Seismological Association of Australia

SAA Newsletter

#3/2023

From the Editor We encourage members to submit articles with an earthquake connection of interest to members but accepting they may be edited or not published, at the discretion of the editor. Contributions to: mccue.kevin@gmail.com

Contents

Major Earthquakes Worldwide in April - June 2023

The Southwest Pacific region garnered all eight of the M7+ earthquakes in this quarter. No surprises here. The largest were the M7.7 earthquake on 19 May, shallow depth SE of Loyalty Islands, and the M7.6 earthquake on 10 May at intermediate depth (210km) in the Tonga region.

Figure 1 Location of the World's major earthquakes, M>6.9, April to June 2023, from the USGS.

Only three of the earthquakes were shallow and the deepest at ~600km, occurred on 14 April under Java. One might have been tempted to test the polarity of your station but the first motion is messy. The mechanism from the USGS is shown in Figure 2.

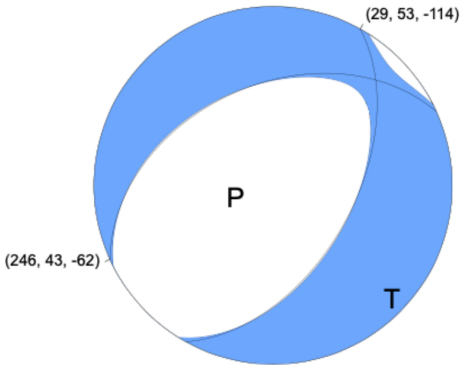


Figure 2 The focal mechansim is that of a *normal* fault (the principal stress is vertical). At most seismographs in Australia, the first motion should have been down (in the "P' quadrant) because the angle of incidence is quite steep.

Seismograms of this earthquake on SAA stations look very different on the broadband stations (such as TPSO) to the normal short-period seismographs most of us operate (such

as WKA). Several secondary phases can be seen, PcP a reflection off the core boundary about 3 minutes later and tantalising a PKPPKP or P'P', a reflection off the underside of the Earth's far surface, 35 minutes after the P. But is it actually an aftershock? Such riches are the reason some of us operate seismographs I suspect.

World Earthquakes April - June 2023, M≥7 (from USGS)

Date/time	latitude	longitude	depth*	mag	magType	place
2023-06-15T18:06:28.174Z	-22.976	-177.13	175	7.2	mww	274 km SW of Houma, Tonga
2023-05-20T01:50:59.158Z	-23.042	170.560	27	7.1	mww	southeast of the Loyalty Islands
2023-05-19T02:57:03.172Z	-23.206	170.742	18	7.7	mww	southeast of the Loyalty Islands
2023-05-10T16:02:00.334Z	-15.628	-174.493	210	7.6	mww	Tonga
2023-04-24T20:00:57.265Z	-0.808	98.511	34	7.1	mww	171 km SSE of Teluk Dalam, Indonesia
2023-04-24T00:41:55.837Z	-29.958	-177.831	46	7.1	mww	Kermadec Islands, New Zealand
2023-04-14T09:55:45.220Z	-6.041	112.048	597	7	mww	Java, Indonesia
2023-04-02T18:04:11.261Z	-4.323	143.166	70	7	mww	Chambri Lake, Papua New Guinea

***** I rounded the depth to a whole number, quoting 3 decimal places is embarrassing.

An Early Melbourne Victoria Earthquake

Several earthquakes have been felt throughout Melbourne in recent years which may seem very unusual but history shows that is not the case. Here is an example of one such earthquake long forgotten felt throughout Melbourne.

1855 09 16 at 16:55 UTC, Gippsland

The earthquake is described in *The Argus* on Page 5 on Monday 17 September:

> EARTHQUAKE.—At five minutes to three o'clock this morning a severe shock of an earthquake was felt in Melbourne. It lasted about a minute. The rocking motion was very distinct, and caused the slates and windows to shake.

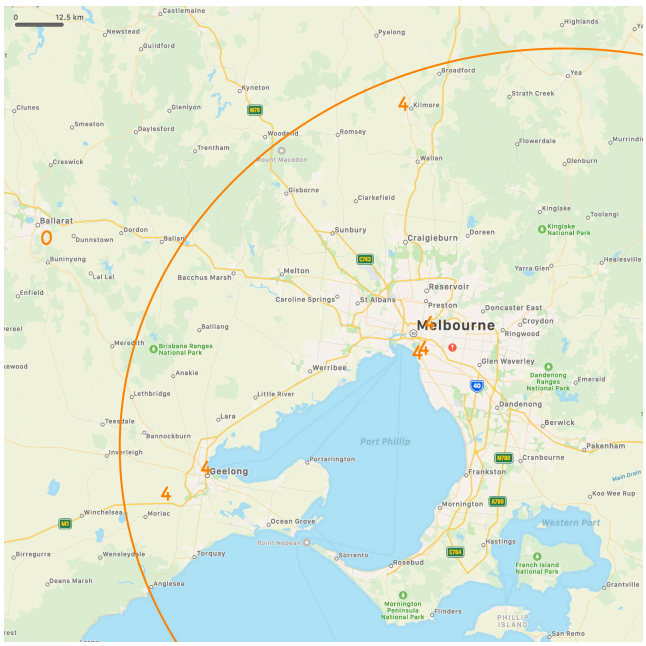


Figure 3 Approximate felt area of the Gippsland earthquake of 16 September 1855.

It was discussed in a letter dated Monday 17th September 1855, to the Editor of *The Argus* by one Ludwig Becker. The earthquake occurred at 2:50 a.m. that morning and reportedly lasted between 1 and 2.5 minutes. He reported that in the Union Hotel the shaking was sufficiently intense to awaken nearly all sleepers. Strong shaking *creakings, clatterings and grindings of objects on the surface of the earth* was observed at Collingwood, St Kilda and Windsor. This shaking was preceeded by a subterranean noise (P wave?) with the *same pitch or tone as a heavy omnibus or artillery wagon passing rapidly*.

