GROUND DEFORMATION MONITORING BY CONVERGENCE MEASUREMENT AND DAMAGED AREA MAPPING IN DEEP ORE ZONE (DOZ) MINE AT PT. FREEPORT INDONESIA

ANDRE SEBASTIANO GINTING and HADNALTIAS ALPEKI Underground Geotechnical and Hydrology Department, PT Freeport Indonesia, Tembagapura, Indonesia

Abstract

ABSTRACT: Deep Ore Zone (DOZ) Mine is an underground mine with block caving method within The East Erstberg Skarn System (EESS) deposit. Safe ground condition is the most important thing on production stage related to safety of employees and property in underground. Rockfall is one of fatal risks for employees who work in underground. It happens when ground deformation getting worse. The deformation monitoring is a needed to observe the behavior of rock mass, early detection of hazards, and evaluate current ground support system. The damaged ground in DOZ Mine on production stage is mainly caused by stress around the pillar. It has related to the lifetime of DOZ Mine approximate 3 years left. No mucking activity causes rock wegdes above the pillar and total load for pillars strength. There is maximum stress and strain rock of pillar which it will be broken ground when the stress and strain pass through the maximum value. The type categories of damaged are slight damage, moderate damage, heavy damaged, and squeeze or collapse ground. Those damaged type have to be recorded on a damaged area map for a comparison with other monitoring data. Convergence measurement is one of methods to monitor ribs ground displacement. Strain in rock masses represents its change in length from its orginal length. Convergence measurement is one of methods to monitor ground displacement, especially the strain between two ribs on a panel. The station installed on each ribs of drawpoint of active panel and fix facilities area. The significant value of displacement by convergence measurement is more than cummulative 75 mm. Based on those informations, the ground support dan panel rehabilitation can be consider needed or not. The area with significant value and oberserved damaged ground will be proposed a rehabilitation for safety work area. For example, we found increasing trend displacement followed by moderate damaged observed. The significant displacement found at Panel 04 around Drawpoint 18W to 19W. We proposed a rehabilitation for this area after a week from the day of significant displacement measurement. Rehabilitation has proposed when the increasing trend was higher to prevent ground become broken or unsafe condition.

Keywords: Displacement, Damaged Area, Rehabilitation

I . INTRODUCTION

1.1. Issue Background

The DOZ (Deep Ore Zone) block cave operated by PT Freeport Indonesia is the third block cave in the East Ertsberg Skarn System (EESS) after the Gunung Bijih Timur (GBT) Mine and the Intermediate Ore Zone (IOZ) Mine. The production level of the DOZ block cave lies at a depth of about 1200 meters below the surface and has column heights up to 500 meters. The western part of the DOZ is about 300 meters below the IOZ block cave. The DOZ block caving started production in 2000 and by the end of 2005. By now, DOZ Mine is conducting mucking activity on eastern panel, while western panel was closed related to reserves issue. The production target of DOZ Mine is 32,000 tonnes per day with 887 drawpoints. The damaged has related to the lifetime of DOZ Mine approximate 3 years left.

Rockfalls are a major hazard in underground mines with consequences ranging from insignificant to catastrophic (fatalities). The risk to personnel and damage associated with rockfalls must therefore be managed. In most cases, rockfalls occur in distinct and localised areas of a mine. These "local events" are nevertheless the result of an overall system response to mining activities. The solution to the problem of rockfalls must therefore account for activities beyond the local areas where they occur and rest upon a sound understanding of the overall underground

1.2. Problem Identification

1. What are methods can be used to monitor ground deformation in underground mine?
2. How does ground monitoring can prevent rockfall as major hazard in underground mine?

1.3. Limitation of Problems

To clarify the scope of discussion, the issues discussed is limited to the problem:

1. The scope of this discussion is only ground deformation monitoring and the right moments of repair to the area based on the data.

