Seismic emergency response and preparedness

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Introduction

Seismic events can be either natural (through earthquakes) or mining induced and both can affect open cut and underground mining operations. Strong and potentially destructive ground shaking may occur up to hundreds of kilometres from the earthquake epicentre. Seismic events may trigger movement along otherwise inactive faults, resulting in rock falls and damage to ground support and ground conditions.

Mining induced seismicity can be a sudden release of energy as a result of stress re-distribution from mining.

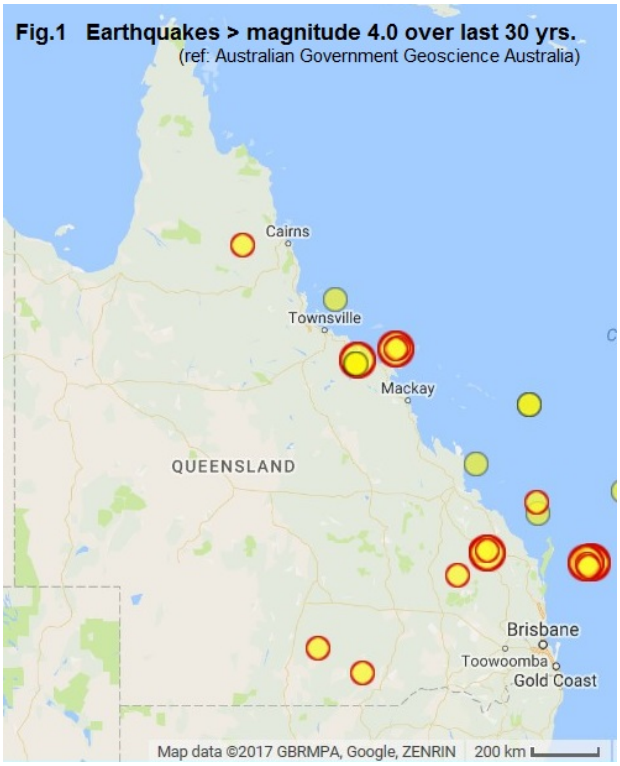
Earthquake activity in Australia and Queensland

Most of the world's earthquakes occur on tectonic plate boundaries as the plates move. Earthquakes in Australia are usually caused by movements along geological faults as a result of compression in the Earth's crust rather than by plate movement.

The smallest magnitude earthquake known to have damaged infrastructure and caused fatalities was the magnitude 5.4 Newcastle earthquake in 1989. Magnitude 4.0 earthquakes may topple structures or result in other damage, which could potentially cause injuries or fatalities. Earthquakes with magnitudes of less than 3.5 seldom cause damage.

During the past 30 years there have been 37 recorded seismic events of greater than magnitude 4.0. Six of these were greater than magnitude 5.0. During 2016, 137 earthquake events were detected and catalogued in Queensland, through the Central Queensland Seismological Research Group (CQSRG).

Fig.1 Earthquakes > magnitude 4.0 over last 30 yrs.
(ref: Australian Government Geoscience Australia)



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Place alert on noticeboards and ensure relevant people in your organisation receive a copy.
See more safety alerts and bulletins at http://dnrm.qld.gov.au/
And the hazard database at https://www.business.qld.gov.au/industry/mining/safety-health/mining-safety-health/mining-hazards/hazards

