Production Blast-Induced Vibrations in Longhole Open Stoping: A Case Study

John Henning, Goldcorp Inc., Canada
Hani Mitri, McGill University, Canada

ABSTRACT

This paper examines stope design approaches employed at a metal mining operation in Canada for extraction of transverse primary, transverse secondary, and longitudinal stopes. Variations in stope and slot design, blast design, and blast vibration attenuation are presented in detail. It is shown that the type of blasthole stoping technique employed varies according to stope sequence and ore zone width. Within this range of stopes, blasting design practices have been standardized in terms of drillhole diameter, powder factor, and the type and pattern of the explosives used.

Keywords: Blasting Design Practices, Explosives, Metal Mining, Stope Design Approaches, Stopes

1. DESCRIPTION OF OREBODY

The case study ore deposit is a lens of massive sulphide and associated disseminated breccia and stringer sulphides, located in the Abitibi region of the province of Quebec, Canada. The orebody is hosted within a series of volcanic rocks, primarily schists of varying quality. The main massive pyrite lens extends from 180 m below the surface and is open at depth.

The mine property is situated in the Abitibi Greenstone Belt in the Superior Province of the Canadian Shield. The orebody follows an east-west regional structural trend, dipping steeply south in a tabular form, and is accessed by a shaft, driven to a depth of 1250 m on the footwall side of the orebody. Shaft stations located at 120 m intervals access the main levels of the mine. Rock mass conditions are controlled extensively by the geology, with the dominant schistose fabric controlling the behaviour of wall rocks in all underground excavations. The host rock is strongly schistose, quartz-mica schist.

The schistocity contains sericite and acts as a dominant low friction angle weakness plane in the rock mass. These weakness planes form platy blocks up to 50 mm in thickness. The lenticular shaped massive pyrite orebody, with

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thickness up to 20 m has lateral and vertical dimensions of 300 m and 1500 m respectively.

2. MINING METHOD

The case study describes a trackless bulk-mining operation, with production levels connected by an internal ramp. Production from below the 1200 m level is hauled by a 40-ton capacity truck up from the 1380 m level, to be dumped in ore and waste bins located on the 1230 m level. The mined rock is crushed to minus 150 mm and then hoisted to the surface in skips. Production rates are approximately 1800 tonnes per day. An internal ramp connects the main production levels with three sublevels which are developed at 30 m intervals between the main levels. Footwall haulage drifts, running parallel to the orebody, with 50 m long draw-point cross cuts provide direct access for removing the ore bearing rock from the stopes. The open stope mining with delayed backfill method is used at the mine to take advantage of steeply dipping tabular orebody geometry, and to optimize production rates and recovery. Primary stopes are mined one lift at a time and backfilled with cemented rockfill. Secondary stopes, mined between two primary stopes as indicated in Figure 1, are filled with non-cemented rockfill.

3. STOPE DESIGN

In ore widths exceeding 4 m, stopes are mined transversely. The main ore zone is divided into a grid of 15 m wide stopes with sublevels located at 30 m vertical intervals. Stope widths are up to 20 m. When mined, primary stope strike lengths are 15 to 17 m, strike lengths for secondary stopes are 13 to 15 m. Stope production sizes are typically 10,000 to 15,000 tonnes. At the lateral fringes of the ore zone, where the ore width is less than 4 m, stopes are mined longitudinally. Strike lengths range from 10 to 15 m, depending on the rock mass quality. Stope sizes range from 4,000 to 6,000 tonnes.

3.1 Primary Transverse Stopes

In the transverse open stope mining method, an expansion slot is developed by enlarging a 1.07 or 1.30 m diameter slot raise to the width of the stope, using parallel hole blasting. Ore is fragmented in the stope using long parallel (primary stopes) or ring-drilled (secondary stopes), and mucked from a drift, orientated perpendicular to the stope strike, at the base of the stope. Stope production drilling is performed by Tamrock Data Solo drills. The top sill of the primary transverse stopes are excavated to the full stope strike length to permit drilling of...
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