Reducing mining tailings and operational dilution: a new application of the room-and-pillar mining method

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Dates:
Received: 28 Jul. 2021
Revised: 18 Feb. 2022
Accepted: 21 Feb. 2024
Published: August 2024

How to cite:
Rodovalho, E., El Hajj, T.M., Teodoro, G.C., de Tomi, G., and Tenório, J.A.S. 2024. Reducing mining tailings and operational dilution: a new application of the room-and-pillar mining method. *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 124, no. 8. pp. 483–490

DOI ID:
http://dx.doi.org/10.17159/2411-9717/1696/2024

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Abstract

The selection of an underground mining method stems from a multivariate analysis that considers geomechanical, geological, economic, and operational parameters. Even after identifying the most compatible method, there is no assurance that the mining company will achieve the best performance. The geological complexity of some deposits requires adaptations of methods described in the literature to obtain more selectivity and reduce mining waste. There are some studies on geometry of underground structures, but a methodology that describes an adaptation of a room-and-pillar mining method for ore bodies with down-dip varying from 20° to 25° is novel. The present work aimed to reduce dilution by adapting the traditional room-and-pillar mining method (TRP) to inclined ore bodies. This new method is entitled short-hole room-and-pillar (SHRP). The equations that measure the dilution are defined according to the geometry of stopes and openings. The results comprise comparative analyses of the operational and planned dilutions to measure the performance of the SHRP method. The average operating dilution of the SHRP method was more than five times lower than the planned dilution according to the TRP method. Low operational dilution indicates high selectivity of the method and its potential to reduce underground mining tailings.

Keywords

dilution; underground mining; short-hole room-and-pillar; mining tailings

Introduction

The main reason for evaluating new underground mining projects is the market value of the mineral or products obtained from these operations. Only minerals or materials with high value can make this kind of industrial structure viable, because these are mined together with waste to create a sufficiently high stoping height. Gold mineralizations are examples, but their geometry, shape, and ore grade distribution are diversified. In addition, host rocks have a great diversity of geomechanical, geological, and structural conditions. Based on this information, the adjustment of a certain mining method seeks to maximize the productivity and safety of operations and openings (Emad et al., 2014; Iphar and Alpay, 2018). In both works, the authors discuss the state-of-the-art of underground mining methods to propose a design capable of increasing operational efficiency and safety. In addition to these objectives, it is necessary to reduce losses and waste generation through a multivariate analysis that identifies a mining method or customizes an existing one. According to Costa et al. (2017), many of the world's leading underground mines operate more than one mining method at the same mine. This reality places the customization and development of new mining methods as a fundamental practice to achieve higher levels of economic, operational, and environmental efficiency in mining. Furthermore, it is possible to generate an index of sustainable development of mining activities by analyzing these factors (Amirshenava and Osanloo, 2019). This practice is strongly recommended in order to promote responsible mining and cleaner production.

It is important to emphasize that the aim of the modification or combination of classical mining methods, first and foremost, is ensuring the stability of underground excavations. Suitable conditions for safety allow more effective control of economic, operational, and environmental parameters. According to Ghasemi and Shahriar (2012), the design of supporting pillars is the most critical geometric aspect of the room-and-pillar method. These authors developed an experimental application of a coal mine where a direct relationship between the pillar design and an increase of recovery was identified. The authors also indicated that the increase in recovery can generate a reduction in the dilution. In this same context, Mark (2016) used empirical techniques applied to rock mechanics that represent another viable alternative for the design of pillars. The authors present a practical and innovative methodology to measure the quality of rock mass. In addition, Zhu et al. (2018) associated the geometry of the pillars with safety of the operations; however, the methodology is based on the analysis of pillar failure applied only to flat and tabular ore bodies. It is well known that excavation stability and safety of operations are fundamental aspects in the application, modification, or combination of underground mining methods. This scenario motivates the application of different geometric simulation methods for underground structures. Even results obtained from small-scale tests are meaningful to guide future actions. As an example, Zhang et al. (2018) developed a laboratory simulation method to increase ore recovery. Following this practice, the present work also relies on geometric simulations to evaluate the compatibility of a stope's geometry with the mining equipment employed.

Considering current active mines, stability remains a major challenge for the mining industry. Heidarzadeh et al. (2018) stated that stress-induced failure is among the main causes of underground mine stoppages in Canada. The authors emphasize that the main variable capable of controlling the instability effects is the geometry of the openings. Dilution is an aspect among the main reasons for closing underground mines around the world. Jang et al. (2015) stated that high dilution is the main cause of mine closures and that the combination of different mathematical modeling methods can control this variable.

As dilution is strongly related to waste generation in mining, it is important to highlight some important points. An et al. (2018) stated that operations in veins and narrow ore bodies usually present high rates of overbreak and underbreak. The present research is applied to narrow ore bodies where the geometry of the openings is directly related to dilution. Additionally, the authors propose a method capable of reducing these losses and waste, generated by modifying variables related to the geometry of the openings. Recently, other studies have also presented methods capable of reducing losses and mining waste generation, such as ore losses (Jang et al., 2015; Rodovalho and Cabral, 2014). The application of these techniques is even more important with mine aging, because these operations tend to generate more waste and tailings (Lagos et al., 2018). Even in small-scale operations, reduction of waste generation is a necessity. Seccatore et al. (2014) described adaptations of more efficient industrial techniques for small-scale underground mining. Regarding small-scale gold mines, waste management is even more deficient due to adopting outdated technologies (Astrand et al., 2018; Seccatore and Theije, 2017).

