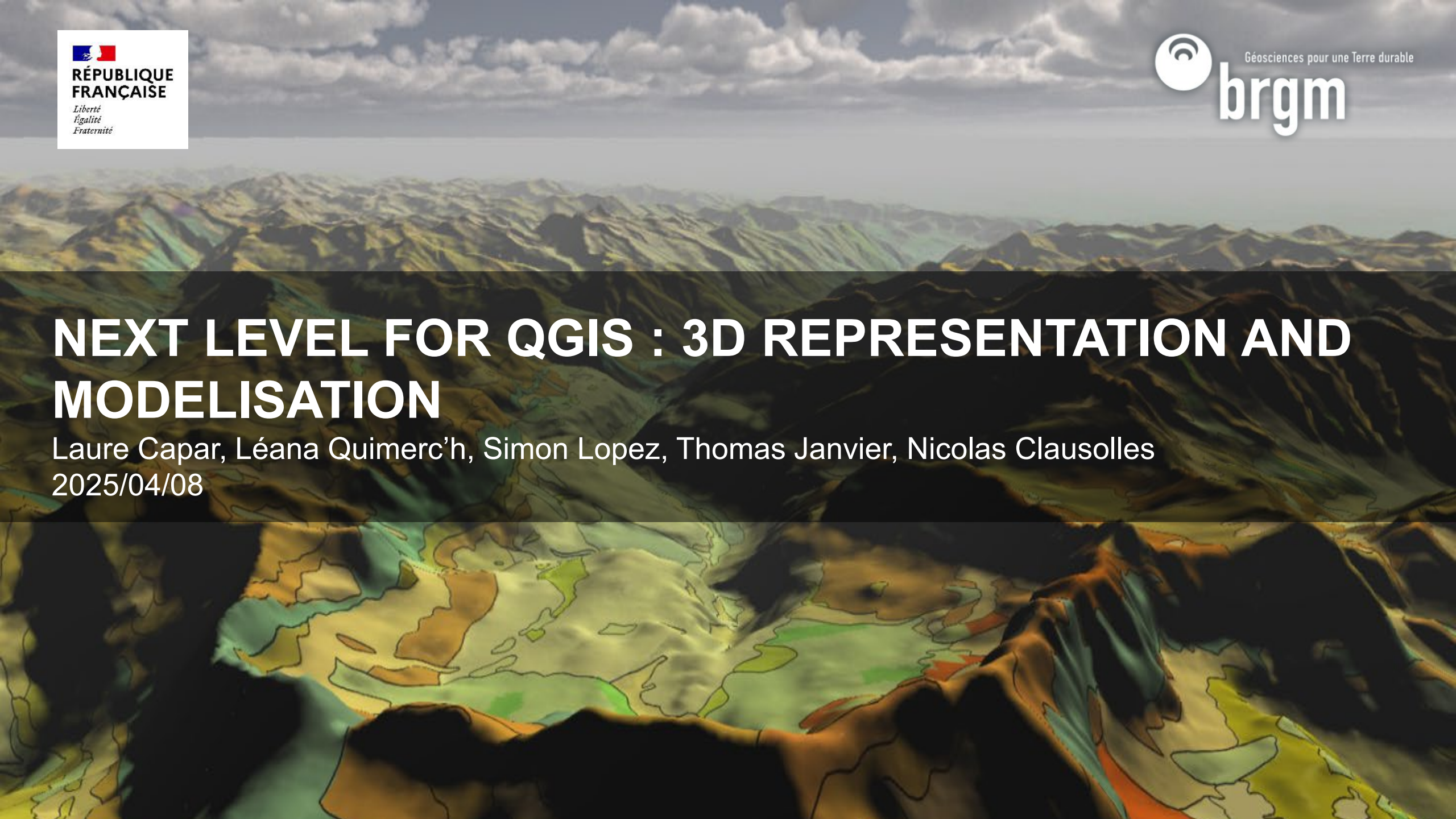
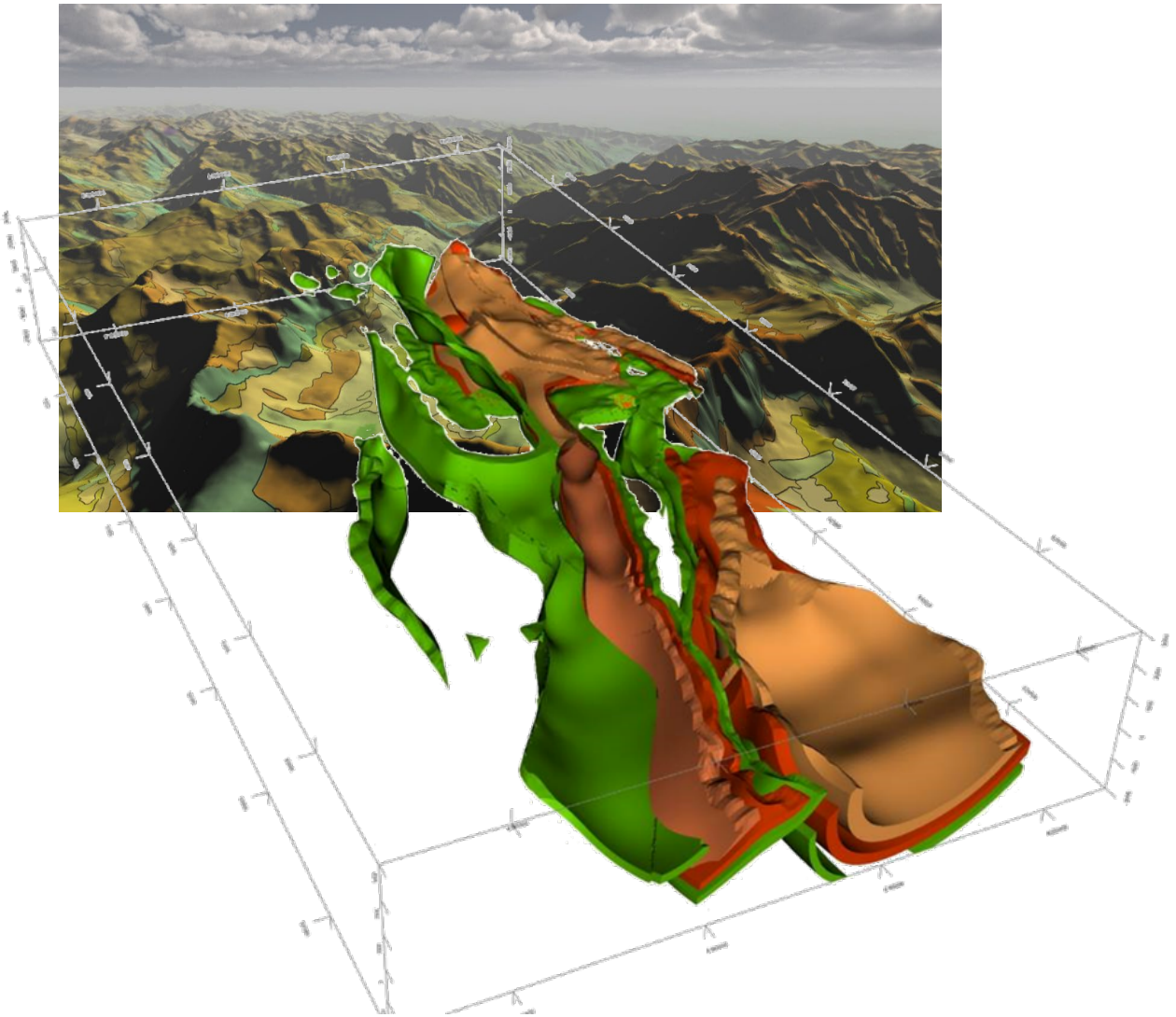


