Advances in the management and dissemination of geological data: the 3D geological model of Catalunya at 1:250.000, first results

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1 Introduction

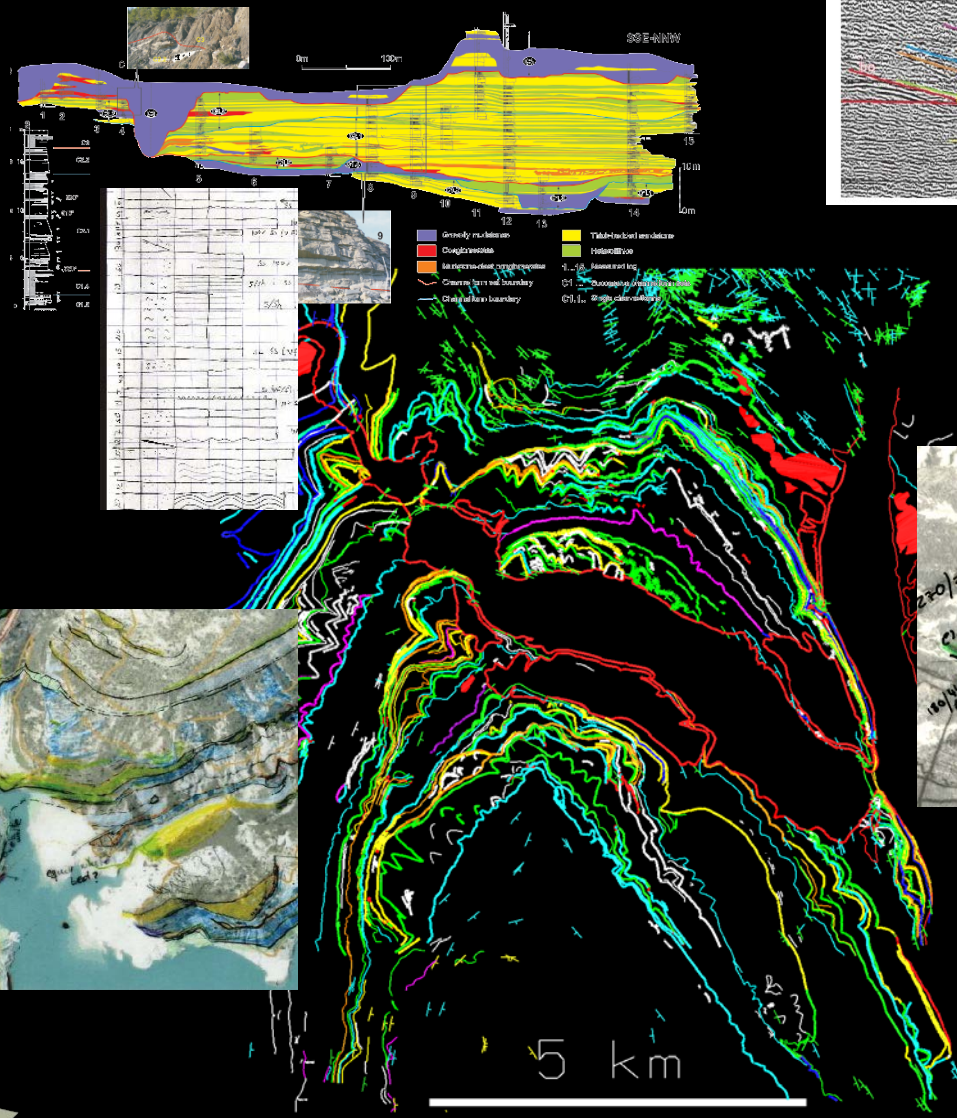
2 Why a 3-D model?

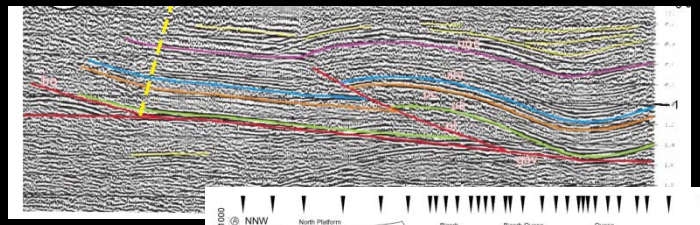
3 Methodology

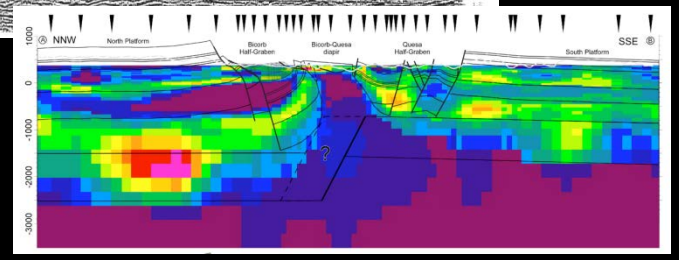
4 The 3-D geological model of Catalunya at 1:250.000

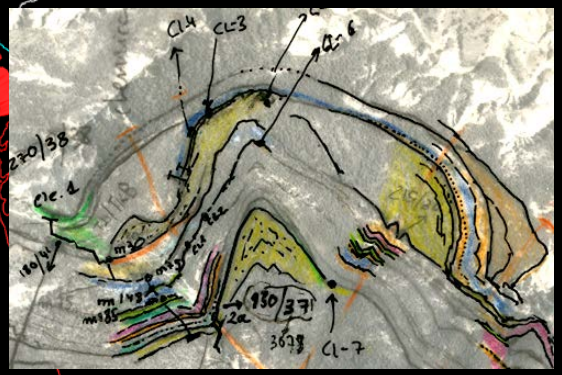
5 Conclusions

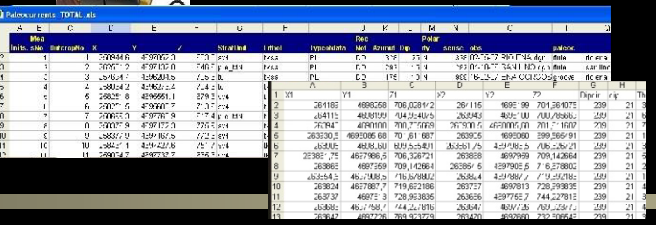
Surface or **subsurface** geological data











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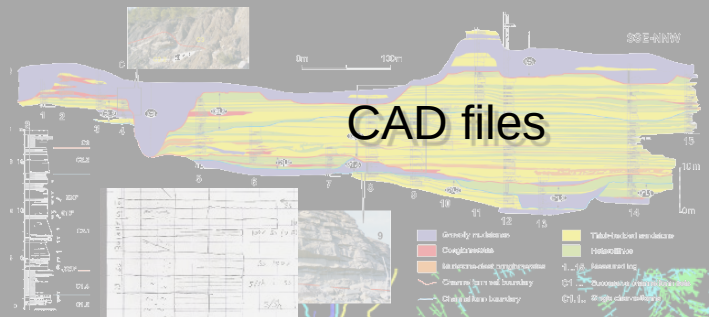
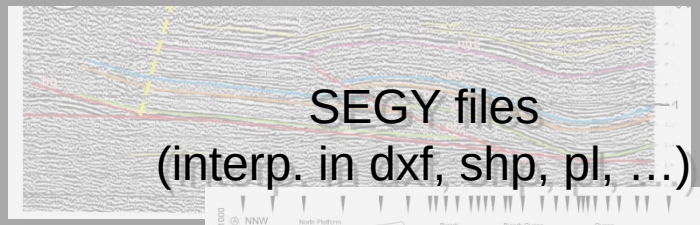
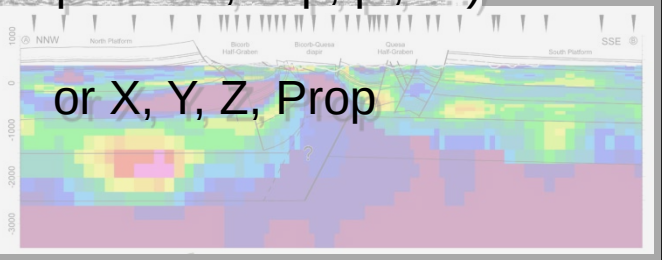
Direct or indirect geological data



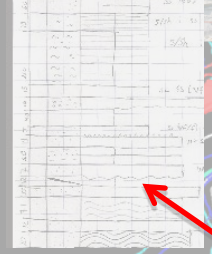
CAD files

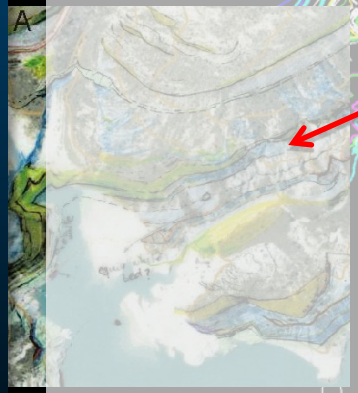


SEGY files
(interp. in dxf, shp, pl, …)

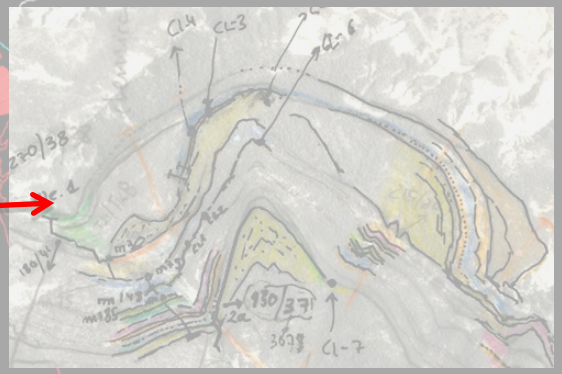


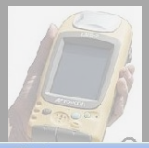
or X, Y, Z, Prop



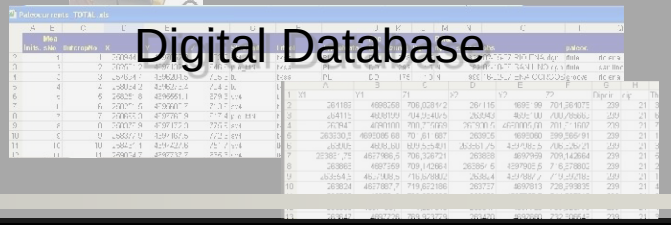


RAW data in
analog format



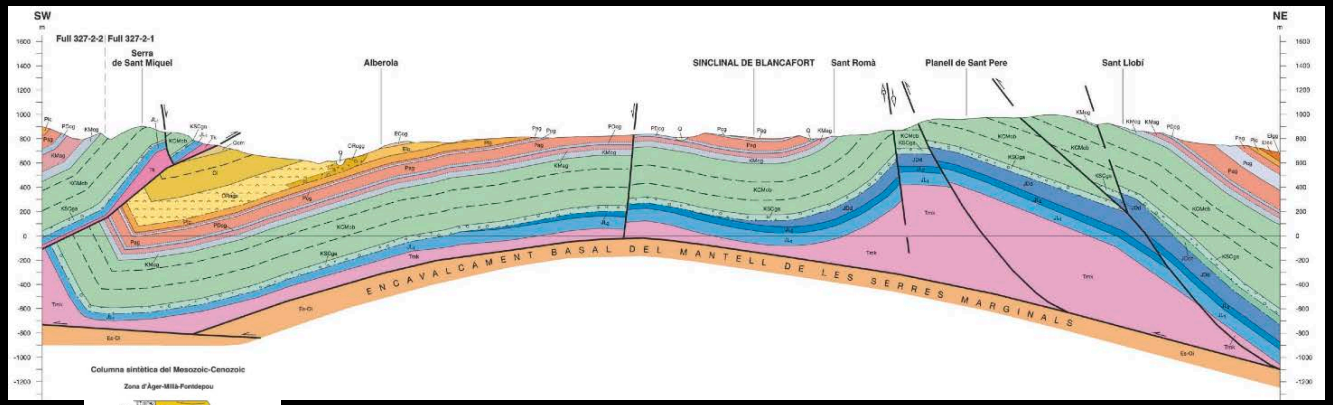


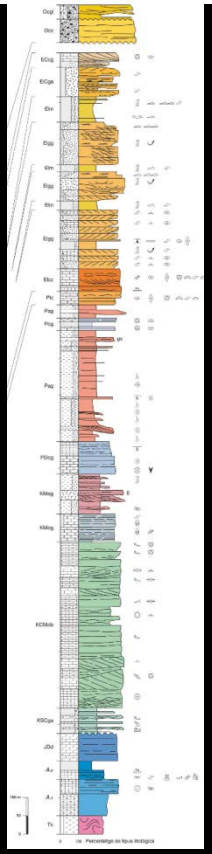
Digital data
(shp, dxf, pl, … files)

