Le Référentiel Géologique
DE LA FRANCE
and 3D modeling

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Géosciences pour une Terre durable
brgm

The RGF : A three-dimensional information system

**Objective**: To build a three-dimensional geological knowledge: continuous, consistent data base

Purpose: anticipate and answer the new societal demands implying the underground (energy, natural hazards, resources, urbanization, pollution…) and in particular to make easier the data preparation for 3D modeling
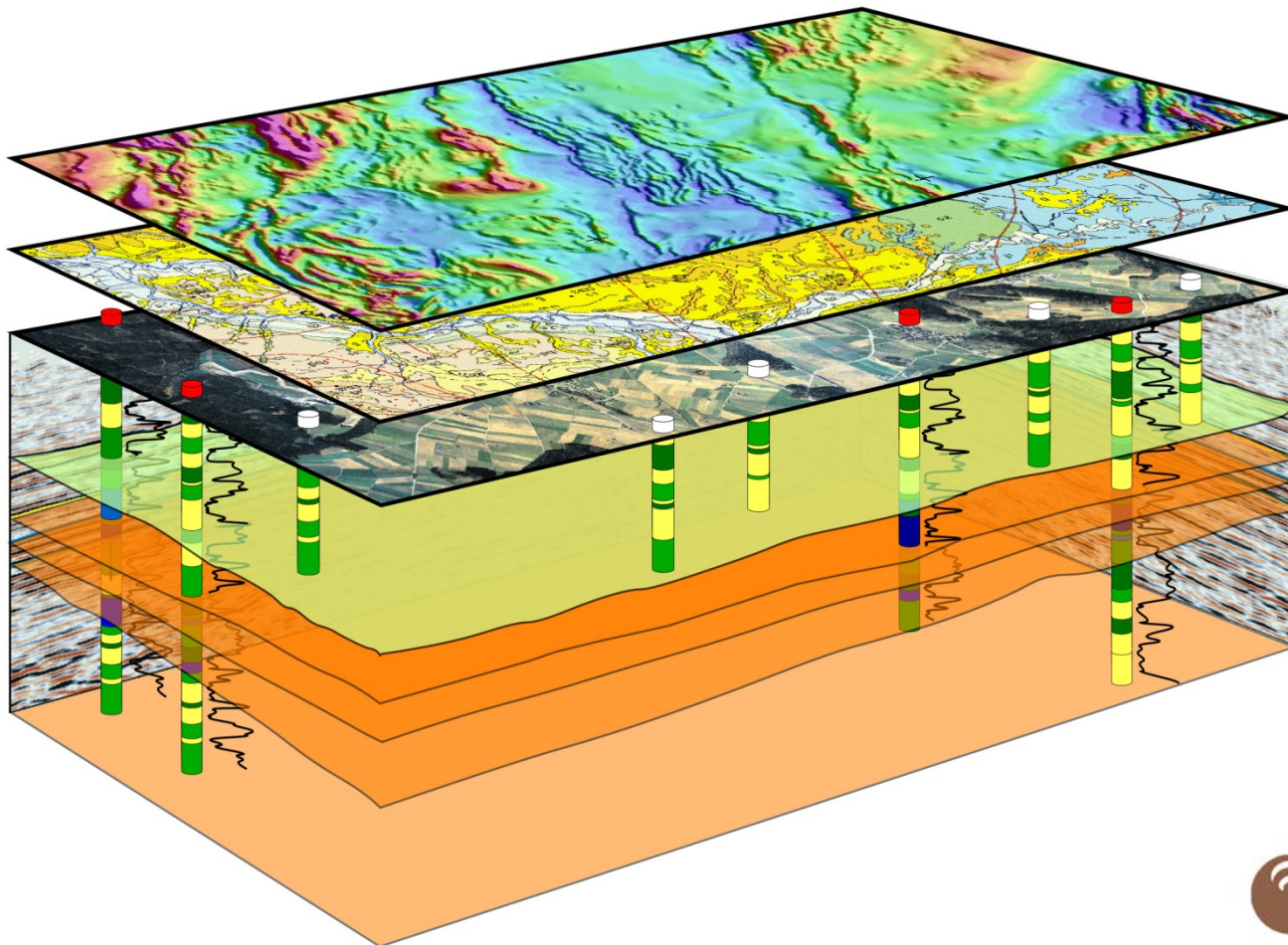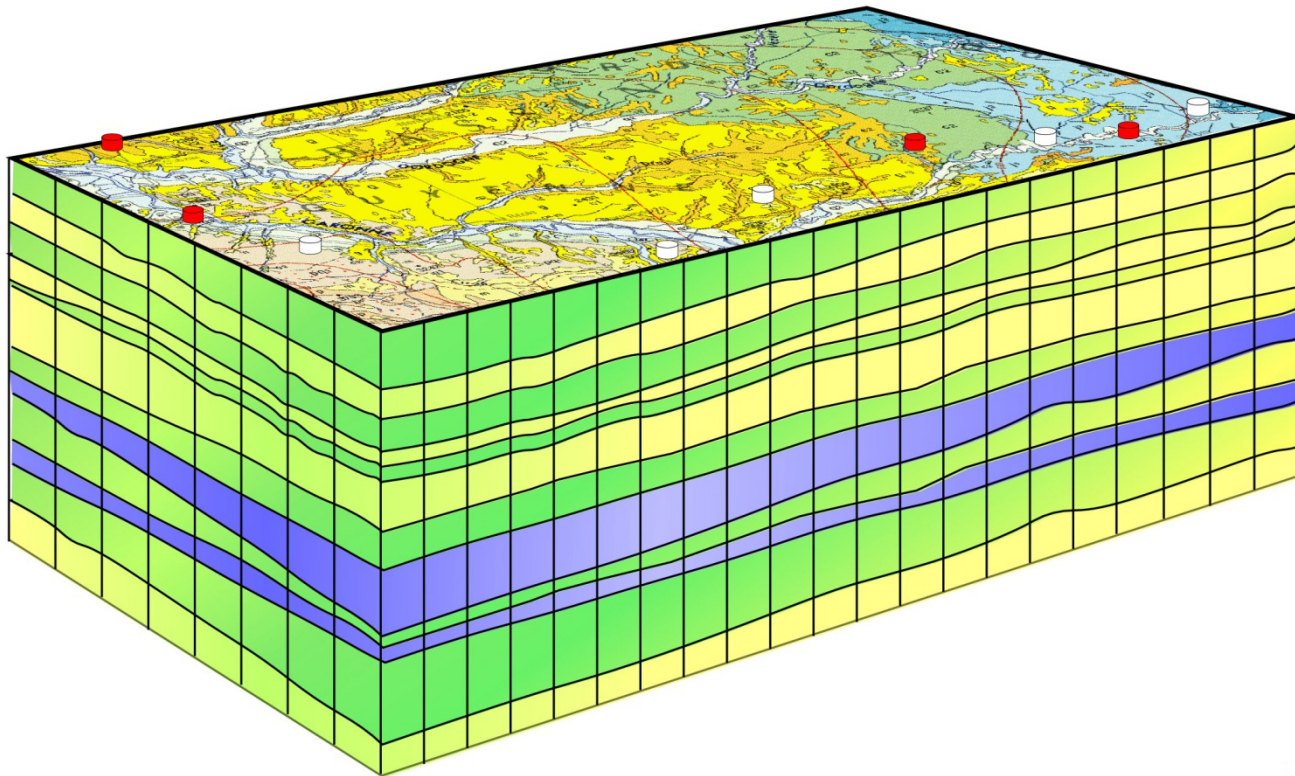
Géosciences pour une Terre durable
brgm

