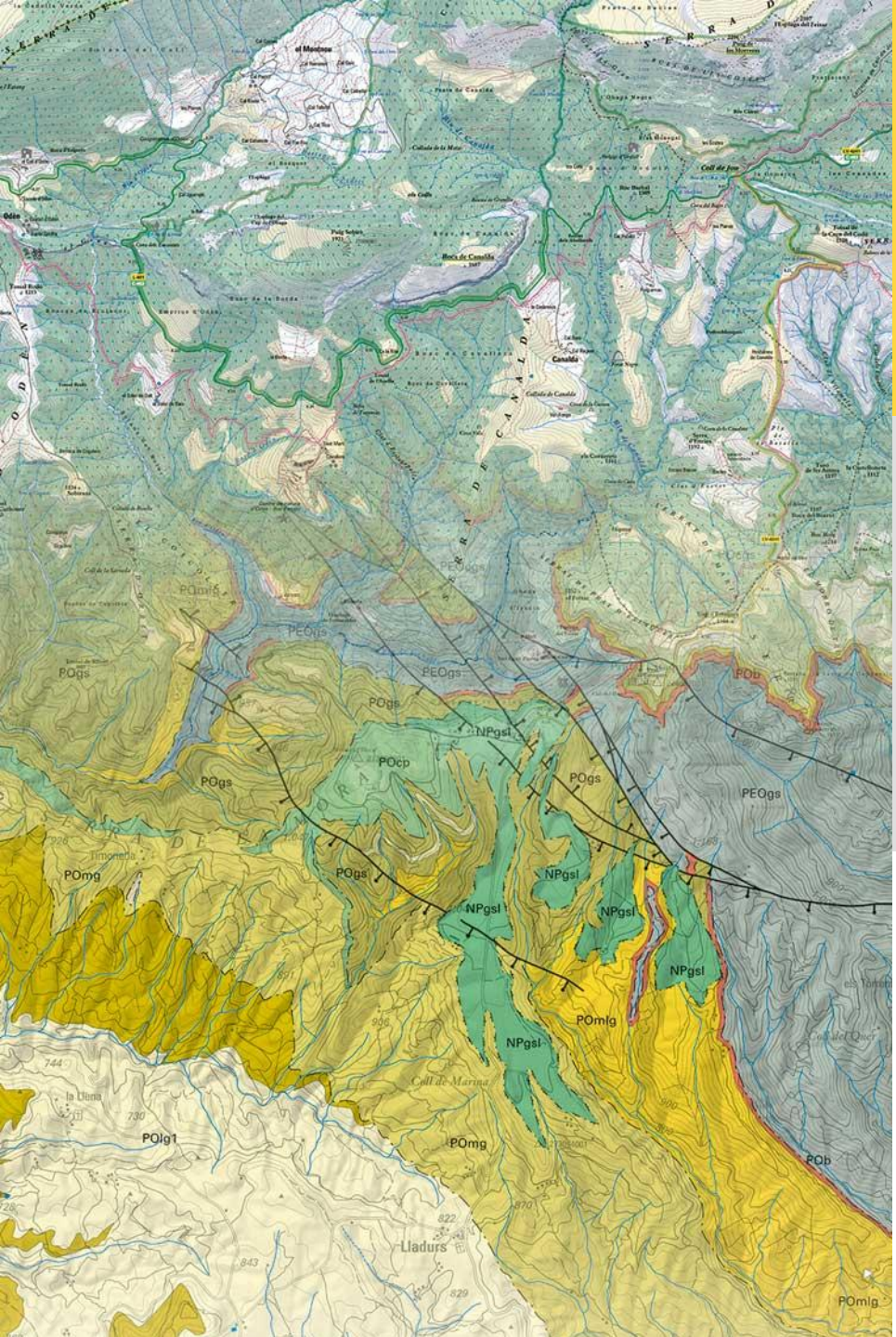

3D image of the Empordà Basin (NE of Spain) obtained from rescued seismic data

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Astrid Ribot

Albert Macau

Anna Gabàs

Ricard Puig

Sara Figueras

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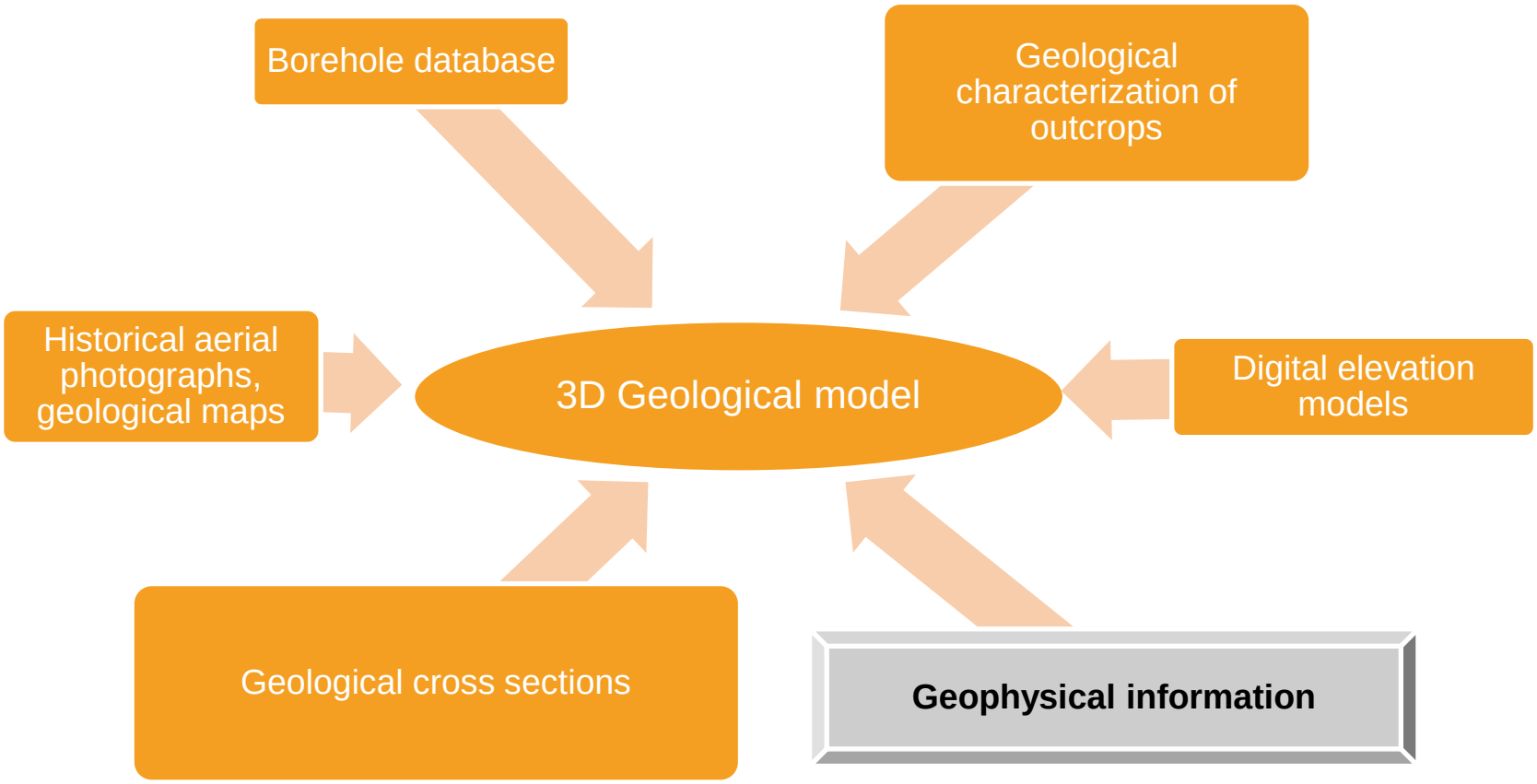
de Catalunya

