9-11 June 2004
Emmetten - Lake Lucerne
Switzerland
Methods and Techniques Session
GeoMod 2004

How 3D implicit geometric modelling helps to understand geology : Experience from BRGM (France)

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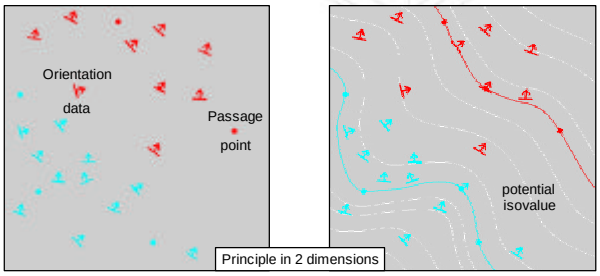
3D geometric modelling is a powerful tool to better understand geology. It allows to check and validate the consistency of the separate 1D or 2D data. Building a 3D model is a way to share and communicate a common geological view of a studied area. 3D integrating methods such as gravimetry can be used to refine and validate the 3D model by comparing a measured field to the model contribution. Moreover, a consistent 3D geometric model is essential for post-process computations that need an accurate and consistent geometry of geological bodies.

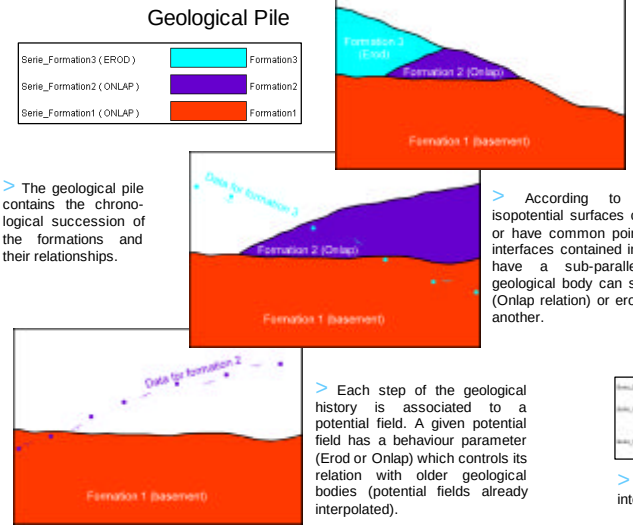
An original methodology has been developed in BRGM (French Geological Survey) to interpolate at the same time geological contacts locations and dips of the formations. The model is calculated using a 3D potential field or multi-potential fields, depending on the geological context and complexity. This method also includes a geological pile containing the geological history of the studied area and the relationships between geological bodies. The geological pile drives automatic computation of intersections and volume reconstruction. Then, the geologist focuses on geological issues by easily testing different interpretations.

Interpolation Method Using 3D Potential Field



> The potential field method allows to interpolate in the whole 3D space of the area. It considers the limits between geological bodies as isopotential surfaces while their orientations represent the gradients of the potential. This method needs the position of the interfaces between geological bodies to be known at some places. It also requires orientation vectors (azimuths, dips and polarities) of the geological structures measured on field. Dip measurements are not necessarily located on the geological interfaces. When the potential field is calculated, the potential value is known for every point in 3D space. A range of potential values defines a geological body.

Generalisation With Multiple Potentials

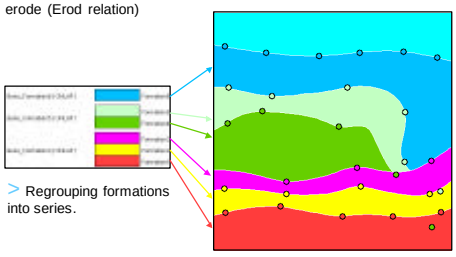


> The geological pile contains the chrono-logical succession of the formations and their relationships.

> According to their definition, isopotential surfaces can not be secant or have common points. Two adjacent interfaces contained in a given potential have a sub-parallel behaviour. A geological body can settle and stop on (Onlap relation) or erode (Erod relation) another.