The Geelong Advertiser notices the occurrence adverted to, by stating:—*A smart shock of an Earthquake was felt in Geelong, on Monday (yesterday) morning. The hour is variously stated at from 2h. 45m. to 3h. 10m. The vibration lasted about ten seconds, and appeared to oscillate from south-west to north-east. It was felt in the majority of homes in Geelong and suburbs, and from the surrounding country, during the whole of yesterday, persons called at our office to make enquiries and to communicate their impressions of the occurrence. One worthy farmer was under the impression that heavy drays were coming round his paddock, and got up to see if it was so. On the Barrabool Hills, the shock seems to have been more severe than in lower localities, and one professional gentleman hurried out of his bed on the supposed call for medical assistance by the ringing of the night bell. In a large ironmonger's store in Ryrie-street the storeman was aroused by the rattling of pots, pans, bullock bells, and the multifarious objects usually suspended from the roofs of such establishments.*

Kilmore Free Press (Kilmore, Vic. : 1870 - 1954), Thursday 16 April 1914, page 1

September 22nd 1855.— The local news column announced "On Monday the 17th instant, a few minutes after 2 a.m., a sharp shock of an earthquake was felt at Kilmore. The precise direction we have not been able to ascertain. Sydney street, lying nearly north and south, is situated between two hills, and the shock was felt from one end to the other end of it. From the crown of the hills, east and west, we have received no account of it. Many of the houses were violently shaken, and the inmates felt considerably alarmed. The vibration was accompanied by a long rumbling noise, and the shock lasted for several seconds."

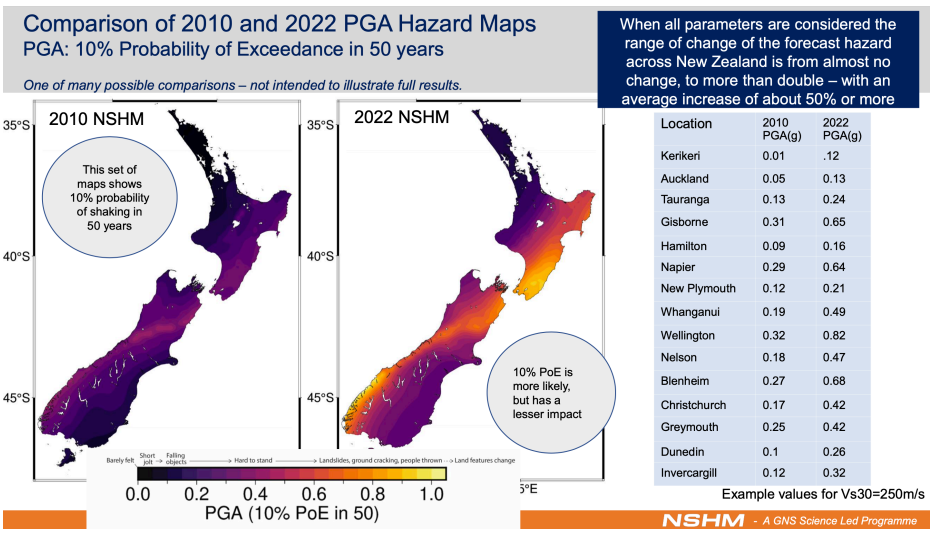
The earthquake was not felt in Warrnambool but a recently found Kilmore report changes my original assumption that this earthquake occurred between Geelong and Melbourne. The gold rush had started in 1851 and by 1855 there were thousands of people living at Ballarat, with their own newspaper, but no reports have been found that this earthquake was felt there. That points to an epicentre ESE of Melbourne in Gippsland. A location near Warragul satisfying the intensities would rate a magnitude 5.0.

GNS Science update of earthquake hazard model, New Zealand.

https://www.gns.cri.nz/research-projects/national-seismic-hazard-model/

A lot has happened since the 2010 model was published, not the least of those the Christchurch sequence of destructive earthquakes in 2010-2011 and the Kaikoura sequence in 2016.

The pga is not a good measure of hazard, just one point on the response spectrum, but a table in the GNS website showing the