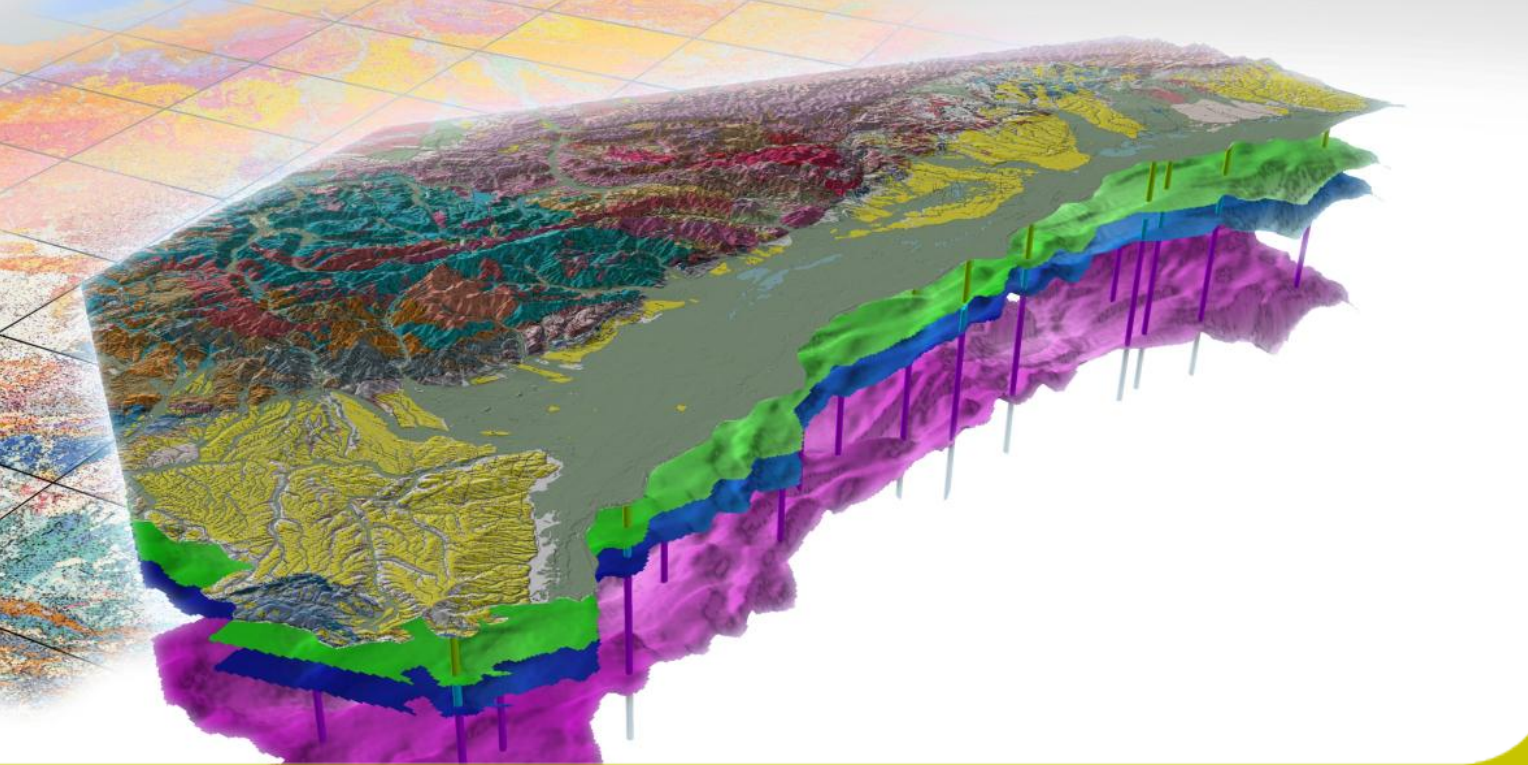*A three-dimensional alignment of data from various data bases available at BRGM*
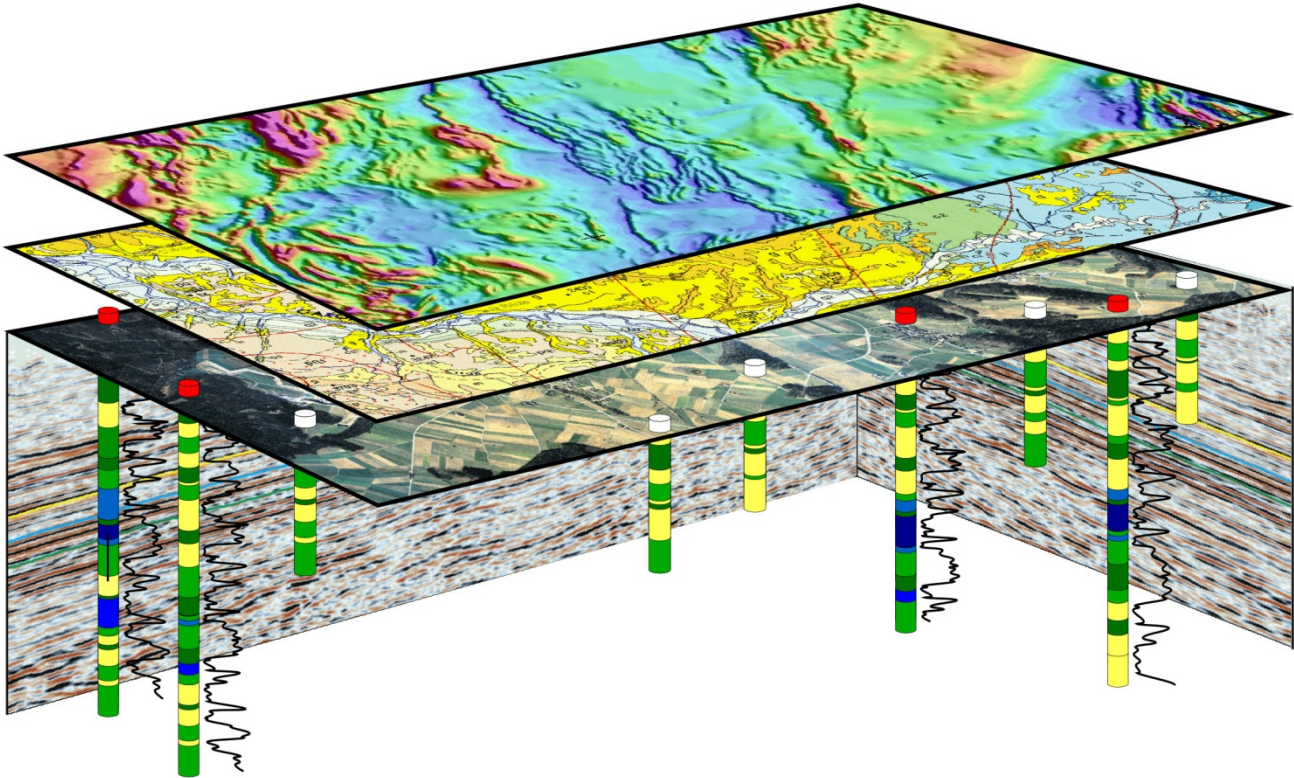
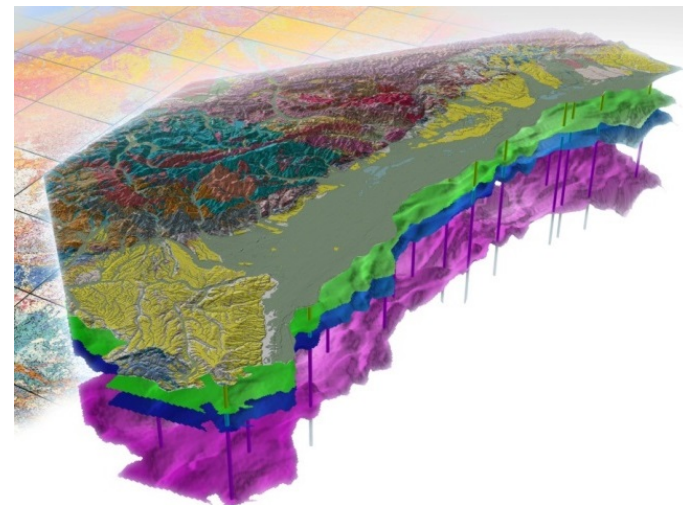*Interpolation of surfaces to controle the 3D consistency of integrated data*
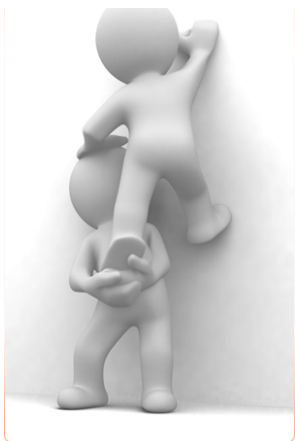
*…**to improve** data accessibility and geological kowledge for creation of 3D models*

