New cave mining method for mining at great depths

T. Ladinig[1], H. Wagner[2], M. Koivisto[3] and M. Wimmer[4]

1. Research Assistant, Montanuniversitaet Leoben, Leoben, Austria, 8700. Email: tobias.ladinig@unileoben.ac.at
2. Professor, Montanuniversitaet Leoben, Leoben, Austria, 8700. Email: horst.wagner@unileoben.ac.at
3. Research Engineer, LKAB, Kiruna, Sweden, 98186. Email: mikko.koivisto@lkab.com
4. Manager Mining Technology, LKAB, Kiruna, Sweden, 98186. Email: matthias.wimmer@lkab.com

ABSTRACT

Block and sublevel caving progress to greater depths associated with increasing rock mechanical and operational issues. In order to address these issues a new cave mining method was developed. A pre-study was conducted at LKABs Kiruna mine and the suitability of the new cave mining method was investigated by means of theoretical considerations, numerical simulations, field observations and mining experience. The design concept is based on de-stressing the rock mass so that vital mining infrastructure such as stope development, rock passes or footwall development can be protected from high stresses. Protective pillars are used to control stresses and seismicity. These pillars are removed in the course of subsequent stoping activities. The paper discusses the general concept and outlines considerations related to rock mechanics. Well-established design criteria and design methodologies were used to evaluate the potential of the method. A calibration of the applied design criteria based on current mining experience is the background for discussing the suitability in the prevailing rock mass condition and comparing the method with the currently applied sublevel caving in Kiruna mine. It was found that the proposed cave mining method is applicable from a rock mechanics perspective up to depths of 2000 m in Kiruna. Results indicate that the method would principally be applicable for depths even exceeding 2000 m. In comparison to currently applied sublevel caving the proposed method offers significant improvements in the overall rock mechanical situation. These improvements comprise stability of infrastructure as well as encountered seismicity. Besides rock mechanics, the paper outlines effects on productivity, potential for automation and safety. Based on the promising results of the pre-study, an extensive, joint research program was launched with the objective to develop the new cave mining method further.