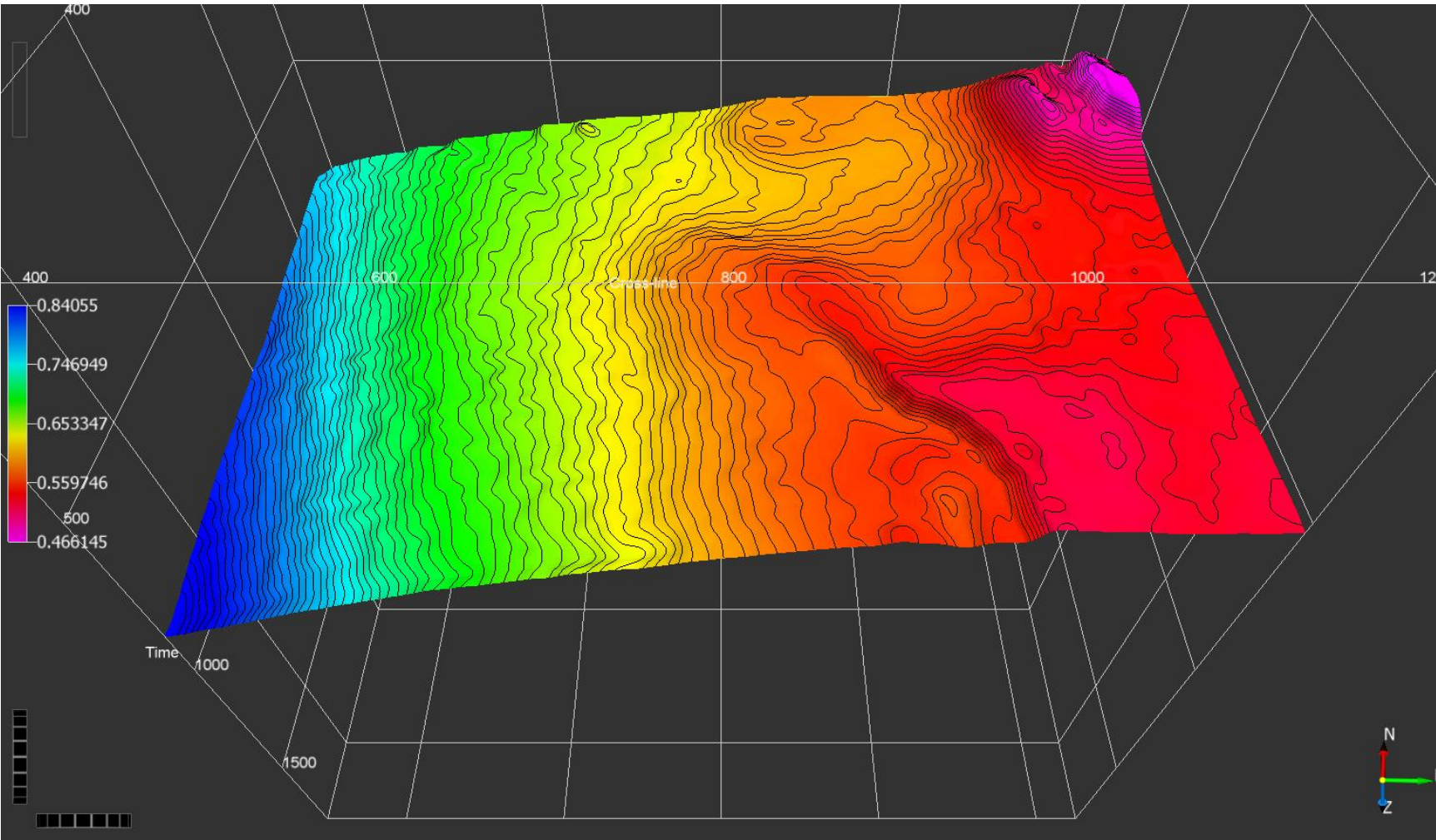
Sub Horizontal 01



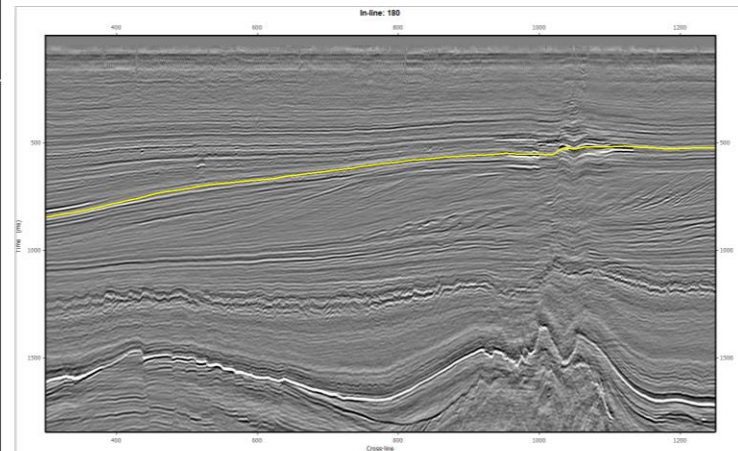
Amplitude RMS



ATRIBUTOS SÍSMICOS 3D



Mapa estructural
Sub Horizontal 03
IC = 5m

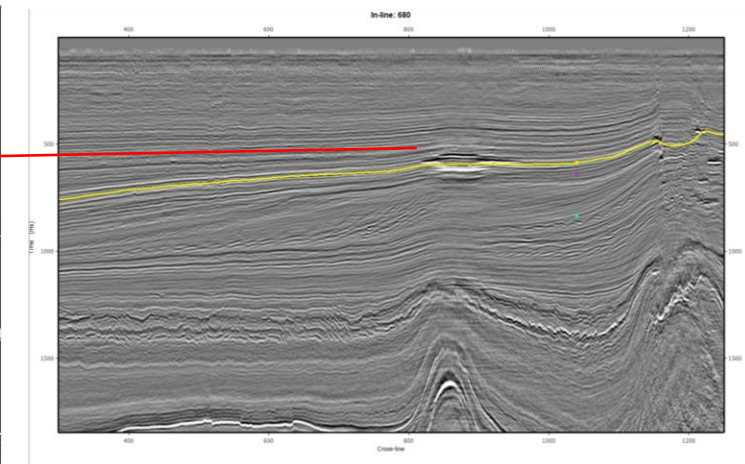
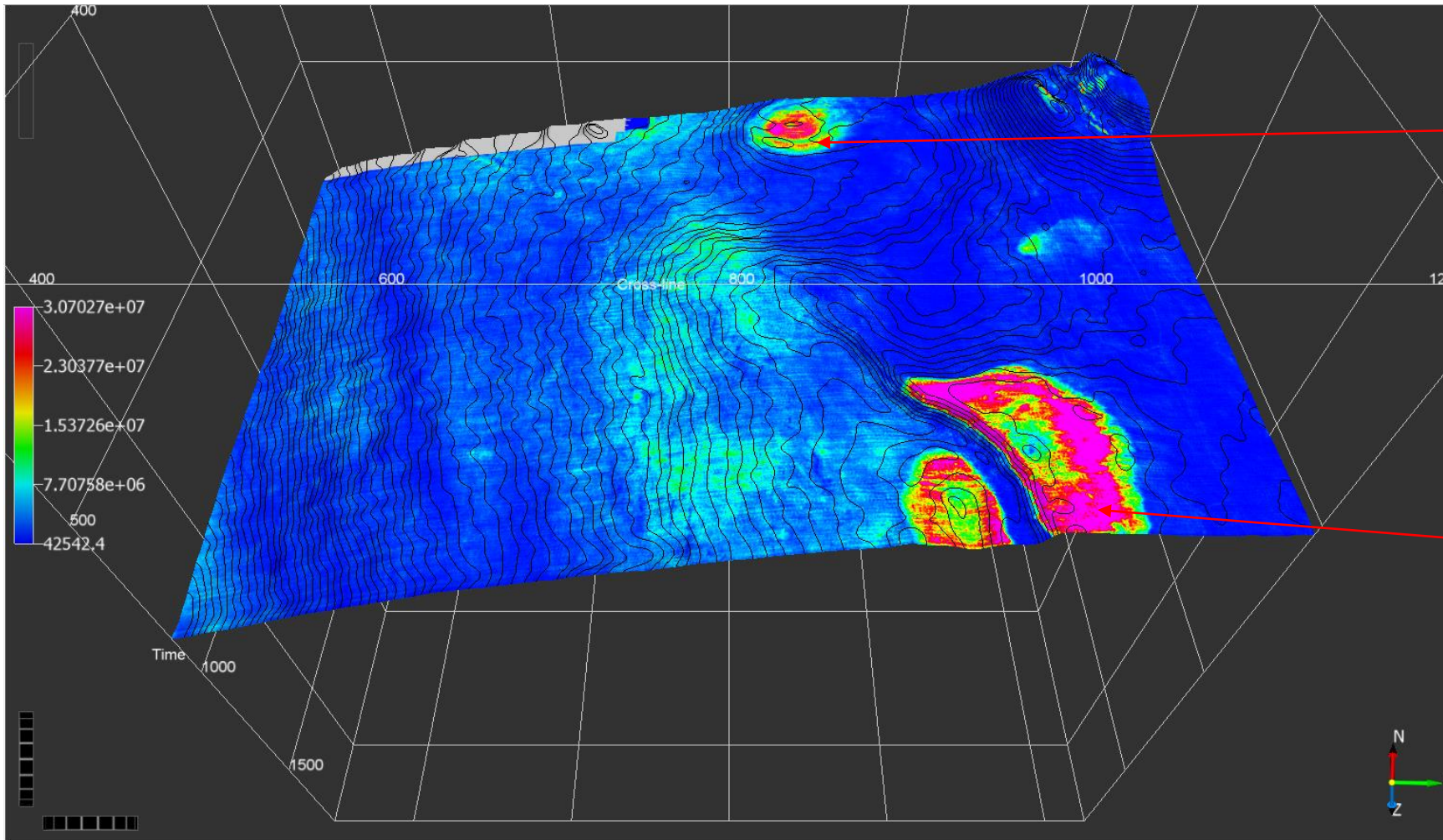


 Sub Horizontal 03

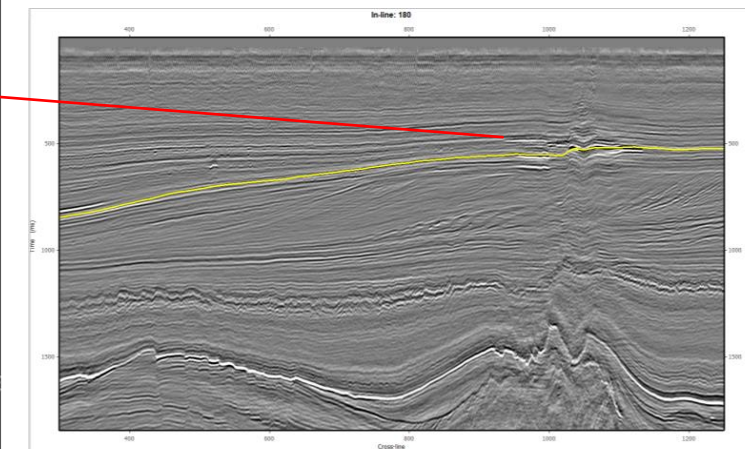
ATRIBUTOS SÍSMICOS 3D

Mapa de Atributo RMS
Sub Horizontal 03
IC = 5m

Anomalia de Amplitude
(Bright Spots)