RGF pilot study in «Vosges Fossé-Rhénan» region

RGF pilot project

Suggest, develop and test :

- data processing to insure 3D consistency between data set

- data base to link depth and surfasic information

- deliver geological product with 3D consistency useful for social and scientific requirements

- RGF's workflow

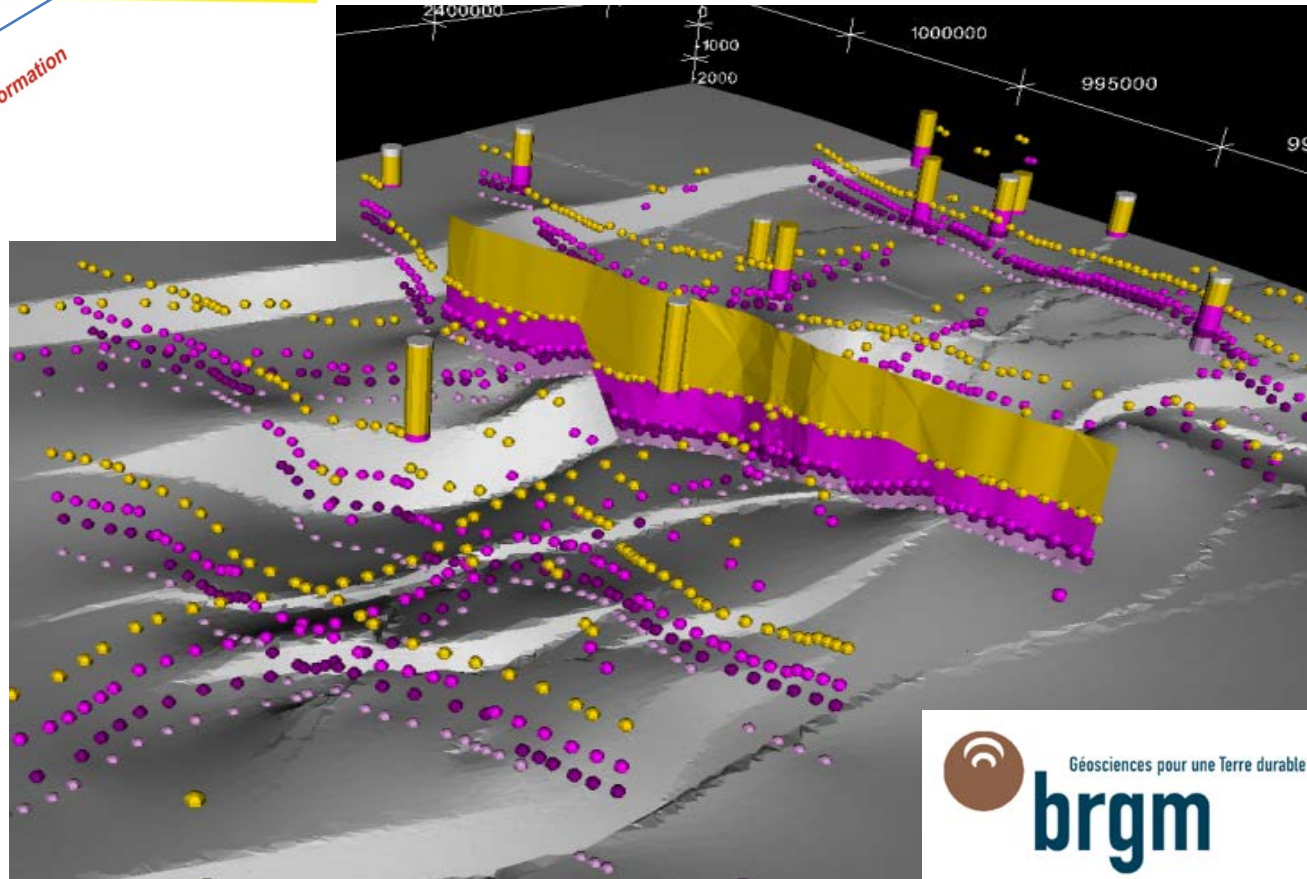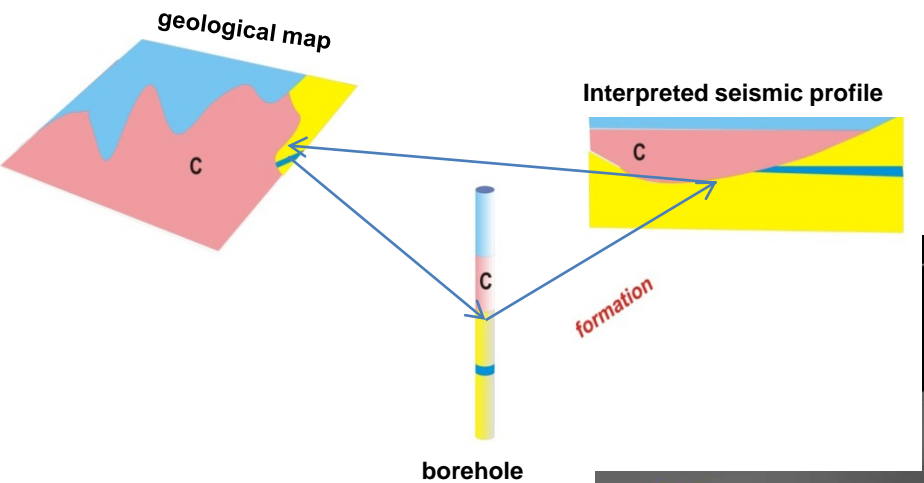- experience feedback for the national program
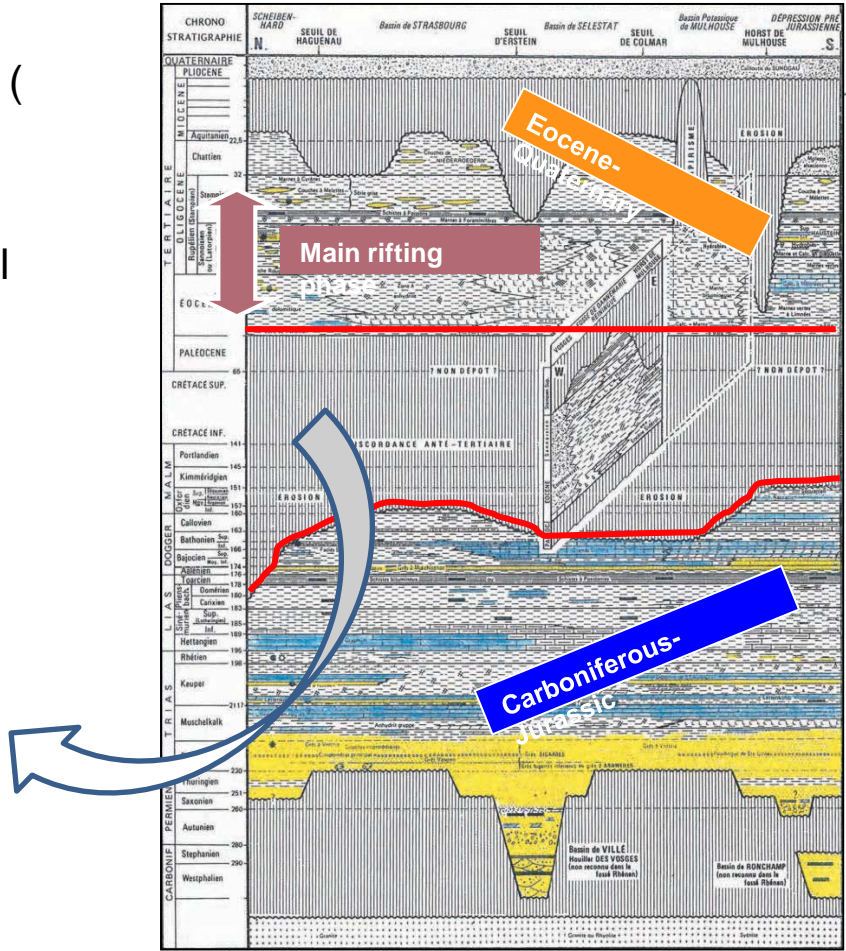
Feedback experience
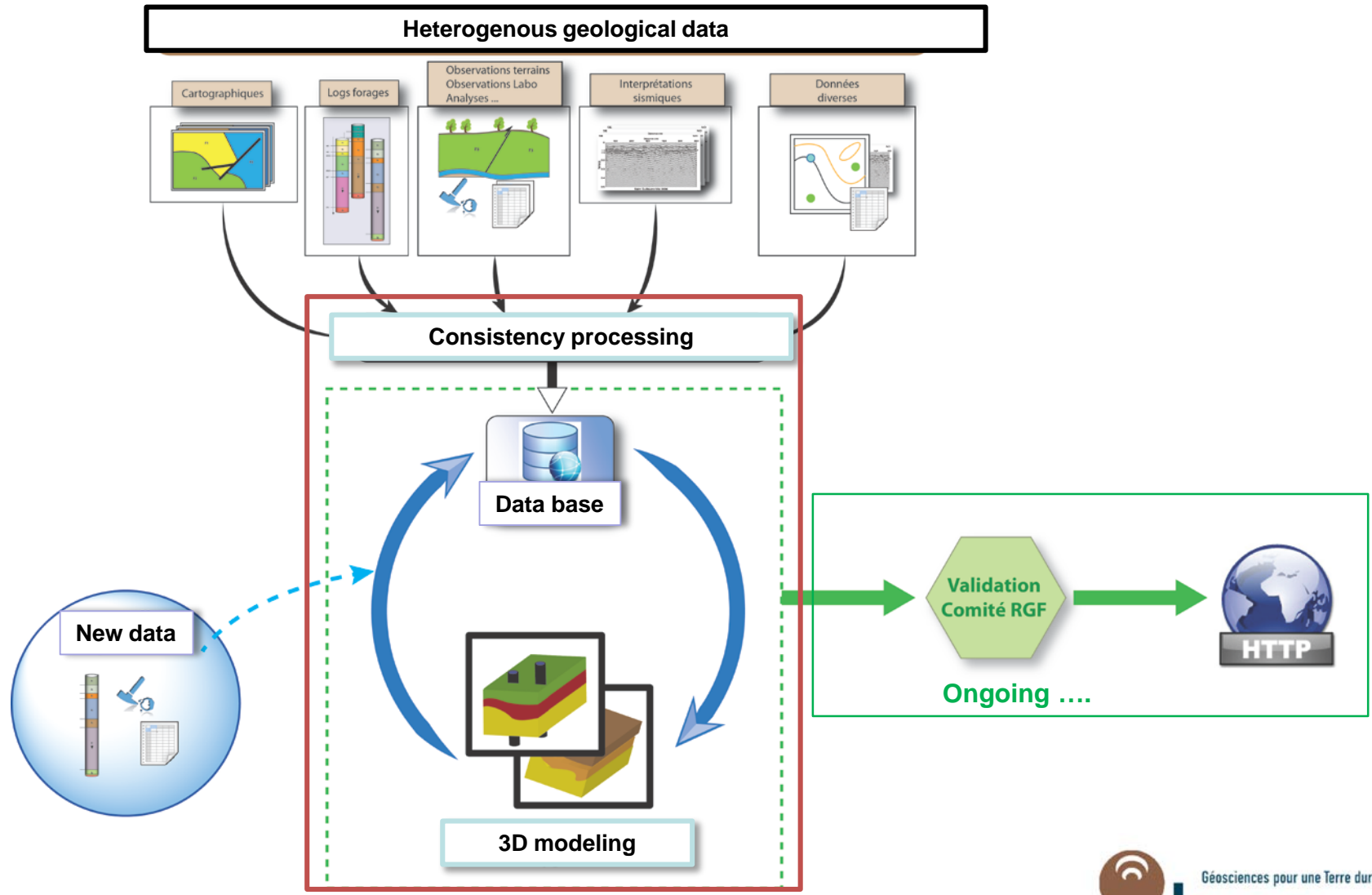
make data description and codification coherent all together (maps, boreholes, seismic profiles)

