Newsletter of the Seismological Association of Australia Inc. Quarter 1, 2022

Seismological Association of Australia Inc.

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

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

2022 SAA Member Meeting Schedule - Please note the following dates for Member's meetings which will continue to be held via ZOOM for the foreseeable future, we'll let you know if this situation changes as the year progresses. Monday, February 21st : Monday, April 11th : Monday, June 13th and Monday, August 8th. The AGM will be held on Monday, October 10th at 7:30pm ACST, 8:00pm AEST and 12:00 UT. via ZOOM. All members should receive an invitation and link to attend prior to each meeting.

2022 SAA Committee Meeting Schedule - Should members wish to propose an initiative, make a suggestion or just have a whine about something we've done, or plan to do, please note the following dates for Committee Meetings. Monday, January 11th : Monday, March 14th : Monday, May 9th : Monday, July 11th : Monday, September 12th and Monday, November 14th.

Data Communications and Equipment - Our network currently relies heavily upon the Telstra 3G phone network which is due for closure in 2024. Blair has been tasked with looking at the technology available for modem replacements / upgrade. David will be working on a grant proposal of > $50k under Disaster Management and Planning communication.

Site Updates - TPSO, the new 900mm pvc magnetometer pier has been installed and filled with dry rock inside. The mag is attached to the top and pvc pier glued to seismic pier. The Lippmann tiltmeter has been installed and DC power requirements for the tiltmeter and it's RPi4 controller have been completed. ‘Anydesk’ software for remote communication has been installed and replaces TeamViewer, which has now been removed. Our old computer monitor failed during a recent upgrade visit and has been replaced with a new unit. There is a high humidity problem in the vault which needs to be addressed, Paul Hutchinson will investigate a suitable solution. **Myponga**, the planned rebuild is still on hold due to ongoing COVID restrictions. David currently prefers to use the old site as mobile phone connection works there. **Peake**, a Ubiquiti nanoM2 Access Point has been purchased to address the Wi-Fi link problems that have been experienced recently at the farm. **Wilmington**, Roger Fuller’s new site is still offline due to Roger's work committments further north in the Finders Ranges, so no progress to date.

Science Alive 2021 - Science Alive in Adelaide was eventually held in November and our members put on an impressive show. There are some images from the event on the final pages of this newsletter. Those members attending were kept busy with surprisingly good crowds to keep amused but a few additional volunteers to share the workload would have been preferred across the weekend.

Perhaps some serious consideration should be made for members preferences toward Science Alive, prior to committing to this year's event.

Murrayville Aftershock Deployment

Kindly submitted by David Love,
Gary Gibson and Blair Lade

The first call came to David from Gary Gibson at 7:21am. "That was a nice earthquake". "What earthquake?" was the reply. The quake had struck at 3:17am SA time (9th October 2021, local day) in the Big Desert Wilderness Area south of Pinnaroo and Murrayville. Geoscience Australia already had over 100 felt reports on their website, and the magnitude appeared to be 4.5 to 5.

A quick phone call to Blair and we decided that we could prepare three portable units and leave fairly quickly. It took a little longer than expected, as we were out of practice. Channel 7 Adelaide rang. I informed them that if they could be at my place by 10:20 we could do a short interview. They did, and we got about two seconds of fame. Blair and I left Adelaide just after 10:30 am in his Tarago to head for Pinnaroo, 230 km away.


Figure 1 Recent damage on top of previous damage

Covid restrictions were in force causing a major problem. We were not allowed to cross the border unless we wanted to quarantine for 14 days coming back to SA, and one had to be careful (or lucky) as to which shops and petrol stations one stopped at. (We did the trip on one tank.) Gary had only just returned the night before from a servicing trip around the Woods Point aftershock network, however, he decided to put in an instrument on his side of the border. This should give us reasonable coverage.

One important piece of information for successful aftershock deployments is the most reliable location. That is not always easy. The nearest seismograph, Willalooka, was 125km away. Another important piece of information was the memory of a previous earthquake 25km north of Nhill, two days before Christmas 1987. It similarly was in the night, was felt from about Adelaide to Melbourne, and had only a few aftershocks which died away very quickly.

Murrayville Aftershock Deployment

We arrived in Pinnaroo about 1pm, and went straight to the Police Station. We chatted with the officer, Matt, told him what we wished to do, and he directed us to Wade Nicholls, who he thought was probably the closest landholder on the SA side of the border and asked if he was willing to help us deploy some instruments. While in town, Blair noticed some damage on the old Community building on the main street in Pinnaroo (Figure 1). On closer inspection it appeared to be recent, and the building also showed signs of patched up damage from the previous event in 1987. We passed the details and a couple of photos of the damage on to the local shire Council.

We drove south east to Wade's place, which was along the Border Road. He was happy to take us in his 4WD further south along the very sandy border track, into the park on the South Australian side of the border. It was a rough ride up and down sandhills, and David was a little stressed about how the Guralp seismometer would cope. We had hoped to see a cleared area or track to the east, to get closer to the presumed epicentral area, but there was nowhere that looked navigable. Eventually we picked a spot and installed the first instrument. We then backtracked, and found some travellers who had missed their camping destination. Wade pointed them in the right direction; thank goodness for local knowledge. Near the park entrance we travelled a little east and installed the second unit. Both of these were three component seismometers. The third unit (an L4C vertical seismometer) we installed back near Wade's house (Figure 2). This left time for Wade to clean up and head off for an evening engagement with his wife.

Figure 2 Portable L4C Seismometer

We left Pinnaroo about 5pm and picked up a quick bite for the trip home.

On the other side of the border, things were not so easy for Gary. Murrayville had a hard lockdown that morning, so he and Saide travelled to Nhill where he set up station NHILO at the motel. Next day they tackled the road through the park. Comments of '4WD only', 'impassable when wet', with heavy rains the previous week, caused some trepidation. However, it turned out to be a drive in the park, although a long day all the same.

Gary's instrument had no solar panel, and required a battery change after two weeks, another 995km round trip!

Murrayville Aftershock Deployment

Aftershocks fortunately kept going longer than expected. Blair and Nina had a nice outing with Wade to pick up the equipment 25 days later. Gary removed his recorder at about the same time.

Initial results

All four recorders operated for the full time, although one did not get GPS lock, meaning only S-P times could be used.
The first location we installed on the border fortuitously turned out to be much closer to the epicentre than expected. Using only the portable instruments, the larger aftershocks were placed very close to the border (-35.465, 140.975), about 8 km from the events located with the regional network only.
This immediately shows the value of having an aftershock network (Figure 3). Comparing the two closest instruments resulted in the detection of about 150 aftershocks in 26 days. Half of these occurred in the first three days (Figure 5). Speed is particularly important in decay sequences for smaller events.

The S-P times on the closest recorder covered a very limited time range with over 90% being 1.27 to 1.30 seconds. Only a small number of events were recorded clearly on all four recorders. These are shown in Figure 3 on the following page. These all fall within a circle of less than 1km radius. The limited S-P range suggests that they may all be very nearly at the same spot. This is a little disappointing. It had been hoped that the aftershocks might outline a rupture area of 5 to 10 sq km.

Rotation of axes was attempted for the best records at the closest station. Direction could be demonstrated, but not to better than 5 degree accuracy, and the angles all fell within a band of 10 degrees.

The located aftershocks are just within the portable network, meaning that locations are likely to be moderately accurate. Also, with the first station being very close to the epicentre, calculated depths are also quite reliable. These were in the 7 to 9 km range. There was only a small amount of variation in position and depth with model, and the VIC5A model gave slightly smaller residuals than the SA1A model. See the legend on Figure 3.