Generalitat
de Catalunya

OVERVIEW

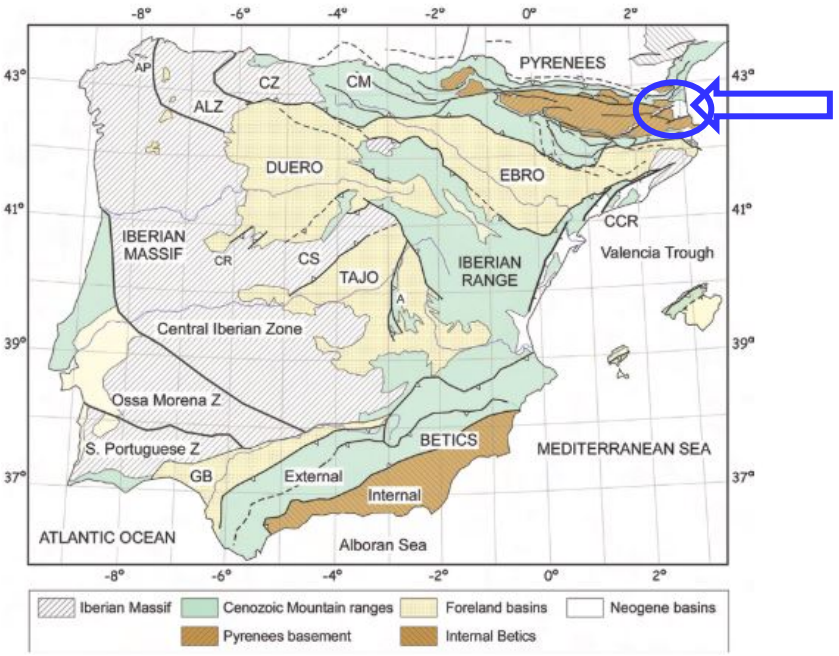
- Introduction
- Geological Setting
- Data
- Methodology
- Results and Interpretation
- Conclusions

Introduction



Geophysical information

Study area: Empordà Basin (NE Spain)



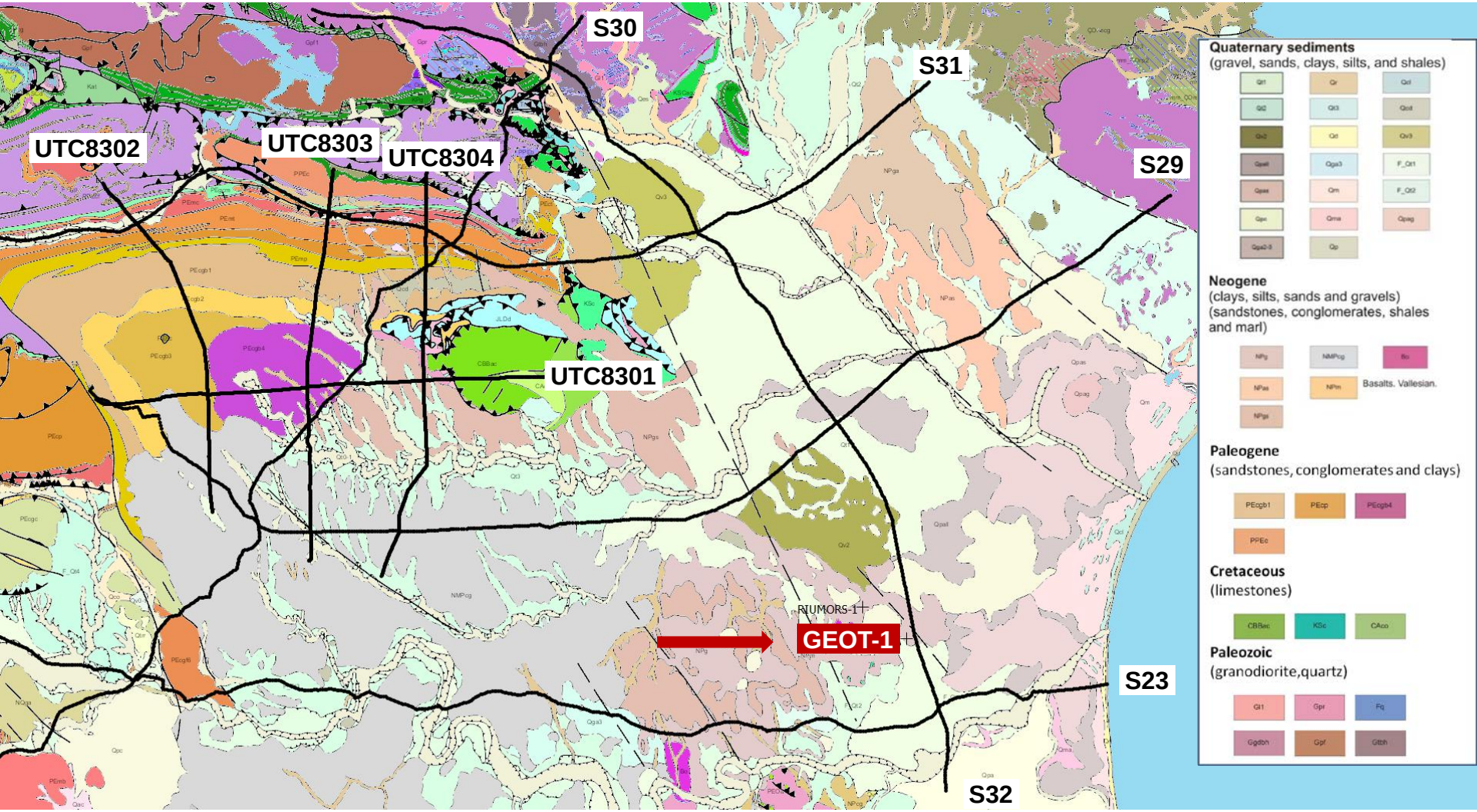
Vergés and Fernández, 2006

GOALS

- **Significant contrasts within sedimentary sequence**
- **Neogene Base**
- **Basement structure**

Methodology: Reprocessing seismic vintage data and Integration of seismic refraction and reflection information

GEOLOGICAL SETTING



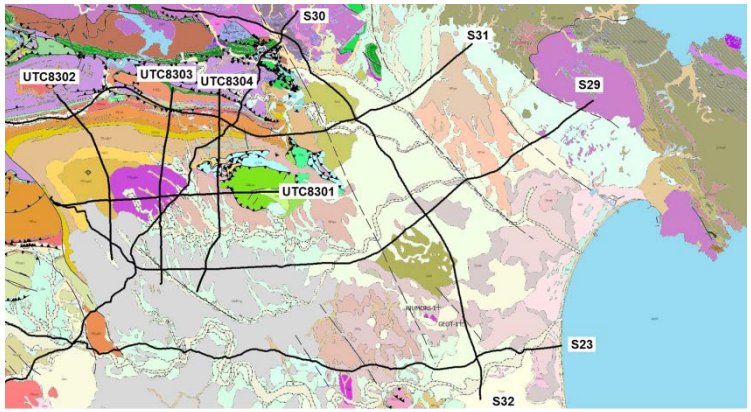
SEISMIC DATA

S lines (1981)

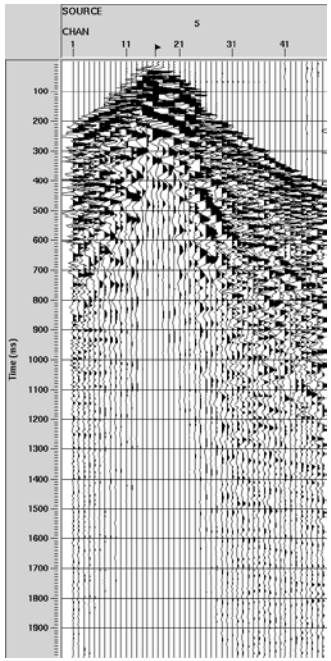
- 48 channels
- Receiver group spacing 60 m
- Shot interval 120 m
- Source: dynamite at 20-30 m depth

UTC lines (1983)

- 192 channels
- Receiver group spacing 25 m
- Shot interval 50 m
- Source: dynamite at 20-30 m depth

