2018 Lake Muir, WA, Earthquake Sequence

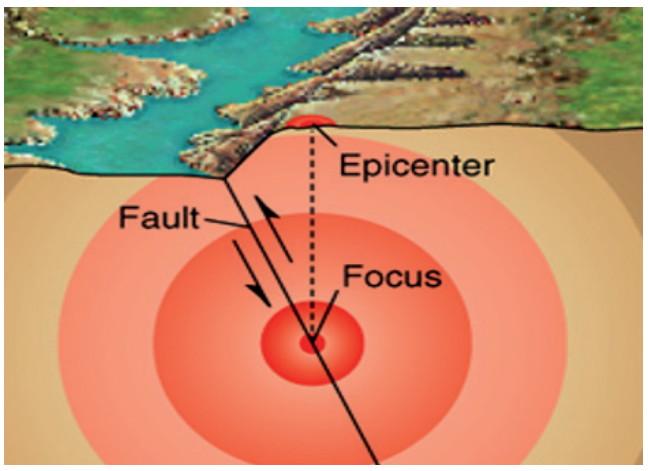
Australian Government
Geoscience Australia

GOVERNMENT OF WESTERN AUSTRALIA

DFES Department of Fire & Emergency Services

What is an earthquake?

An earthquake is the sudden release of energy and subsequent ground shaking from rocks breaking along a fault line under stress (usually) from *plate tectonic* forces.



How do we measure earthquakes?

- Earthquakes are detected by instruments called seismometers.
- Seismometers measure the intensity and duration of ground shaking generated by an earthquake.
- The arrival times of these seismic waves, and the speed at which they travel are used to determine the location of the earthquake.
- The size of an earthquake (or its magnitude) is the measure of the energy released when the fault ruptures.

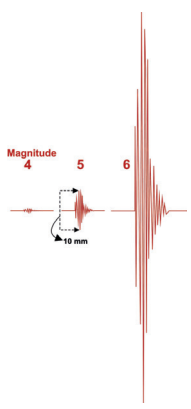
Earthquake Magnitude

As magnitude increases, the strength of ground shaking, duration, and area impacted increases very quickly.

Ground shaking
Increases by 10 times for every magnitude unit.

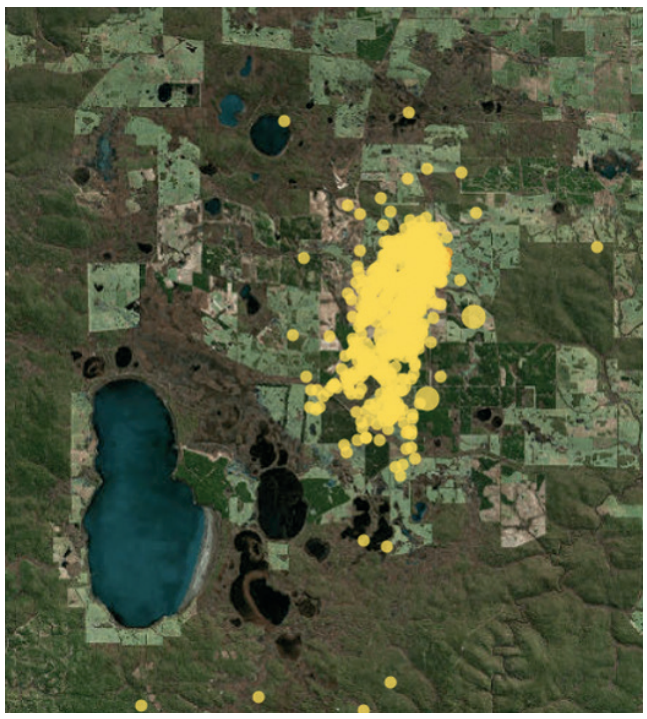
Energy released
Increases by 32 times for every magnitude unit.

Duration of shaking
From a few seconds (magnitude 4) to several minutes (magnitude 9).