There are several case studies and methods capable of reducing dilution, but there is little availability of a geometry or operational arrangement for the room-and-pillar mining method applied to ore bodies with 20° to 25° of dip. Oosthuizen (2005) described a mining method suited to the shape of these ore bodies, known as the T-cut mining method. The author showed relevant achievements after comparative analysis carried out in a South African platinum mine. Traditionally, this method is applied to horizontal or sub-horizontal bodies. The present work sought to adapt the room-and-pillar mining method for gold ore bodies with dip varying from 20° to 25°, aiming to reduce the operational dilution. To illustrate the application of the method, a gold mine located in Brazil was used as the experimental application. The mining method, called short-hole room-and-pillar (SHRP), is developed through simulation and geometric analysis. This is an unprecedented application in underground mining in Brazil. The main result of this development is the reduction of the operational dilution in relation to the planned dilution. In the experimental application, it is possible to identify operational dilutions up to 20% of the planned dilution, indicating a high reduction of dilution generated by the mining operations. Operational dilution represents the greatest challenge in the development of underground mining projects. Control of this variable represents a greater capacity for reduction of residues of mining, because a smaller volume of gangue minerals will be sent to minerals processing. This reduces the demand for new tailing dams, increases the operational efficiency of the project, and improves environmental performance.

Methodology

The methodology of the present work begins with evaluation of the development structures and typical accesses of an underground mine. These data are the result of geometric simulation, based on a geological and geomechanical model using mine design software. However, it is necessary that these excavations are compatible with the mineralization to be evaluated in the experimental application. The research scope is to evaluate the selectivity: the operational variable related to this factor is the dilution. This was practically evaluated in a gold mine in Brazil. The main alternatives for calculating the dilution are discussed and selected for application to the experimental site as a part of the strategic mine plan. Figure 1 presents a flowchart that summarizes the methodology applied during this work.

Proposed mining layout

The SHRP mining method, applied by the studied mine, has a height limitation of 2.4 m. The cycle of operations starts with drilling by fan drill. After blasting, the material is removed by low-profile loaders and hauled by low-profile trucks that climb up the main ramp to the crusher. The height of all equipment cannot exceed 2.4 m. The most important access excavation to mining panels is the main ramp. This structure allows access to the main drift through haulage crosscuts. Figure 2 shows the layout of these structures applied to stope development. The main drifts are represented in red: they are always horizontal and follow the strike of the ore body. Along the main drift, there are accesses to the secondary ramps that represent the connection with rooms and short-hole stopes. The spans are highlighted in Figure 2. Figure 3 shows details of the rooms and short-hole stopes through a vertical section. In this layout, it is possible to identify the positions of the mining panels in relation to the development structures and pillars.

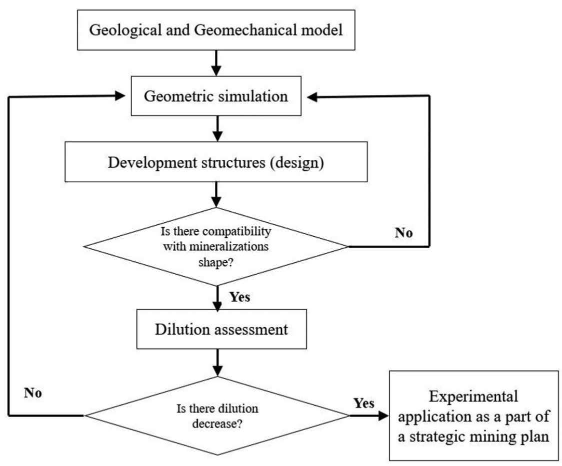

Figure 1—Methodological summary detailing the sequence of activities aimed to reduce dilution

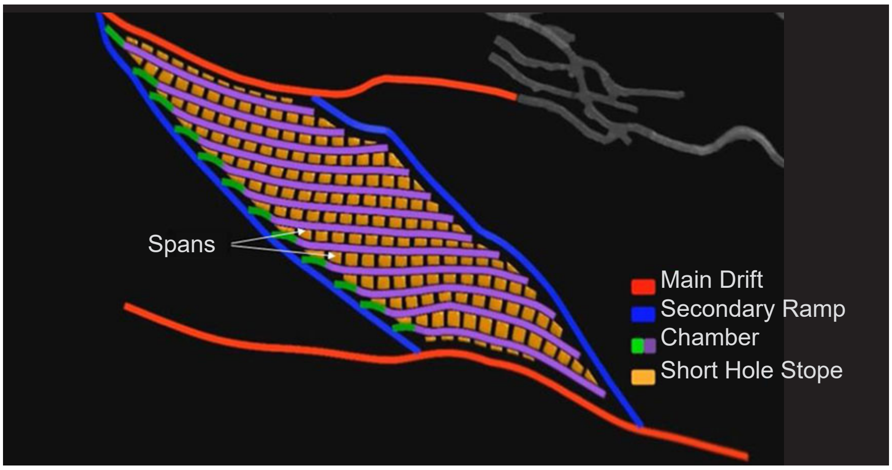

Figure 2—Sketch of stope development during room-and-pillar mining (plan view)