NEXT LEVEL FOR QGIS : 3D REPRESENTATION AND MODELISATION

Laure Capar, Léana Quimerc’h, Simon Lopez, Thomas Janvier, Nicolas Clausolles

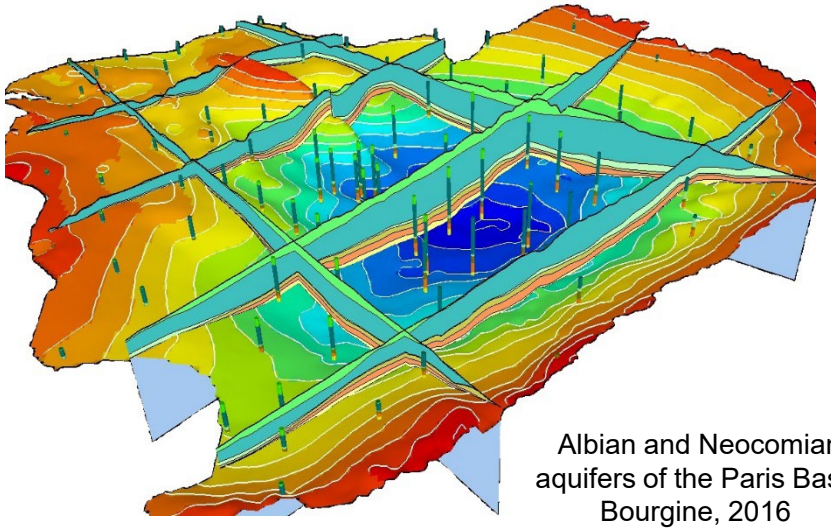
2025/04/08

CONTENTS

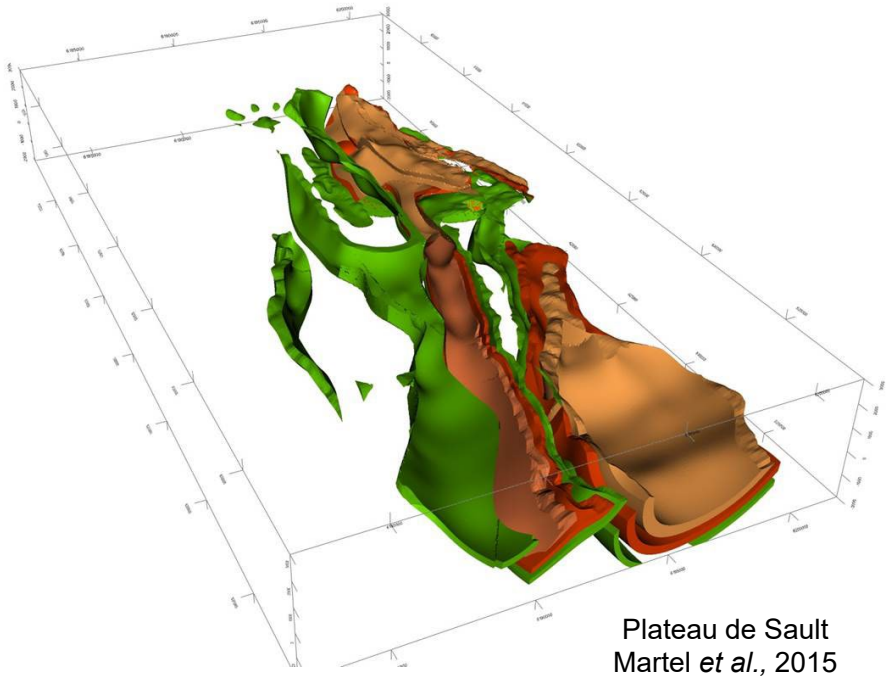


- Background to 3D modelling at the French Geological Survey (BRGM)
- BRGM/Modellers' needs
- Why integrate 3D modelling into a 2D GIS and Why BRGM is integrating its 3D modelling tools into QGIS
- BRGM 3D developments in QGIS
- What's next

BACKGROUND TO 3D GEOLOGICAL MODELING AT BRGM



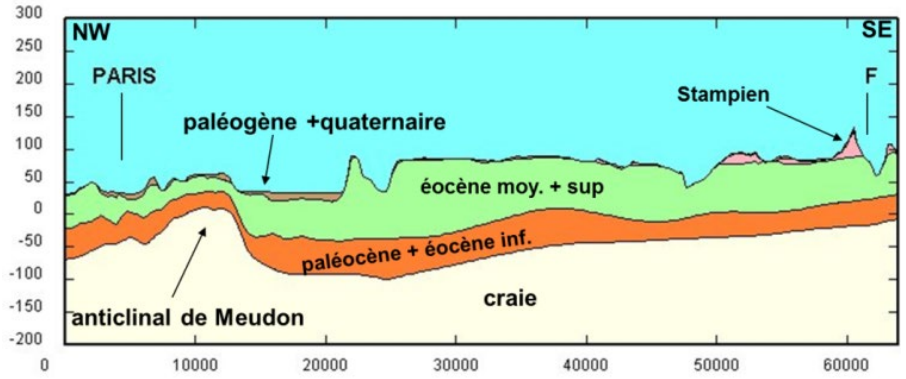
Albian and Neocomian aquifers of the Paris Basin
Bourgine, 2016

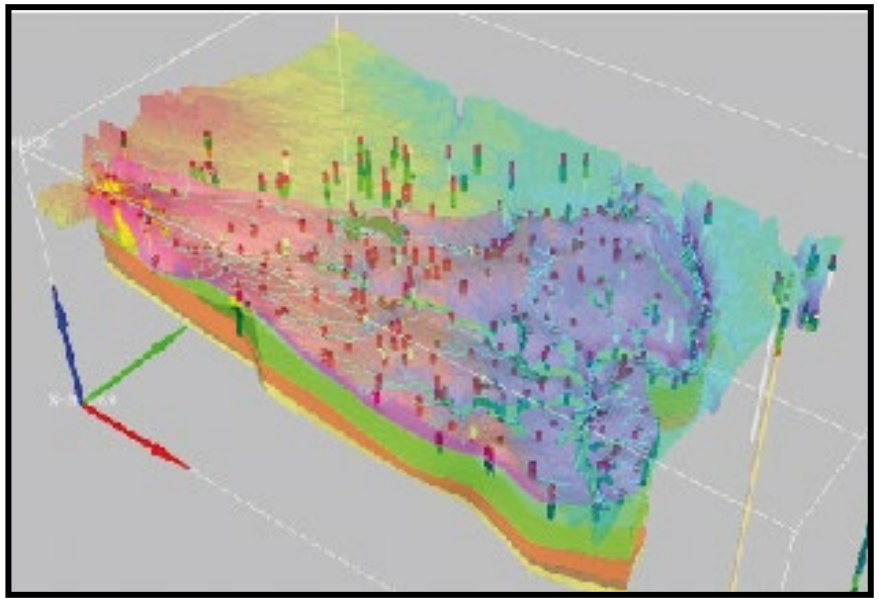


Plateau de Sault
Martel *et al.*, 2015

- 50 years of experience
- continuous production of multi-purpose 3D geological models
  - geological knowledge
  - applications towards predictive geosciences
- « home-made » innovative (but legacy) solutions:
  - **GDM Suite**
  - **GeoModeller**
  - and others standalone developments…
- common DNA / characteristics:
  - operational purposes: tools implement both algorithms and practical know-how
    - field mapping
    - *downstream* (quantitative) applications
  - geostatistics

BACKGROUND TO 3D GEOLOGICAL MODELING AT BRGM



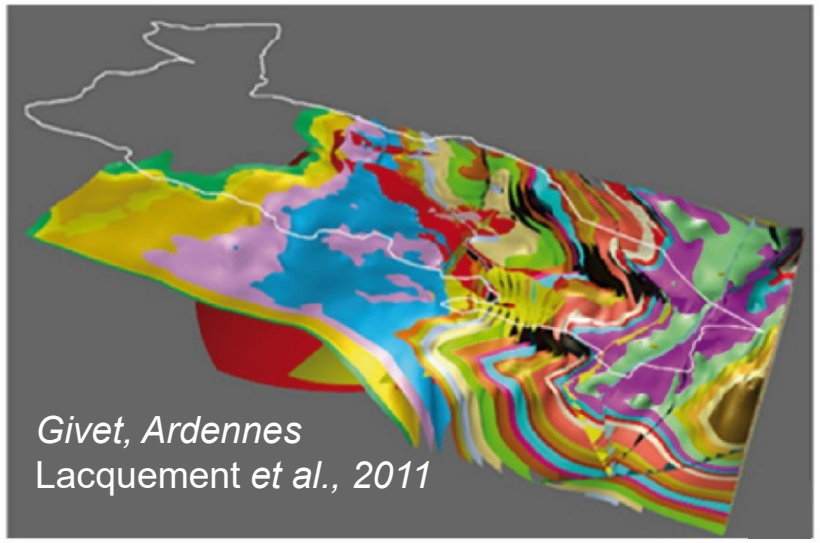


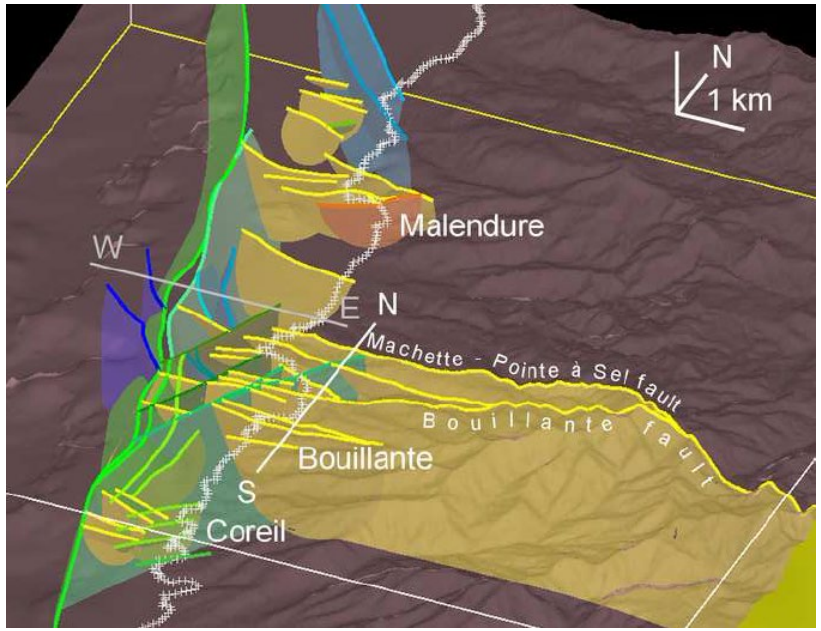
Geological Data Modeling

- a set of complementary components:
  - delivery processing, Viewer geological data
  - interpolation
    geostatistical toolbox, data modeling and exploration
  - 2,5D modeling
    stratigraphical pile to combine multiple layers: interpolated thicknesses and/or elevations with an explicit description (i.e. z=f(x,y))

- a focus on geological data management
  - cross validation tools…

BACKGROUND TO 3D GEOLOGICAL MODELING AT BRGM





Bouillante geothermal field, Guadeloupe
Calcagno *et al.*, 2012

GeoModeller

3D Geological Modeling

- originally developed for 3D geological cartography
  - 3D description of complex geological architectures: erosions, fault networks, intrusions…
  - co-kriging of both interfaces location and orientation data
  - pioneered the use of implicit geological modeling
- geophysical forward and inverse modeling (Monte Carlo approach)
- some developments on unstructured mesh generation for simulation applications