prerequisite to apply consistensy

- list all geological units existing in the area study (map, borehole, …)

- organise in a hierarchical table of all geological units identified (spatio-temporal organisation)

Richard et Weisgerber, 1985

Link between boreholes, geological maps, interpreted seismic profil

> Result of the processing of all available geological data in the regional area

> Capacity of gathering for each type of data

P. Chèvremont, D. Cruz Mermy, C. Prognon, E. Skrzypek, A.S Tabaud, Y. Vernhet, H. Berthier
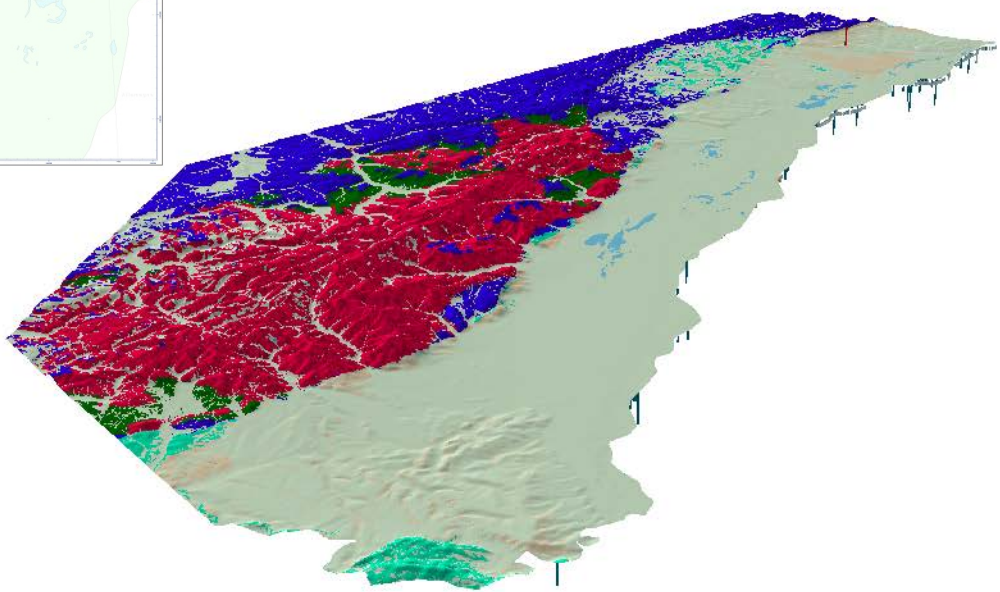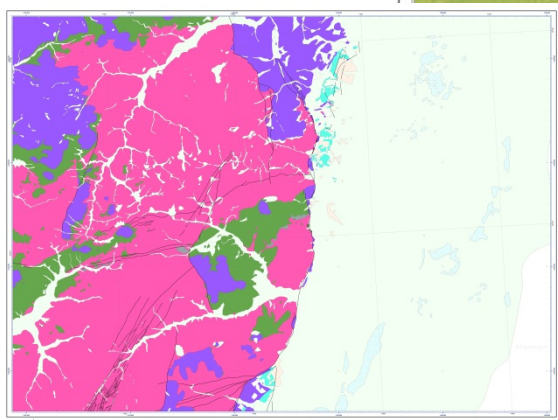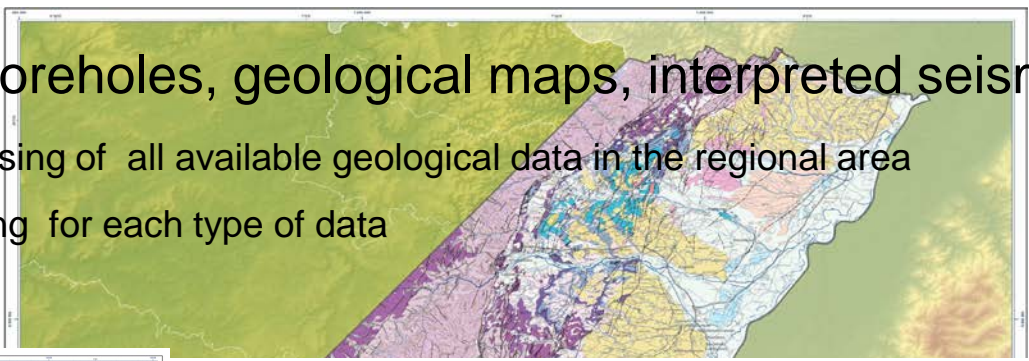
## 3D modeling integrated in RGF consistency processing