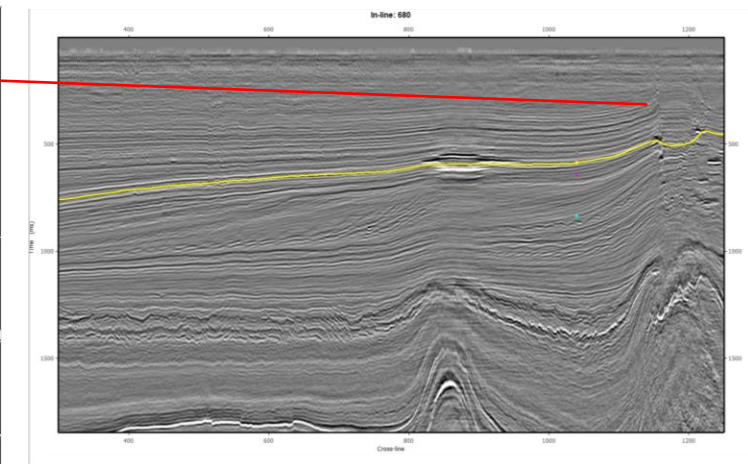
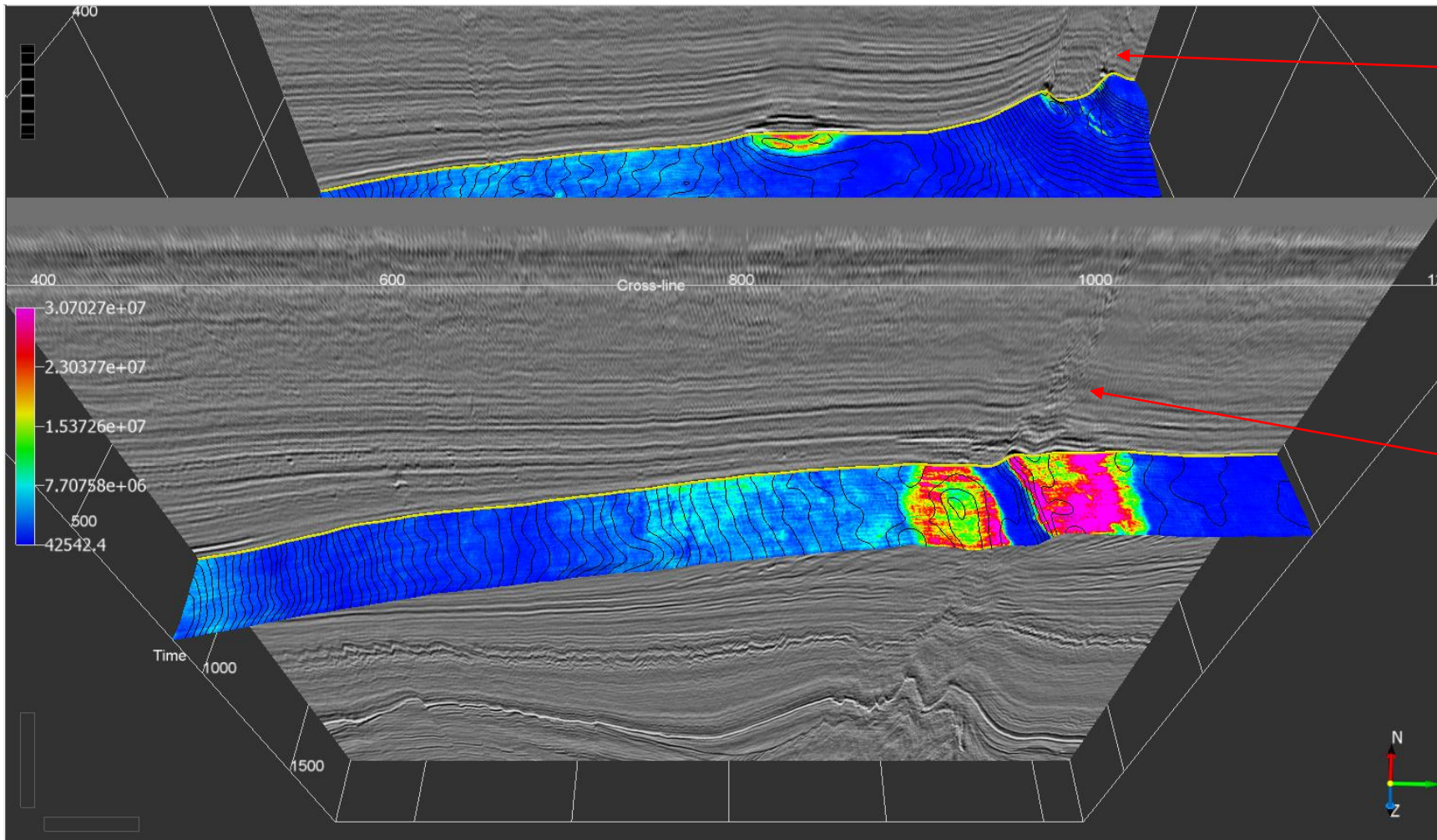
 Sub Horizontal 03



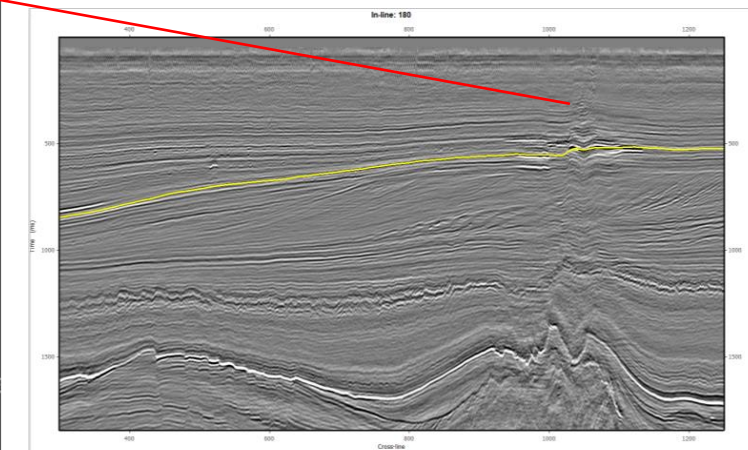
ATRIBUTOS SÍSMICOS 3D

Mapa de Atributo RMS
Sub Horizontal 03

Chaminés de Gas

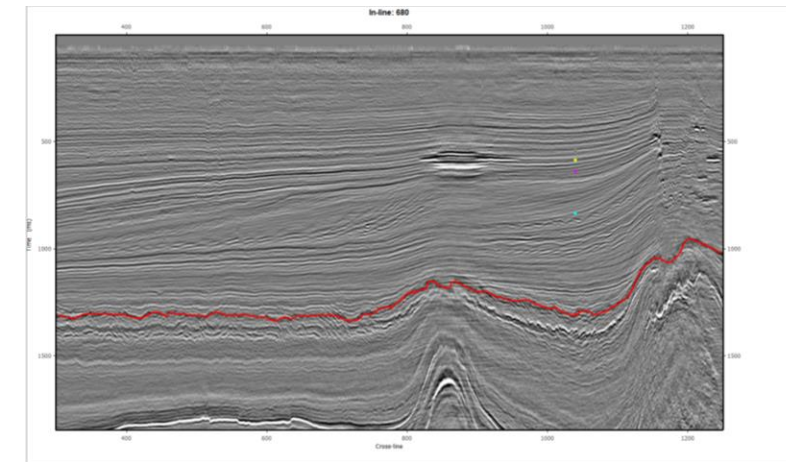
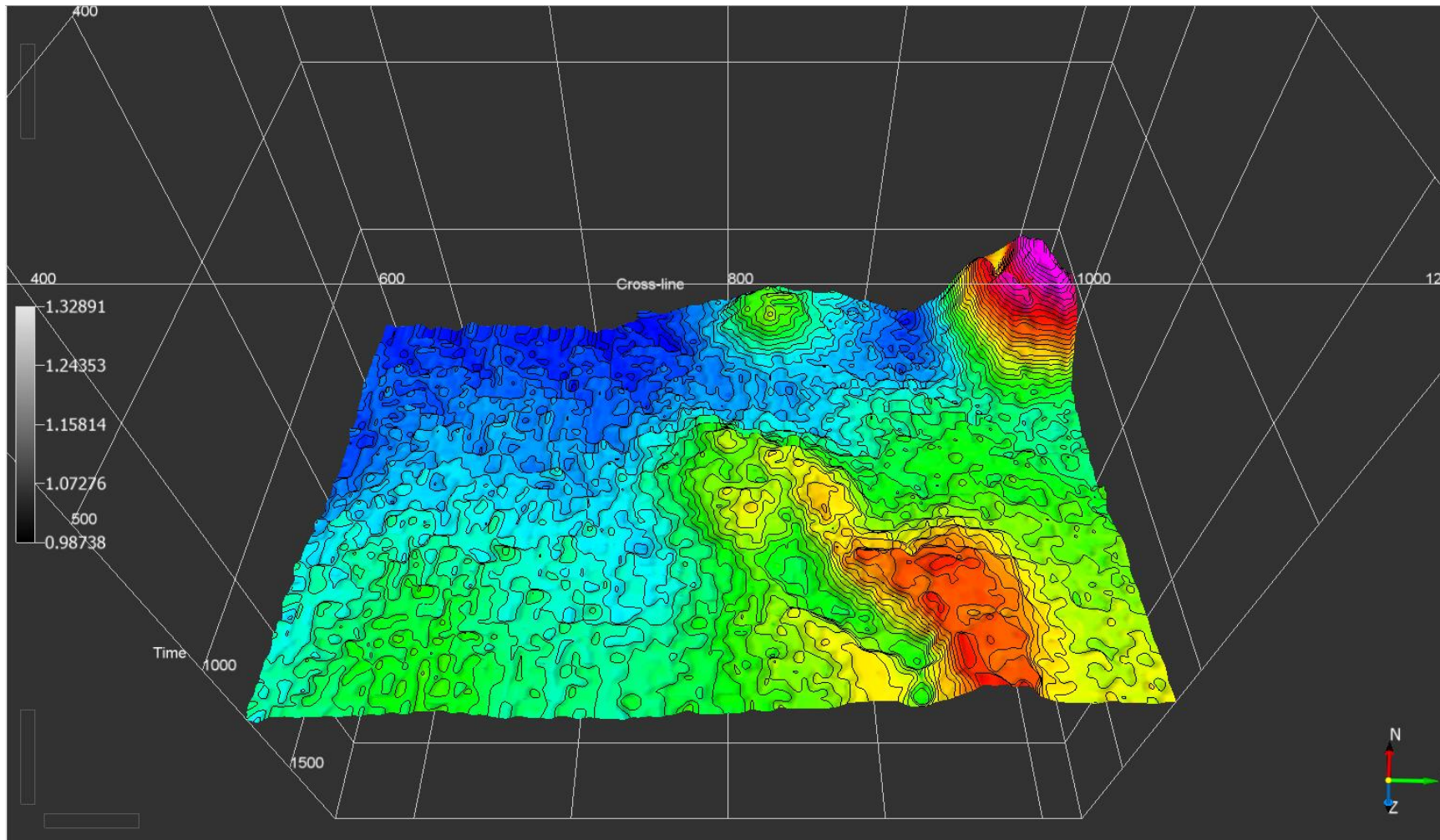


Sub Horizontal 03

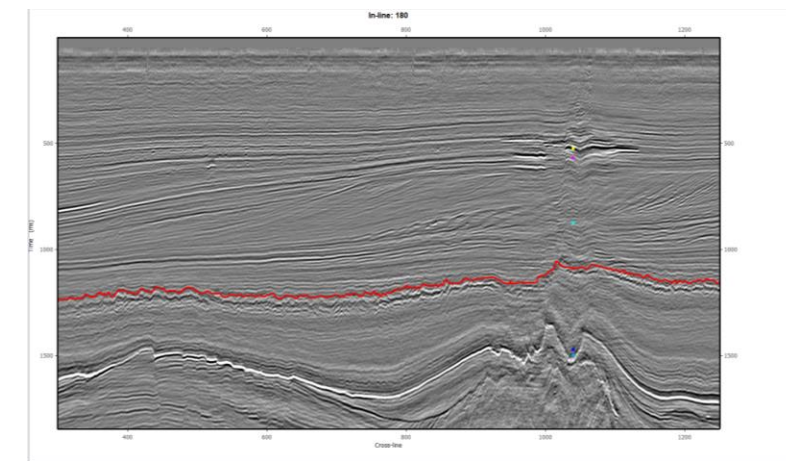


ATRIBUTOS SÍSMICOS 3D

Mapa estrutural
Topo dos Caóticos
IC = 20m

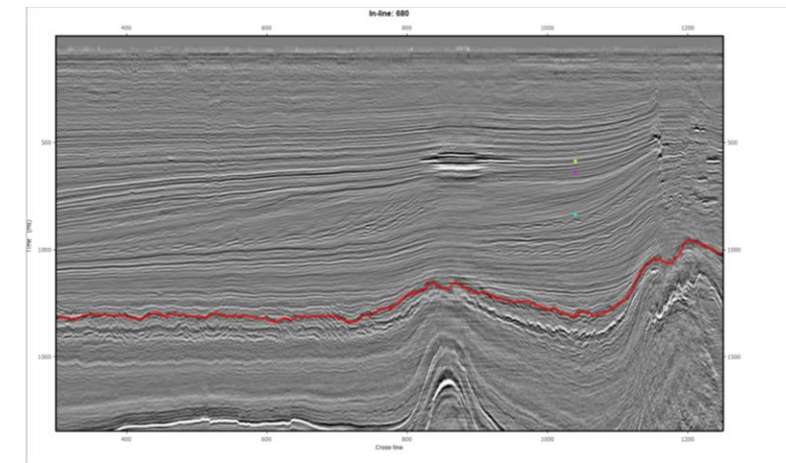
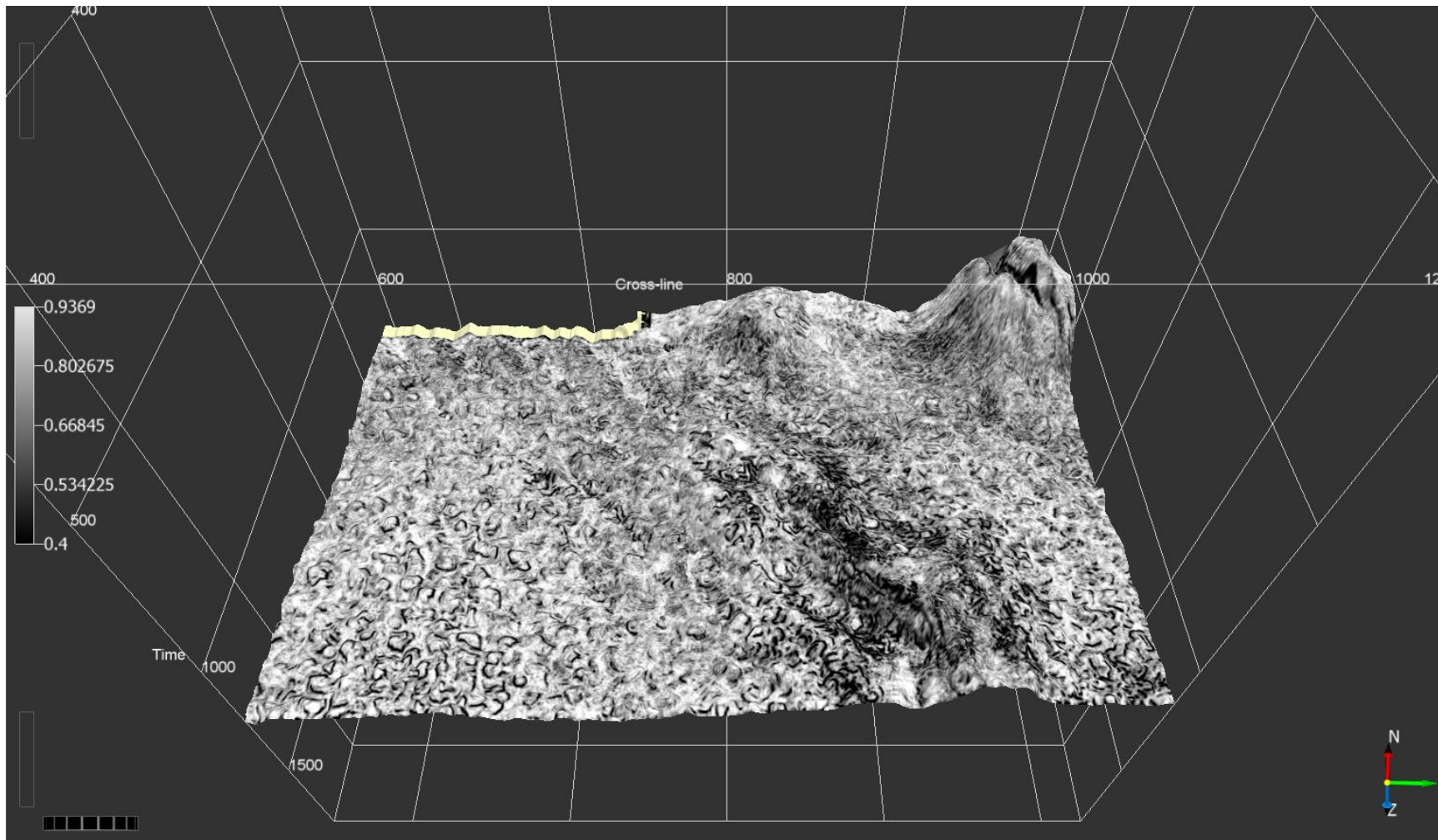