1.4. Problem Formulation

Based on the background and the limitation issue, the problems discussed can be formulated as follows:

1. Determining some methods to monitor ground deformation in underground mine.

2. Preventing rockfall as major hazard in underground mine as early as possible.

II. DISSCUSION

2.1. Damage Classification in DOZ

Damage Observastion is conducted to ground drawpoint and ground in front of drawpoint. There are 11 parts must be observed in a drawpoint and determined into 5 damage classification, such as slight damage, moderate damage, heavy damage, partial closure, complete closure. The highest damage of those part will represent the damage class of a drawpoint. The observation result will be compare with other monitoring data to show the ground displacements.

The moderate damage was observed at Panel 04 DP15E-DP17W, while the heavy damage was observed at Panel 04 DP18E-DP20E. The concern ground is located on heavy damage area, this area will be the first conducted rehabilitation.

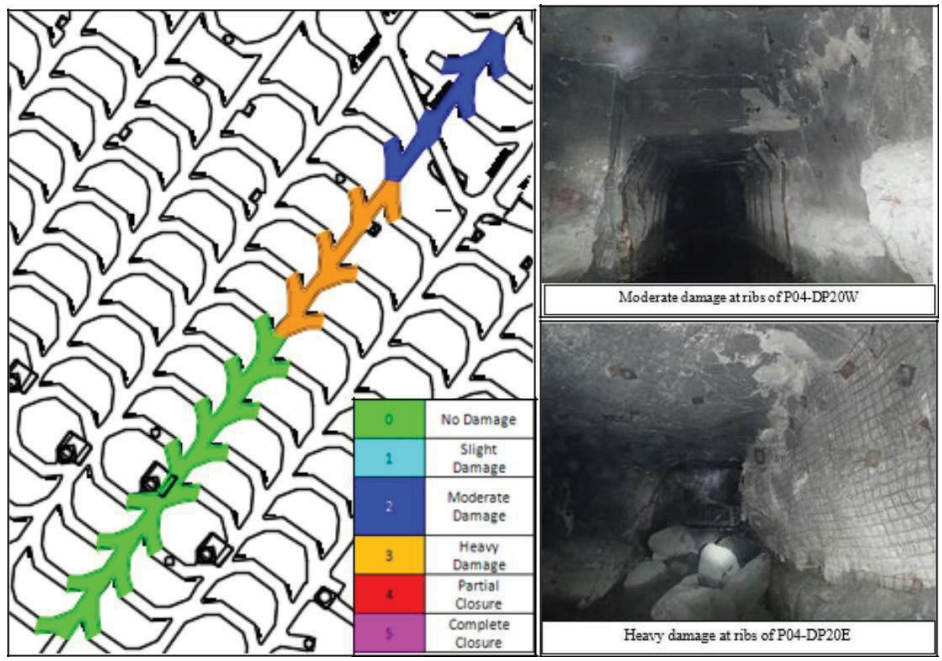


Figure 1. Damage Map of Panel 04 DP15E-DP20E

The moderate damage was observed at Panel 03 DP15E-DP17W, while the heavy damage was observed at Panel 04 DP17E-DP19E. The concern ground is located on heavy damage area, this area will be the first conducted rehabilitation. Steel probs aslo installed as ground movement indicator in front of DP19E

