

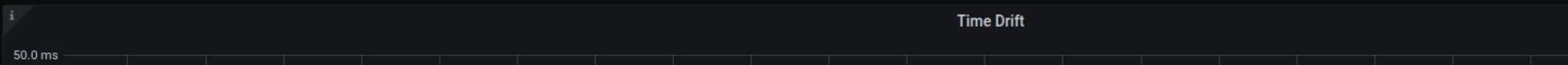
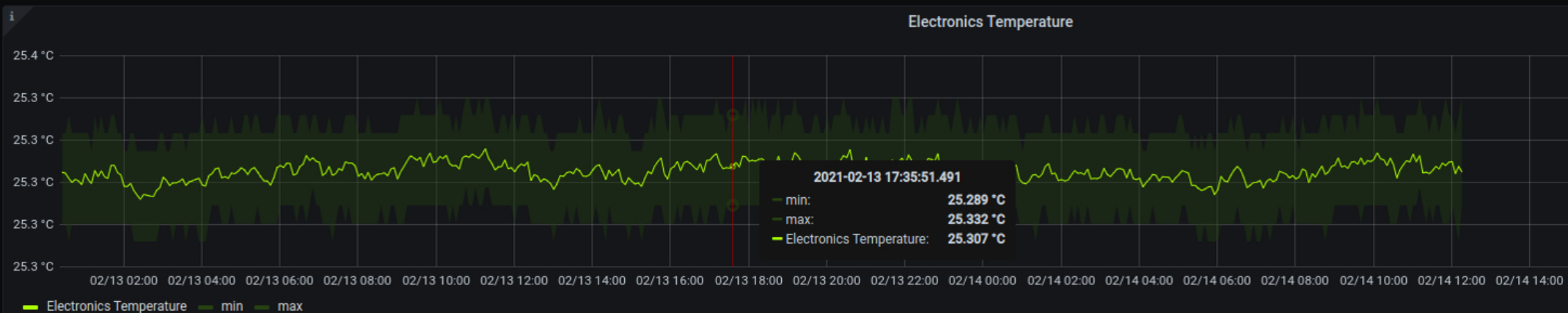
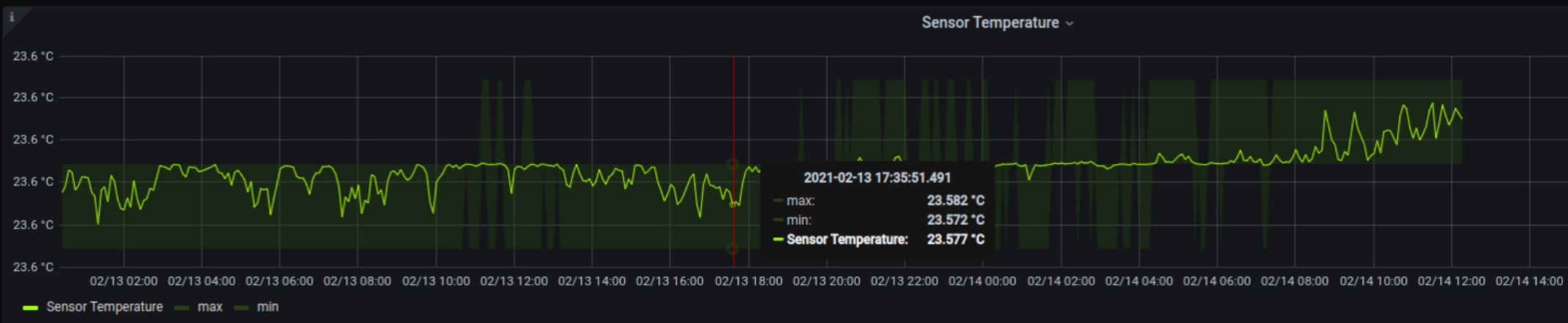


# Newsletter of the Seismological Association of Australia Inc.

## Quarter 1, 2021

> Magnetic Field (4 panels)

~ Housekeeping





Welcome to the Newsletter of the  
**Seismological Association of Australia Inc.**  
PO Box 682, Mylor SA 5153

**Membership** of the SAA is open to all, with the only prerequisite being an interest in seismology. Membership applies for the calendar year. (January through to December)

Membership fees are: Full member \$50

A Membership application form can be obtained from the Treasurer by email or [you may download it here](#).

### **Member Submissions**

Submissions for inclusion in the Newsletter are welcome from all members; please note that submissions may be held over for later editions. Wherever possible, text submissions should be sent via email in almost any word processing format. Images should be high resolution and uncompressed, although high resolution JPEGs are acceptable. Your name may be withheld only if requested at the time of submitting.

All enquiries and submissions should be addressed to the Editor and preferably sent by email to [weaksignals@iinet.net.au](mailto:weaksignals@iinet.net.au)

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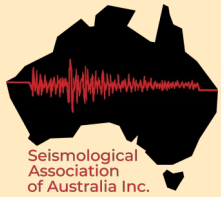
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The SAA can be contacted by post to the address above, or by email to any member of the Committee.



# SAA News

**Members Meetings** - On Monday, February 8th, the first of this year's General Meetings was held via Zoom. It was pleasing to see over 50% of financial members in attendance, along with our guest for the evening, Marcus Weidemann. Markus is the owner of the magnetometer which is being loaned to the SAA and installed at The Peters Seismic Observatory (TPSO). The meeting opened with Chairperson Blair Lade welcoming members and guest, followed by a short introduction from those present. Secretary/Treasurer Joe Grida then presented a state of membership report, followed by a brief financial statement. David Love took to the screens and gave a short talk on a project primarily developed for land owners hosting our seismic sites - a series of maps showing the number of seismic events detected and determined by each station during 2020 (refer pages 7, 8 & 9 for details). Another presentation followed, showing inconclusive results from a series of small quakes around the area of Moonta SA, where David Miller is investigating some unusual seismic activity using his own station (WALR) and several temporary sites located close by.

Members are reminded of upcoming General Meetings via Zoom, the second being held on April 12th, the third on June 14th and the final on August 9th. The 2021 AGM is currently scheduled for October 25th. For SA members and those members with interstate travelling permission, there may be an "in-person" casual BBQ/working bee at Jim Deer's residence just outside of Lobethal, sometime in April. Following the bushfire which swept through the area last year, there are a few jobs around that we should be able to assist with.

**State of the Network** - It's all happening at TPSO. In January, there was a small scrub fire close to the house and just up the hill from the vault. SA Power Networks appears to have concluded that the power pole (we call them stobie poles) may have been the problem and decided to replace the whole thing. Trouble was they forgot to restore power to the farm (and the vault) for over 24 hours. Fortunately, our recent DC power upgrade helped the facility continue to function for the whole outage without even a glitch. In between the natural and man-made disasters, Blair & Peter were able to install a pair of Ubiquiti LOCO M2 Nanostations Wireless Access Points, extending the Fixed Wireless NBN available at the house, down to the vault. Eventually all the instruments will be moved from the 3G modem to the new connection, allowing additional data capacity, significantly higher speeds and greater reliability.

David Love and Jim Deer have removed the remaining equipment from Torrens Island (refer pages 19, 20 & 21)

**On the Cover** - the public website for the new [Magson Magnetometer](#). It's a little early to say much about the magnetometer at TPSO, other than it is in and connected to the outside world via our new datalink to the vault. Additional work needs to be carried out to find an optimal location for the device where the effects of structural steel is minimal. This image does indicate one of the primary reasons that Markus has chosen TPSO as a suitable site for the instrument, a stable temperature.



# Bowen Sequence Update

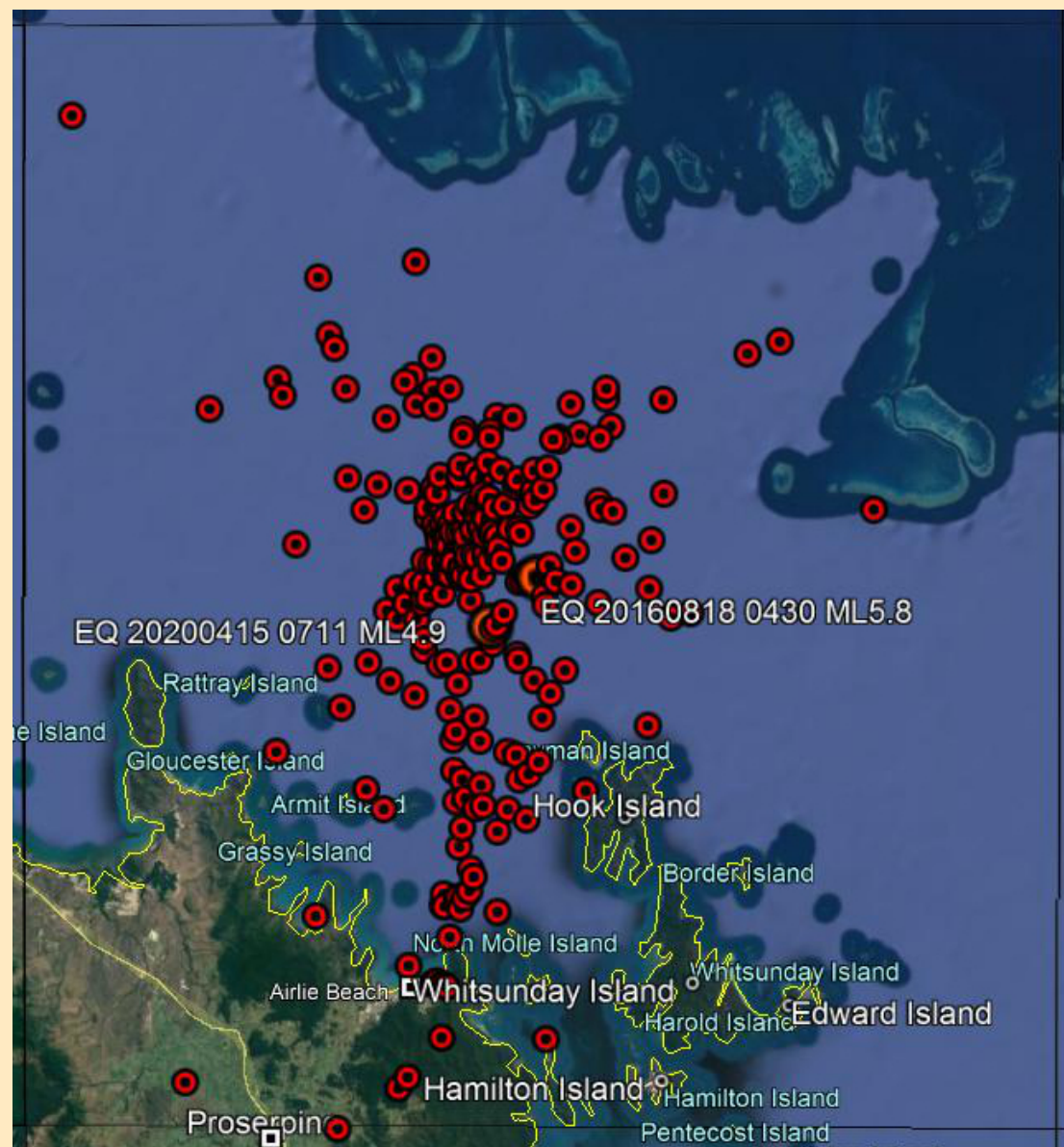
2021-01-31

Kindly submitted by Mike Turnbull  
Lead Seismologist, Central Queensland  
Seismology Research Group (CQSRG)