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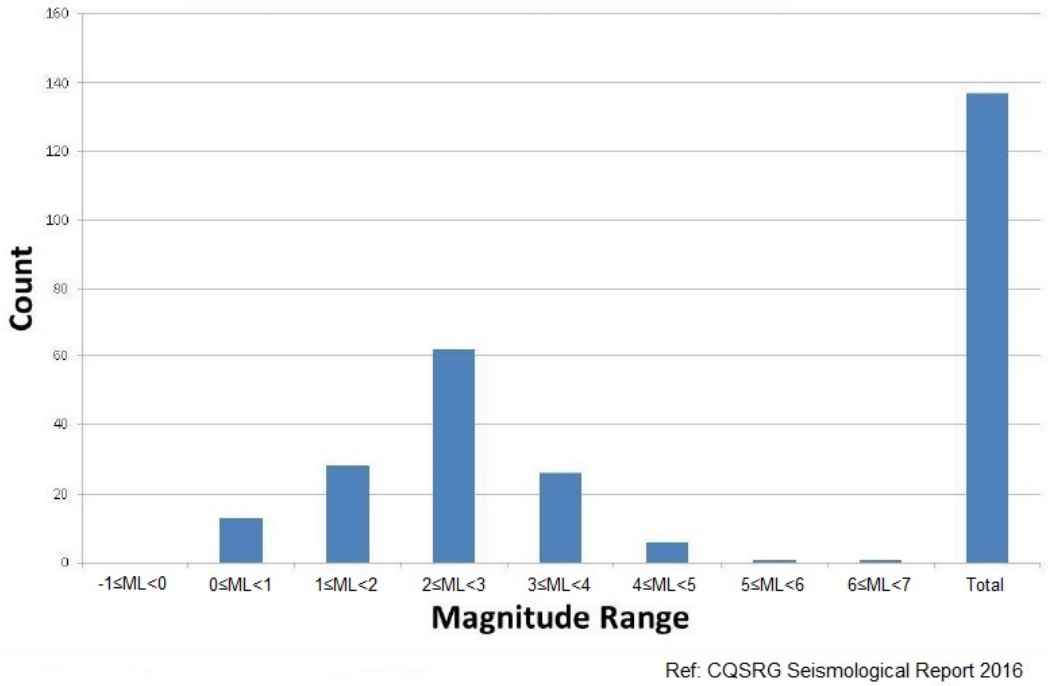
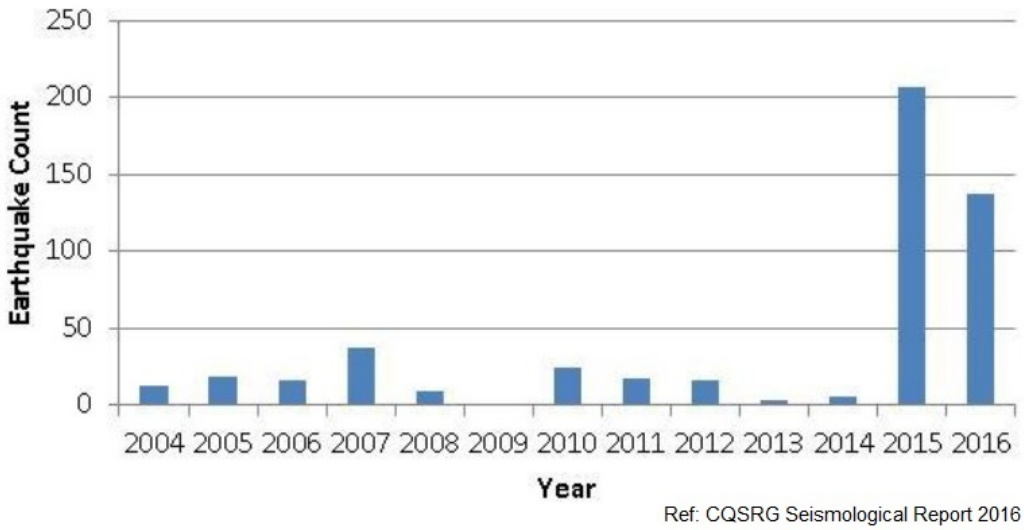
Figures 2 and 3 highlight the magnitude and frequencies of events and the overall number of events in Queensland.

Fig. 2 Earthquake magnitude frequency 2016



Ref: CQSRG Seismological Report 2016

Fig. 3 Yearly count of earthquakes detected by CQSRG



Ref: CQSRG Seismological Report 2016

On 13 April 2017, a magnitude 4.3 earthquake occurred near Orange, New South Wales, impacting underground operations at the Cadia East underground mine.

In August 2016, Bowen experienced a magnitude 5.8 earthquake followed by a series of aftershocks that were detected for seven months after the main event.

In February 2015, Mount Rawdon Mine reported a magnitude 5.2 earthquake with an aftershock of magnitude 4.0. The earthquake caused two rock falls that were contained within a bunded area.

Consequences of an earthquake at a mine may include:

- rock falls and damage to ground support and ground conditions
- damage to infrastructure e.g. tailing storage facilities, water dams / weirs, mine services shafts, headframes and winders, rupture of tanks and bins in process plants etc.
- damage to underground fill bulkheads and potential liquefaction of fill mass.

Recommendations

Operations must be aware there is a risk of seismic activity in Queensland, consider potential consequences of an event, and plan accordingly.

When undertaking the risk assessment/planning process, consider the following recommendations:

- Identify if the operation is in an area prone to seismic activity.
- Review known higher risk areas, fault zones, key infrastructure and safety critical areas.
- As necessary, develop a seismic event response plan forming part of the site's safety and health management system, including emergency procedures as appropriate. This may include:
  - withdrawal of personnel to a place of safety (away from high walls; a safe place underground)
  - post event visual inspection of ground conditions and ground support by competent geotechnical personnel prior to re-entry
  - inspection of critical infrastructure such as:
    - at risk plant (conveyors, elevated structures etc.)
    - tailings dams and water dams
    - underground openings
    - shafts and winding equipment
    - bulkheads
    - ventilation control devices
    - roadways.
- Mines should contact Geosciences Australia to validate the occurrence of the seismic event (www.ga.gov.au).

References

1. *ABC Report, 13 March 2017, Earthquake hotspots identified in regional Queensland as seismic activity heats up*, http://mobile.abc.net.au/news/2017-03-13/report-identifies-earthquake-hotspots-in-regional-qld/8349172?pfmredir=sm
2. *Australian Government Geoscience Australia http://www.ga.gov.au/earthquakes/home.do*
3. *Beaconsfield Investigation Report Prepared for the Coroner at the Request of the Tasmanian Government* http://www.mineaccidents.com.au/uploads/beaconsfield-investigation-report.pdf
4. *Central Queensland Seismology Research Group CQSRG Seismological Report 2016 Compiled by Michael Turnbull* https://www.whitsunday.qld.gov.au/DocumentCenter/View/3003