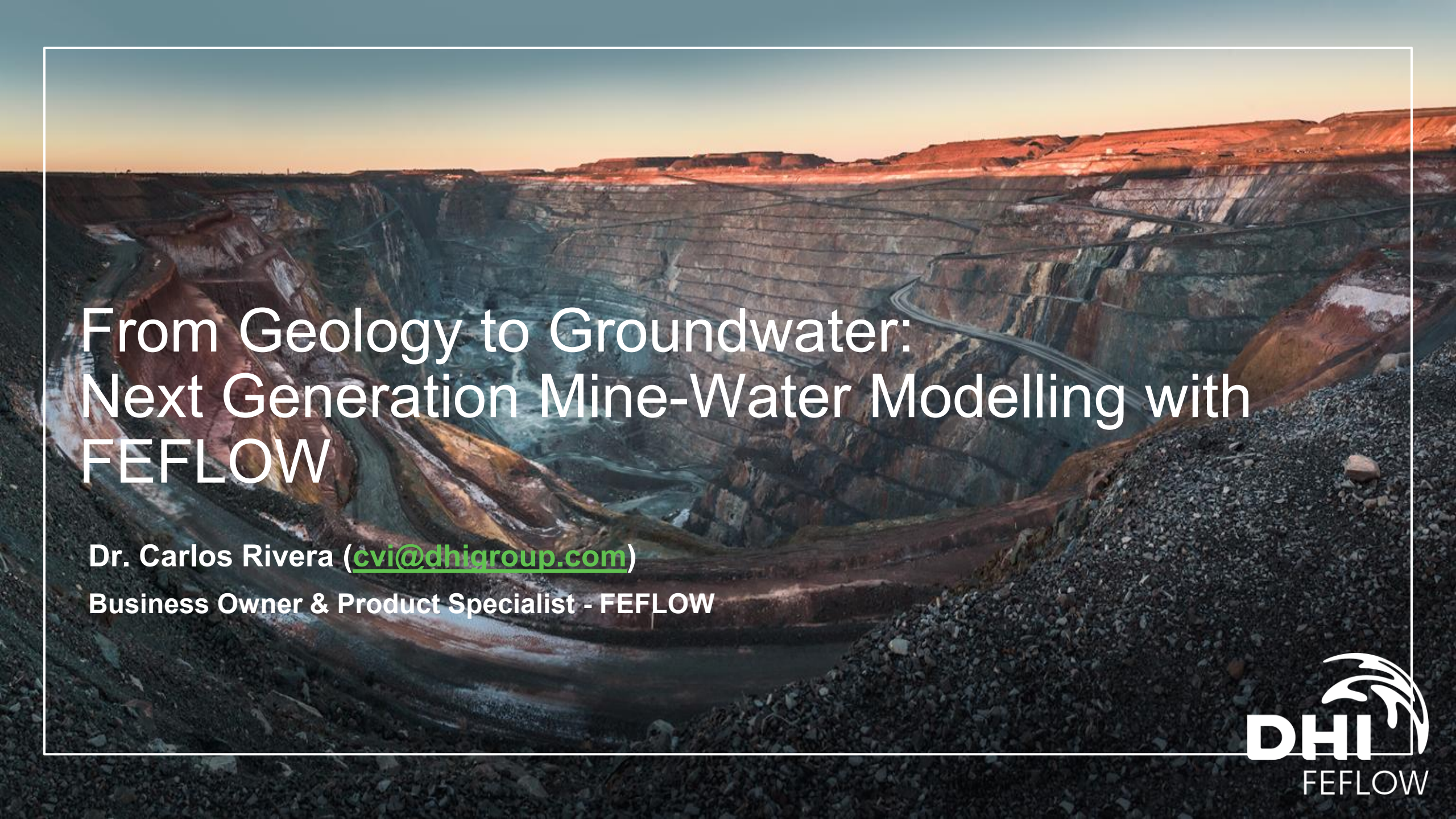


From Geology to Groundwater: Next Generation Mine-Water Modelling with FEFLOW

Dr. Carlos Rivera (cvi@dhigroup.com)

Business Owner & Product Specialist - FEFLOW

DHI FEFLOW

Agenda

- Announcement
- Challenges & solutions:
  - Groundwater Modelling at mine sites
  - Integrating geological data in hydrogeological models
- Live Demonstration

Discover more

FEFLOW International User Conference 2026

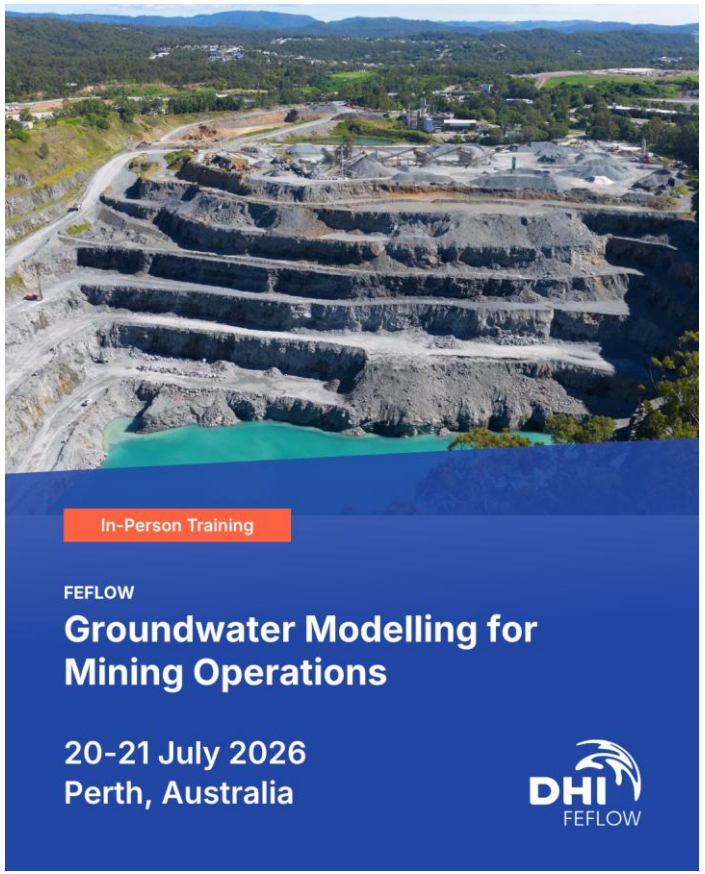
29 September – 2 October 2026 | Montreal, Canada

What to expect

- Visionary keynotes from leading experts shaping the future of groundwater, mining, and geothermal applications
- In-depth technical sessions showcasing FEFLOW capabilities
- Influence future software developments through interactive discussions
- Valuable networking opportunities with professionals, researchers, engineers, and decision-makers from across the global FEFLOW community.

Discover more

In-Person FEFLOW Training in Perth



Objective

Comprehensive overview of the workflows involved in developing groundwater flow models for mining applications using FEFLOW.

Location | Date

Perth, Australia | 20-21 July 2026

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Introduction

With **FEFLOW**, you can simulate a multitude of subsurface processes involving flow, contaminants, groundwater age and heat transport under fully or variably saturated conditions.

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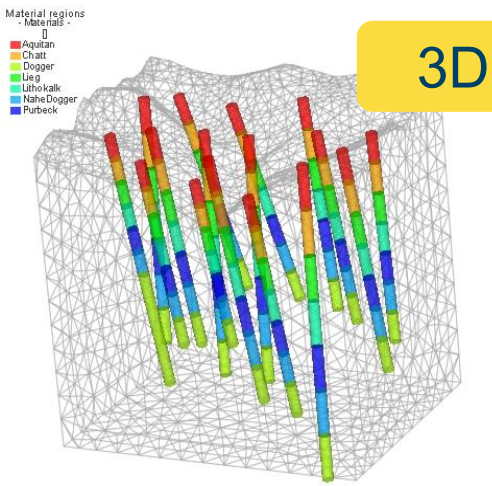
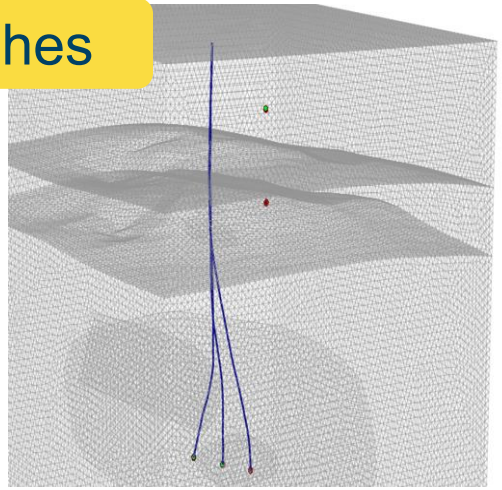
Development History

1979	Birth and first manifestation based on finite-element predecessor program FINEL developed since 1973.
1986	FEFLOW 1: FEFLOW was already able to compute 2D transient groundwater flow and transport.
1992	FEFLOW 3: Commercial development, Motif GUI implementation, FEFLOW became a registered trademark.
2001	FEFLOW 4: 3D Visualization, GIS interfacing, Adaptive meshing, Unsaturated flow, IFM Interface (API)
2012	**FEFLOW 6**: New Qt-based GUI, data management and architecture based on C++.
2013	FEFLOW 6.2: New Problem Class “Groundwater Age”, FePEST became true.
2015	**FEFLOW 7**: Support of fully 3D Unstructured meshes, significant improvements in meshing workflows.
2017:	FEFLOW 7.1: Dual-node support, coupling 2D surface water (M21FM.)
2018:	FEFLOW 7.2: Significant extension to Python interfacing.
2019	FEFLOW 7.3: Cloud-computing support in FePEST.
2020	FEFLOW 7.4: Hydromechanical support, new OpenGL GUI, extended Python API support, meta information.
2021	FEFLOW 7.5: Hydrodynamical support, PEST++, model conceptualization
2022	**FEFLOW 8.0**: Model conceptualization, Geode integration, Well Manager, etc.
2023	FEFLOW 8.1: Geothermal, new CAD import, 3D Supermesh, Well Manager and Groups

3D Meshes

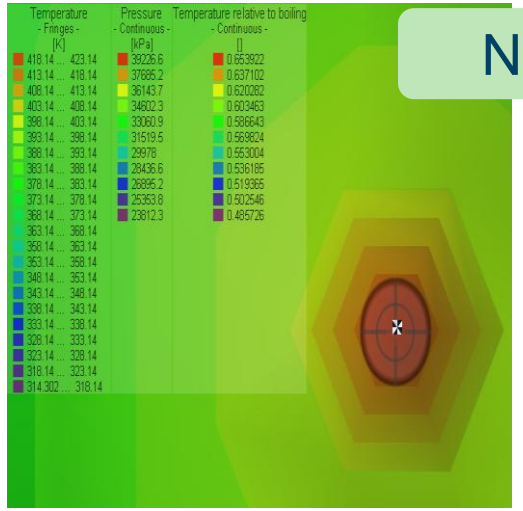


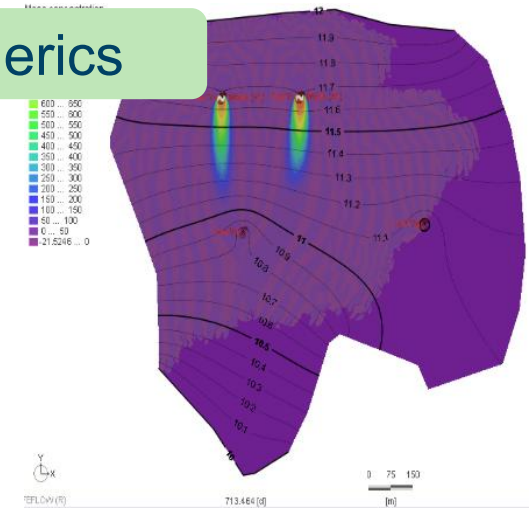


3D Supermesh &
Implicit Modelling of Geological Surfaces

Enhanced Geode Methods

Numerics



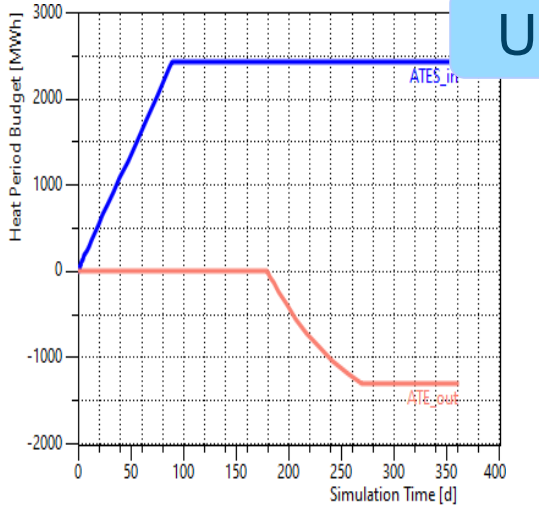


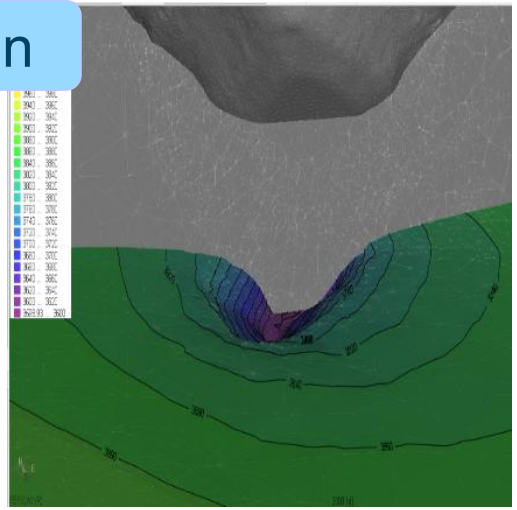
Equation of State

Standard Transport Formulation

FEFLOW 10 – Previous Release

Usability and Visualization





Budget-History Charting

Online Map Visualization and Reference Projections

Isosurfaces as canvas for visualization

FEFLOW-Python

New APIs

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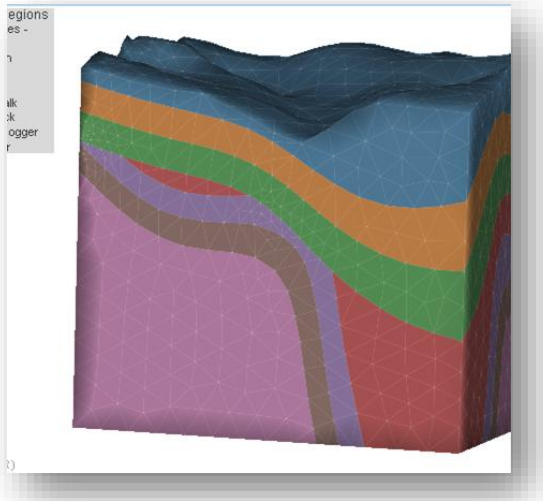
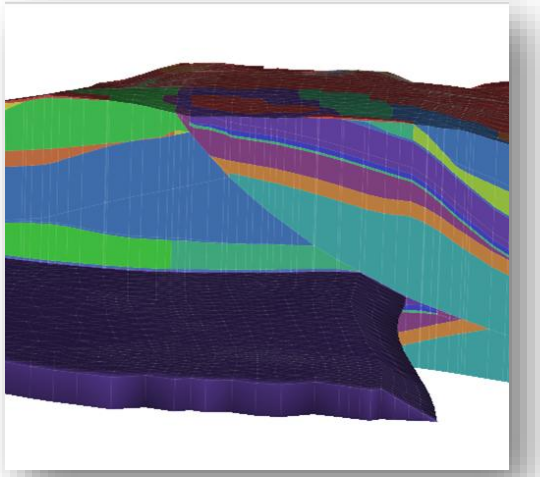
FEFLOW 11 – Current release