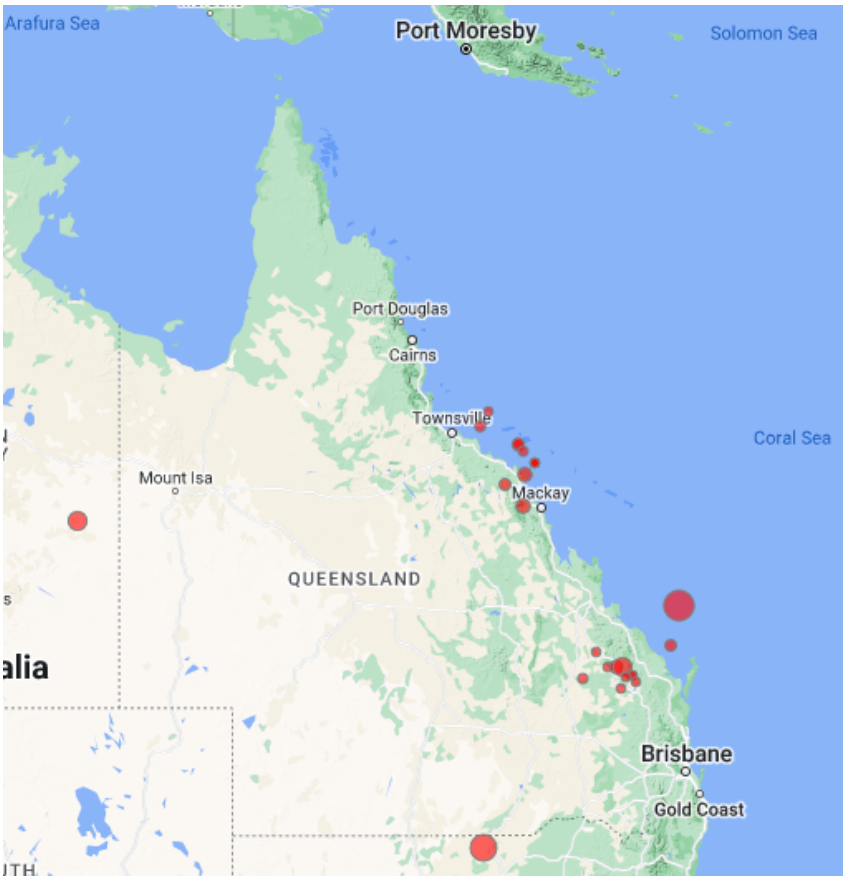


old vs new hazard models, attached below, is instructive. None of the tabled sites shows a reduction in pga. At some sites like Christchurch the 10% PoE in 50 years (the ~500 year earthquake) pga is more than doubled.

Better monitoring has contributed significantly to the change which is why monitoring is so important.

Queensland Earthquakes

by Mike Turnbull



Attached is a map of the 25 earthquakes I have detected and located in Queensland (two just over the borders) from 1 Jan 2023 to 21 May 2023.

They range in Magnitude from ML 0.8 to ML 3.2 (the one out near Lady Musgrave Island).

There have been several small earthquakes in the Eidsvold (EIDS) catchment for which I have insufficient records to locate. Now that I don't have my FS03 station, although the EIDS records are available to detect local earthquakes, most events are not large enough to register on the Roma (RMQ) and Rockhampton (RK1H and RK2S) stations. I am thinking of adding those to my catalogue as unlocated events (within x km of EIDS). It is a very active area, producing up to two local events per week).

The four Queensland regions continuing to be seismically active are the Mt Perry area, the Wide Bay area, the Whitsunday Passage area, and the offshore Townsville area.

The far south-west is quiet at this time but does throw up some moderate events once or twice each year; and it is currently quiet in the south-east corner.

If anyone wants a pdf of this year's catalogue just send me an email request.

28th IUGG & 42nd IASPEI General Assembly Berlin 2023

IUGG BERLIN 2023

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THE 28TH GENERAL ASSEMBLY OF THE INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

The 28th IUGG General Assembly (IUGG2023 https://www.iugg2023berlin.org)

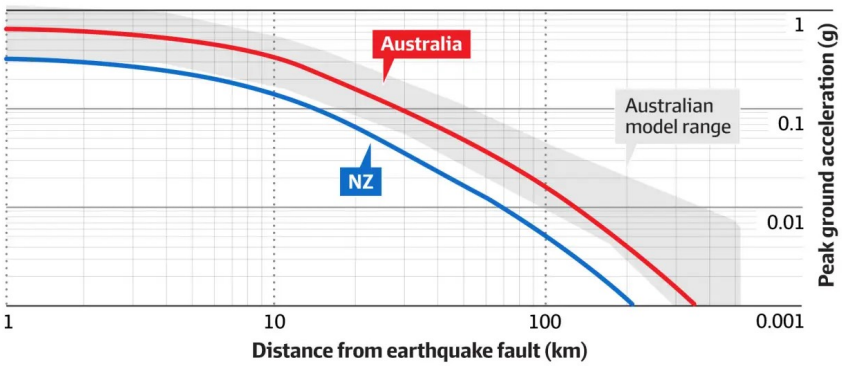
Australia Complacent about Earthquake Catastrophe: Seismologists

This note is from Col Lynam who noticed the article in the Financial Review by Tom Burton, Government Editor Mon May 29, 2023.

https://www.afr.com/politics/federal/australia-complacent-about-earthquake-catastrophe-seismologists-20230529-p5dc1a

Australians are complacent about earthquakes and, with many cities sitting on fault lines, authorities should better prepare city buildings for catastrophic damage, say seismologists.
The warning comes amid cautions that the greater Melbourne region should expect further tremors beyond the aftershocks of Sunday night's magnitude 4.0 quake.
Experts warned there was a misconception that Australia was a low-risk country, and it would inevitably face tremors as powerful as the 2011 Christchurch earthquake. This complacency meant Australia was not addressing obvious building and infrastructure vulnerabilities.
Melbourne University associate professor of earthquake science Mark Quigley lived in Christchurch and witnessed the destruction of the magnitude 6.5 earthquake, which killed 185 and caused more than $30 billion damage.
But after returning to inner-city Melbourne he was shocked at the vulnerability of buildings and structures.