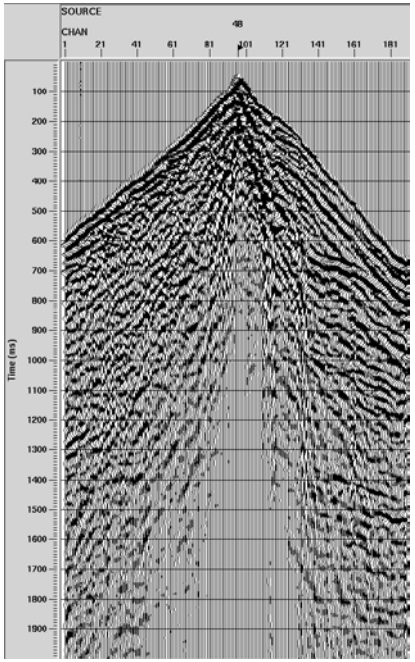


S29



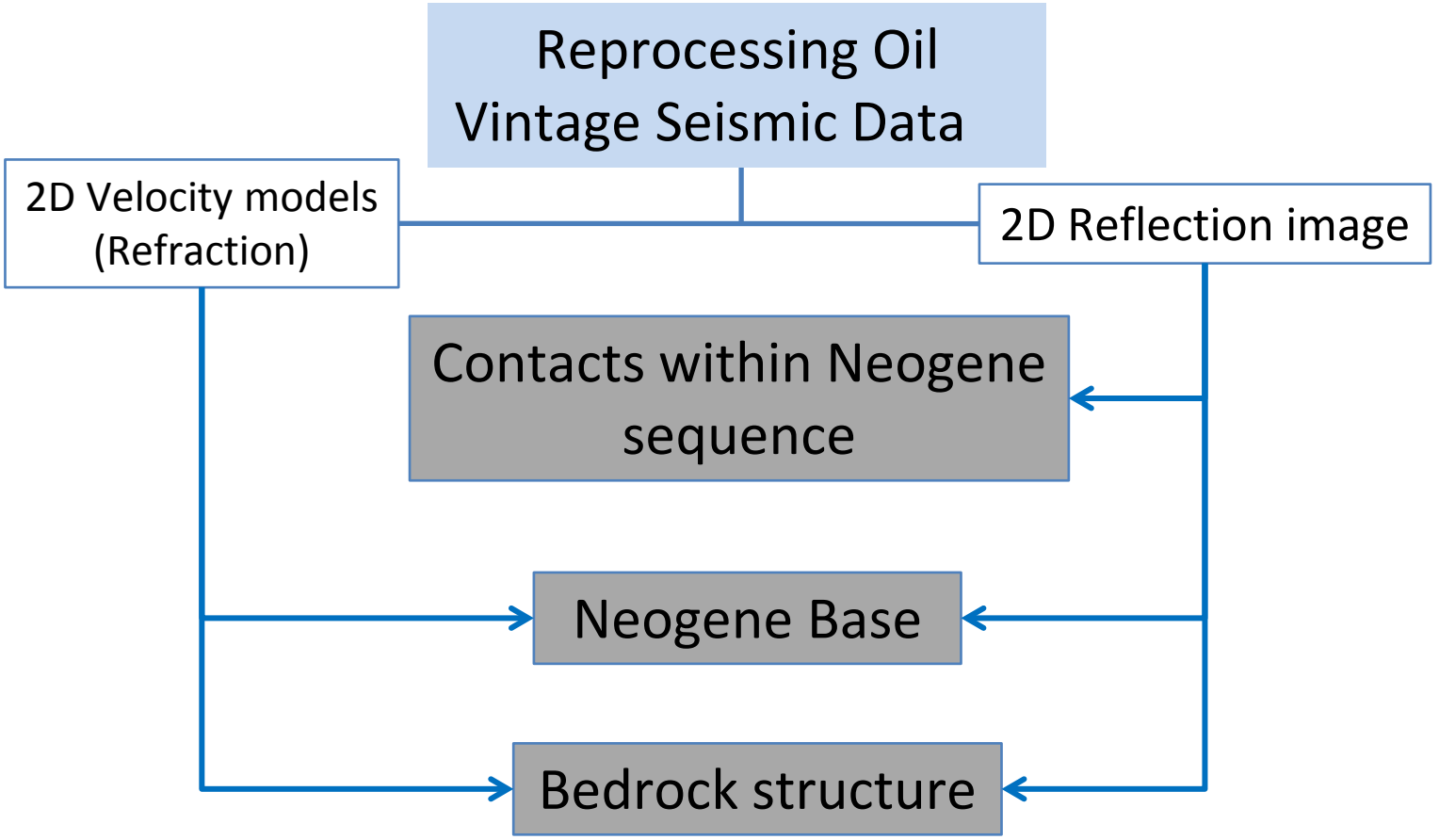
← 2820 m →

UTC8301



← 4775 m →

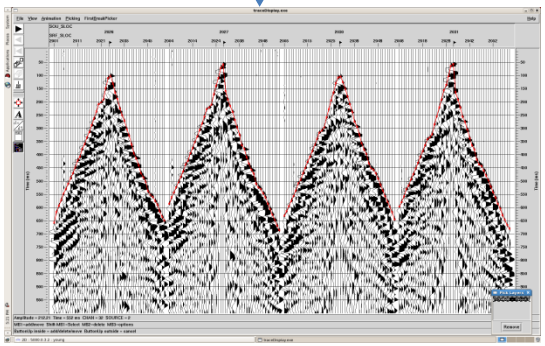
METHODOLOGY



Seismic data (shot gathers)

PROMAX

First break Identification

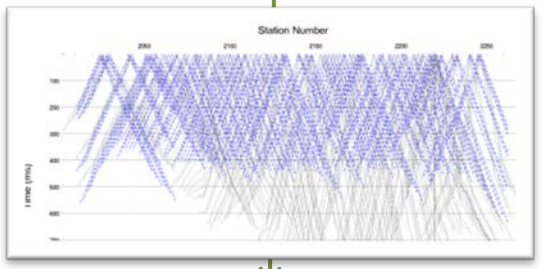


Geometry and first break traveltime (Promax format)

Home-made MATLAB codes

Geometry and first break traveltime (Rayfract format)

RAYFRACT (First arrival travel time inversion)



Seismic refraction tomography

Theoretical traveltimes

Theoretical-Measured tt

NO

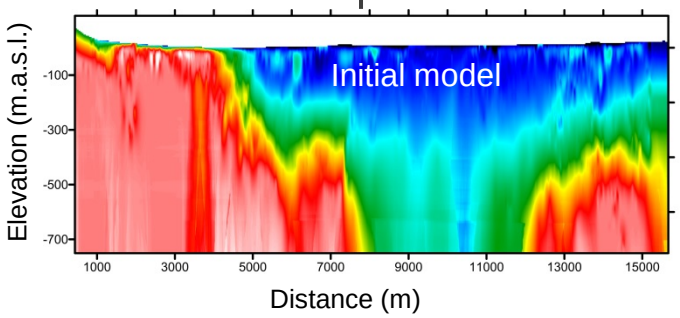
Updated velocity model

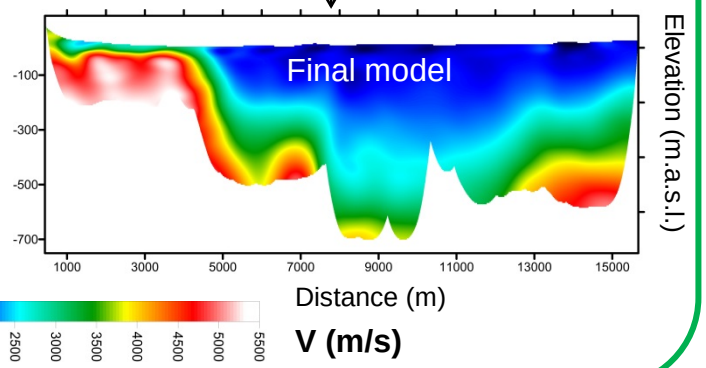
Theoretical traveltimes

Is the difference small?