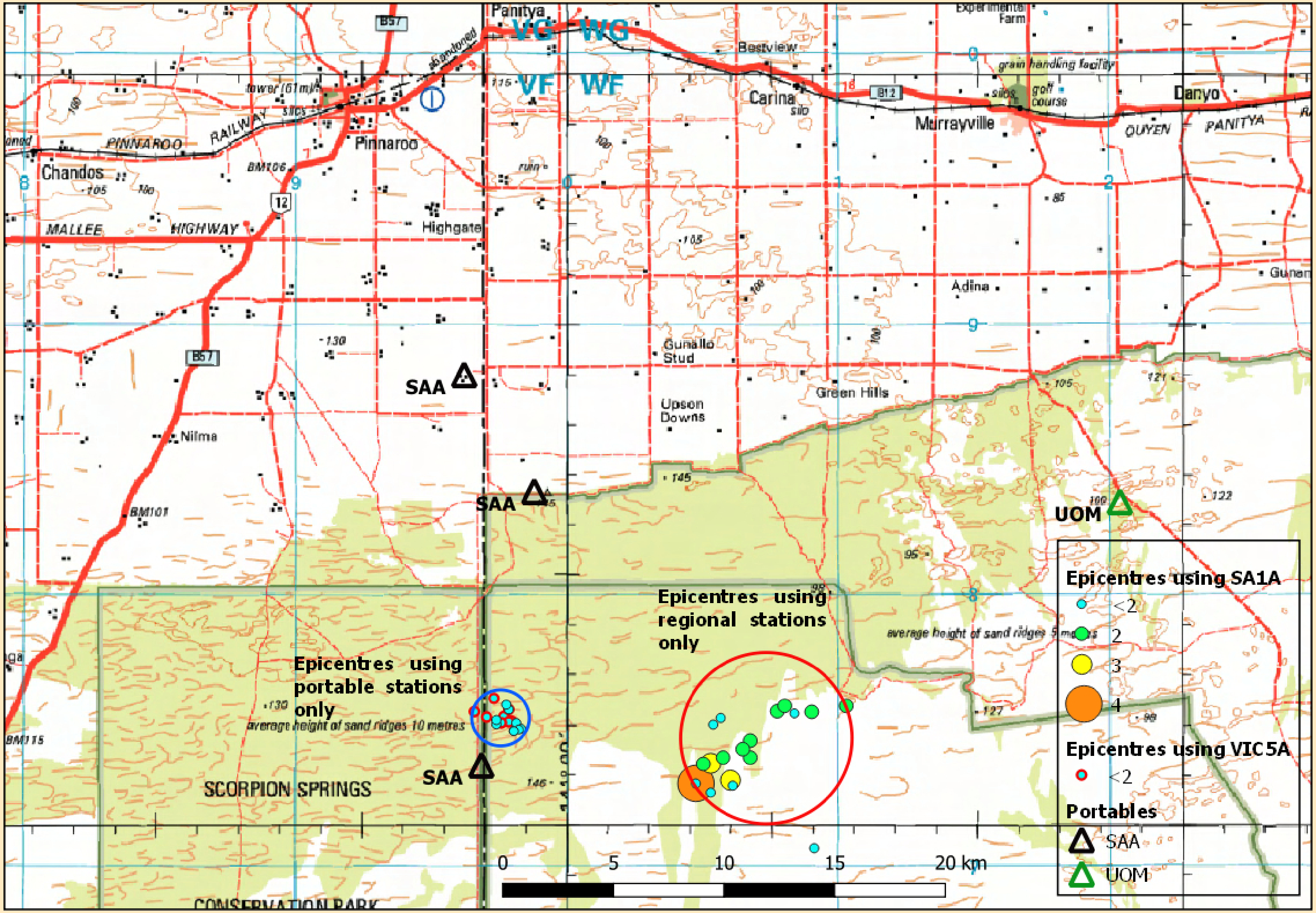
There are indications of a significant velocity change in the region. All three component stations exhibited a peak on the vertical before a clear S on one or both horizontals. This is shown in Figure 4. This suggests an S to P conversion at the interface, labelled SP on the vertical trace. A major refraction line is planned through the region in 2022. This may provide some better velocity information.

Most station first motions for the main event are difficult to pick. The first motion diagram is shown in Figure 6, but no clear nodal planes can be drawn.

Murrayville Aftershock Deployment

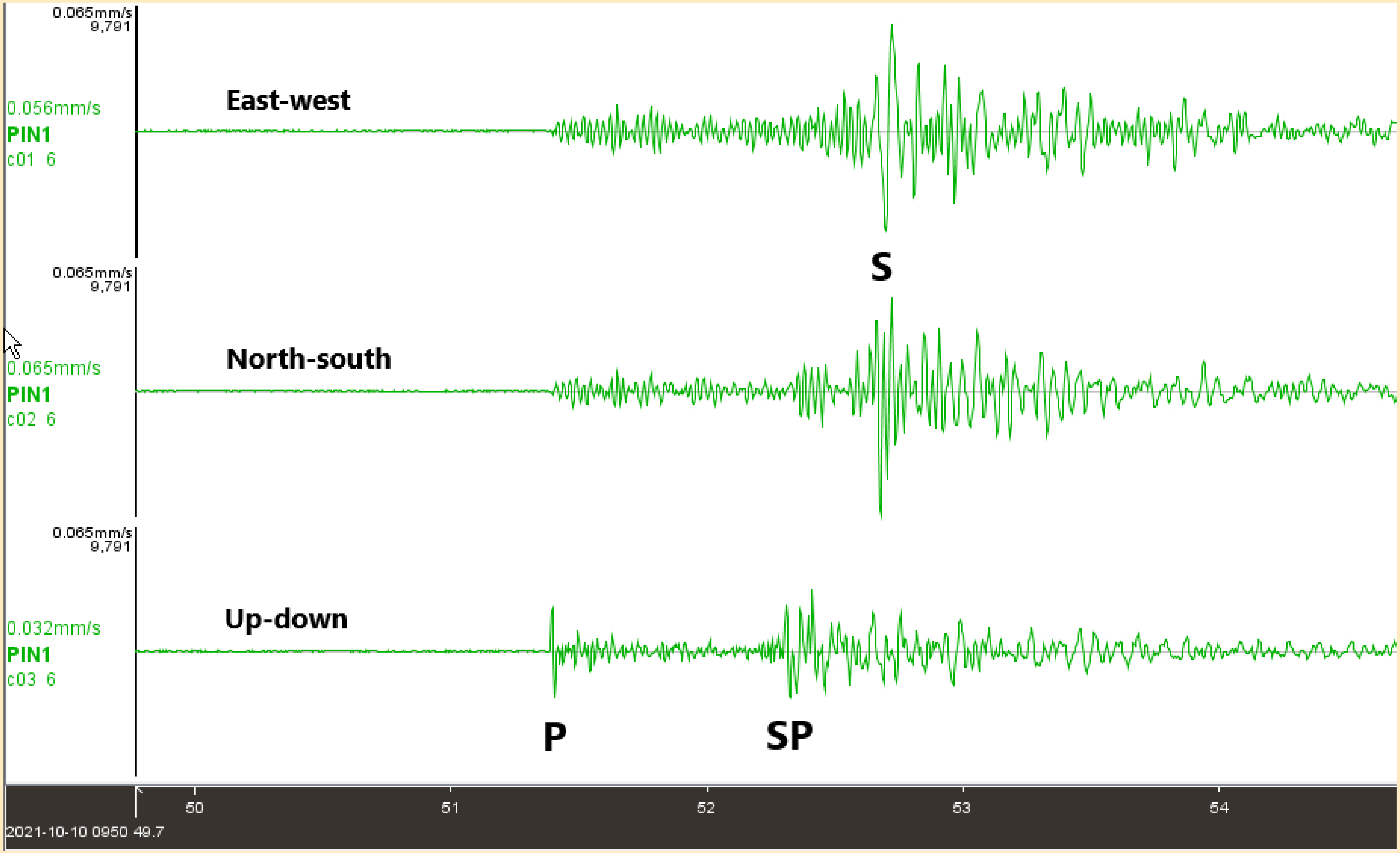
Figure 3

Epicentres



Murrayville Aftershock Deployment

Figure 4



Murrayville Aftershock Deployment

InSAR (note 1) has not shown any elevation variation of interest, which is not surprising given the calculated depth.

In conclusion, we can be fairly sure of the position and depth, but not of any focal mechanism, rupture surface or rupture direction. The position is much closer to the border than most early epicentre calculations.

Note 1

Interferometric Synthetic Aperture Radar (InSAR) is a geodetic technique that can identify movements of the Earth's surface. Observations of surface movement made using InSAR can be used to detect, measure, and monitor crustal changes associated with geophysical processes such as tectonic activity and volcanic eruptions.