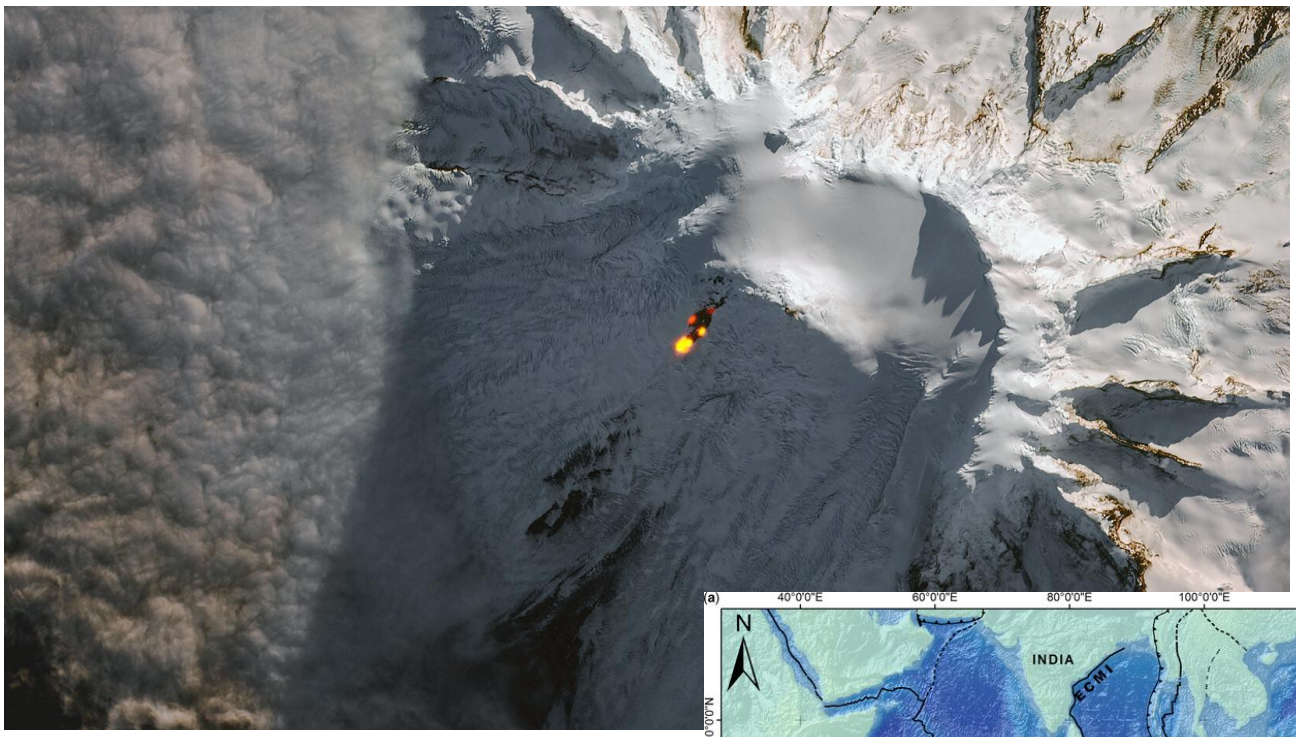
Magnitude 6 earthquake intensity comparison at bedrock (log scale)



SOURCE: MARK QUIGLEY, SCHOOL EARTH SCIENCES, UNIVERSITY OF MELBOURNE, SEISMOLOGY RESEARCH CENTRE

Australia's active volcano – active again

The active volcano on Heard Island, known as Big Ben, sits at 2745m above sea level and makes up most of the island.
A recent photo shows lava flowing down the side of Mawson's Peak on May 25, the summit of Big Ben. Big Ben is known to have erupted at least four times since 2000. The last known eruption occurred in 2016 and was witnessed and recorded by scientists who happened to be in the area on an expedition, though activity can be seen from the French Kerguelen islands.
At 517m taller than Mount Kosciuszko, the mountain is the tallest in Australian owned territory – excluding any in the Australian-claimed Antarctica territories. McDonald Island, 43km west of Heard Island, is also known to be volcanically activity, and causing the island to double in size since the 1980s.
The two volcanic islands are intraplate volcanoes on the Kerguelen Plateau, a 1.2 million km^2 microcontinent.



that submerged 20 million years ago save for about 7,000 km² of island peaks.

Figure 1 A satellite photo shows lava spilling through a fissure in the side of Mawson Peak, on Heard Island, one of Australia's few active volcanoes. Copernicus Sentinel-2 / Pierre Markuse. Images captured by the European Space Agency's Copernicus Sentinel-2 satellite

The plateau and its relation to the Indian Ocean plate boundaries can be seen in Figure 2 from https://www.reddit.com/r/MapPorn/comments/ts3cnq/the_kerguelen_plateau_an_12_million_km2/

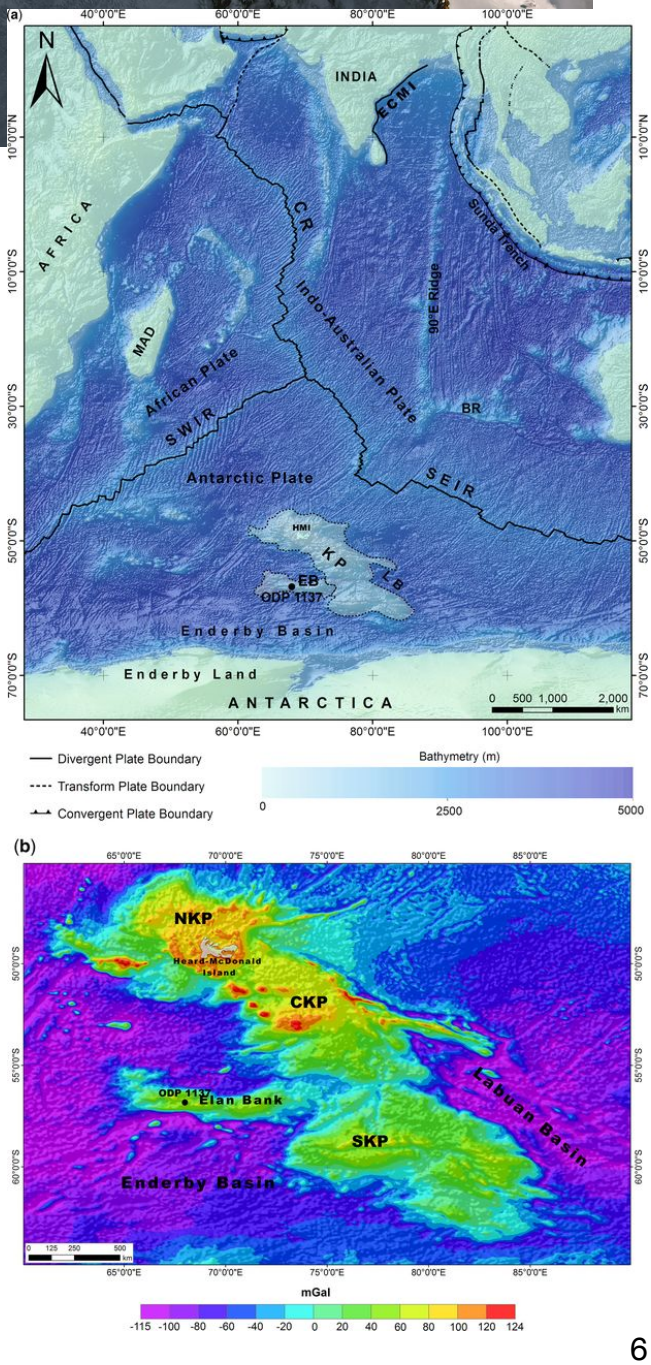


Figure 2 Heard Island is shown on the map located on the Northern Kerguelen Plateau (NKP). Its intraplate setting within the Antarctica Plate near the junction of the Antarctic, African and Australian Plates is shown in the lower picture.