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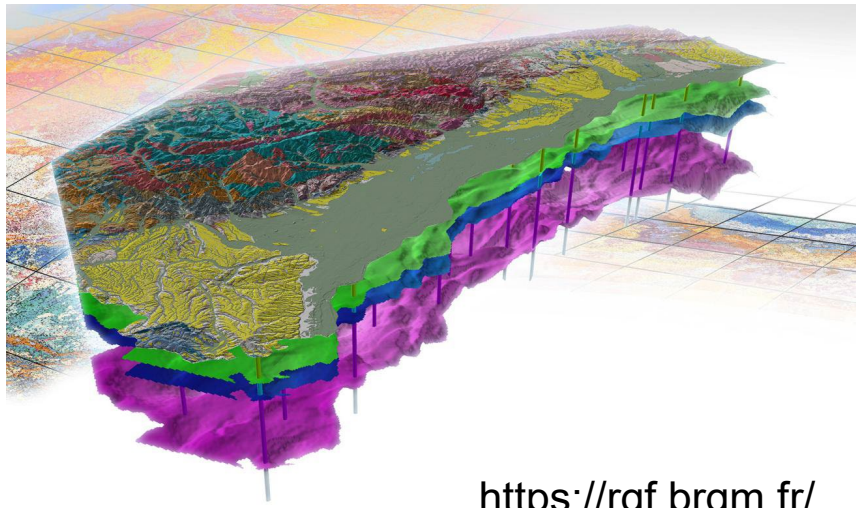
BRGM'S NEEDS



https://rgf.brgm.fr/

❑ *Need to better understand and model the under ground geology*

- for the energy transition and decarbonization
- Enabling responsible use of mineral resources
- Managing soil and subsoil risks
- Preserving groundwater resources
- Geothermal ressources

Before : Geological maps
Only the surface representation

Need a 3D vision

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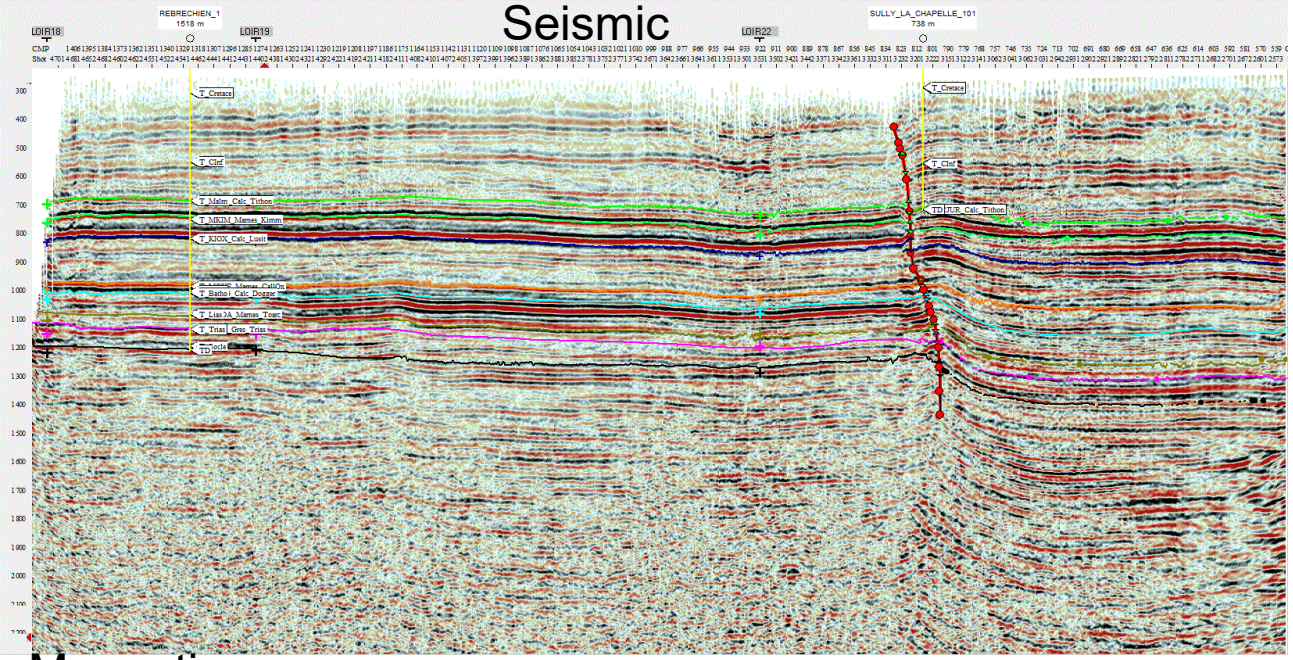
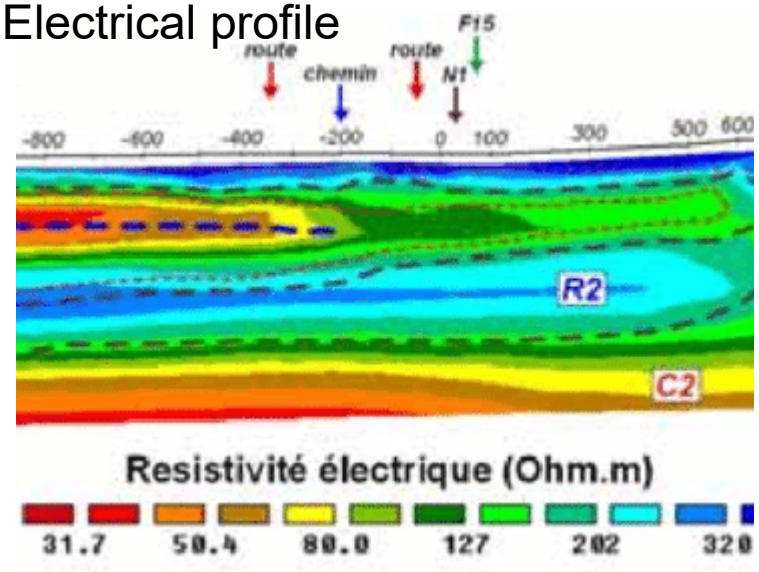
MODELLERS' NEEDS

Seismic



Magnetism

Electrical profile



- *Other data*
  - seismic
  - electrical profiles
  - gravimetry
  - magnetism
- *Modeling algorithms*
- *Tools to communicate the results to the stakeholders*

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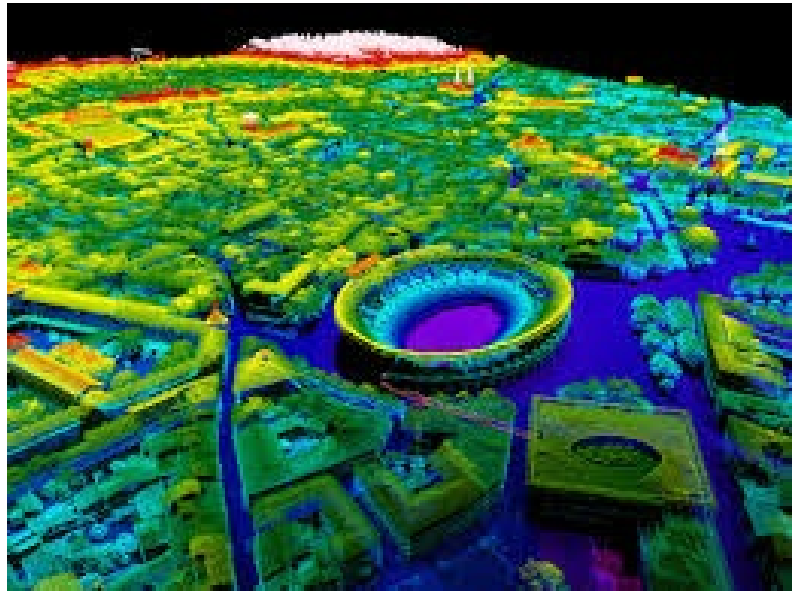
WHY INTEGRATE 3D MODELLING INTO A 2D GIS AND WHY BRGM IS INTEGRATING ITS 3D MODELLING TOOLS INTO QGIS

- Advance of open source GIS software, driven by extremely innovative communities

- Software bricks as plugins in a GIS, providing
  - An operational alternative to historical tools
  - Modular and scalable environment
  - can be recomposed according to production needs
  - adapted to modern computing resources
  - serving as an incubator for research projects



HR Lidar data

- GIS software mainly designed for 2D applications
  - the move towards 3D representation and use driven by emergence of new needs : Building Information Modelling, use of large point clouds (Lidar)

WHY QGIS ?

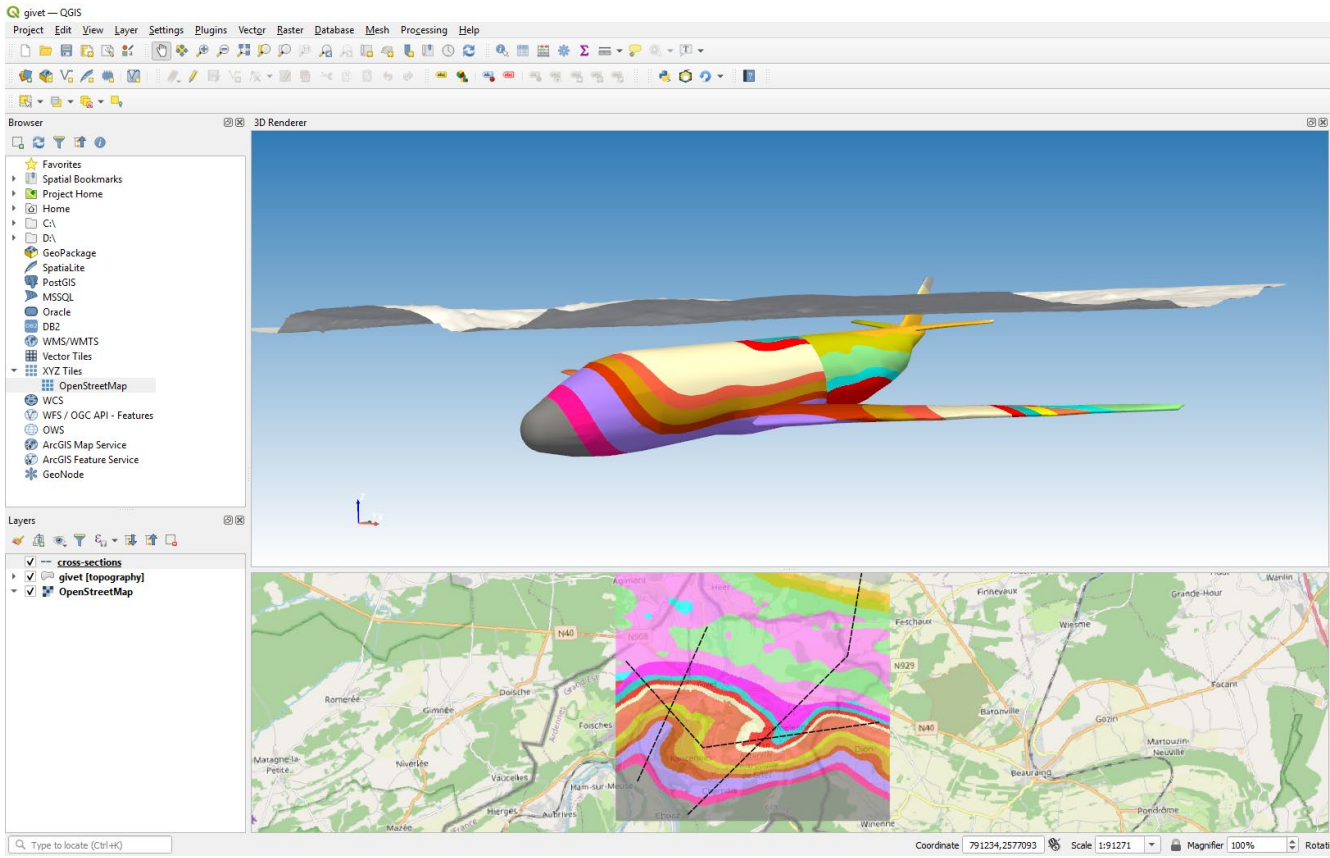
- a lot of people use GIS on a daily basis
  - more than (geo-)modelling software