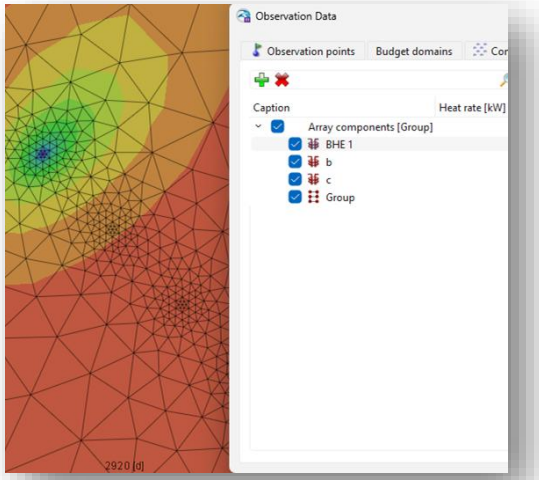
A major software release and empowers the users with multiple features



Geological Modelling



Meshes and workflows



Geothermal

Performance boost

What's new page in Online Help

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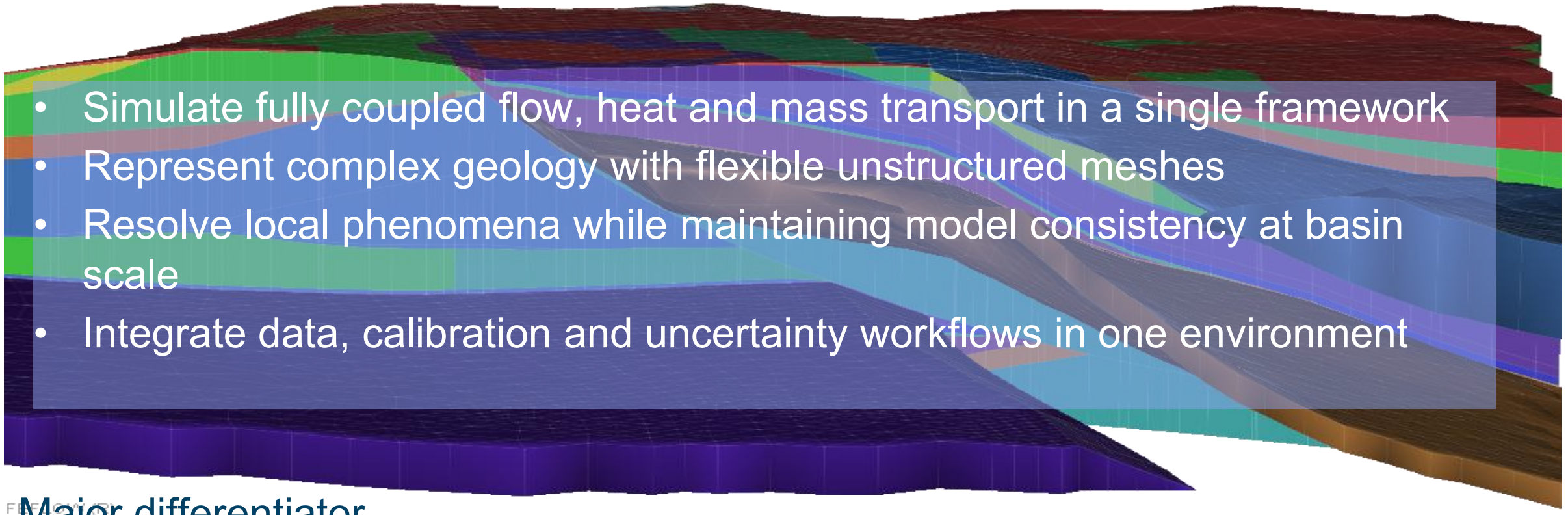
Why FEFLOW



- Simulate fully coupled flow, heat and mass transport in a single framework
- Represent complex geology with flexible unstructured meshes
- Resolve local phenomena while maintaining model consistency at basin scale
- Integrate data, calibration and uncertainty workflows in one environment

Major differentiator

End-to-end control of the simulation engine and interface allows fast adaptation to evolving geothermal challenges, from shallow systems and thermal energy storage to deep geothermal reservoirs with complex coupled physics.

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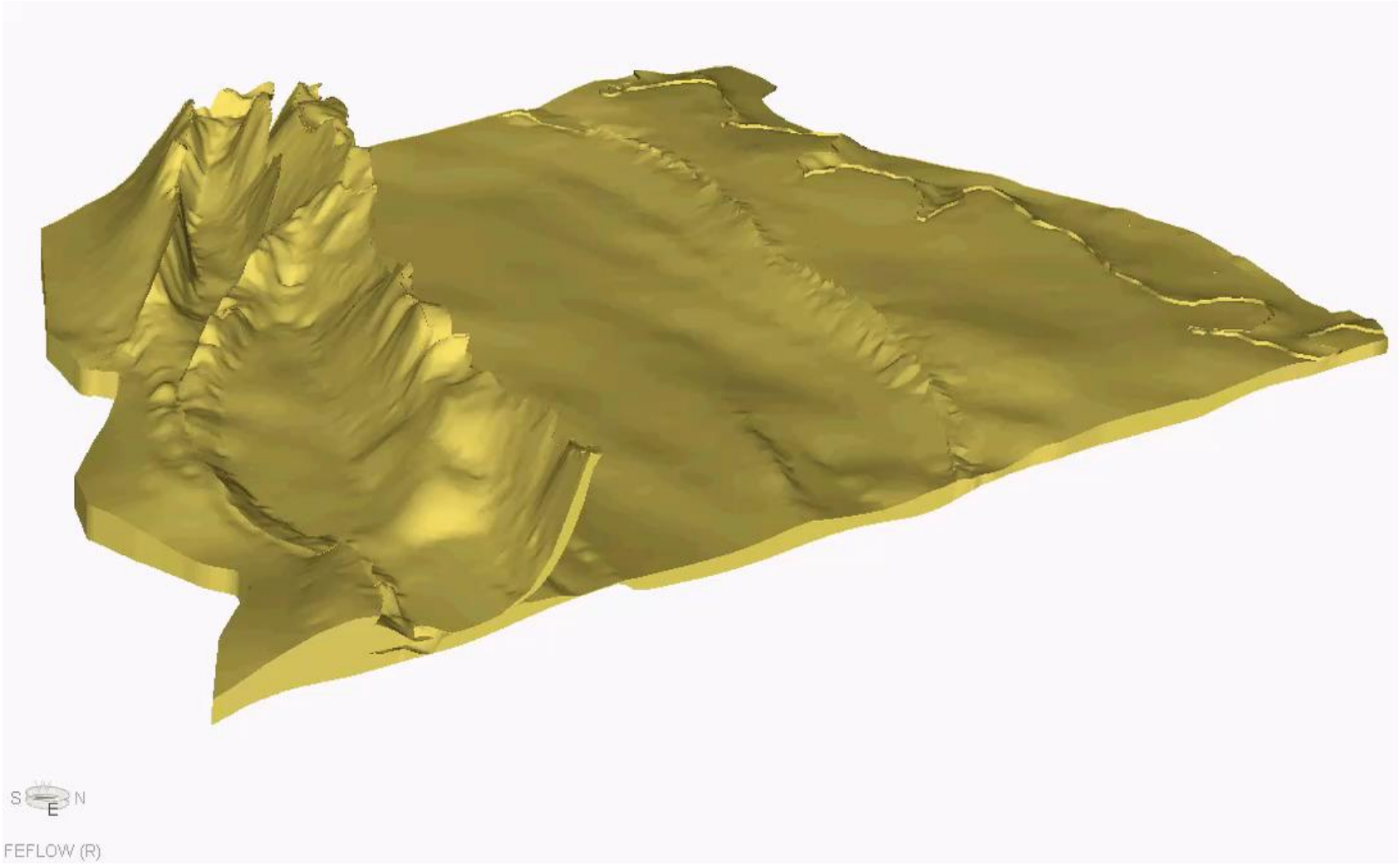
Integrating Geology in Groundwater Models

FEFLOW

Example of complex hydrogeological model using FEFLOW



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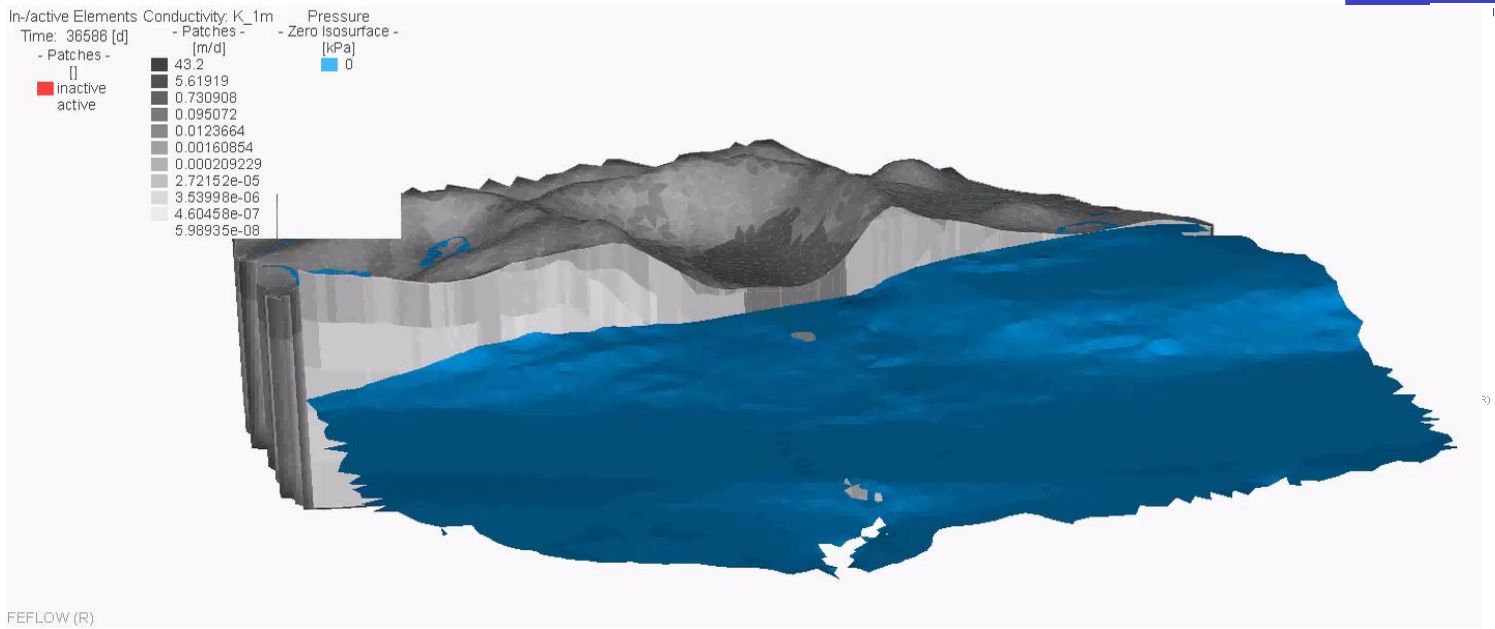
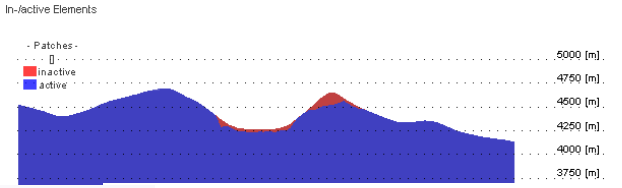
FEFLOW