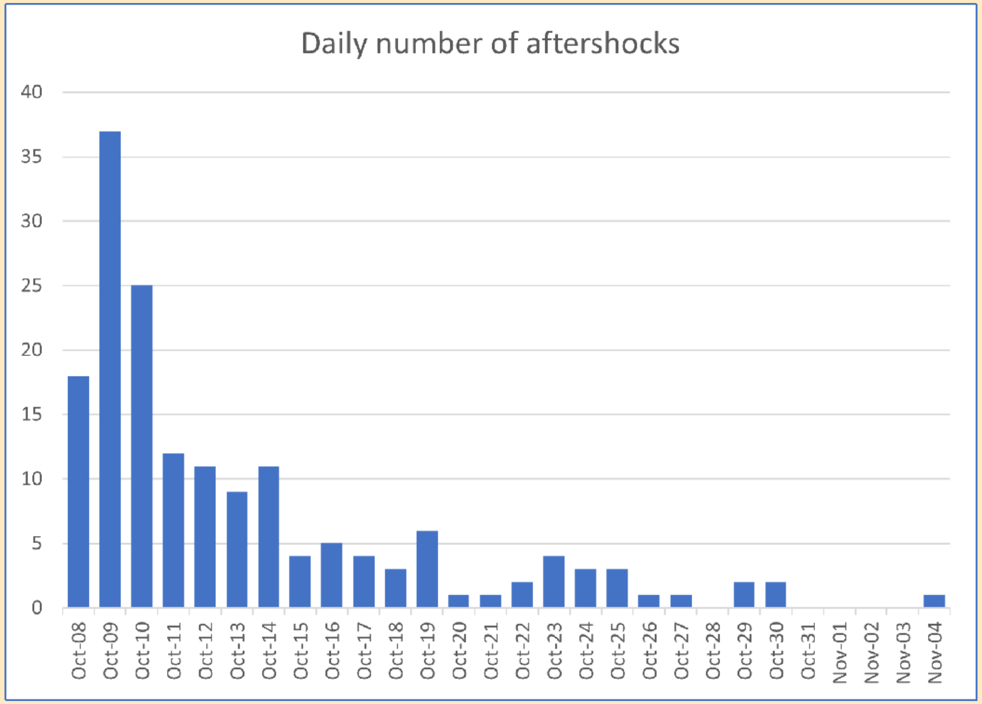


Figure 5 Aftershocks

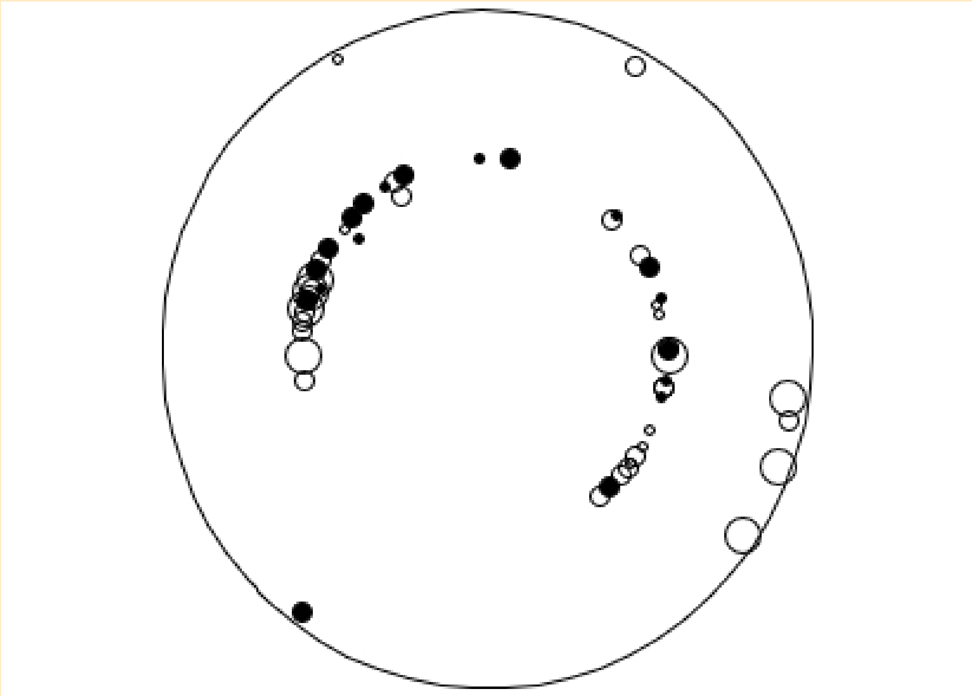


Figure 6 Focal Mechanism for Main Event ML 4.8

Barometric pressure observations from the Tonga volcano explosion

Kindly submitted by
Michael Andre Phillips, SAA
Blair Lade, SAA and
Gabor Papp, EPSS/GGKI

It's been a fair while since the Pacific Ocean was rocked by a large atmospheric explosion, perhaps the last time being when Mt. Pinatubo in the Philippines erupted in 1991, and prior to that the final French atmospheric nuclear test conducted at Mururoa Atoll in 1974. But last Saturday a dormant underwater volcano located nearby Tonga unexpectedly exploded with nuke-like energy. The Hunga Tonga-Hunga Ha'apai volcano had been trembling for several days and last Saturday (15th January, 2022) it exploded, triggering tsunamis which were felt as far away as Japan and the US. The event was recorded by weather satellites which showed a giant cloud appearing within minutes from what appeared to be open ocean. Loud explosions were heard on nearby Pacific islands, but also as far away as Australia and New Zealand.

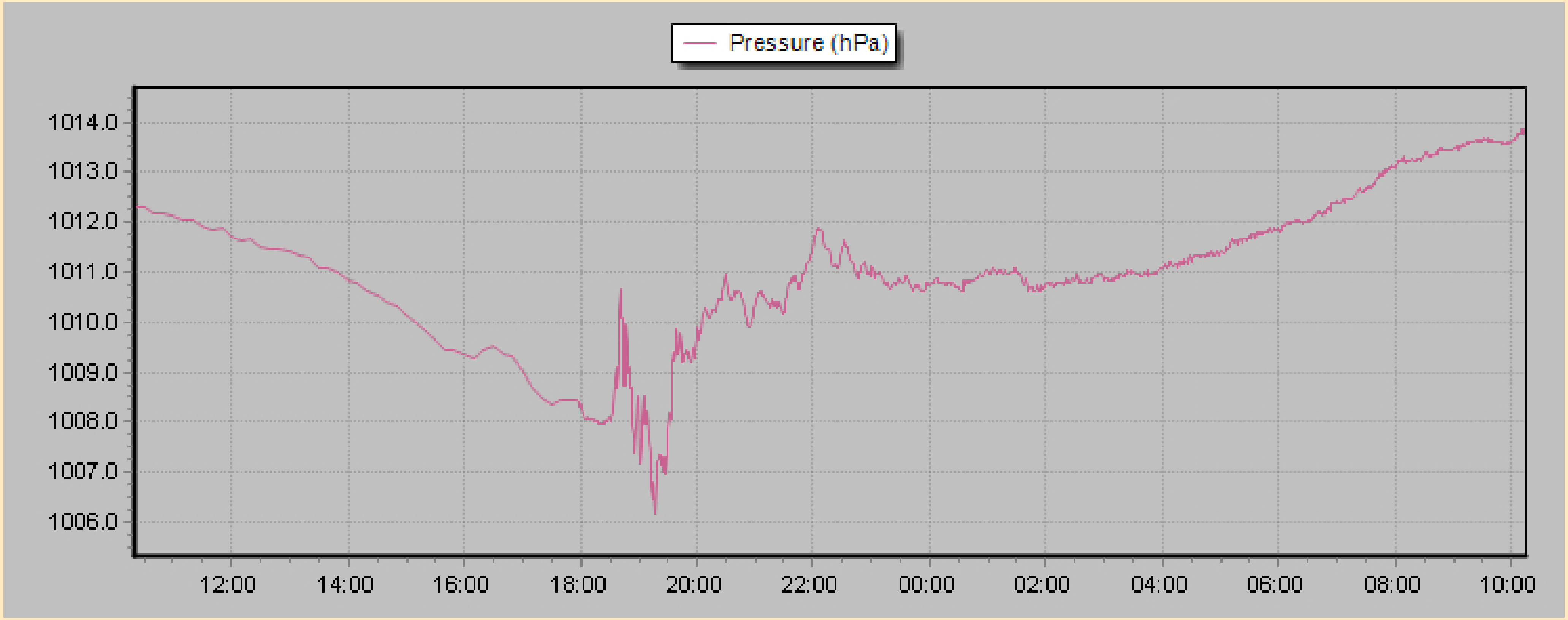


Figure 1 24-hour plot of Coonabarabran air pressure (corrected to sea level pressure). Local time is AEDT, with the arrival time of the pressure wave indicated at 15th January at 18:40 = 6:40pm

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Barometric pressure observations from the Tonga volcano explosion

As well as generating sound waves which humans can hear, the explosion also generated a large atmospheric pressure wave which travelled around the globe, moving at the speed of sound (around 330 m/s). I was first tipped-off about the pressure wave by friend and colleague Blair Lade when he spotted something curious occurring on his 24-bit microbarometer that he operates at his home at Blair Athol, Adelaide. When I then looked at my home weather station barograph records, I saw something unusual also, with the local pressure abruptly bouncing around (which I had spotted but assumed might have been due to intense thundersotrms which we had in the local area at the time). The direct distance between my hometown of Coonabarabran (NSW, AKA 'Coona') and the Hunga Tonga volcano is around 2860km, so a blast pressure wave would take around 2.4 hours to travel this distance, and on Saturday night at around 6:40pm* the pressure wave arrived here (* Australian Eastern Daylight Time - AEDT). Anyone living in Coona keeping a close eye on their home wall barometer at this time would have noticed that the pressure suddenly jumped a couple of hectopascals (hPa), then suddenly dropped a couple of hPa, then proceeded to bounce around for the next few hours.

Nearby Coona, I operate a seismic observatory and one might also expect a sizable earthquake associated with this large atmospheric explosion, but such was not the case here. I observed indications of a very small earthquake (Ml = ~5) that occurred at around 3:13pm AEDT, which is consistent with satellite observations showing the first indications of the explosion at 3:10pm. It is very likely that this explosion could have been heard in Coona also, but at the time there was a large thunderstorm rumbling due west of town which would have drowned out the sound. The pressure wave was also recorded by arriving in Hobart at around 6:55pm and in Adelaide at around 7:30pm AEDT.