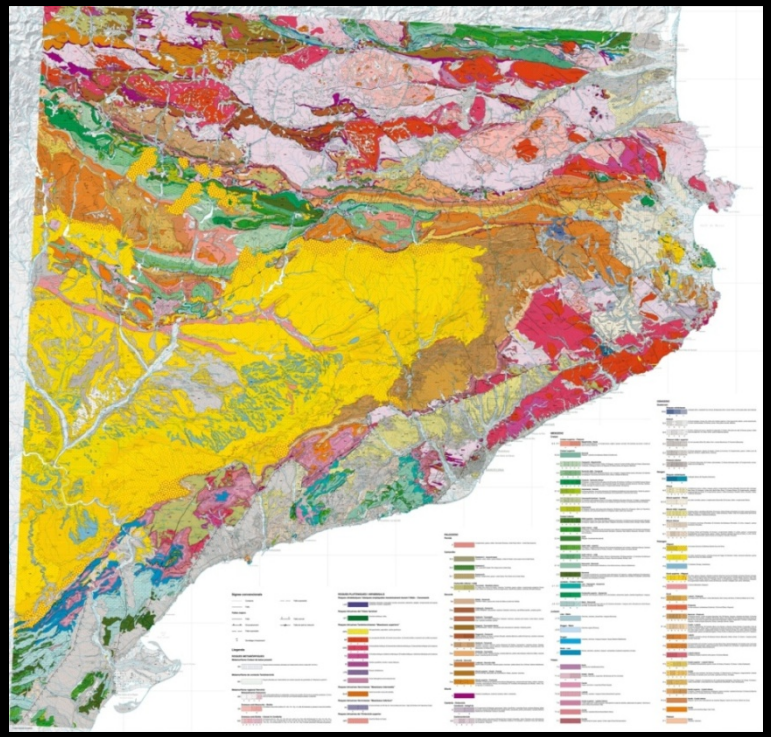


Digital Database

Introduction







1D / 2D products in digital or analog format:

- Maps
- Cross-sections
- Stratigraphic columns
- ...others

1
2
3
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1 ✓ Introduction

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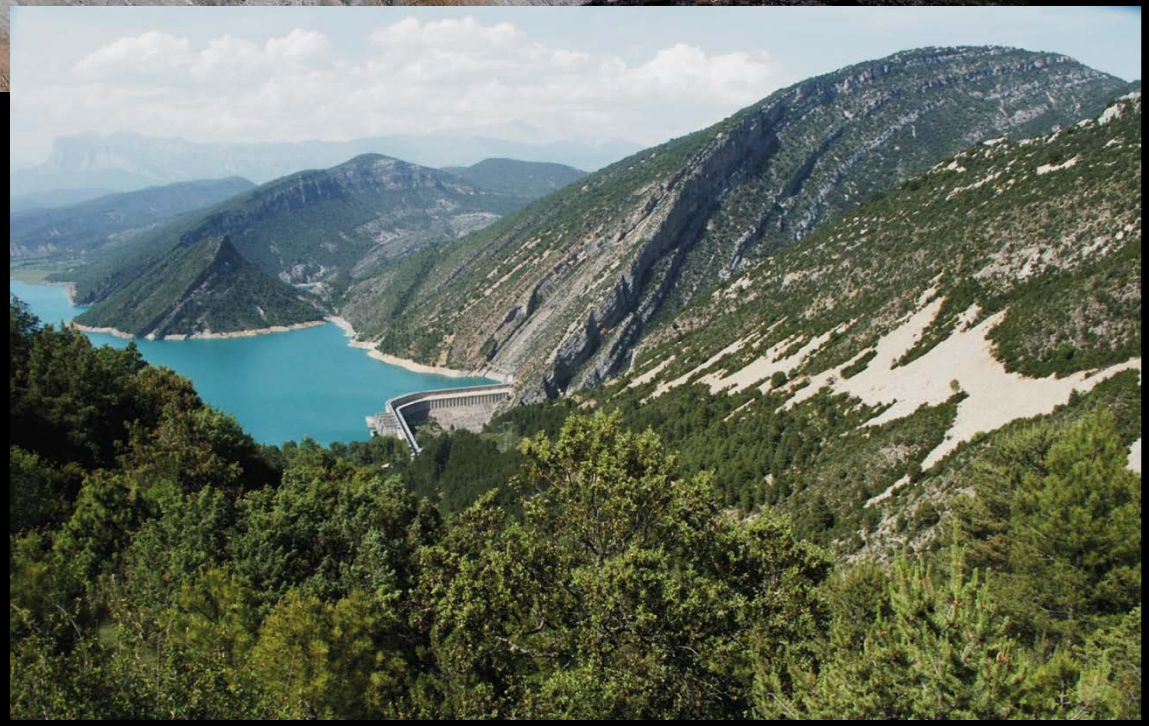
Why a 3-D model?

If reality is 3-D,
Why simplify it with a 2-D section?



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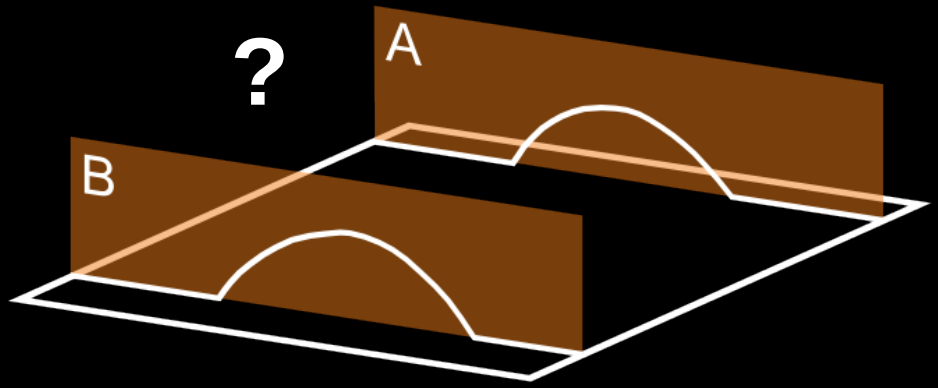

What is the structure that best explain these 2D cross-sections?

Modified from Fernández, 2004

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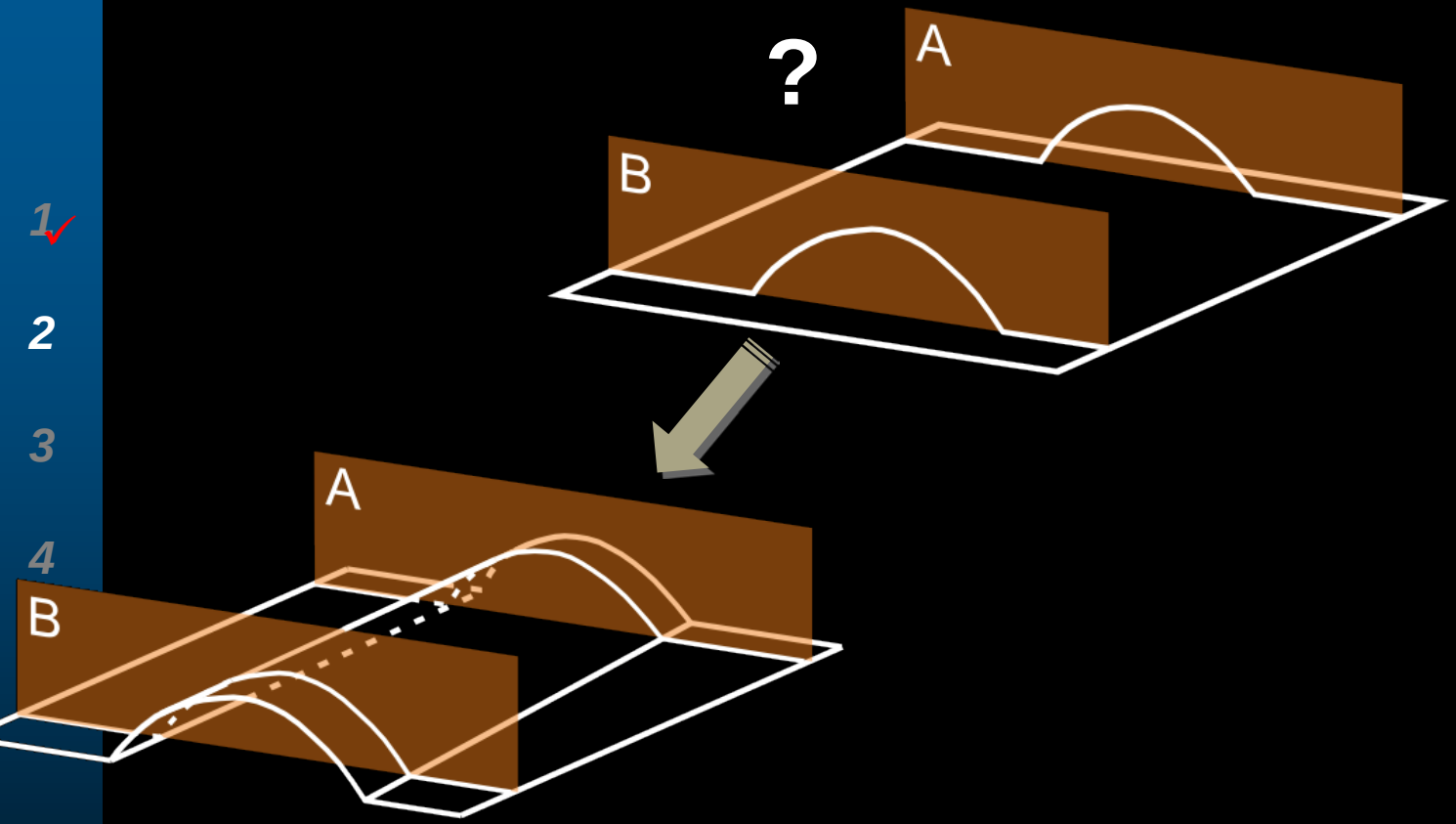