Example of dewatering model using FEFLOW





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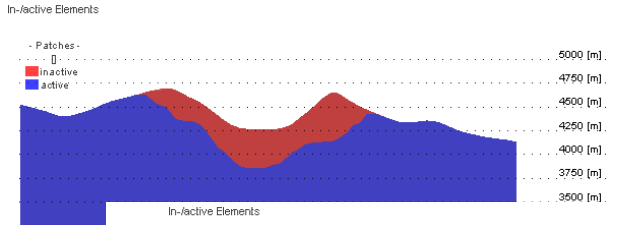
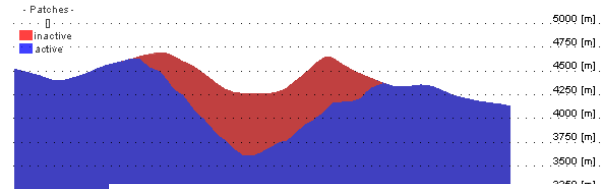
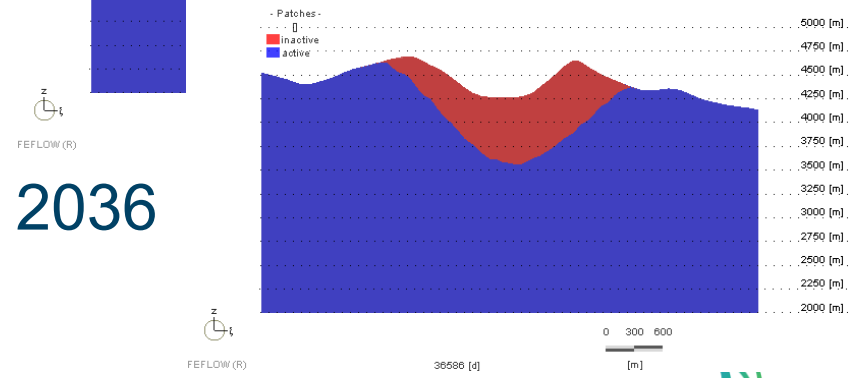


2020



2030



2036

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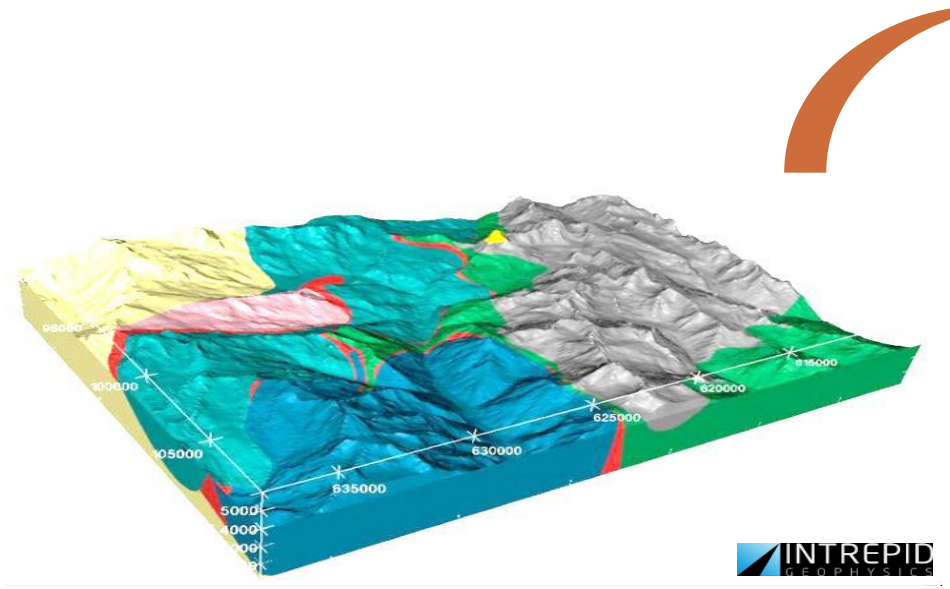
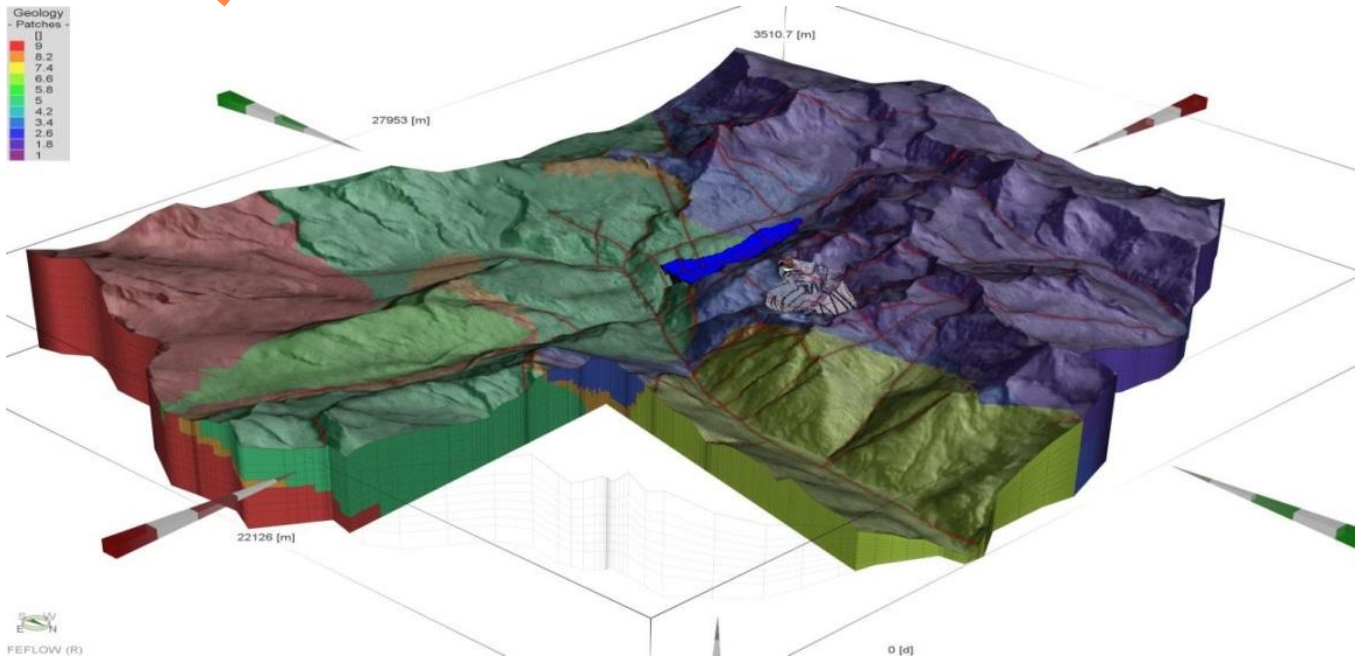
But where do we start?



3D GeoModeller geologic model



How easily is this integration?

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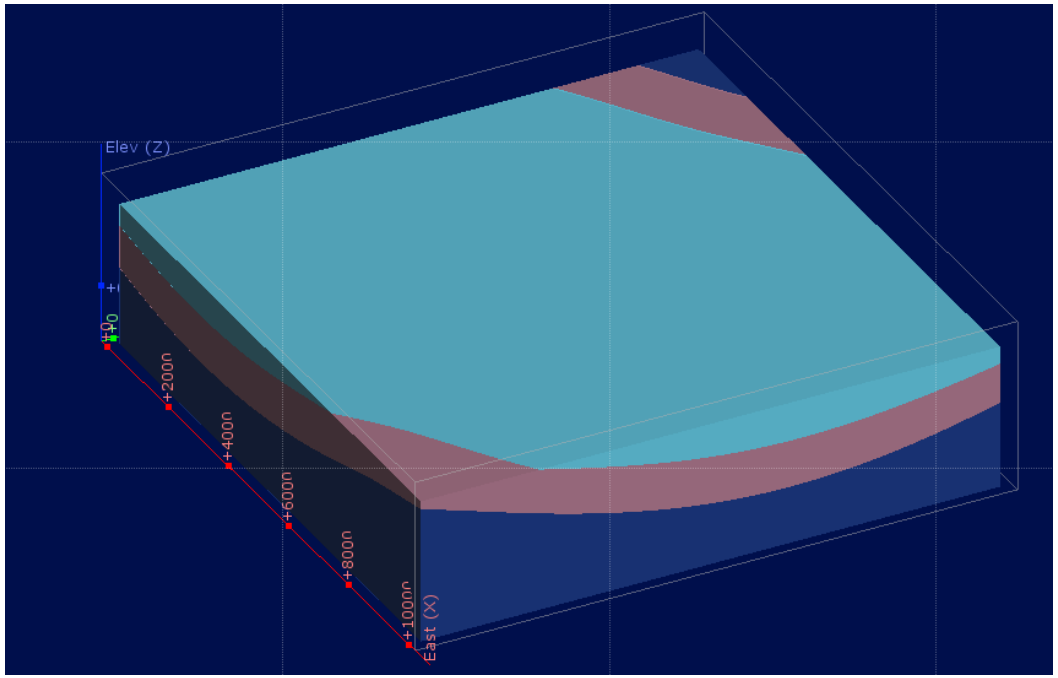
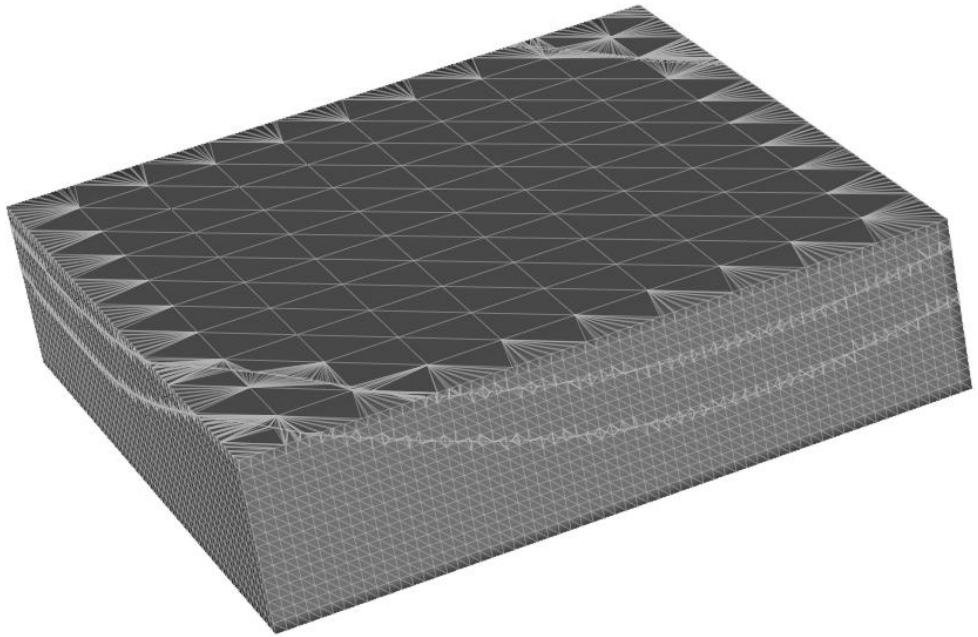
Already some challenges in a simple box-model





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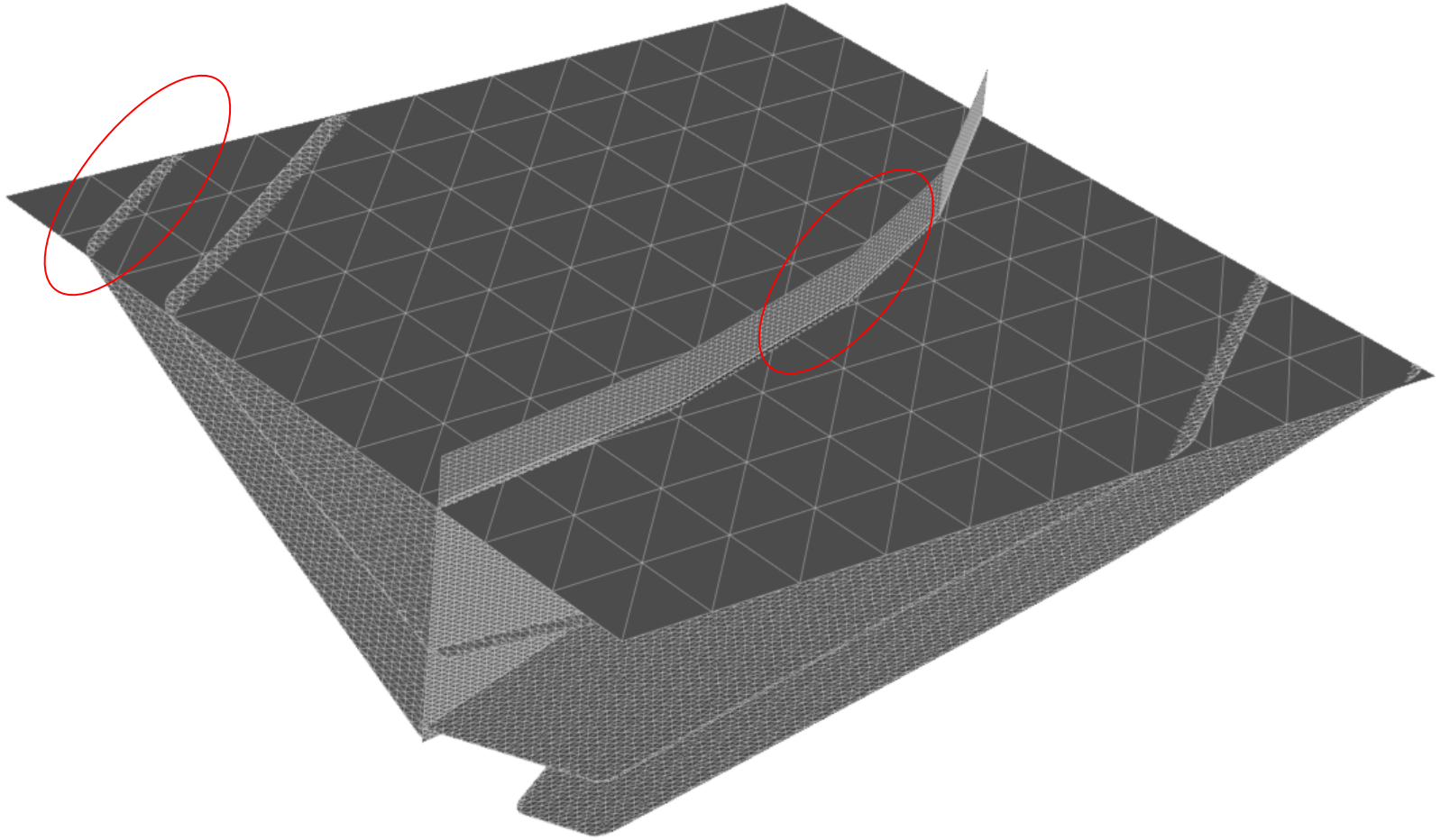
The Problem of Self-intersecting Surfaces