As I mentioned in my previous post, the upgrade of the BW1H and BW2S stations has allowed me to continue scanning for low magnitude events occurring subsequent to the 2016 ML 5.8 event in the Whitsunday Passage area. I am unsure whether to refer to the current ongoing events as aftershocks; although, I am certain that the current elevated seismicity is occurring as a consequence of the 2016 ML 5.8 event. In that sense they are genuine dependent events, and therefore fit that classification of aftershocks; however, the longevity of the sequence is such that it does not fit the classical description of aftershock events. All current indications are that the sequence will be ongoing for the foreseeable future in the immediate Whitsunday Passage area at the current temporal, spatial, and magnitudinal seismicity. For this reason I will refer to them as The 2016 Whitsunday Reactivation Series.

I am restricting the target area to the one degree geographical square centred on the main 2016 event location, as shown in the accompanying map, which shows the events that have been located. The event in the NW extreme is possibly not part of the series.

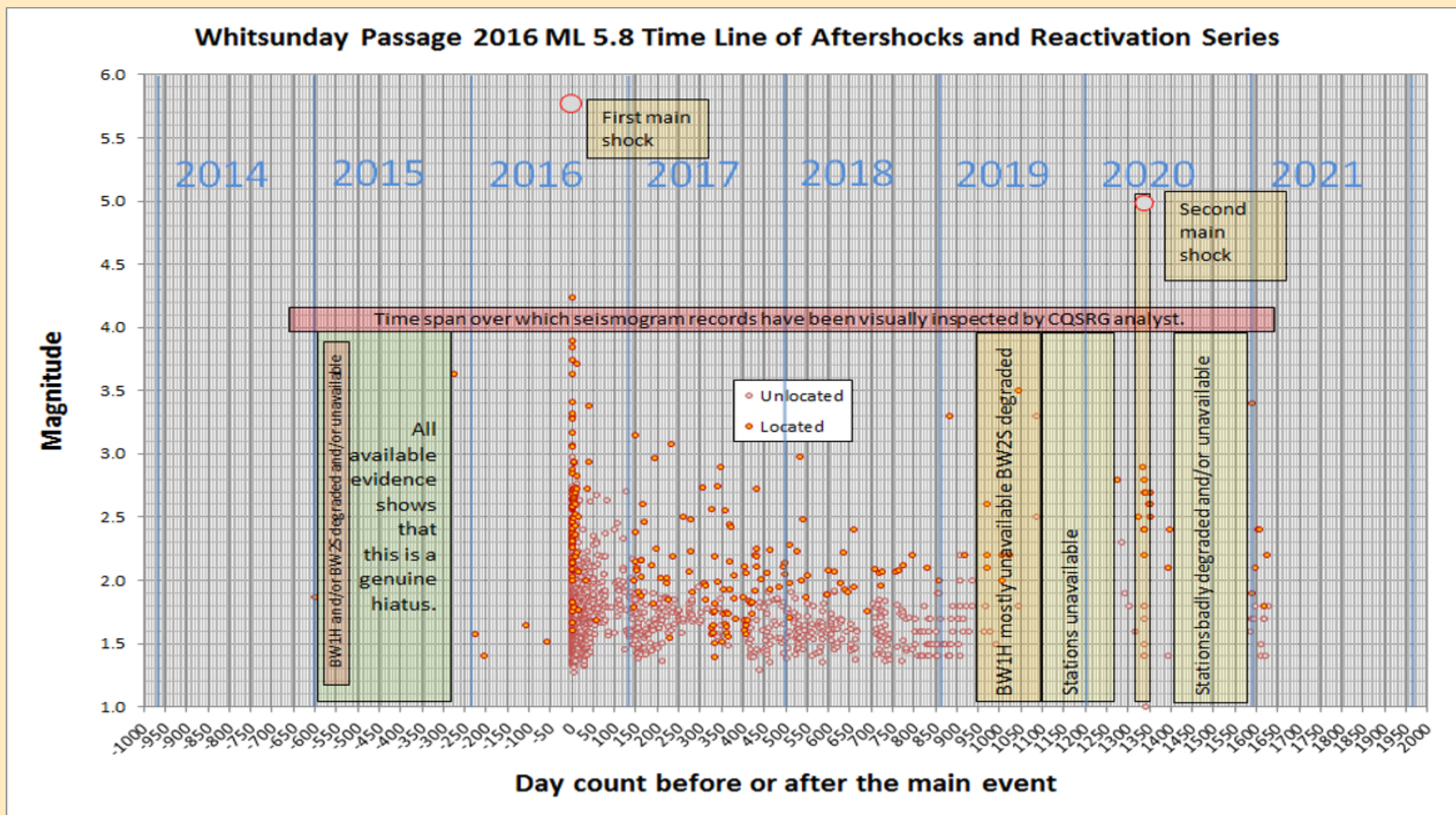
I am currently reviewing all of the events that I have detected from the main event forward in time, and discrimination between those events I have been able to get a location on, and those I have not (due to insufficient or dubious recordings). The graph I have included on the next page has been updated to reflect this work. It also has annotation that clarify gaps in the series.





# Bowen Sequence Update

2021-01-31





# Bowen Sequence Update

2021-01-31

I am also scanning backward in time from the main event to look for previous events – and there have been some. These may or may not be precursor events, or they may be representative of the independent ambient seismicity prior to the main event.

In general the new Bowen instrumentation is allowing me to get much more distinct recognition of earthquake events.

I am using two methods to determine the assigned magnitudes:

1. Using the magnitudes published by GA for numerous post-main events and performing regression against the BW1H and BW2S peak amplitudes, I have determined an empirical magnitude formula.
2. Waves V3.6 uses published online station parameters to calculate magnitudes. This works for the Bowen stations prior to the December 2020 upgrade, but does not work for the post-upgrade Bowen stations, but works for the CTAO station (consequently I am currently using my empirical formula for the Bowen stations).

I am confident that the vast majority of the detected-but-unlocated events shown in the graph are occurring in the target area – although there may be a very small number of false positives. I am using the relative arrival times at the two Bowen stations to indicate that the events are coming from the eastern half plane and the diagnostic appearance of the 2Hz to 10Hz filtered Bowen station seismograms, as discrimination factors.

While I can devote time to recording and documenting the ongoing series, I do not have the time nor the resources to conduct more in-depth research into this series. I would therefore strongly encourage GA to recognise this series as being of sufficient importance in the Queensland seismological history to warrant some serious investigation. In particular what information it provides for determining the future Queensland seismic hazard.

It is not just this series that is of importance – there are the 2015 ML 5.0 Mt Perry and the 2015 ML 5.7, 5.2 and 5.0 Rainbow Beach events that also warrant further investigation. Unfortunately, unlike the Mt Perry and Whitsunday events, there is no instrumentation close enough to the Rainbow Beach events to provide meaningful evidence of ongoing dependent events.

As well as giving serious consideration to the abovementioned research, I believe it is time that active consideration be given to densifying the Queensland monitoring network – particularly in the Wide Bay/Burnett and Bowen regions. Meaningful research depends on good data and in the absence of sufficient monitoring density research quality is destined to be poor or meaningless. There is an opportunity to partner with the SEQWater and SUNWater organisations to reactivate their currently languishing infrastructure monitoring networks. The instrumentation is in the field and there is an existing data collection communication network (that was working in 2017). It may only be a matter of formal negotiation with the water companies that results in the data from those stations becoming available for GA to use and publish.

As always, you can keep up-to-date on the Whitsunday Series as it unfolds by visiting the [CQSRG web site at http://cqsrq.org/bowen/](http://cqsrq.org/bowen/).