- free software GIS system
  - a powerful toolbox to handle georeferenced data
  - seamless and easy connection to data sources and web services (WMS, WFS…)

- widely used solution
  - a vibrant community : QField, QFieldCloud…
  - promoted as default GIS system at BRGM

- extension capacities through « plugins » (easily written in python)

- Many plugins targeting geological applications are developed by the community



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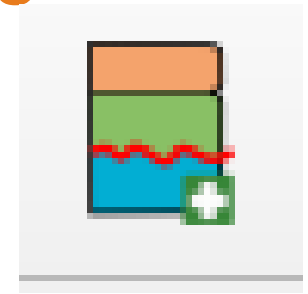
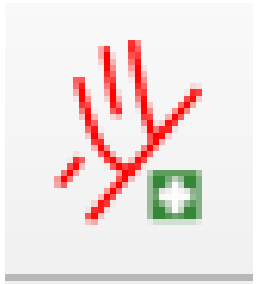
BRGM 3D DEVELOPMENTS IN QGIS

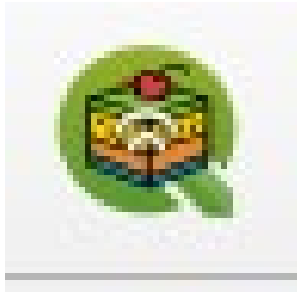
- ForGEO plugin:



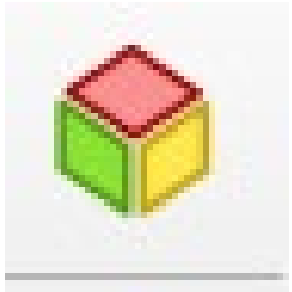
  - Stratigraphic pile
    - defines the architecture of the geological model
    - Interaction between the geological formations



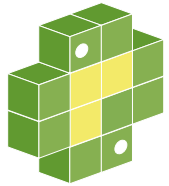
  - Fault network
    - defines the interfaces that offset or do not offset geological formations
  - Model
    - models volumes and the geometry of the geological formations



- pvGIS plugin
  - 3D representation



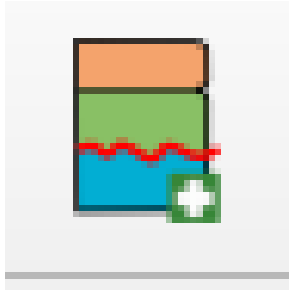
- Managing plugins external dependencies

