Evaluation of in-stope pillar failure: A case study of deep to ultra-deep level gold mining in South Africa

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Abstract

In-stope pillars are a common natural support system employed in order to maintain ground stability in underground excavations. The design of an appropriate in-stope pillar size is becoming a customary problem faced by mechanized deep to ultra-deep level mines in the Witwatersrand basin of South Africa. Several in-stope pillar sizes have been employed in deep to ultra deep level gold mining in a bid to investigate the most appropriate in-stope pillar sizes for excavations stability. Despite advances in in-stope pillar design studies, in-stope pillar failure continues to take place. The failure poses threats to the health and safety of mine personnel as they execute their daily duties. In addition, in-stope pillar failure significantly affect mining operations as mining is halted immediately when the failure occurs. This study aims to evaluate the causes of in-stope pillar failure as well as to improve the design of in stope pillars in deep to ultra-deep gold mines in South Africa. The study makes use of data from six sections of the mine where in-stope pillars have been implemented and several problems associated with in-stope pillar failure have been experienced. The results of the study indicated that in-stope pillar scaling and fracturing is influenced by high vertical stress acting on the in-stope pillar. Further analysis indicated that ground closure along the destress cuts is influenced by the extensive extraction of secondary stopes. Numerical modeling indicated stress ahead of the mining faces and at the vicinity of the in-stope pillars.