# Seismic Location Maps by Station - 2020

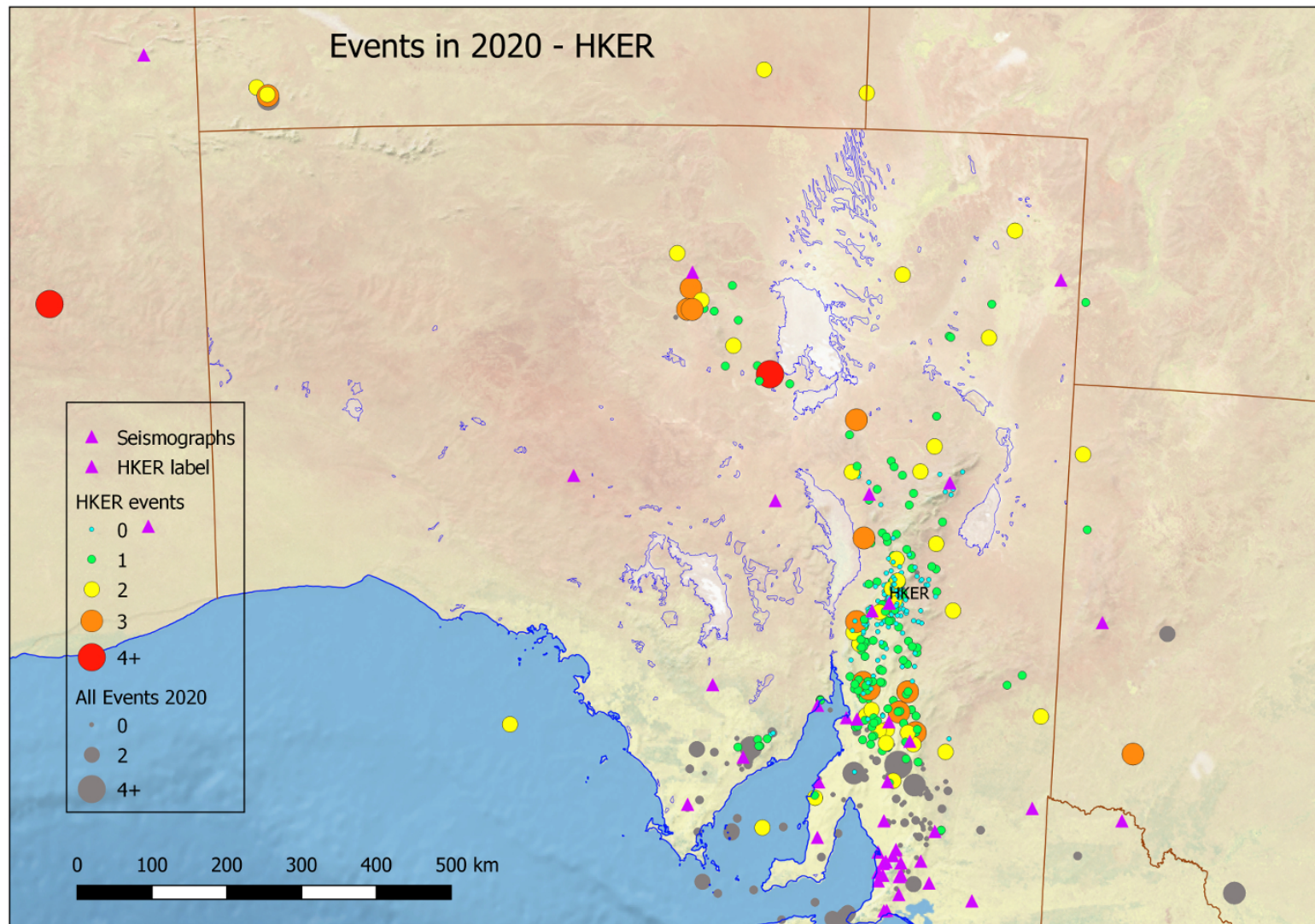
Kindly submitted by David Love  
Chief Seismologist  
Seismological Association of Australia Inc.

The network in SA worked very well during 2020. Alison Wallace added nearly all of the 568 earthquakes that are listed

on the [SAA's mappage website](#). The graph shows how many times each station was used in an event, including a number of interstate stations.

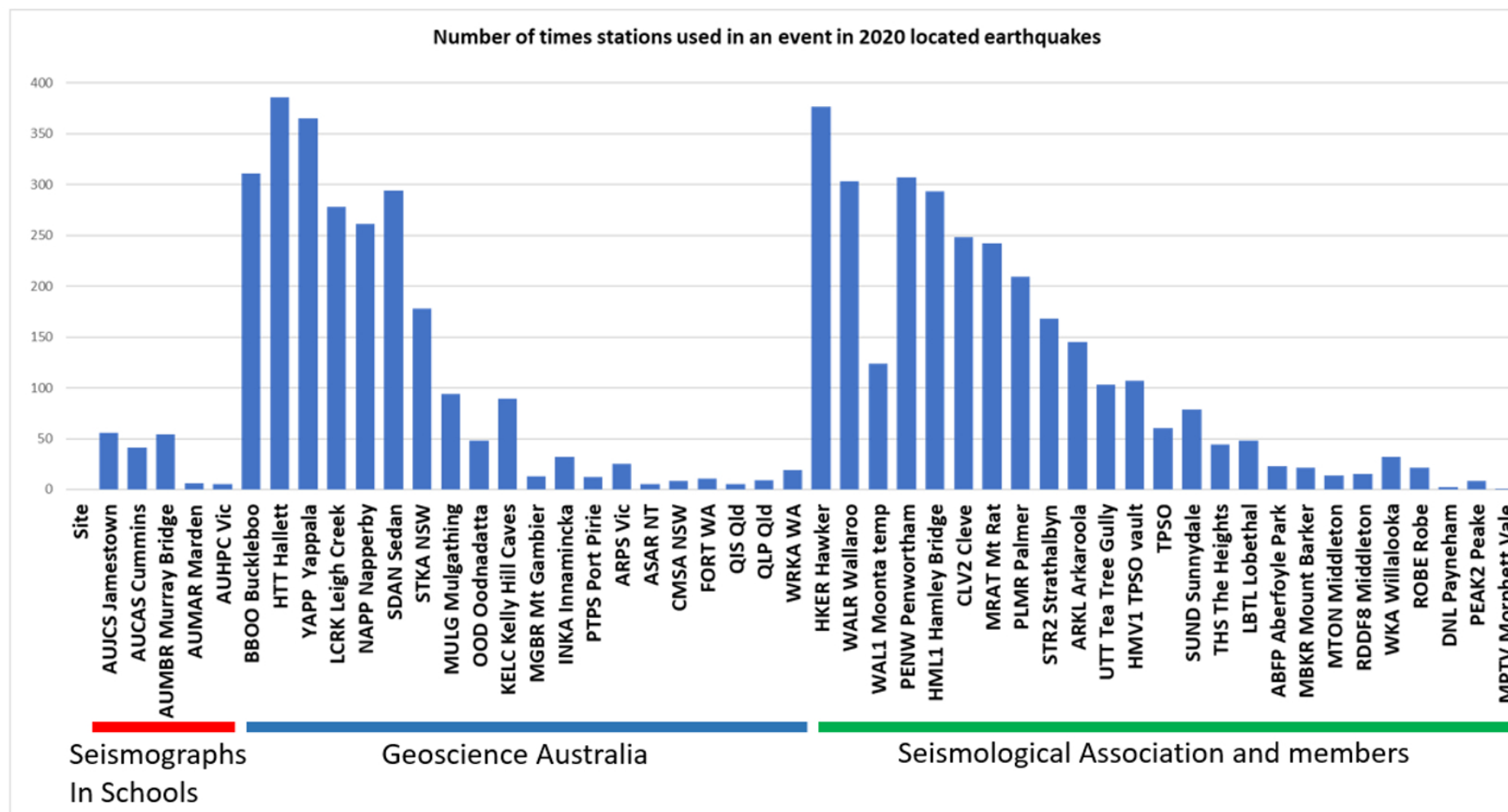
We use stations from the SAA network, Geoscience Australia, and the ANU's Seismographs in Schools network. Stations in active areas, away from civilisation, or on rock figure prominently. Stations in seismically quiet areas, near habitation, or on soft soils are least often used.

The Seismographs in Schools sites are noisy but three of them have often been used, and the Cummins site has been particularly helpful. A couple of plots for the Hawker and Cleve seismographs are shown.