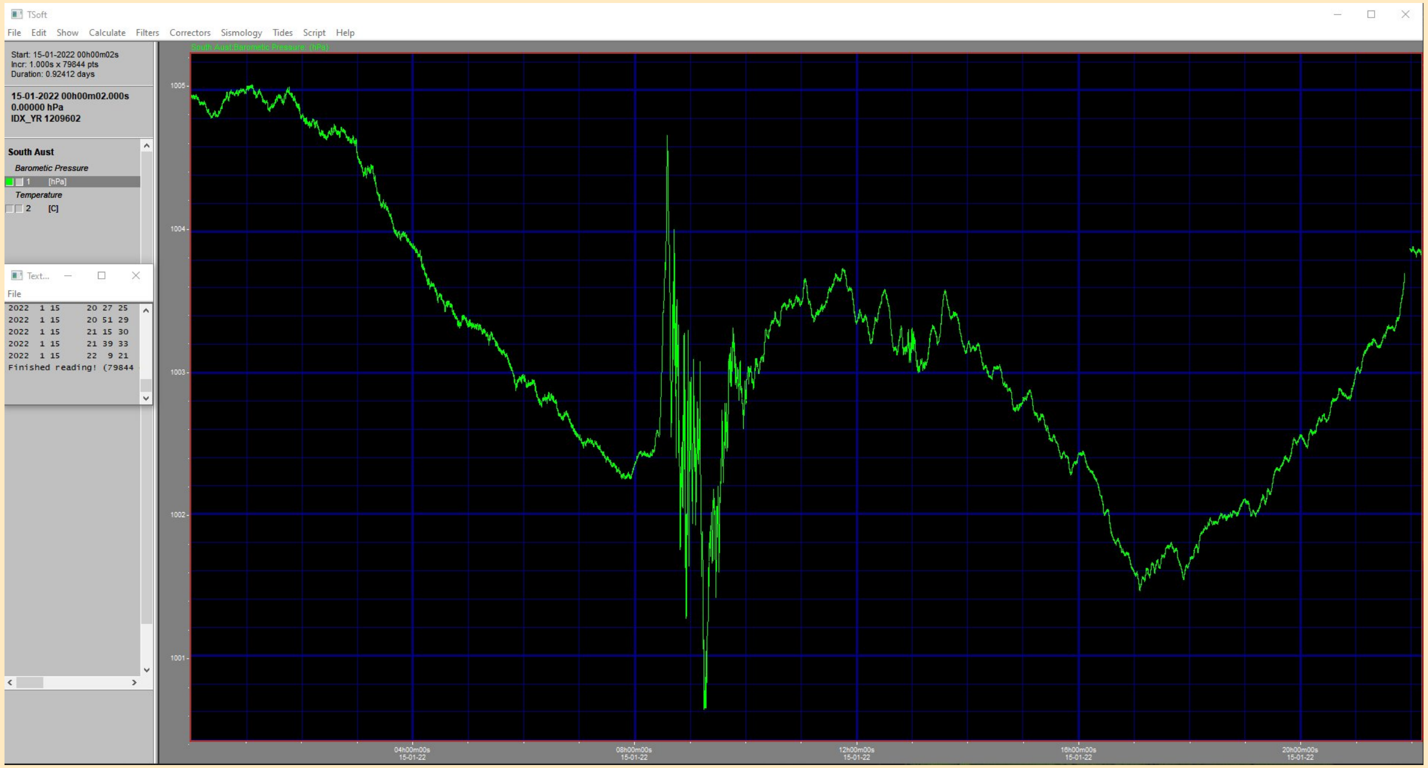

Figure 2 Pressure wave arrival at Adelaide, SA

Barometric pressure observations from the Tonga volcano explosion

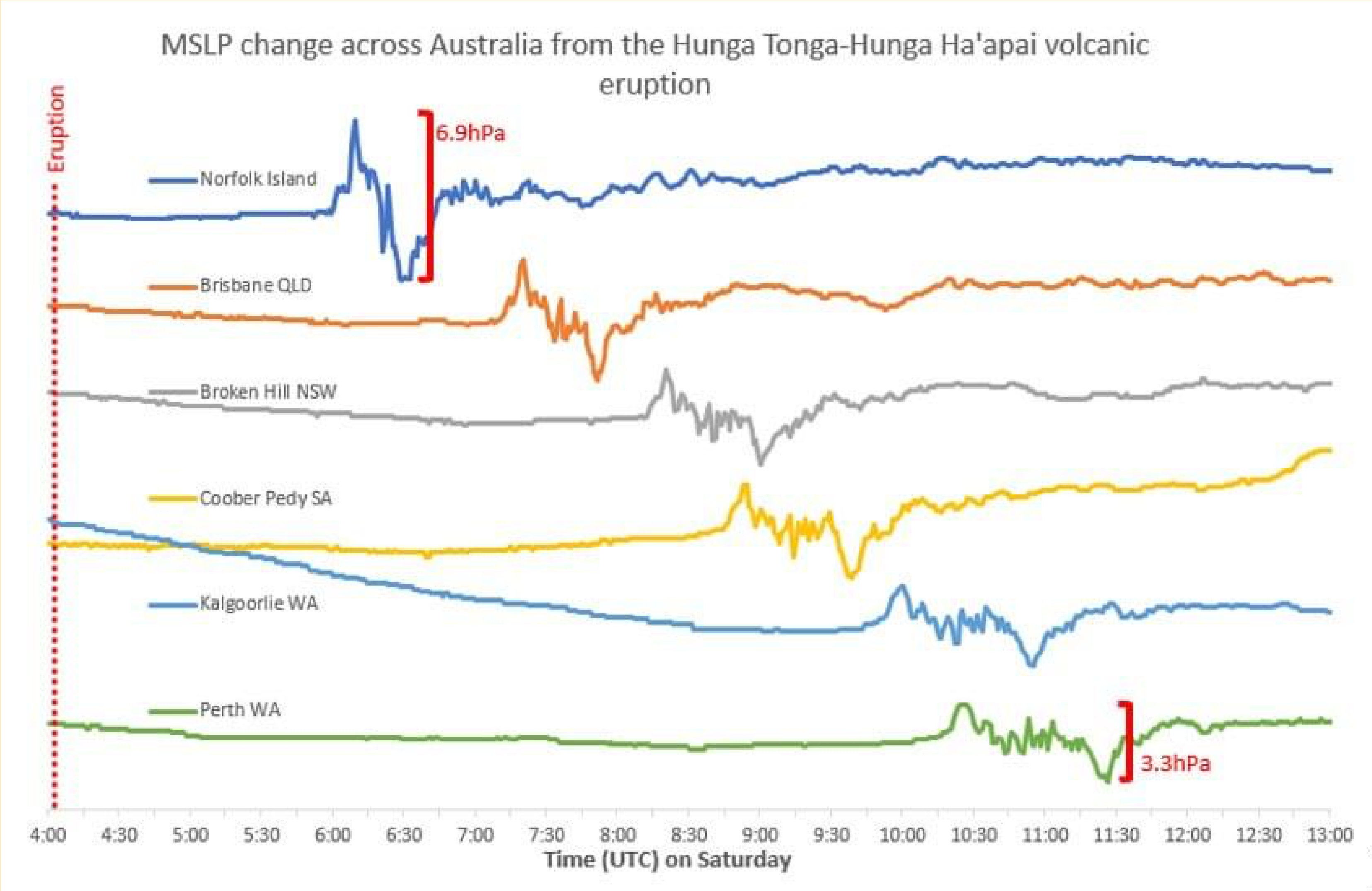

Figure 3 BOM plots of Mean Sea Level Pressure as the wave moved across Australia

Barometric pressure observations from the Tonga volcano explosion

In all cases the pattern was the same, with the air pressure suddenly rising a couple of hectopascals, followed by a drop of a couple of hectopascals. An initial sudden rise in pressure, followed by a fall, is normal for any air explosion such as with mine blasting or from a atmospheric nuclear bomb.

The tsunami from the explosion caused significant damage to Tonga's capital Nuku'alofa but so far there have been a only a few reports of deaths or injuries in the news media (which may also be due to the current loss of internet communications to Tonga, and with the current difficulty with surveying nearby islands). The cloud of volcanic ash extended upwards to at least 20km (66,000 feet), so I imagine that airliners will be avoiding the area for a while.

How did the instruments of different institutions of earth physics recorded the eruption of Hunga Tonga - Hunga Ha'apai volcano?
Several kinds of geoscientific instruments operated by EPSS partly in international cooperation at seismological and geodynamical stations (Conrad Observatory, Austria; The Peters Seismological Observatory, Australia) recorded the effects of the seismic and atmospheric shock waves generated by the huge volcanic explosion. The time series of high (nano-scale) resolution tilt sensors and extensometers, infra sound detector arrays, barometers, etc… indicate clearly the influence of it on the recorded parameters. Among them a Lippmann-type 2D tilt sensor installed and run at The Peters Seismological Observatory (Victor Harbor, South Australia, Seismological Association of Australia) will hopefully provide very useful information about the pre- and post-eruption crustal deformations being the closest to the site of the explosion. The resolution capability of this type of tilt sensors reaches 1 mm/1000 km. It seems that the trend of the E-W component of the tilt shows a significant change in some hours after the eruption. Such sudden tendency changes, however, can be coupled also to local e.g. hydrological processes, so careful analysis of the continuously recorded data, including the environmental parameters too, are necessary for its correct interpretation.