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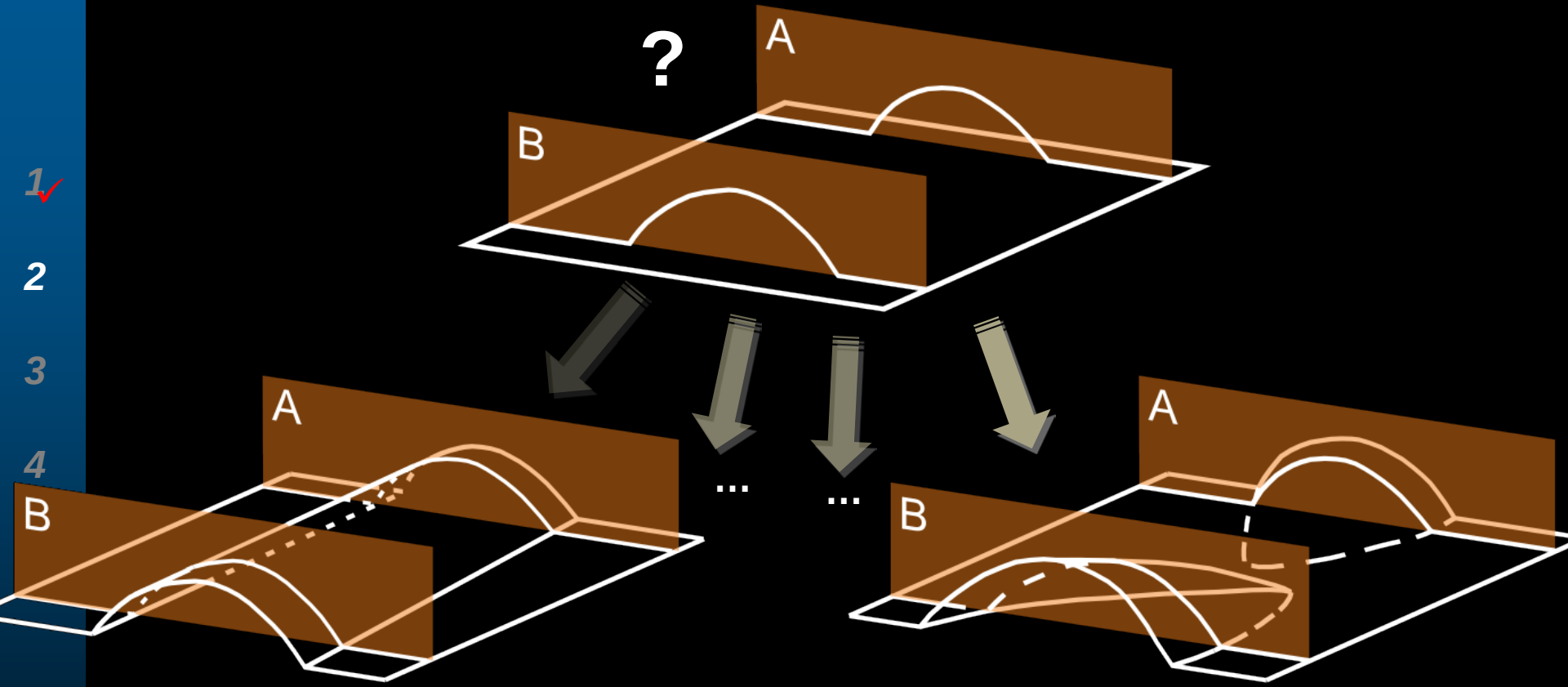

Which one is the best solution?

Modified from Fernández, 2004

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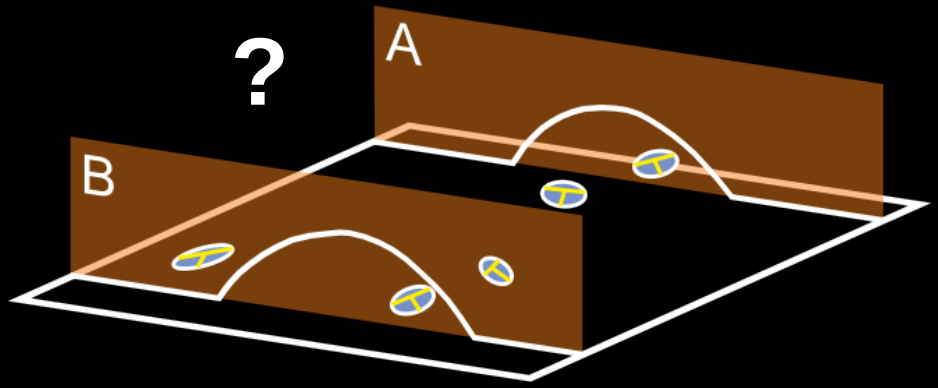
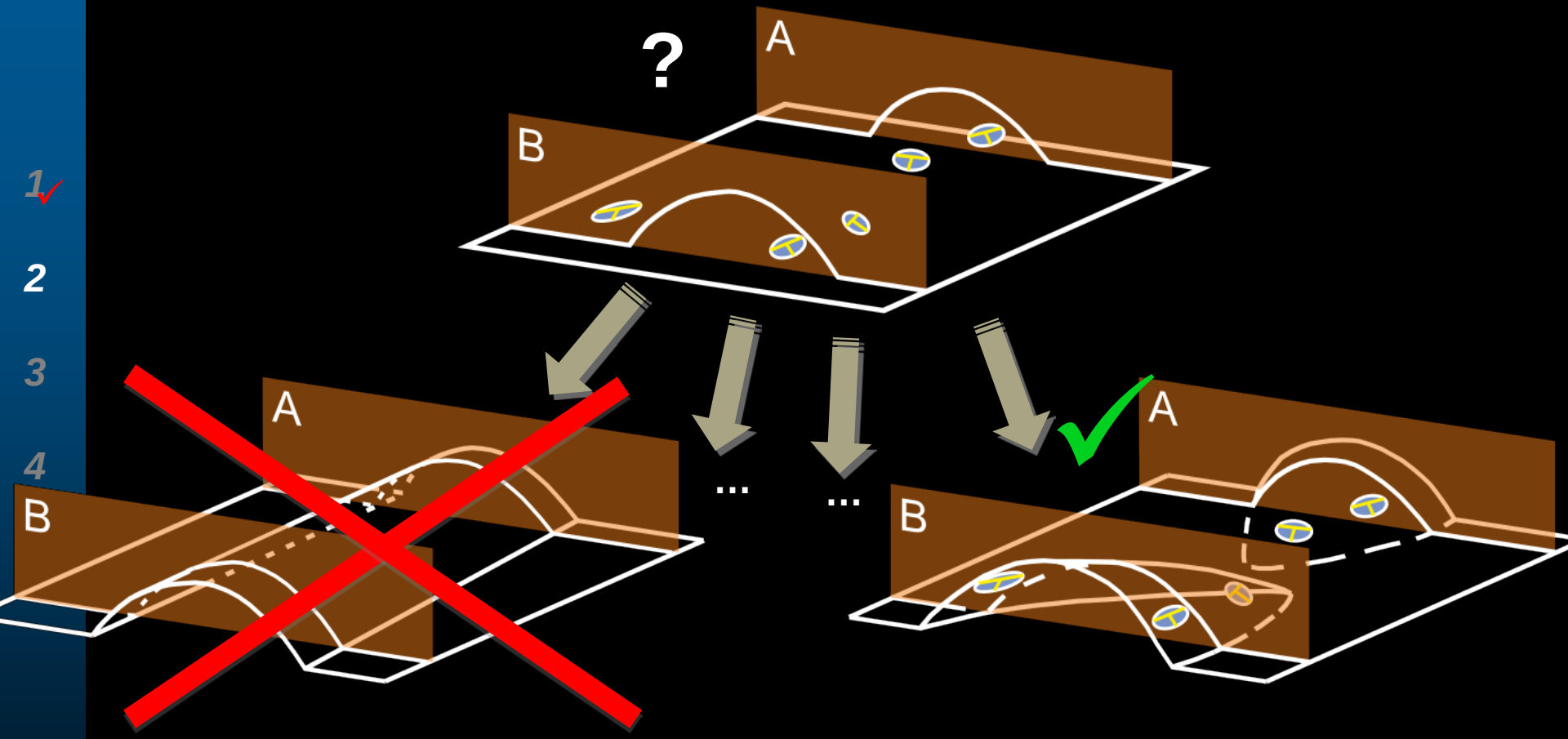


If we considers more information…

Modified from Fernández, 2004

Why a 3-D model?



Considering more information... less and best solutions!

Modified from Fernández, 2004

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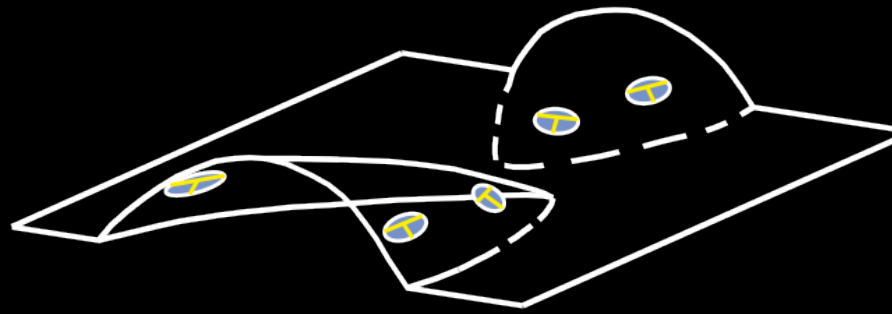

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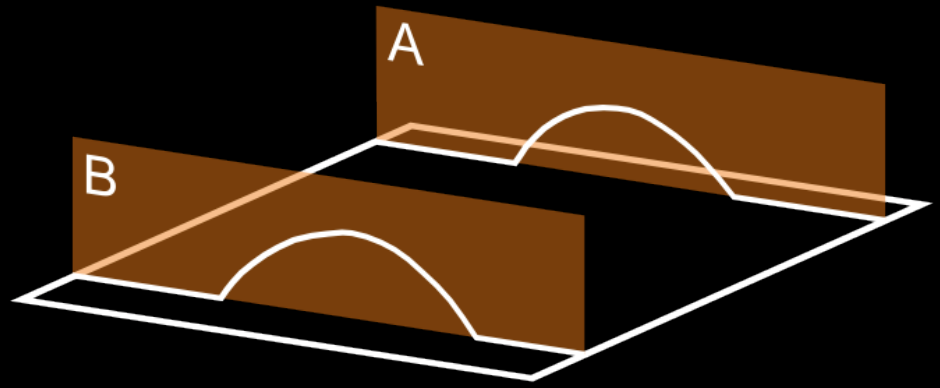
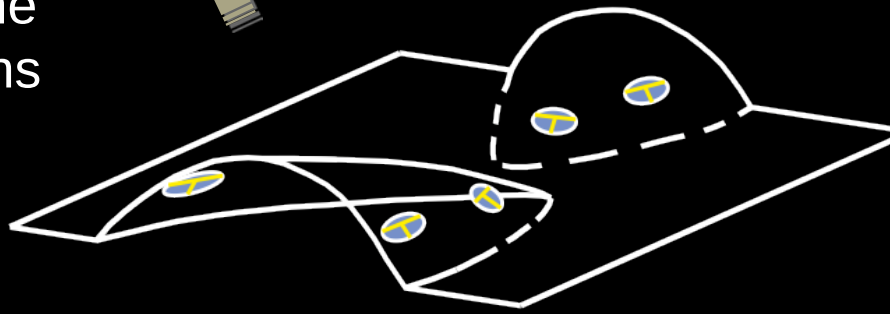


Simplifying and projecting into the 2D cross-sections

?