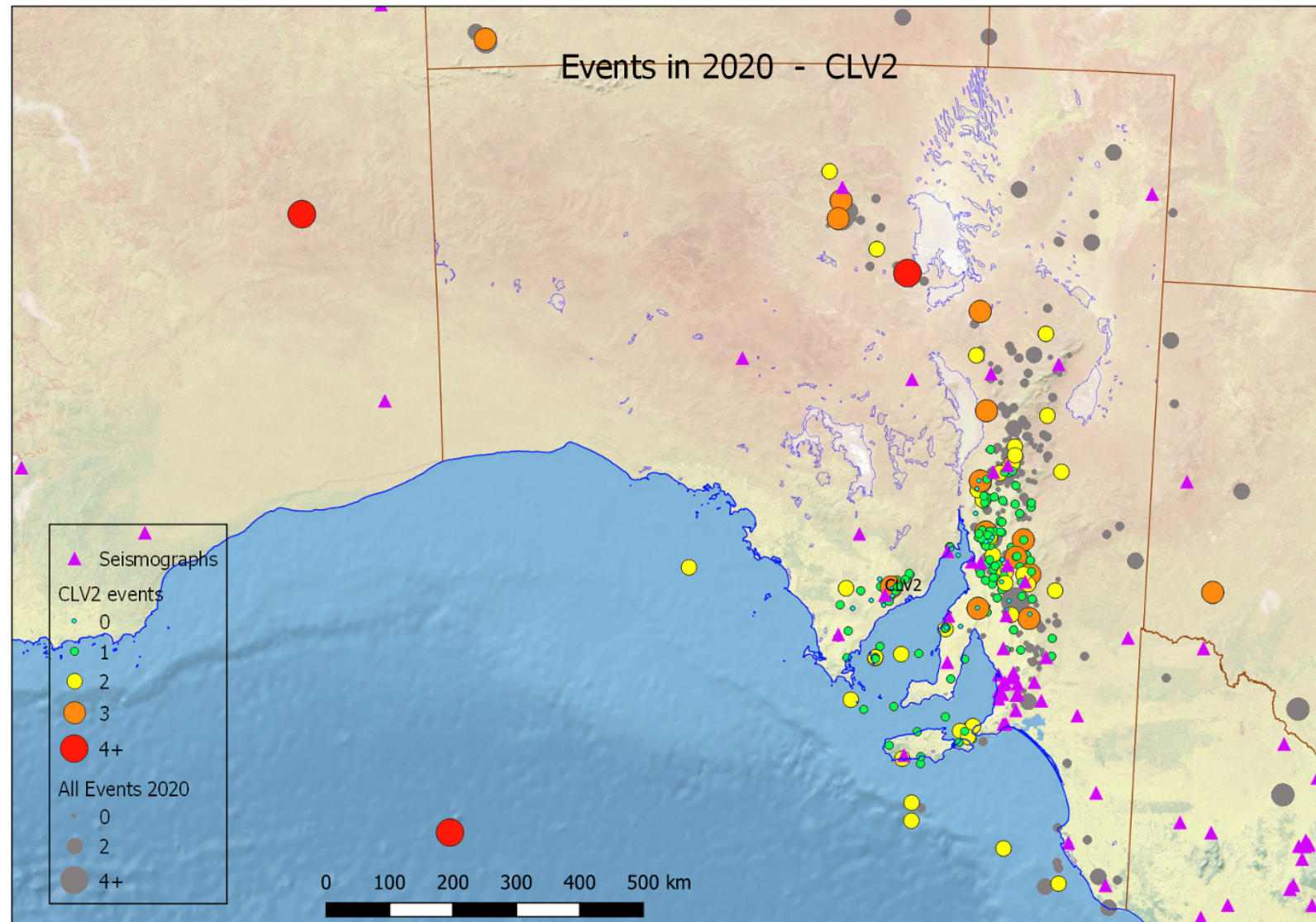


# Seismic Location Maps by Station - 2020





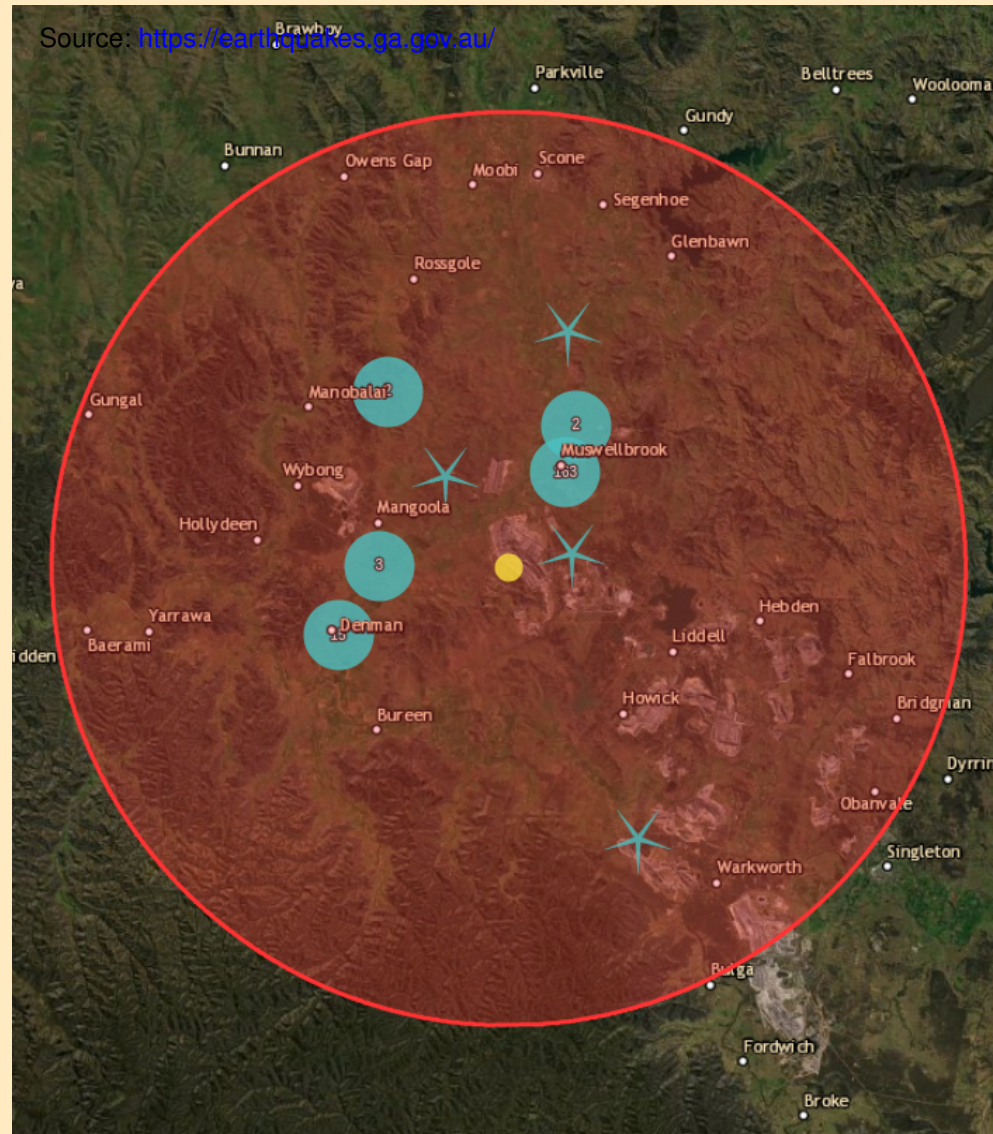
# Seismic Location Maps by Station - 2020





# Recent Seismic Activity - New South Wales

2021-02-07 09:41 SW of Muswellbrook -32.34, 150.84 3.5ML



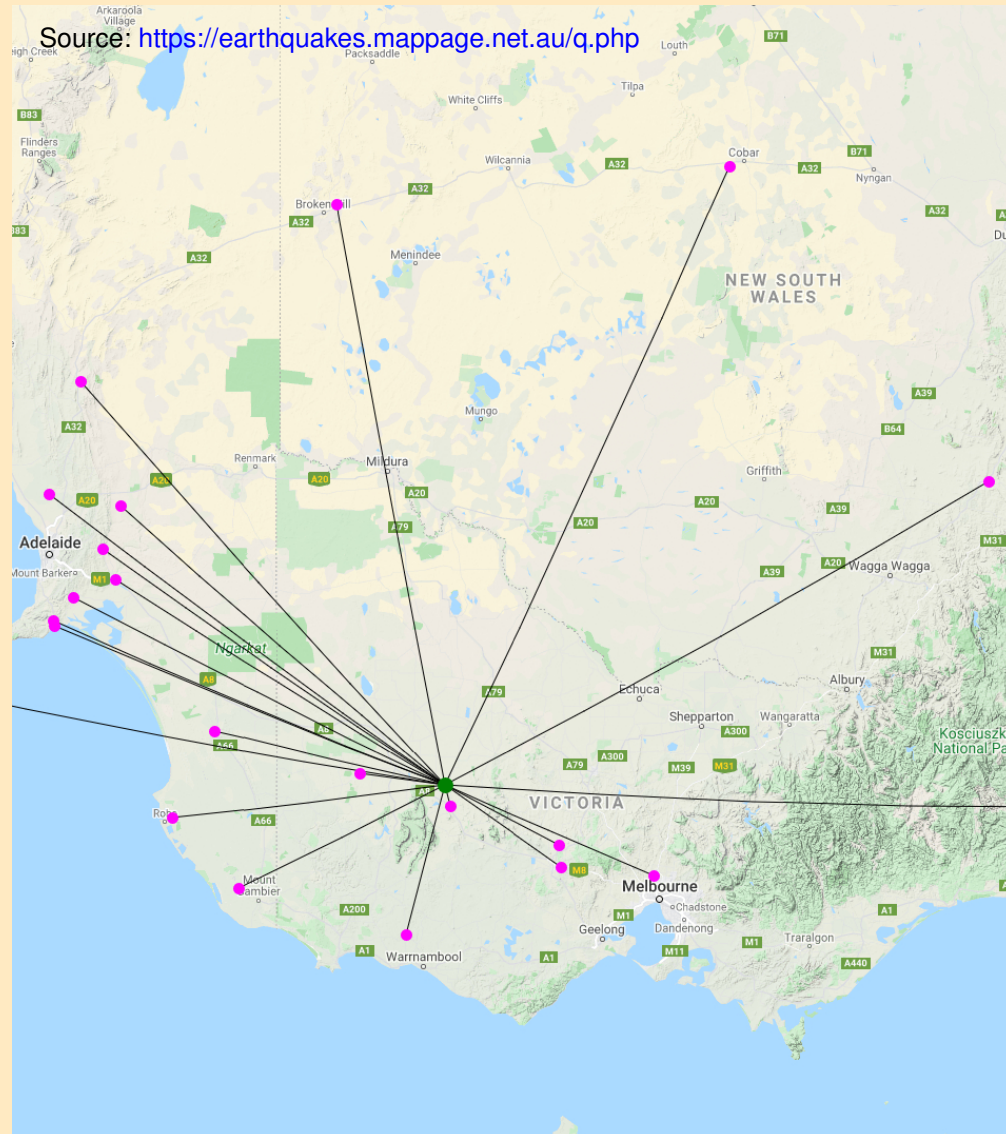
2021-01-31 20:20 NW of Boomi -28.64, 149.51 2.7ML





# Recent Seismic Activity - Victoria

2021-01-14 20:28 Stawell -36.875, 142.719 3.9MLv



2021-01-25 20:51 N of Balmoral -37.12, 141.86 2.3ML





# Recent Seismic Activity - Western Australia

2021-01-29 19:47 S of Seringapatam Reef -13.92, 121.80 5.6ML

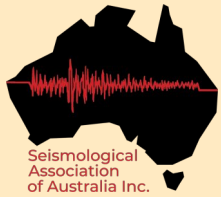
Source: <https://earthquakes.ga.gov.au/>