Figure 4 The geographical locations of TPSO and Tonga

Figure 5 The geographical locations of COBS and SOPGO

Barometric pressure observations from the Tonga volcano explosion

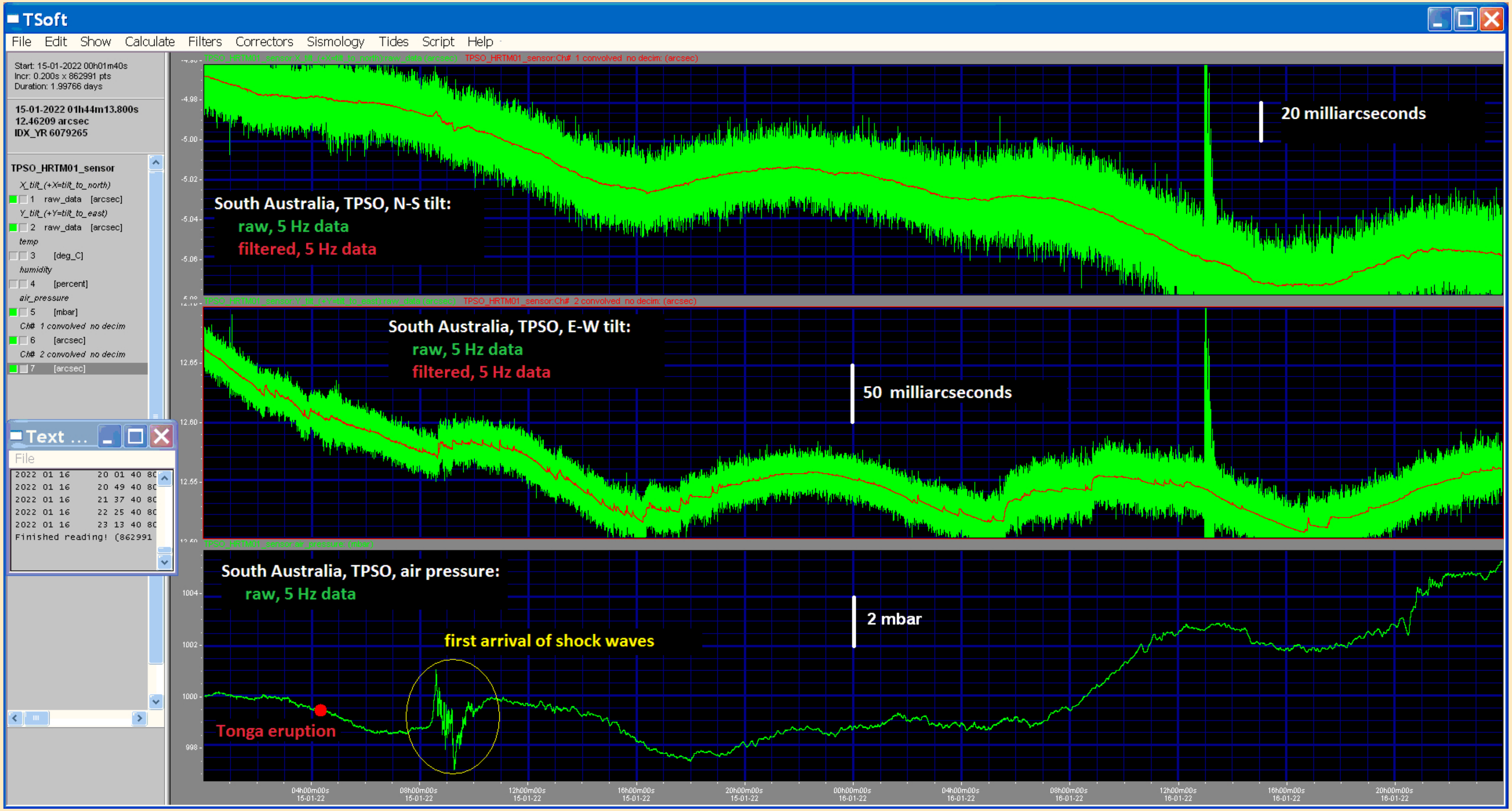

Figure 6 Tilt and air pressure data recorded on the 15th and 16th of January, 2022 at The Peters Seismological Observatory (TPSO is operated by the Seismological Association of Australia), Victor Harbor, South Australia, Australia

Barometric pressure observations from the Tonga volcano explosion

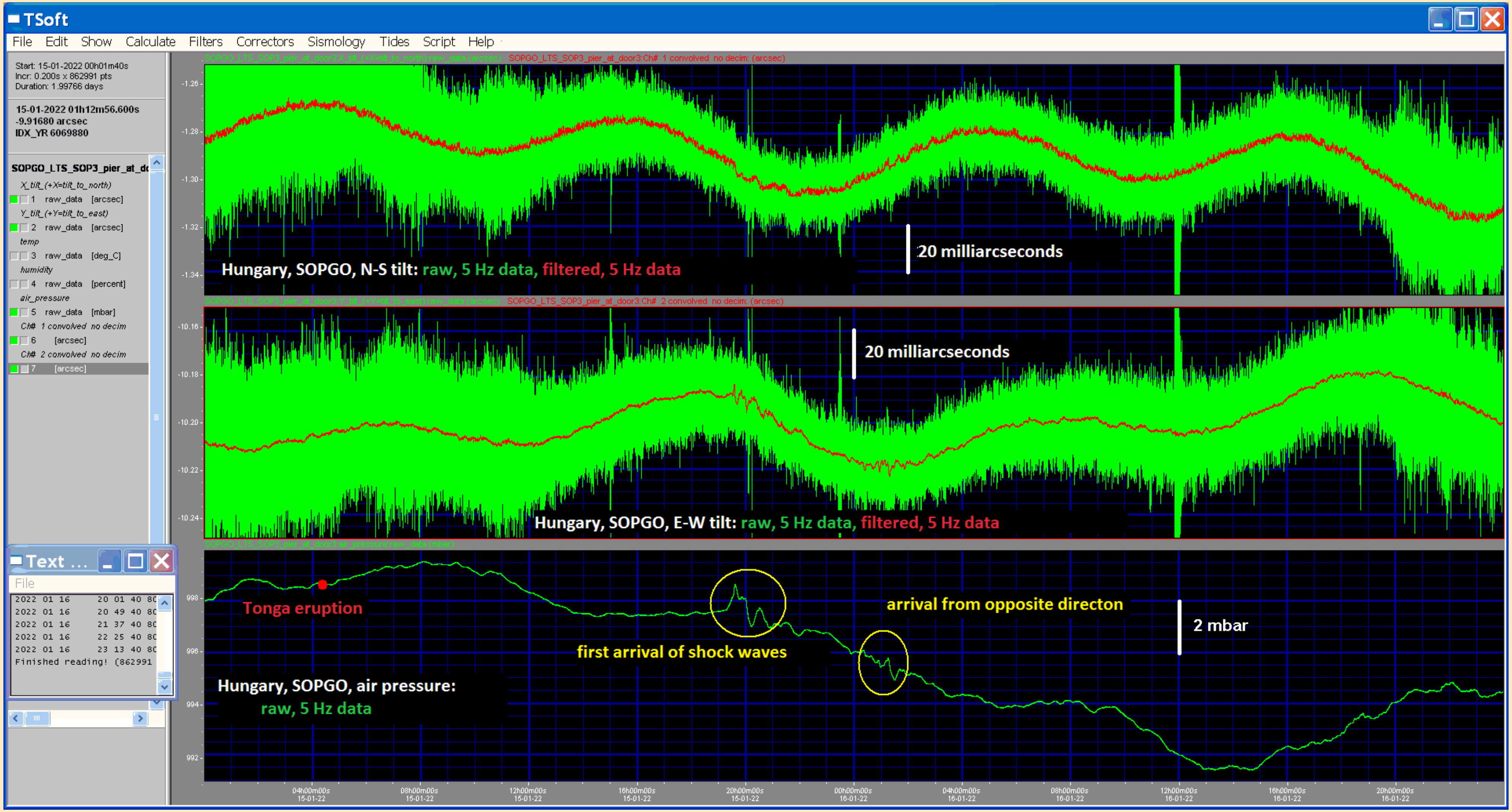

Figure 7 Tilt and air pressure data recorded on the 15th and 16th of January, 2022 at the Geodynamic Observatory Sopronbánfalva (SOPGO), Institute of Earth Physics and Space Science, Sopron, Hungary