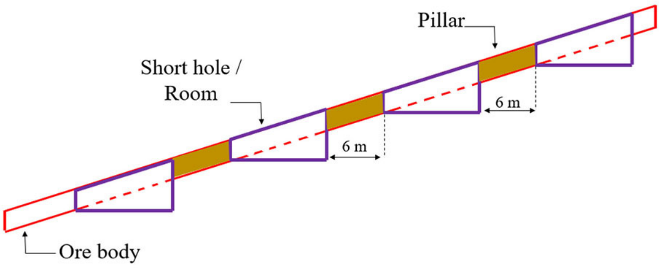

Figure 3—Vertical section indicating positions of support structures and development structures (rooms and short holes)

All short-hole stopes have pillars between them, represented by spaces in Figure 2. After the mining stope, there is no circulation through these openings as a link between one room and another. The method relies on the barrier pillars to strengthen the support of the openings in the mining and development areas. Figure 4 highlights these structures that are provided along the secondary ramps and main drifts. The initial stages of mining are indicated in orange, where the lower rooms are located. Development starts with the lowest elevation rooms and proceeds upwards.

The advance system of the SHRP method is based on retreating from lower rooms up to the higher rooms. The geometry shown in Figure 4 is a plan view, where the stopes of the lower part of the figure are at a lower elevation. Following this premise, the orange stopes represent the initial phase of mining and then the operations advance to the upper stopes. As the ore body presents down-dip ranging from 20° to 25°, it is not possible to use the traditional room-and-pillar mining method (TRP) where the openings follow the design floor-to-floor and roof-to-roof. For ore bodies with this inclination, only the concept of short-hole and long-hole openings remains. This denomination is applied in the traditional method and is associated with the length of the drilling column, which varies from 1 to 1.3 m. These dimensions are typical features of narrow vein mineralizations and make the method highly selective. Van Dorssen (2002) provided a description of the development of a long-hole stoping system suitable for narrow platinum reefs and discussed the difficulty of mechanized mining operations to this ore body geometry.

Figure 5 presents the results and dimensions of the geometric analysis for typical sections of short-hole and long-hole bords. The main procedure of this analysis is the computational simulation

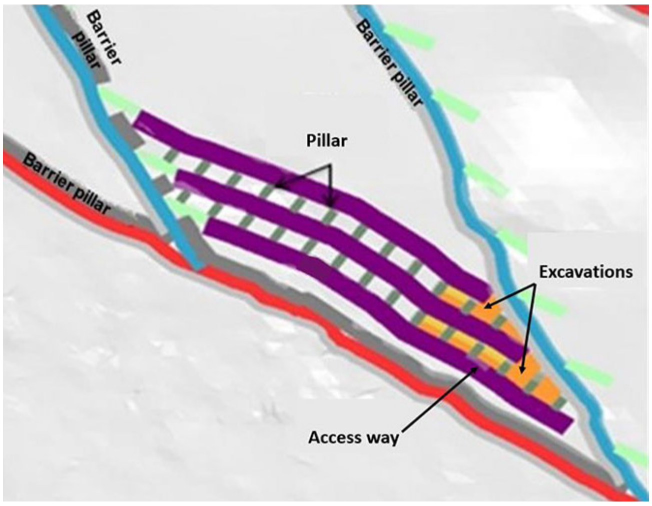

Figure 4—Positions of main support structures and initial stages of development (plan view)

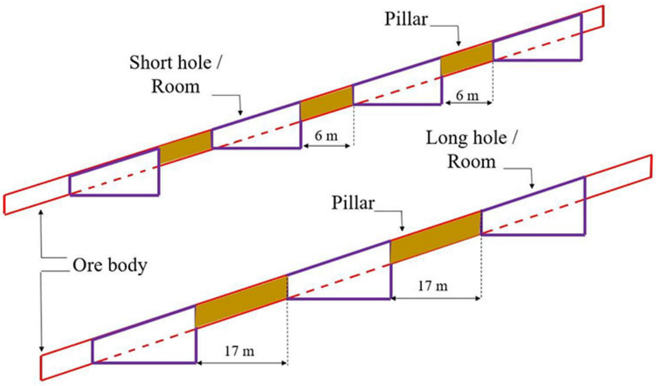

Figure 5—Comparison of designs of long-hole and short-hole rooms

that considers the equipment dimensions, geotechnical variables, and ore body geometry in order to minimize dilution. Most of the mineralized body has down-dip up to 23°, which implies application of the SHRP method. With the aim of increasing the selectivity, several geometric configurations were tested using computational tools for mine design. The distance between rooms that most favoured selectivity was 6 m, as shown in Figure 4. Considering that the horizontal width of the pillars follows the standard of 3 m, according to geomechanical constraints, the total area of the pillar is 18 m². Each short hole has a maximum length of 8 m, limiting an area of only 48 m² of blasting to be executed on the ore body. The efficiency evaluation of the mining method proposed in this work is made based on short-hole openings due to their predominance in the studied mine. Considering a given room, the roof and floor do not correspond with the roof and floor of the adjacent room. The brow between the short- and long-hole excavations was 8 m. After blasting, the brow is removed by low-profile dozers. This is the main difference between the SHRP and TRP methods, as shown in Figure 5. If the TRP method was adopted in the studied mine, the design of a room considers the same roof and floor of the adjacent room. This conceptual divergence implies different dilution indices that are evaluated in this study.