But… How we obtain the 2D representation of the 3D structure?

Modified from Fernández, 2004

Why a 3-D model?

Advantages

- Work with field data in its original geographic position

1 ✓
2
3
4
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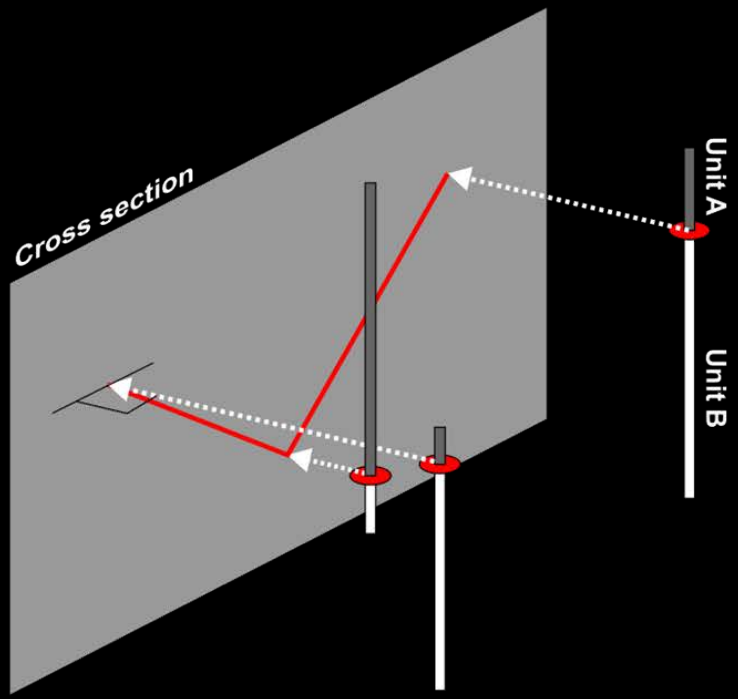
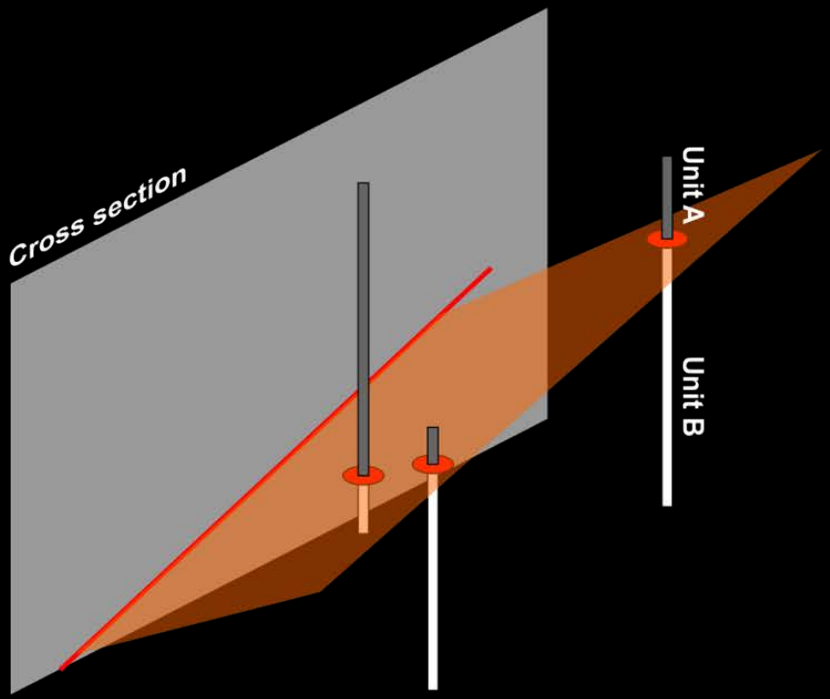
Advantages

- Work with field data in its original geographic position
- Avoid errors and simplifications in the projection process

Perpendicular



Following a geologic constrain



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- Allows to validate data that can be compared with the surrounding
- Increase the understanding of the entire structure and its complexity
- Taking advantage of the 3-D component of the field-data to obtain more information:

  dip data, 3D geologic traces (combining a DTM with cartographic traces)

Why a 3-D model?

Likewise…

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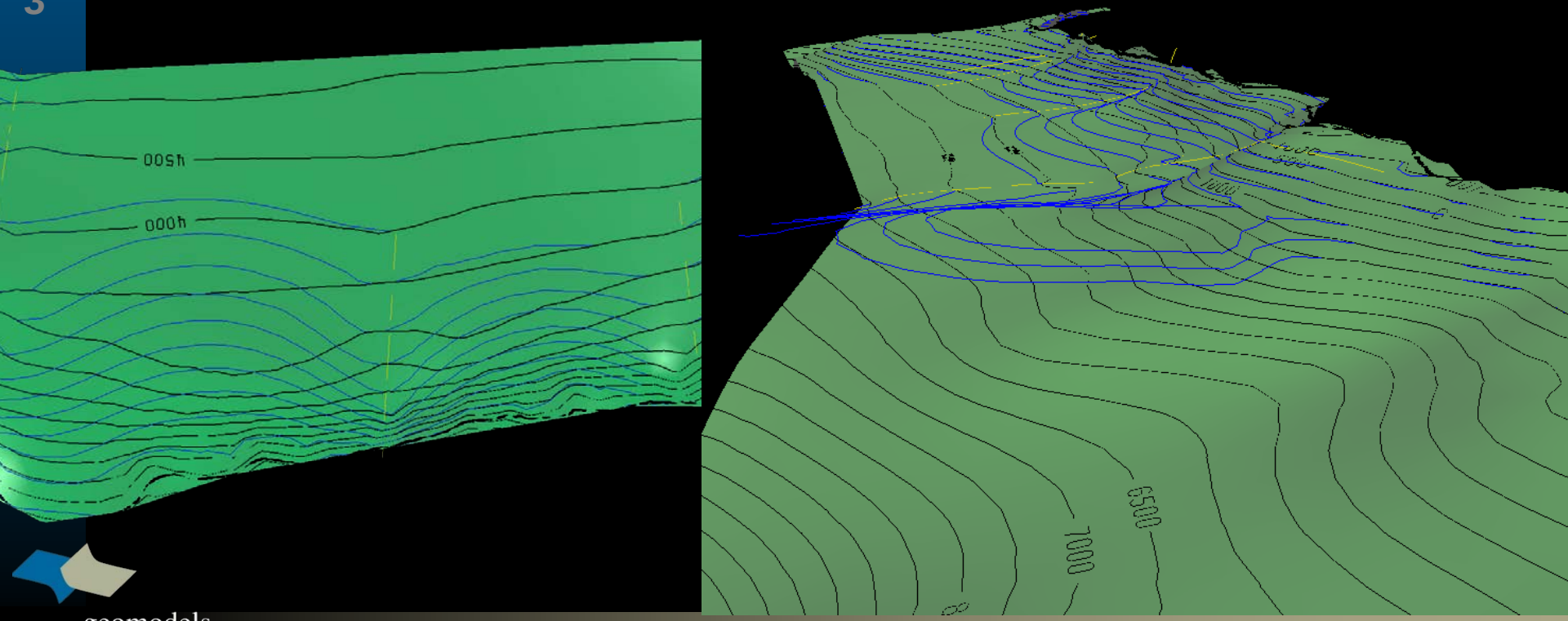

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Likewise…

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For this purpose it is essential the use of a **methodology** that would not even consider initial hard data but also allow introducing derived geological constraints.

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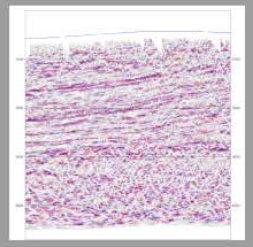
Methodology

Hard Data (Digital, 3D georeferenced)

Subsurface

Well

Seismic



Surface

1 ✓
2 ✓
3
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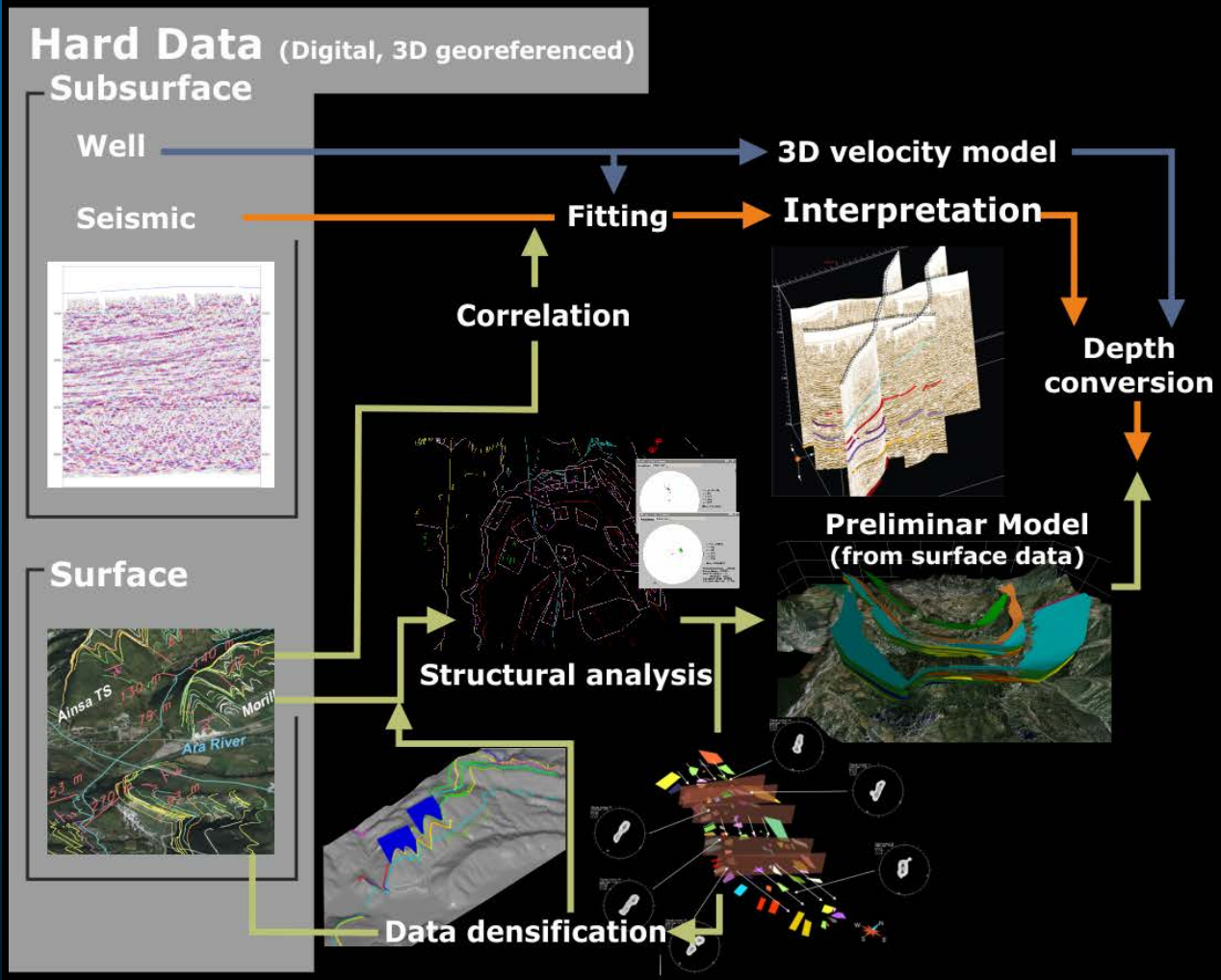
Methodology