2021-02-07 07:29 Pannawonica -21.71, 116.39 3.6ML

Source: <https://earthquakes.ga.gov.au/>

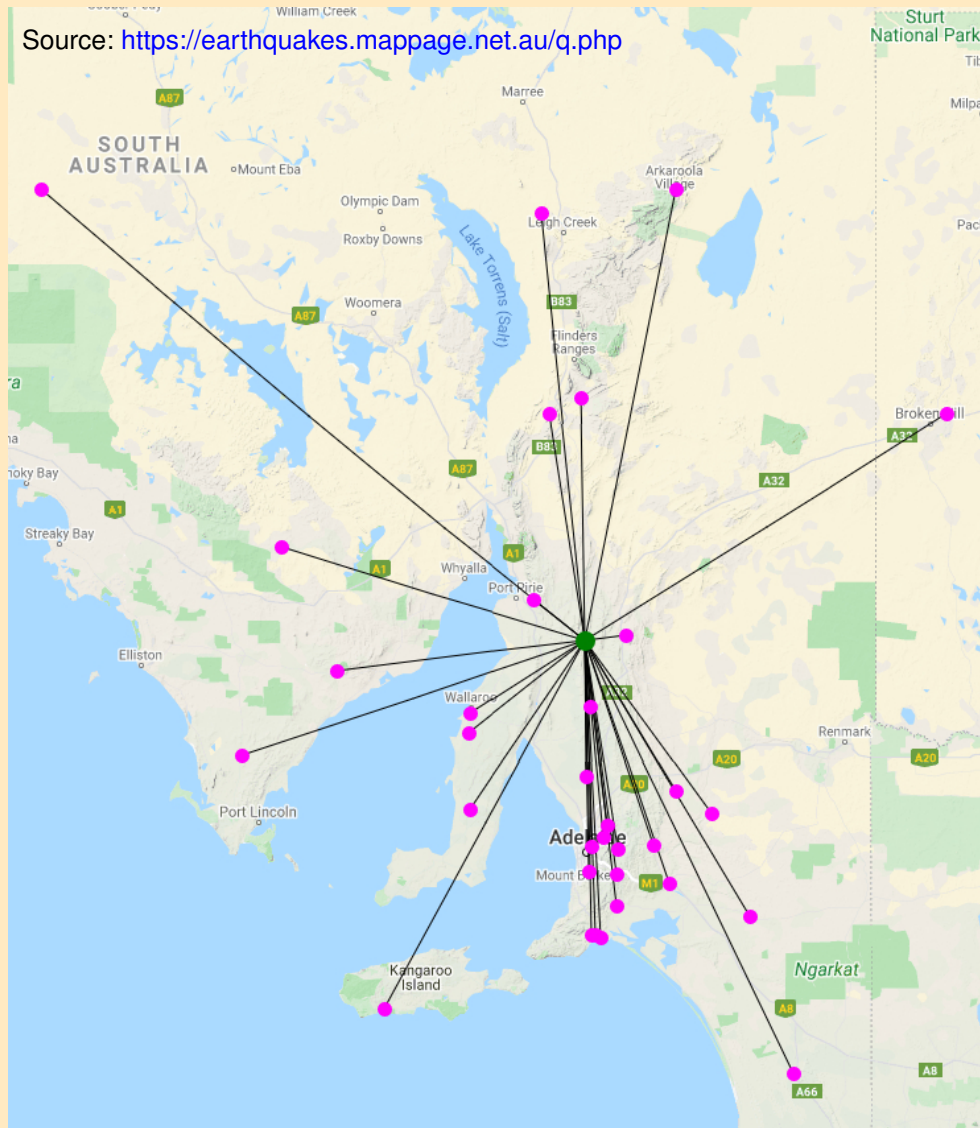




# Recent Seismic Activity - South Australia

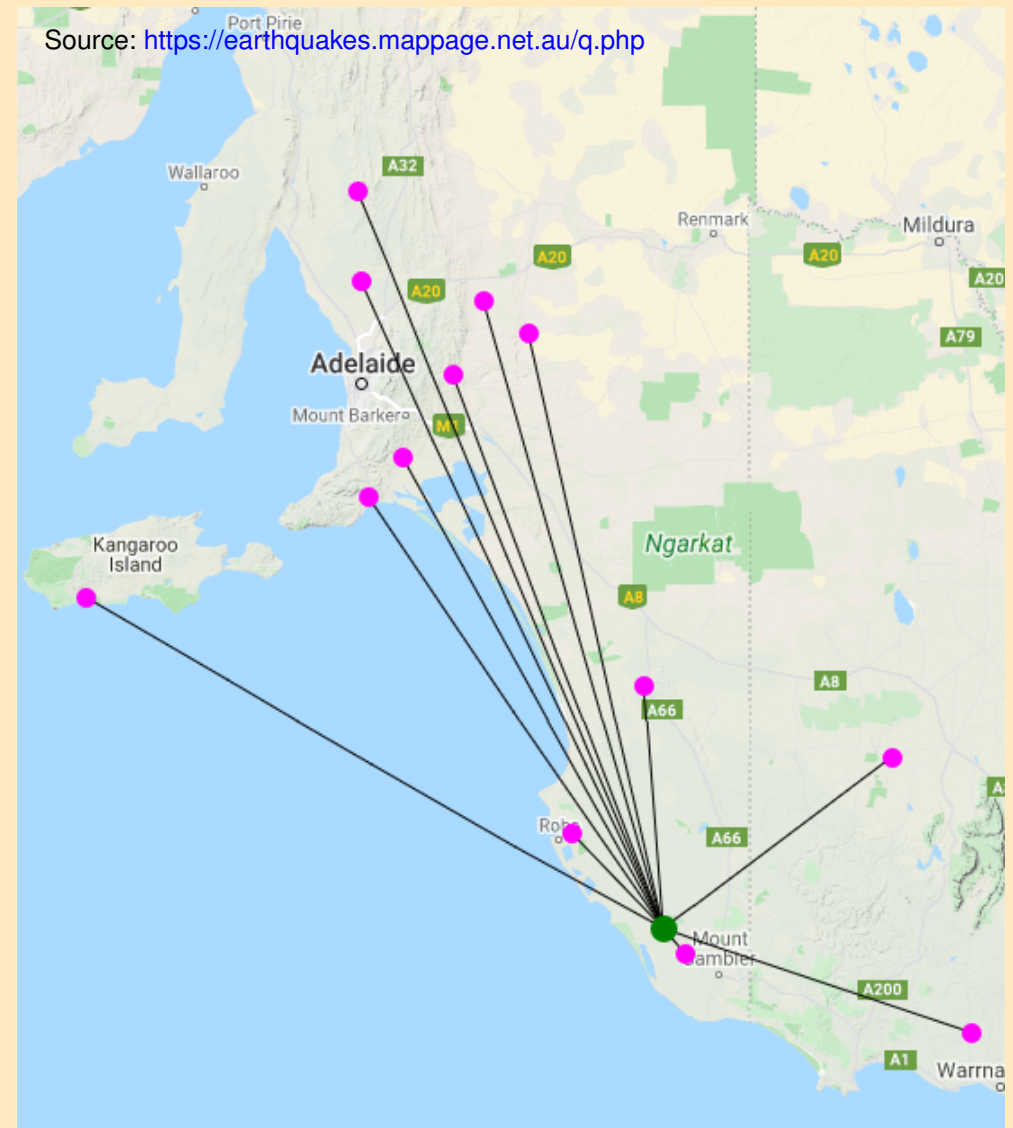
2020-12-12 09:35 Spalding -33.4641, 138.58 2.8MLv

Source: <https://earthquakes.mappage.net.au/q.php>



2020-12-26 14:06 Millicent -37.6094, 140.438 2.5MLv

Source: <https://earthquakes.mappage.net.au/q.php>

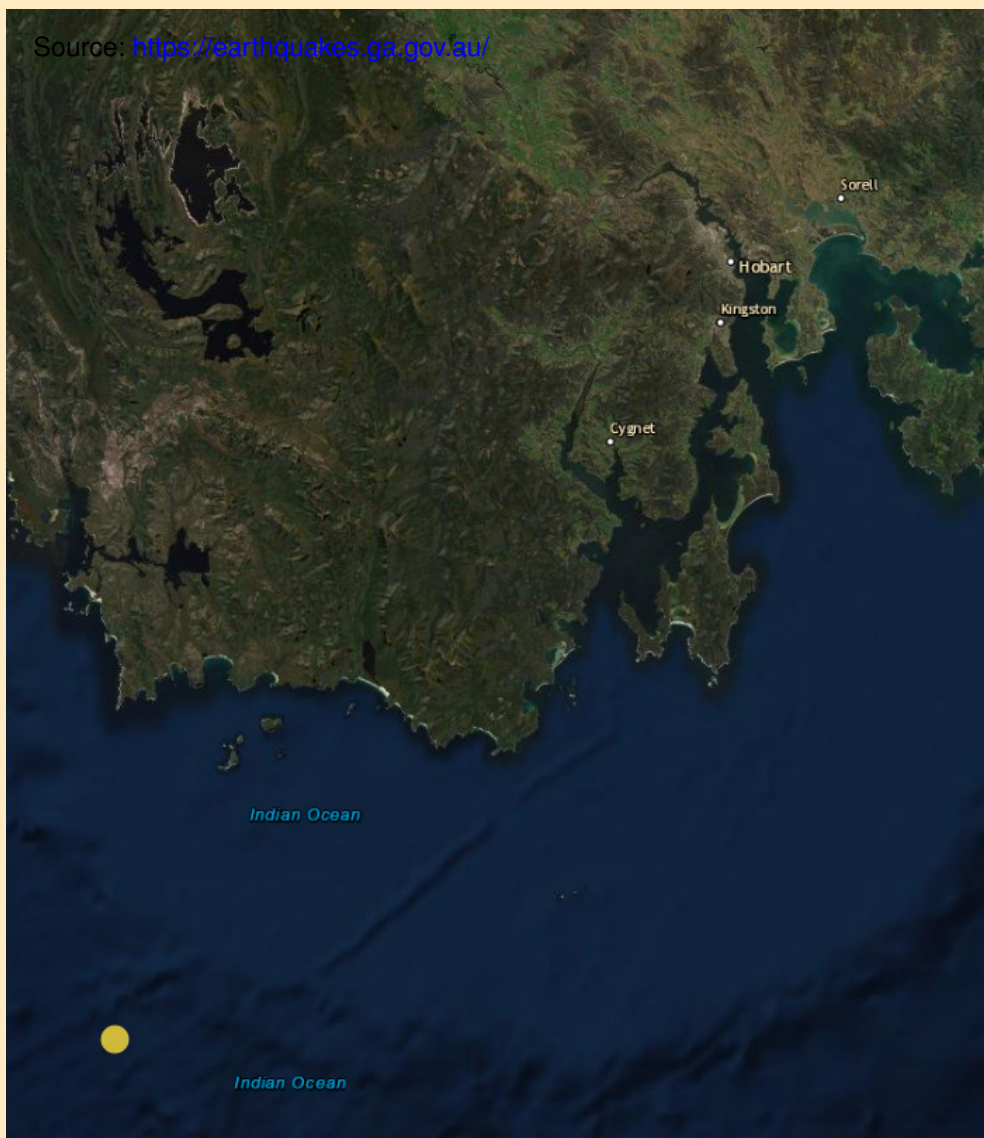




# Recent Seismic Activity - Tasmania

2020-12-11 08:24 Indian Ocean -44.08, 146.03 3.4ML

Source: <https://earthquakes.ga.gov.au/>



Sadly, there wasn't much in the way of seismic events to choose from in Tasmania and none in Queensland, from the beginning of December 2020 to the middle of February. Not according to Geoscience Australia's website anyway.