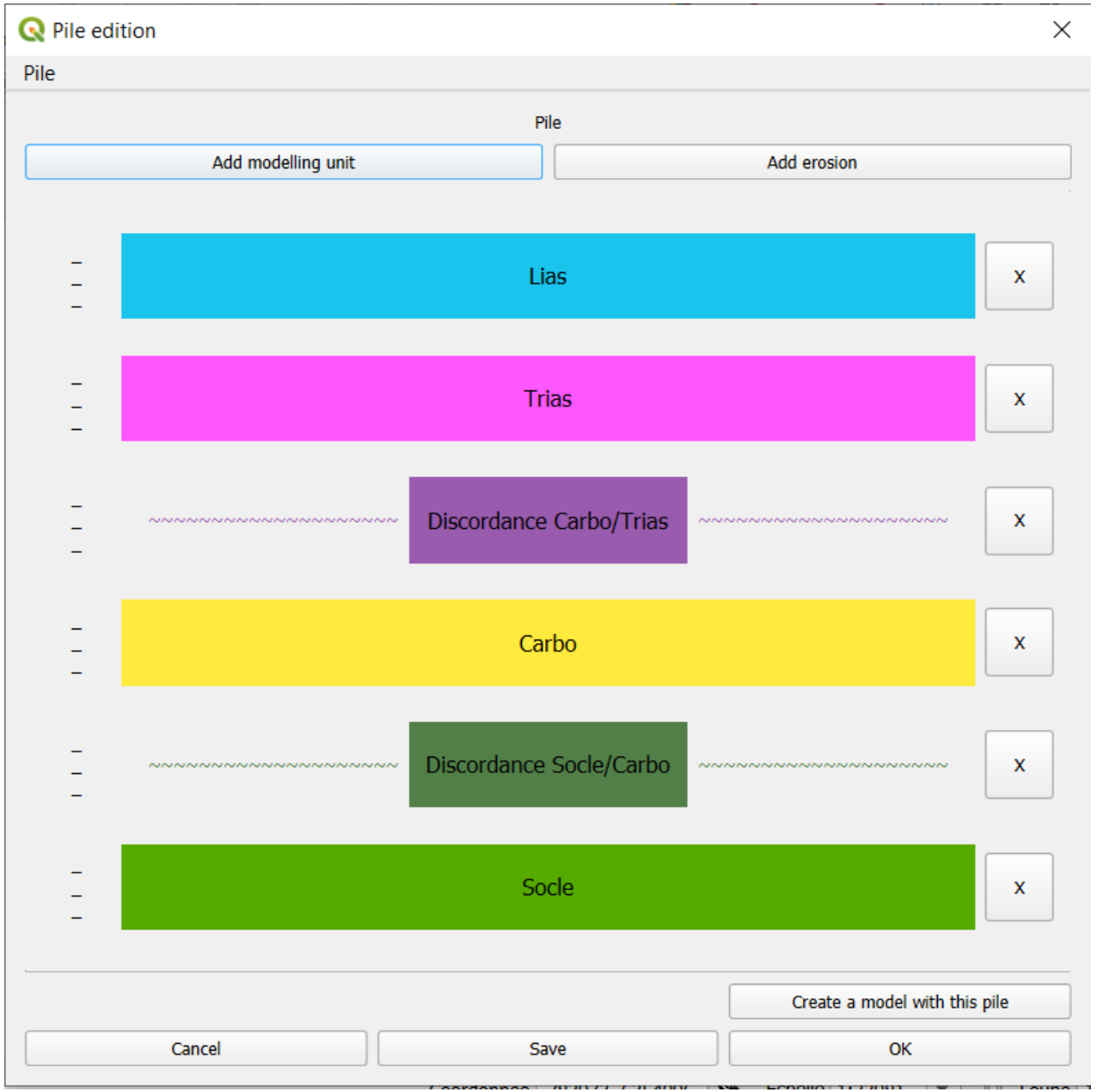


package-installer-qgis

BRGM 3D DEVELOPMENTS IN QGIS

- Stratigraphic pile





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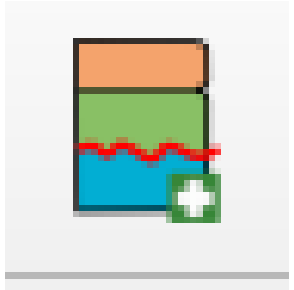
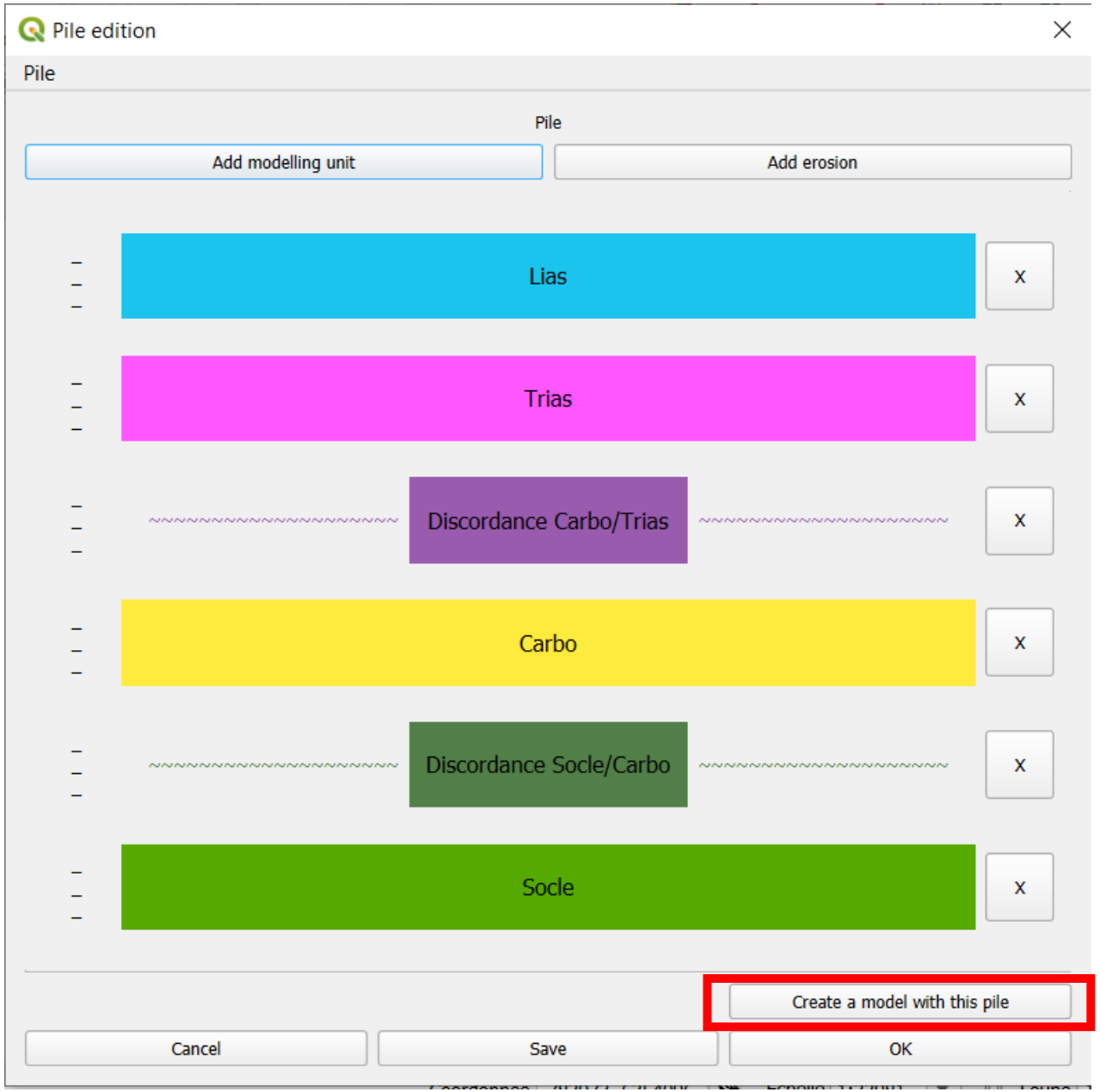
BRGM 3D DEVELOPMENTS IN QGIS

- Stratigraphic pile





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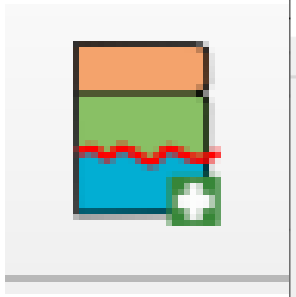

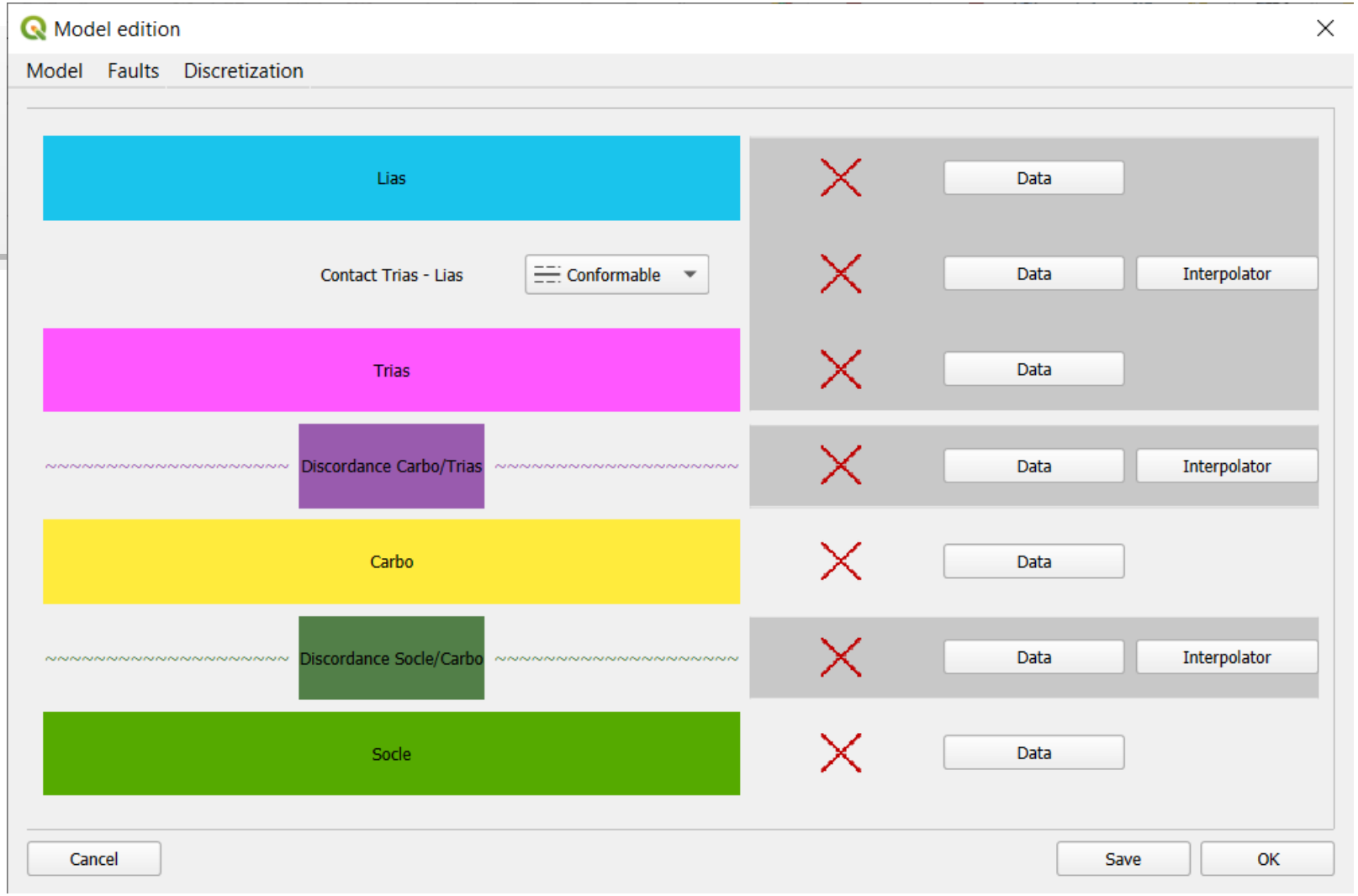

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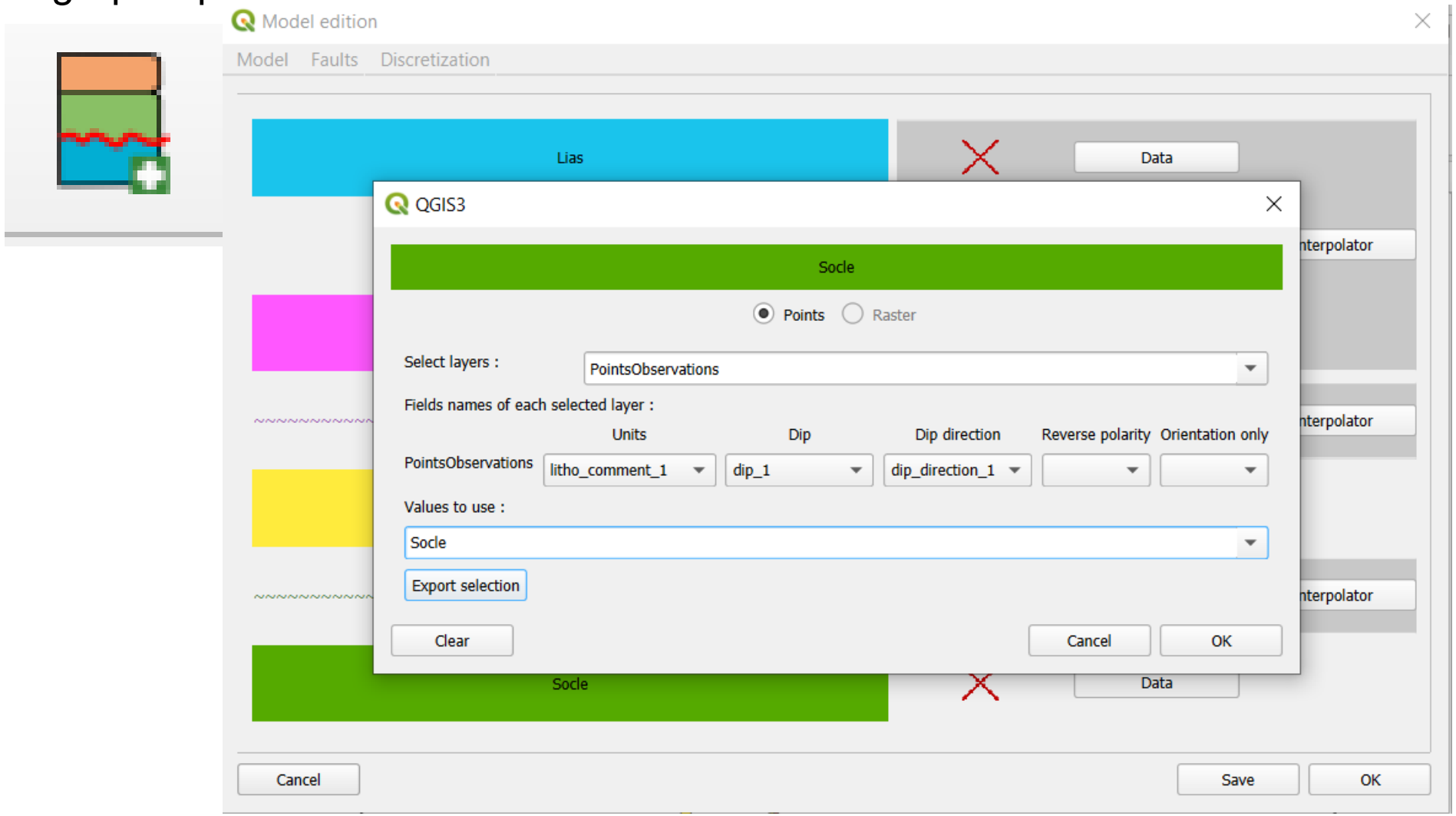