At some spots in the studied ore body, the dip is greater than 23°. In these places, long-hole geometry is more adequate and the distances between the mining galleries are up to 17 m, according to Figure 5. In this case, the horizontal spacing of the long hole is 8 m, where the sections of the pillars are 3 m × 17 m. Considering these dimensions, the openings have an area of 132 m², which indicates the need to install rock bolts to support the roof. This stabilization is an important aspect as it reduces the possibility of dilution with material coming from the roof. After waste removal, the ore is blasted and removed by low-profile loader.

Dilution

The main variables to evaluate the efficiency of a mining method are the dilution and loss of ore. Considering underground mining following the SHRP method, the ore loss is denominated as underbreak and dilution as overbreak. Jang et al. (2015) stated that overbreak measures the contamination of ore with host rocks. The principle of this measure is the relationship between the mass of waste that contaminates the ore during development. Figure 6 shows a cross-section between two rooms following the TRP method to illustrate the concept of dilution. Considering the shape of the ore body, the limit of the planned geometry will be defined. However, during development, deviations may occur in relation to the mining plan. The main causes are instability, geomechanical factors, rock mass characteristics, or operational deviations. The presence of these factors defines the operational geometry.

Considering that the scope of the present work includes evaluation of the SHRP method compared with the TRP method, the dilution evaluation is a key step to measure differences between the methods. For this, the planned dilution was calculated following the TRP method parameters, as shown in Figure 6. As the studied mine applied the SHRP method, the operational geometry was compared with the short-hole geometry that allows calculation of the operational dilution. Equation [1] measures the planned dilution

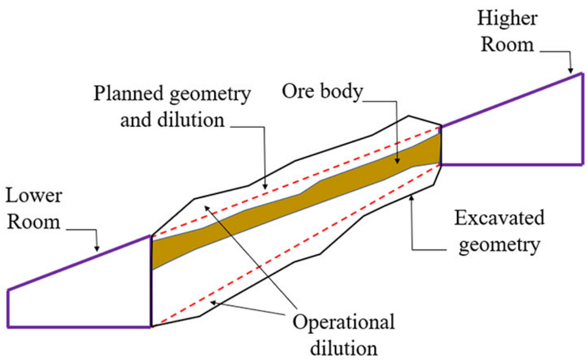

Figure 6—Cross-section of a mining plan according to the traditional room-and-pillar method, detailing the planned and operational dilution

(*PD*), while Equation [2] measures the operational dilution (*OD*). The *PD* parameter is calculated according to the geometry described in Figure 6, following the TRP method. The variables used in the equations are described in Table I, which also informs the units of measurement. The product $PV \times \gamma_{mat}$ represents the planned production (PP) according to the opening dimensions in the SHRP method described in Figure 4.

$$PD = \frac{Waste\ mass}{Ore\ mass} \quad [1]$$

$$OD = \frac{RP - (PV * \gamma_{mat})}{PV * \gamma_{mat}} \quad [2]$$

Experimental application

The methodology was created and applied at a Brazilian gold mine. The studied mine is dedicated to underground mining of narrow bodies with a mean thickness of 1.8 m and down-dip ranging between 20° and 25°. The application of the SHRP method is unprecedented in Brazil and the method to evaluate performance based on the TRP method is a meaningful discussion. The most relevant operational difference between the methods is the free access between rooms in the TRP method. In contrast, the SHRP method does not have this type of access. The procedure selected to evaluate the efficiency of the SHRP method is the comparative analysis of dilution indicators.

Selection of mining areas

Figure 7 represents a plan view of the rooms and pillars of the mine. The figure shows the secondary ramp RS604, one of three secondary ramps selected for the study, especially rooms C5, C6, C7, and C14. The areas bordered in purple represent the short holes selected for study in this area. The area that separates them laterally represents the pillars that support the roof of the mine. In addition, the traffic of equipment in one room is isolated from the other rooms. The present study considered a total of 12 rooms that comprised 105 short holes.

Regarding drilling and blasting operations, it is important to highlight some aspects. As shown in Figure 7, each short hole has a length ranging from 2 to 8 m. Considering that drilling equipment has drill rods of 3.2 m in length, short holes with higher lengths require additional drilling in the adjacent room. After drilling, blasting is performed on both sides. This is standard procedure; however, there may be variations that require specific blasting projects that are not addressed in the present study.