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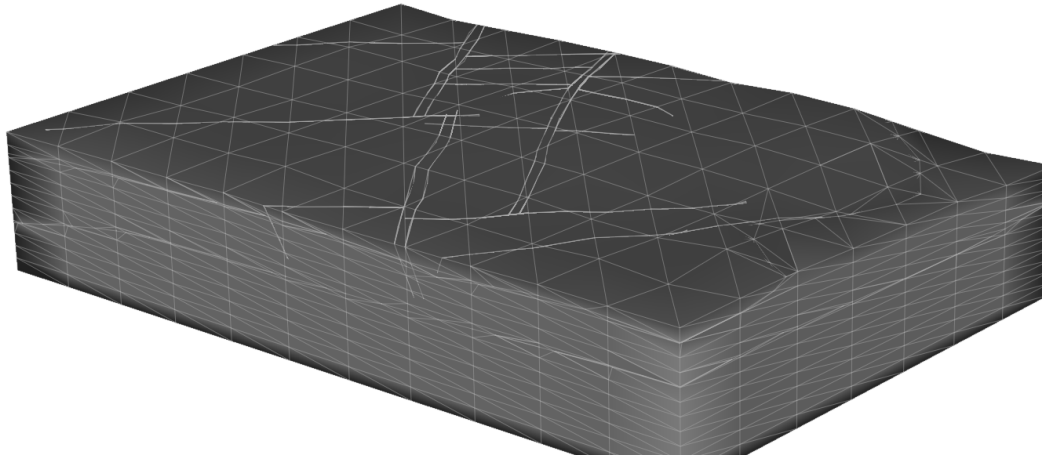
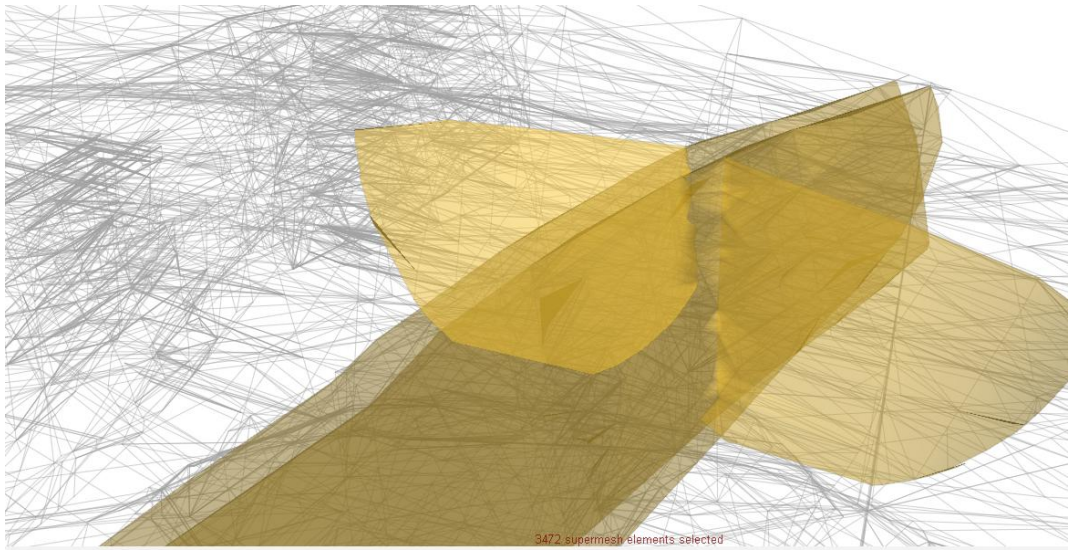
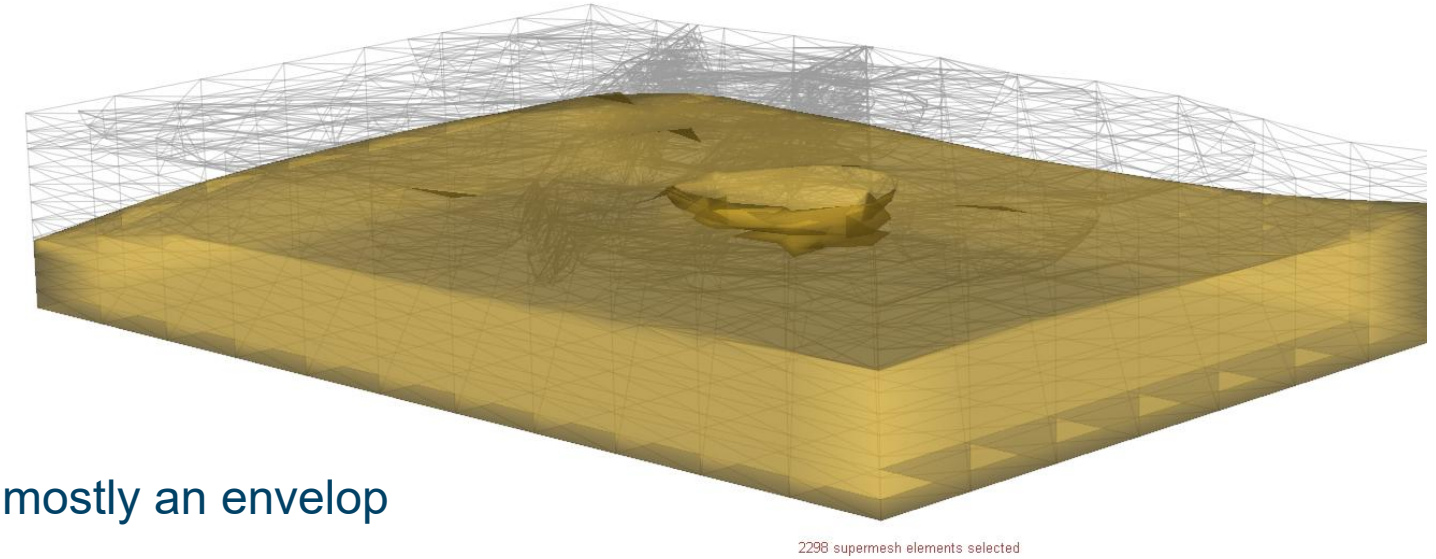
Another example



Faults being discontinued.





Surface is mostly an envelop

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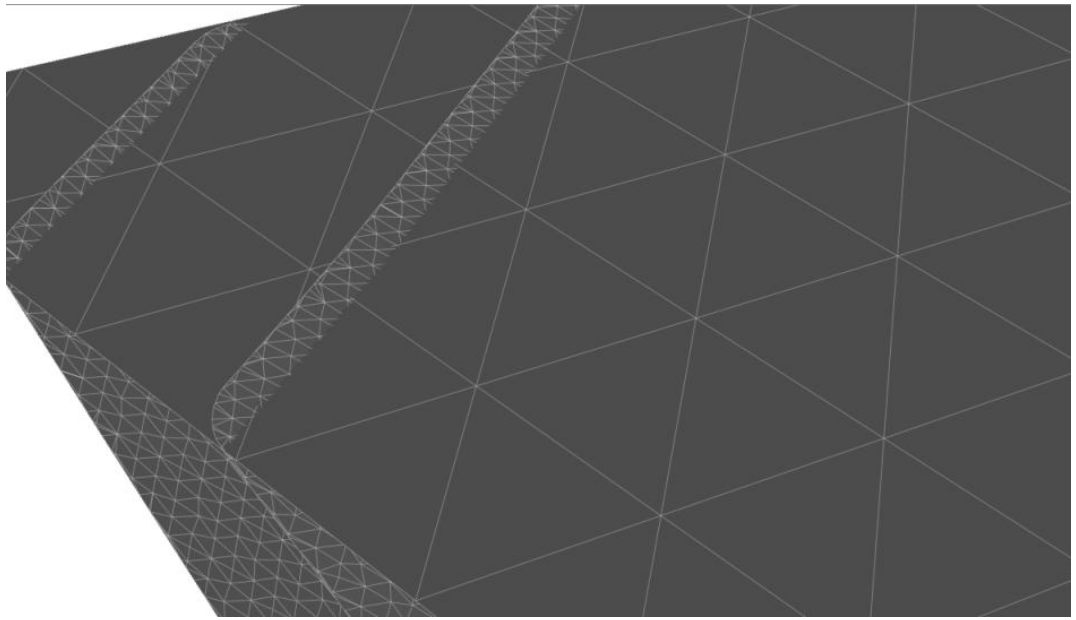
Solving the challenge

FEFLOW 7.0 (Release 2015)

- First manifestation of fully-unstructured (tetrahedral) meshes in FEFLOW.
- A lot *responsability was given to the third-party software*.
  - In many case, user needed to iterate between geological software and FEFLOW.
  - In other cases, there was no even a fix.



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FEFLOW 8.0 (Release 2023)

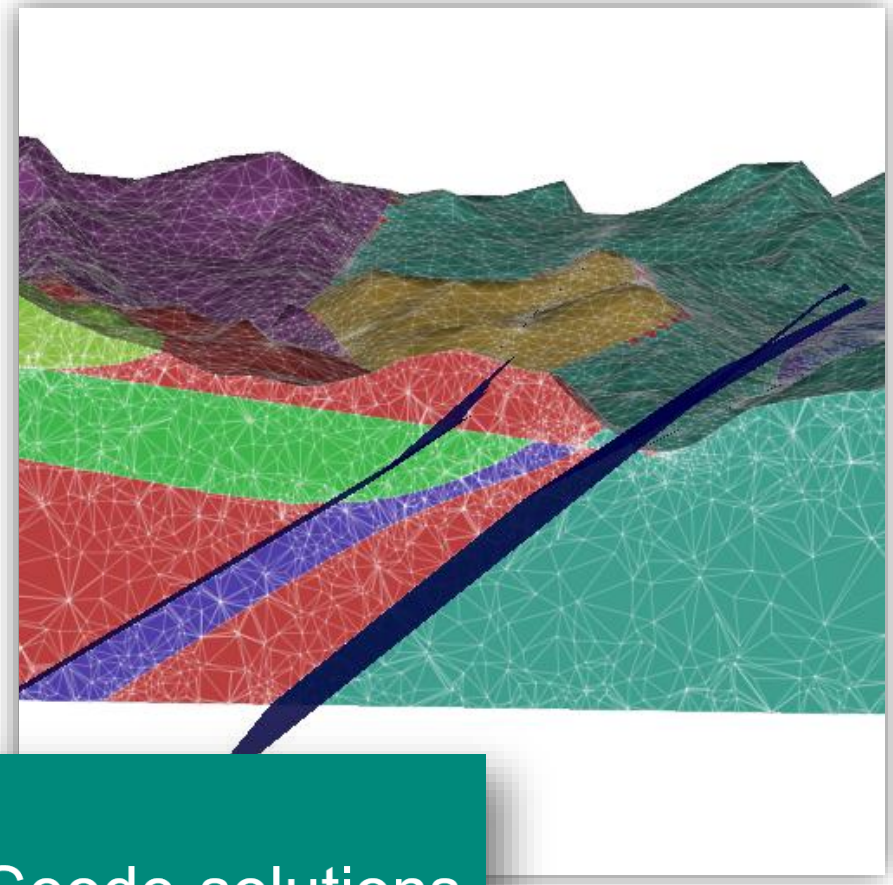
New License Module

FEFLOW Advanced

First Intend to repair "somebody else problem"

- User can *repair improper 3D data* (geometries with non-conformities) such as a surfaces and polylines imported into FEFLOW and subsequently increase success with building a complex 3D mesh.

- Possibility to easily *integrate new datasets* to the 3D Supermesh.



The Beginning of a strong collaboration

Geode-solutions

https://geode-solutions.com/

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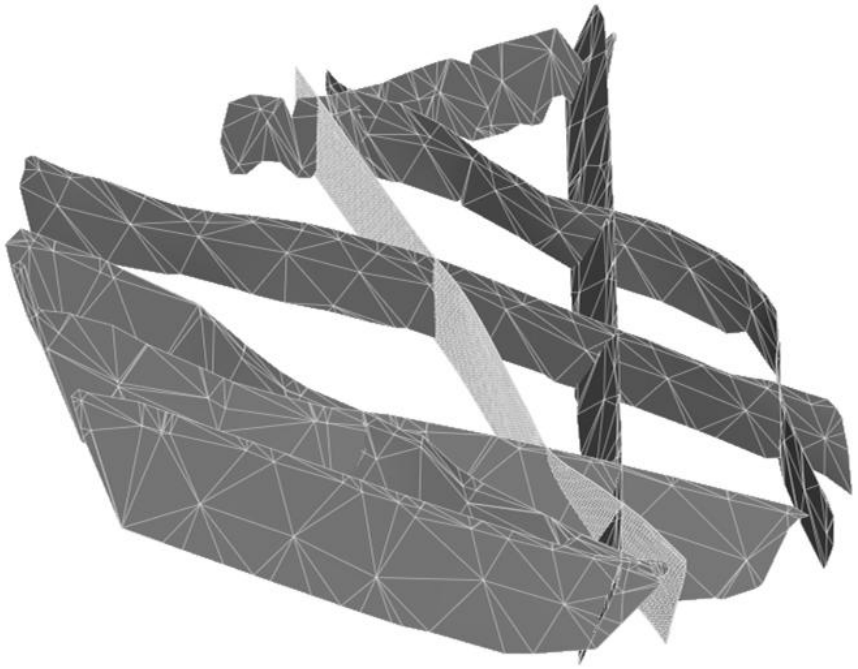
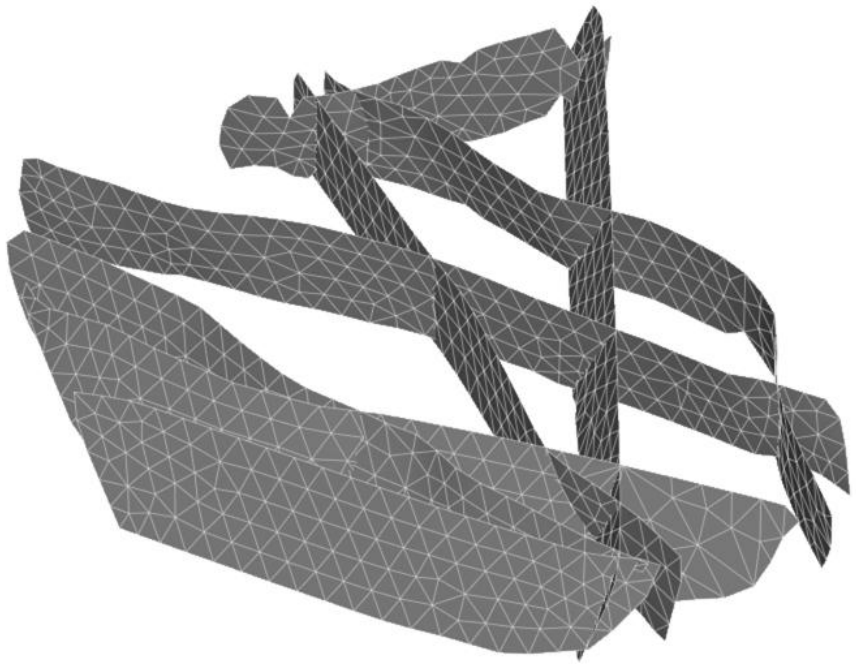
Example: Mine site located in the Peruvian Andes