YES

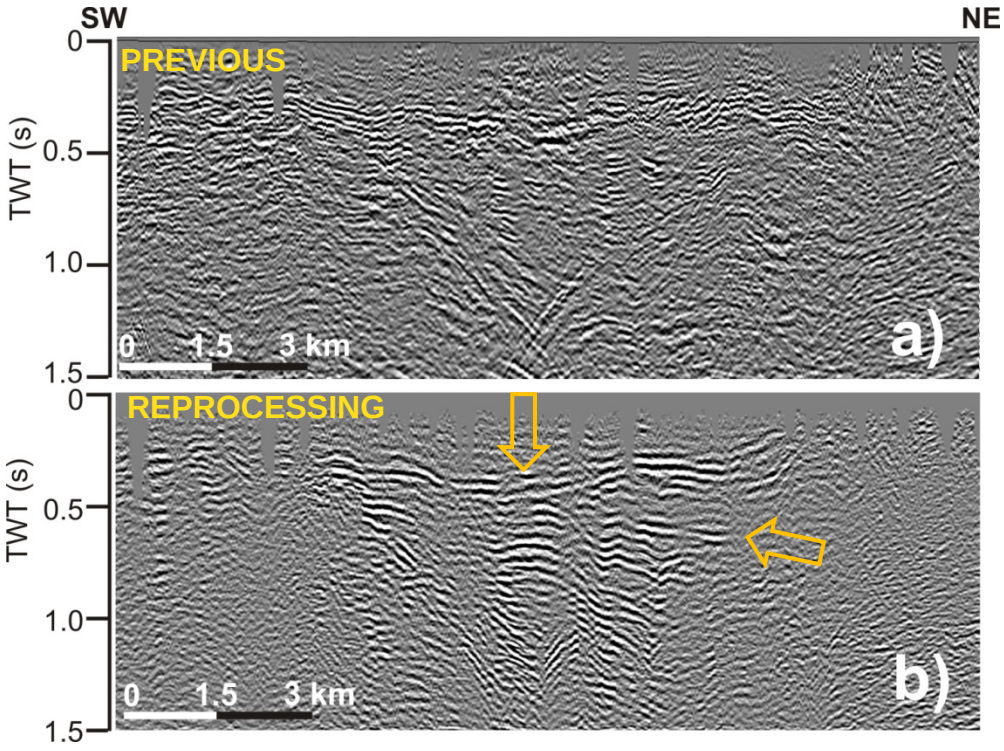
Measured traveltime





Reflection processing

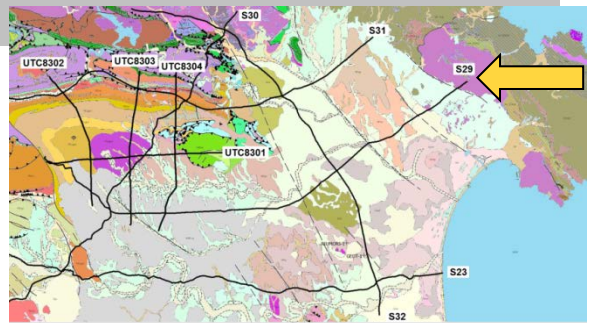
- **First break removal**
- **Offset selection (maximum 750 m)**
- **TomoStatics**
- Band-pass filtering (10-90 Hz)
- Spectral Whitening
- AGC (750 ms window)
- **Velocity Analysis**
- NMO/Stack
- FX-Deconvolution



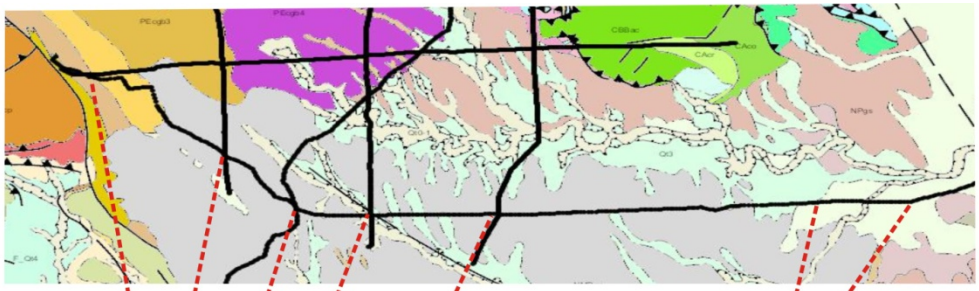
a) Seismic stacked section provided by a processing company (courtesy of CEPSA)

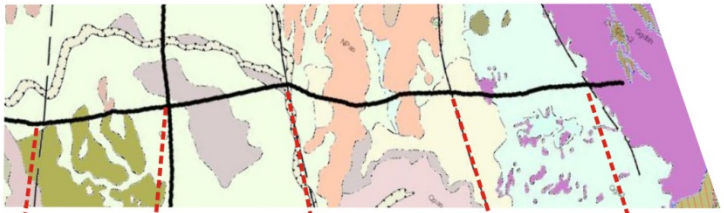
b) Stacked section resulting from reprocessing steps applied in this work