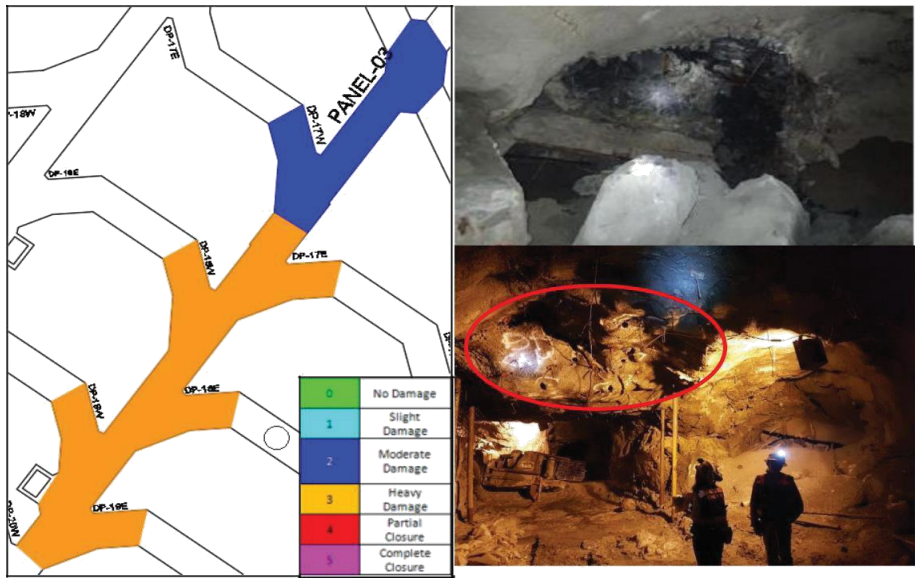


Figure 2. Damage Map of Panel 03

The moderate damage was observed at Panel 1H DP02E-DP06W. The potential shotcrete fall has also observed in this area. Borehole camera and high pressure grout also conducted on this area related to reinforce ground support has been installed but the ground still barring down.

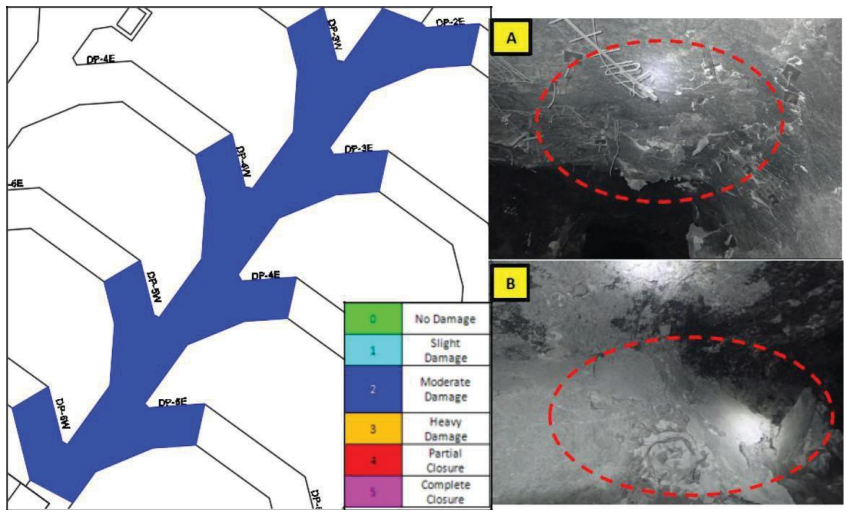
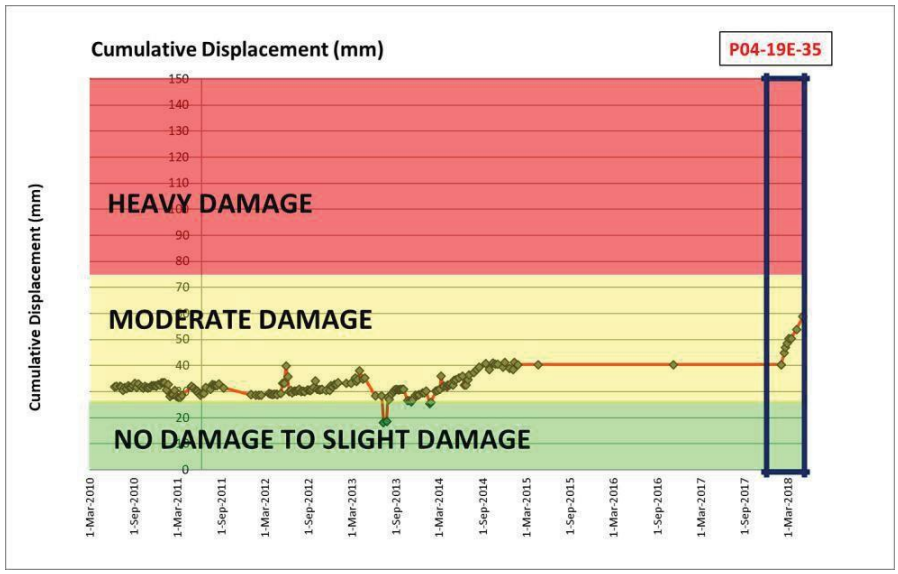