Surface Remesh



Original surfaces

Remeshed surfaces

Improving regional faults

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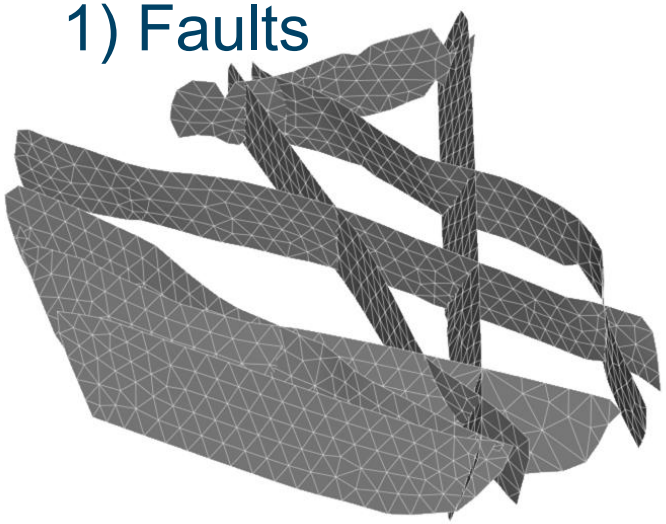
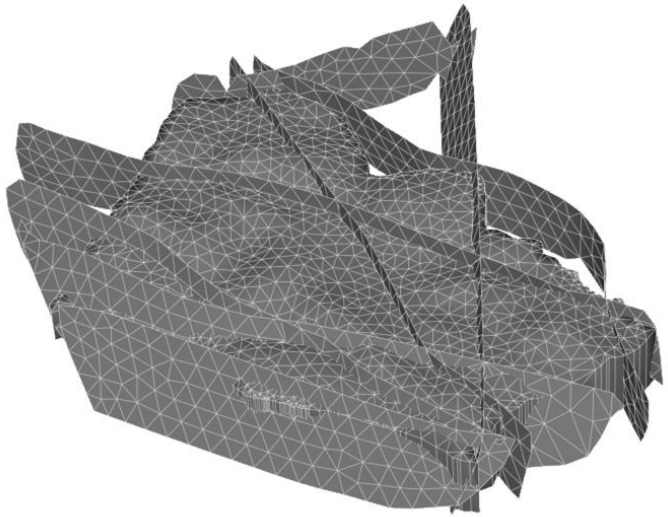
Example: Mine site located in the Peruvian Andes

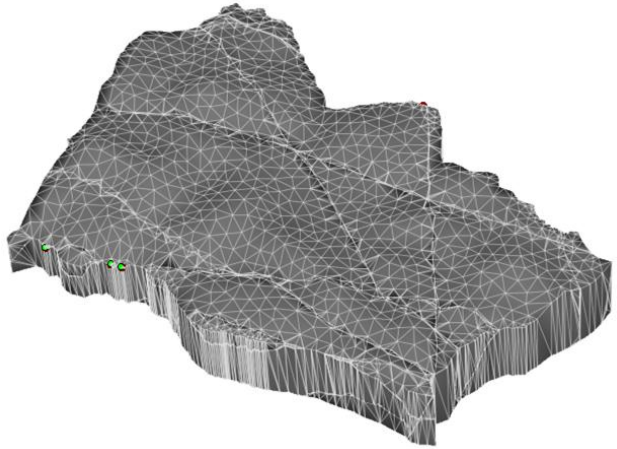
1) Faults



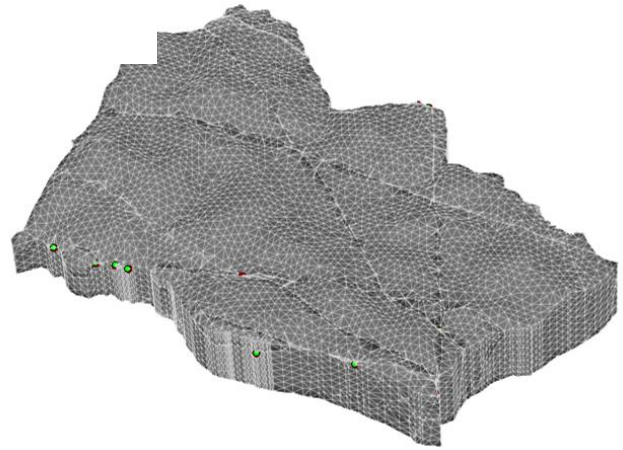
2) Faults & domain



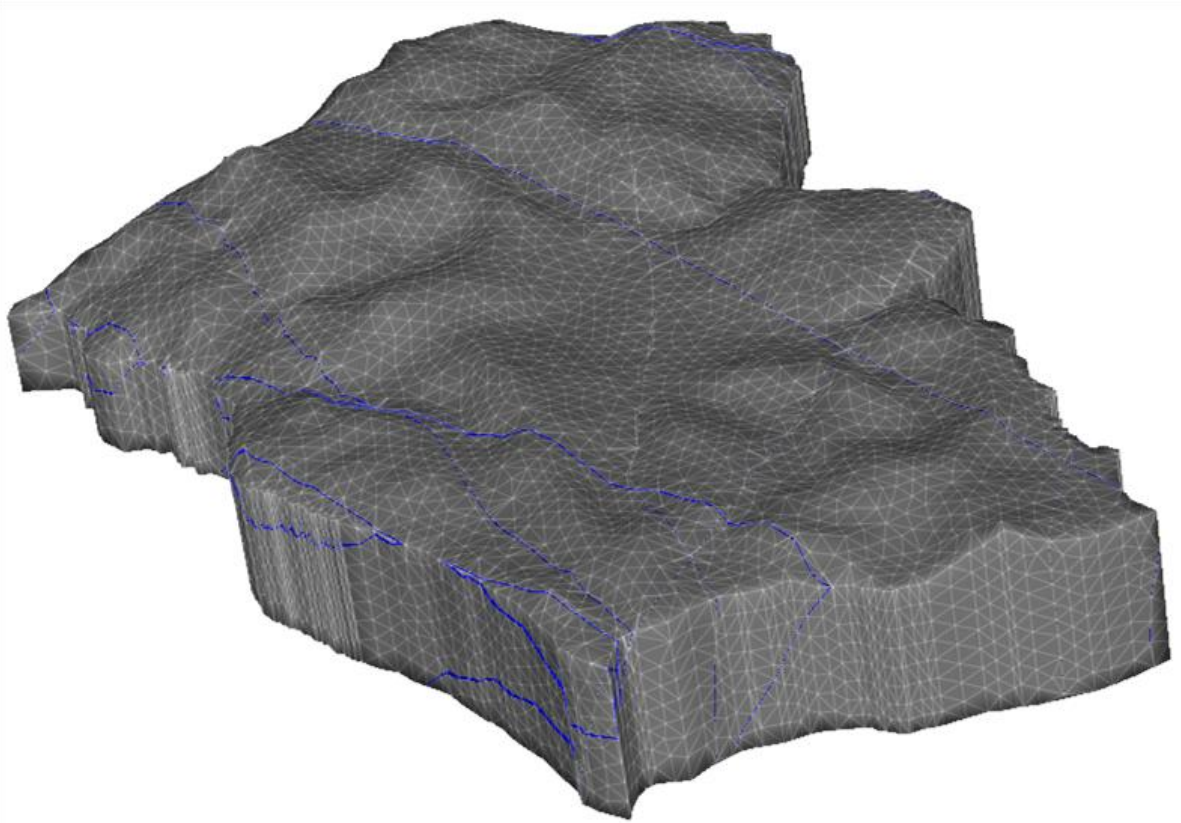
3) Repaired

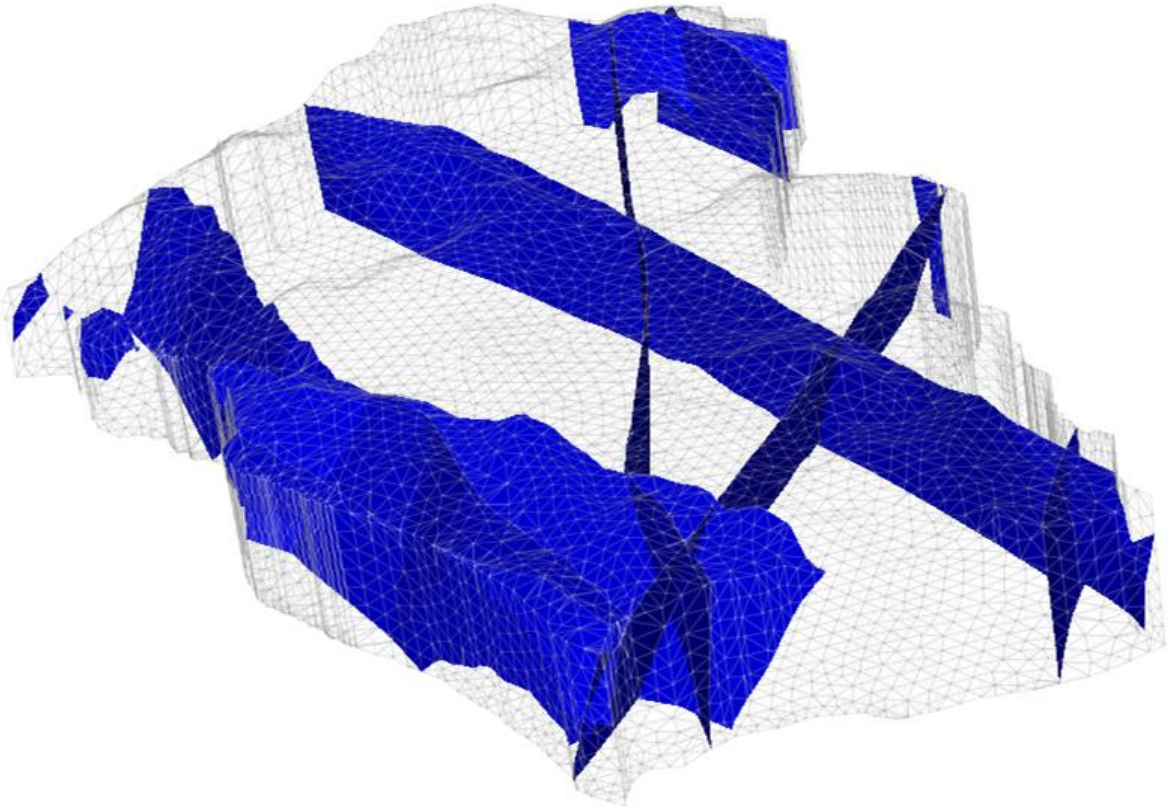


4) Remeshed



Example: Mine site located in the Peruvian Andes





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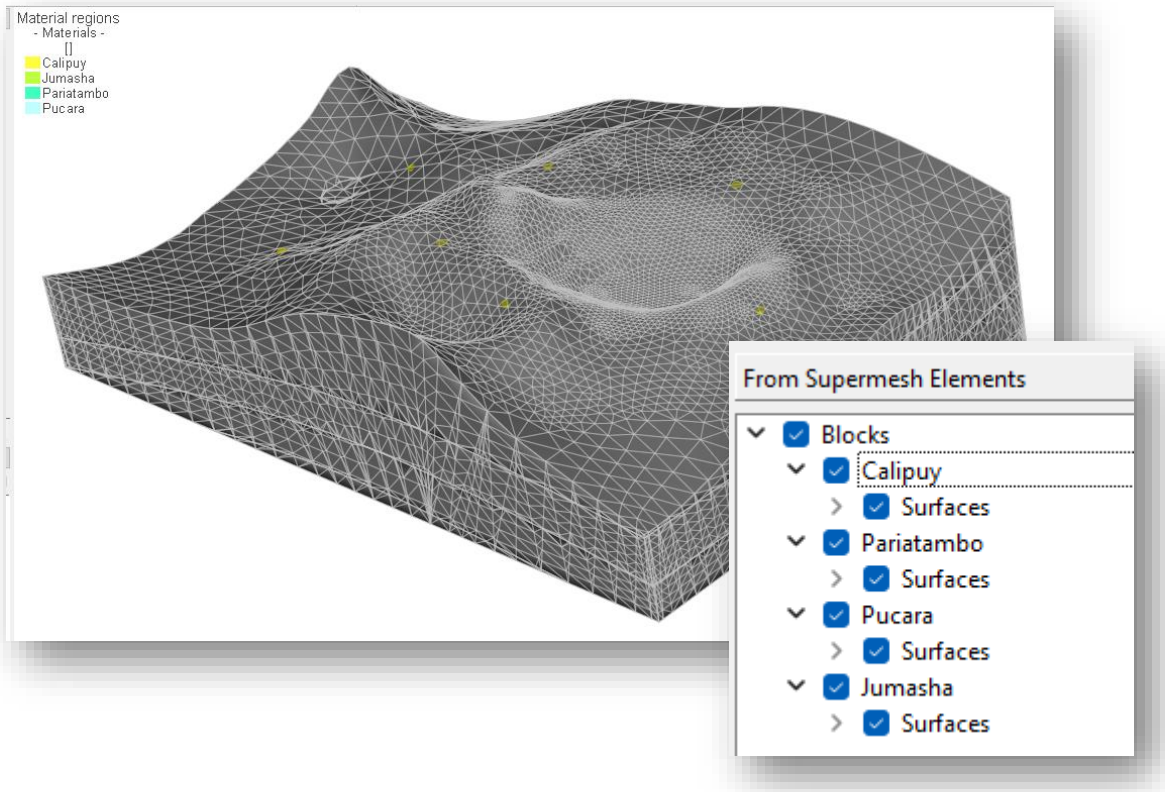
FEFLOW 10 (Release 2025)

- FEFLOW gets closer to geological concepts:
  - Surfaces are not enough, we need block association.