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Methodology

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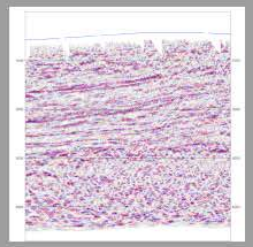


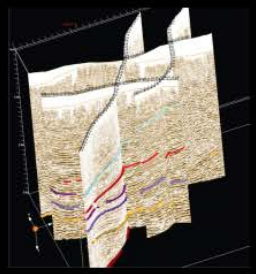
Surface

Correlation

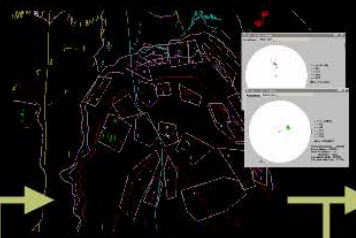
Fitting

3D velocity model

Interpretation

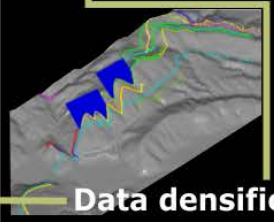


Depth conversion

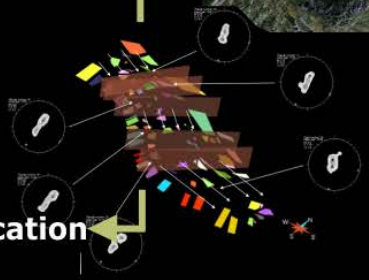


Structural analysis

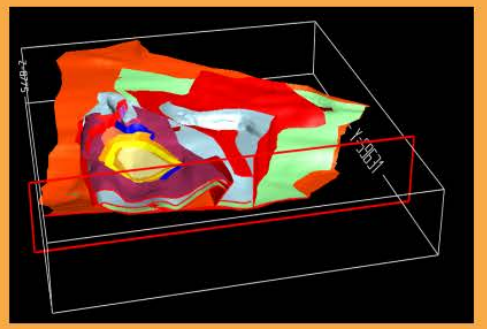
Preliminar Model
(from surface data)



Data densification



Products



Structural deterministic model
(based on surfaces)

Methodology

1 ✓
2 ✓
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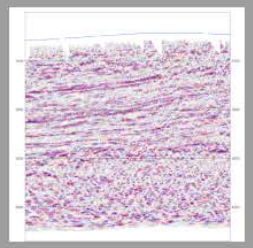
Hard Data (Digital, 3D georeferenced)

Subsurface

Well

Seismic



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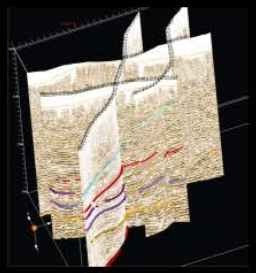
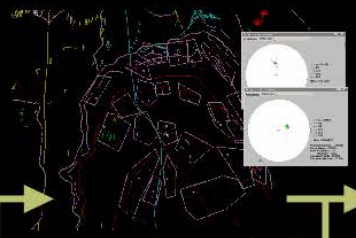
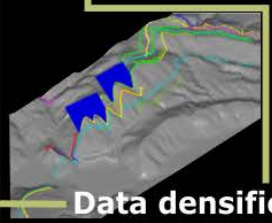


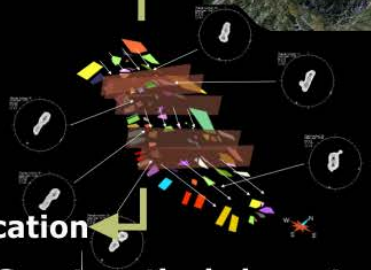
Depth conversion



Structural analysis

Preliminar Model
(from surface data)



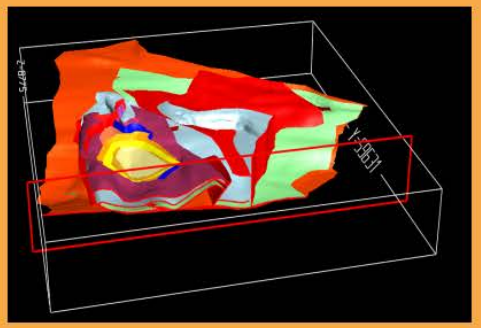


Data densification

Geostatistical characterization
(*Soft data*)

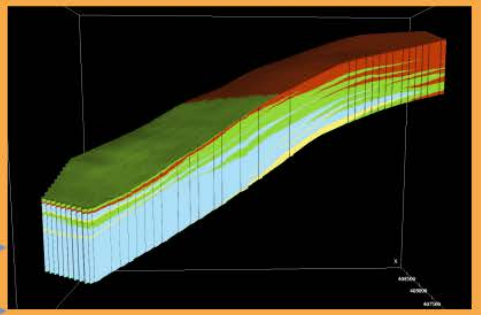
Hard data

Products



Structural deterministic model
(based on surfaces)

Others
(e.g. probabilistic models)



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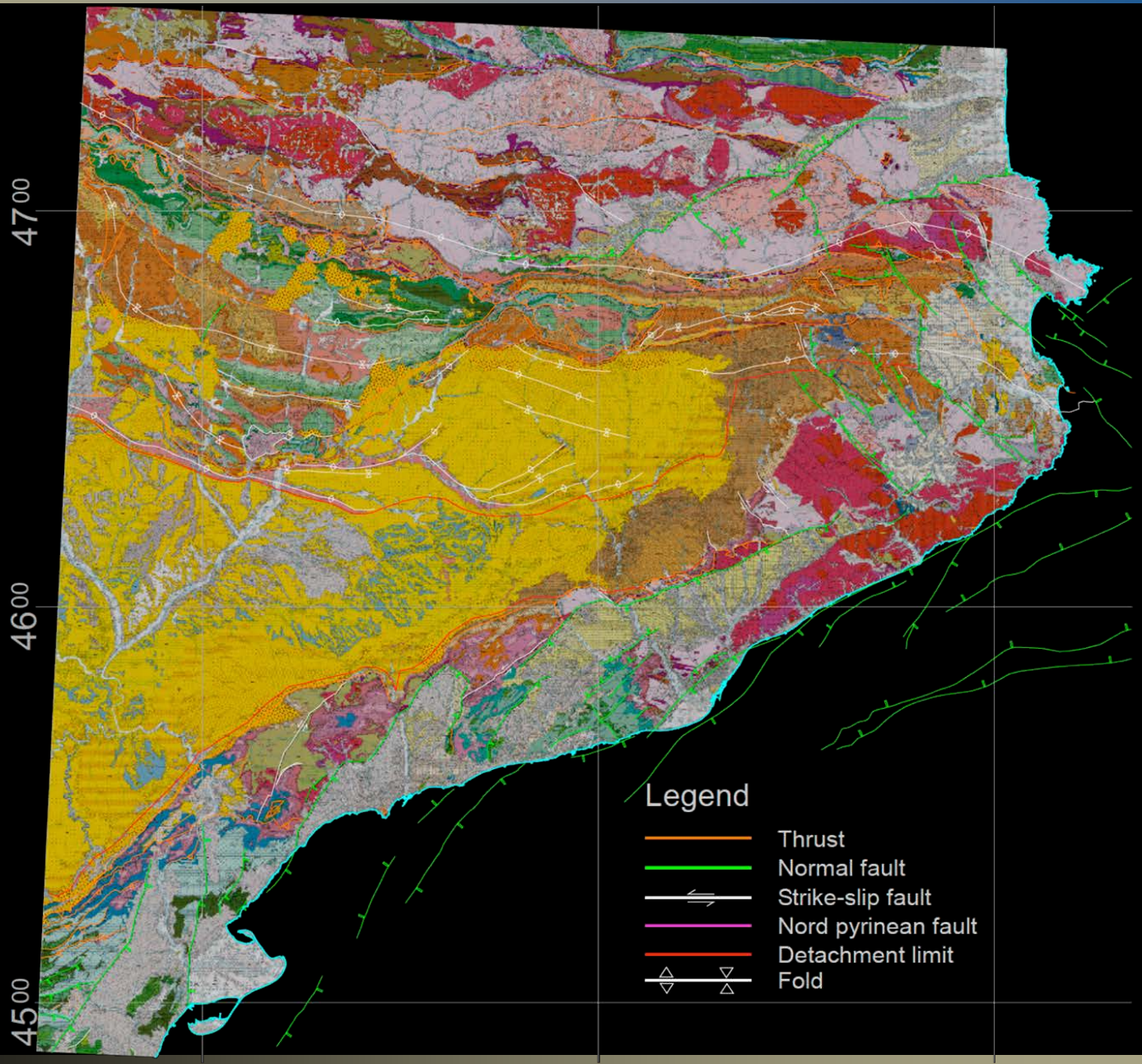
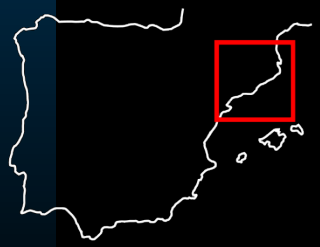
The 3-D geological model of Catalunya at 1:250.000





