A BOOKLET ON

The scheduling of panel blasting to influence short-term seismic hazard

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Project Objective

A previous SIMRAC project (GAP601a) showed that it may be possible to influence the short-term seismic hazard of an area by blasting panels in specific configurations.

A task of SIM020302 was to investigate these findings and develop practical advice for mine personnel involved in scheduling of panel blasts and rock engineering practitioners.

Background

In order for large damaging seismic events to occur, stress fields in the rock need to become correlated. This correlation is enhanced by blasting all at the same place and time. The ideal would be if blasting could be scattered in space and time, as this would de-correlate the stress fields and promote more small seismic events and less large events.

Test Site

The 104/109 48-49 mining area of Mponeng was chosen as the home of this project. The high-resolution seismic micro-network there provided excellent data with seismic events above magnitude -1.5 consistently recorded.

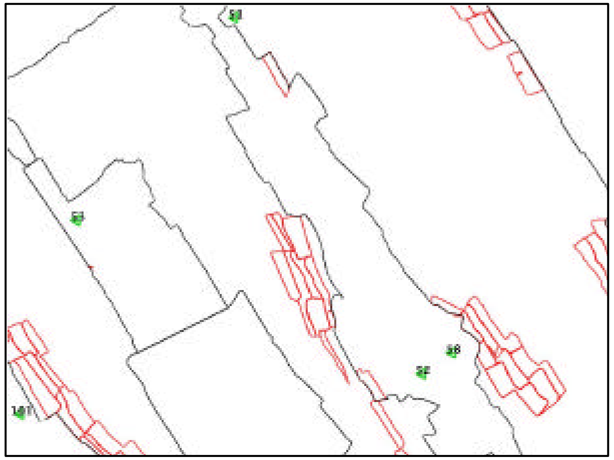


Figure: A plan view of the 104/109 48-49 pillar of Mponeng mine. The 4 east panels were blasted in this period.

During the period September 2003 – January 2004 1595 seismic events were recorded in this pillar.

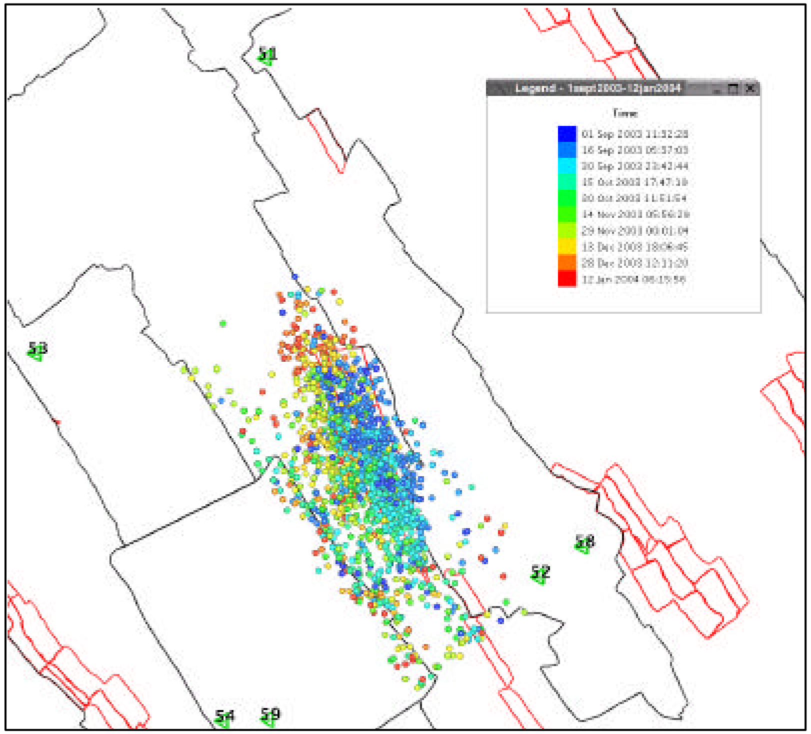
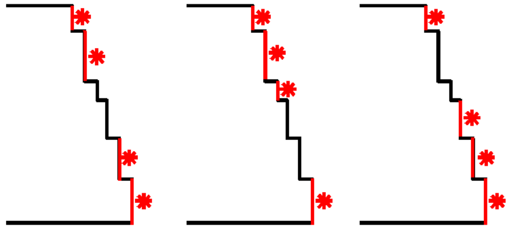


Figure: Micro-seismic events recorded during Sept 2003 – Jan 2004.

Sometimes the panels were blasted contiguously, i.e. neighbours were blasted, while sometimes separated panels were blasted.

Definition: A blast consisting of contiguous (neighbouring) panels is called a **1-segment blast**. Blasts consisting of 2 sets of contiguous panels are called **2-segment blasts**.



Some examples of 2-segment blasting (blasted panels shown as red stars)

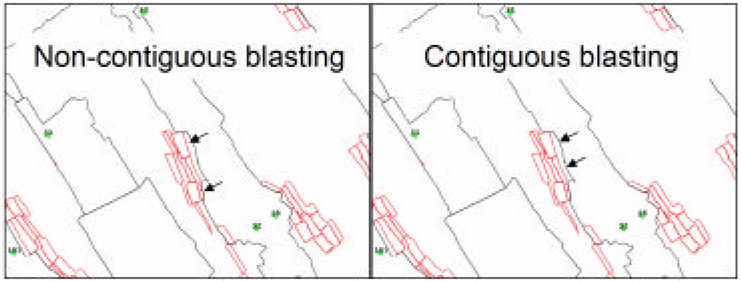


Figure: An example of a contiguous (right) and non-contiguous panel blast at Mponeng

The panel blasting for these months was separated into the contiguous and non-contiguous categories. The recorded seismic response was then correlated to how the panels were blasted.