- First implementation of the geological modelling package.



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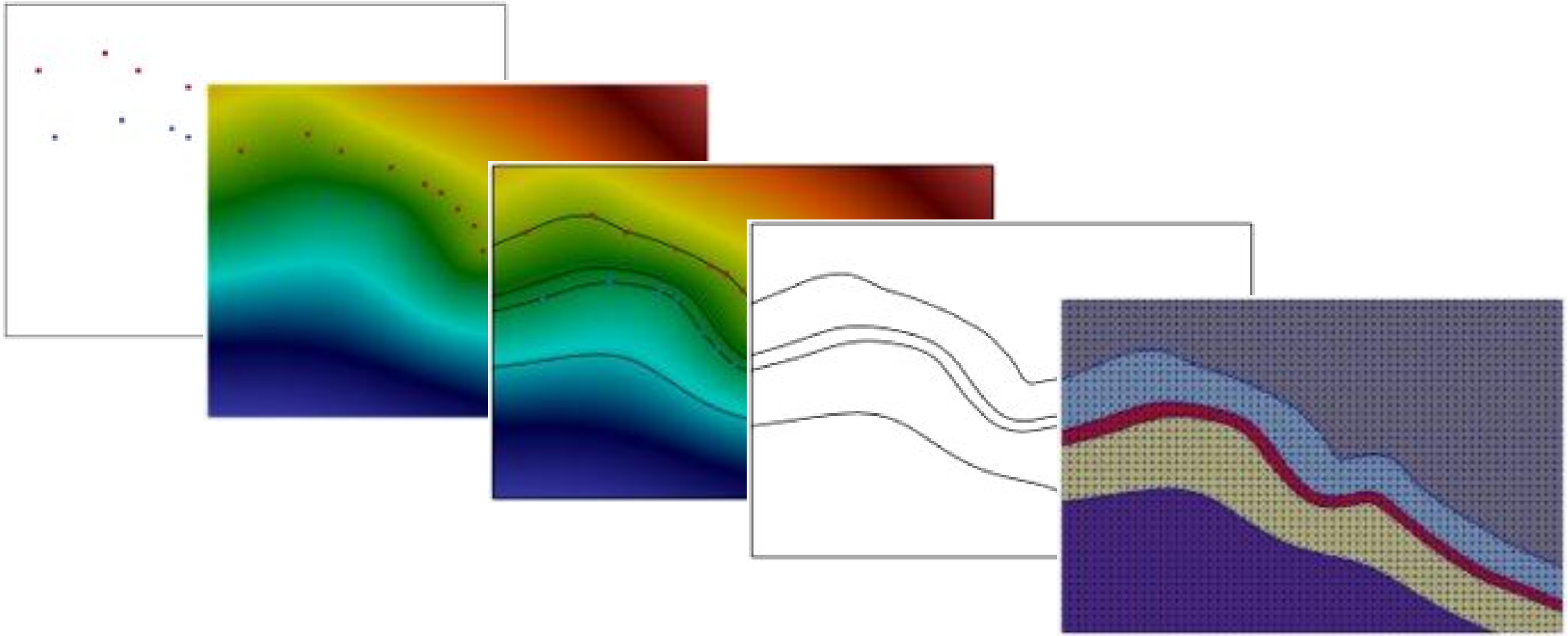
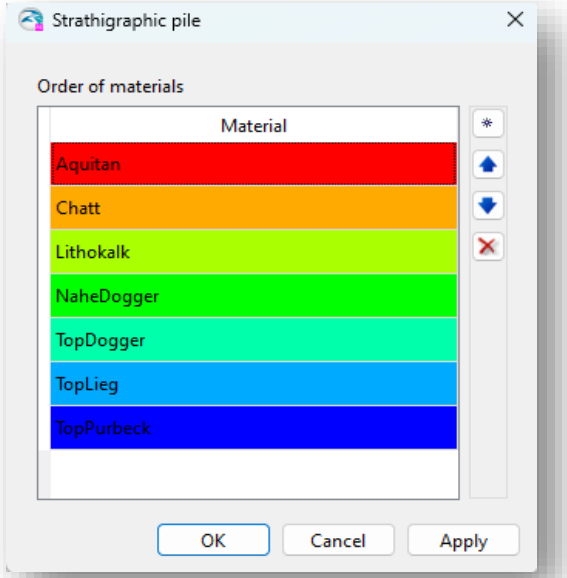
Implicit Modelling... *(Explain like I am 5)*

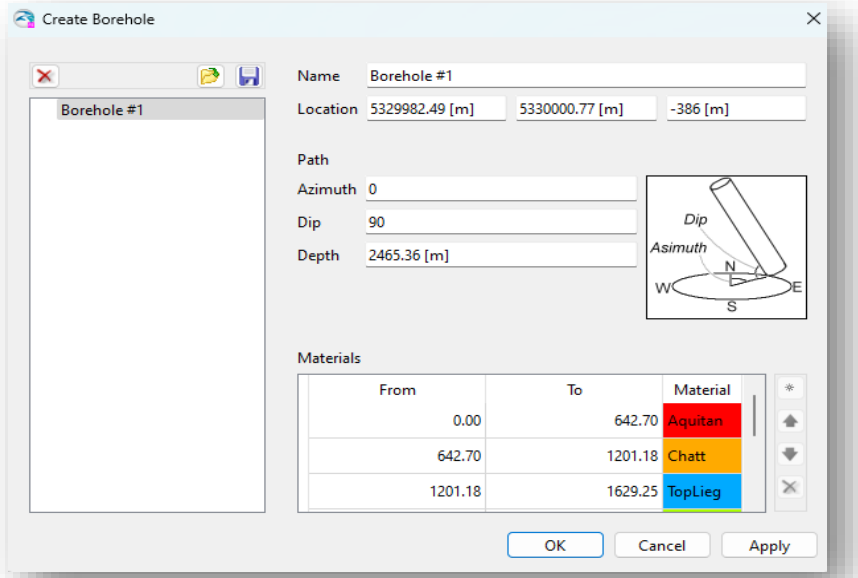


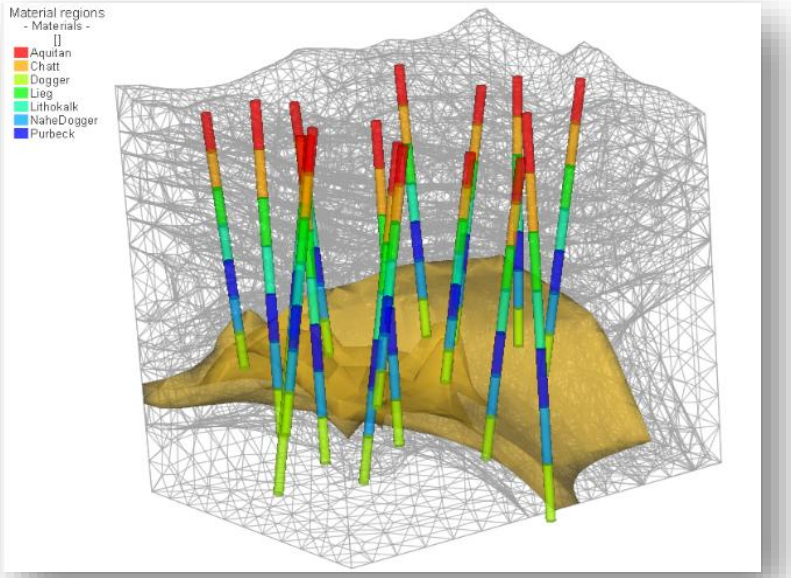
DHI FEFLOW

New Implicit Modelling Toolbar – The Foundation

- Define stratigraphic pile.
- Interactive creation of boreholes.
- Fast import/export of 100‘s boreholes.



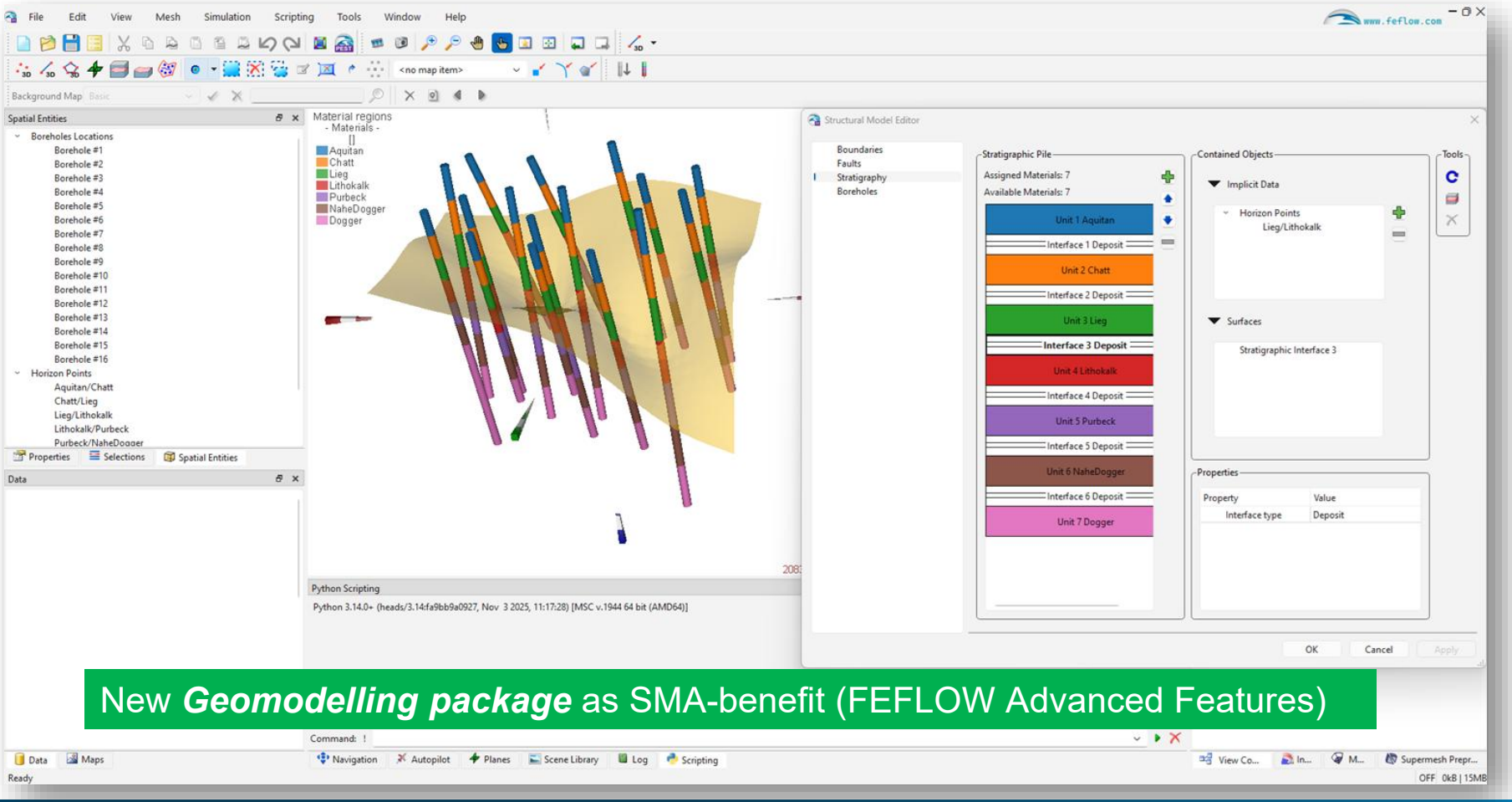




DHI FEFLOW

FEFLOW 11 (Release 2026)