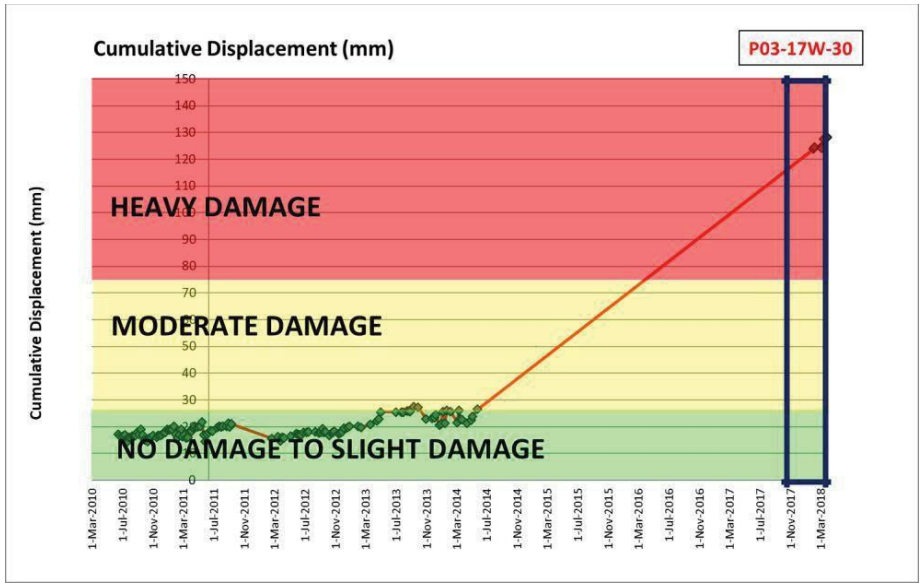
Figure 3. Damage Map of Panel 1H

2.2. Convergence Measurement

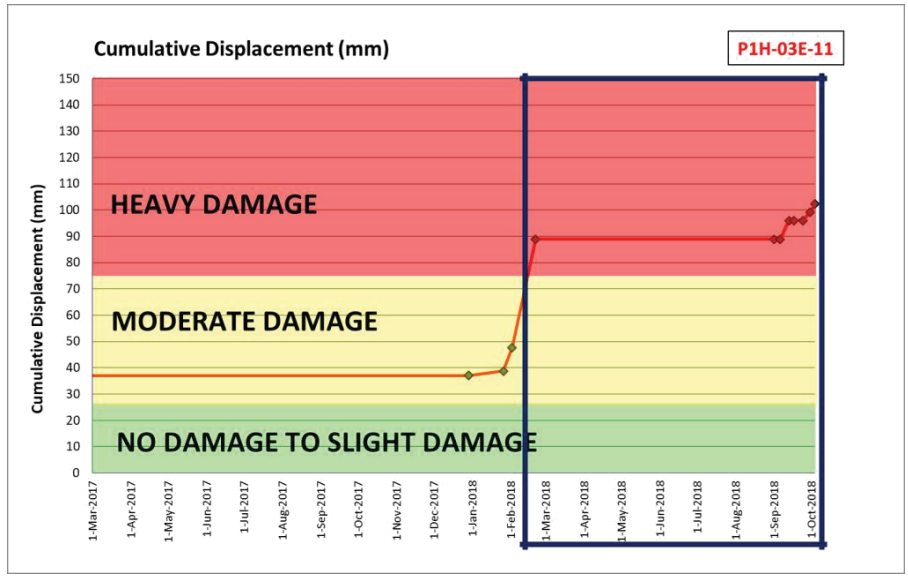
Convergence measurement shows the displacement of two ribs in a drawpoint. The significant values of displacement is 1.0 mm/day. If this value is recorded, it needs to compare with other monitoring data to ensure the significant value is no mistake or human error. The other monitoring data are ZF Laser Scan and uGPS.