Trials and Tribulations of Observatory Life

If you thought Paul Hutchinson, Blair Lade and Peter Gray were having a hard time with humidity at TPSO, spare a thought for Observatory colleagues back in 1918.

Australasian (Melbourne, Vic. : 1864 - 1946), Saturday 29 June 1918, page 42

THE POULKOVA OBSERVATORY.

During the first week of November, 1917, rumours reached the astronomical colony at Poulkova that bodies of Cossacks were coming towards the capital. to restore the Ministry of M. Kerensky. Poulkova Observatory is one of the finest in the world, and is situated about 13 miles south-west of Petrograd (St Petersburg). Between noon and 6 p.m. on the afternoon of November 12 the observatory was under an intense artillery fire from the Cossacks. Fortunately none of the fine instruments was damaged, although a shell burst beside the brick foundation of the dome of the large photographic telescope. Many holes were made in the dome of the great refractor and in the roof of the director's office. The wall of the seismological station was pierced; the report states that probably the instruments registered their largest earthquake. Much damage was done to windows, and the ground was torn up by many holes of a diameter of about four feet. The director of the observatory had been able in the preceding days to foresee the dangers of the situation and had the valuable objectives and other optical parts of instruments removed to a safe place. By a singular good fortune no one of the personnel of the Observatory was injured during these exciting events.

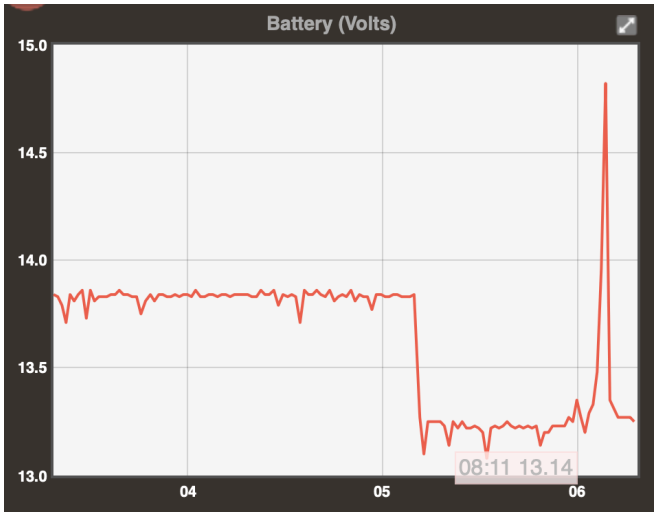
It is very unusual for an astronomical observatory to be under artillery fire, and it is to be hoped that this beautiful institution will receive no further damage. Recent reports seem to indicate that there is no cause for anxiety. It is to be hoped that the admirable work carried on at this observatory during the past 80 years may continue unimpaired, despite the political and economic changes through which Russia is passing.

Running a Network is Fraught

Or - why can't you believe the blurb on a solar regulator? Even our cars run on batteries so it shouldn't be rocket science to run a seismograph using a solar panel to charge a 12V battery rather than using a small, low noise power supply, as I have done for the last 20 years.

I needed a spare battery/charger to replace the Bega one which has just, for some unknown reason stopped. Either battery or charger has died.

I decided to take my battery and regulated charger to Bega and use solar to power the RNDA Echo. I have a 100w solar panel so I bought a new LiPo 12V battery and a regulator rated for a 100W panel and LiPo battery. Simple, just connect them up, preferably in the dark when the panel isn't charging, I read.