Difference between Magnitude and Intensity

- An earthquake's ***magnitude*** is related to the energy released at its ***epicentre***.
- The ***intensity*** of an earthquake refers to the level of ground shaking ***at a given location***.
- Earthquake intensity ***decreases*** with ***increasing distance*** from an earthquake.
- The Modified Mercalli Intensity (MMI) scale is commonly used to describe the effects of an earthquake at a given place.
- MMI is a ***qualitative*** assessment of earthquake effects on structures and people.
- Earthquake magnitude is a ***quantitative*** measure based on physical recordings made on seismometers.

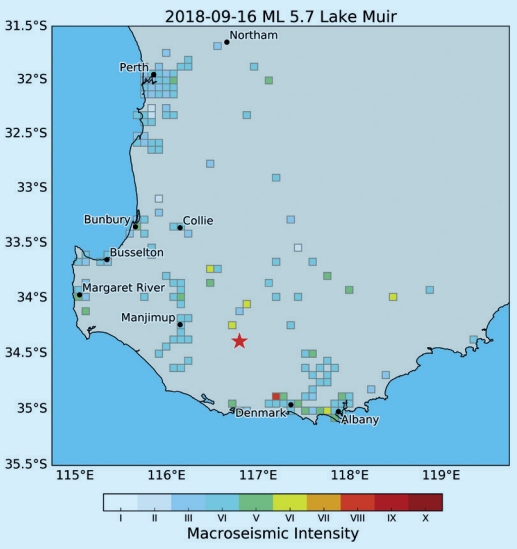


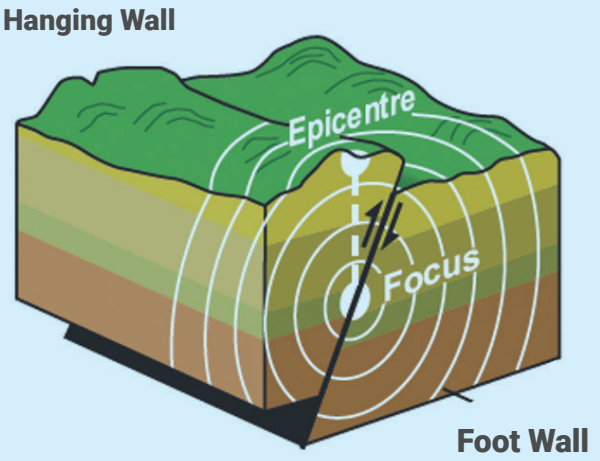
Distribution of aftershocks recorded following the 16 September 2018 Lake Muir earthquake. Source: Geoscience Australia

What do we know about the Lake Muir earthquake sequence?

- The sequence began with a magnitude 5.7 main shock on 16 September 2018, which is the largest recorded earthquake in WA, south of Perth, since records began.
- A surface deformation approximately seven kilometres long has been observed from satellite imagery.
- Damage occurred to localised structures near the fault scarp and epicentre.
- Five Rapid Deployment Kits (RDKs) were installed within days of the main shock and began live streaming data back to the Geoscience Australia (GA) Operations Centre in Canberra.
- Over 700 aftershocks have been recorded, including a magnitude 4.6 on 13 October 2018 and a magnitude 5.4 on 9 November 2018.
- These events were widely felt throughout the south west of WA including parts of the Perth metropolitan area.
- The 9 November event was more widely felt and GA is investigating further to determine the rationale for this.