Table I
List of variables applied to the dilution calculation

Variable	Description	Unit
Ore mass	Planned ore mass	t
Waste mass	Planned waste mass	t
RP	Real production of short hole	t
PV	Planned volume is the multiplication of height, width, and advance (SHRP method)	m³
γ_{mat}	Material density	t/m³

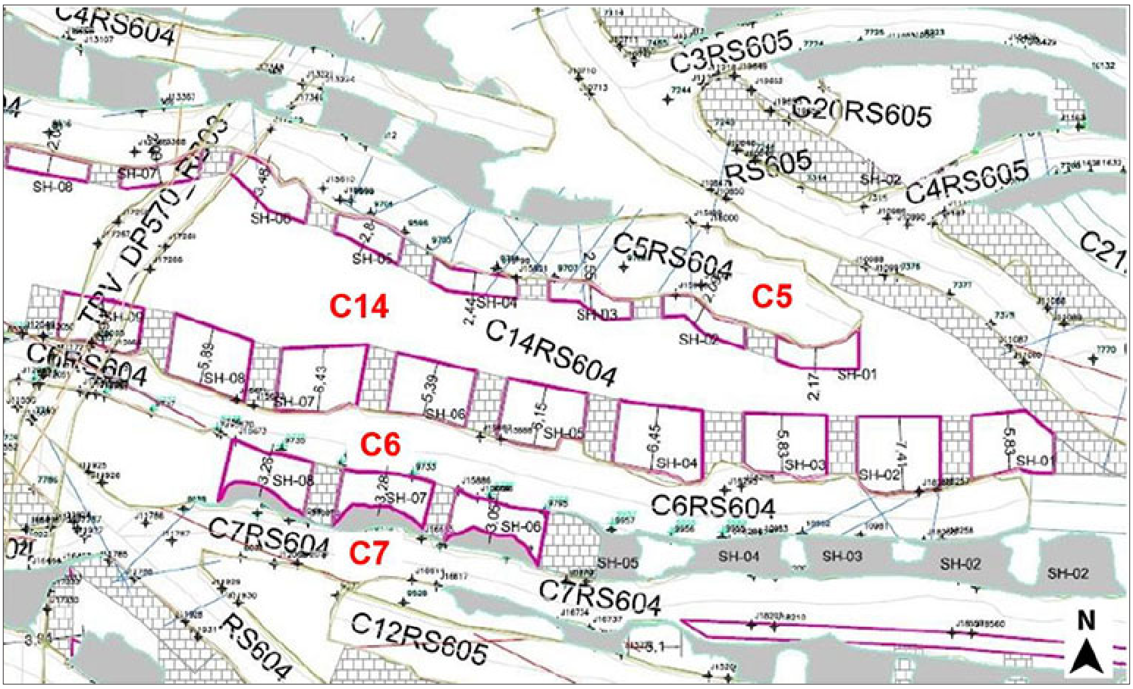

Figure 7—Plan view of some rooms connected to secondary ramp RS604 that were selected for comparative analysis

Equipment selection

The equipment selected to perform the mining operations was the same for both SHRP and TRP. The equipment used to provide safe conditions into the openings were the scaling machine and rock-bolting rigs. Scaling is the operation of knocking loose rocks off the back. The studied mine uses scaling machines to take loose rocks off the back before any other operations, to avoid unsafe conditions. Roof bolting is the operation devoted to stabilizing the back and walls by installing rock bolts and cable bolts. The equipment selected for roof bolting was a rock-bolting rig, which was applied to installation of both cable bolts and rock bolts.

After the stabilization and safety operations, the mining operations comprised drilling, blasting, loading, and haulage start. The studied mine adopts low-profile face-drilling rigs for drilling operations. This equipment fits well in current opening dimensions and provides good operating conditions. A low-profile loader was selected for loading operations due to the reduced opening dimensions, considering the minimum stoping height of 2.4 m. Haulage was performed by low-profile dump trucks that hauled the materials to the destination.

Results and Discussion

The comparative analysis between PD and OD indicators for each selected short hole represents the main parameter of comparison between the SHRP and TRP methods. These indicators are defined by Equations [1] and [2], respectively. The results for the rooms of secondary ramp RS604, according to Equations [1] and [2], are available in Figure 8. After analyzing the PD and OD results, only one (SH C04) of the 28 short holes evaluated obtained an operational dilution higher than the planned dilution: the other 27 stopes indicated that the operational dilution following the SHRP method was lower than the planned dilution that followed the TRP methodology. These results indicate that the SHRP methodology allows more selective mining, where the ore is mined with lower levels of waste contamination. Minor ore contamination implies lower generation of tailings in minerals processing.

Figure 9 shows the mean PD and OD values for all three secondary accesses evaluated in the present study. These results also indicate significant reduction of the dilution for the other secondary accesses after adoption of the SHRP method. Another important aspect for evaluation is the position of the short hole according to the elevation. As the ore body has a down-dip of up to 25°, the mining direction of some short holes is upwards or downwards in the same room. Both configurations can be comparatively evaluated between the SHRP and TRP methods. Figure 10 shows the results of OD and PD for upward and downward short holes. As in other comparisons, the SHRP method had the lowest dilution in any mining direction.

The evaluation of mining geometries in the mining industry is often performed with the use of computer graphic design tools. Some mining methods allow optimization techniques and mathematical modelling to be applied in order to define, among several possible alternatives, the most suitable mining geometry. This assumption is not valid for the present study due to the operational characteristics of the studied method.