 Caóticos

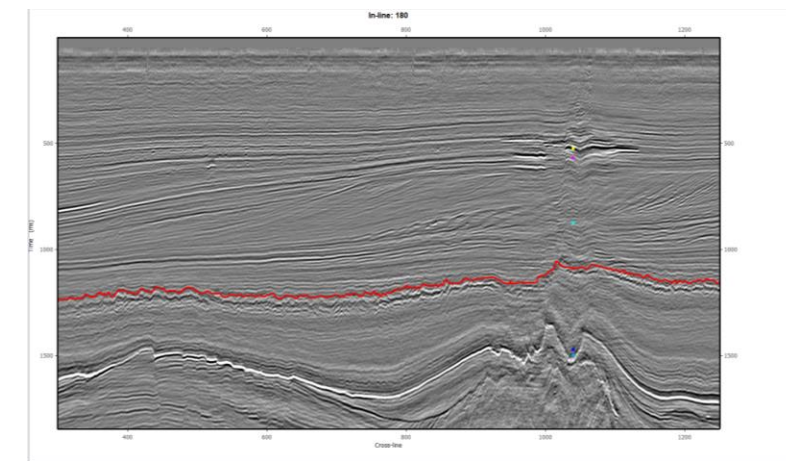


ATRIBUTOS SÍSMICOS 3D

Mapa de Atributos - Similaridade Caóticos



 Caóticos





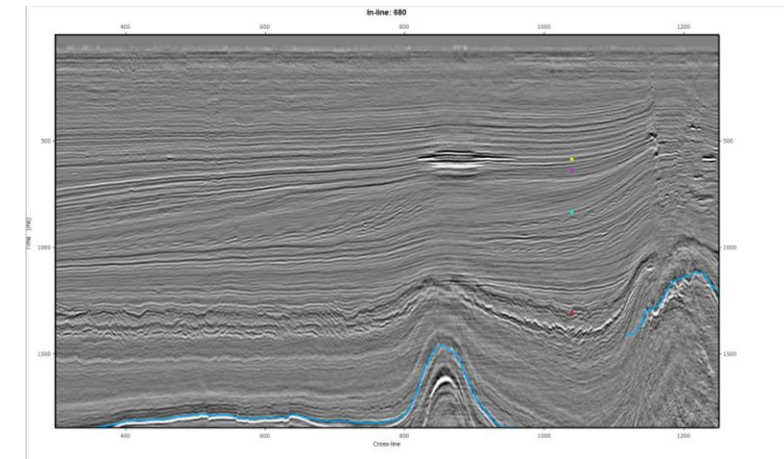
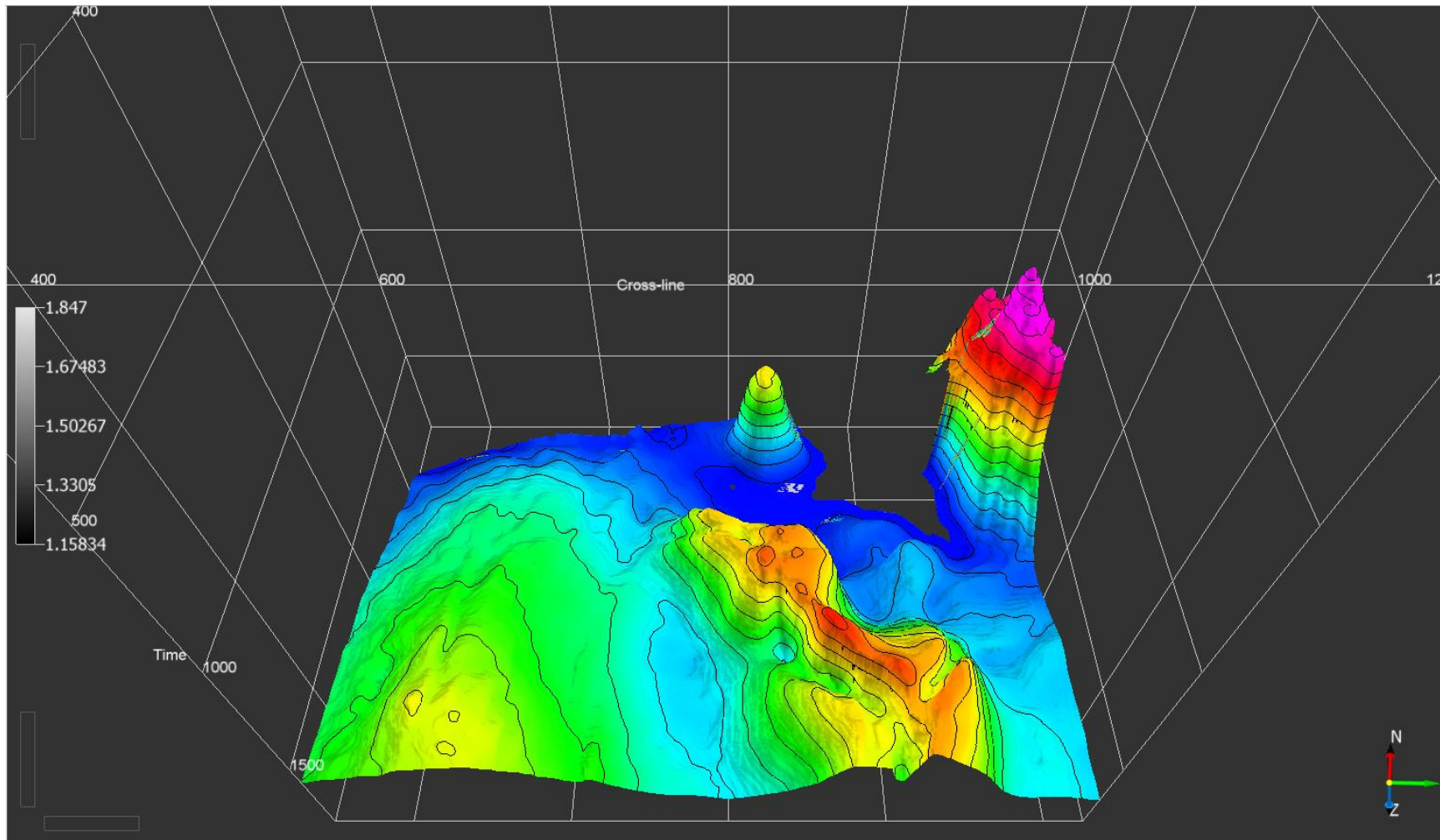
F3 Netherlands

Carbonatos

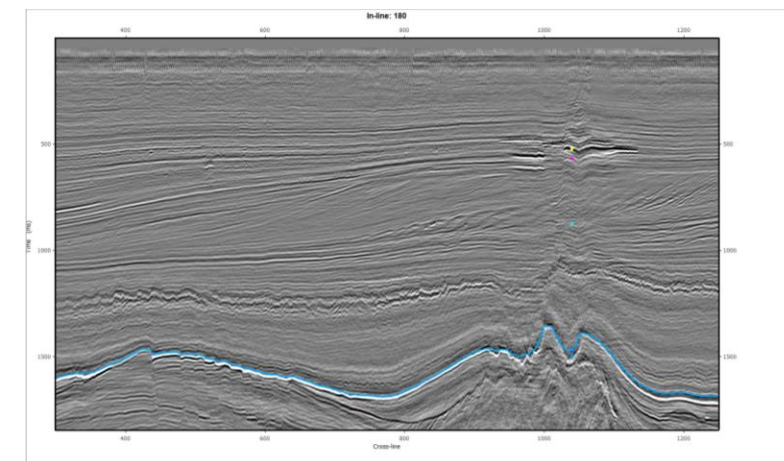
(Frequência)

ATRIBUTOS SÍSMICOS 3D

Mapa estrutural
Topo dos Carbonatos
(IC = 40 m)

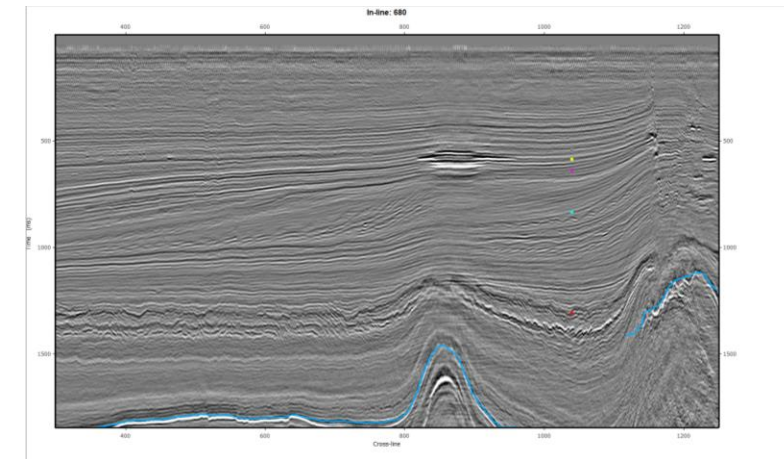
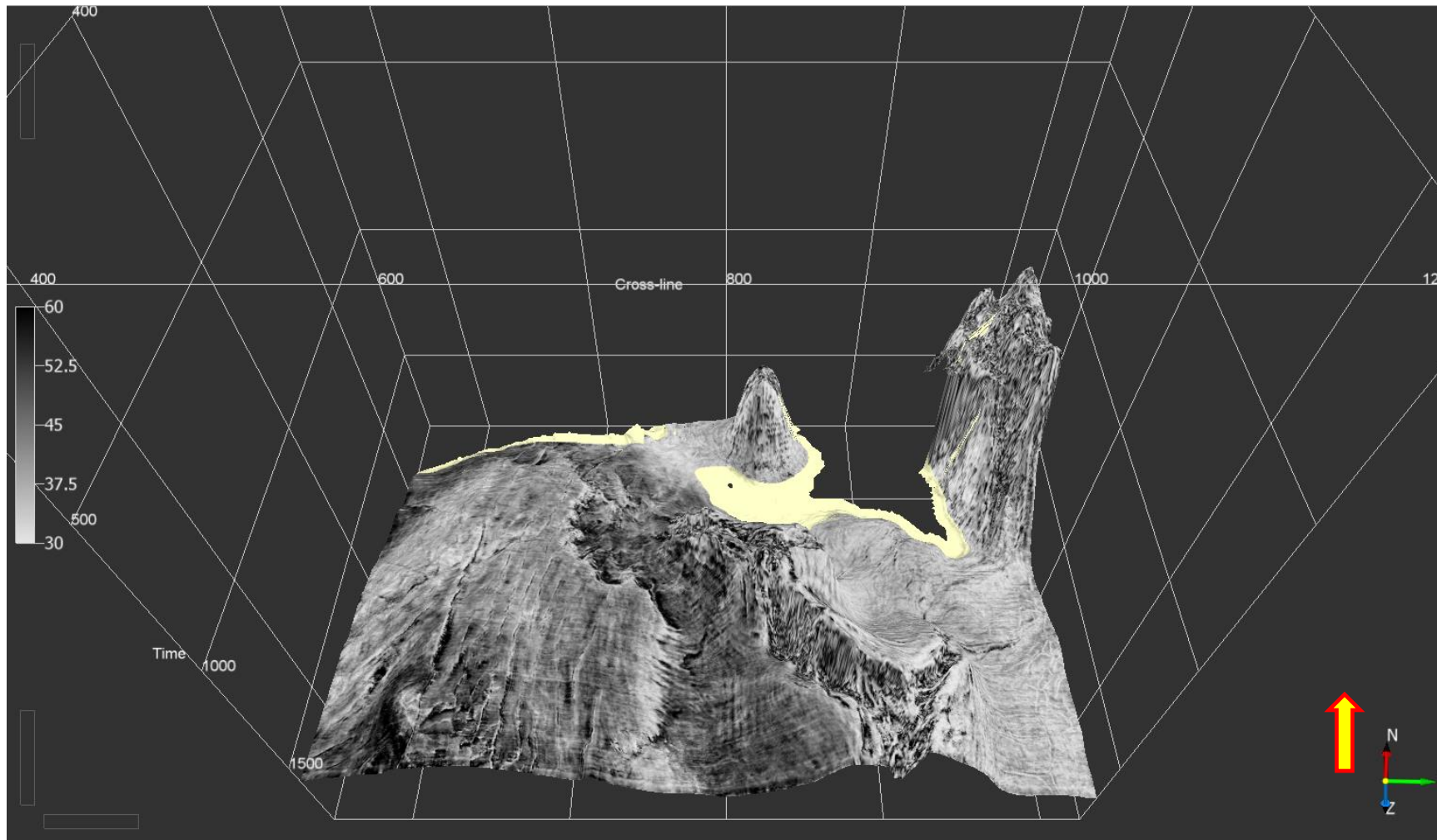


