Modeling Large-Scale Mine Dewatering

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Introduction

Groundwater is a key factor affecting mine operations worldwide. On one hand, underground and open pit mines need to pump out groundwater in order to proceed with mineral extraction and increase the stability of rock slopes. On the other hand, groundwater abstractions can produce undesired environmental and social impacts, which should be anticipated in the environmental impact assessments and mine feasibility studies.

Simulating open pit dewatering activities is not trivial because usually involves large-scale domains (basin scale), complex geological settings, including fracture zones and faults and difficult geometrical constrains due to mine engineering.

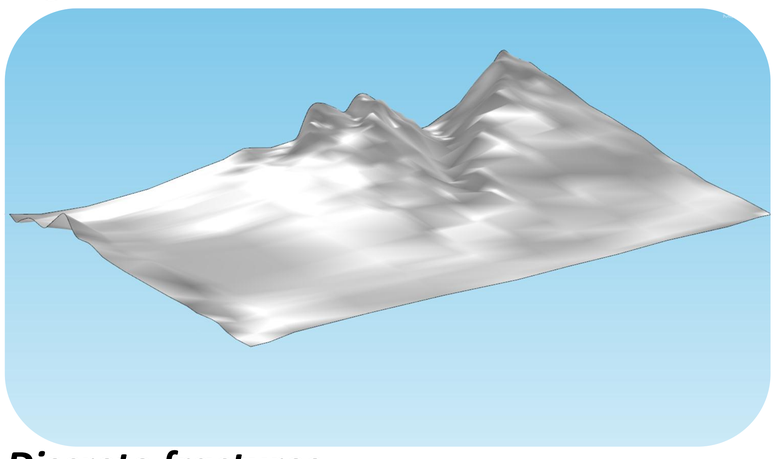
Use of Comsol Multiphysics

In this work, the subsurface flow module of COMSOL Multiphysics was used to simulate the feasibility and hydrogeological impact of a future mine dewatering operation. Digital Elevation Model and geological settings were imported into COMSOL

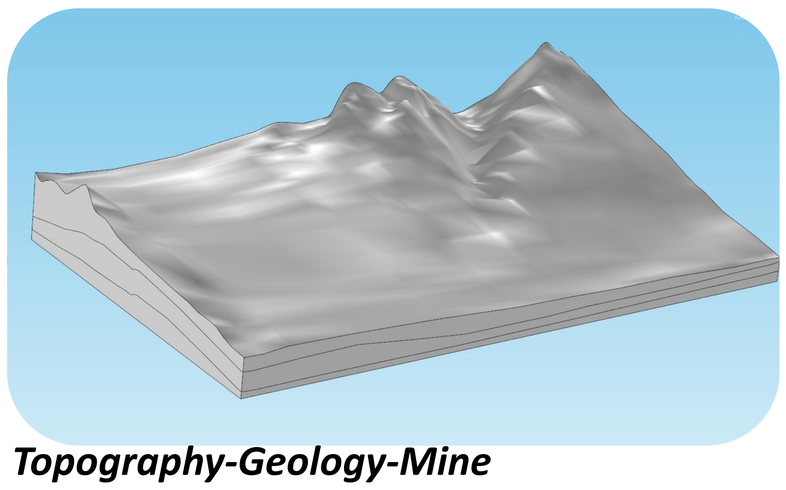
The finite element mesh was generated for the whole hydrological basin, highly refined in the mine vicinities, in order to properly adapt the open pit geometry. The major fracture zones known by the geological and hydrogeological studies were considered as planar features by means of 2D elements.