The analysis of mining geometries is a summary of the fit between the dimensions of the openings and the ore body shape. The dimensions of the openings are minimal and compatible with mining equipment. Therefore, the methodology of the present work was based on adjusting the openings with the help of computational tools of graphic design. In addition, the dilution calculation considered classical concepts widely published in literature. Currently, some bibliographical references describe dilution calculation methods that are more accurate and adapted to the geometry of the mineralized body. Vokhmin et al. (2017) described a method that considers irregular contact zones. These authors developed equations where the dilution is calculated considering the irregularity of the geological contacts. Considering that the experimental application refers to gold mineralization of narrow

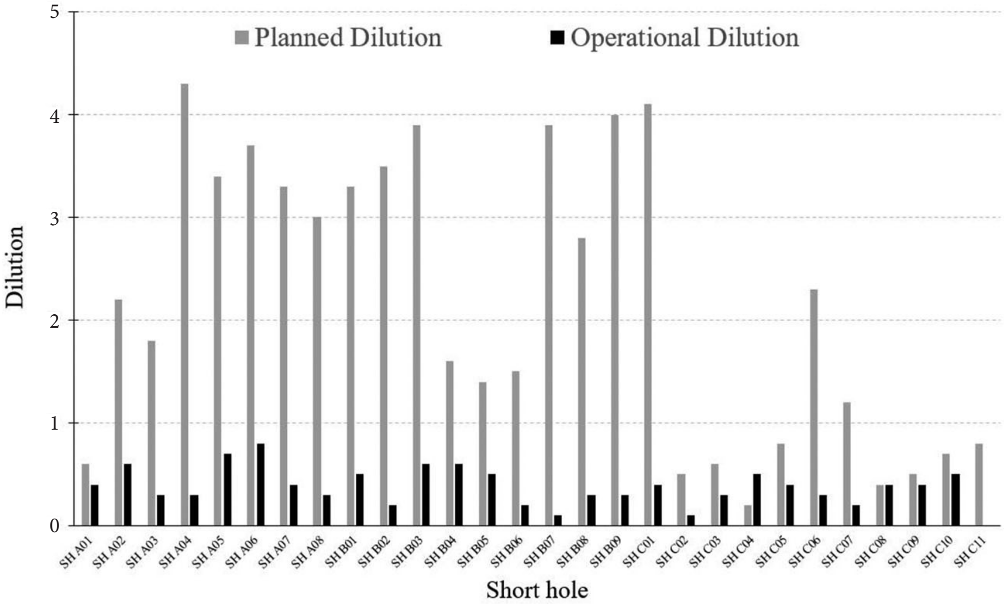

Figure 8—Planned and operational dilution for all short holes of secondary ramp RS604

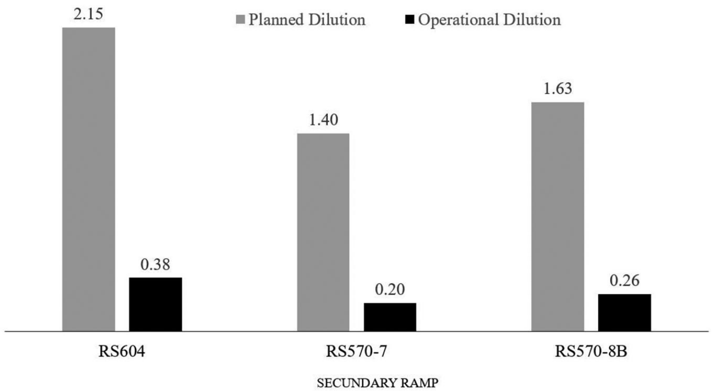

Figure 9 —Comparative analysis: dilution rate stratified by all three secondary ramps

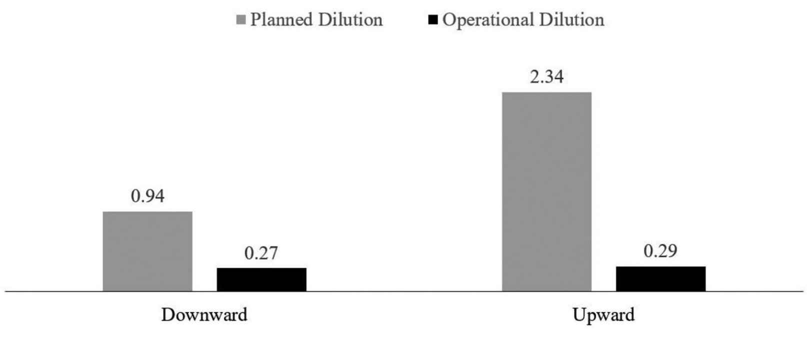

Figure 10—Analysis of dilution rate regarding the mining direction for all secondary ramps

veins with microstructures, it is possible to identify more precise dilution values. However, the algorithm developed by Vokhmin et al. (2017) is not yet available on an industrial scale and was not applied in the present study.

Conclusions

The mining industry, especially underground operations, are under severe pressure from society to reduce waste and environmental impacts. Other industrial segments have already implemented reduced waste and environmental impacts in their value chains, applying concepts of circular economy and green technologies. However, the mining industry has adapted its operations slowly. In the case of Brazilian mining, the wasteless concept does not yet have widespread application, as traditional methods of mining continue to dominate. The present work describes the first industrial application of the SHRP method in a gold mine in Brazil. Dilution is directly related to the generation of tailings in mining, as it increases the presence of gangue minerals in minerals processing. The application of this methodology in other mines can reduce the demand for new tailing dams. Therefore, the present work describes an important step of the mining industry in the application of wasteless practices.