 Topo dos Carbonatos

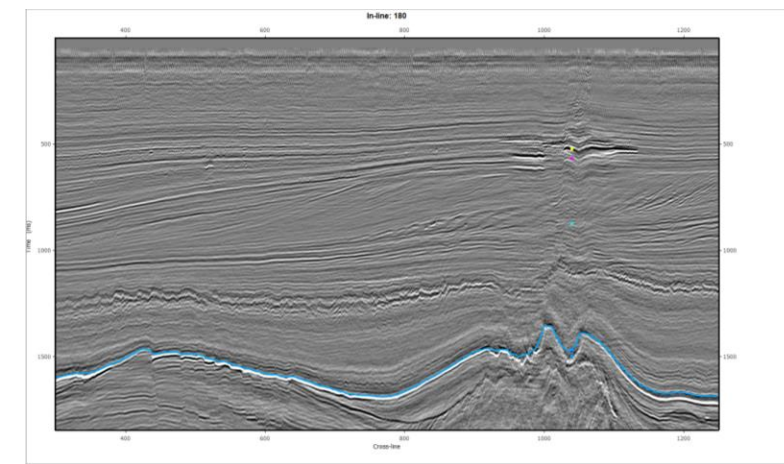


ATRIBUTOS SÍSMICOS 3D

Mapa de Atributos – Frequências Médias
Topo dos Carbonatos
(30 Hz – 60 Hz)

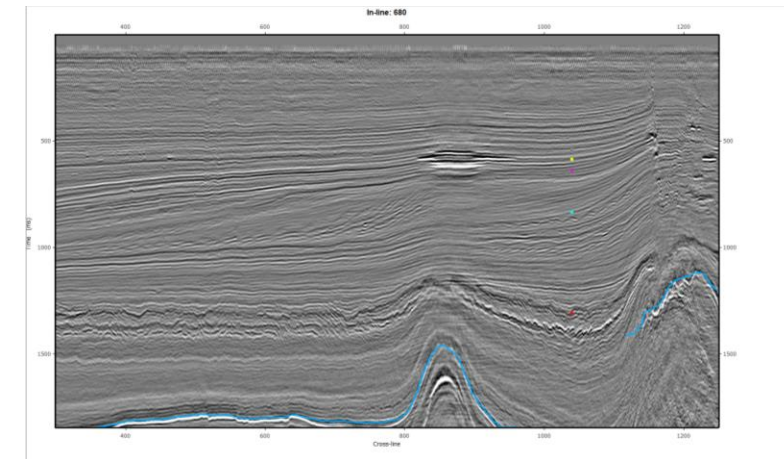
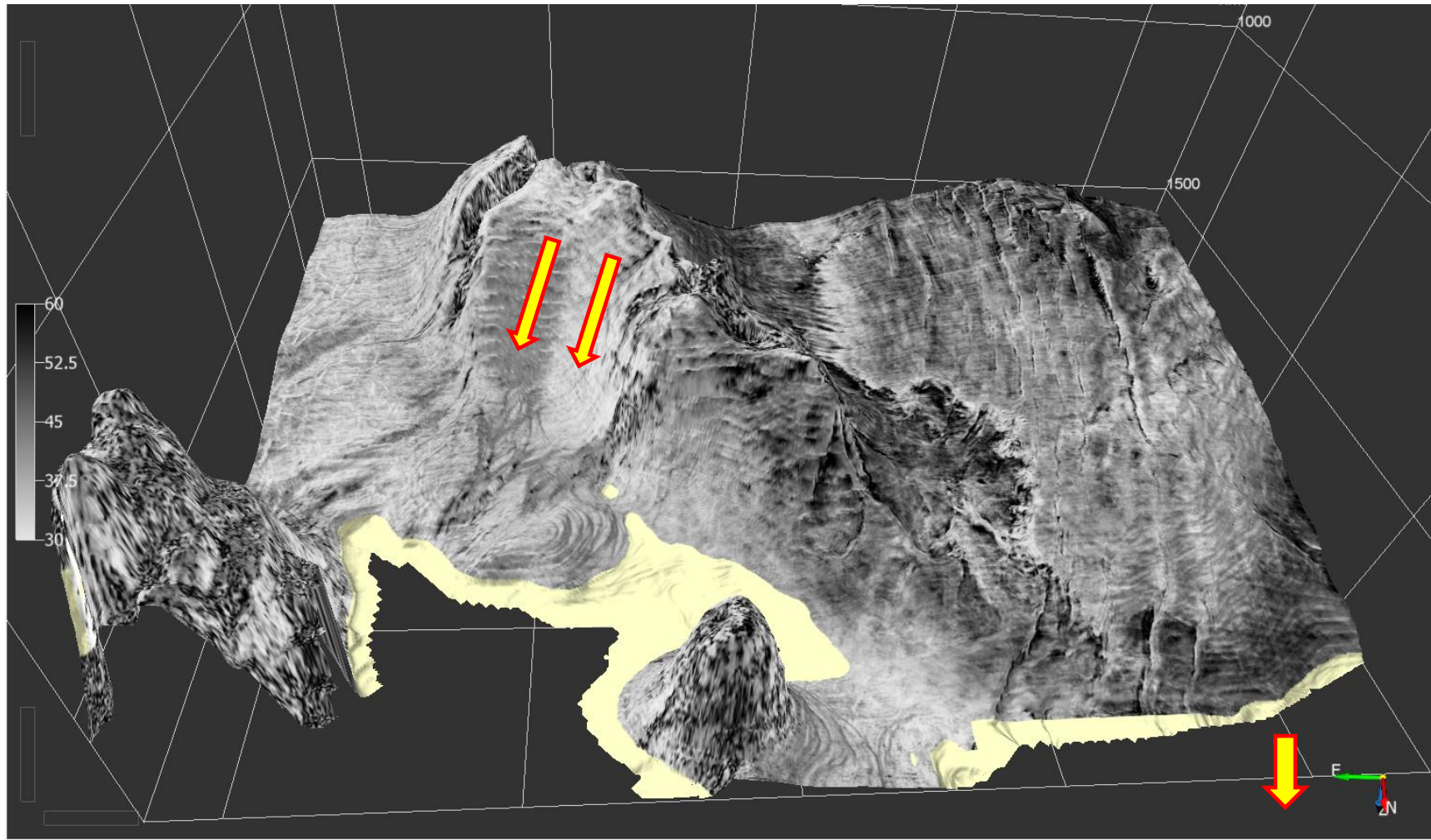



 Topo dos Carbonatos

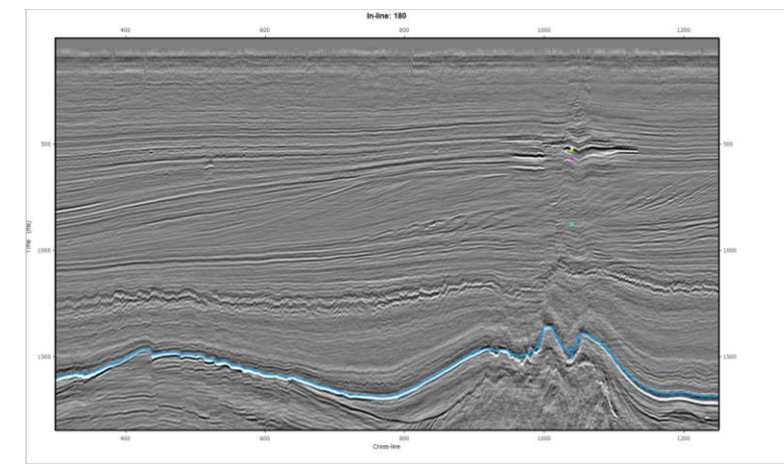


ATRIBUTOS SÍSMICOS 3D

Mapa de Atributos – Frequências Médias
Topo dos Carbonatos
(30 Hz – 60 Hz)

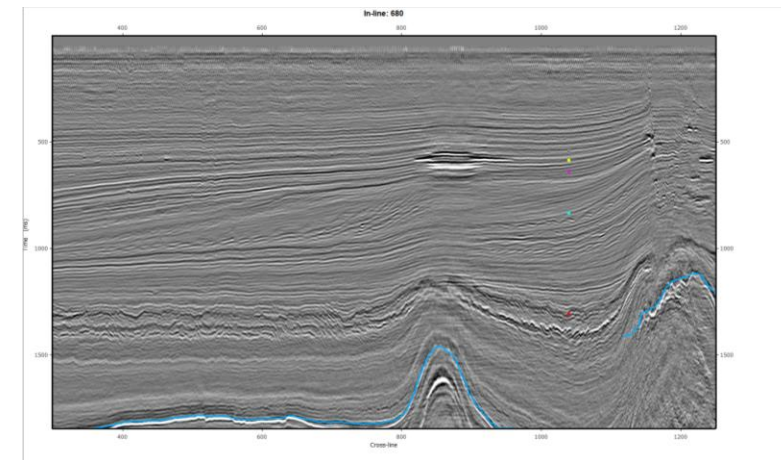
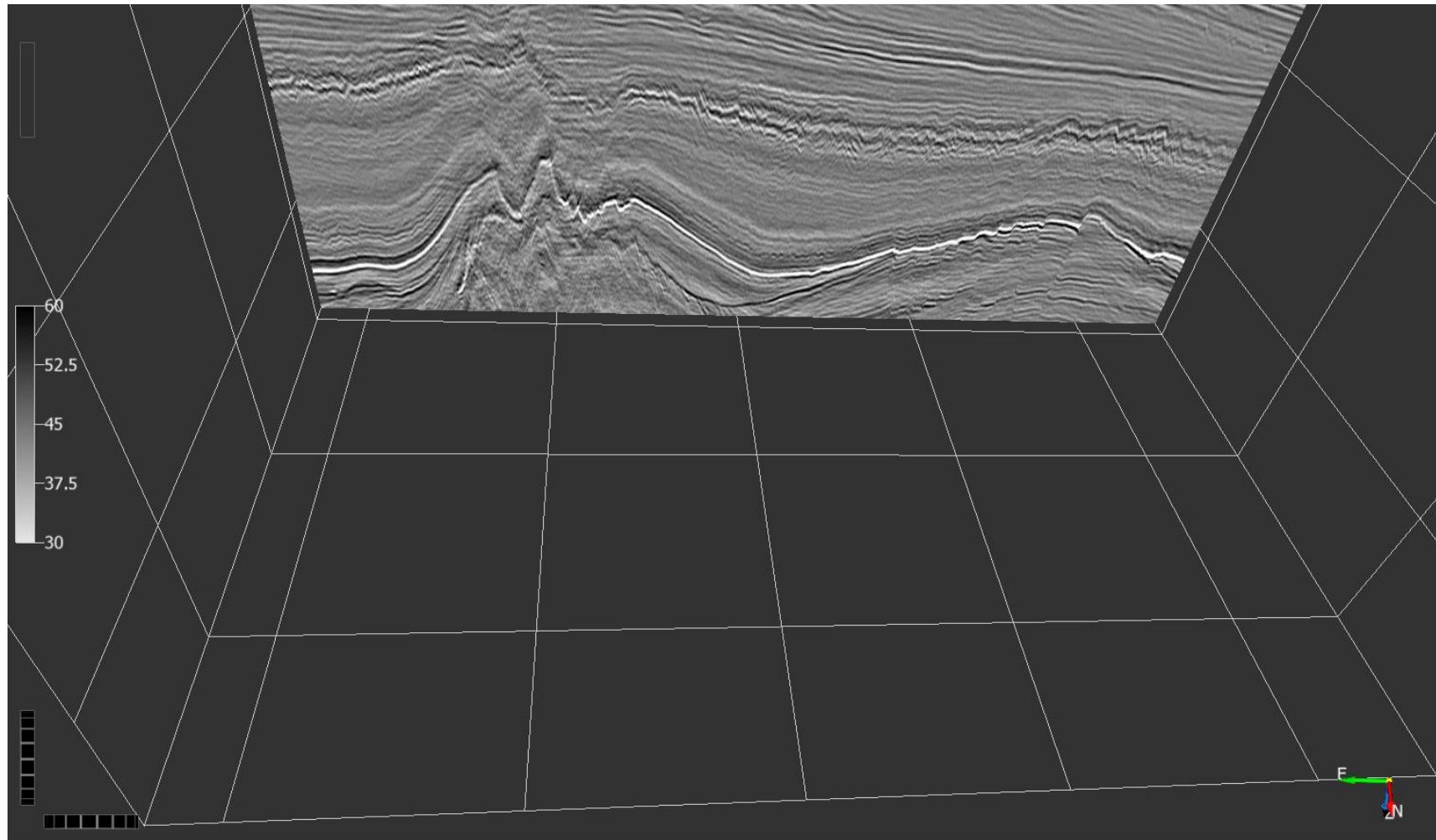



 Topo dos Carbonatos

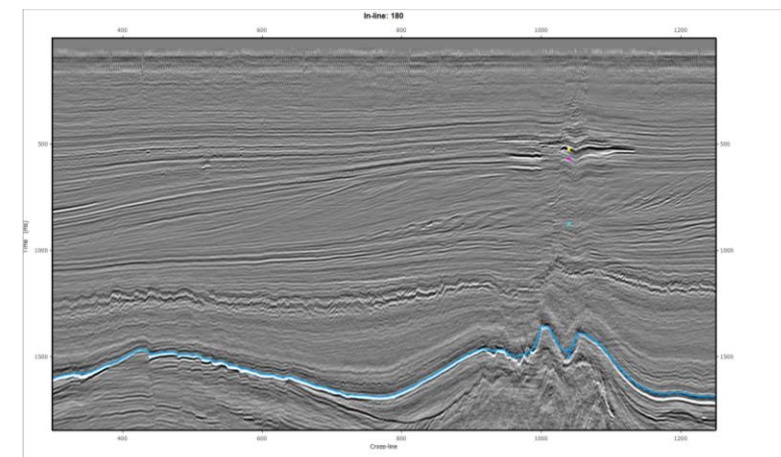


ATRIBUTOS SÍSMICOS 3D

Mapa de Atributos – Frequências Médias
Topo dos Carbonatos
(30 Hz – 60 Hz)