The Case Study

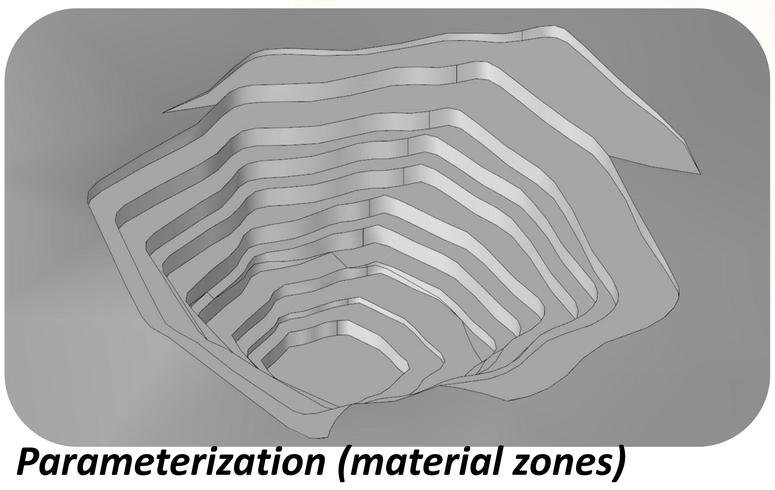
Digital elevation model



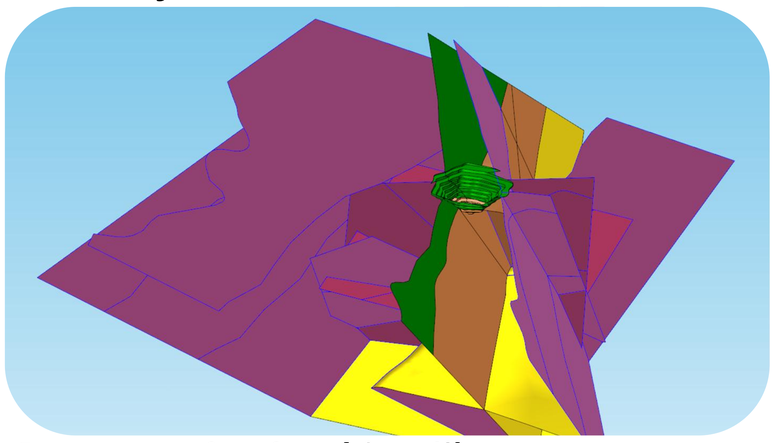
Geological model



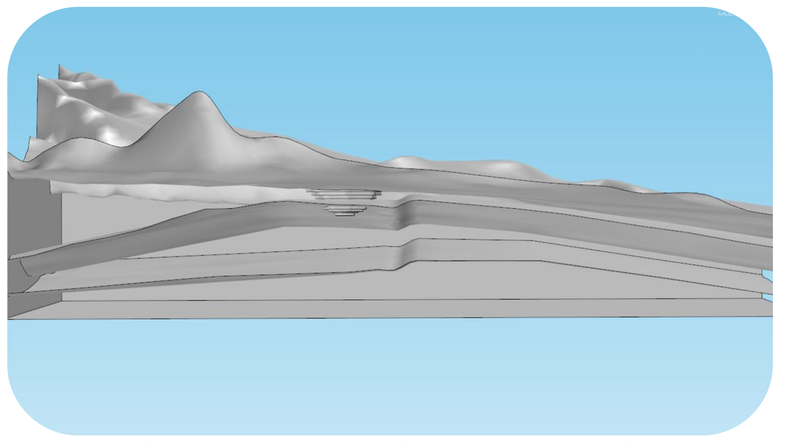
Mine geometry



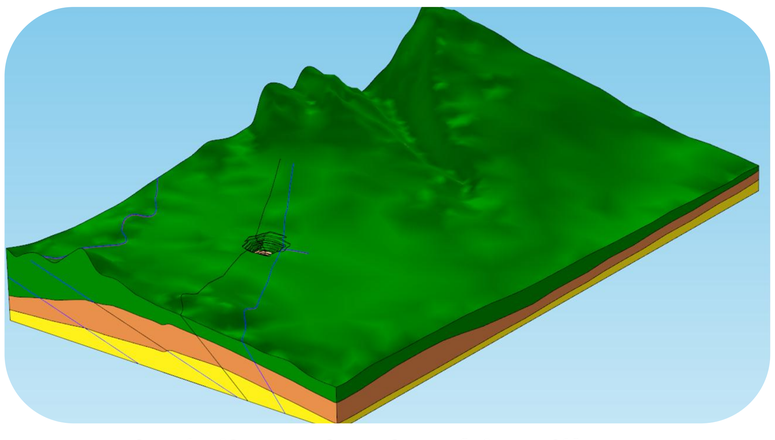
