SIRIMA

SINKHOLE HAZARD AND RISK MANAGEMENT IN POST MINING AREAS

RFCS PROJECT NO 101157400

Co-funded by the European Union

Numerical Model

WP.3. Mine flooding impact on surface instability

Task 3.1. Verification and optimization of the process of flooding mine workings over time

Responsible Partner: IMG – PAN, Poland

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1. Introduction

This report presents the achievement of the milestone related to the development of a numerical model for assessing mining-induced ground response within the SIRIMA project. The objective was to establish a fully coupled hydro-mechanical framework capable of simulating the interaction between mining activities, groundwater conditions and ground deformation in post-mining areas.

2. Development of the Numerical Model

A numerical model representing the geological profile, mining conditions and groundwater system was developed using a fully coupled Stress–Seepage analysis. The simulations included three stages: the initial stress state, mine dewatering during mining operations, and groundwater recovery after pumping ceased, enabling realistic simulation of transient hydro-mechanical processes.

3. Evaluation of Ground Response

The simulations showed that mine dewatering causes significant groundwater lowering and the formation of an extensive settlement trough, whereas groundwater recovery results in gradual surface uplift. The analyses demonstrated that the deformation trough associated with groundwater withdrawal and subsequent recovery is considerably larger than that induced directly by underground mining. Its radius extends approximately four to five times the mining depth, indicating that hydrogeological processes may affect a much larger area than the mining excavation itself.

4. Summary of Main Achievements

The completed work resulted in a fully coupled numerical framework capable of reproducing the interaction between mining activities, groundwater changes and ground deformation. The study confirmed that mine dewatering and subsequent flooding can generate large-scale surface displacements extending far beyond the mined area. Future work will focus on increasing the geological complexity of the model by incorporating additional geological layers with hydraulic conductivity assigned according to rock mass quality and fracturing, providing a more realistic representation of groundwater flow and mining-induced ground response.