This study fulfilled the objective of developing a method capable of reducing operational dilution over traditional methods (TRP). The results indicate that the reduction in operational dilution is steady and significant. The mean operating dilution in the 105 short holes evaluated was 5.3 times lower than the planned dilution in the TRP method. The results indicate that this proportion extends to the individual short holes, because more than 96% of the short holes of the secondary ramp RS604 achieved lower operational dilution than planned. When comparing upward and downward mining areas, operating dilution remained significantly lower. Even after shift in direction along the ore body, the operational dilutions of upward and downward mining were 7 times and 2.4 times lower, respectively. These results confirm that the SHRP method is more efficient because it reduces the generation of mining waste and promotes better economic exploitation of the deposit. The SHRP method was successfully implemented. Operation dilution control is the main achievement after SHRP operational implementation.

The results obtained in this research may be significantly improved with further investigations of two aspects. The first is to develop adaptations of other mining methods to reduce losses and waste generation. The second is the implementation of algorithms devoted to the calculation of dilution as applied to narrow bodies. Vokhmin et al. (2017) developed applications for contacts for which the shape approaches a sinusoidal and sawtooth profile. New algorithms can function as a plug-in of mine design software and support the adjustment of mining geometries to narrow bodies with different shapes. Further studies may verify the rock mechanics aspects relating to excavation and pillar stability.

Acknowledgements

The authors would like to thank Brio Gold Inc. for supporting this research. The present work was carried out with the support of CNPq, National Council of Scientific and Technological Development - Brazil (Process number: 155140/2018-3). English editing of this manuscript was carried out by Kathryn C. Sole (PhD).

References

Amirshenava, S., Osanloo, M. 2019. A hybrid semi-quantitative approach for impact assessment of mining activities on sustainable development indexes. *Journal of Cleaner Production*, vol. 218, pp. 823–834. https://doi.org/10.1016/j.jclepro.2019.02.026

An, L., Suorineni, F.T., Xu, S., Li, Y., Wang, Z. 2018. A feasibility study on confinement effect on blasting performance in narrow vein mining through numerical modelling. *International Journal of Rock Mechanics and Mineral Science*, vol. 112, pp. 84–94. https://doi.org/10.1016/j.ijrmms.2018.10.010

Costa, L.V., Silva, J.M., Lima, H.M. 2017. Analysis of options of production and access ways in underground mines. *Revista Escola de Minas*, vol. 70, pp. 237–242. http://dx.doi.org/10.1590/0370-44672015700030

Emad, M.Z., Mitri H., Kelly, C. 2015. State-of-the-art review of backfill practices for sublevel stoping system. *International Journal of Mining, Reclamation and Environment,* vol. 29, pp. 544–556. https://doi.org/10.1080/17480930.2014.889363

Ghasemi, E., and Shahriar, K. 2012. A new coal pillars design method in order to enhance safety of the retreat mining in room and pillar mines. *Safety Science*, vol. 50, pp. 579–585. https://doi.org/10.1016/j.ssci.2011.11.005

Heidarzadeh, S., Saeidi, A., Rouleau, A. 2019. Evaluation of the effect of geometrical parameters on stope probability of failure in the open stoping method using numerical modeling. *International Journal of Mining Science and Technology*, vol. 29, no. 3, pp. 399–408. https://doi.org/10.1016/j.ijmst.2018.05.011

Iphar, M., Alpay, S. 2018. A mobile application based on multi-criteria decision-making methods for underground mining method selection. *International Journal of Mining, Reclamation and Environment*, vol. 32, pp. 1–11. https://doi.org/10.1080/17480930.2018.1467655

Jang, H., Topal, E., Kawamurab, Y. 2015. Decision support system of unplanned dilution and ore-loss in underground stoping operations using a neuro-fuzzy system. *Applied Soft Computing*, vol. 32, pp. 1–12. https://doi.org/10.1016/j.asoc.2015.03.043

Lagos, G., Peters, D., Videla, A., Jara, J.J. 2018. The effect of mine aging on the evolution of environmental footprint indicators in the Chilean copper mining industry 2001–2015. *Journal of Cleaner Production*, vol. 174, pp. 389–400. https://doi.org/10.1016/j.jclepro.2017.10.290

Mark, C. 2016. Science of empirical design in mining ground control. *International Journal of Mining Science and Technology*, vol. 26, pp. 461–470. https://doi.org/10.1016/j.ijmst.2016.02.015

Oosthuizen, C.C. 2005. Bord and pillar applications on the platinum mine: T-cut mining method. *Journal of the South African Institute of Mining and Metallurgy*, vol. 105, pp. 187–192.

Rodovalho, E.C., Cabral, I.E. 2014. Estimate of hourly productivity applied to elaboration and implementation of mining plans. *Revista Escola de Minas*, vol. 67, no. 2, pp. 221–227. http://dx.doi.org/10.1590/S0370-44672014000200015

Seccatore, J., Magny, L., De Tomi, G. 2014. Technical and operational aspects of tunnel rounds in artisanal underground mining. *Revista Escola de Minas*, vol. 67, pp. 303–310. http://dx.doi.org/10.1590/S0370-44672014000300010

Seccatore, J., Theije, M. 2017. Socio-technical study of small-scale gold mining in Suriname. *Journal of Cleaner Production*, vol. 144, pp. 107–119. http://dx.doi.org/10.1016/j.jclepro.2016.12.119

Van Dorssen, P., Valicek, P., Farren, M., Harrison, M.G., Joubert, W., Pickering, R.G.B., van Rensburg, H.J. 2002. A long hole stoping system for mining narrow platinum reefs. *Journal of the South African Institute of Mining and Metallurgy*, vol. 102, pp. 151–154.