Discrete fractures



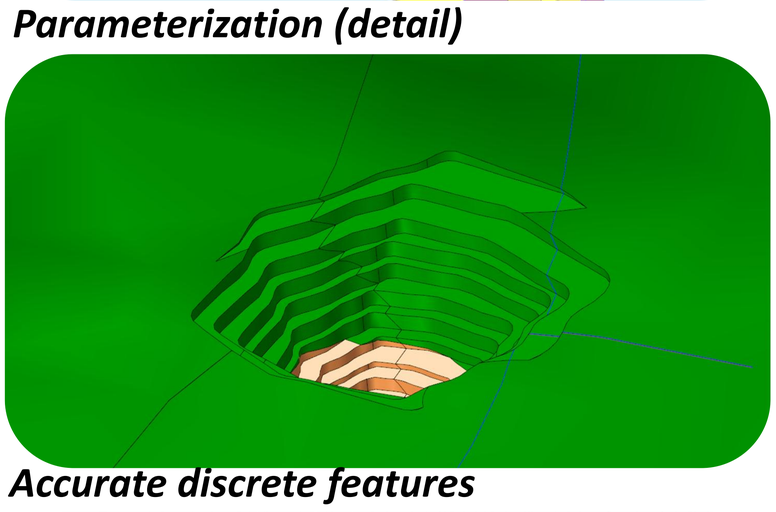
Topography-Geology-Mine



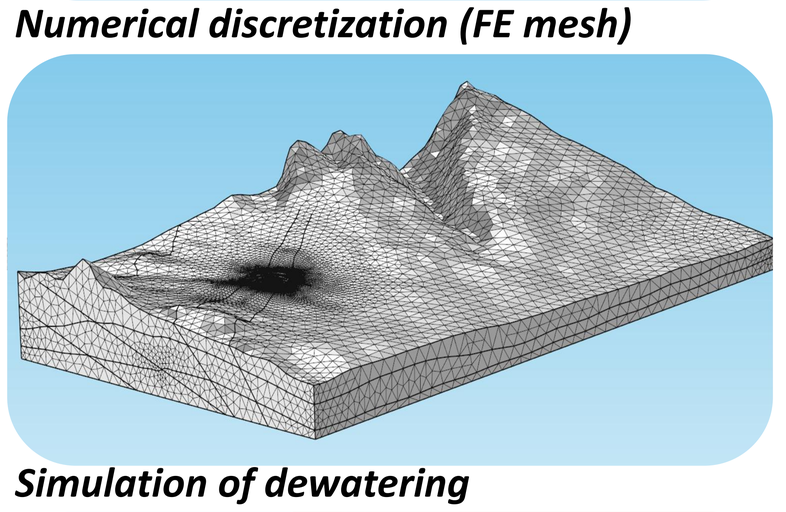
Parameterization (material zones)



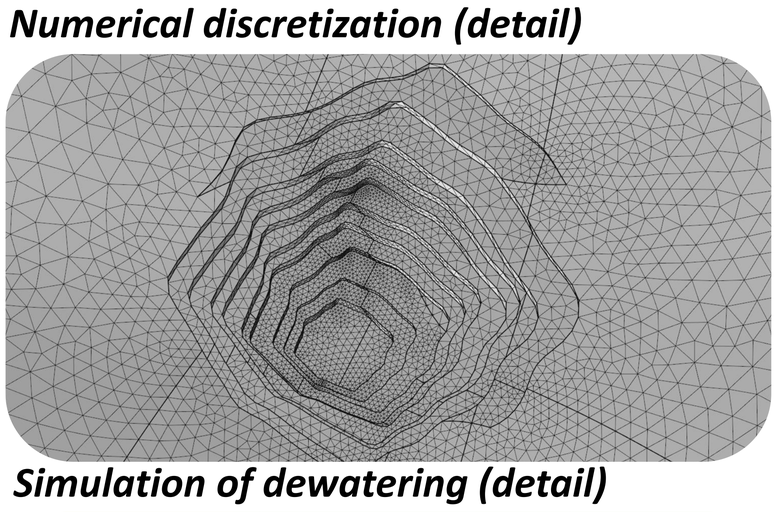
Parameterization (detail)