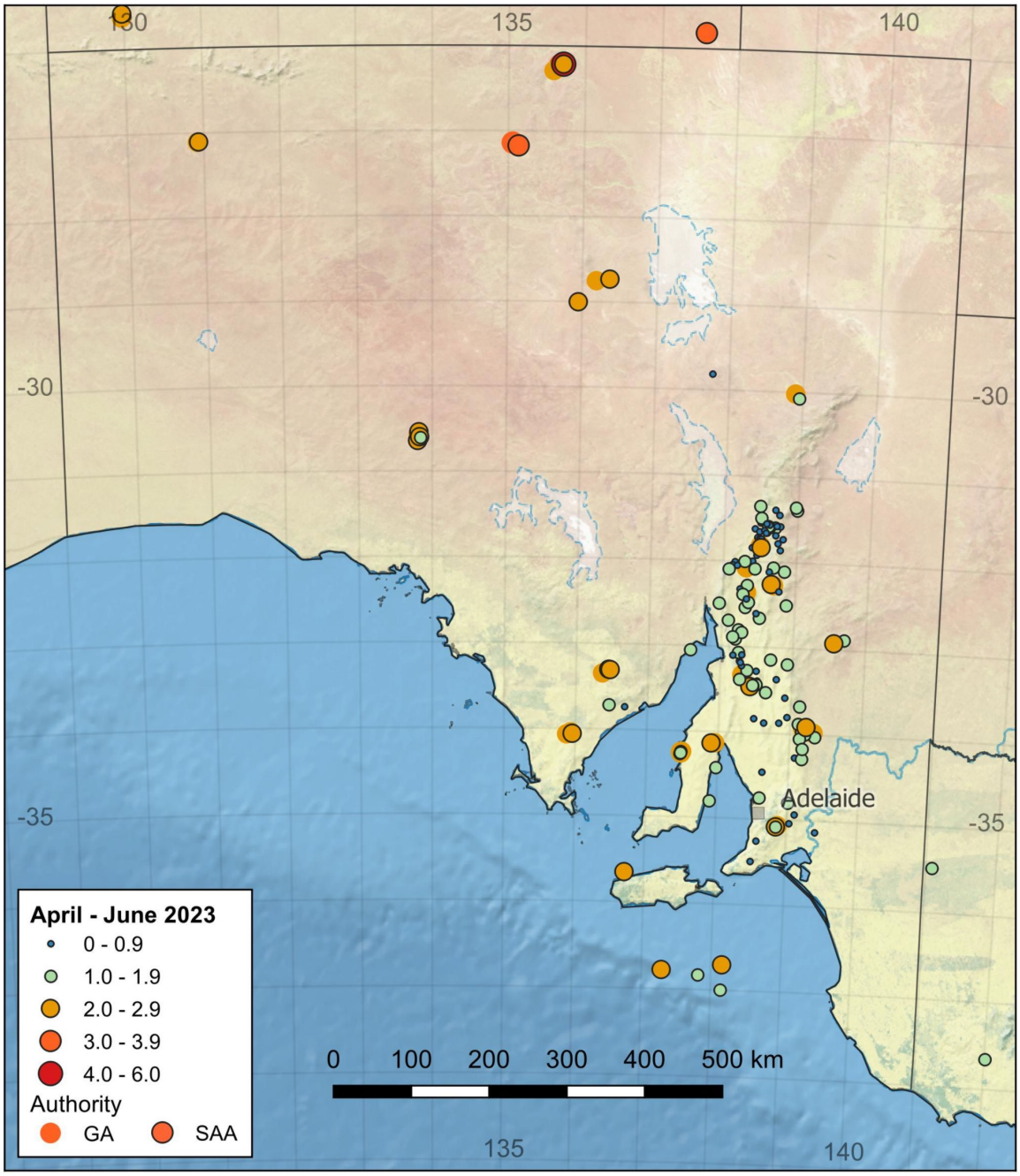


The chart above shows the battery voltage 13.8V from the power supply drop to 13.2V, the LiPo battery voltage, the solar panel was connected but not charging. The voltage to the Echo stayed at this level. When the sun rose next morning I carefully watched the voltage rise and then drop before suddenly risng again and hover at 14.1V at which point I went outside to inspect the regulator A third led came on which I thought indicated it had regulated the voltage but by the time I got back to the computer it was 14.8V so I disconnected the solar panel. Next – I'll try a better quality regulator after Blair has tested it.

Dr Cvetan Sinadinovski
16 November 1959 - 24 June 2023

An SAA Member, Cvetan died in Clare Holland Hospice Canberra after an eight month battle with Motor Neurone Disease.

Cvetan was destined to be a seismologist. At the age of four his father rescued him from their apartment, badly damaged by a magnitude 6 earthquake that struck Skopje Macedonia on 26 July 1963, at 5:17 am local time.
He lived in Skopje during its reconstruction but travelled to Zagreb University for his BSc (honours in Physics) in 1981. That began a lifelong fascination for seismology and international travel with short-term postings in the US at Fermi Lab, Chicago and University of Southern California (with Trifunac) whilst studying, working and lecturing Oct 1981 - Feb 1988 at the UNESCO Institute of Earthquake Engineering and Engineering Seismology (IZIIS) in Skopje. In this time he was awarded an MSc in (Geophysics) in 1986.
Then he flew to Sydney Australia to start another life. From May 1988 to July 1989 he worked as a Software Support Specialist and 3-D Software Design Engineer for DATA GENERAL Pty Ltd, Sydney. He told me recently that he happened to meet Dr Stewart Greenhalgh at a conference in Sydney and their discussion resulted in him undertaking a PhD at Flinders University in Adelaide, his topic geotomography. Stewart organised with Reg Nelson for Cvetan to work part-time at the Mines Department with David Love locating earthquakes and using his software skills to reformat the earthquake database and convert magnitudes between scales. That's when he and I first made contact - sharing data on state-boundary earthquakes. Then in 1994, nearly 30 years ago, he took on a job at BMR/AGSO/GA, yet another move for the family. He was in great demand for his computer skills at BMR/AGSO/GA so I only managed to get a share of his time to work on earthquake hazard problems with Malcolm Somerville, a productive three years we all enjoyed very much. He never let me forget that Mohorovičić was Macedonian as was Alexander the Great. He had great genes.
He left GA and moved on to work and teach at the ANU and then another major relocation to Suadi Arabia where he used his tomography skills in the oil industry for 10 years and teaching at the University in Jaddah. Publication of research was not encouraged by Saudi Aramco in this period so he returned to Canberra to try his hand at consulting in the private sector and pursue academic research. He worked closely with an Indonesian PhD student Agus Abdullah to simplify some tomographic software Agus and others had developed for the oil and gas industry, to look at earthquake sequences in 3-D. We used this to investigate the pattern of aftershocks following a major earthquake in Papua New Guinea, and earthquakes in Macedonia with a close colleague Lazo Pekevski in Macedonia. The software inverts travel times with structure along the wave paths to yield both locations and structure in 3-D.
When his father, a Professor of Physics, took ill, Cvetan returned to Macedonia to help the family look after him until his father died, about a year later. But Cvetan himself then became ill and not long after he returned to Australia was diagnosed with Motor Neurone Disease. Such a tragic loss, with so much interesting research still to do. A huge loss for his family, his colleagues and for earthquake engineering.