- Test / approve data consistency and geological interpretations

- Test scientifics hypothesis by a 3D interpretation approch at regional scale and specific applications

- Iterative approch between 3D modeling and data interpretation

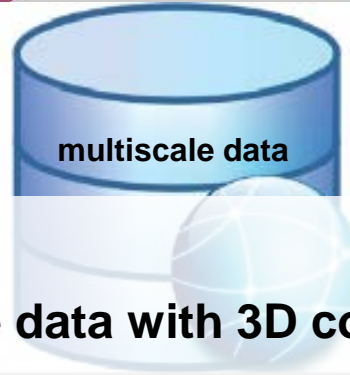Need to create a **physical link** between the data base and models!
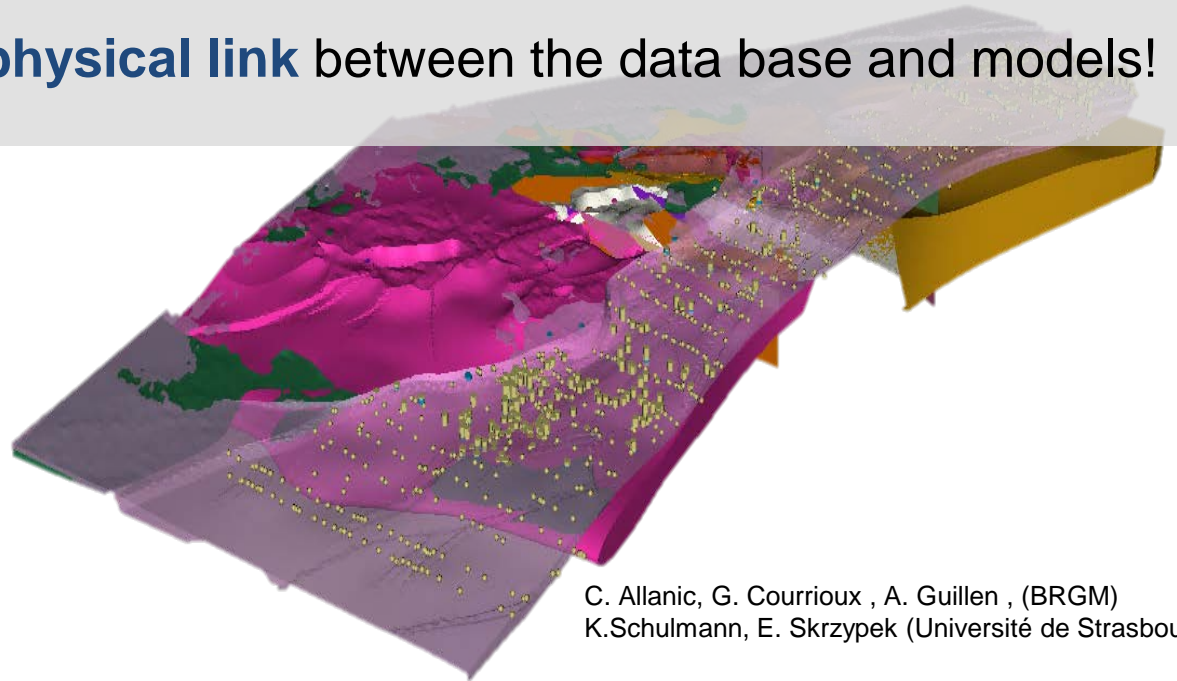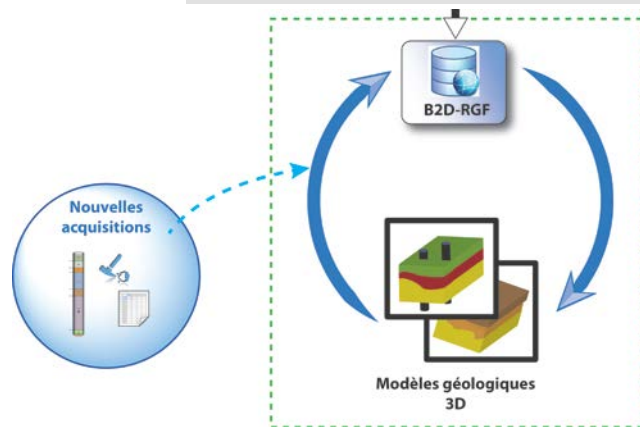
C. Allanic, G. Courrioux , A. Guillen , (BRGM)
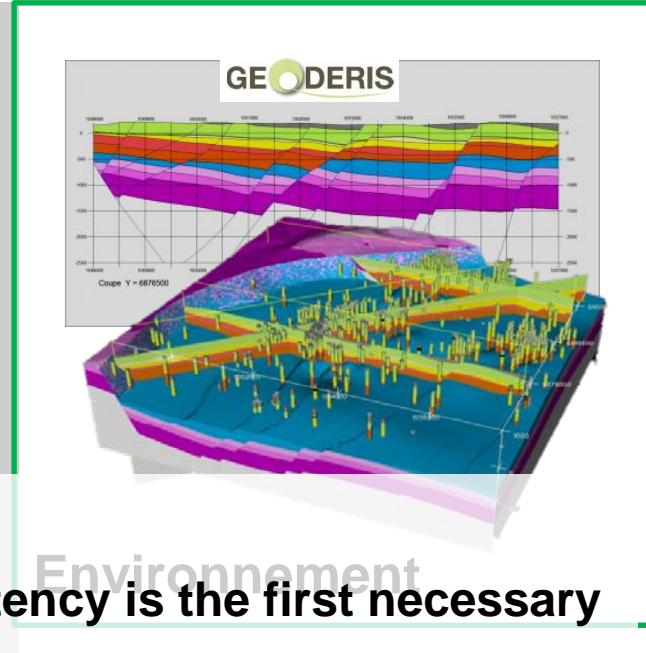K.Schulmann, E. Skrzypek (Université de Strasbourg)