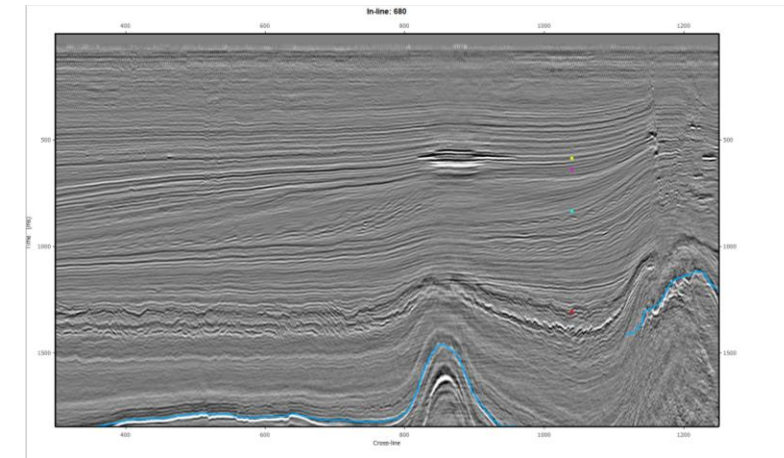
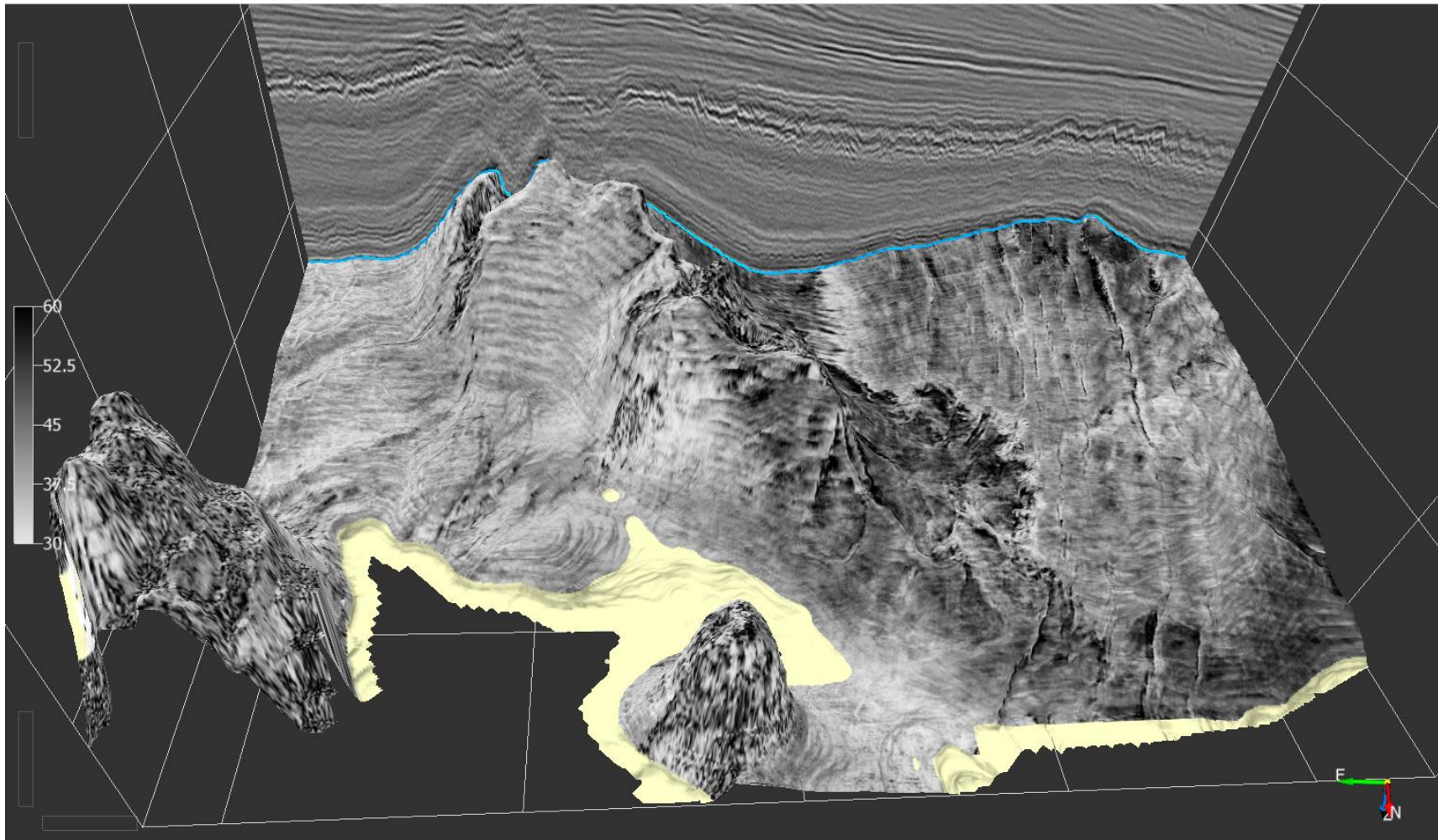



 Topo dos Carbonatos

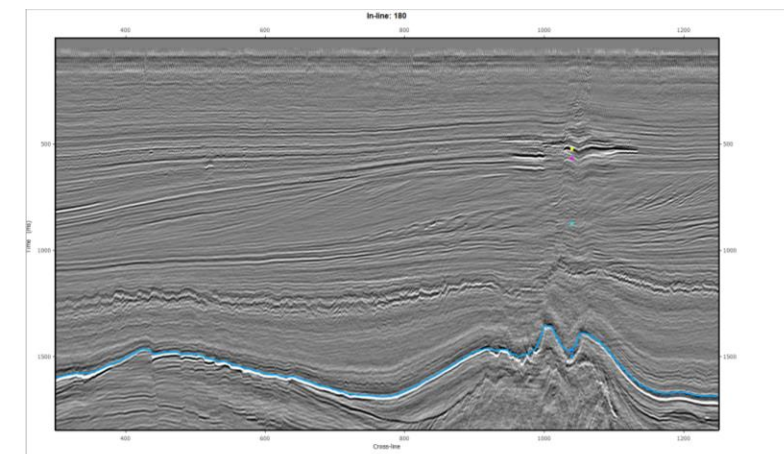


ATRIBUTOS SÍSMICOS 3D

Mapa de Atributos – Frequências Médias
Topo dos Carbonatos
(30 Hz – 60 Hz)

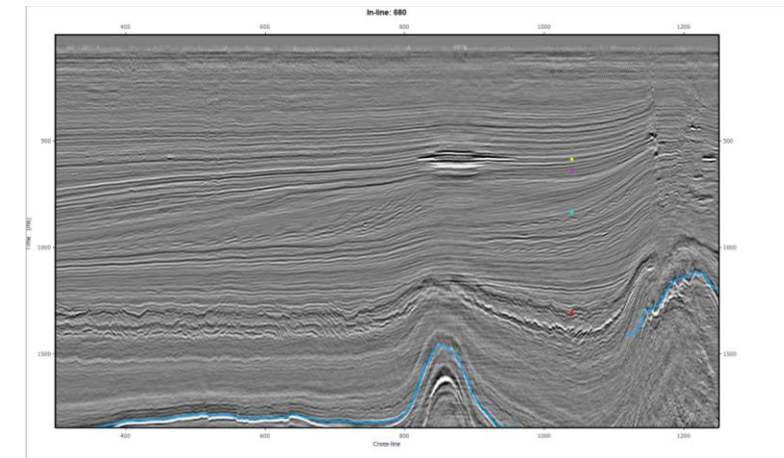
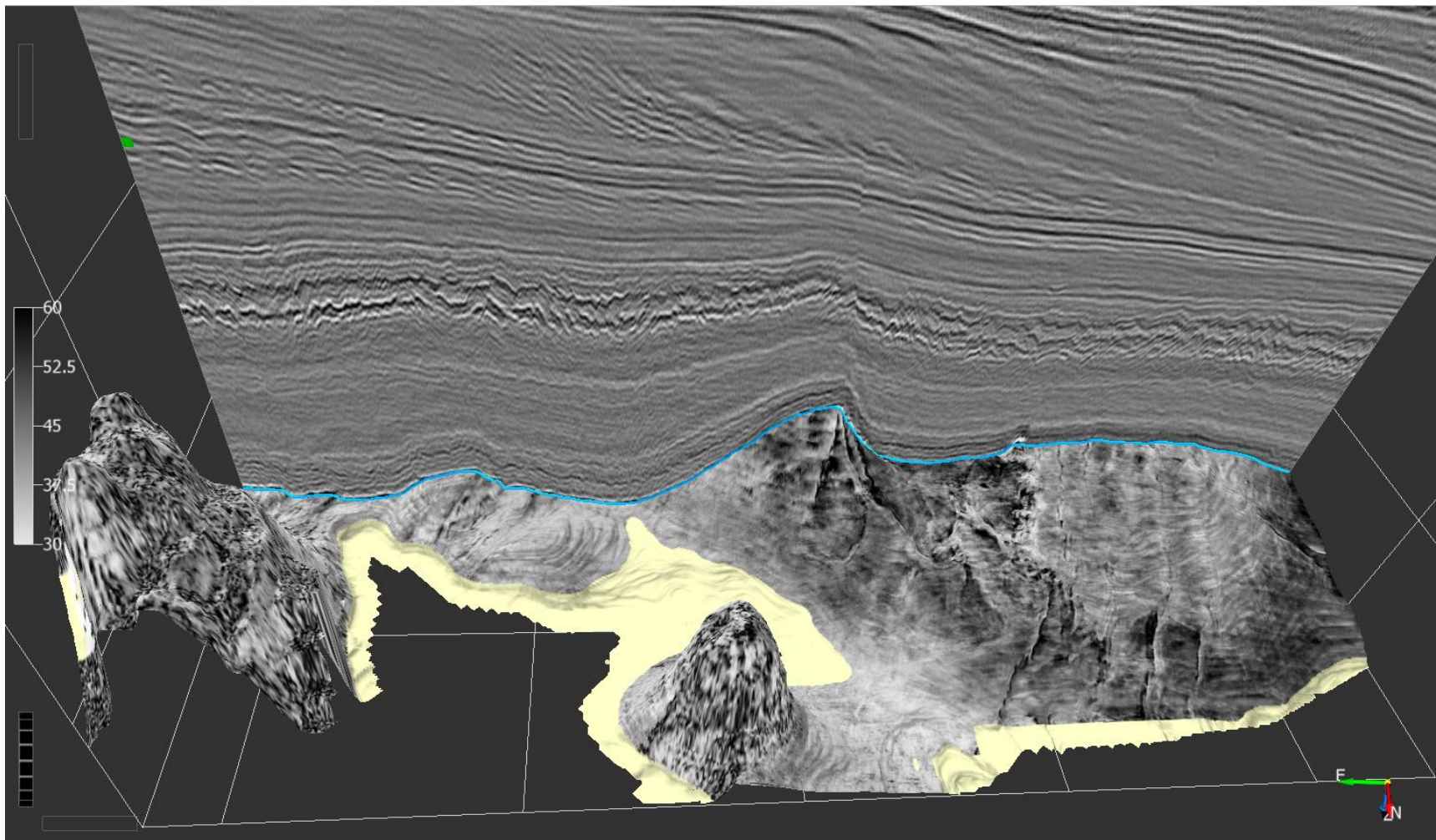


 Topo dos Carbonatos

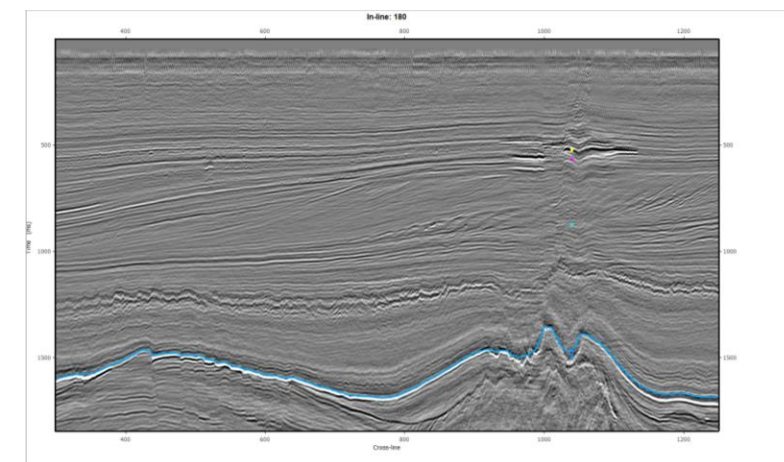


ATRIBUTOS SÍSMICOS 3D

Mapa de Atributos – Frequências Médias
Topo dos Carbonatos
(30 Hz – 60 Hz)