Results

The seismic data recorded in the 18 hours following production blasting was used to estimate the seismic stiffness[?] K_s of the pillar.

There is significant scatter in this data. This may be due to different blasting times for each panel, but could not be verified because accurate records of the exact blasting times were not available.

[?] Seismic stiffness, K_s, defined in SIMRAC project GAP303, gives a measure of the ability of the system to resist seismic deformation. It is estimated from seismic data using the formula: $K_s \; ? \; \frac{4?^{2}? V ? \; E_i}{? ? \; M_i ?}$

What we see is that, <u>on average</u>, blasting panels together (red solid line) does degrade the system stiffness more than blasting the same face length spread over different places (blue dashed line). Therefore, seismic hazard would be less if non-neighbouring blasting was practiced here.

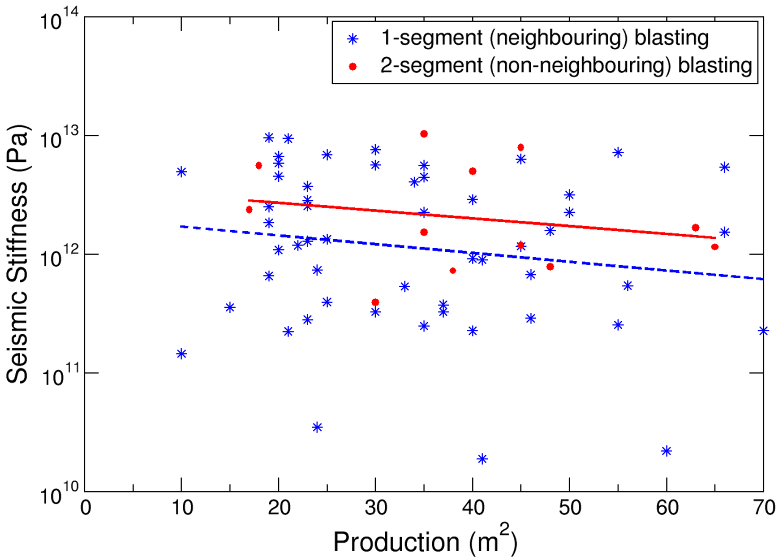


Figure: Seismic Stiffness resulting from different kinds of production.

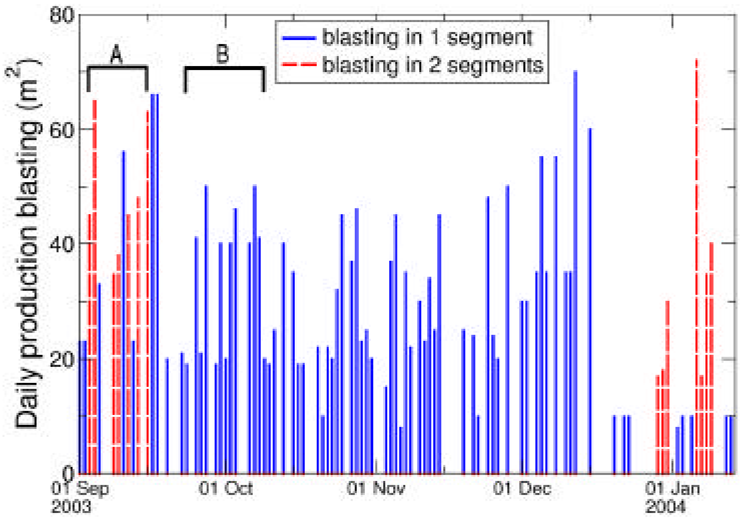


Figure: Amounts and types of blasting in the 104/109 48-49 pillar at Mponeng. During time "A" the blasting was mostly of type 2-segments, while during time "B" the blasting was only of type 1-segment.

The times indicated in Figure 3.2.5 by "A" and "B" were time intervals of equal production: 450 m^2. These 2 time intervals are analysed in the table below.

	Duration	*No. of 1-segment blasts*	*No. of 2-segment blasts*	*Total volume blasted*	*No. of seismic events*	*Seismic Stiffness (GPa)*
Time A	13 days	3	7	450 m^2	275	**48**
Time B	17 days	13	0	450 m^2	241	**17**

It is significant that, although the same amount of production has been carried out in a faster time, mining during time “A” has degraded the stiffness less, and therefore results in lower seismic hazard.

Discussion

Previous research[?] has shown that as seismic stiffness decreases, seismic hazard increases. This work has shown that blasting panels that are not neighbours tends to degrade the seismic stiffness less than blasting the same amount of rock in neighbouring panels. This work therefore indicates that, on average, the short-term seismic hazard in an area may be reduced by scheduling non-neighbouring panel blasts wherever possible.

[?] SIMRAC project GAP303

Conclusion

If convenient, neighbouring panels should not be blasted on the same day to reduce the average expected seismic hazard in the vicinity.

Acknowledgements

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