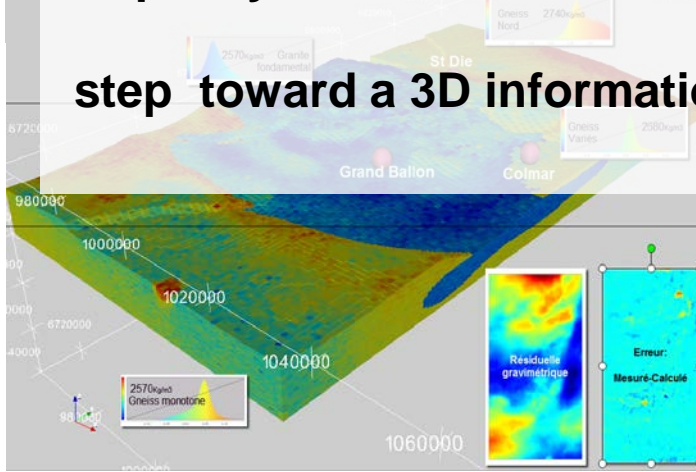**Differente scales for different applications**
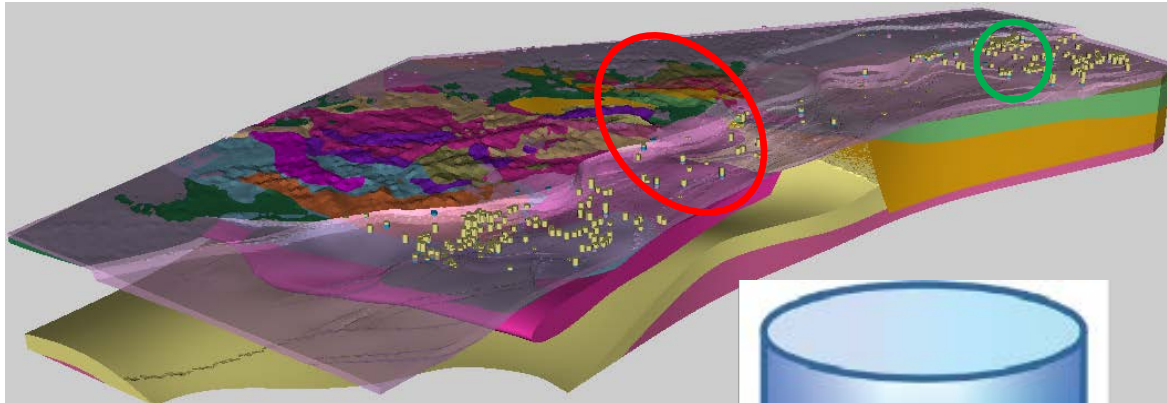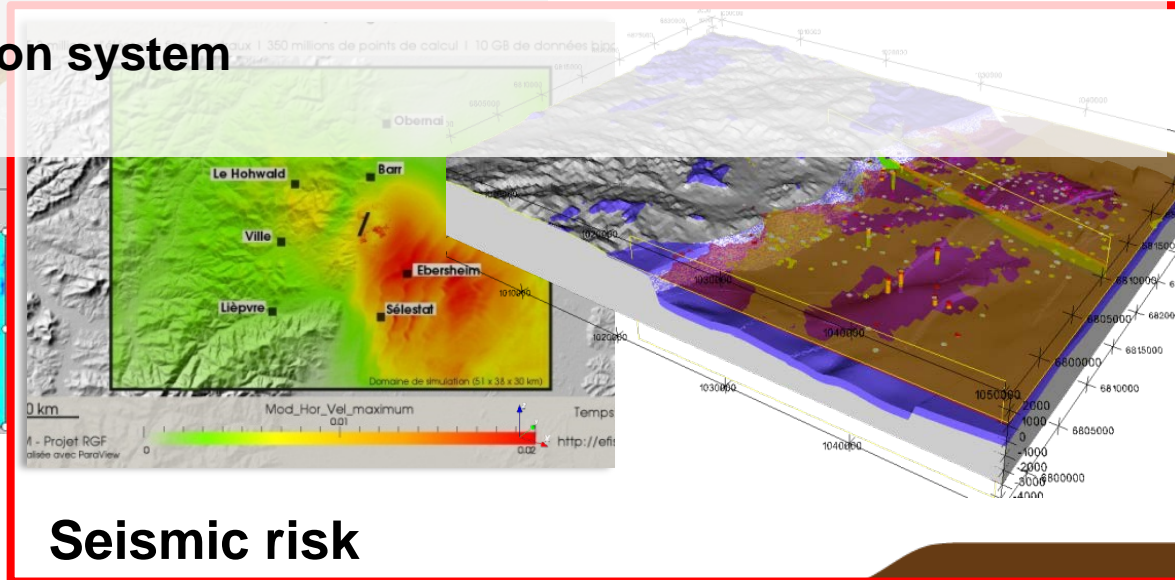
Crustal scale

multiscale data

Environnement

Capacity to deliver multiscale data with 3D consistency is the first necessary step toward a 3D information system
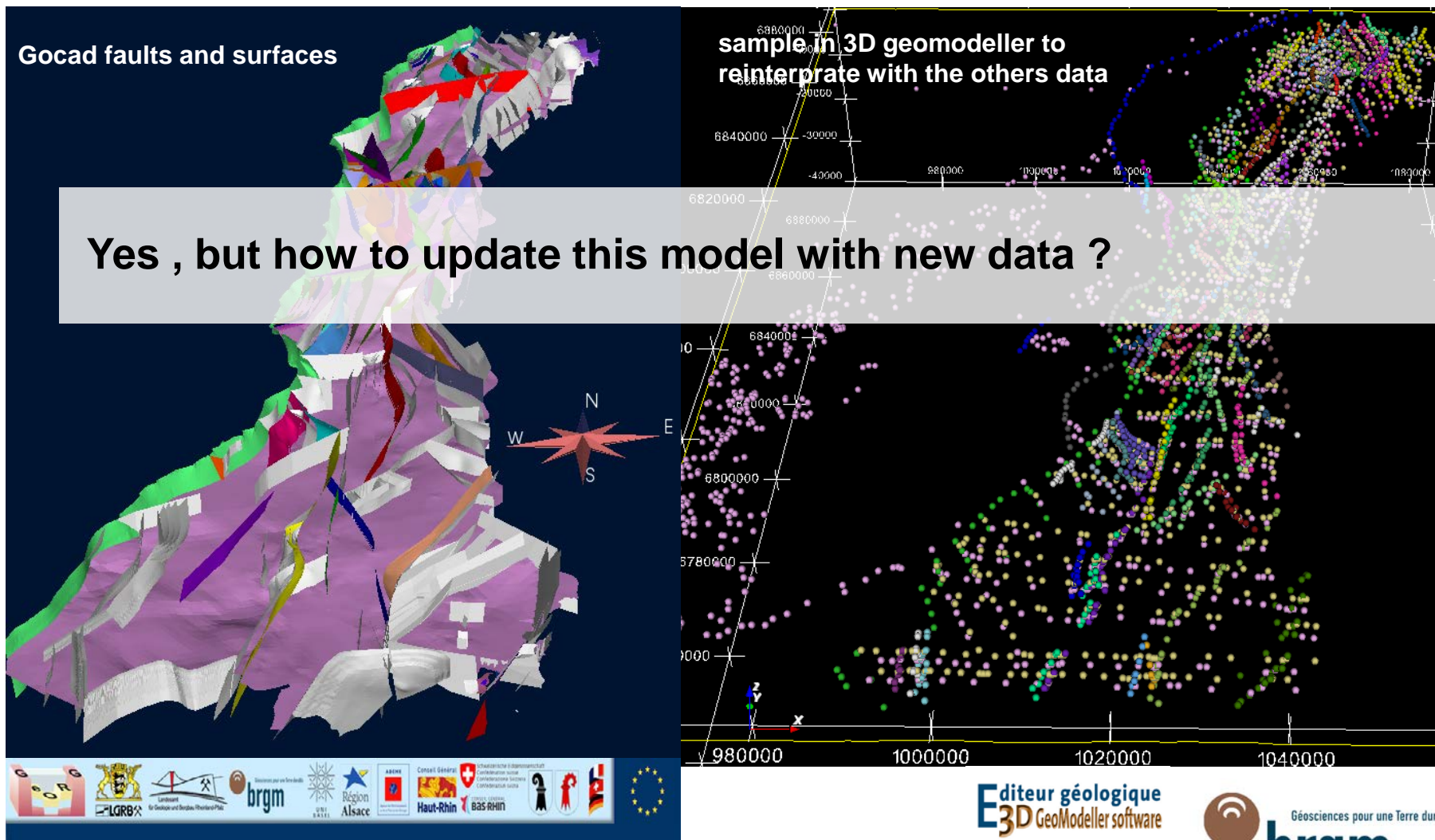
deep geophysic