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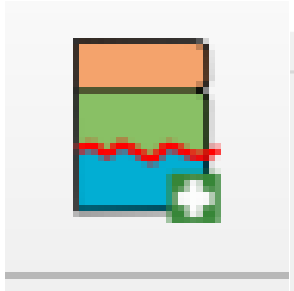

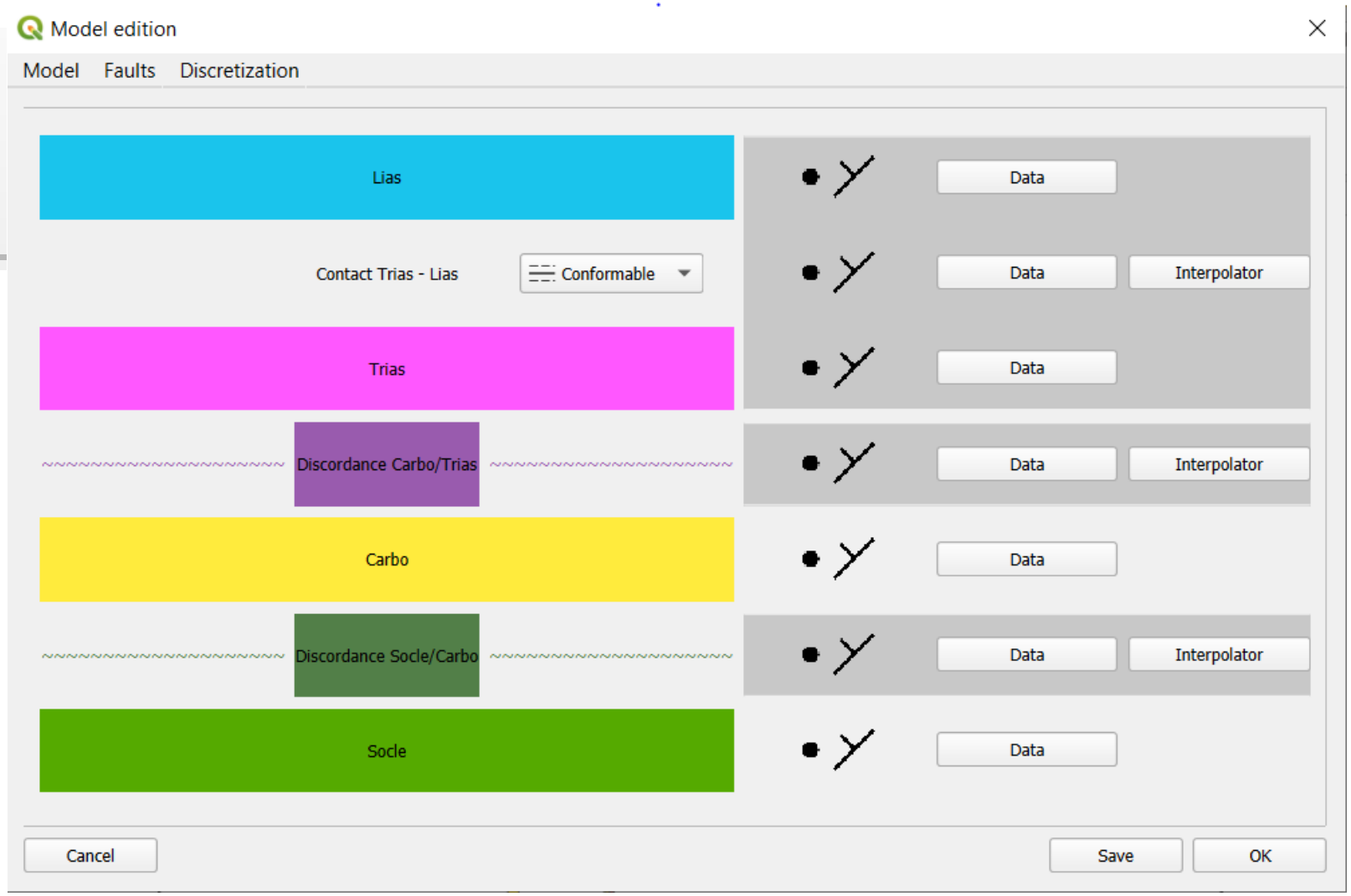

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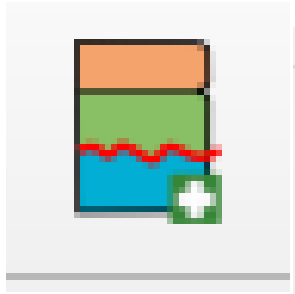