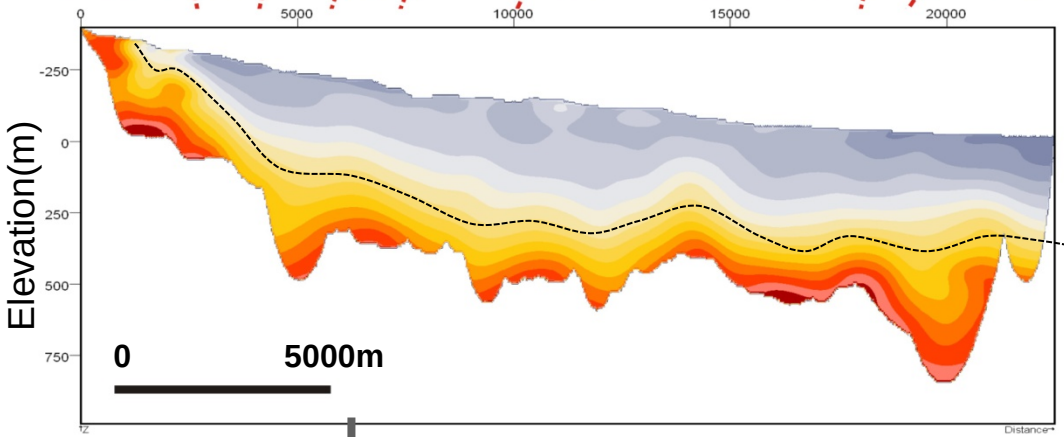
RESULTS

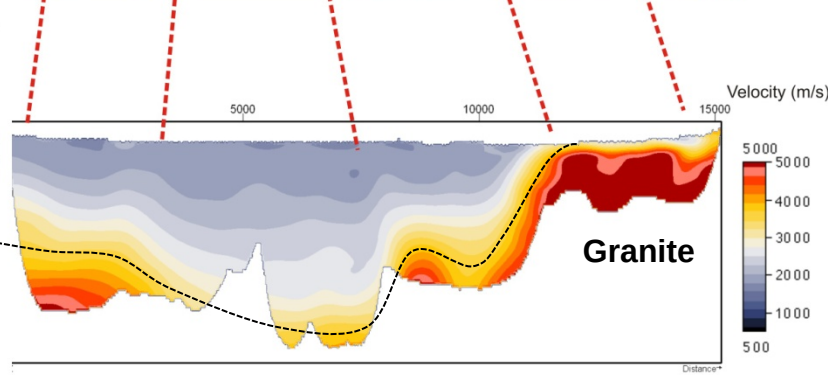


S29



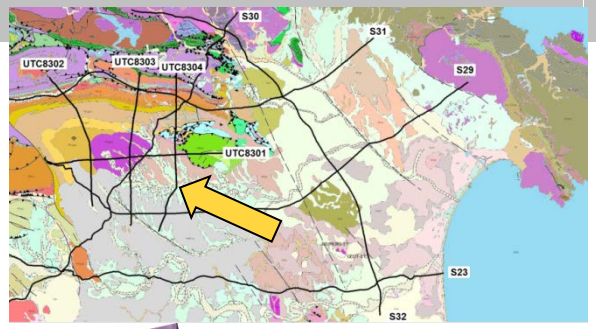




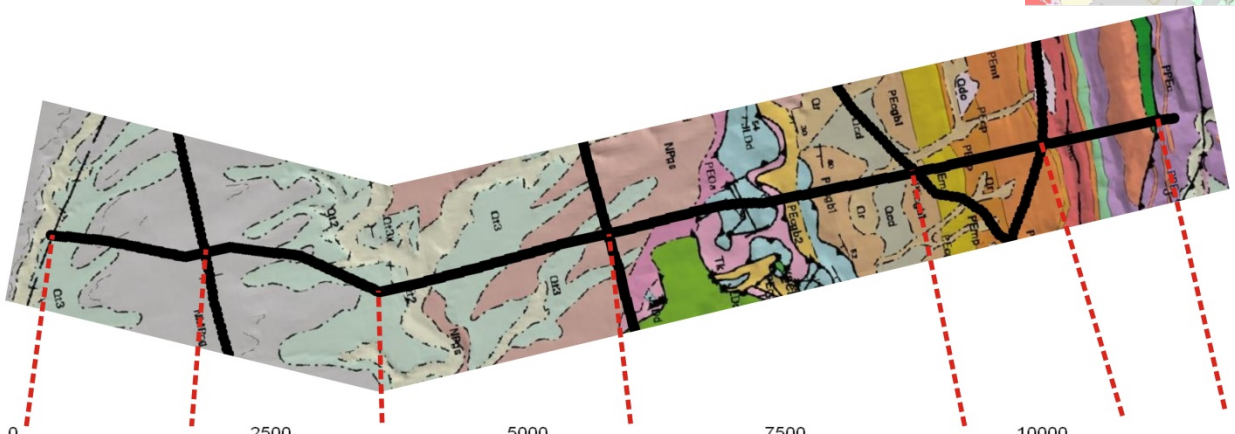


NE SW | W E | SW NE

Maximum velocity gradient

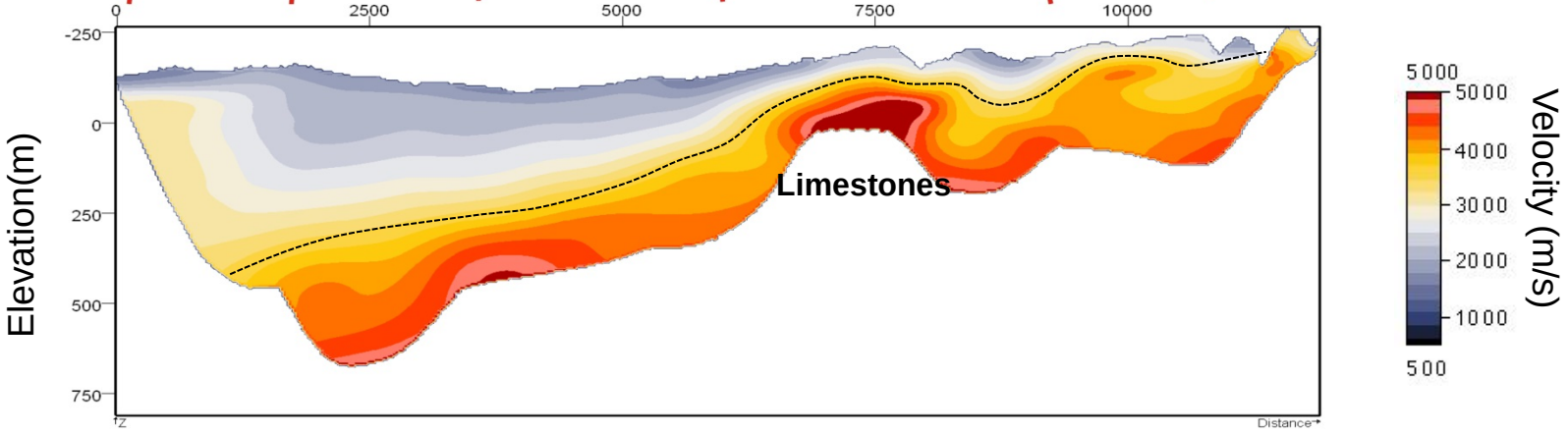


UTC8304



S

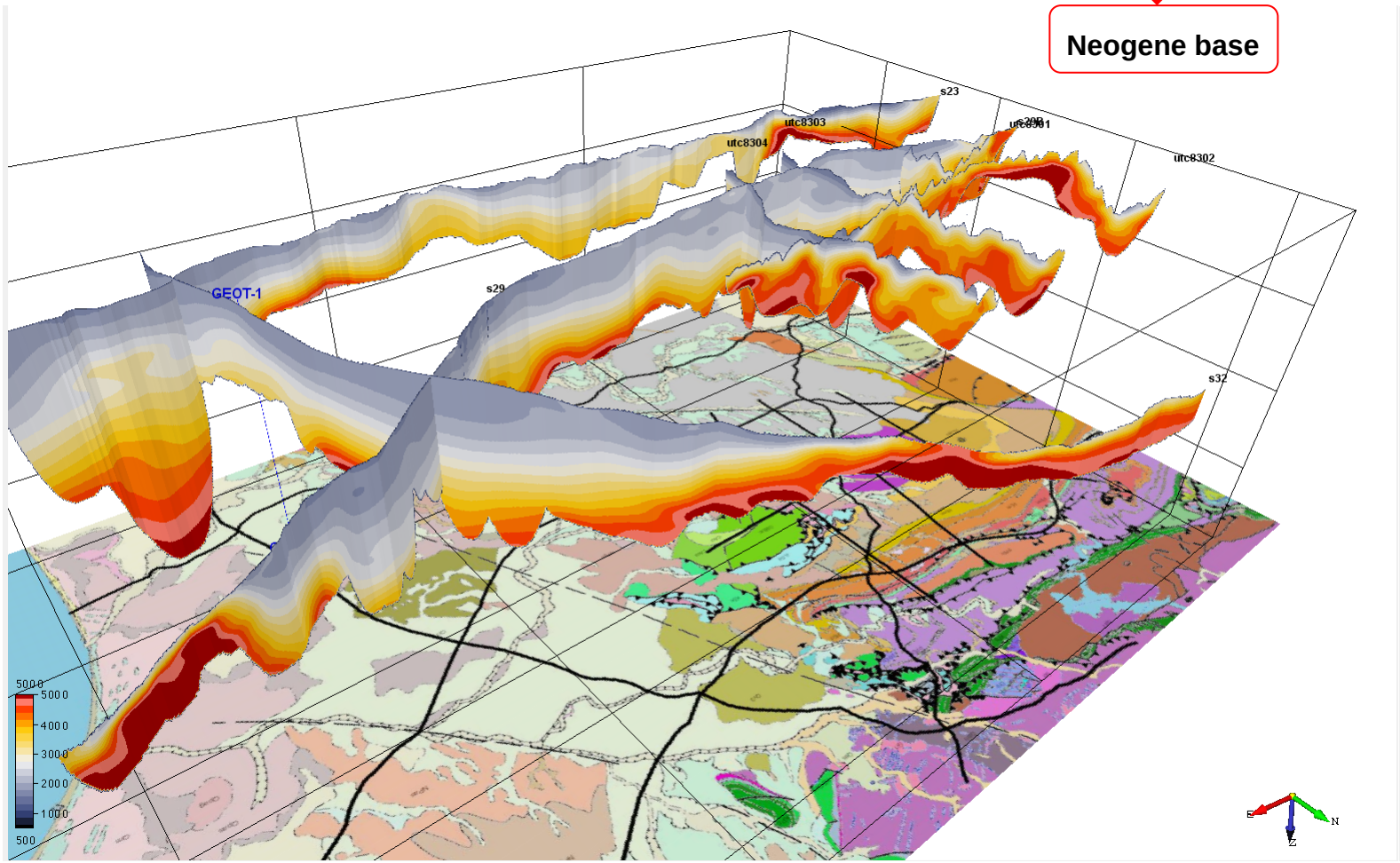
N



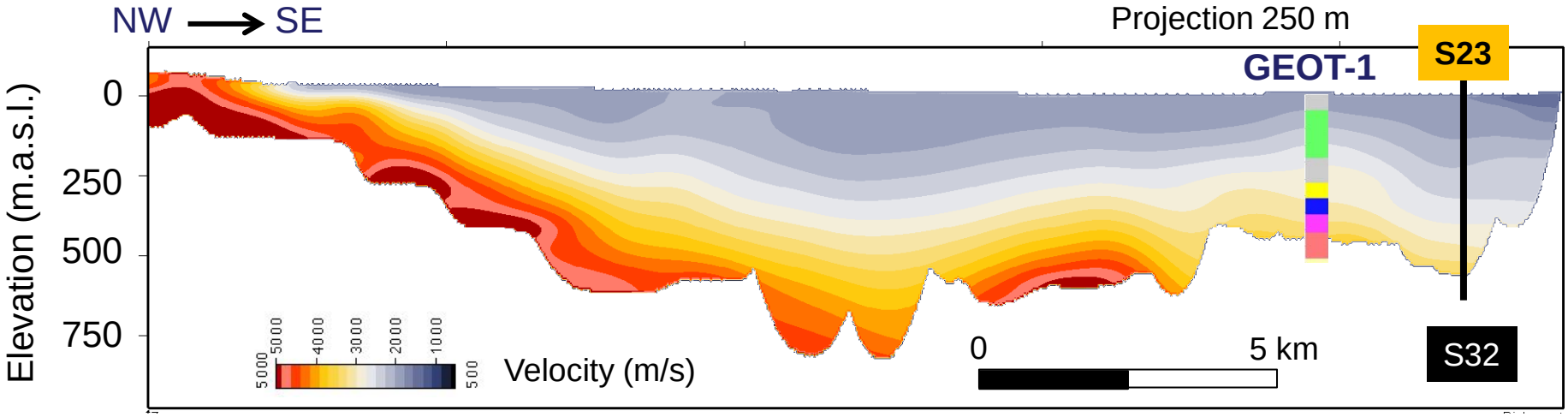
Maximum velocity gradient