Vokhmin, S.A., Kytmanov, A.A., Kurchin, G.S., Trebush, Y.P., Kirsanov, A.K. 2017. Calculation of loss volumes and dilution of mineral deposits in near-contact zones. *Journal of Engineering and Applied Science*, vol. 12, pp. 5447–5456.

Zang, X., Tao, G., Zhu, Z. 2018. Laboratory study of the influence of dip and ore width on gravity flow during longitudinal sublevel caving. *International Journal of Rock Mechanics and Mining Science*, vol. 103, pp. 179–185. https://doi.org/10.1016/j.ijrmms.2018.01.039

Zhu, W., Chen, L., Zhou, Z., Shen, B., Xu, Y. 2018. Failure propagation of pillars and roof in a room and pillar mine induced by longwall mining in the lower seam. *Rock Mechanics and Rock Engineering*, vol. 51, pp. 1–17. https://doi.org/10.1007/s00603-018-1630-y

Contributions

E. da Cunha Rodovalho - First lead author (carried out the study and wrote the paper). T.M. El Hajj carried out the operational studies and literature review. G. Calegari Teodoro carried out the operational studies. G. de Tomi supervised the study. J.A. Soares Tenório proofread the manuscript. ◆

MiNE SAFE

MINE HEALTH AND SAFETY CONFERENCE 2024

ELIMINATING HARM THROUGH CRITICAL CONTROL COMPLIANCE

SAIMM THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY — 130 Years OF TECHNICAL EXCELLENCE

HYBRID CONFERENCE

6-7 NOVEMBER 2024 – CONFERENCE
8 NOVEMBER 2024 – INDUSTRY AWARDS DAY
EMPERORS PALACE CONVENTION CENTRE

Conference Registration Link

Industry Awards Day Registration Link

AMSPSA | MINERALS COUNCIL SOUTH AFRICA | MMMA | SAIMM THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY

ECSA Validated CPD Activity, Credits = 0.1 points per hour attended.

Abstract Submission Deadline – 05 August 2024

OBJECTIVES

The conference is centered on improving safety, health and environmental practices within the mining and metallurgical industry. It seeks to create a platform for knowledge-sharing and idea exchange among various stakeholders, including mining companies, Department of Mineral Resources and Energy (DMRE), Minerals Council South Africa, labour unions, and health and safety practitioners at all levels within the industry.
The main objectives of the conference are as follows:
Promoting Learning: The conference aims to facilitate a space where attendees can learn from each other's experiences and best practices. This will help enhance overall safety and environmental standards in the mining and metallurgical sector.
Addressing Safety, Health, and Environment: The conference will focus on discussions related to safety and health issues within the industry, including the well-being of employees, contractors, and local communities. It will also emphasize the importance of reducing the environmental impact of mining and metallurgical processes.
Enhancing Relationships with Local Communities: Recognizing the significance of local communities, the conference will address the issues surrounding their relationship with mining companies. This can include concerns about environmental effects, community engagement, and socioeconomic impacts.
Zero Harm Approach: The conference will highlight the importance of adopting a 'zero harm' approach to health and safety in the mining and metallurgical sector. This means striving for an injury-free and accidentfree
workplace.
Value-Based Approach: A value-based approach to health and safety implies that these aspects are not just compliance-driven but are deeply ingrained in the organizational values and culture. This conference aims to encourage discussions and strategies to promote such a value-based approach.
Addressing Key Challenges: The conference will tackle major challenges in the mining industry, such as logistics, energy usage, and safety concerns related to employees, contractors, and communities.
By bringing together diverse stakeholders and sharing their expertise and experiences, this conference hopes to foster a safer and more sustainable mining and metallurgical industry. It emphasizes the importance of collaboration and collective efforts to address the complex challenges faced by the sector.

PARTNERSHIP OPPORTUNITIES

Sponsorship opportunities are available. Companies wishing To partner on this event should contact the Conference Coordinator.

WHO SHOULD ATTEND

The conference should be of value to:

- Safety practitioners
- Mine management
- Mine health and safety officials
- Engineering managers
- Underground production supervisors
- Surface production supervisors
- Environmental scientists
- Minimizing of waste
- Operations manager
- Processing manager
- Contractors (mining)
- Including mining consultants, suppliers and manufacturers
- Education and training
- Energy solving projects
- Water solving projects
- Unions
- Academics and students
- DMRE

CALL FOR PAPERS

Call for papers on the topics of safety, health and environment
Prospective authors are invited to submit titles and abstracts of their presentations in English and not longer than 500 words. Abstracts should be submitted to: Camielah Jardine, Head of Conferencing,
E-mail: camielah@saimm.co.za

KEY DATES

Abstract submission – **5 August 2024**

Acceptance of Abstracts – **19 August 2024**

Extended Abstract submission - **23 September 2024**

FOR FURTHER INFORMATION, CONTACT:

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