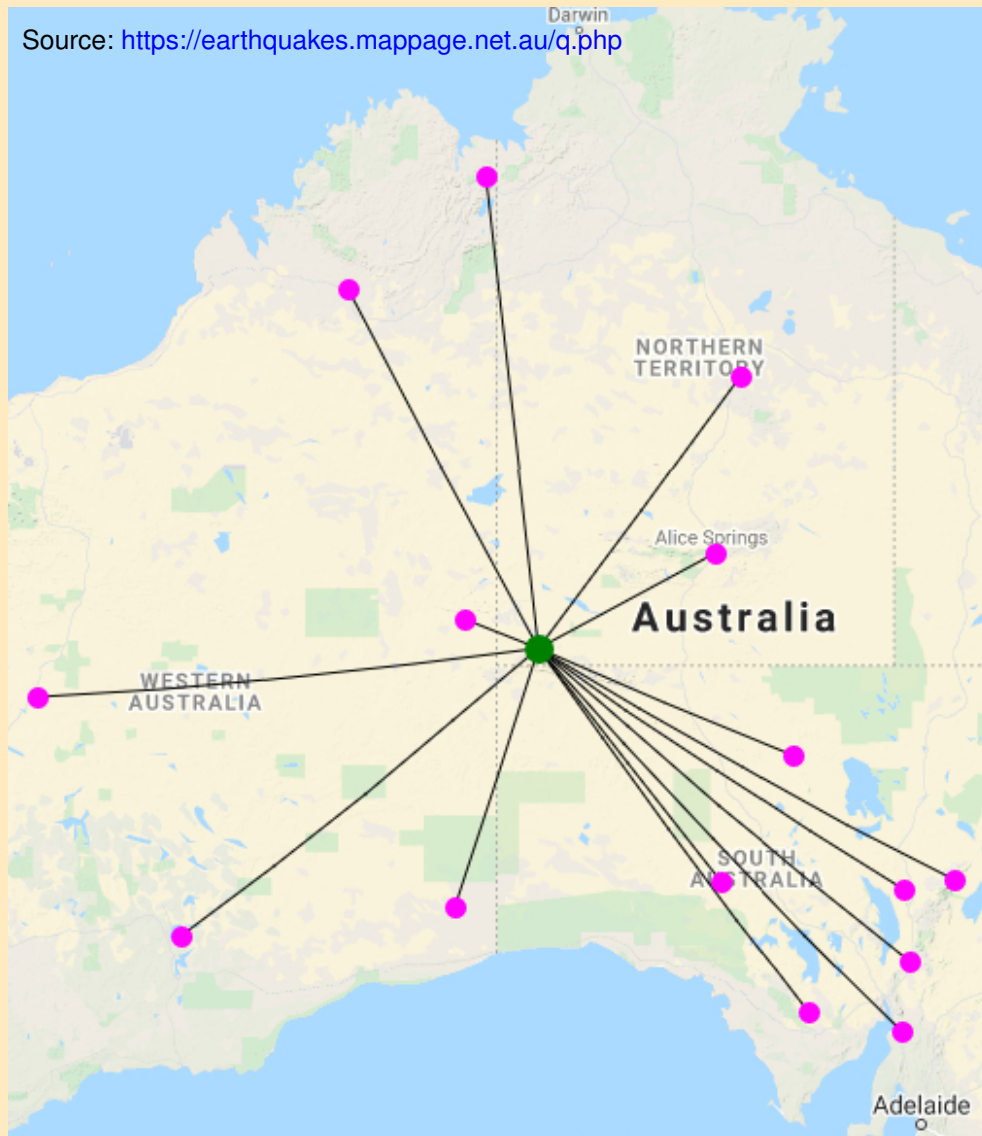
So if you have felt, detected, recorded an event in your region (anywhere in Australia) I'm looking for info on two sizable quakes that have occurred in each state since the last SAA Newsletter. The best reported will be published in the following edition. You can get an idea of what's important from the images on these pages - event date/time in UTC, location coordinates and magnitude. If possible, please identify the stations used to determine the hypocentre of the earthquake.



# Recent Seismic Activity - Northern Territory

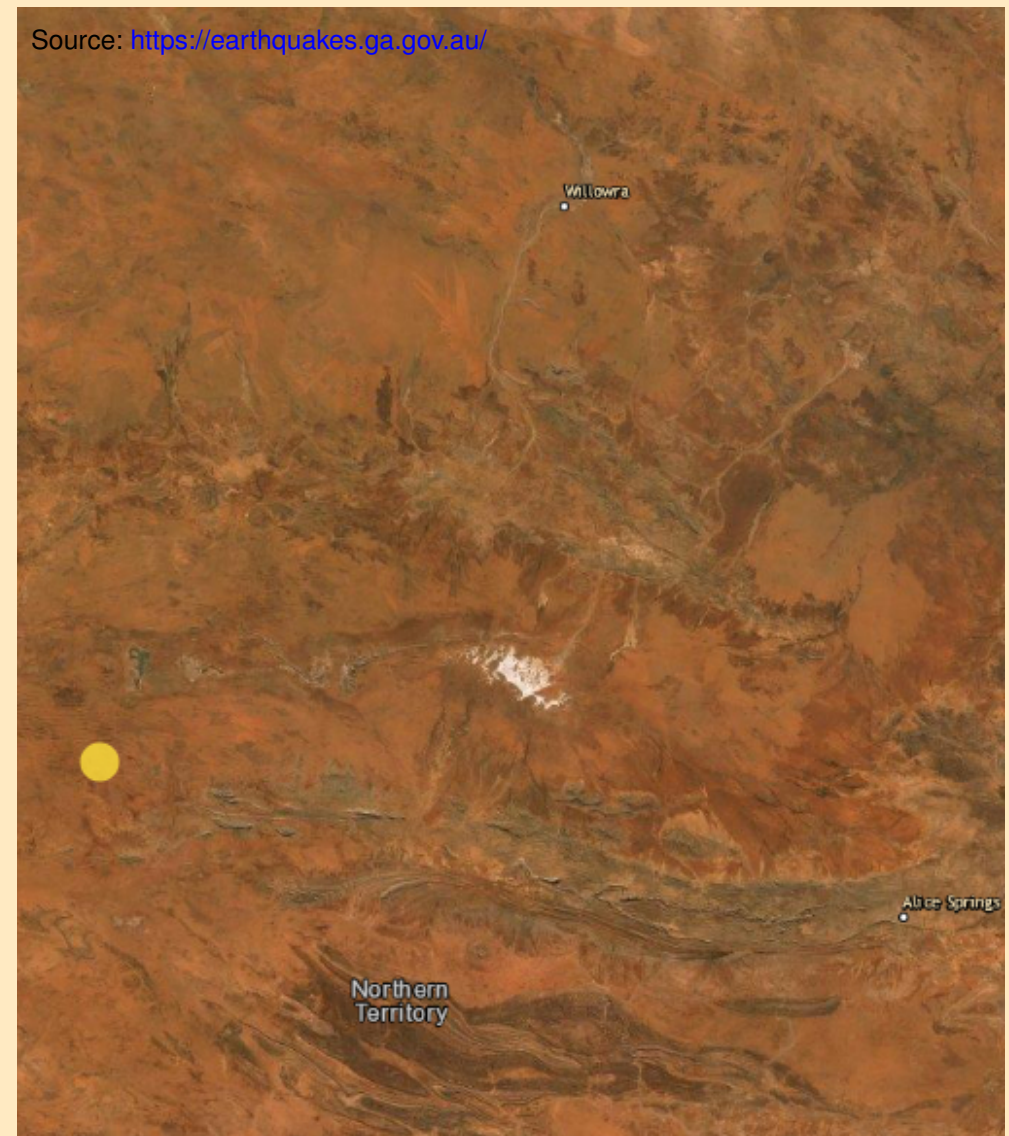
2020-12-05 05:05 SW of Yulara -25.6359, 129.944 3.2MLv

Source: <https://earthquakes.mappage.net.au/q.php>



2020-12-21 17:14 SE of Nyirripi -23.17, 130.88 3.3ML

Source: <https://earthquakes.ga.gov.au/>





# CROATIAN EVENT

Kindly submitted by  
Kevin McCue

**Thought a short note about the recent Croatian earthquake would be interesting.**

A shallow magnitude Mw 6.4 earthquake struck near Petrinja, Croatia, about 30 miles southeast of the capital of Zagreb, on December 29, 2020 at about 12:20 pm local time. Seven people died in the collapse of old URM (un-reinforced masonry) buildings. There were two strong foreshocks and hundreds of small aftershocks in following days.