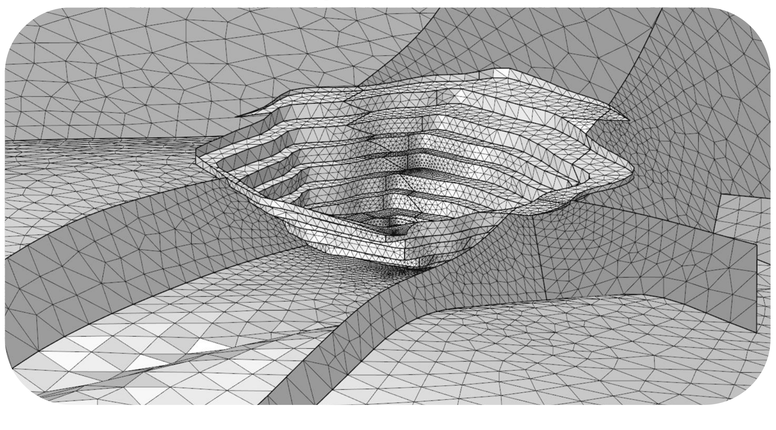
Numerical discretization (FE mesh)



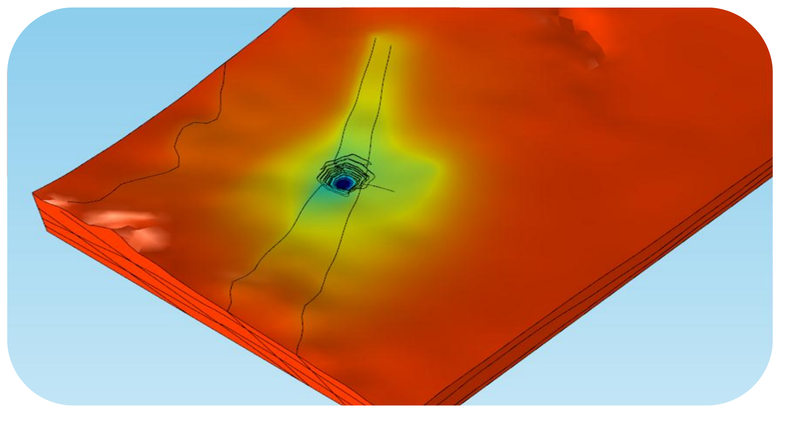
Numerical discretization (detail)



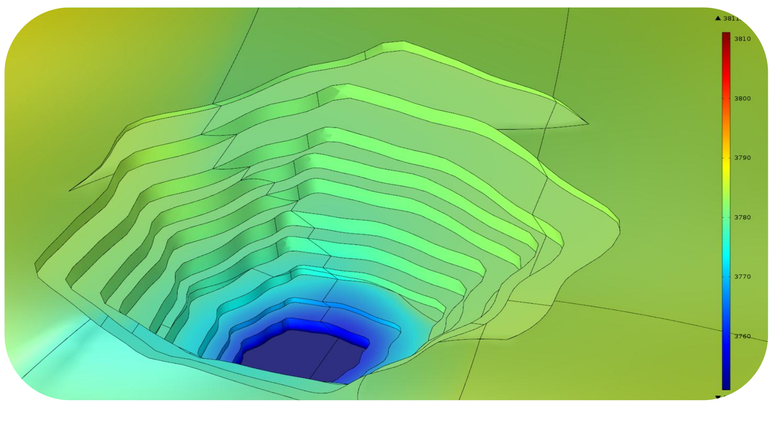
Accurate discrete features



Simulation of dewatering



Simulation of dewatering (detail)



Conclusions

Hydrogeological High Performance Computing (HHPC) can be applied to the mine industry needs, particularly to dewatering activities where large-scale complex simulations are required. Here we show a particular case study were HHPC has been successfully applied to optimize the design of a dewatering system in an open pit mine operation. HHPC allows incorporating accurate geological, structural and hydrogeological information into the models, ensuring realistic simulations and reliable results.

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