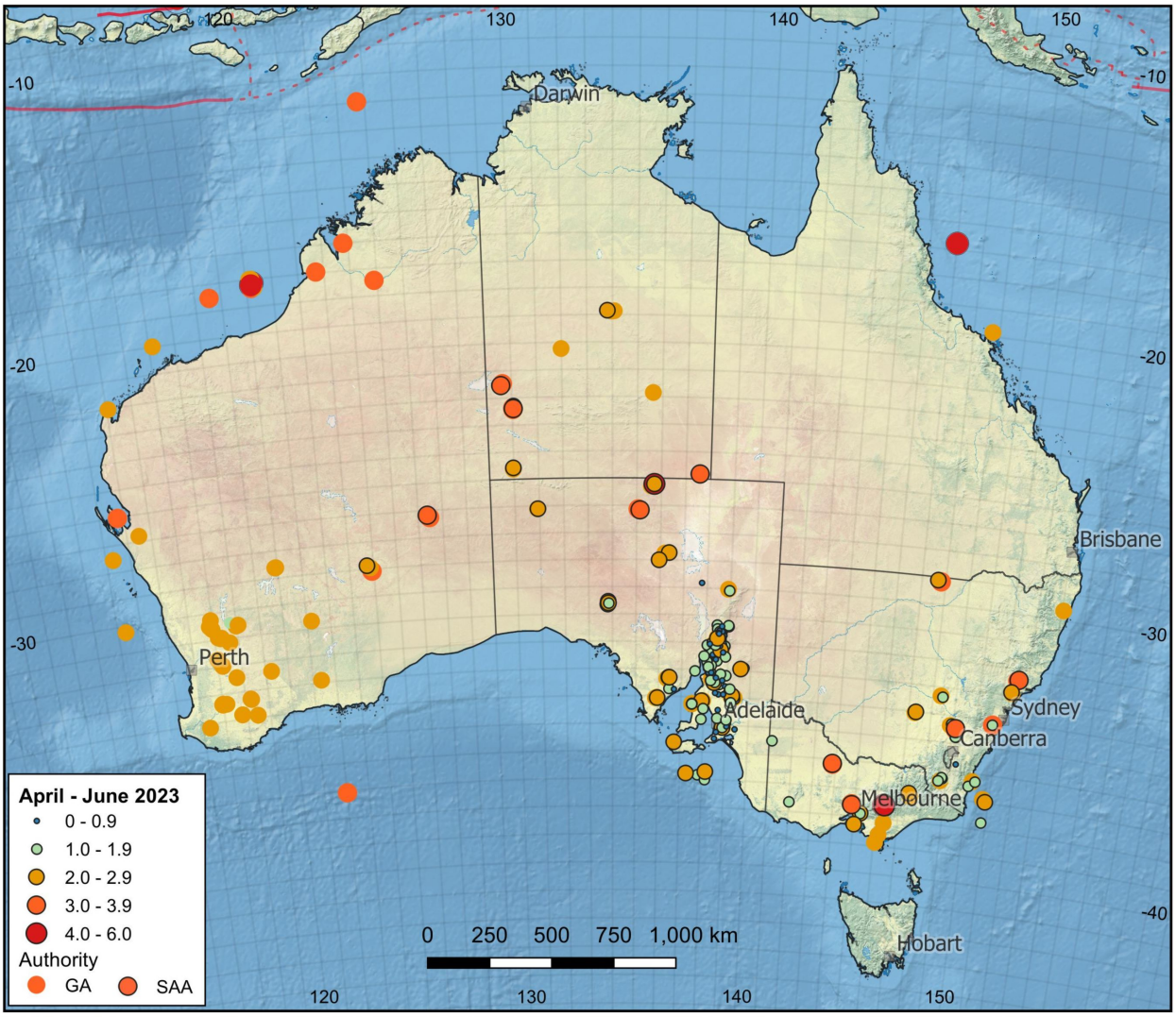
Maps of Earthquakes April to June 2023

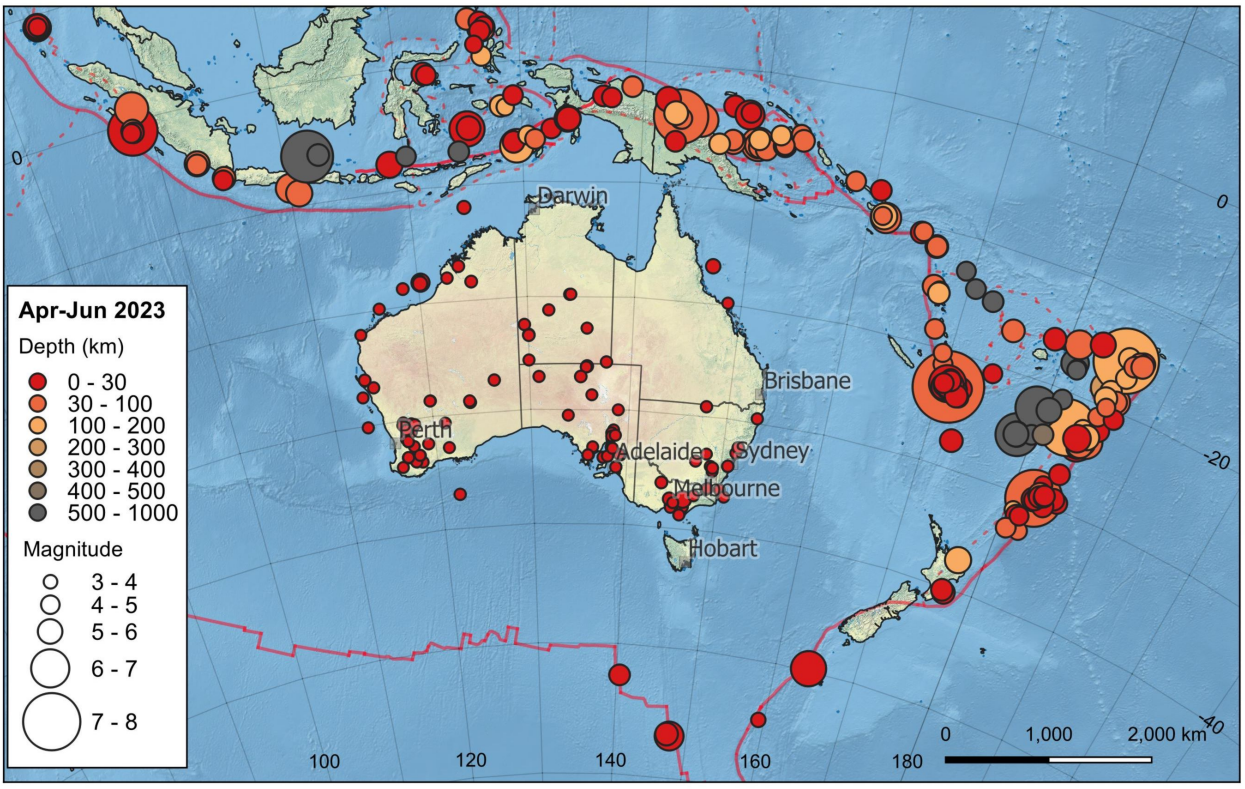
Clive Collins has again created three interesting epicentre maps for the Newsletter covering the second quarter of 2023.