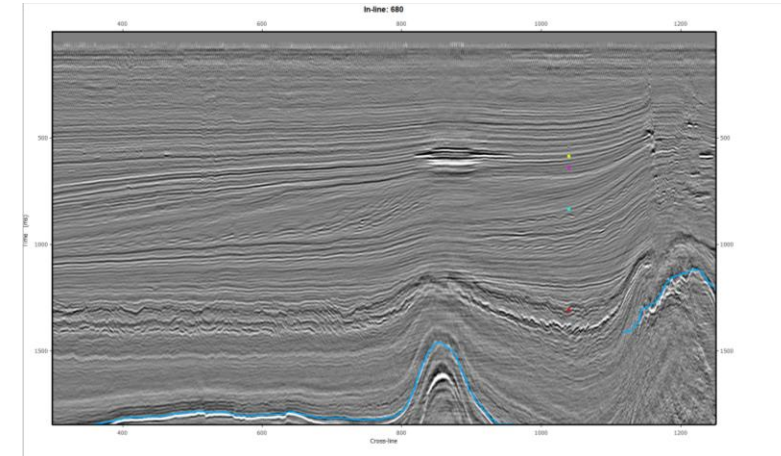
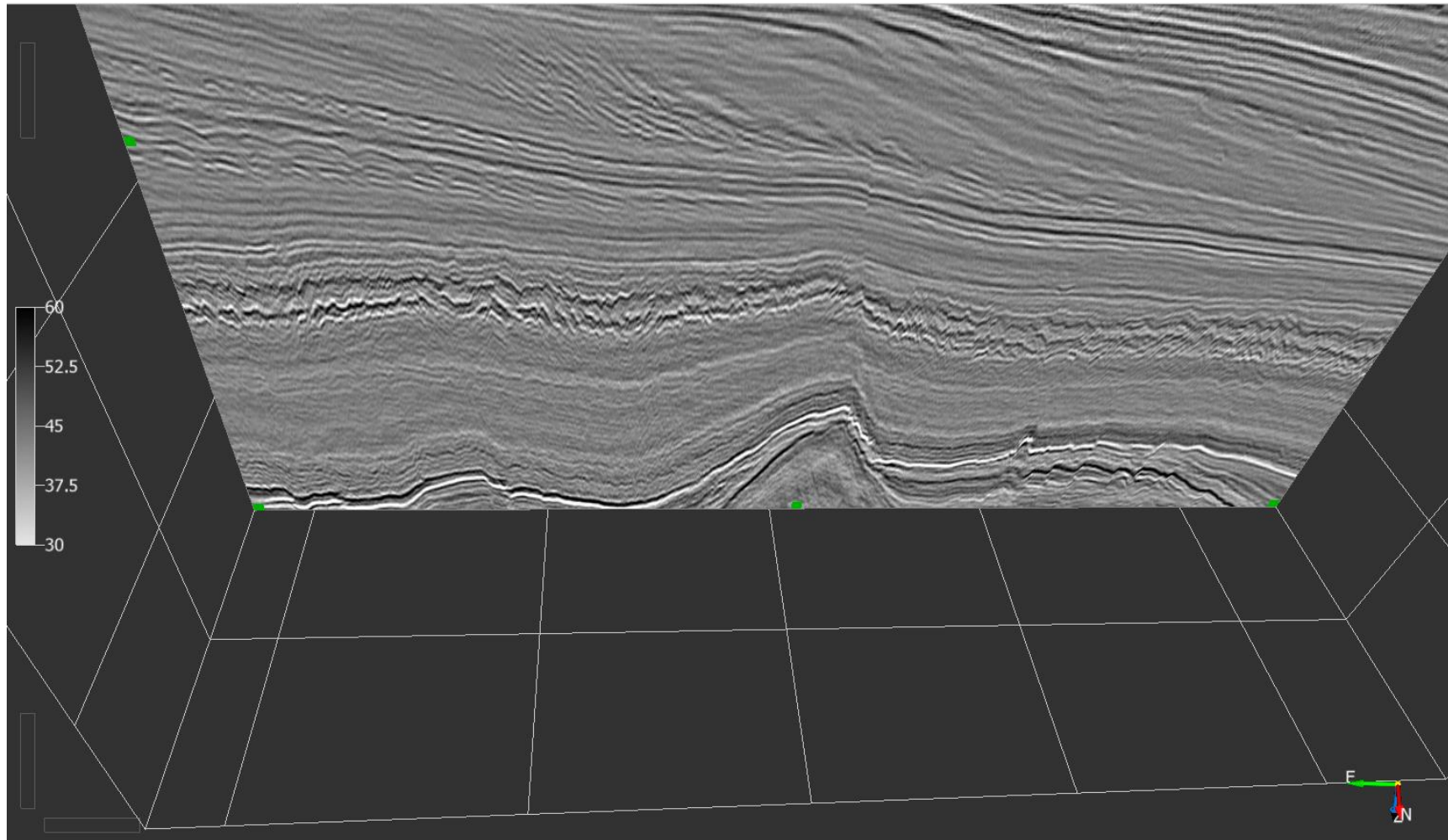



 Topo dos Carbonatos

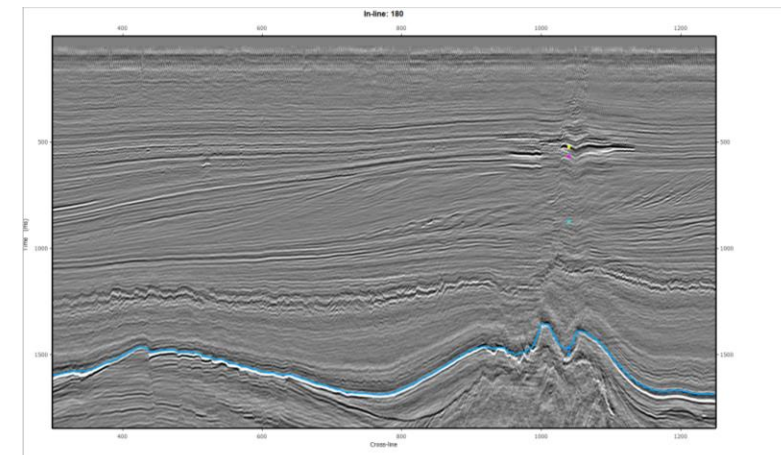


ATRIBUTOS SÍSMICOS 3D

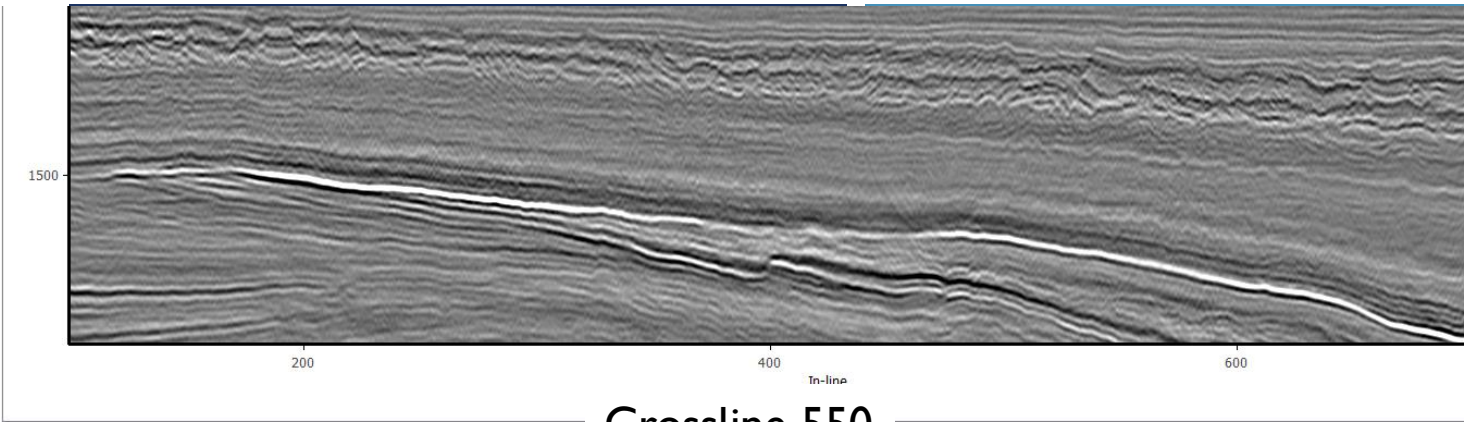
Mapa de Atributos – Frequências Médias
Topo dos Carbonatos
(30 Hz – 60 Hz)