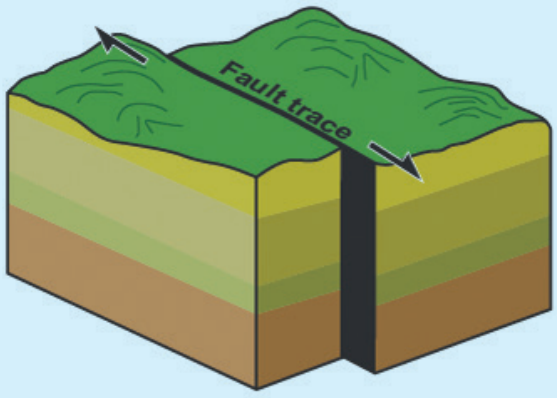
ML 5.7 (MW 5.3) – Lake Muir, Australia 16 September 2018



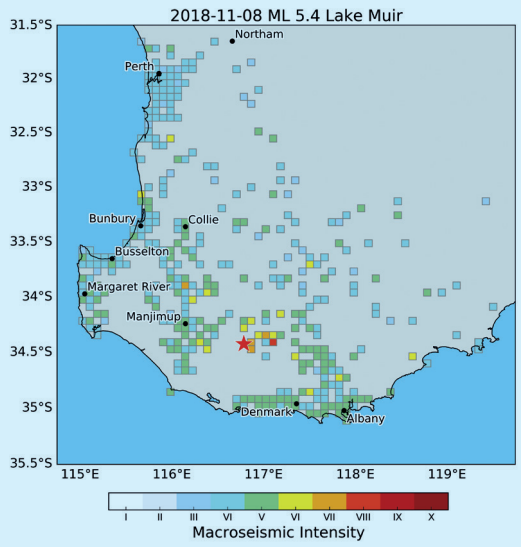


Source: Geological Survey of Western Australia

ML 5.4 (MW 5.3) – Lake Muir, Australia 9 November 2018



Source: Geological Survey of Western Australia



Next Steps

Aftershock monitoring ceased in February 2019. Ongoing research will include:
— assessment of surface deformation
— precise relocation of aftershocks
— evaluate data from online felt reports.

For more information visit earthquakes@ga.gov.au or email hazards@ga.gov.au

Lake Muir Earthquake | Frequently Asked Questions

Earthquake

What kind of measures does Australia have in place in the event of an earthquake?

It's impossible to accurately predict exactly when and where an earthquake will occur but the history of earthquake activity in a region can tell us a lot about its potential risk for future earthquakes. GA operates and maintains the Australian National Seismograph Network to provide the emergency management sector and the public with rapid notification of Australian earthquakes of magnitude 3.5, or greater through the National Earthquake Alert Centre.

In order to minimise the impact of future earthquakes, GA also develops the National Seismic Hazard Assessment (NSHA). This assessment identifies regions across Australia that are more or less likely to experience potentially damaging earthquake ground shaking. This information is important for risk management and decision making by the public, industry and government, and is used to improve building codes and standards.

Who provides the response to earthquakes in WA?

The Department of Fire and Emergency Services (DFES) is the hazard management agency for earthquake. DFES maintains the emergency management arrangements for earthquakes in WA (State Hazard Plan). In the event of an earthquake, DFES issues public information and manages the response and recovery of the incident.

What is the likelihood of an even bigger earthquake occurring in the Lake Muir area following the two recent 5+ magnitude earthquakes?

The south west of Western Australia is known to be one of the most seismically active areas in Australia and has experienced several damaging earthquakes in the last 50 years. These included the 1968 magnitude 6.5 Meckering earthquake, the 1970 magnitude 5.9 Calingiri earthquake, the 1979 magnitude 6.1 Cadoux earthquake and the 2010 magnitude 5.0 Kalgoorlie-Boulder earthquake.

We would generally expect to experience a magnitude 5.0 earthquake approximately every 10 years somewhere in the south west of WA. Due to the short recording history, the chance of a larger earthquake occurring has large uncertainties. However, a magnitude 6.0 earthquake might be expected every 50 to 100 years or so. We cannot rule out the potential for a larger event to occur in the Lake Muir region, however, preliminary analysis of the local geology suggests this may be unlikely on the fault system that is presently active.

What was the purpose of the earthquake detection equipment installed by GA in the Lake Muir region?