Seismic risk

The RGF pilot project give the launching tools for the new national program

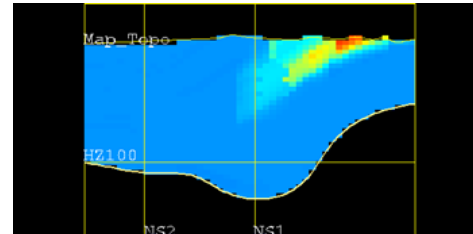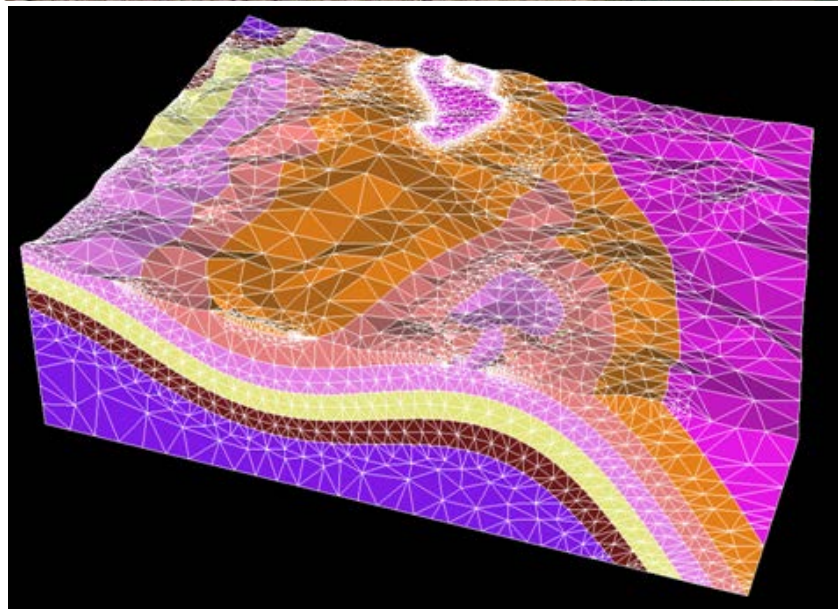**Research and developement effort must be maintain ….**
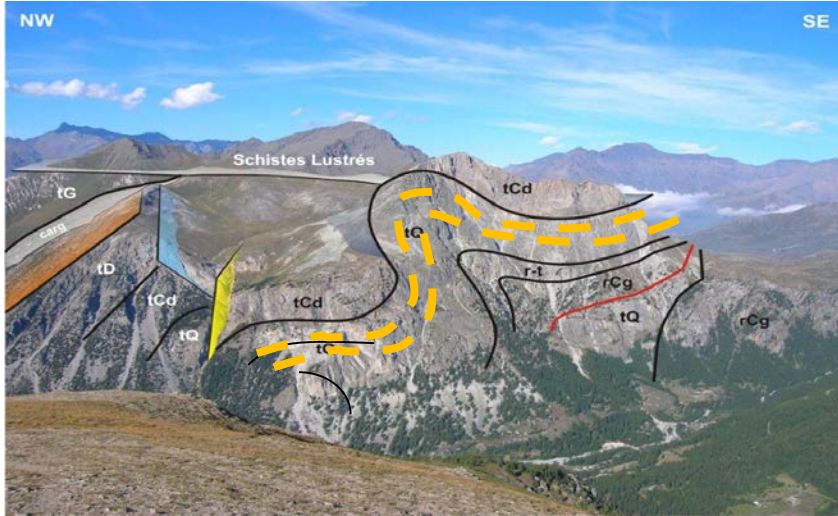
BRGM challenges and ongoing development for 3D modeling

GEORG project model integration in RGF regional model

- A model created for a specific application, can it be recycle for others studies ?

Gocad faults and surfaces

sample in 3D geomodeller to reinterprate with the others data
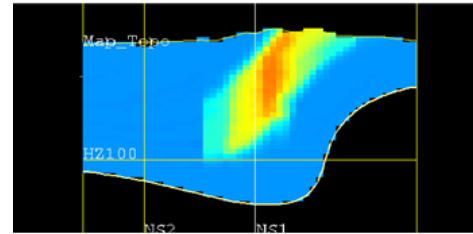
Yes , but how to update this model with new data ?

3D MODELING …. Kriging - Simulation
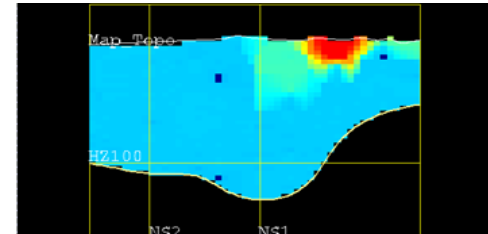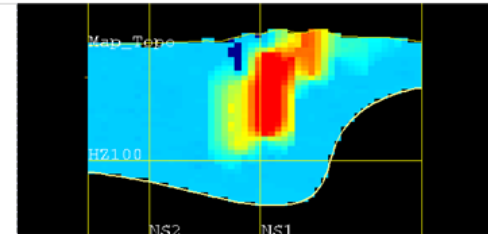
3D MODELING …. Geophysics- Uncertainties

a-priori model

Granite probability

Drorite probability
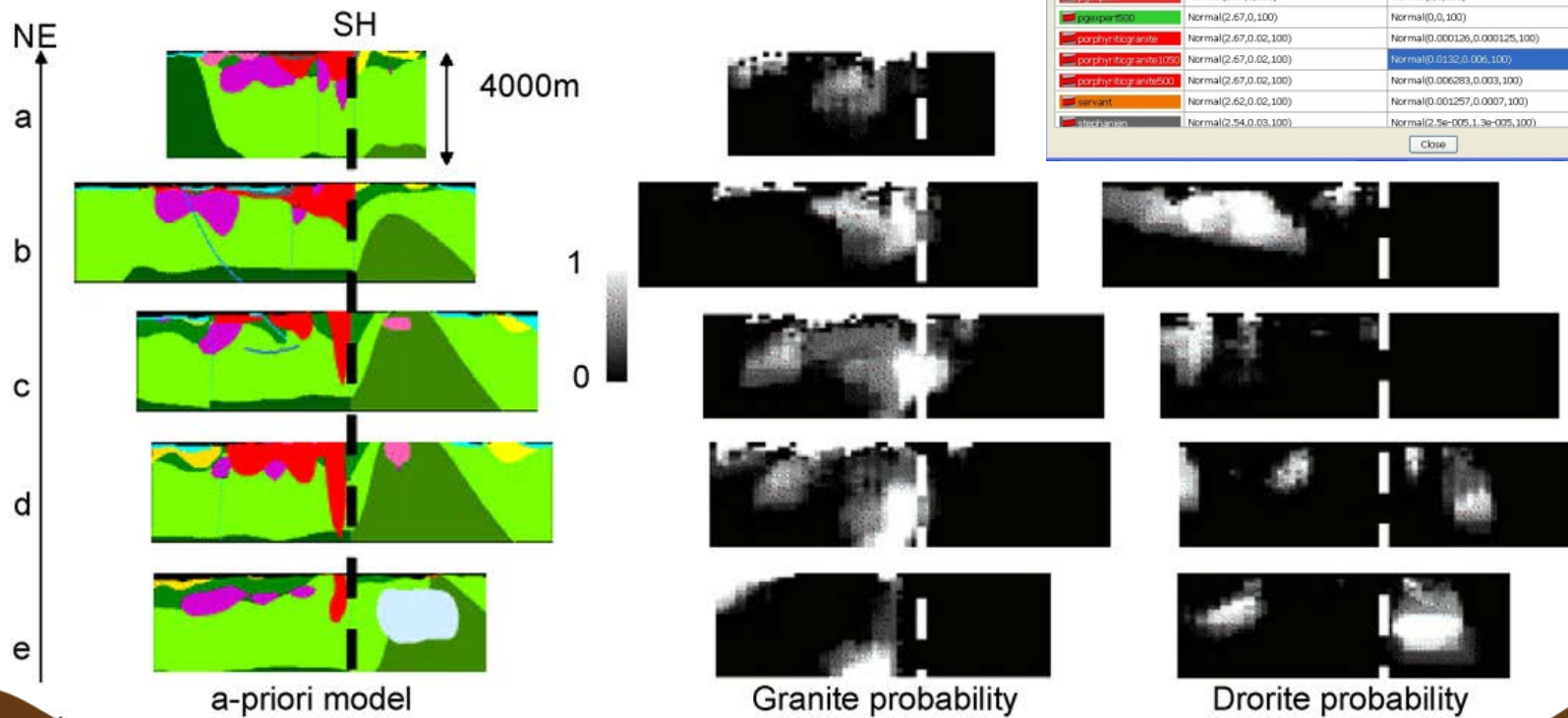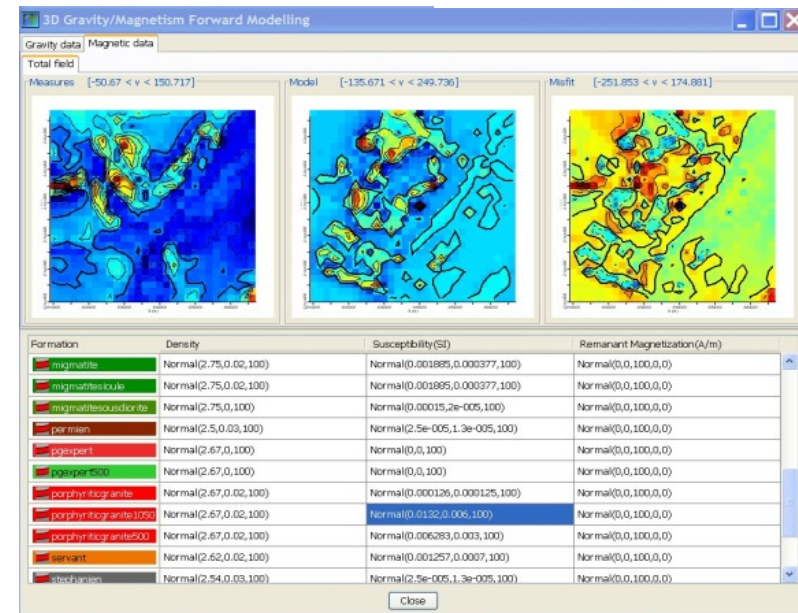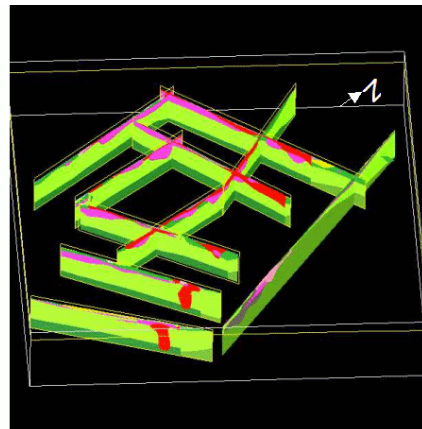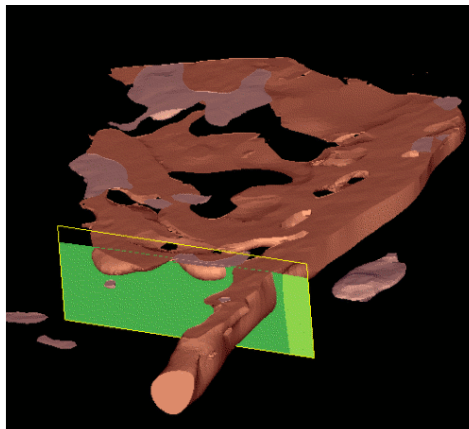
3D MODELING ....Uncertainty issue