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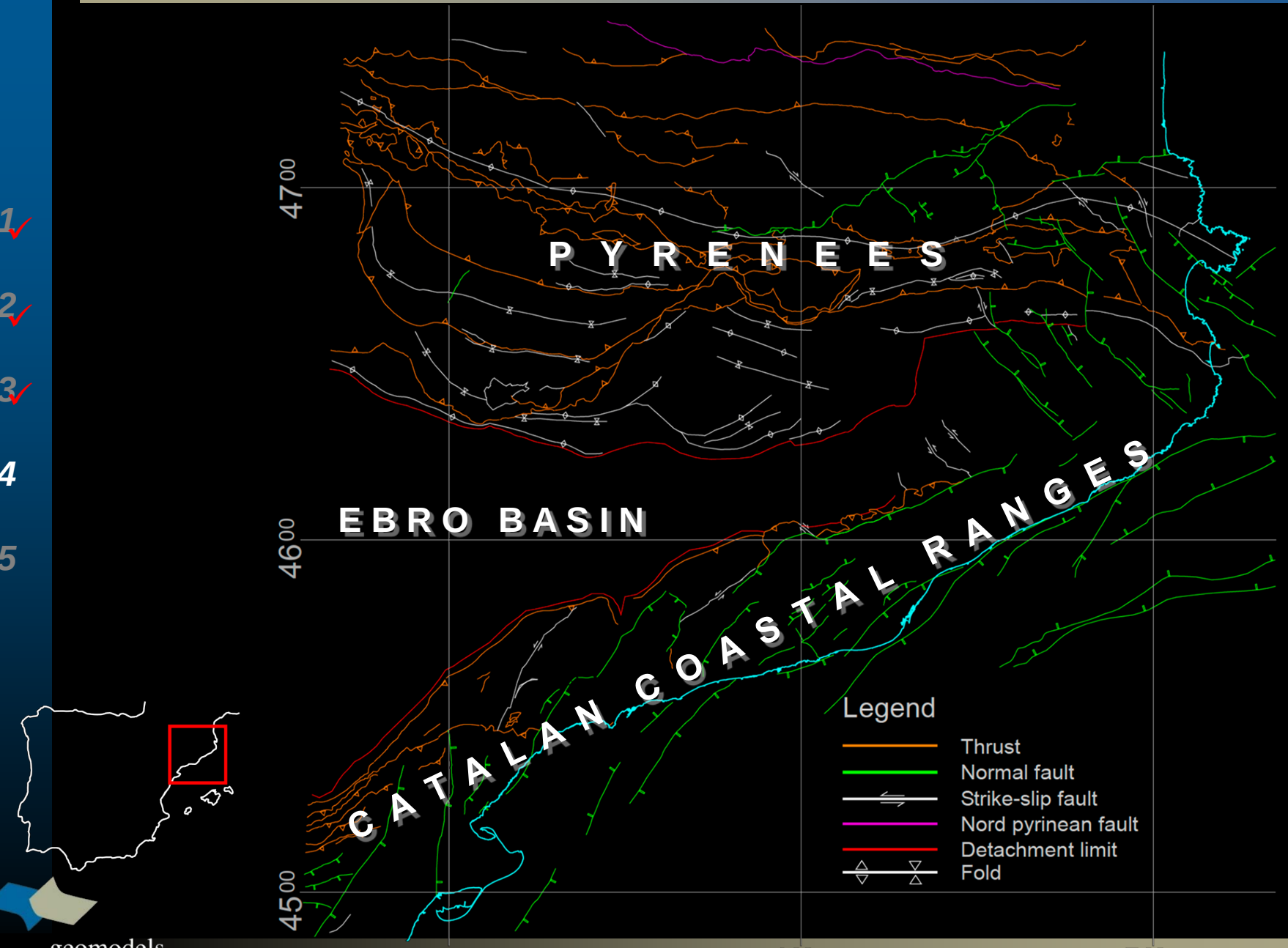
The 3-D geological model of Catalunya at 1:250.000



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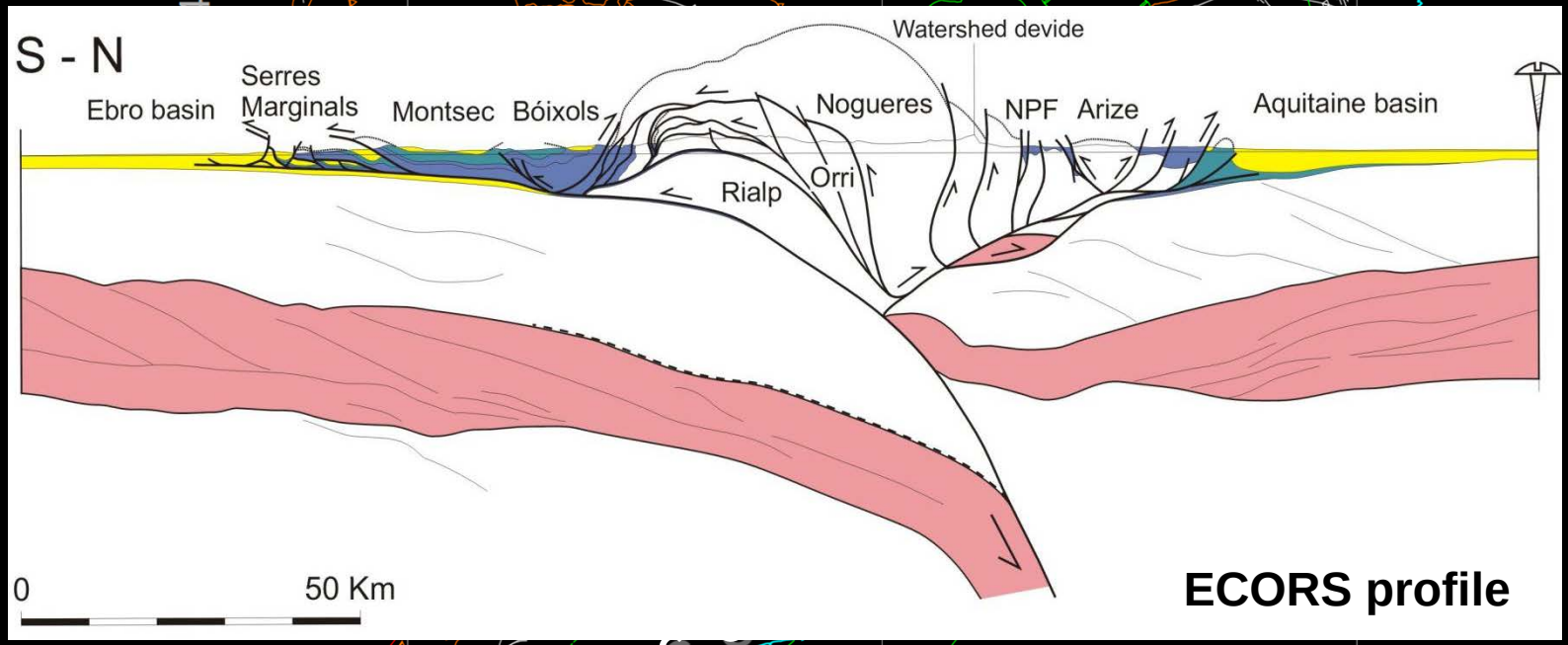

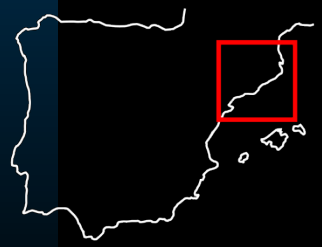

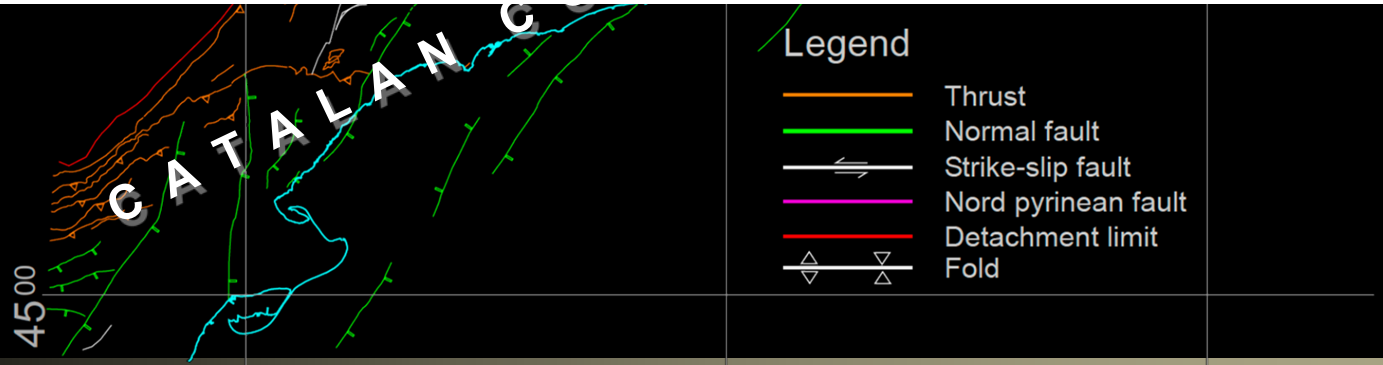

1 2 3 4 5

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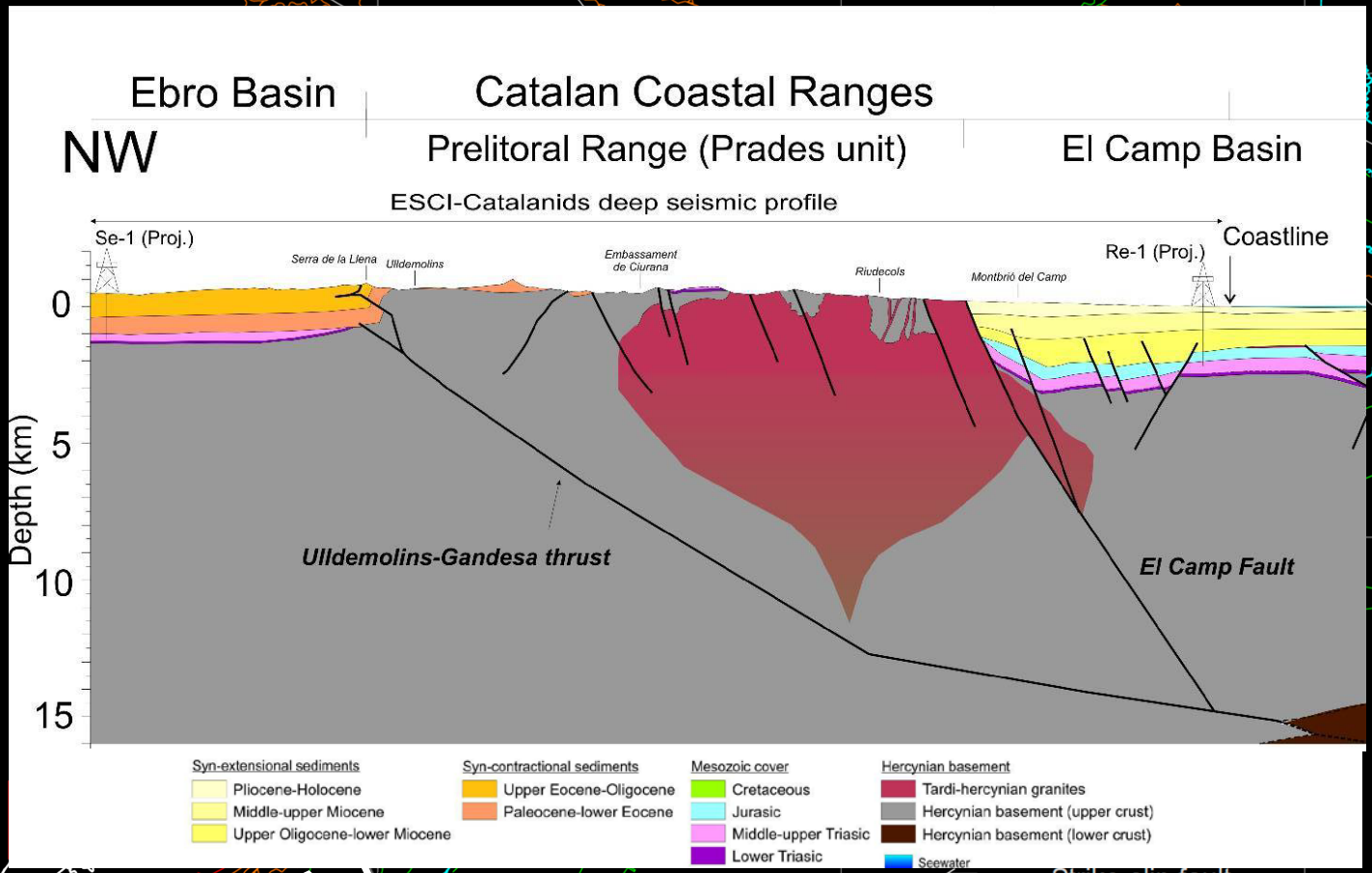
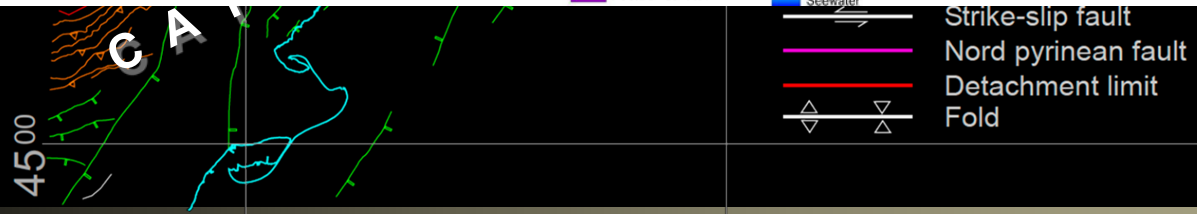
The 3-D geological model of Catalunya at 1:250.000