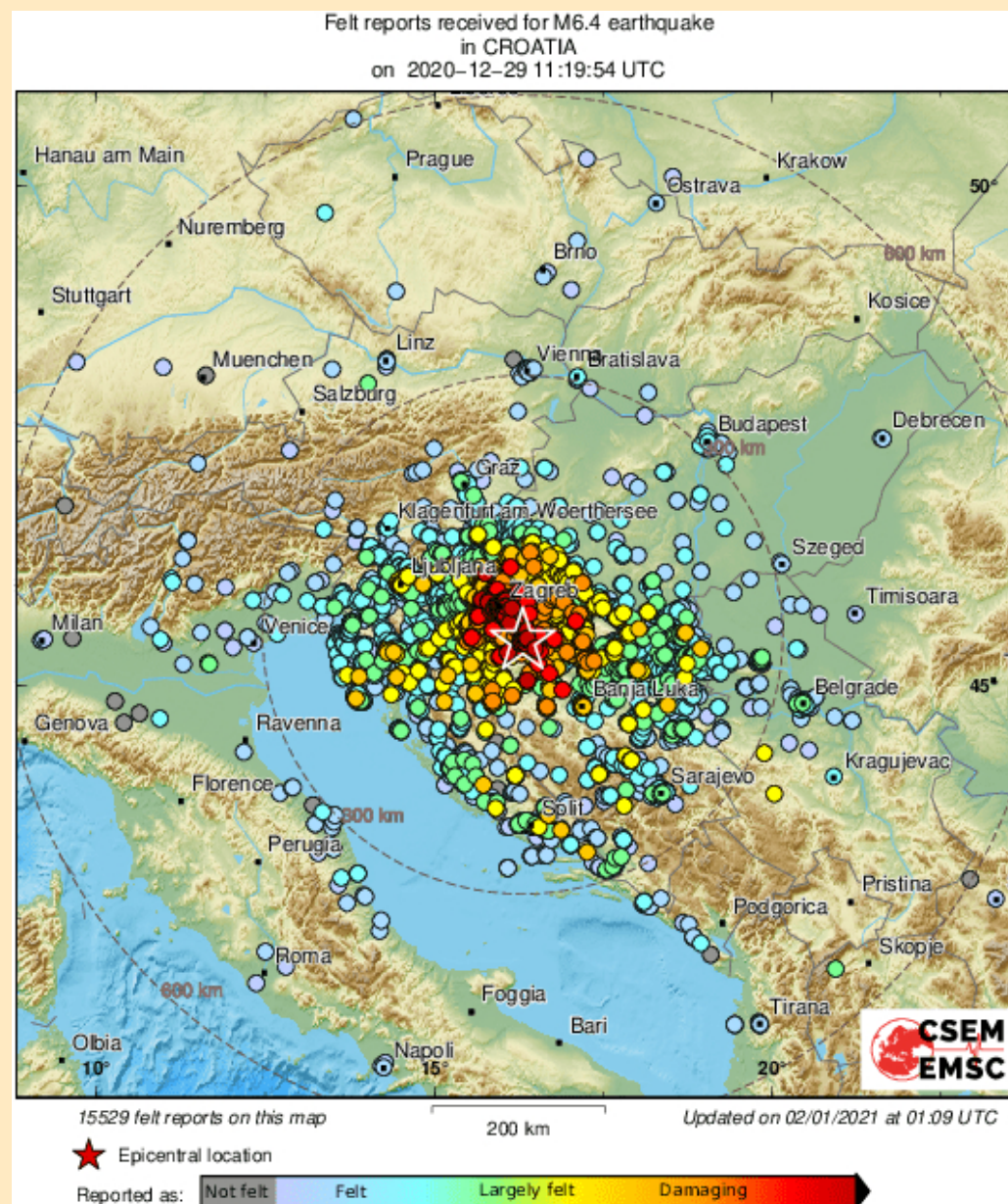
This is the largest earthquake to occur in Croatia since the advent of modern seismic instruments. An earthquake of similar size occurred in 1880 near Zagreb and three magnitude 6 and larger earthquakes have occurred within 200 kilometers of the December 29, 2020 earthquake since 1900. The felt area included Germany and Austria, the felt radius nearly 600km.

Below is Dr Sinadinovski's translation of a Facebook article written by Josip Stipčević on the day of the earthquake in Croatia.

## 30 Dec 2020 Facebook text on the Croatian earthquake.

A couple of explanatory notes:

- 1) Josip Stipčević is an Assistant Professor at Zagreb University, Faculty of Science, Department of Geophysics.
- 2) Pokuplje is the name for the Kupa river basin in Croatia.
- 3) Major settlements are Karlovac, Sisak, Petrinja, Glina and Topusko.
- 4) Andrija Mohorovichic studied the 1909 earthquake in Pokuplje and the seismic waves associated with that event. He noticed





# CROATIAN EVENT

that the seismic waves arriving at stations when passing through the mantle had a greater velocity than through the crust. The amount of time differences allowed him to determine the depth of this boundary layer, later named MOHO in his honour.

5) The accompanied figures of the text are given in the Facebook links below

"While we anxiously follow the efforts of rescuers in Petrinja and the surrounding area, I will try to explain something about the earthquakes that happened in the area. Today's earthquake occurred on a fault which roughly extends in a northwest-southeast direction through the Pokuplje region near Petrinja and Glina ([Figure 1](#)). That is a border between two very different tectonic blocks - the Dinarides and the Panonian basins. Stress and strain are compensated through these constantly moving blocks. The main cause of today's and yesterday's earthquakes is far from the very location of the earthquakes, more precisely in the Adriatic area. The Adriatic area is a small tectonic plate that used to be part of the large African plate, which separated many million' years ago. Thus, "our" small plate called Adria and its movement and its interaction with the European continent is the cause of earthquakes in Croatia, Italy, Bosnia and Herzegovina, Slovenia and surrounding areas. The impact of this interaction is most visible in the areas along the Adriatic coast where mountain chains clearly indicate the Adria's borders in respect to other tectonic plates. Also, the strongest earthquakes in the areas occur near the contacts of various blocks, but the impact is not limited only to those narrow zones and is transferred to the wider region as well.

If we take a closer look at the fault system where today's earthquake

has occurred, it is obvious that fault slip during that earthquake was lateral i.e. the movement was horizontal and happened on a plane perpendicular to the surface as show on [Figure 2](#). Such an earthquake mechanism is very unusual for Croatia where most of the earthquakes occur because of pressure from the Adria's plate and a compression regime in which one side of the fault is pushed over another. The first estimates point towards the earthquake occurring on the northwest-southeast fault and the rupture length was about 25 km.

Such a fault plane mechanism and its fault extension indicate that there has been a shift in the northern part of the fault's side towards the east. The last strong earthquake in that area happened in 1909, when Pokuplje was shaken by a destructive earthquake of magnitude 5.8. After that event, when the elastic energy accumulated in the rock mass around the fault was released, a new cycle of stress and strain along the blocks began under the influence of the tectonic forces. Since then, till today, the tectonic forces have strained rocks in the area until the breaking point which caused today's catastrophic shaking in the area of Glina and Petrinja.

It is important to look back at the unusual trace of events in this earthquake series. Although we hoped that yesterday's shaking was the main earthquake, it turned out to be just the foreshock and a stronger earthquake happened today. Of course, it's not excluded that an even stronger earthquake may occur in the next few days, although it is unlikely. So far, it is certain that there will be many more subsequent earthquakes, some of which might be quite strong and may cause further damage. Today's earthquake reports and its catastrophic impacts will still be useful. From the records of the earthquakes which happen and the ones that will happen in the coming days and weeks, we will learn a lot and that will help in mitigation of the devastating effects of future earthquakes in Croatia."



# CROATIAN EVENT

**Destroyed houses  
and a car are seen  
on a street in  
Petrinja, Croatia**

**December 30, 2020**

**[Slavko Midzor/  
Pixsell/Reuters]**





# Closure of Torrens Island Seismograph

Kindly submitted by David Love  
Chief Seismologist  
Seismological Association of Australia Inc.

In 2007 a seismograph (TORR) with accelerometer was installed in the backyard of a cottage on Torrens Island (Figure 1). The quarantine service operated the cottage, and the seismograph was powered from the mains supply. It was particularly placed to see what response there might be in a larger event, on the soft marshy coastal area.



Figure 1



Figure 2



# Closure of Torrens Island Seismograph

While there were no large earthquakes over its lifespan, phase times were used for locating a number of small local events, and onset polarities were used in a number of focal mechanisms.

On 12 February Jim Deer and David Love removed the equipment (Figure 2). The quarantine service no longer uses the cottages, and the power was turned off. It is hoped that the equipment can be used at another site in the general region.

Over recent years we have had a small net loss of stations near Adelaide. We are still able to get good depths and locations for events, but we may not have sufficient polarities to get reliable focal mechanisms. Figure 3 shows the state of the network a few years ago compared with today. TORR can be seen about 15 km northwest of the city. While a number of sites in the Adelaide region are not low noise, this is not much of a problem with small local events.