- Full release of ***Structural Model Editor***

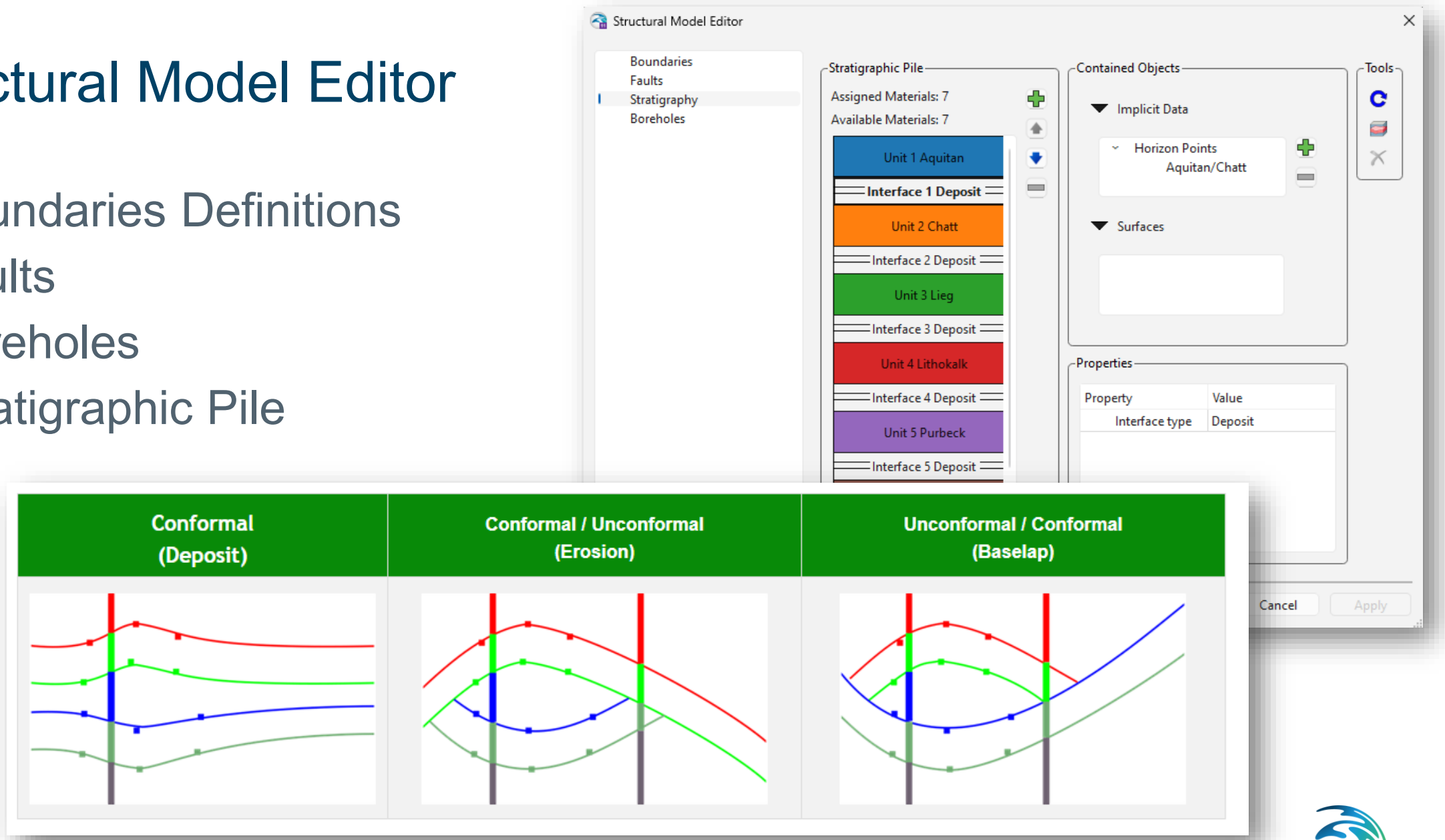


New ***Geomodelling package*** as SMA-benefit (FEFLOW Advanced Features)

DHI FEFLOW

Structural Model Editor

- Boundaries Definitions
- Faults
- Boreholes
- Stratigraphic Pile



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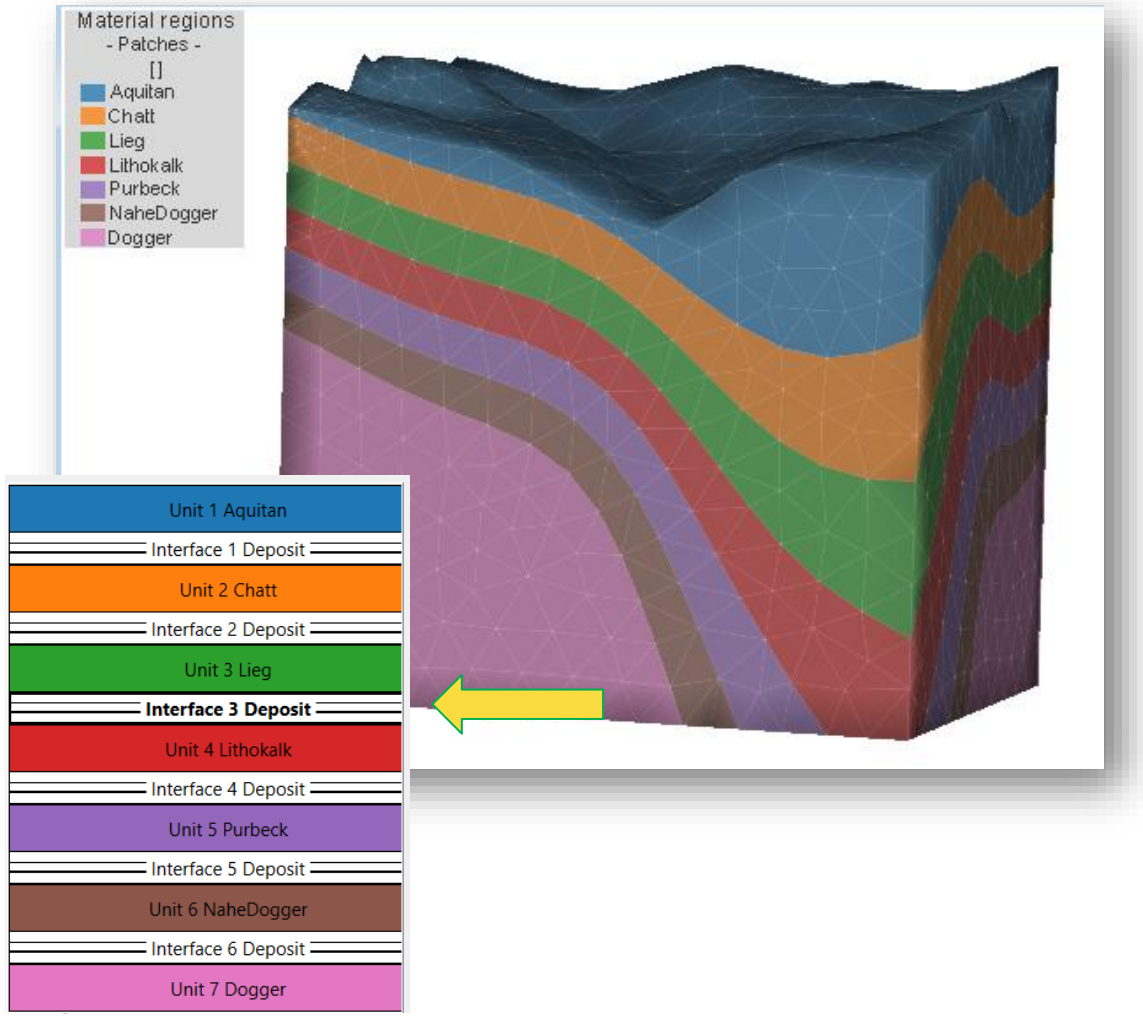
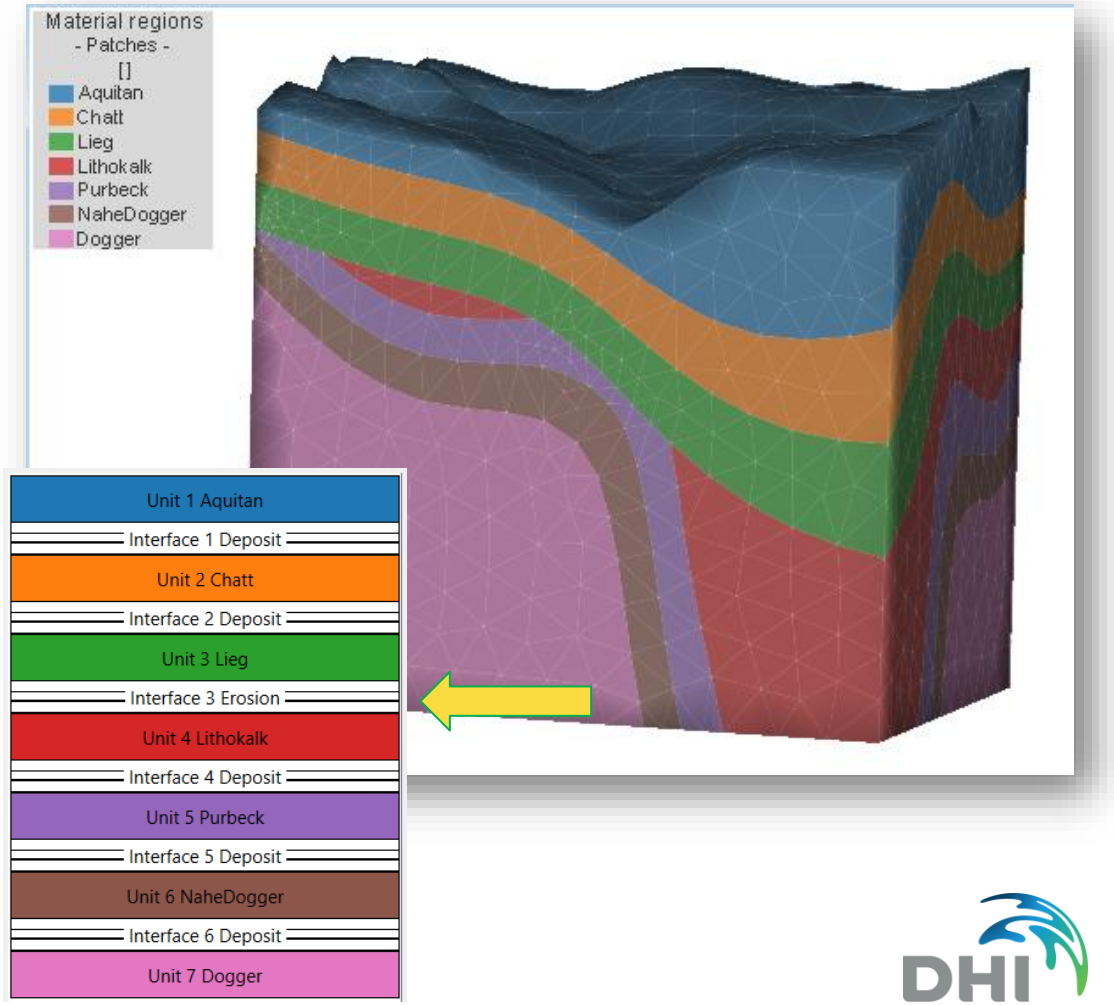
Example: Structural Model using different Interfaces





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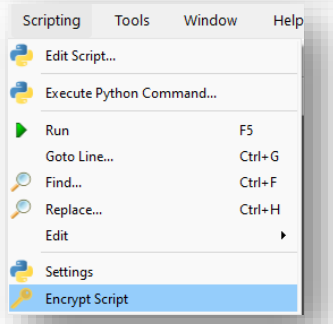
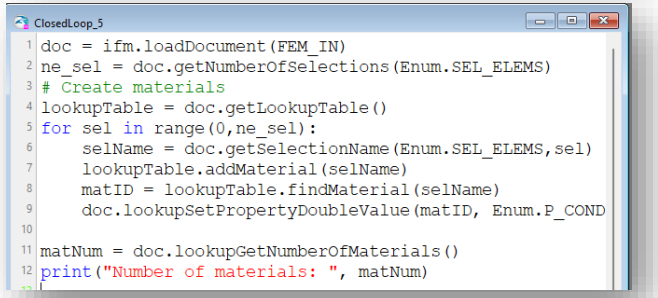
Geomodelling directly via Python

```python
__author__ = 'cvi'
import ifm
from ifm import Enum

SMH3d = r'..\..\smh3d\09_00_openpit.smh3d'

print('FEFLOW Version: ', ifm.getKernelVersion())

doc = ifm.loadDocument(SMH3d)
doc.enableAdvancedFeatures(True)

smh = doc.getSuperMesh3D()
tool = smh.getProcessingTool(Enum.SMH_TOOL_GEODE)
tool.setOptions({'GeodeDumpDebugFormat' : 'NODUMP', 'GeodeSolutionsLog' : True})
version = tool.getVersion()
print("Geode processing tool version: " + version)
smh.processSupermesh(tool, Enum.SMH_GEODEOP_RESET_TOPOLOGY)
```





- Build the entire conceptual model using Python.
- Run multiple Geometric Tools to improve/correct external datasets.
- Build entire geological model using Python.