Barometric pressure observations from the Tonga volcano explosion

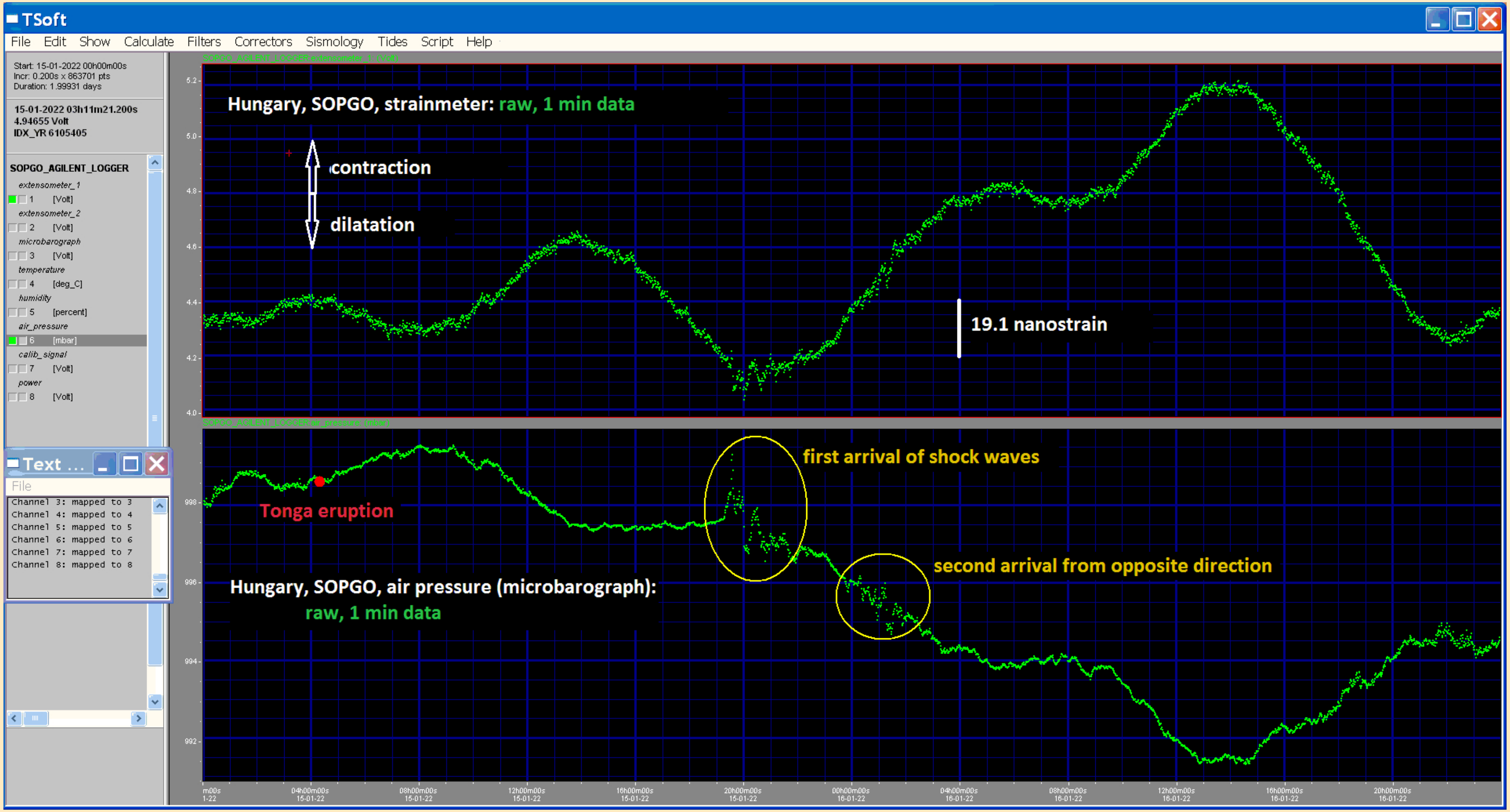

Figure 8 Strain and air pressure data recorded on the 15th and 16th of January, 2022 at the Geodynamic Observatory Sopronbánfalva (SOPGO), Institute of Earth Phyisics and Space Science, Sopron, Hungary

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Barometric pressure observations from the Tonga volcano explosion

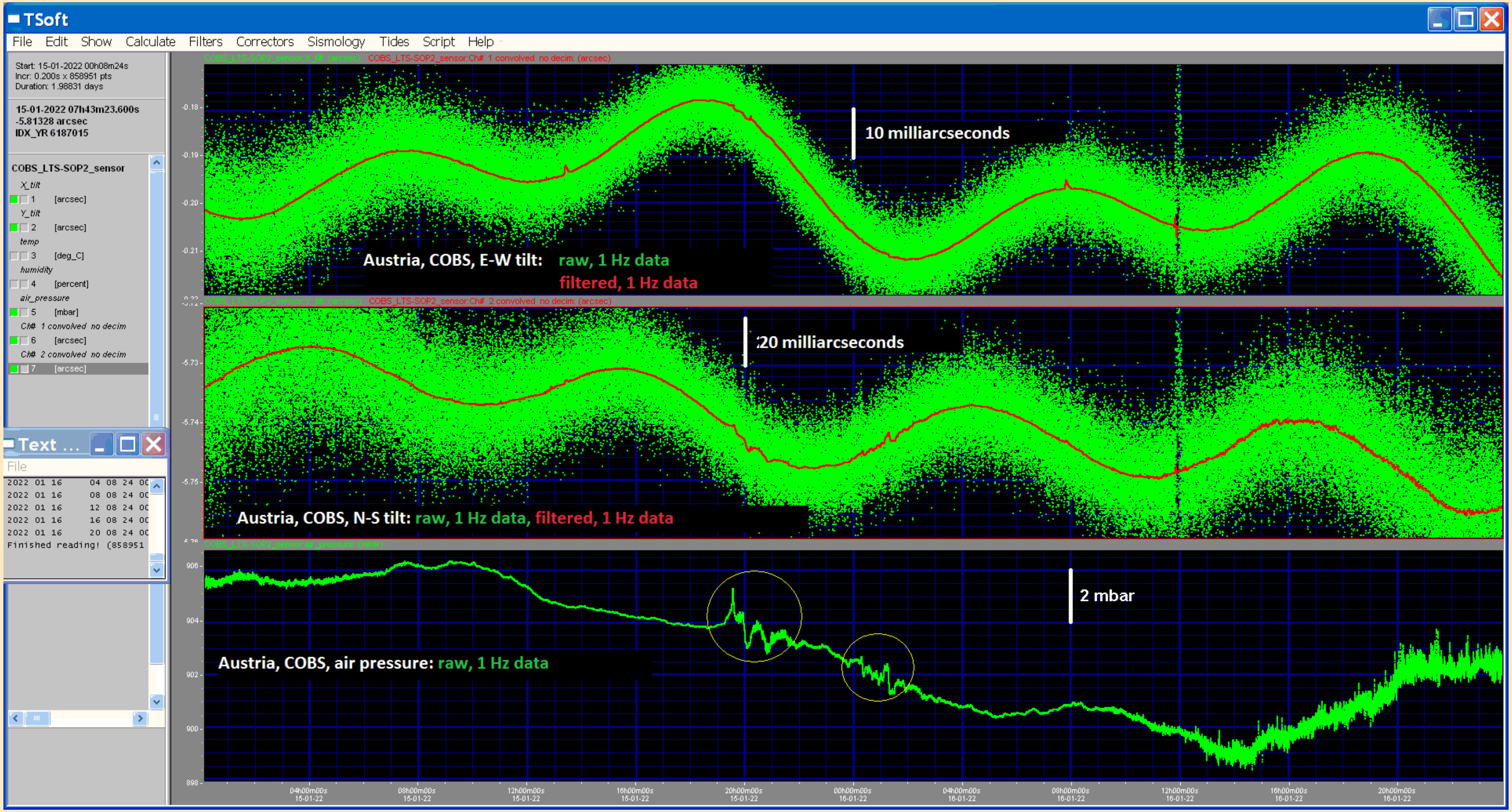


Figure 9 Tilt and air pressure data recorded on the 15th and 16th of January, 2022 at the Conrad Observatory (COBS) operated by the Zentralanstalt für Meteorologie und Geodynamik, Wien, Austria

Seismological Association of Australia Inc.

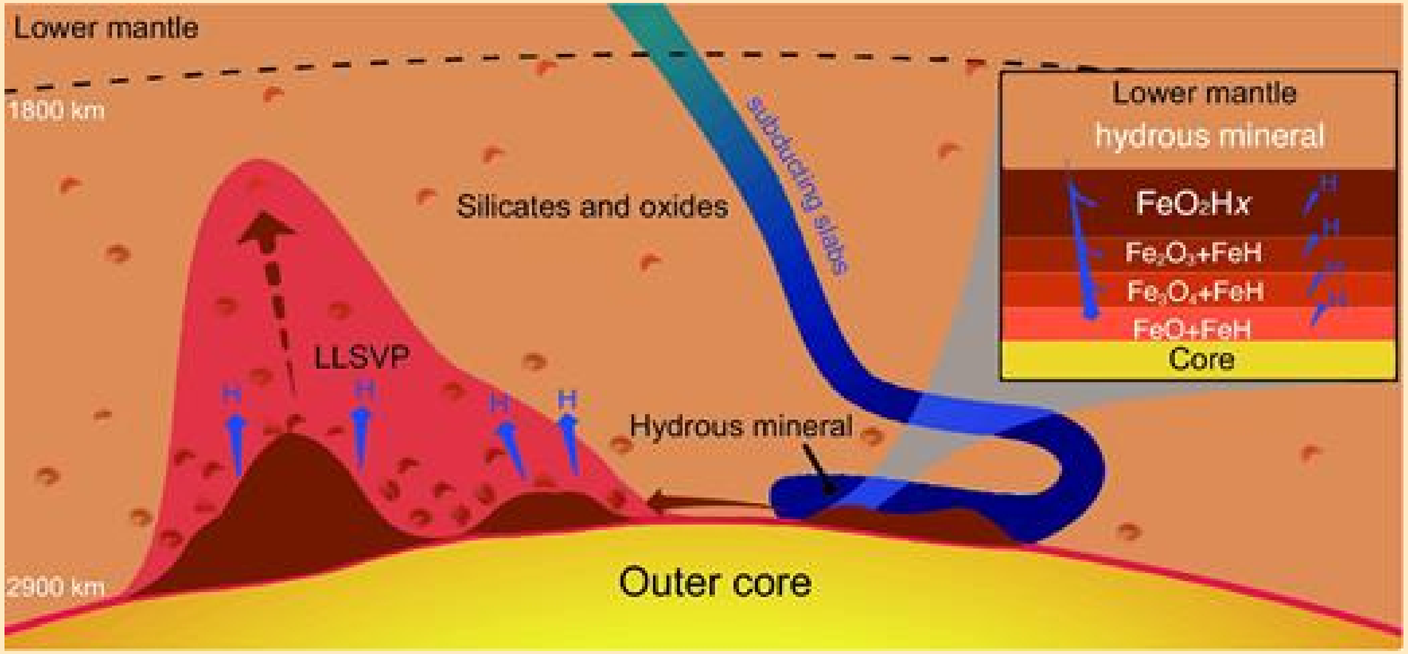
The Tonga shock wave

Kindly submitted by
Kevin McCue, CQSRG and Bruce Boreham

At 17:26 local time on 15 January 2022, an explosive eruption began on the uninhabited Hunga Tonga–Hunga Ha apai island of Tonga in the SW Pacific about 65 km north of Tongatapu, the country's main island. This island chain sits astride the Tonga–Kermadec Islands subduction zone, a plate boundary where the Pacific and Australian Plates are in collision. The eruption caused destructive tsunamis in Tonga and these travelled across the Pacific Ocean. This eruption is probably the largest since the 1991 eruption of Mount Pinatubo in the Phillipines.

