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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Introduction

Why a 3-D model?

Methodology

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

Conclusions
Introduction

Surface or subsurface geological data
Introduction

Direct or indirect geological data

RAW data in analog format

CAD files

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

or X, Y, Z, Prop

Digital data (shp, dxf, pl, ... files)

Digital Database
1D / 2D products in digital or analog format:
- Maps
- Cross-sections
- Stratigraphic columns
- ...others
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Why a 3-D model?

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

What is the structure that best explain these 2D cross-sections?
Why a 3-D model?

Modified from Fernández, 2004
Why a 3-D model?

Which one is the best solution?

Modified from Fernández, 2004
Why a 3-D model?

If we considers more information…
Why a 3-D model?

Considering more information... less and best solutions!

Modified from Fernández, 2004
Why a 3-D model?

Modified from Fernández, 2004
Why a 3-D model?

Simplifying and projecting into the 2D cross-sections

But… How we obtain the 2D representation of the 3D structure?
Why a 3-D model?

Advantages

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

-Construct a 3D model is not an easy task.

… if we want to introduce geological constraints (imposed by the structure) that determine the resulting structure
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  … if we want to introduce geological constraints (imposed by the structure) that determine the resulting structure.

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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Hard Data (Digital, 3D georeferenced)

Subsurface
- Well
- Seismic

Surface
Methodology

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Subsurface
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Surface

3D velocity model

Interpretation

Correlation

Depth conversion

Structural analysis

Preliminary Model (from surface data)

Data densification
Methodology

Hard Data (Digital, 3D georeferenced)

Subsurface
- Well
- Seismic

Surface

\[ \rightarrow \text{Correlation} \rightarrow \text{Fitting} \rightarrow \text{Interpretation} \rightarrow \text{Depth conversion} \rightarrow \text{Structural deterministic model (based on surfaces)} \]

Products

Data densification

3D velocity model

Preliminary Model (from surface data)

Structural analysis

alinas TS

Ari River
Methodology

**Hard Data** (Digital, 3D georeferenced)
- Subsurface
  - Well
  - Seismic
- Surface
  - Structural analysis
  - Data densification
  - Geostatistical characterization
    - Soft data
    - Hard data

**Interpretation**
- 3D velocity model
- Depth conversion

**Products**
- Structural deterministic model (based on surfaces)
- Others (e.g. probabilistic models)
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Ebro Basin  |  Catalan Coastal Ranges

Prelitoral Range (Prades unit)  |  El Camp Basin

Ulldemolins-Gandesa thrust

Depth (km)

Syn-extensional sediments
- Pliocene-Holocene
- Upper Oligocene-lower Miocene

Syn-contractional sediments
- Pliocene-Oligocene
- Late Oligocene-lower Eocene

Mesozoic cover
- Crataceous
- Jurassic
- Middle-upper Triassic
- Lower Triassic

Hercynian basement
- Tardihercynian granites
- Hercynian basement (upper crust)
- Hercynian basement (lower crust)

Strike-slip fault
- Nord pyrenean fault
- Detachment limit
- Fold

Se-1 (Proj.)  |  Re-1 (Proj.)
The 3-D geological model of Catalunya at 1:250,000

Data used:

- DTM
  - 200x200 m
  - or
  - 20x20 m

- Surface field data
The 3-D geological model of Catalunya at 1:250,000

Data used:

45 seismic lines
The 3-D geological model of Catalunya at 1:250,000

Data used:

48 wells
The 3-D geological model of Catalunya at 1:250,000

Data used:

65 cross sections
The 3-D geological model of Catalunya at 1:250,000

**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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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.

• 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 inconsistencies.

• 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.
Thanks for your attention