Groundwater Modeling As an Assessment Tool for Underground Mines Located in Fractured Massifs

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Abstract

Introduction
Some of the present metallic ores mines located in Peru have been emplaced following the general geological lineament that divide the Atlantic (Amazonian)-Pacific watersheds. The geological medium of these areas is formed by a heterogeneous fractured massif where groundwater flows preferentially through fractures. Underground mining in these zones can cause impacts in streams, lakes and change the natural water balance of the watersheds, leading to conflicts between traditional uses of water and the mining activity. Quantification of these impacts is crucial for the sustainability of the operation. Numerical models not only can be useful tools for the evaluation of these impacts but also for the assessment of the correct design and emplacement of the tunnels, mines and constructive components. Furthermore, their capacity for quantifying groundwater inflow/outflow rates in tunnels could provide valuable information for mining engineers.

Use of COMSOL Multiphysics®
In this work we develop a 3D integrated hydrogeological numerical model of a mining construction and operation in a fractured media using the COMSOL Multiphysics® software. Concerning modelling of fractured rocks, here we propose a hybrid (mixed) model which combines major discrete fractures embedded in an equivalent low permeability porous media. Main fractures, tunnels and mines have been introduced at their real depth and position in a realistic geological model. Furthermore, the scheduled advance of tunnelling and mining works has been considered.

The obtained model can reproduce the transient state of groundwater flows during 40 years of constructing, operation and mine closure. Tunnel inflow can be predicted and the flow variation due to the main fractures can be observed. Lake and surface water flow variations caused by the mining is also forecasted at any simulation time.

Figures used in the abstract

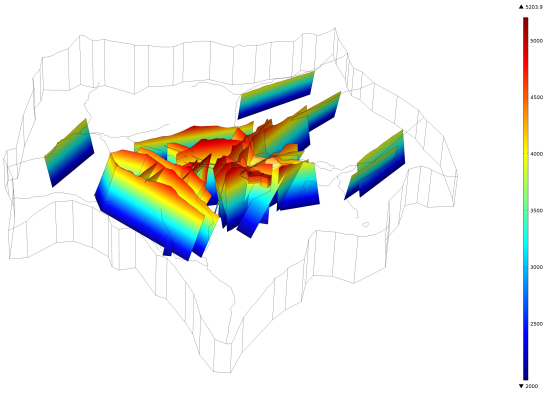

Figure 1: Discrete fracture network used colored by height (m)

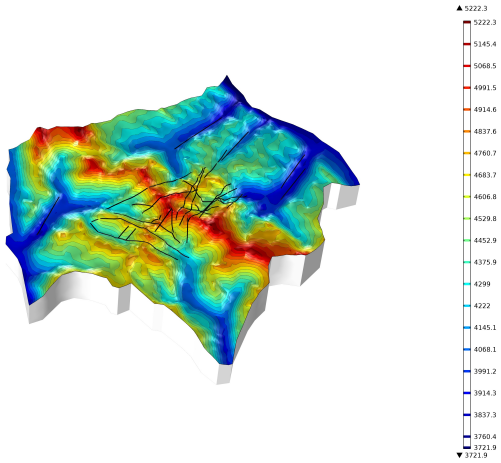

Figure 2: Realistic geometry used incorporates rivers, lakes and discrete fractures

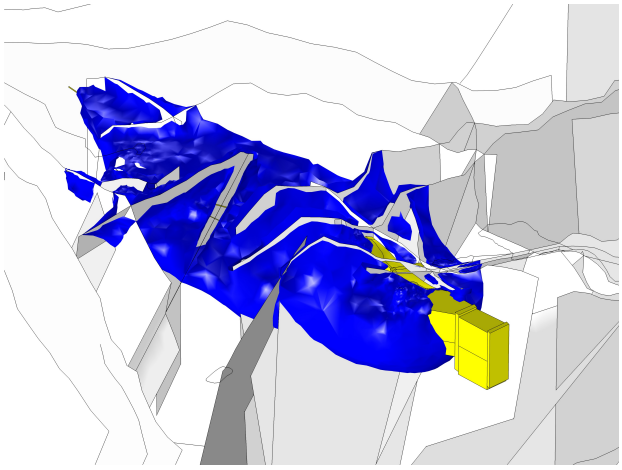

Figure 3: Water level isodrawdowns produced by mining exploration