Strike-slip fault
Nord pyrinean fault
Detachment limit
Fold

1
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Data used:

1 ✓
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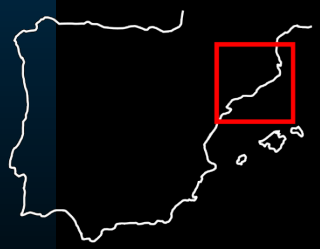
DTM
200x200 m
or
20x20 m

Surface
field
data

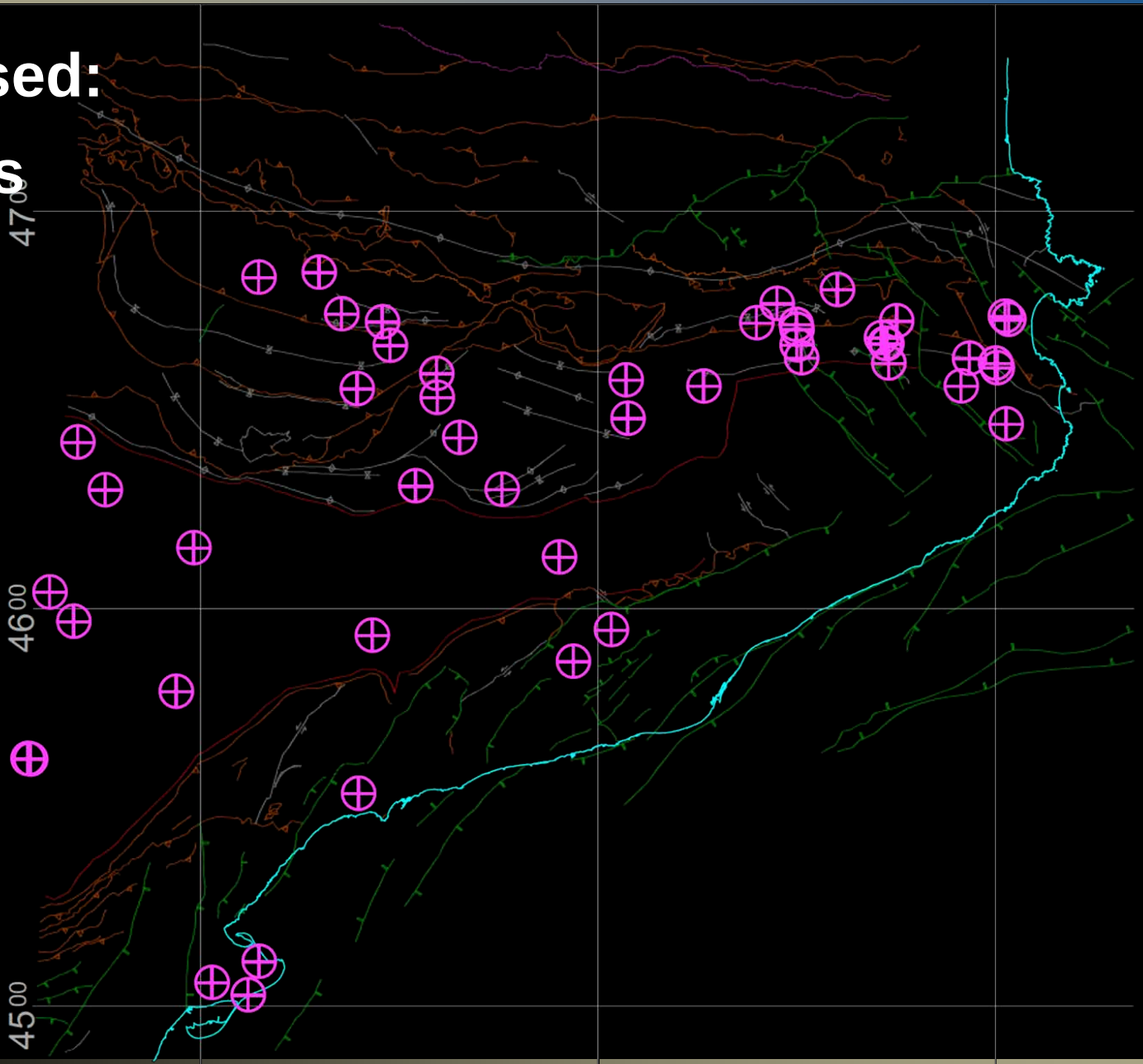
Data used:

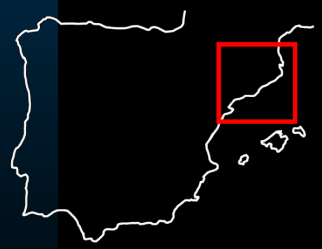
45 seismic lines



Data used:

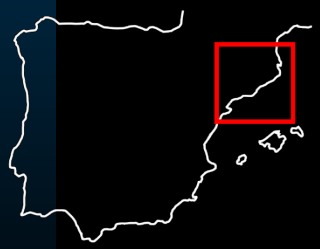
48 wells





Data used:

65 cross sections



Main structures reconstructed

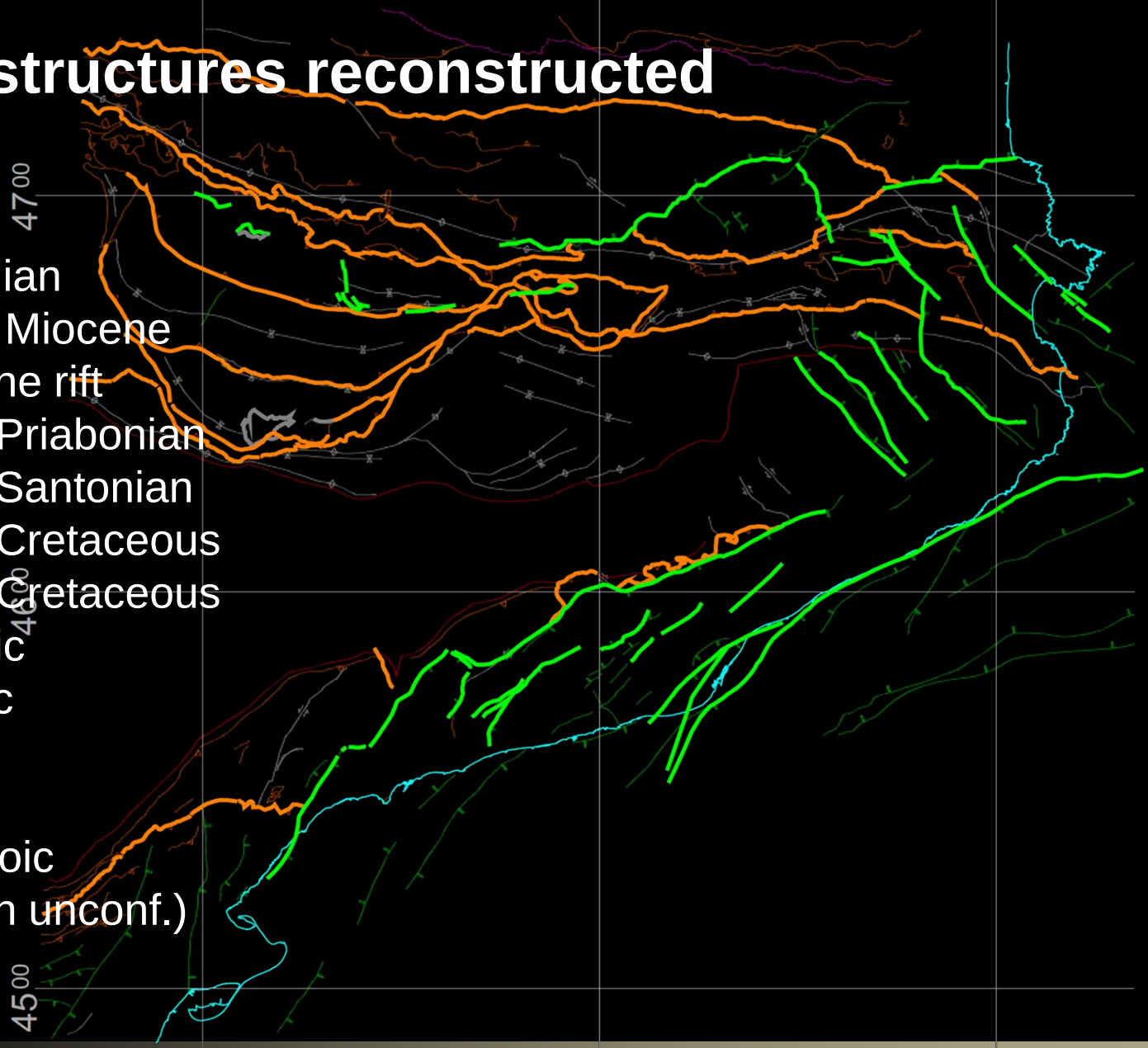
Bottom of:

- Messinian
- Middle Miocene
- Neogene rift
- Lower Priabonian
- Upper Santonian
- Upper Cretaceous
- Lower Cretaceous
- Jurassic
- Triassic

Top of:

- Paleozoic

(Hercynian unconf.)