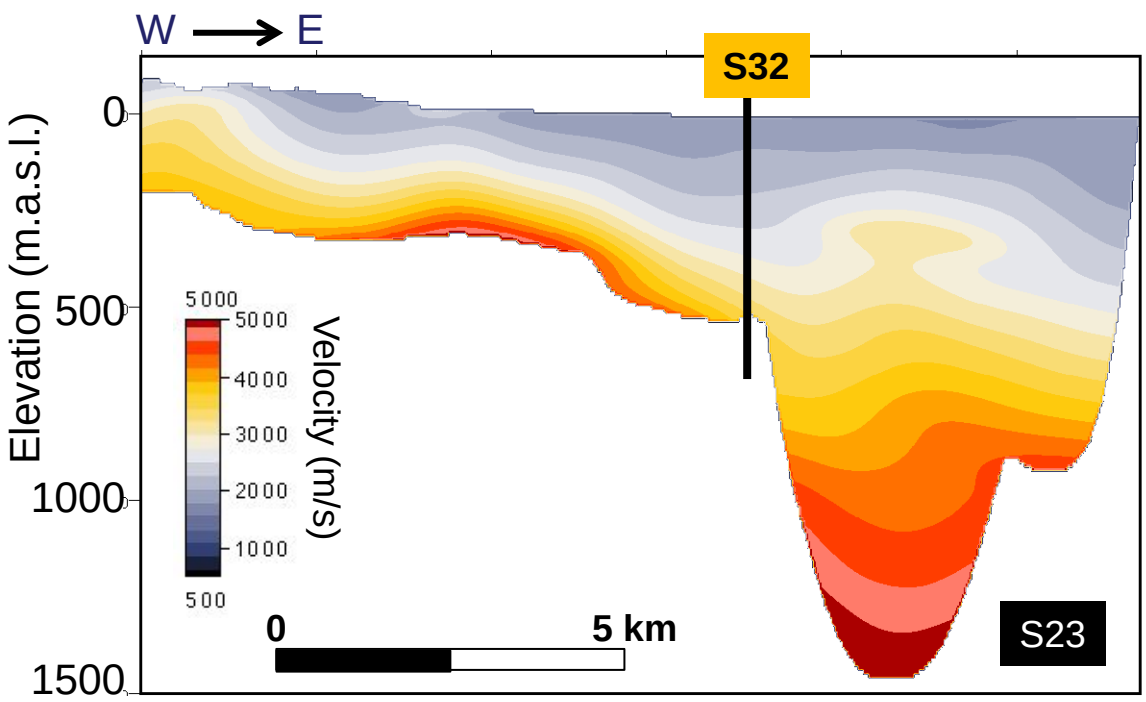
High velocity gradient surface

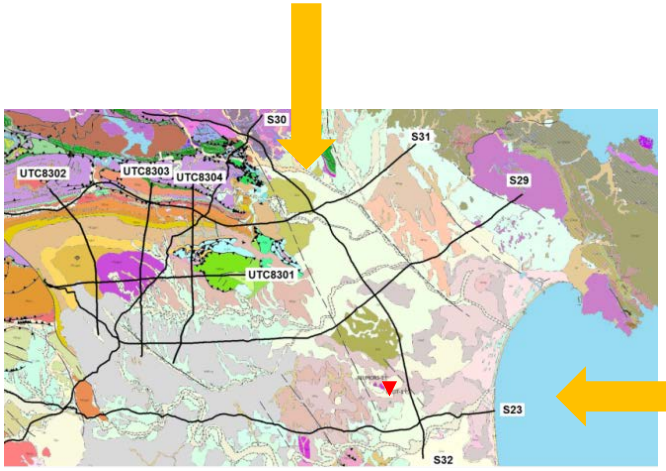
Neogene base

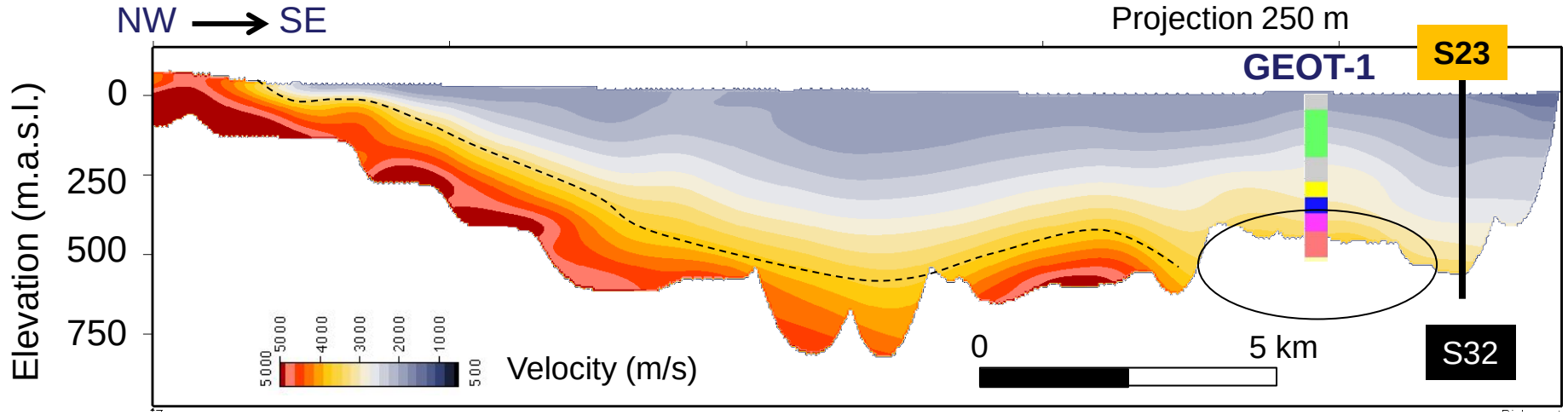


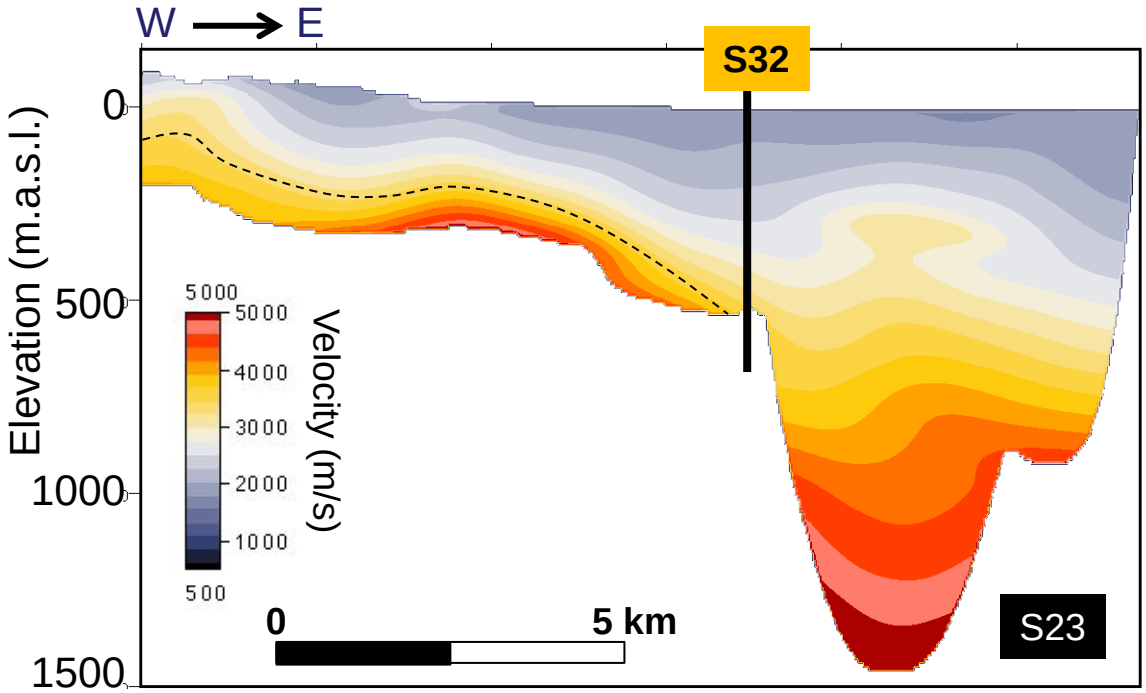
OpendTect & homemade software

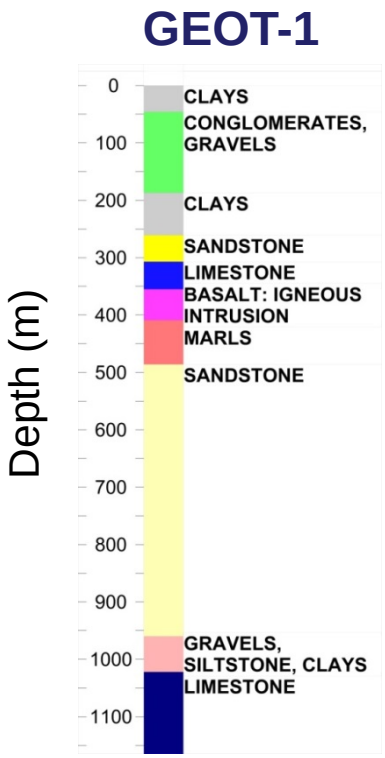

NW → SE
Projection 250 m
GEOT-1
S23
S32
Elevation (m.a.s.l.)
0
250
500
750
5000
4000
3000
2000
1000
500
Velocity (m/s)
0
5 km