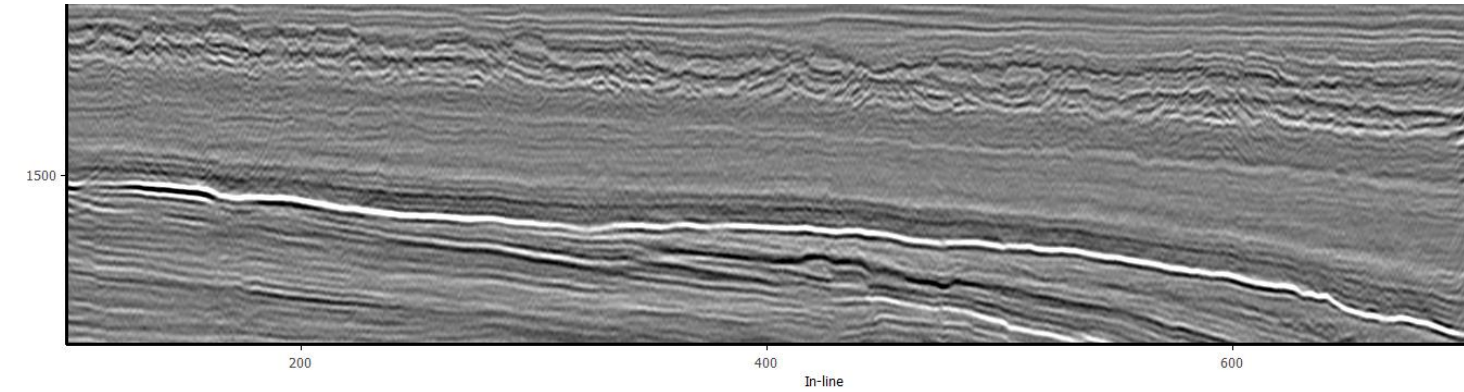
 Topo dos Carbonatos



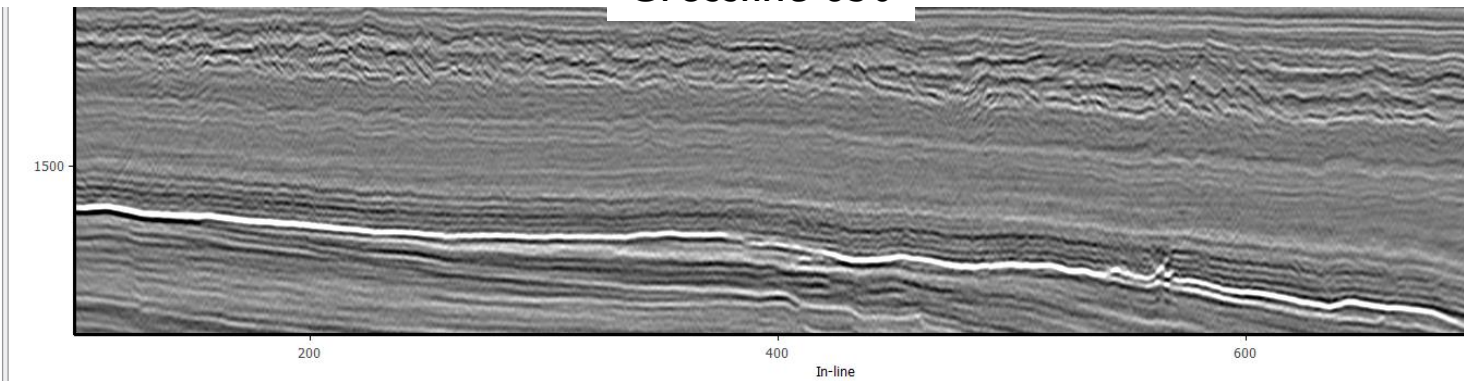
Crossline 450



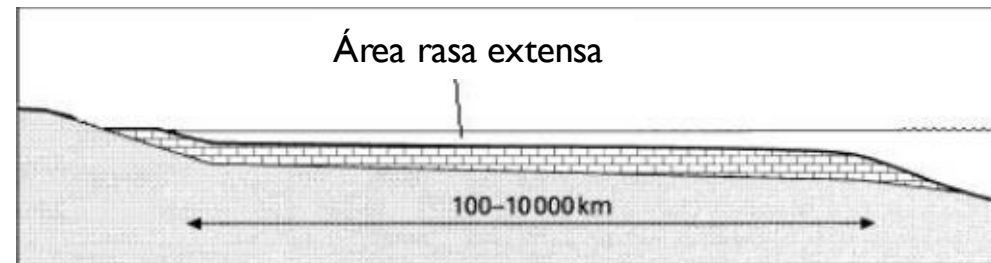
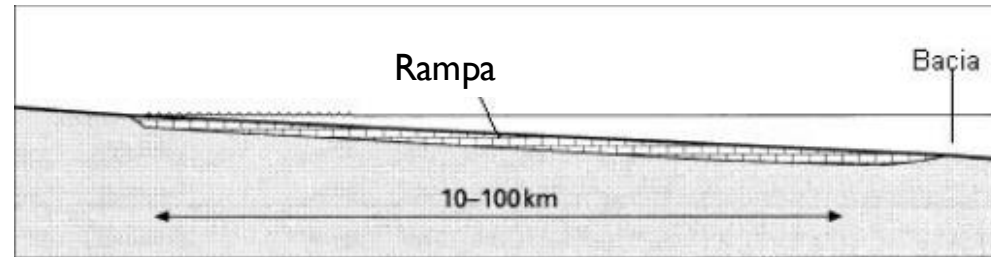
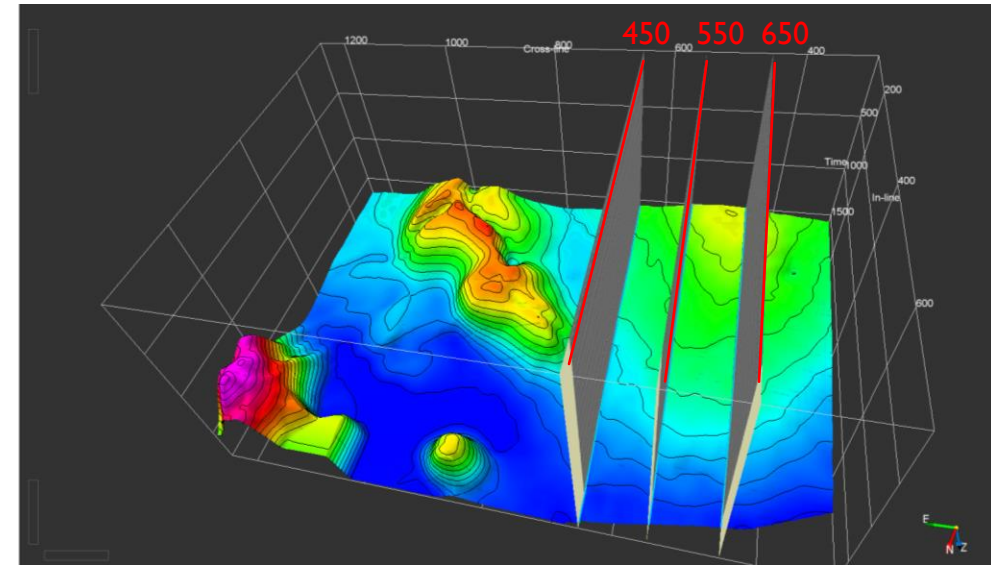
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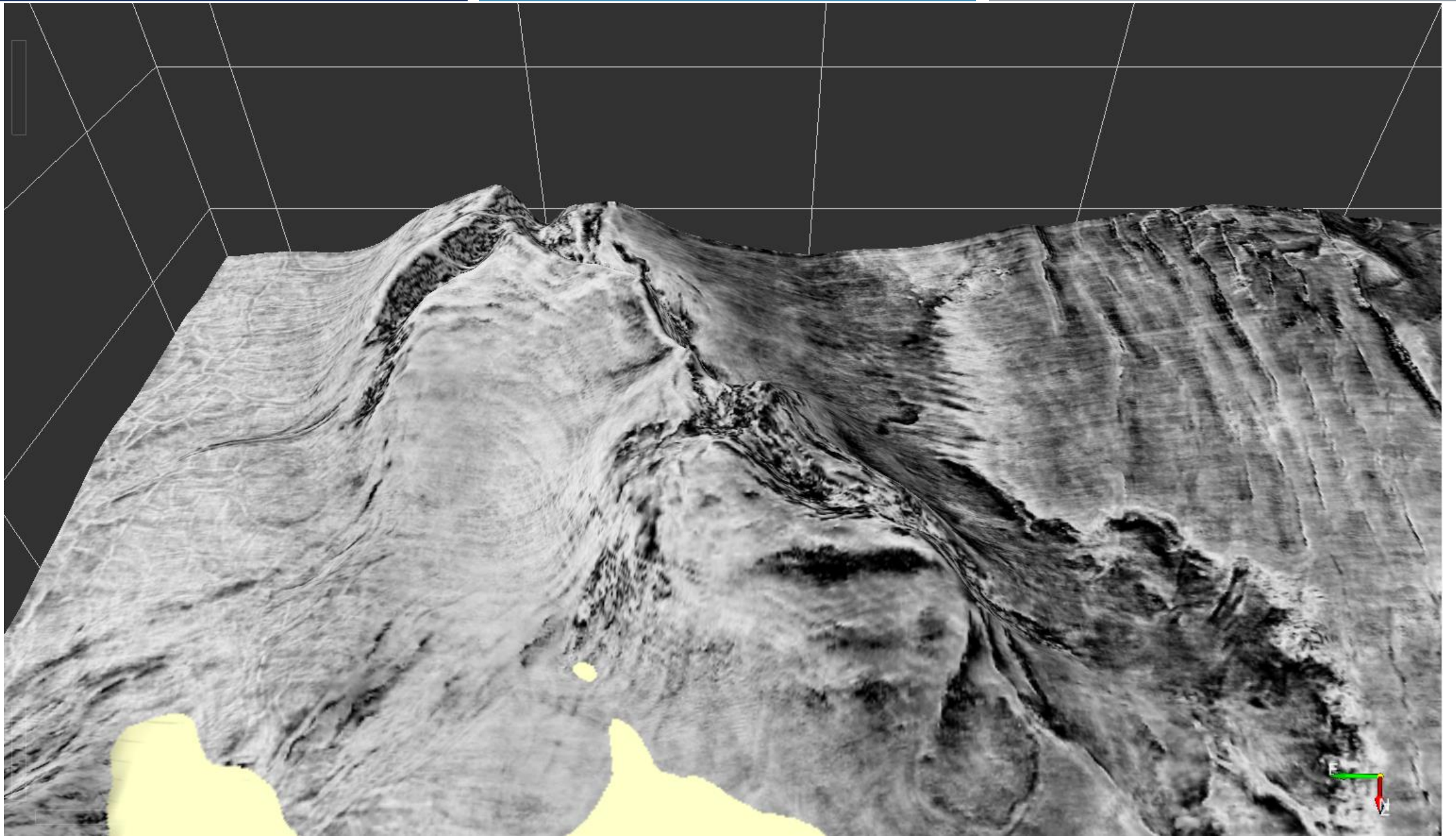


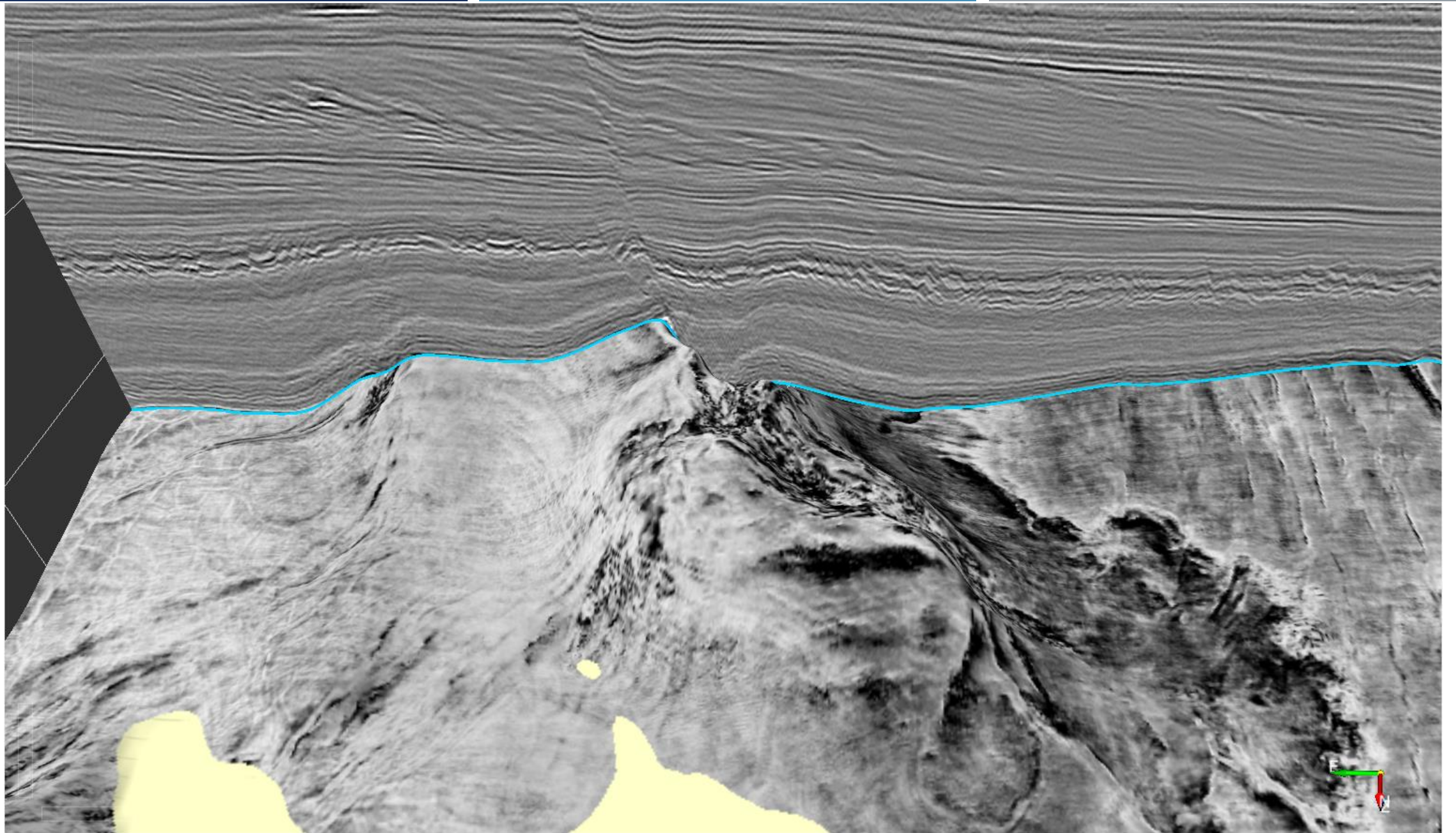
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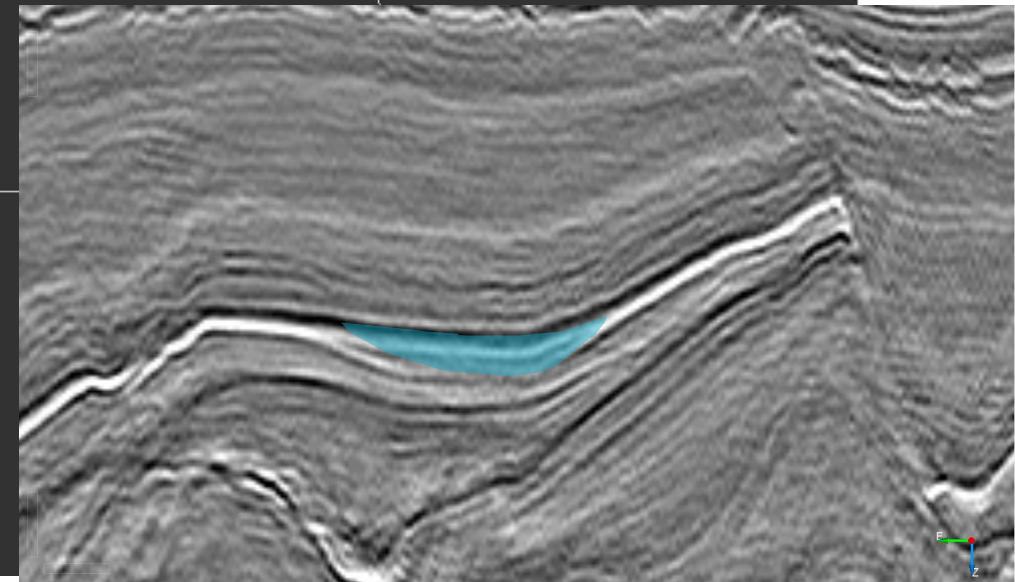
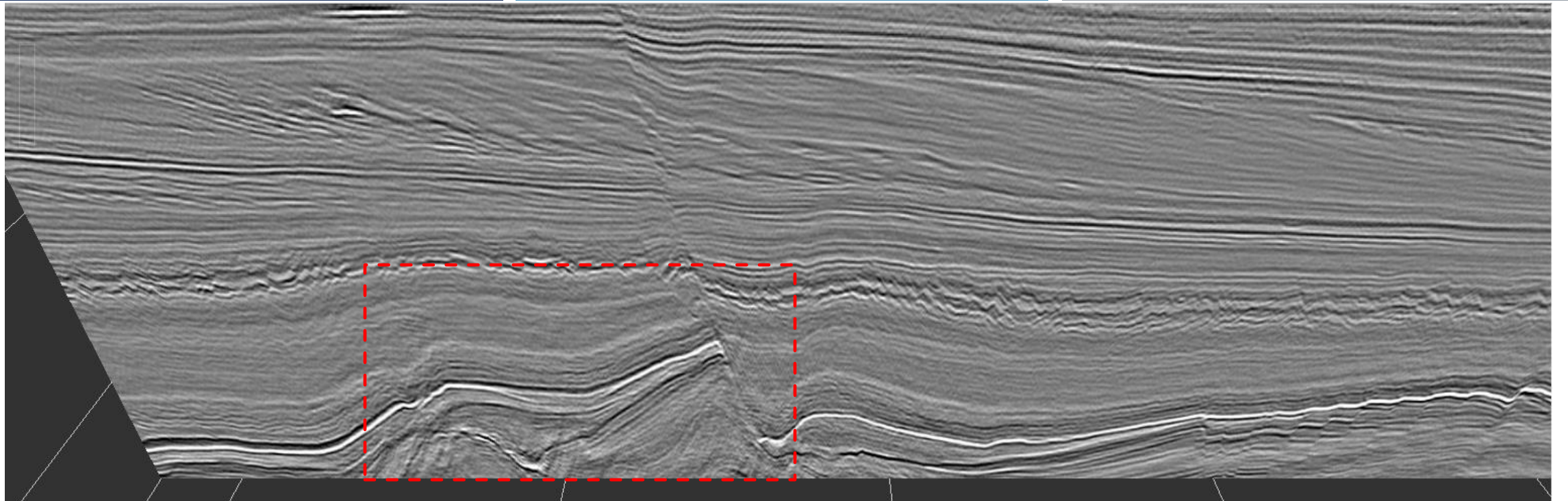