Graph 1. Cummulative Displacement of Panel 04 DP19E



Graph 2. Cummulative Displacement of Panel 03 DP17W



Graph 3. Cummulative Displacement of Panel 1H DP03E

2.3. Comparing displacement by convergence with other monitoring scan data

The ground displacement by convergence measurement is need to compare with ZnF Scan to show that the displacement is not mistaken by mechanical or human error. By ZnF Scan, it shows the exactly moving part of ground.

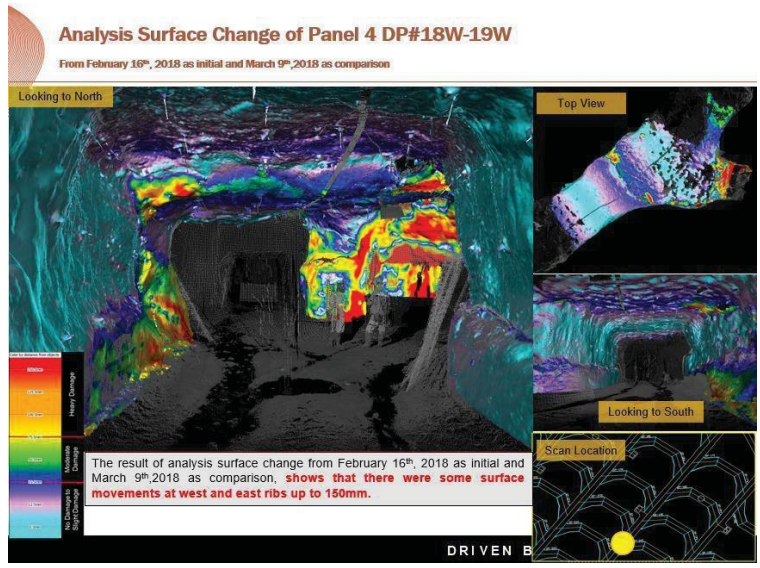


Figure 3. ZF Scan Result of Panel 04 DP18W-DP19W

Based on ZF Laser Scan result on Panel 03 DP17W-DP18W, there was max surface movement up to 50 mm at west and east rib ground. It supports to convergence value recorded that there was a displacement in this area.

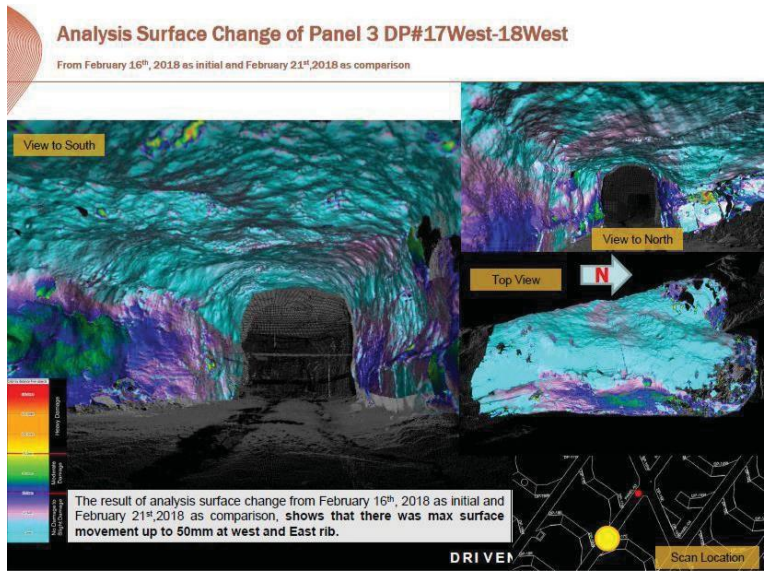


Figure 5. ZnF Scan Result of Panel 03

Based on ZF Laser Scan result on Panel 1H DP02E-DP06W, there was max surface movement up to 50 mm at rib, shoulder, and back of ground. It supports to convergence value recorded that there was a displacement in this area.