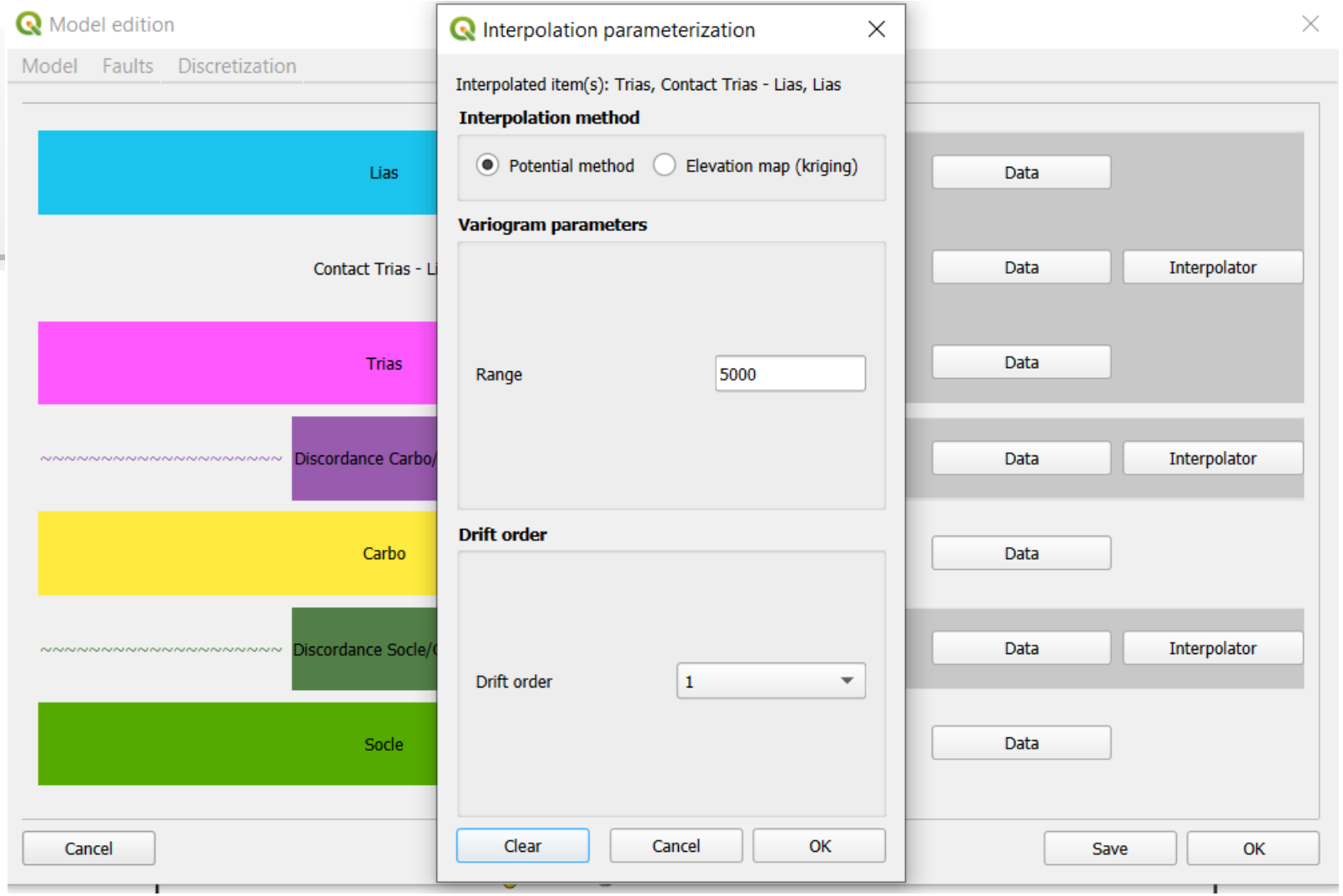

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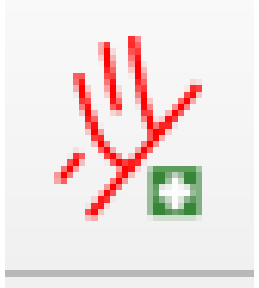
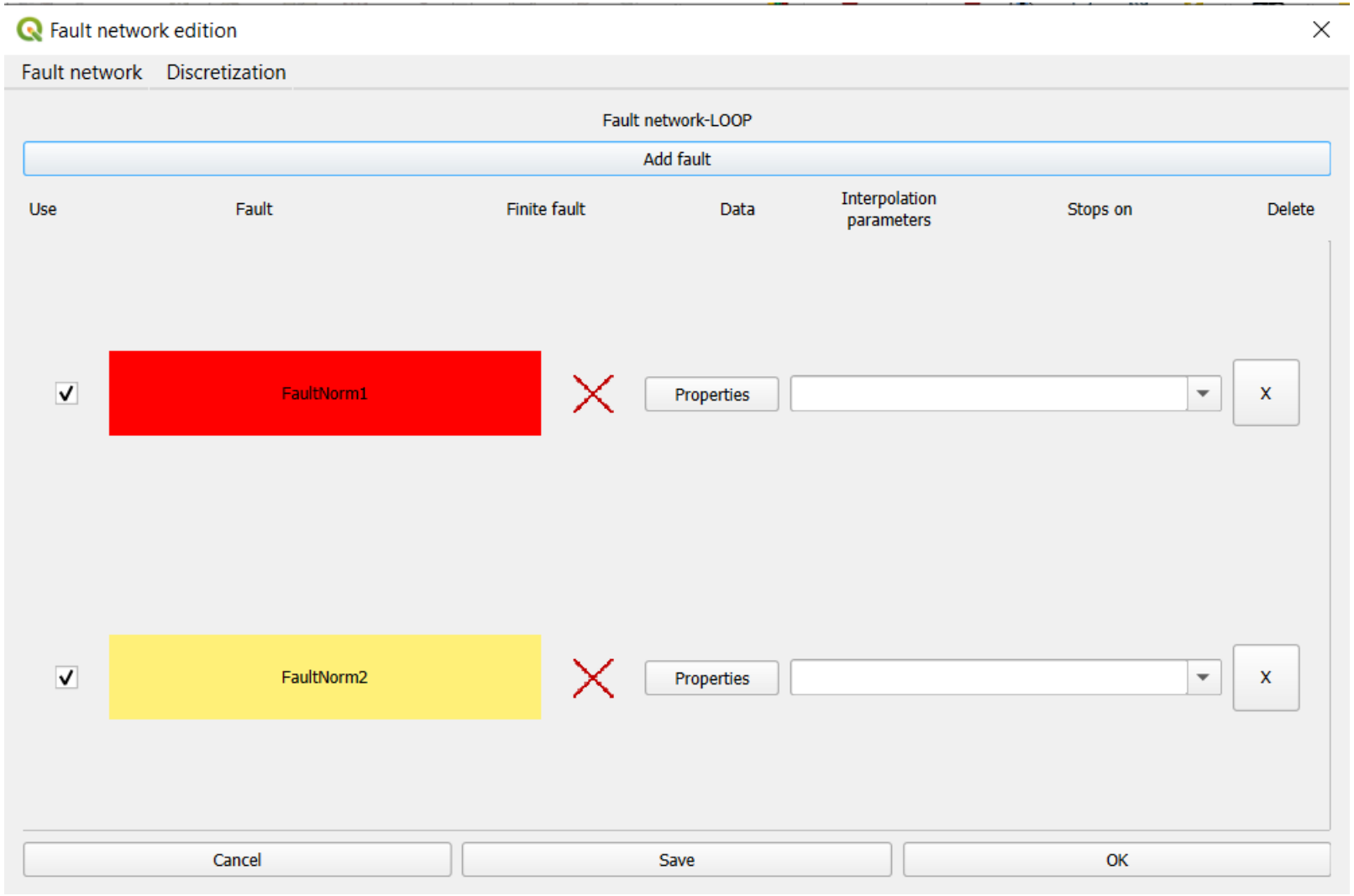
BRGM 3D DEVELOPMENTS IN QGIS

- Fault network





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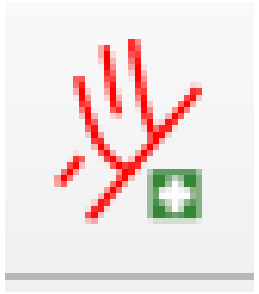

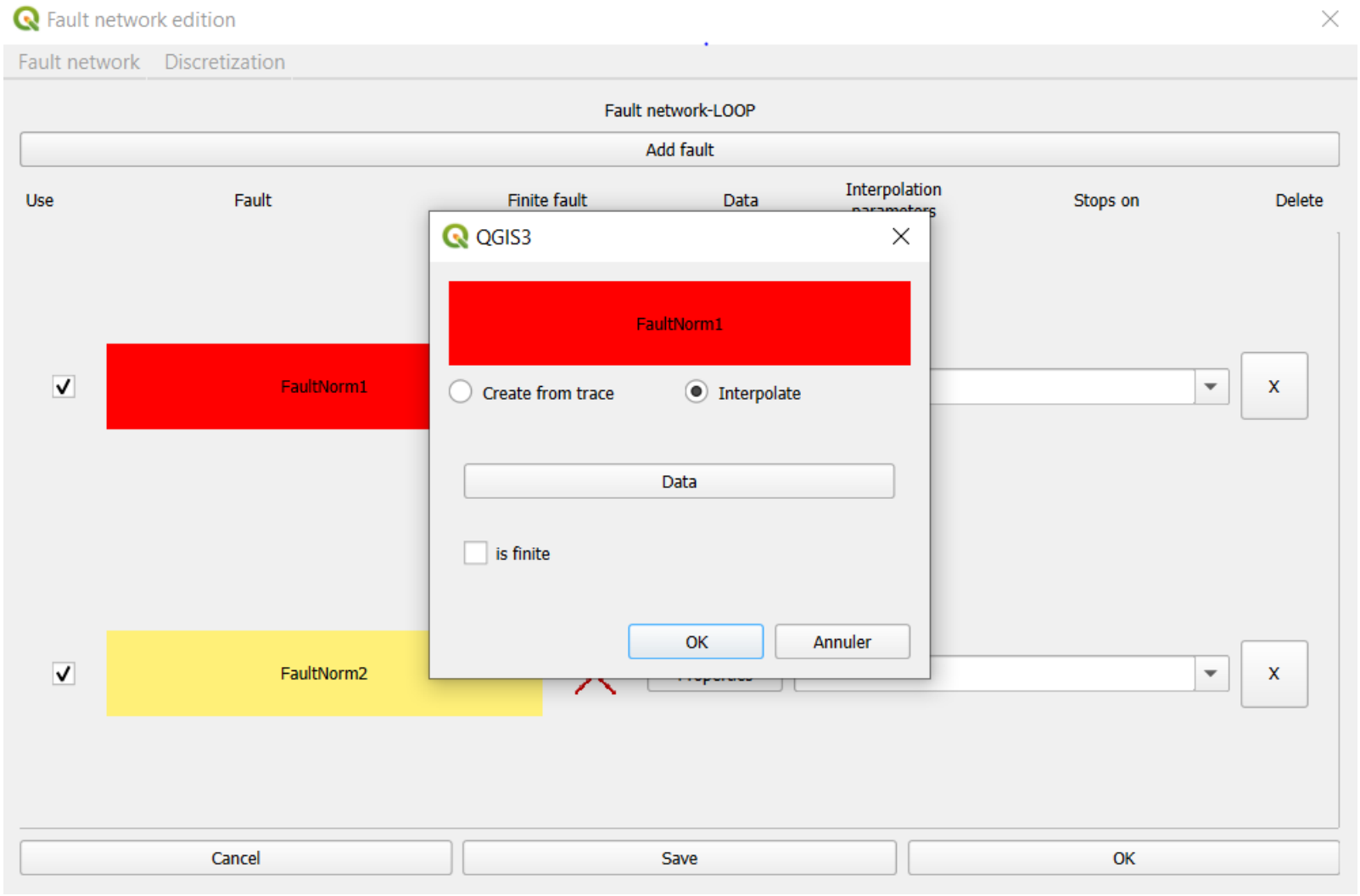

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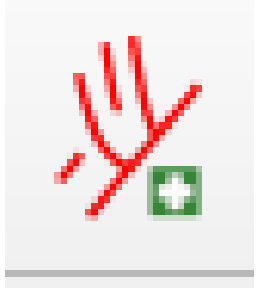