- ## How to estimate errors ?

  - Classical krigging error estimate (Applicable in standard situations)
  - Gaussian simulations

  Many limitations due to the diversity of data and a priori knowledge and interpretations

  - Try to explore the range of possible models The game is to find ways to reduce the space of possible solutions

3D probability map of being in a low permeability terrain. alluviums of a sector of Bordeaux city 7 km * 6 km * 15 m. ISATIS software

Impact of faults location and dips.

- ## How to display uncertainty ?
  - Standard-deviation
  - 2D – 3D
  - Probability maps
  - Entropy maps

3D model entropy

Base of carboniferous Standard-deviation

3D MODELING ....

Make models usefull for applications (flow, seismic simulations, property assesment, civil engeeniring ...)
This mainly concerns appropriate meshing methods

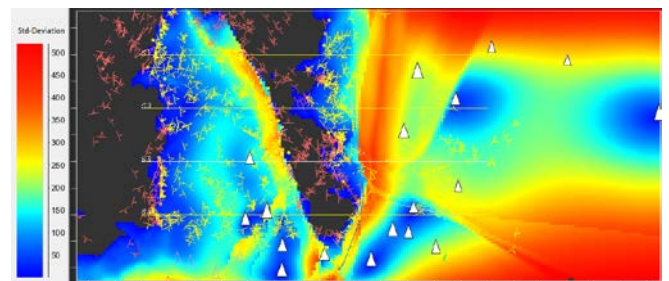- As many different requirements for meshing as different applications (voxels, irregular grids, stratigraphic grids, structured (i,j,k), unstructured (tesselations), hexaedrons, voronoi cells, tetrahedrons... and more.

- Our current works are carried on building tetraedric meshes of models described by implicit functions Use of CGAL (Computational Geometry Algorithms Library)

- The issue is to build a multi-volume representation of the model, conformal with geological boundaries, and which preserves sharp angles.
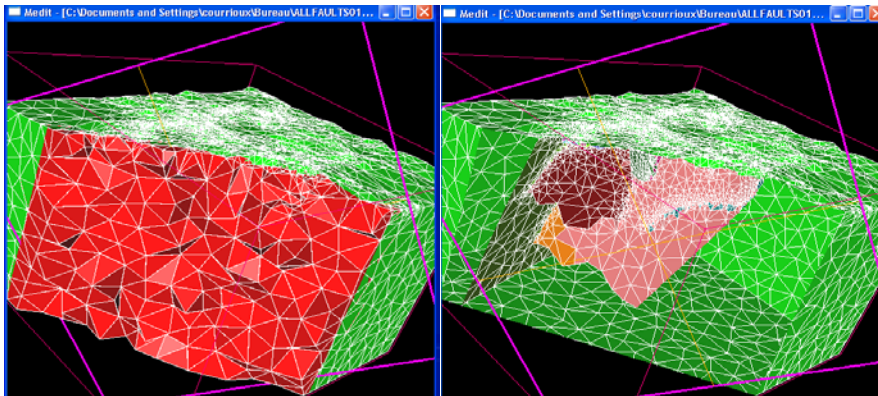
**Solid tetrahedric mesh within a fault network
Application : flow simulation , mechanics, fault block detection - instabilities …**
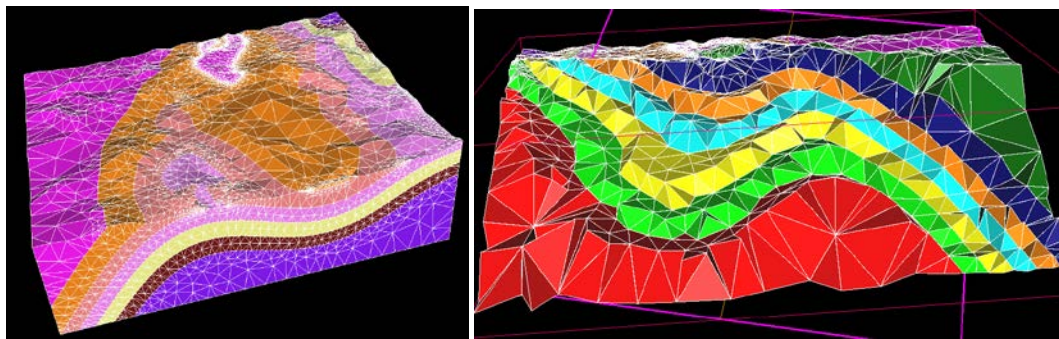
Example of tetraedric mesh conformable with folds.

Conclusions

✓ **The RGF pilot project give the launching tools for the new national program RGF**

  ▪ **data processing to insure 3D consistency between data set**

  ▪ **data base with capacity to deliver multiscale data with 3D consistency**

  ▪ **suggest a RGF's worflow : feedback experience**

  ▪ **3D modeling integrated in RGF consistency processing**

Conclusions

✓ **Challenges in link with 3D modeling**

- **link between 3D model and data base**

- **interoperability between software**

- **multiscale modeling**

- **management of uncertainty for data and models**

- **meshing**

- **property modeling**