Rampa Carbonática









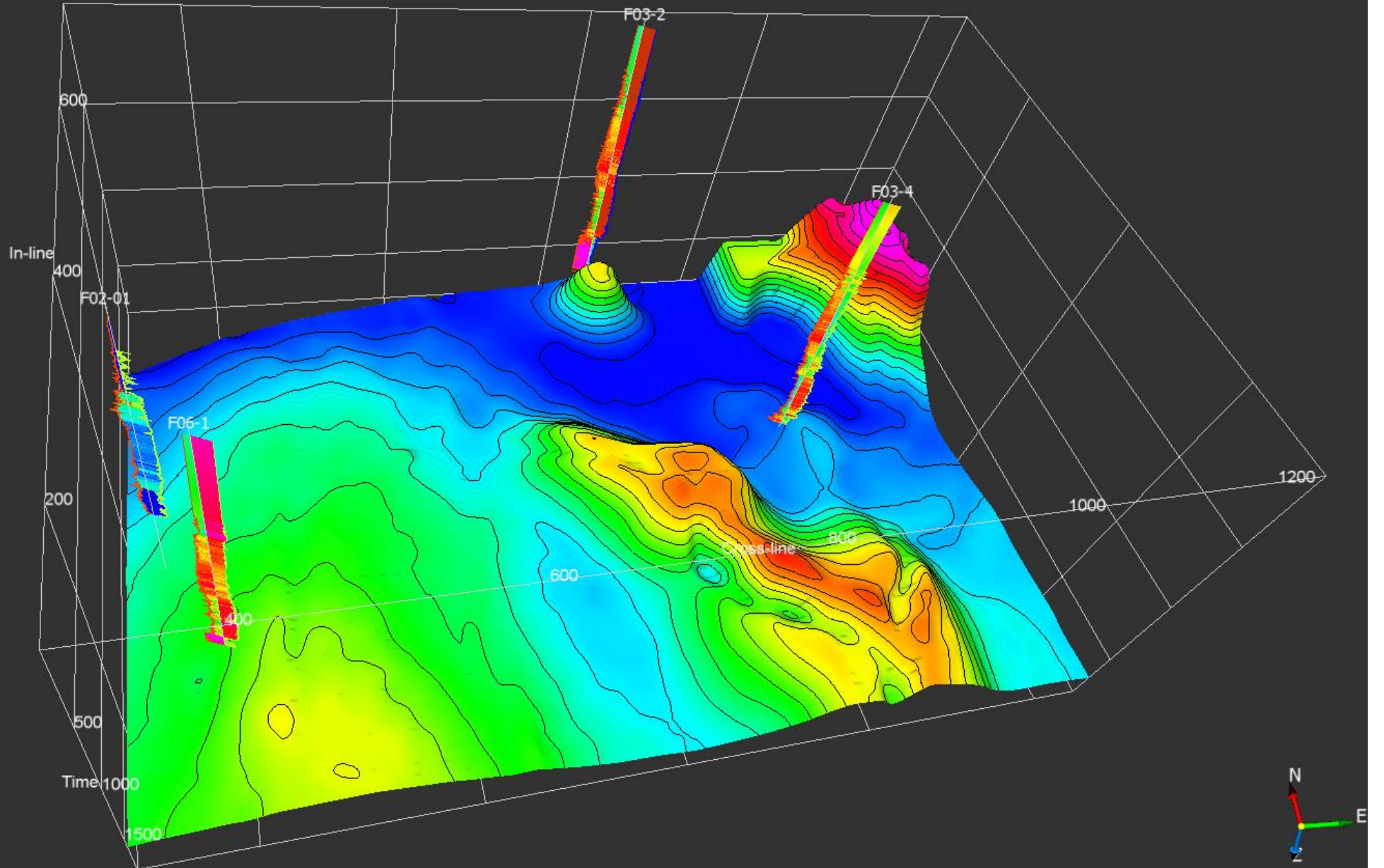


F3 Netherlands

Poços

F3 - LOCALIZAÇÃO DOS POÇOS

Density
Gamma Ray
P-Impedance
P-Impedance_rel
Porosity
Sonic

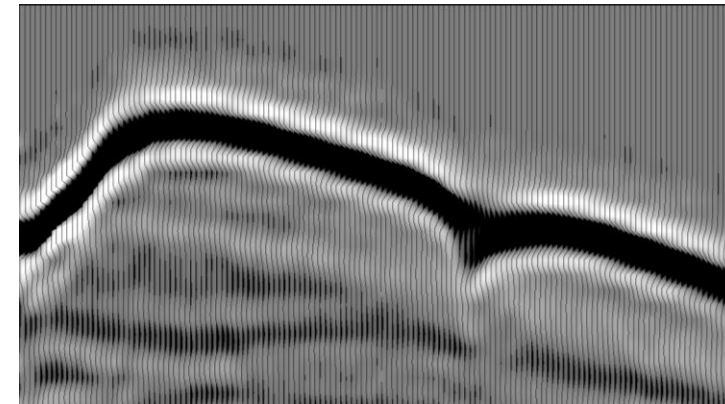
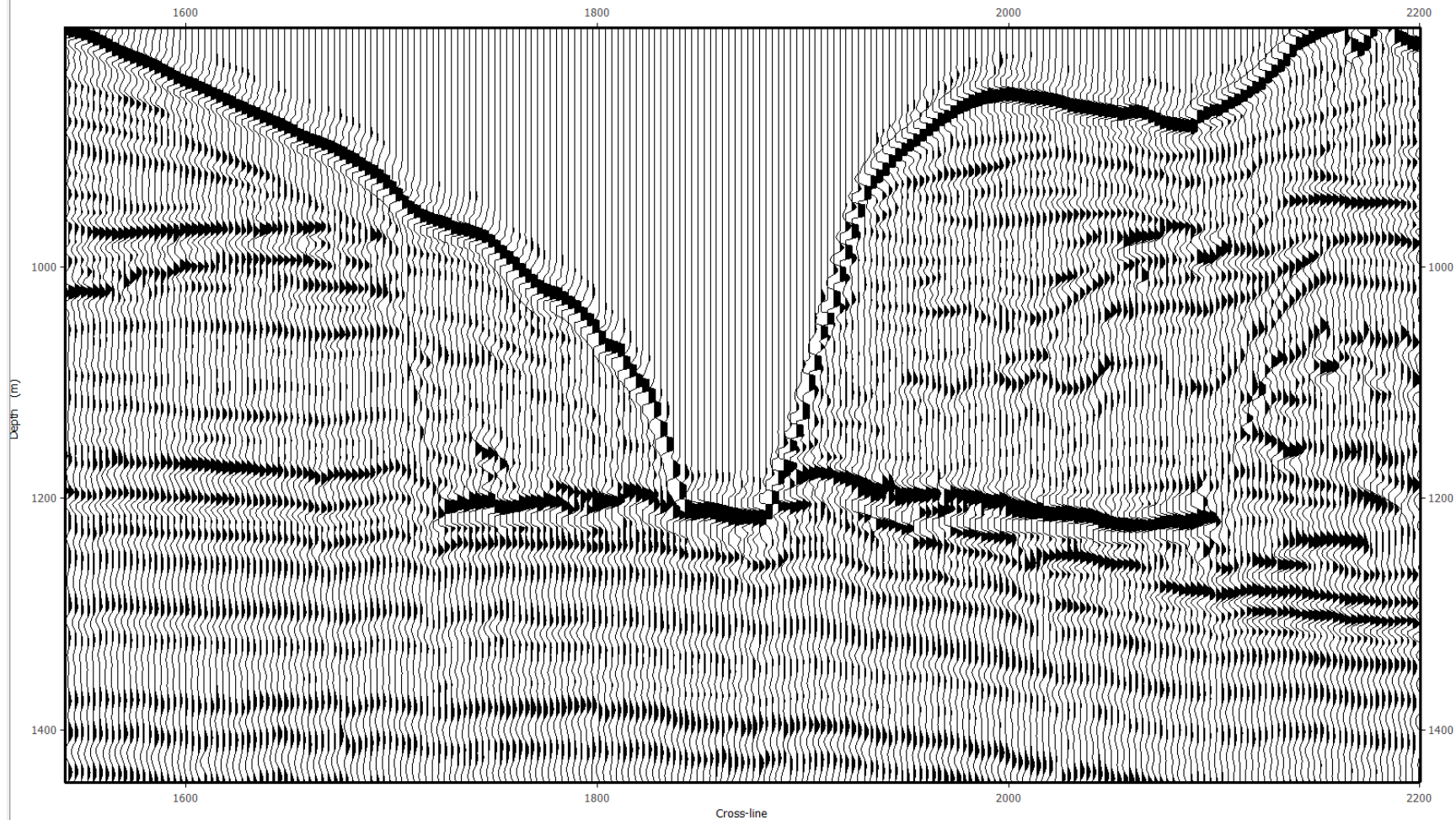


FEIÇÕES SÍSMICAS ENCONTRADAS NA AVALIAÇÃO DOS DATASETS

- Crateras de Impacto
- Estruturas Anticlinais
- Domos de Sal
- Estudo de Fácies Sísmicas (Siliciclásticos e Carbonatos)
- Bright Spots
- Flat Spots
- Falhas
- Canais
- Estratigrafia de Sequências
- Chaminés de gás
- Build ups carbonáticos
- Transporte de Massa (Turbiditos, Leques, Deltas, etc)
- Rochas Vulcânicas (Tipo Vitória-régia)

ADMIRÁVEL MUNDO ANTIGO...

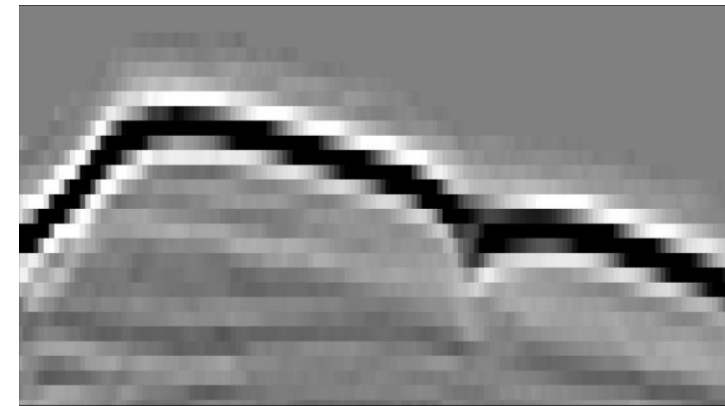
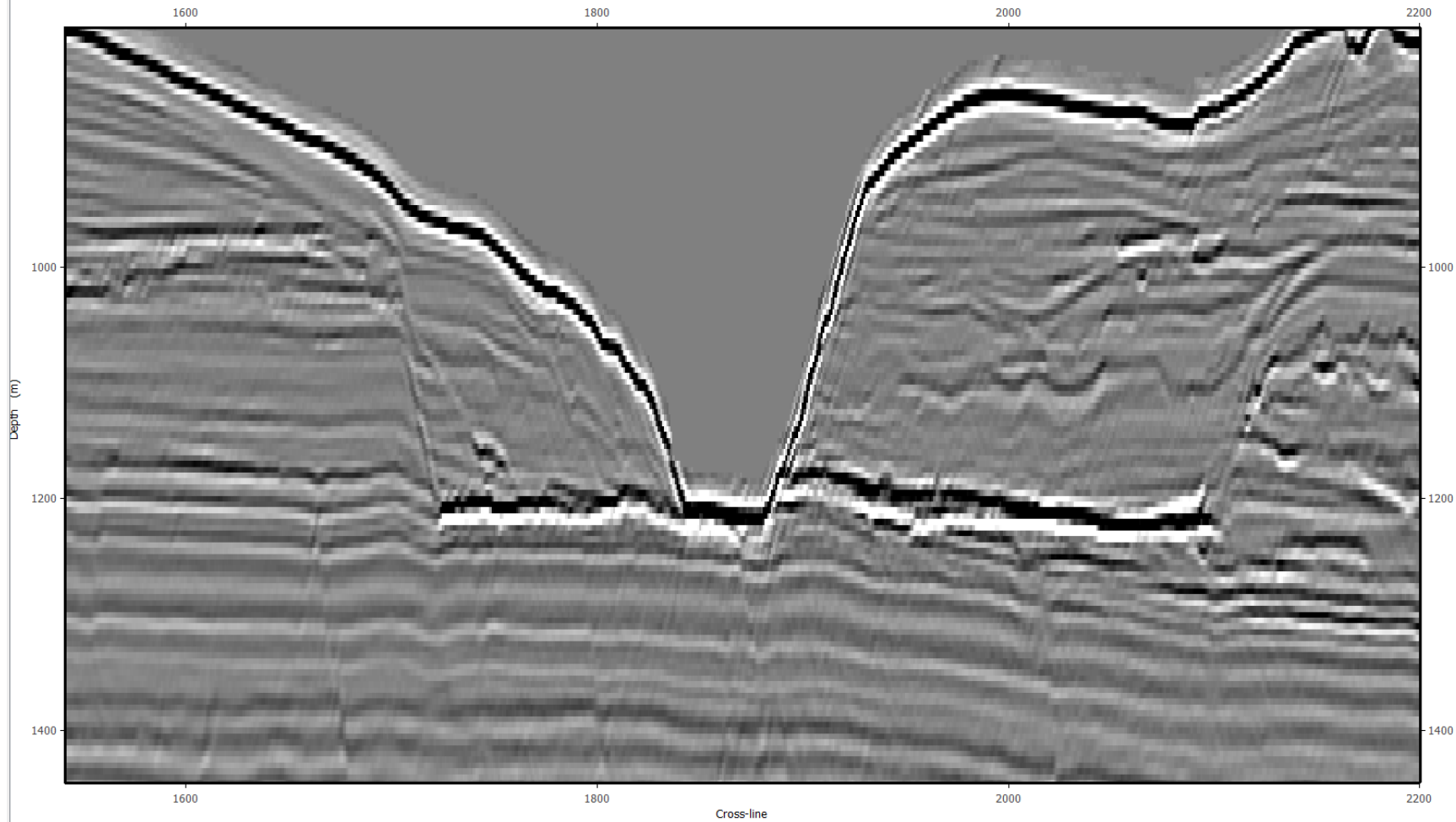
In-line: 1186



Traços - Wiggle

ADMIRÁVEL MUNDO NOVO...

In-line: 1186



Voxels - Pixels



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1899 - 2024

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TECNOLOGICAS