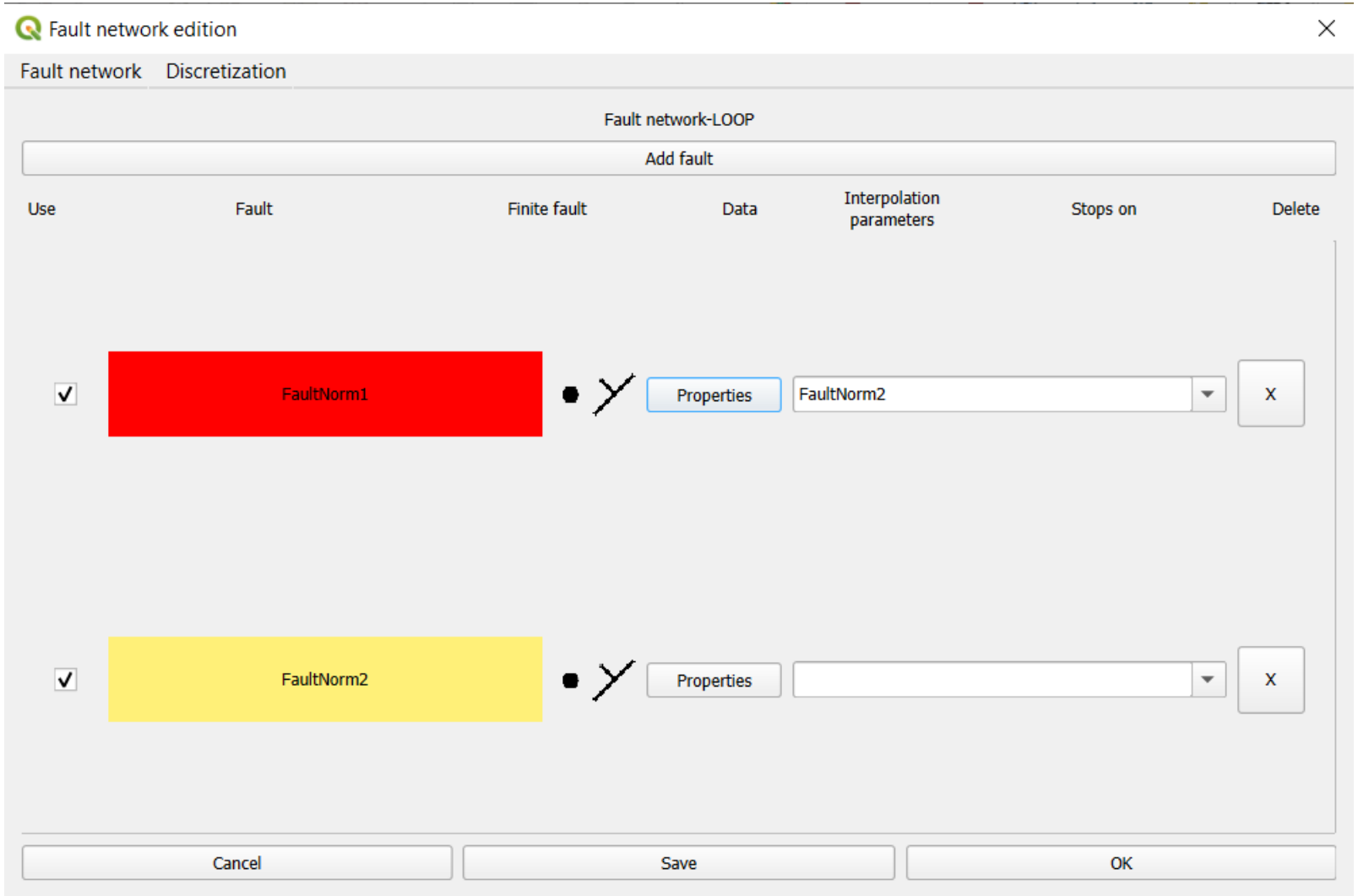

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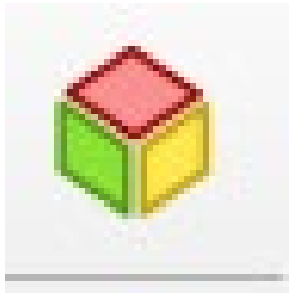
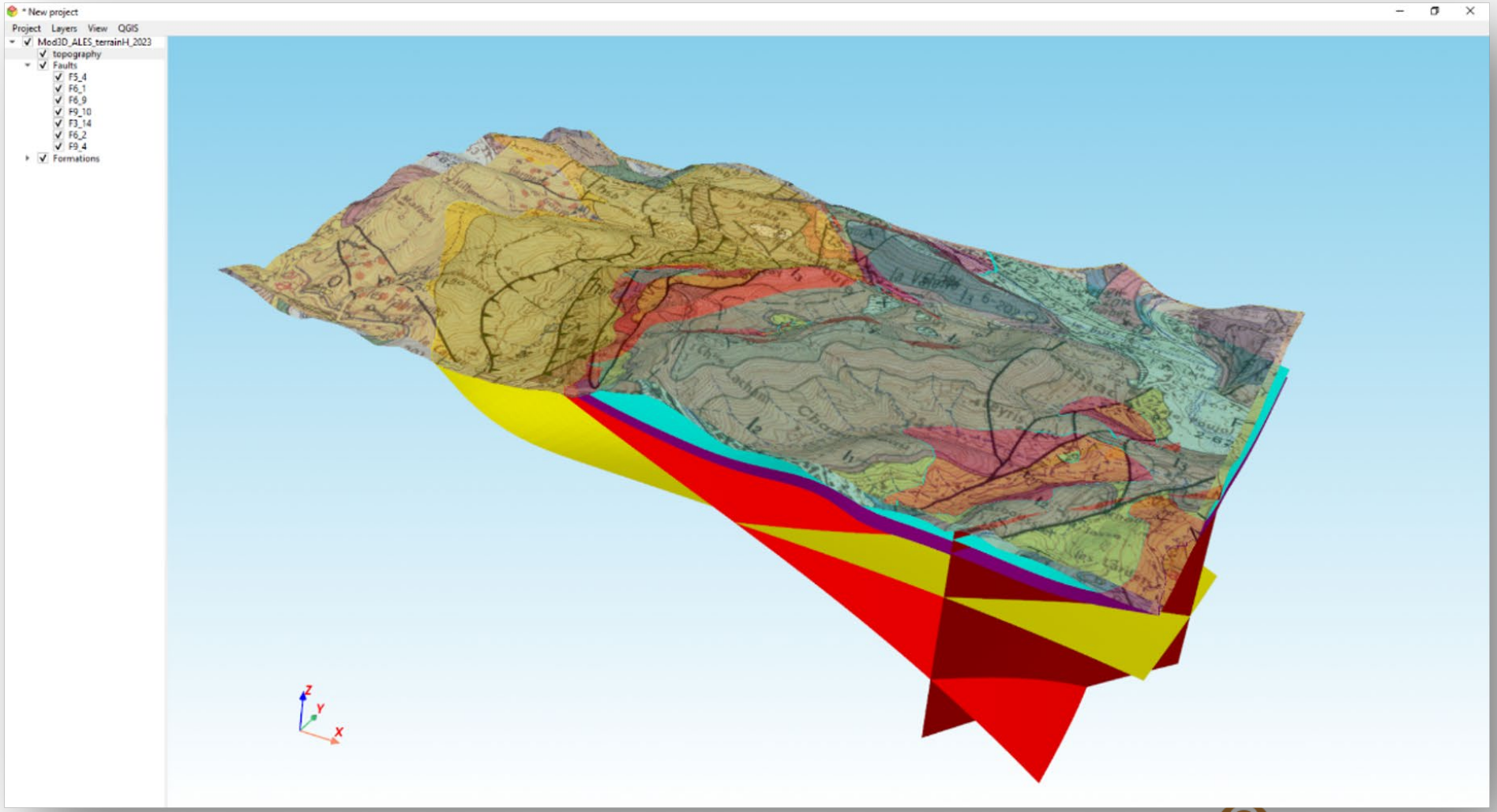
BRGM 3D DEVELOPMENTS IN QGIS

- 3D Viewer : pvGIS Plugin



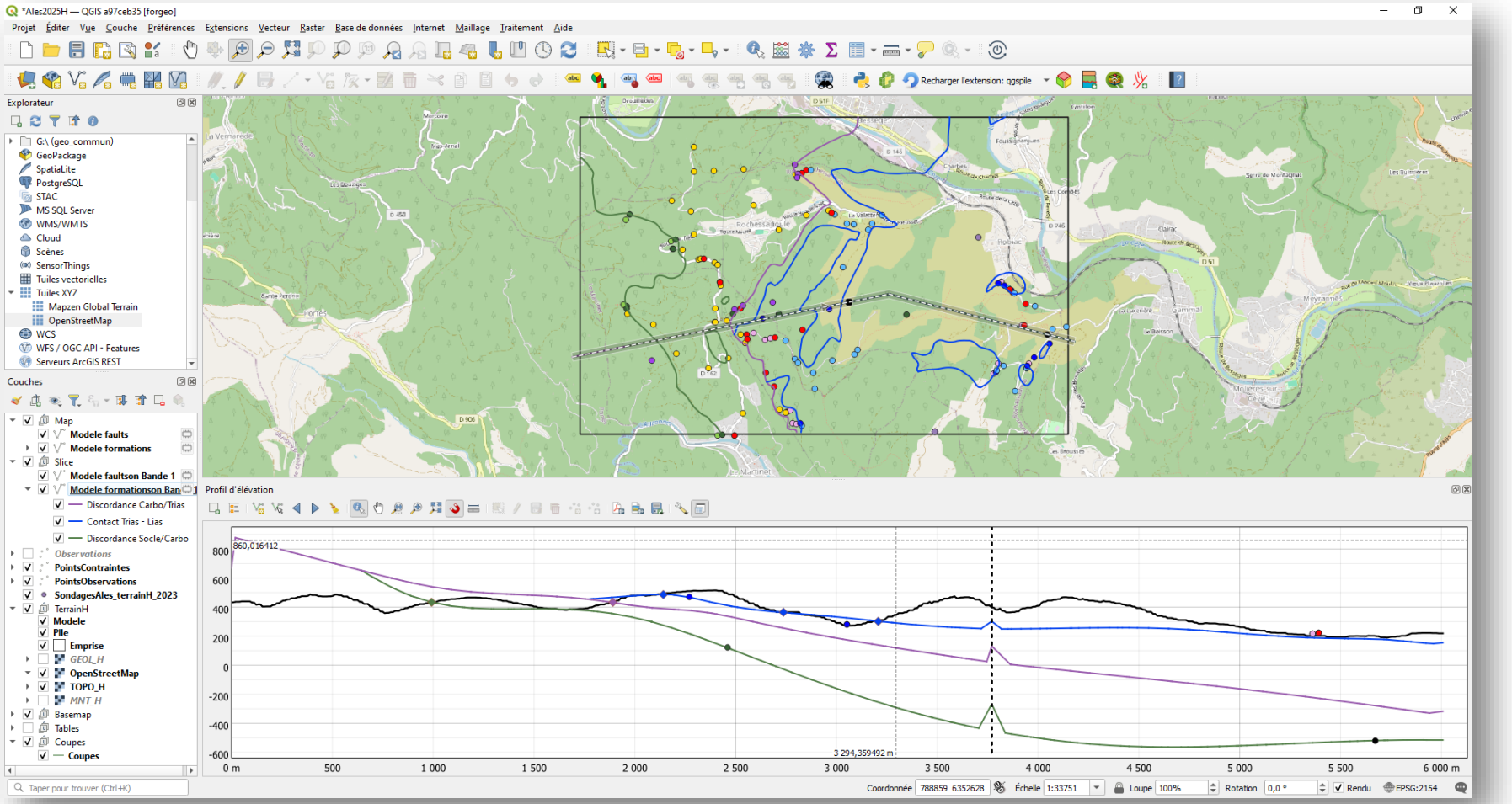


BRGM 3D DEVELOPMENTS IN QGIS

- Elevation profile

contributing to QGis core on cross-section tools (3D points edition, cross-section representation…) in cooperation with Oslandia

-breakingpoint inside cross-section



WHAT'S NEXT

new contributions to QGis core: collaborative fundings ? collaborations ?

- improvement in Elevation profile
  - Save elevation profiles parameters
  - Insert picture as background: seismic, electrical profile, geological cross-section, ..
- Improvement of cross-section viewer capacities : slices in 3D cubes
- Native 3D viewer

Move forward 3D: community

Visio workshops

Needs can be shared

THANK YOU FOR YOUR ATTENTION

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