A recent paper by Mao et al (2017) suggests a model for us to speculate on the mechanism in this case, the critical parameter is the island’s location above an active, deep, long lasting subduction zone.

Mao et al’s abstract reads in part: Hydrous minerals in subducted crust can transport large amounts of water into the Earth's deep mantle. Our laboratory experiments revealed the surprising pressure-induced chemistry that, when water meets iron at the core-mantle boundary, they react to form an interlayer with an extremely oxygen-rich form of iron, iron dioxide, together with iron hydride. Hydrogen in the layer will escape upon further heating and rise to the crust, sustaining the water cycle.



The key point is that Hydrogen produced at the core/mantle boundary reaches the surface. Hydrogen is highly combustible.

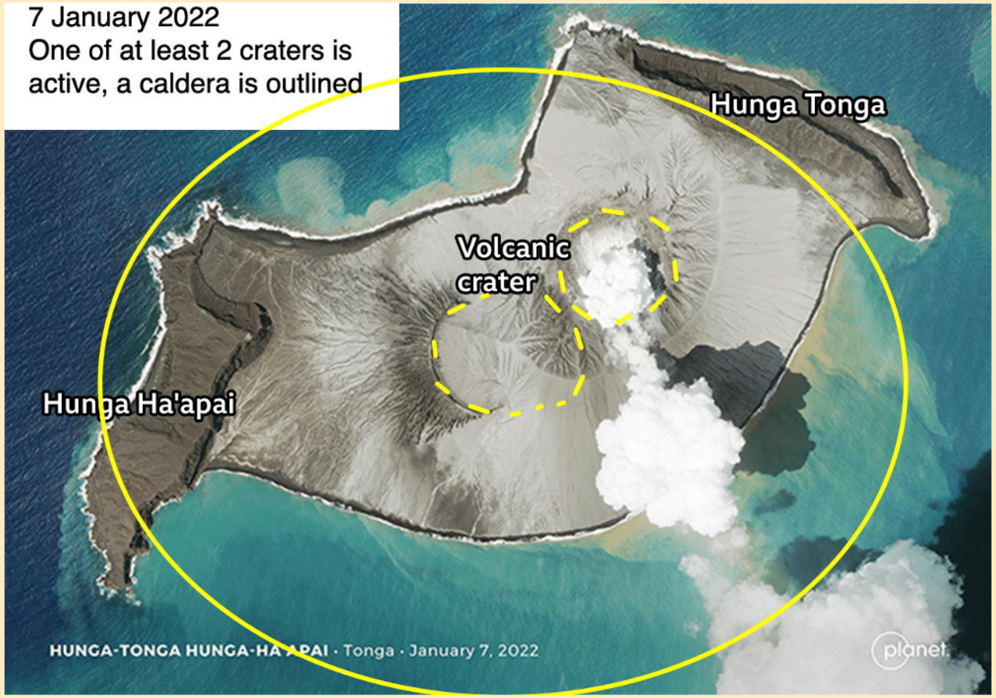
Figure 1 (from Mao et al. (2017)
The hydrogen cycle

The Tonga shock wave

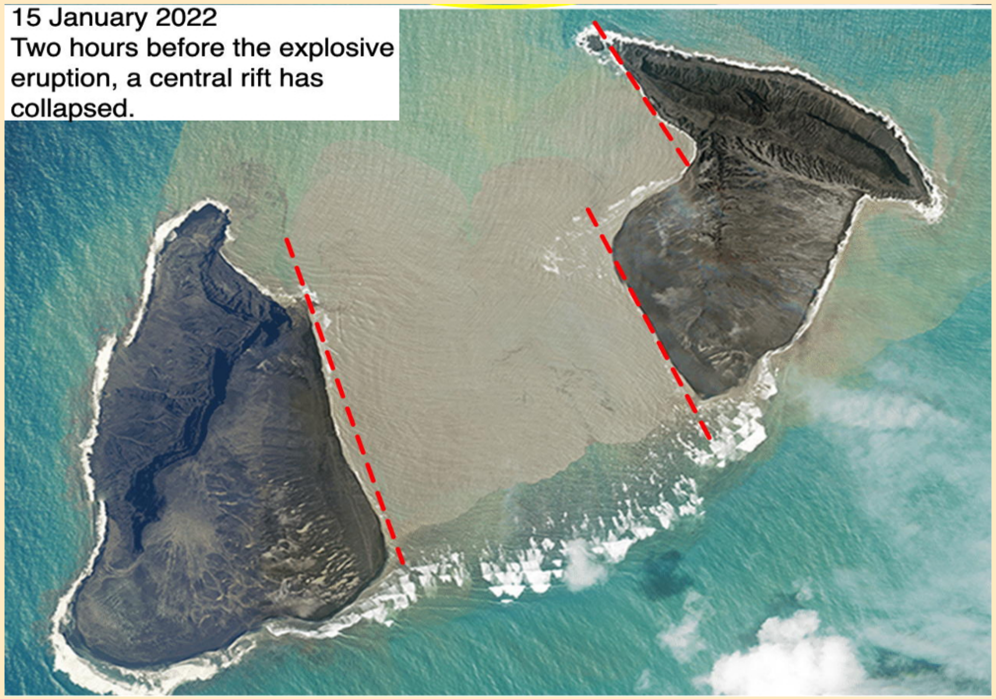
The authors both worked in a lab at the ANU in the last 1960s where helium was the fuel used to drive a unique free-piston shock tube to generate shock waves by the instantaneous venting of a high pressure gas into lower pressure gas (Stalker R, J. 1966). It struck us that the mechanism producing the shock wave that travelled around the world in the explosive eruption of the volcano is analogous to the shock wave generation in the shock tube.

What occurred is captured in the following 3 photographs and our explanation is given in the text.

Two weeks before the eruption - H_2 seeps upwards from the core/mantle boundary area and mixes with O_2 in a volcanic conduit near the earth's surface, confined by a plug of cold crust. [At this stage the volcanic activity is mild, one of the two or three small craters (dashed yellow lines) inside the caldera (solid yellow line) is venting a narrow steam and ash plume]

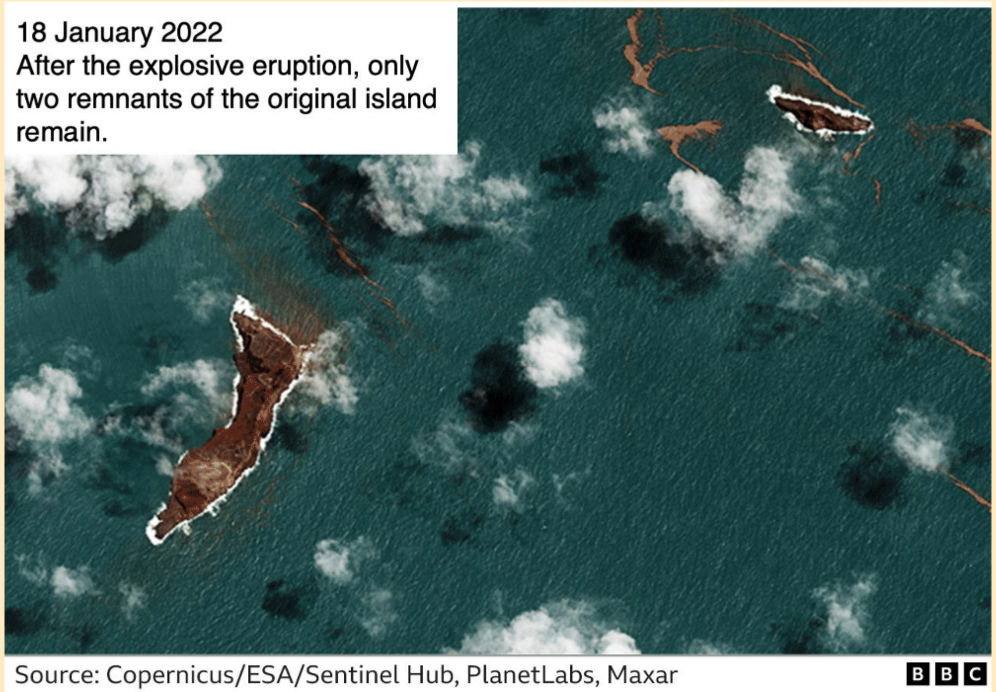


Two hours before the eruption - When enough gas has collected, the plug collapses into the conduit (red lines) increasing the gas pressure. [The caldera disappears below sea level] This confined explosive mixture is just waiting for a trigger, perhaps a pressure/temperature threshold or the injection of a small plug of red hot magma that has been rising up under the volcano [steady state for an hour or two].