Take the first map showing those earthquakes that were locatable in South Australia. Epicentres highlight the Mt Lofty and Flinders Ranges, known earthquake sources, that extend through the Adelaide Metropolitan area. There was no activity in the Southeast apart, from a few small earthquakes on the continental shelf south of Kangaroo Island. The Eyre Peninsula was active. This quarter the central far north of the State saw the largest earthquakes and there were scattered epicentres in the western half of the State where coverage is not as good as it is in the rest of the State.

Adelaide hosted a few local earthquakes, the aftershock sequence following the Mt Barker earthquake on 5 March continued into April and were surprisingly deep, more than 20km deep.

The second map, of Australia, shows that no earthquakes were recorded onshore in either Queensland or Tasmania, for the second quarter in a row. There is a large empty space in WA too, but the rest of the State experienced normal


120
130
140
150
-10
-20
-30
-40
Darwin
Perth
Adelaide
Brisbane
Sydney
Canberra
Melbourne
Hobart
April - June 2023
0 - 0.9
1.0 - 1.9
2.0 - 2.9
3.0 - 3.9
4.0 - 6.0
Authority
GA
SAA
0 250 500 750 1,000 km


0
-20
-40
Darwin
Perth
Adelaide
Brisbane
Sydney
Melbourne
Hobart
Apr-Jun 2023
Depth (km)
0 - 30
30 - 100
100 - 200
200 - 300
300 - 400
400 - 500
500 - 1000
Magnitude
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
100
120
140
160
180
0 1,000 2,000 km

activity, at least in the Southwest in the vicinity of Perth and offshore Exmouth. In Victoria, aftershocks of the Rawson earthquake of 2021 continued at a slow rate, but public interest was aroused by a magnitude 3.8 - 4.0 earthquake a few km northwest of the the suburb of Craigieburn which was felt throughout the metropolitan area and Geelong, one of several disquieting shakes of late. SRC recorded a pga of 0.21g and pgv of 15.6mm/s at 4km from the epicentre.

In NSW, earthquakes were confined mainly to the eastern half of the State, none of them larger than magnitude ML3.2.

The final map of Clive's, the Australian Plate boundary earthquakes, with the plate boundaries as interpreted by the USGS marked by the thin red lines. Most of the earthquakes including all the large earthquakes occurred along the plate boundaries, as expected. For the second quarter of the year, the South Island of New Zealand is virtually aseismic as was the Australian/Antarctic Plate boundary. Papua New Guinea and Indonesia were quite active.

On 19 May 2023 a shallow magnitude 7.7 earthquake off New Caledonia triggered a tsunami warning alert from BOM for Lord Howe island: possible dangerous rips, waves and strong ocean currents. The threat was cancelled 7 hours later. Apparently an 8cm high wave was observed in New Caledonia.

Strange Tremors Rattle Danish Island—But not an Earthquake

Mysterious reports of tremors on a small Danish island in the Baltic Sea prompted a seismological investigation that points toward atmospheric pressure waves as the possible culprit. The tremors occurred on May 13 at around 3 p.m. local time, according to the Geological Survey of Denmark and Greenland, which operates two seismographs on the island of Bornholm.

The seismic data showed that the tremors were not caused by an earthquake, the agency says. And although the tremors occurred about 20 minutes after what might have been a minor blast in Poland, the scientists don't think that caused the strange shaking, either.

Instead, agency officials concluded that "acoustic pressure waves" in the atmosphere likely triggered the tremors—but they declined to speculate about what might have been responsible for those pressure waves. Acoustic waves, or sound waves, carry energy from a vibrating object and cause the pressure of the material they pass through (such as air) to oscillate.

Such unexplained tremors actually aren't unusual, says Björn Lund, an earthquake scientist at Uppsala University in Sweden and director of the Swedish National Seismic Network. The network received about 10 reports of tremors from the part of southern Sweden just north of the island on the same afternoon and evening.

"This happens a couple of times a year," Lund says. "We have reports of shaking and low-frequency noise from a very large area, and we have no indications in the seismic data of earthquakes or major blasts." One common explanation for this sort of incident is an airplane breaking the sound barrier, he says, although he added that he hasn't heard of any such activity occurring around these specific reports.

(Sweden does record about 1,000 earthquakes per year, Lund says—on average, two or three each day—but most are much too small for people to feel, much less report.)

Strange tremor reports with no clear geological explanation aren't limited to Scandinavia, says Allison Bent, a seismologist at Natural Resources Canada.

from Scientific American by Meghan Bartels
May 18, 2023

https://www.scientificamerican.com/article/strange-tremors-rattle-danish-island-but-it-wasnt-an-earthquake/