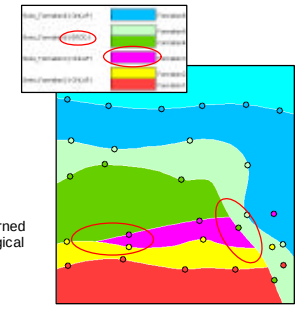
> Each step of the geological history is associated to a potential field. A given potential field has a behaviour parameter (Erod or Onlap) which controls its relation with older geological bodies (potential fields already interpolated).

Same Dataset, Different Geological Pile



> Regrouping formations into series.

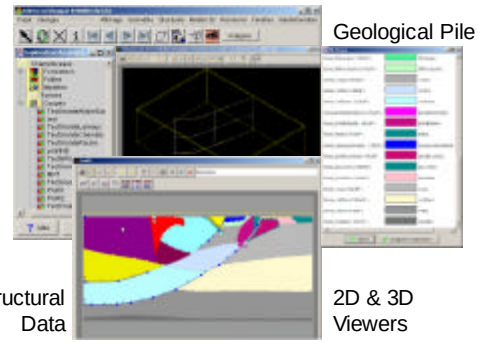
> Only the passage points are shown. Orientation data are not plotted.



> Intersections between geological bodies are automatically governed by the geological pile. By using this tool, one can focus on geological interpretation without managing intersections purposes.

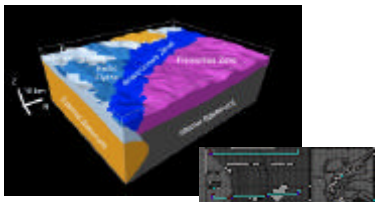
The Editor For Geology

> A software, the "Editor for Geology" has been developed in order to build 3D geometric models from maps, cross-sections, boreholes, etc. This software, providing a friendly Graphic User Interface, is used by geologists to test and refine their interpretations and finally to construct their 3D models. Import/export facilities allows to load data and to use 3D models for post-processes.

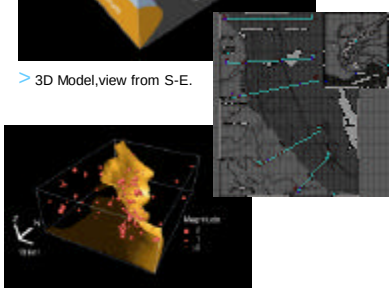


Case-Studies

The Briançon 3D Model (French Alps) from C. Sue et al. (accepted), Tectonophysics

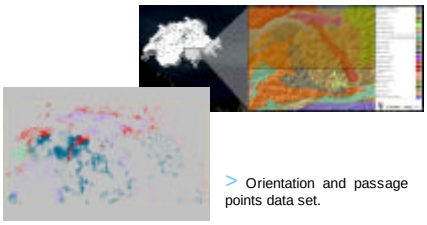


> 3D Model,view from S-E.

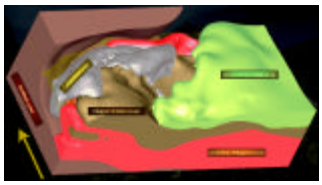


> Crustal Penninic Front and earthquakes localisation. Each earthquake is presented by a sphere located at its epicentre with a radius proportional to the magnitude.

The Nappe Edifice Of The Central Lepontine Alps (Ticino, Switzerland) from M. Maxelon, ETH Zurich



> Orientation and passage points data set.



> Nappes emplacement structures. View from S-SW.

> **References**

- Calcagno P. et al. (2002), RST19, Nantes, p. 79 (abstract).
- Courrioux G. et al. (2001), Tectonophysics (331)1-2, 181-196.
- Lajaunie Ch. et al. (1997), Mathematical Geology, 29(4), 571–584.

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GeoMod 2004 Poster

Interpreting Stage Warping Events Using 3D Simulation: An Example From The Plattengneis Shear Zone, Eastern Alps
Martin Putz et al.

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