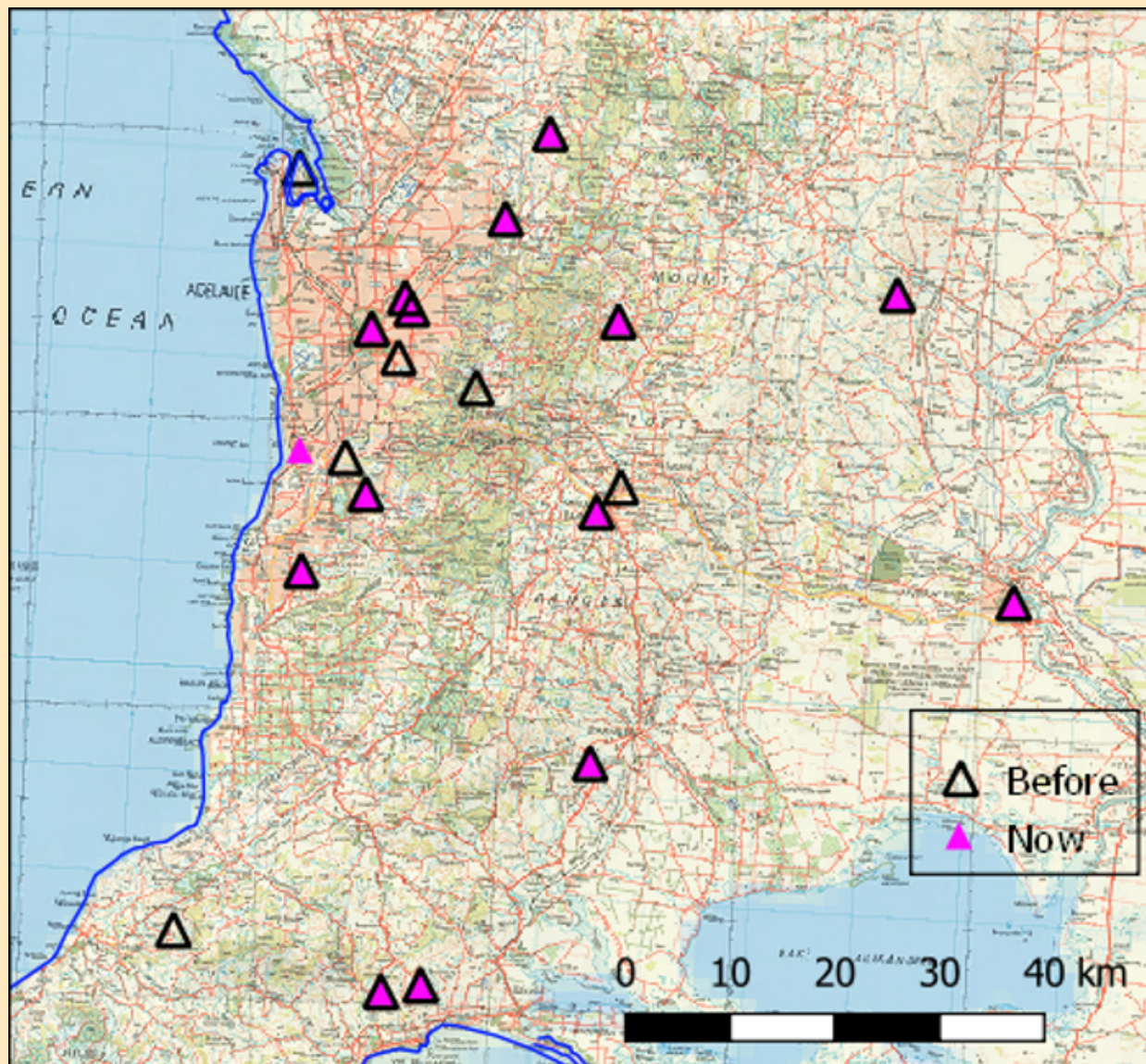


Figure 3



# Closure of Torrens Island Seismograph

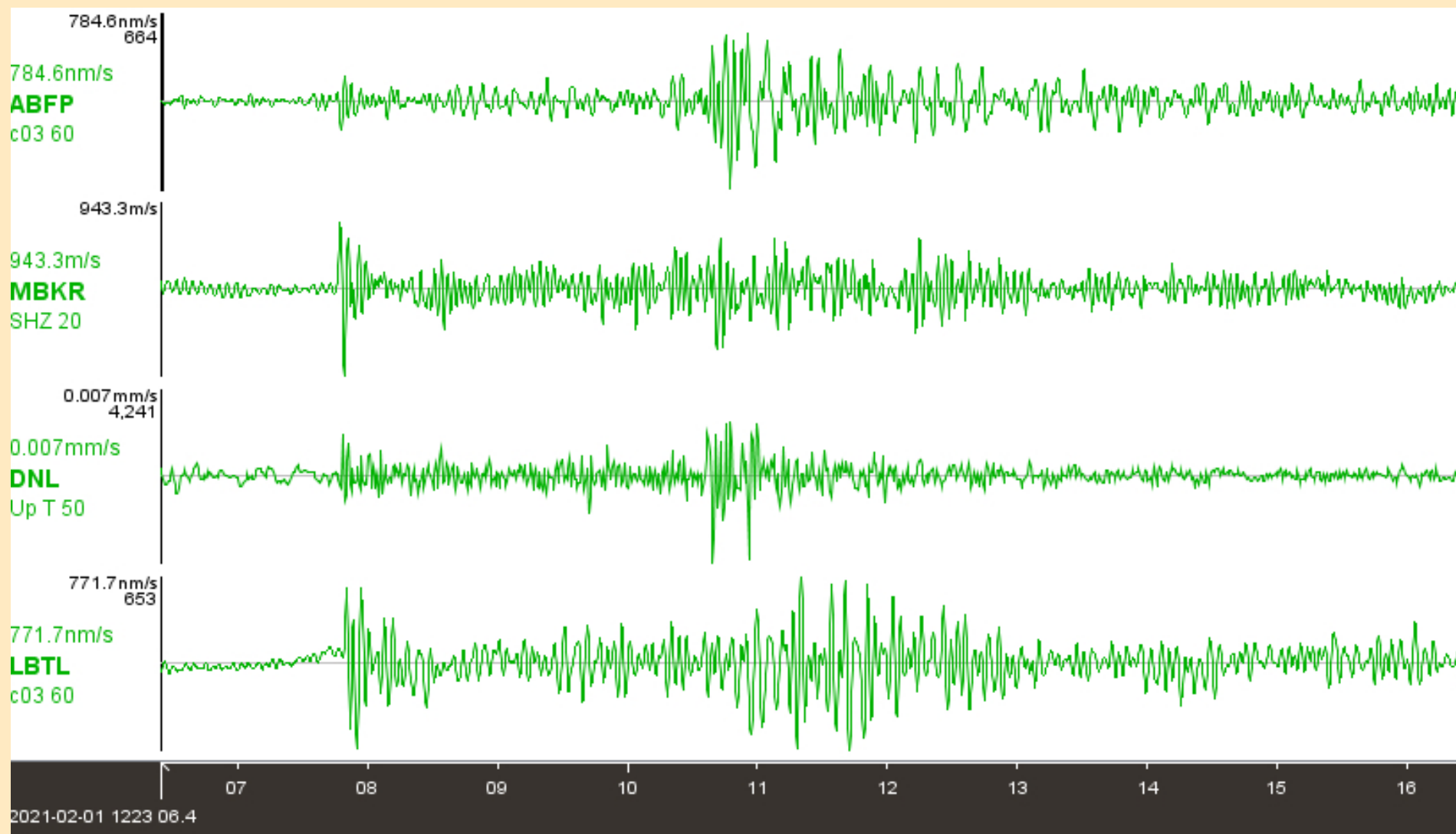


Figure 4 shows the waveforms from four noisy sites for a magnitude 0.5 earthquake which is 20 km deep. Some of the phases are very clear.



# Resources & useful links

Description	URL / Webpage	Notes
<b>SAA Membership Application</b>	<a href="https://www.assa.org.au/media/74629/saa-membership-">https://www.assa.org.au/media/74629/saa-membership-</a>	Join up with the SAA using this form
<b>SAA Flier</b>	<a href="https://www.assa.org.au/media/74629/saa-membership-">https://www.assa.org.au/media/74629/saa-membership-</a>	Our current brochure - flier, saying what we do
<b>SAA Newsletters</b>	<a href="https://www.assa.org.au/resources/seismology/saa-">https://www.assa.org.au/resources/seismology/saa-</a>	Download any SAA Newsletter from this site
<b>SAA EqServer</b>	<a href="http://ade-eqserver.dyndns.org:8080/eqserver/">http://ade-eqserver.dyndns.org:8080/eqserver/</a>	South Australian miniseed seismometers
<b>Melbourne University EqServer</b>	<a href="http://meiproc.earthsci.unimelb.edu.au/eqserver/">http://meiproc.earthsci.unimelb.edu.au/eqserver/</a>	Australian miniseed seismometers
<b>Regional Seismic Network</b>	<a href="http://www.regional-seismic.net/">http://www.regional-seismic.net/</a>	PSN seismometers - Aust. Centre for Geomechanics
<b>Australian Public Seismic Network</b>	<a href="http://cqsrg.org/psn/stations/">http://cqsrg.org/psn/stations/</a>	Australian PSN seismometers
<b>Recent SA Earthquakes</b>	<a href="https://earthquakes.mappage.net.au/q.php">https://earthquakes.mappage.net.au/q.php</a>	Data & summaries of recent SA quakes
<b>Central QLD Seismology Research Group</b>	<a href="http://www.cqsrg.org/">http://www.cqsrg.org/</a>	CQSRG - Kevin McCue
<b>Astronomical Society of SA</b>	<a href="https://www.assa.org.au/resources/seismology/">https://www.assa.org.au/resources/seismology/</a>	ASSA - Seismology page
<b>Geoscience Australia</b>	<a href="http://www.ga.gov.au/earthquakes/initRecentQuakes.do">http://www.ga.gov.au/earthquakes/initRecentQuakes.do</a>	Our national authority on seismic events
<b>Earthquake Services</b>	<a href="https://www.researchgate.net/profile/Colin_Lynam">https://www.researchgate.net/profile/Colin_Lynam</a>	Citizen Science Consultant - Col Lynam
<b>Seismic Research Centre</b>	<a href="https://www.src.com.au/">https://www.src.com.au/</a>	OEM of seismic instruments & software
<b>symCDC</b>	<a href="http://symcdc.com/">http://symcdc.com/</a>	OEM of seismic instruments & software
<b>IRIS Seismic Monitor</b>	<a href="http://ds.iris.edu/seismon/">http://ds.iris.edu/seismon/</a>	Global seismic events
<b>Joint Australian Tsunami Warning Centre</b>	<a href="http://www.bom.gov.au/tsunami/">http://www.bom.gov.au/tsunami/</a>	Bureau of Meteorology site
<b>Australian Earthquake Engineers Society</b>	<a href="https://aees.org.au/">https://aees.org.au/</a>	An organisation with similar interests
<b>Atlas of the Underworld</b>	<a href="http://www.atlas-of-the-underworld.org/">http://www.atlas-of-the-underworld.org/</a>	Mapping the Earth's mantle
<b>Atlas of Living Australia</b>	<a href="https://www.ala.org.au/">https://www.ala.org.au/</a>	A Citizen Science initiative