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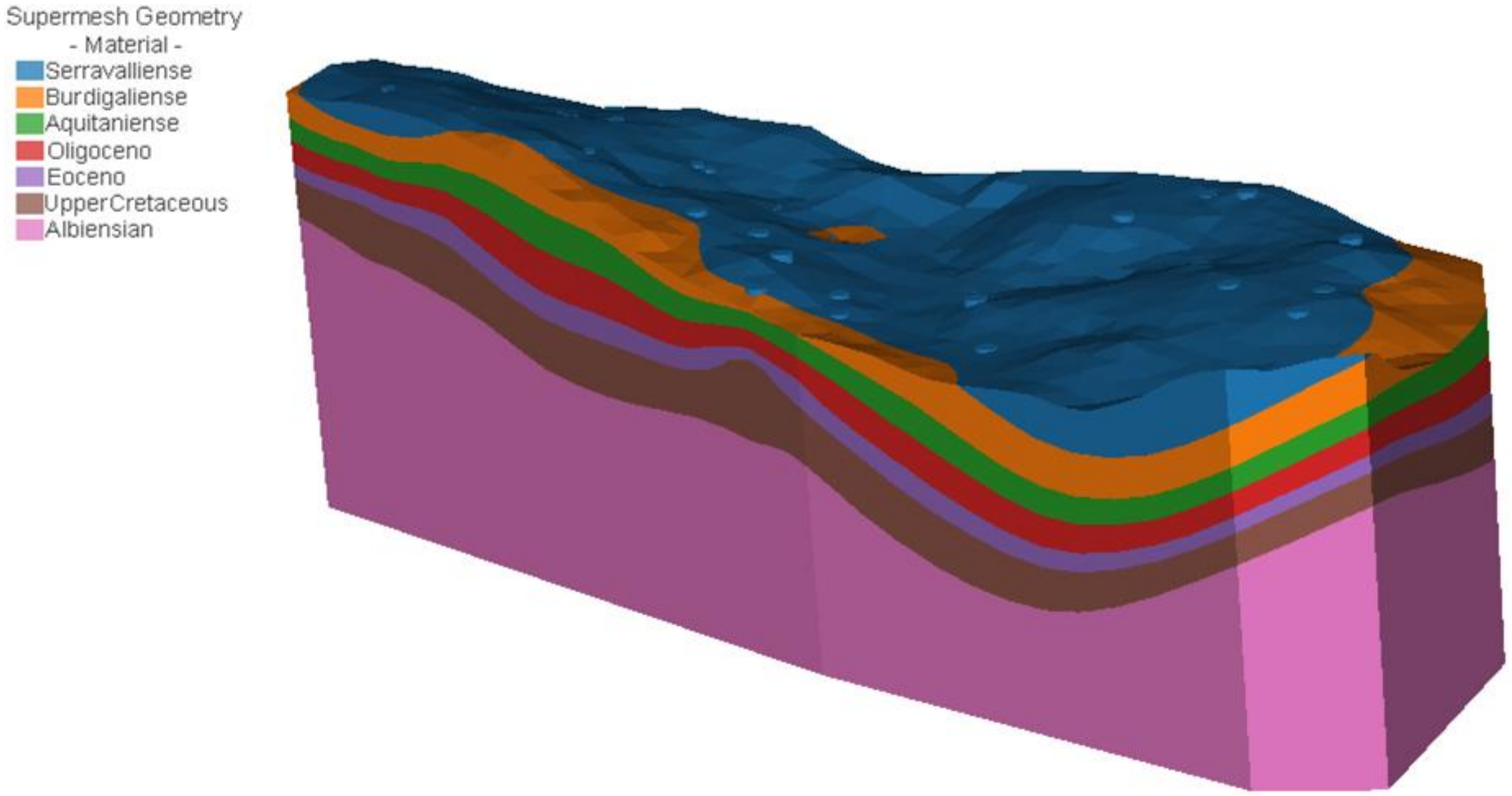
Take the most out of the functionality



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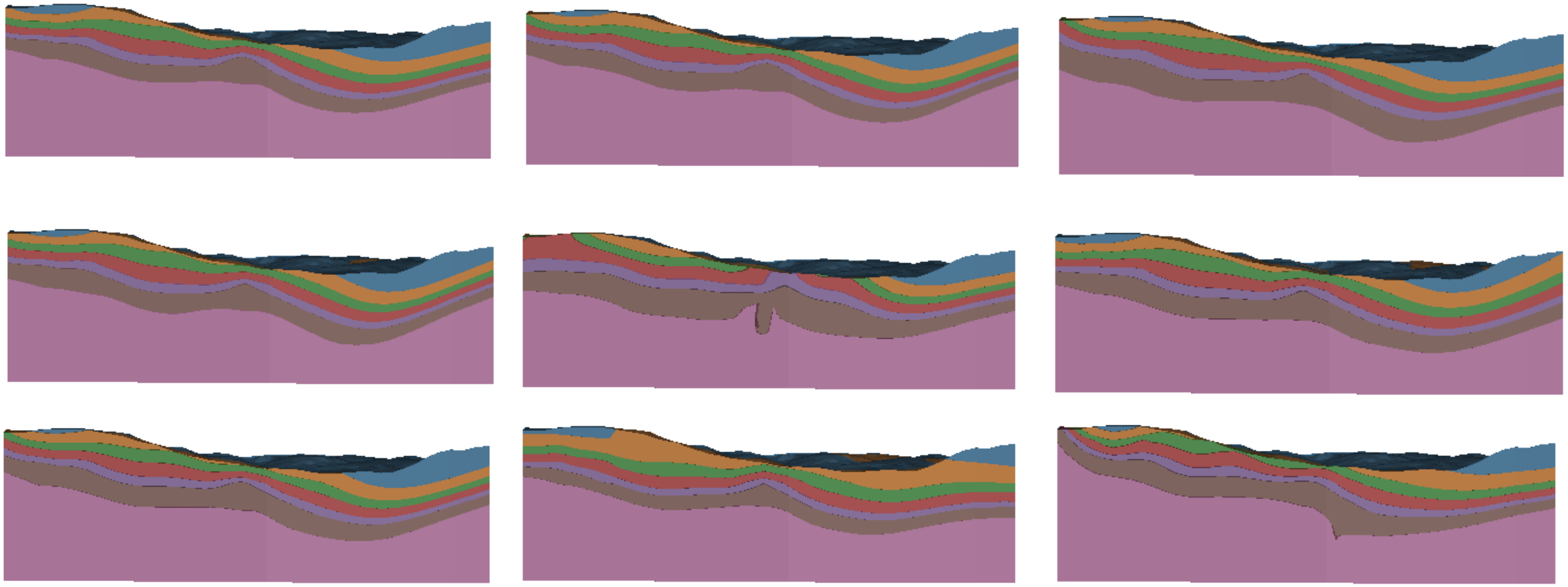
What about Uncertainty?



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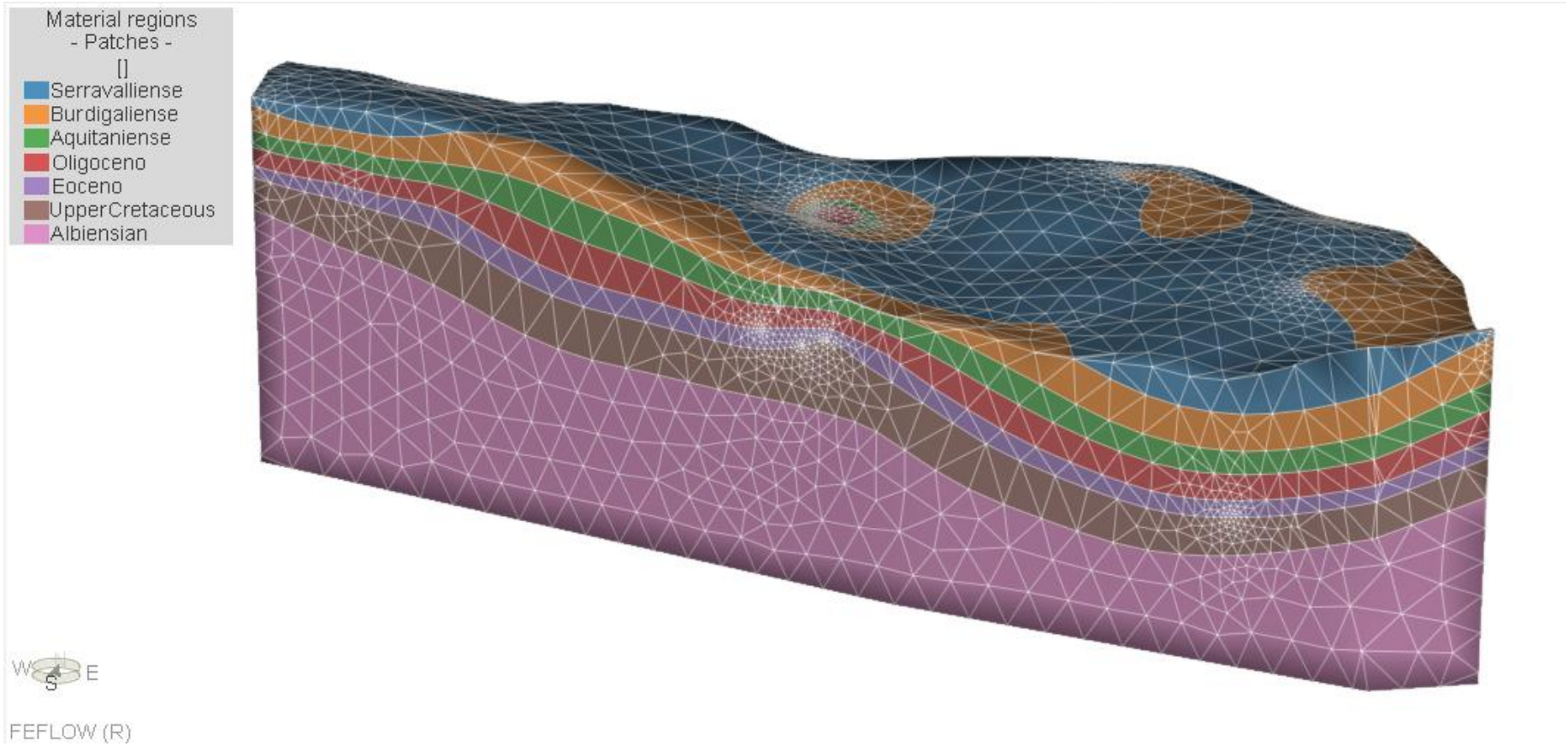
Moving forward: Build not just one, but hundred models



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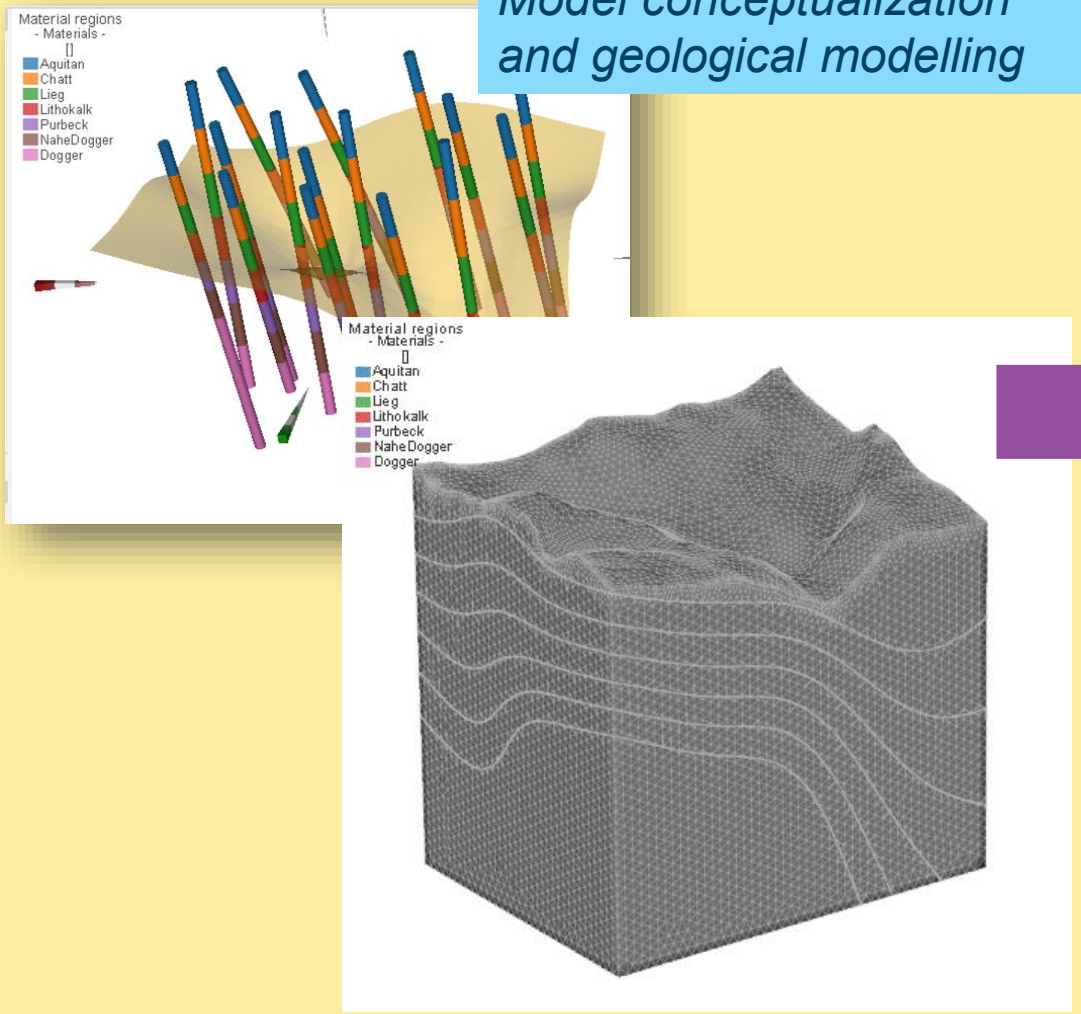
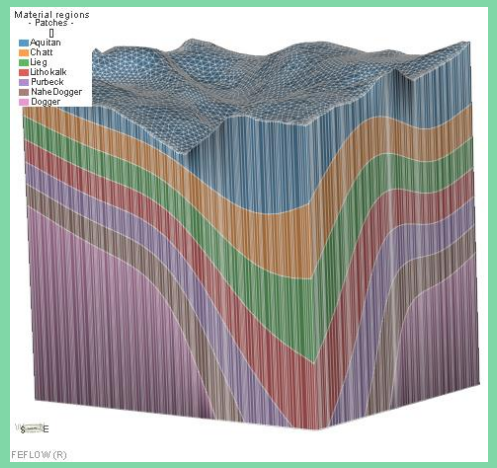
Concluding remarks

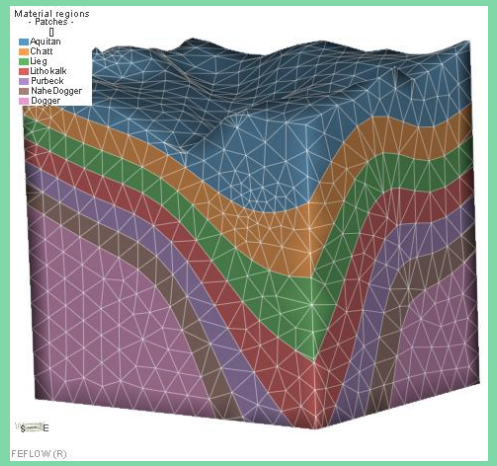
Model conceptualization and geological modelling



Meshing



Layered Meshes (with/wihtout pinch-outs)



Tetrahedral Meshes

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Live Demonstration

Get in touch:

Thank you for your attention!

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