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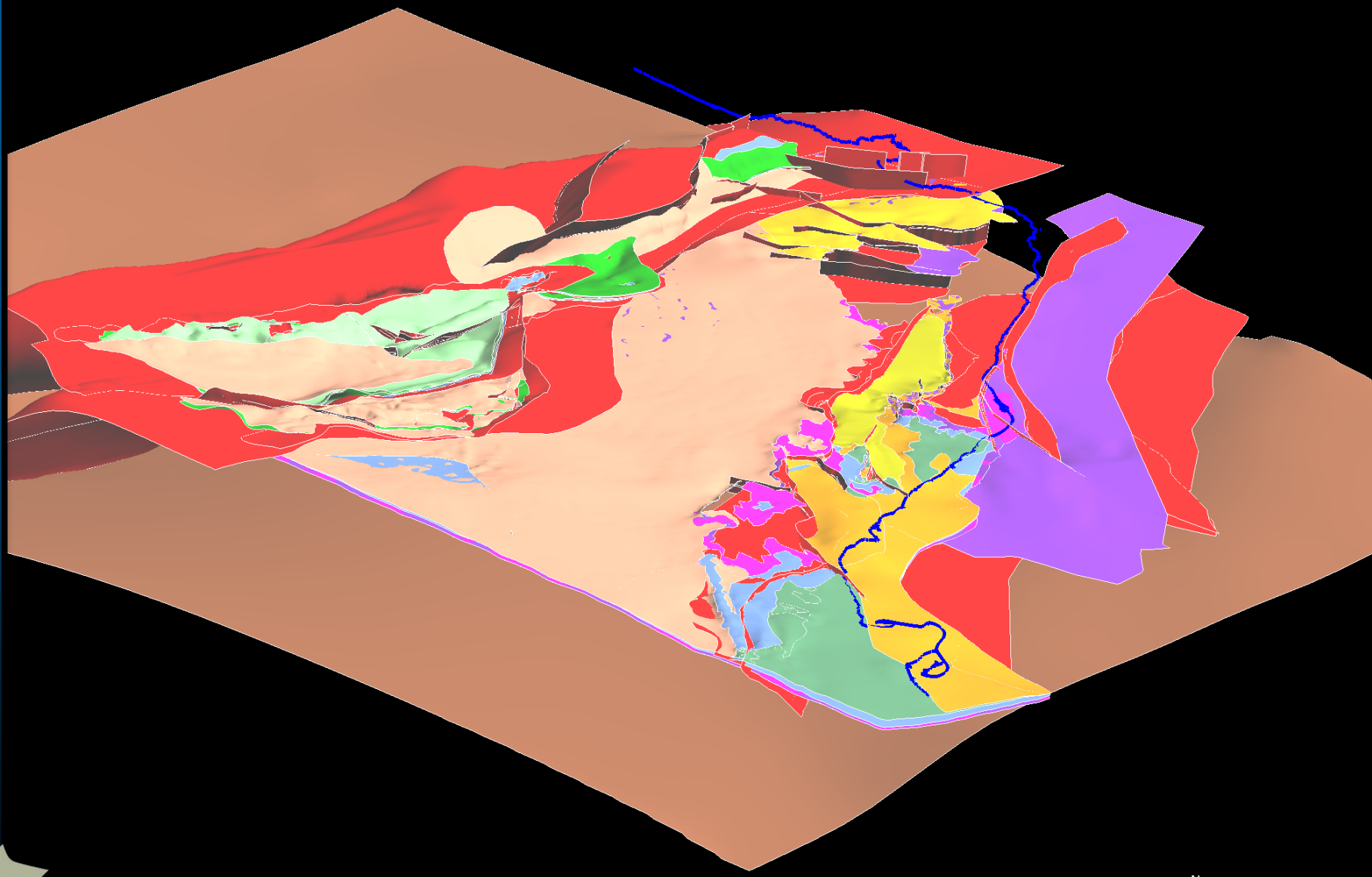

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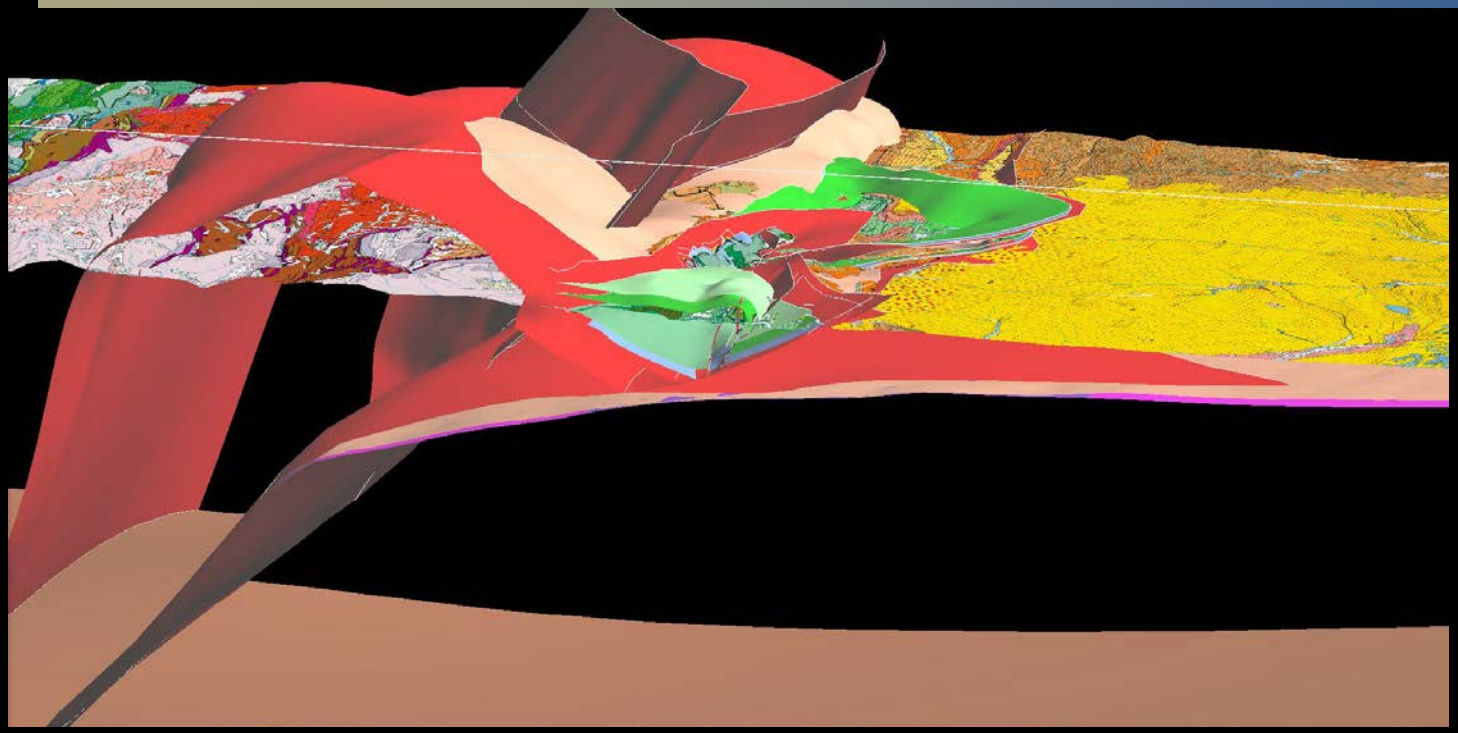
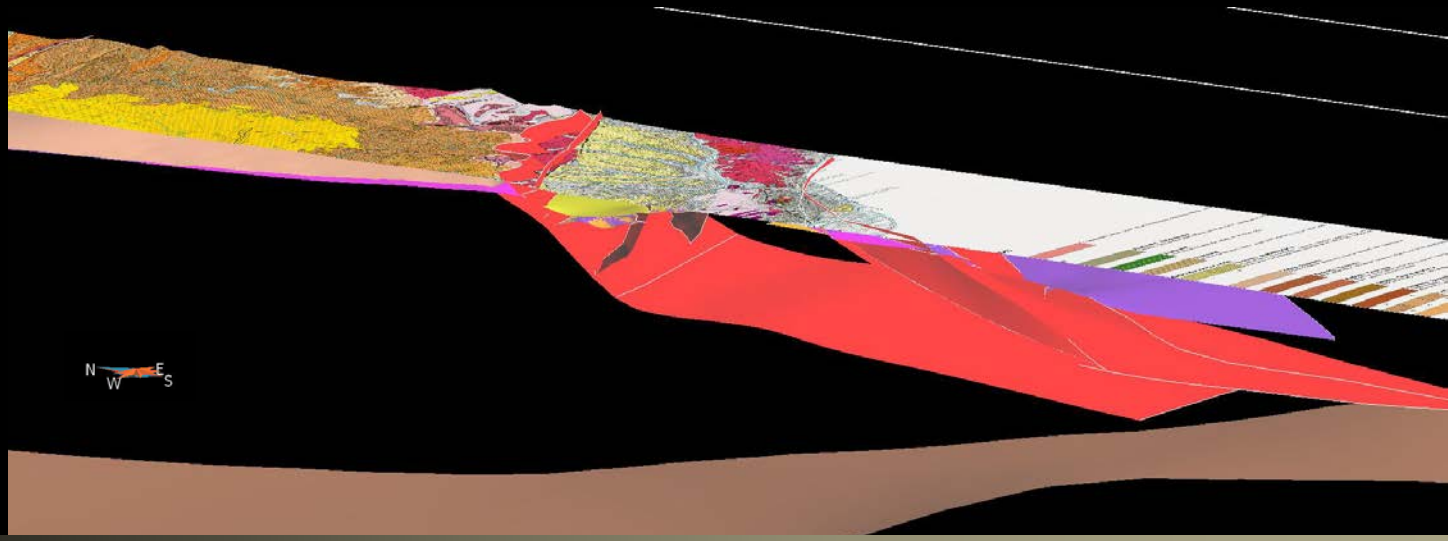
The 3-D geological model of Catalunya at 1:250.000





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1. Introduction
2. Why a 3-D model?
3. Methodology
4. The 3-D geological model of Catalunya at 1:250.000
5. Conclusions

Conclusions

- New computer technologies combined with a **valid 3-D geological reconstruction methodology**, can address the disclosure and understanding geology in a more efficient way.

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Conclusions

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- The use of the described methodology allows to integrate a variety of information with different file format in a common graphic environment. In turn it provides fast and effective access to information and it is valuable to solve data base and geological inconsistences

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Conclusions

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- The use of the described methodology allows to integrate a variety of information with different file format in a common graphic environment. In turn it provides fast and effective access to information and it is valuable to solve data base and geological inconsistences

- The use of 3D geological model of Catalunya is mainly conceived by the IGC to serve as a warehouse of available geological information that would be permanently updated.

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Thanks for your attention