W → E
S32
S23
Elevation (m.a.s.l.)
0
500
1000
1500
5000
4000
3000
2000
1000
500
Velocity (m/s)
0
5 km

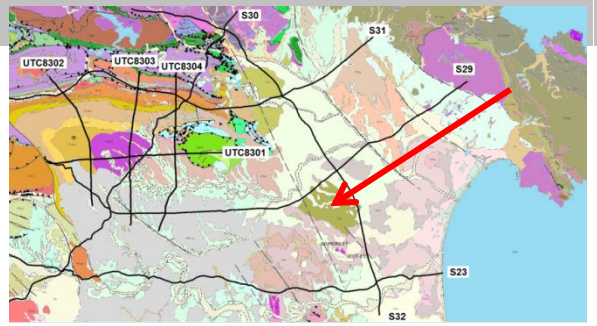

S30
S31
S29
UTC8302
UTC8303
UTC8304
UTC8301
S23
S32


NW → SE
Projection 250 m
GEOT-1
S23
S32
Elevation (m.a.s.l.)
0
250
500
750
5000
4000
3000
2000
1000
500
Velocity (m/s)
0
5 km

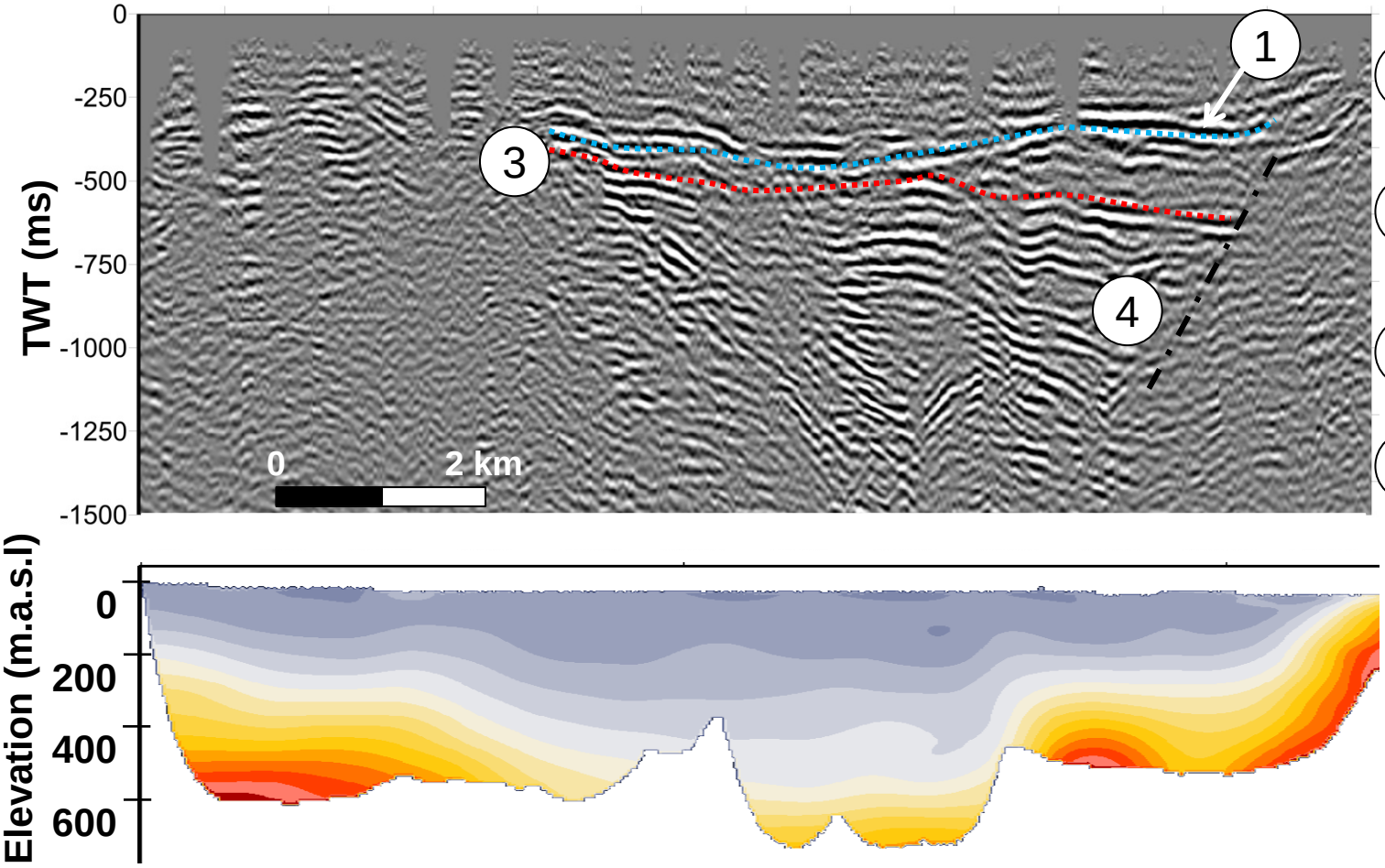

W → E
S32
S23
Elevation (m.a.s.l.)
0
500
1000
1500
5000
4000
3000
2000
1000
500
Velocity (m/s)
0
5 km


GEOT-1
Depth (m)
0
100
200
300
400
500
600
700
800
900
1000
1100
CLAYS
CONGLOMERATES, GRAVELS
CLAYS
SANDSTONE
LIMESTONE
BASALT: IGNEOUS INTRUSION
MARLS
SANDSTONE
GRAVELS, SILTSTONE, CLAYS
LIMESTONE