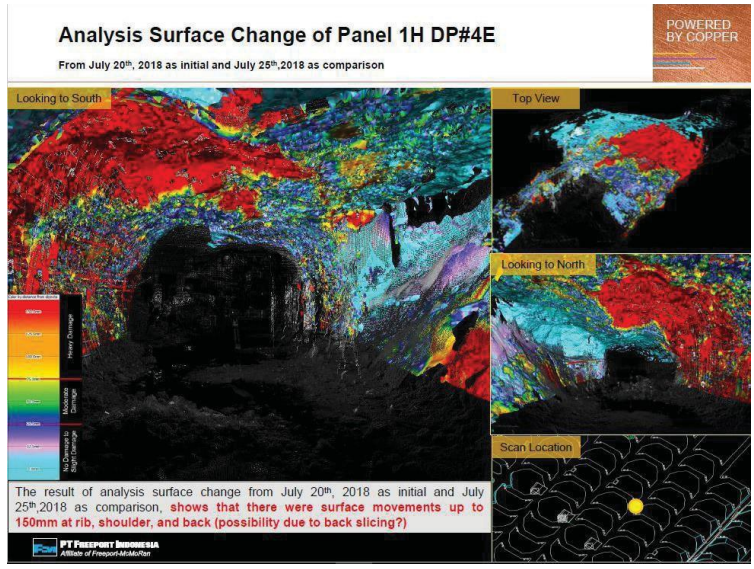


Figure 6. ZF Laser Scan Result of Panel 1H

2.4. Repair Activity

Based on damage area mapping, convergence displacement, and supported by monitoring data. The concern area can be proposed repaired. Rehabilitation/repair is depending on geotechnical concern found on those area.

