

# Recovery of the Northern Mining Block at Cliffs Nickel Mine

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## Abstract

*The Cliffs Nickel Mine extracts a narrow near vertical nickel vein using a mining method of underhand bench stoping with paste backfill. In 2014, at a depth of 400 m below surface, the Northern block of the mine began to experience squeezing within ore development. At first the deformation was localised, within 30 m of the stoping front, but later became pervasive extending across the Northern block and resulting in a hiatus in mine production.*

*The global mechanism is considered a cascading pillar failure, where the interconnecting stability pillars could no longer withstand the induced load and progressively yielded. The local mechanism of failure was observed as crushing of the massive sulphide ore and ‘punching’ of the pillars into the ultramafic hangingwall exhibited as floor and sidewall dilation and unravelling of the mafic footwall. The cause of the global mechanism was attributed to a combination of factors, including: high overall extraction ratio, small vertical pillar heights between ore development, high stress in relation to the low rock mass strength, shallow stope front angle, and insufficient ground support capacity. Following the progressive failure, the remnant rock mass conditions across the northern block were severely degraded, with numerous falls of ground that led to a reassessment of the mine plan.*

*Recovery of the Northern block started in 2016 as a staged process. Development of the recovery work methodology involved a number of considerations, such as: production sequencing, development access design, ground support, and development of specific procedural controls. The Northern block was then broken into smaller mining precincts based on tactical factors such as location, ease of access, scale of rock mass damage and nickel content. A specific ground support standard and work methodology are employed, while cycle sheets are used to ensure quality and completeness of work. Large intersections showing signs of deformation have either been bypassed or treated using Rocprops to maintain stability during stope production.*

*This approach has been successful in safely regaining access and restarting production in areas that had previously been removed from the mining reserve.*

**Keywords:** *Squeezing ground, rehabilitation*