S29



SW ⟶ NE

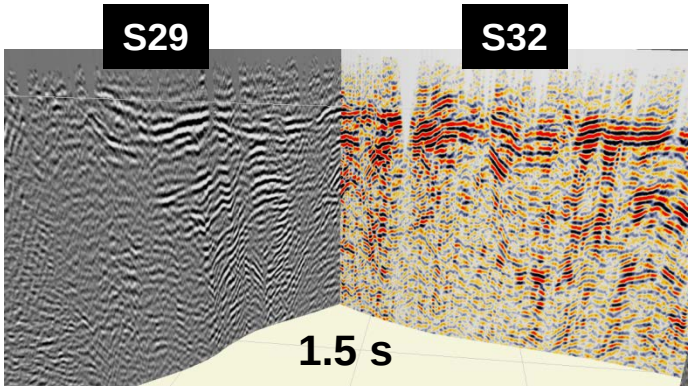


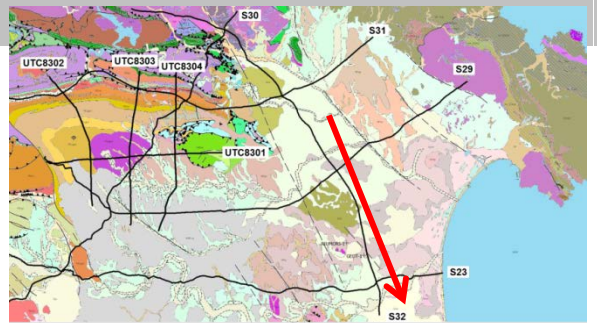
1 **Pliocene base**

2 Neogene Limestone basalts

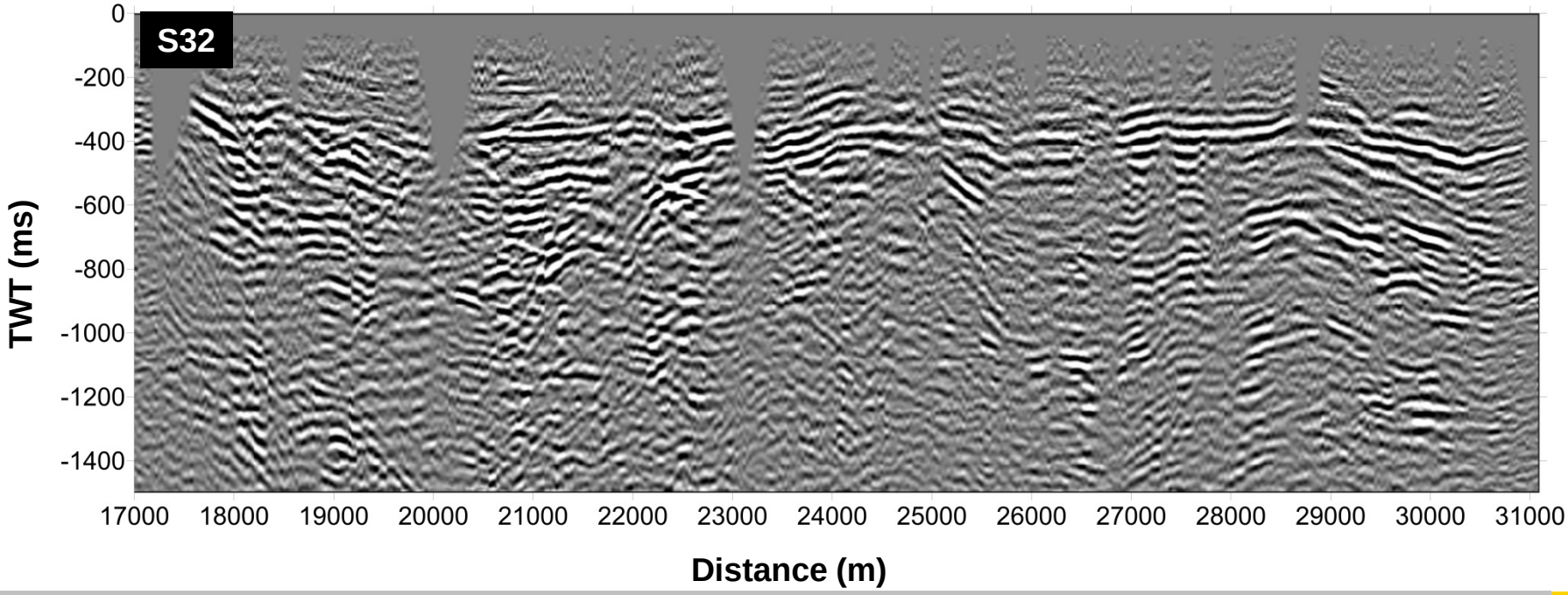
3 **Neogene base**

4 **Bedrock reflections**

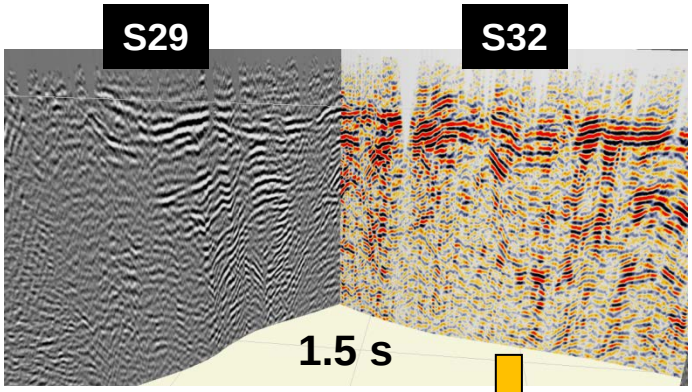

S29
S32
1.5 s


S30
S31
S29
UTC8302
UTC8303
UTC8304
UTC8301
S23
S32

NW ⟶ SE


S32
0
-200
-400
-600
-800
-1000
-1200
-1400
TWT (ms)
17000
18000
19000
20000
21000
22000
23000
24000
25000
26000
27000
28000
29000
30000
31000
Distance (m)

0 2 km

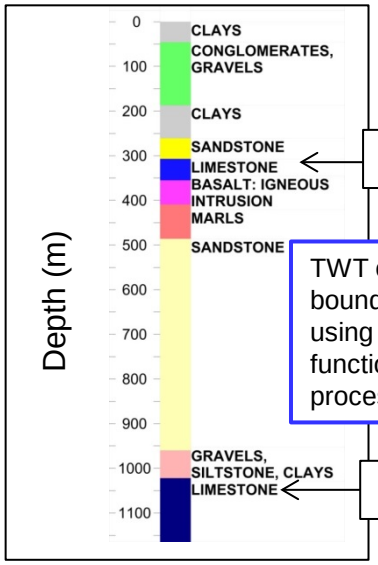


1 **Pliocene base**

2 **Neogene Limestone basalts**

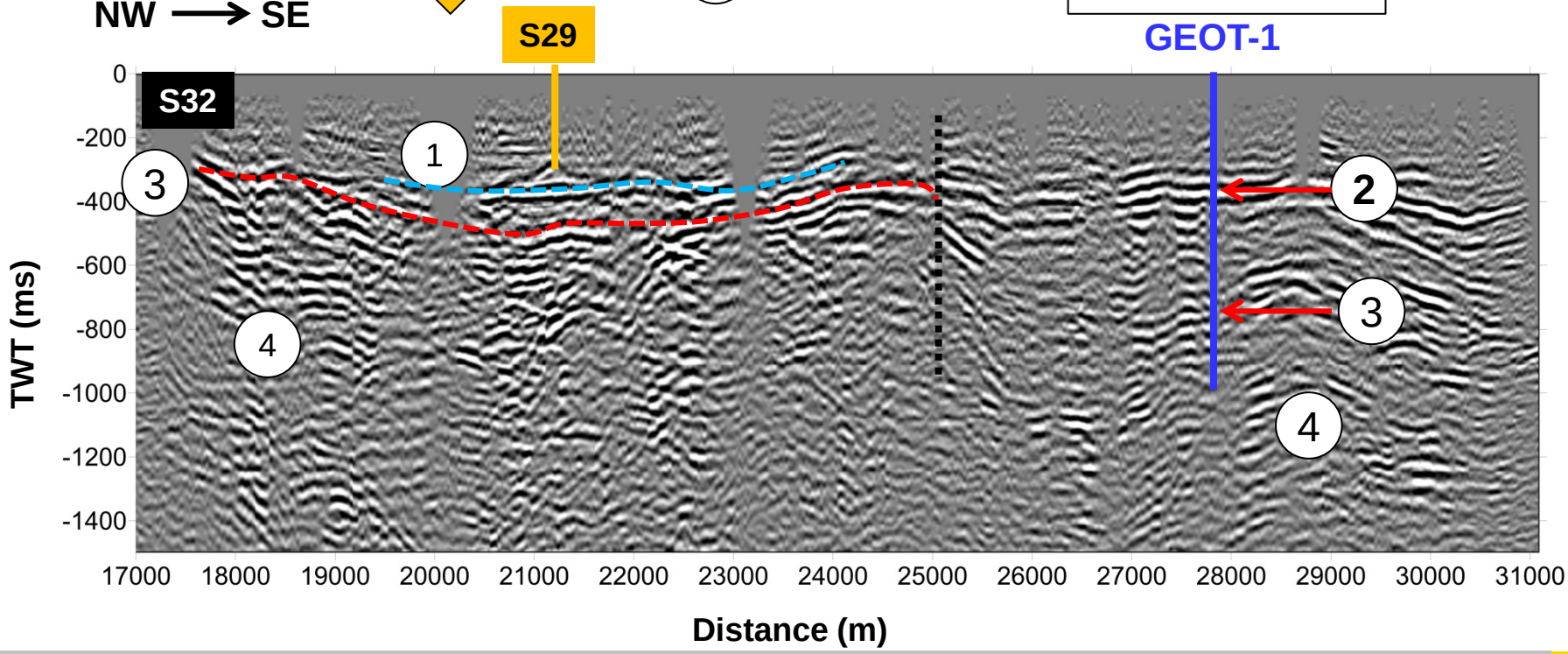
3 **Neogene base**

4 **Bedrock reflections**



TWT of two significant boundaries using time-to-depth function from reflection processing.

NW → SE



CONCLUSIONS

- This work shows the potential of reprocessing land seismic vintage data acquired for oil exploration to increase knowledge of near-surface geological structure in a Neogene Basin.
- Tomographic velocity models provide information about the Neogene allow to delineate bedrock geometry, to define lithological changes of bedrock and to image fault zones.
- A reflection reprocessing flow has been created to enhance shallow reflections not imaged with the original processing.
- Extra thoughts need to be put into areas with strong impedance contrasts within the Neogene sequence (limestones, basalts).
- The results of this work can be used as input to 3D geological models.

Future work. Application of other techniques (Electromagnetic methods and Passive Seismic) to discriminate which high velocity sectors correspond to Neogene materials or to bedrock.

Acknowledgments:

Jorge Navarro from CEPSA for the permission to use the seismic field datasets

OpendTect is a free Open Source Seismic Interpretation Platform created by dGB Earth Sciences (http://opendtect.org/