Figure 7. Rehab activity of Panel 04

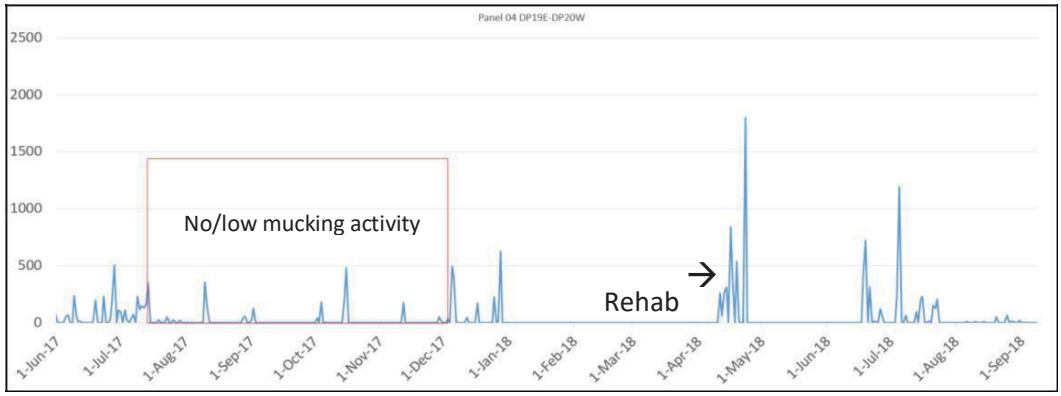
Figure 8. Rehab activity of Panel 03

Figure 9. Rehab activity of Panel 1H

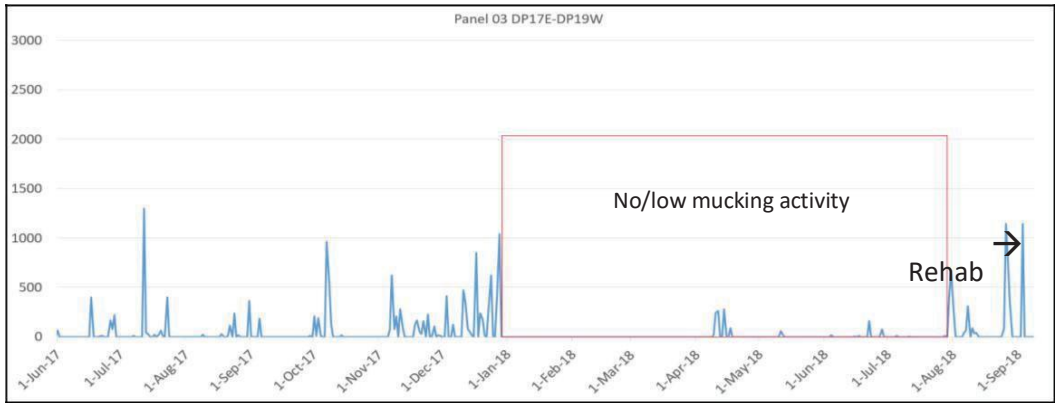
2.5. Pillar Damage Analysis

Pillar damage in Deep Ore Zone (DOZ) caused by no mucking activity, isolated drawpoint, dynamic load seismic event, and hit by loader. In this case, pillar damage

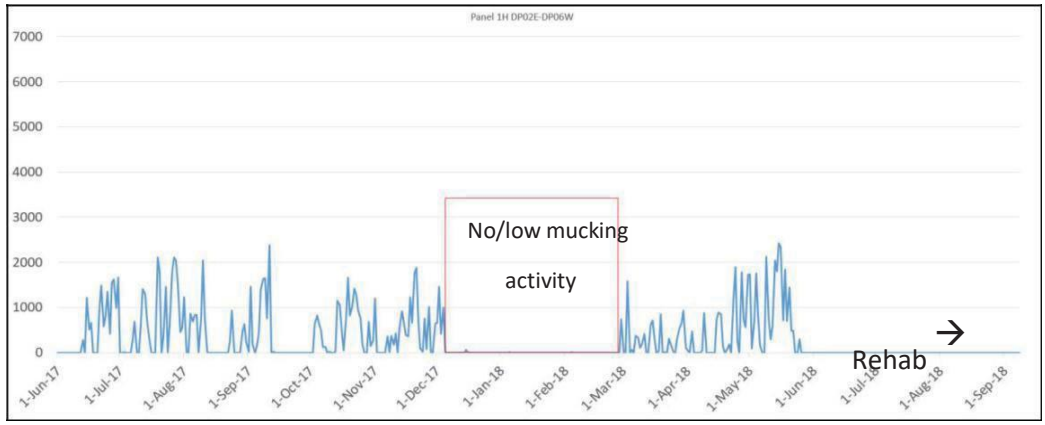
mostly caused static load which It has related to no mucking activity on the drawpoint. Based on mucking activity data and time of rehab, damage and significant displacement found after no mucking activity for long time, such as the graphs as below.



Graph 4. Mucking Activity at Panel 04



Graph 5. Mucking Activity at Panel 03



III. FINAL

3.1 Knot

1. Convergence monitoring and damage area mapping are better method to evaluate the ground condition and determine rehab moments. So that, the underground employees and equipment can be prevented from rockfall hazard which it would be a fatality and delay the productivity of mine.

2. Damage area mapping and convergence measurement with monitoring scan data have correlation each other related to ground deformation, especially displacement of the ground. Compiling these data can be used as indicator the area must be repaired or not. It also prevent failure of rock and potential rockfall as major hazard in underground.

3. PT. Freeport Indonesia is one of the underground mining c ompany in Indonesia which It has a good ground monitoring system. Especially in the DOZ Mine, We have convergence, ZF Scan, uGPS, borehole camera, and multipoint borehole extensometer as ground monitoring methods.

3.2. Advice

1. Ground always searchs for stable condition when there is excavation. No mucking activity on a drawpoint will be static load/stress to the drawpoint. Uniform mucking activity is the better way to reducing potential damage occurred on pillar.
2. PT. Freeport Indonesia still keep safety as first value beasuce PTFI have responsibility for all the underground employee. “If there is no monitoring, then there is no mining”

REFERENCES

Mineral Council of Australia, 2003. “Management of Rockfall Risks in Underground Metaaliferous Mine”. Sydney Avenue. Australia.

Widijanto, Eman, N. Arsana, and A. Srikant. 2006. “ Geotechnical Challenges in the DOZ Block Cave Mine”. PT. Freeport Indonesia. Tembagapura. Indonesia.