Following the 16 September magnitude 5.7 earthquake, GA installed five RDKs to monitor seismic activity of the Lake Muir sequence, and to complement the data collected from the national network seismometers. These instruments were removed in late February 2019 and have helped GA analysts detect and locate over 780 aftershocks.

There are several scientific objectives for monitoring aftershocks following large earthquakes:

1. To record precise locations of aftershocks and to better define the fault rupture plane in three dimensions.
2. To monitor changes in activity to develop improved methods and models that may be used to forecast the likelihood of large aftershocks.
3. To record strong ground motions from large aftershocks that will better inform the likely ground motion accelerations possible from future Australian earthquakes. This information is used to inform building codes and standards.

A decision was made to discontinue monitoring activity in March 2019 as the ongoing activity rates of small aftershocks had reduced substantially. GA will continue researching the collected data to improve the understanding of earthquake hazard in the region.

What is GA doing to improve our understanding of the earthquake hazard?

GA is integrating data and information from a variety of sources to learn more from the Lake Muir earthquake sequence. Field mapping and satellite observations are telling us about the extent of ground deformation that is possible from these moderate magnitude earthquakes. Understanding the extent of an earthquake rupture gives us information on possible damage this deformation could pose to buildings and buried infrastructure (i.e. pipelines), should a similar sized earthquake occur nearer to populated areas.

Additionally, data recorded by the temporary seismometers provides important information on how the strength of ground shaking decays with increasing distance away from the earthquake. With this information, we can develop models that can forecast the potential shaking intensities for larger earthquakes over a wide area. GA also uses "citizen science" to help calibrate these models by using data submitted through the online reporting system. Members of the public can submit a report if they've felt an earthquake via earthquakes.ga.gov.au.

Where can I go to access information about earthquakes and how do I get assistance if I'm impacted by an earthquake?

GA provides an online interactive map viewer detailing all earthquakes in the last seven days at **earthquakes.ga.gov.au**.

If an earthquake causes significant damage, you can keep up to date with information online via emergency.wa.gov.au, DFES Facebook or Twitter accounts, by calling 13 DFES (13 3337) or by listening to your local ABC radio station.

If your house has been badly damaged in the earthquake and you need emergency repairs, call the State Emergency Service on **132 500**. If you are in a life-threatening situation, call **000**.

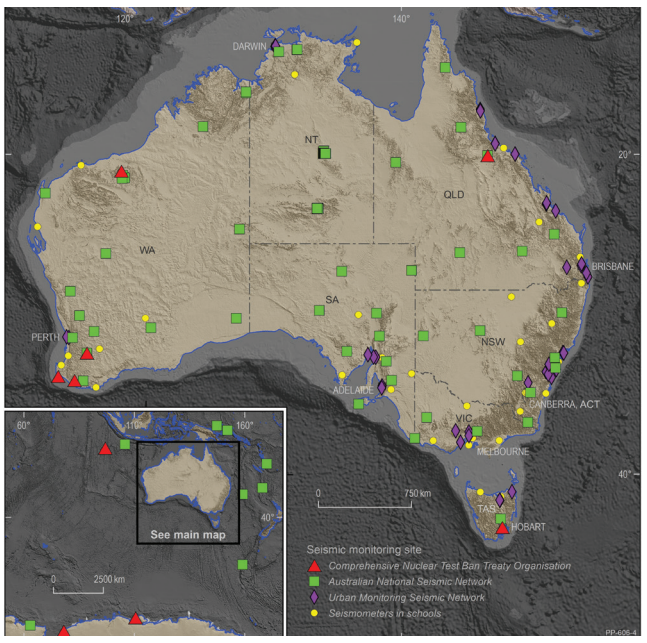


Image courtesy of Geoscience Australia. Map showing location of Seismic Monitoring Stations around Australia

Image courtesy of Geoscience Australia. Image outlines an indicative setup of a seismic monitoring station.