The Tonga shock wave

The explosive eruption - Finally the hydrogen/oxygen mixture ignites in a large explosion shattering the plug, and releasing high pressure hydrogen and hot volcanic ash. As the pressure cooker explodes into the shallow water and atmosphere, the instantaneous release of high-pressure hydrogen into the lower pressure atmosphere causes a shock wave to propagate, driven by this initial pressure differential. The ratio of the pressures across this shock wave is defined as the shock strength (Liepmann and Roshko, 1962). Simultaneously a tsunami is generated, the combination spreading magma as ash vertically and horizontally, with the sonic boom travelling around the globe. Two remnants of the caldera rim is all that remains of the island.



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Liepmann H. W. and Roshko A. (1962). Elements of Gasdynamics, John Wiley, New York, p81.

Stalker R. J. (1966). The Free-Piston Shock Tube, Aeronautical Quarterly. Volume 17, issue 4, November pp. 351 -370.

Back from the dead

Submitted by Peter Gray
SAA Newsletter Editor

Some time ago, I was offered the temporary use of a Sprengnether HSA-3 Triaxial Accelerometer, along with an EchoPro recorder to capture data and send it to the SAA Eqserver. Not being familiar with the hardware, I struggled to make much sense of any of the seismic data amonst the noise or what to do with it. The HSA-3 originally relied upon an external complementary (+/-) 12VDC supply to power the accelerometer, but as technology progressed and electronics minaturised, seismic recorders such as the EchoPro only began to offer a single polarity external sensor power facility, often based on the internal battery technology employed within the recorder. This HSA-3 had previously been modified to work with an EchoPro and to a certain extent it had, but the resulting responses were very noisy and determining where this noise problem came from using an EchoPro was proving difficult.

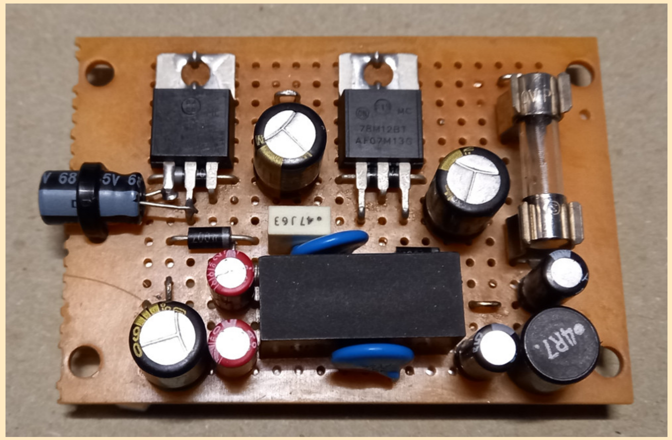
One of the nice features of using an Raspberry Shake RJAM (or any Shake product) is the ability to look at data in real time using several different tools available to shake users. The RJAM allows us to observe the effects of different input stimulus to determine system fault conditions.

Creating a complementary power supply from a single supply can be a trivial task, assuming you exist in a digital world (and don't we all?). If you throw in some sensitive analogue electronic sensors and fundamental frequencies significantly below 10Hz, it can become a totally different proposition. It took a while to get the power supply sorted but when it was done and installed within the HSA-3 enclosure, all three accelerometers were quiet and stable.

After monitoring the background noise responses in my garage for a month or so, it was time to move the RJAM and the HSA-3 into a suitably quiet location and wait for a seismic event that might test it's servicability. The equipment was installed on the pier at TPSO in mid September 2021, just prior to the Woods Point (VIC) and Murrayville (SA) events, either would have been suitable candidates for the job.

Unfortunately, the new TPSO comms connection was blocking the shake from the outside world and the shake's internal memory was set to the default 7 days, so the data was lost. The next couple of weeks proved to be relatively unremarkable seismicly but at 1825 UT on December 29th, it wasn't just Darwin that felt the M7.3 quake located just north-east of Timor-Leste in the Banda Sea.

One of SAA's HSA-3 Accelerometer variants


The new complementary 12VDC Power Supply

Back from the dead

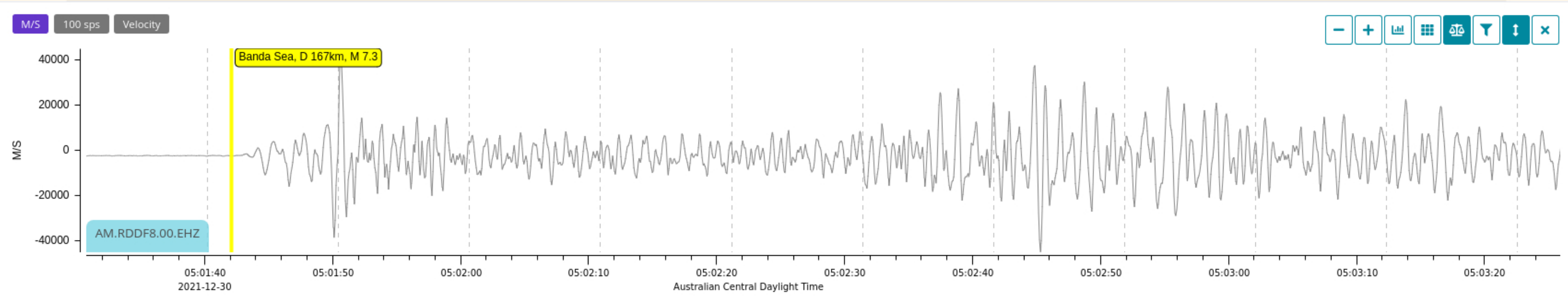


Figure 1 : Vertical channel response from a Guralp CMG 6T-1 at Middleton, SA on Raspberry Shake RJAM RDDF8

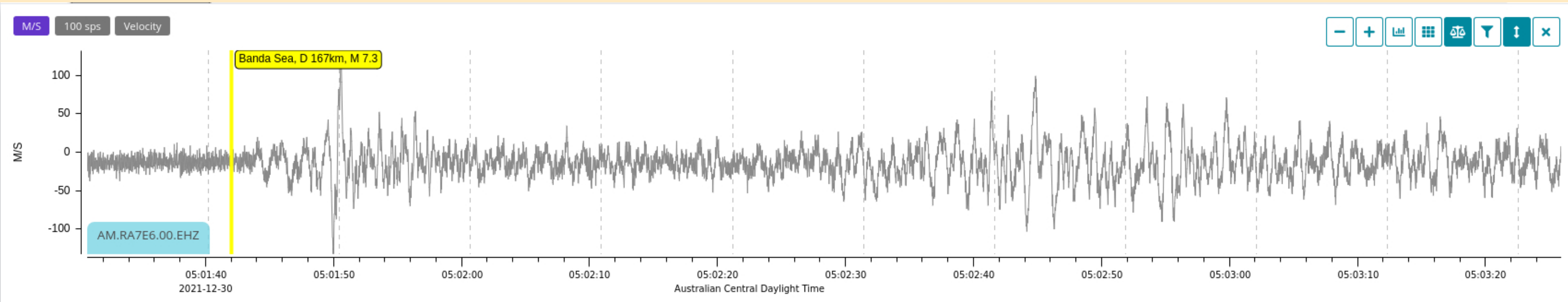


Figure 2 : Vertical channel response from the HSA-3 at TPSO, Hindmarsh Valley SA on Raspberry Shake RJAM RA7E6

The distance between the two shakes is approximately 3.5km and both locations are approximately 3000km from the M7.3 quake epicentre in the Banda Sea. Apart from the significant difference in amplitude between the seismometer and the accelerometer, the waveforms have a lot in common. The peak to peak noise on the accelerometer of about 35 counts shows a significant improvement over my garage, not surprisingly. The misleading labelling on Figure 2, M/S and Velocity, are fixed in this example due to this new Shake software (beta release) for the waveform viewer used.

Wobbly Building - Part 2
The Schulz Building Exercise

Kindly submitted by David Love, Blair Lade and Jack Pappin

Following the success of our first monitoring exercise (Easter 2021, see Newsletter #23), the committee was on the lookout for other opportunites.

The Woods Point earthquake (22nd Sep 21, M5.9) provided some impetus, with hundreds of felt reports in many Adelaide high-rise buildings, and the evacuation of some, including the Schulz Building at Adelaide University. Dr Jerry Vaculik, Civil, Environmental and Mining Engineering, Adelaide University, organised permissions for us to perform another monitoring exercise.

On 6th December, Blair Lade, Jack Pappin and David Love spent the day moving recorders around the building. In this case we used three sensors, one seismometer and two accelerometers, to measure simultaneously at various places in the building, for approximately an hour at each site. We recorded in the centre, east and west ends of the 12th, 9th, 6th, 3rd and ground floors (Figure 1).

A Trillium 120 sec broadband sensor was installed at point A for the whole day. The two accelerometers were first operated at point 1, before being moved to point 2, then on to following points. At each site there was sufficient visibility to obtain GPS lock, so that vibration can be accurately compared between sites. One person stayed near each mobile unit at all times for security, however the building was almost deserted.

The data should be suitable for a student project. It is hoped that besides the natural frequency, harmonics and rotation may be visible.
In short, we hope the data will be sufficient to model how the building responds to ambient vibration.

12th floor	6	A	6
9th floor	5	1	5
6th floor	4	1	4
3rd floor	3	2	3
Ground	7	2	7

Figure 1 Monitoring sites for each of the selected floors of the Schulz building

Wobbly Building - Part 2
The Schulz Building Exercise

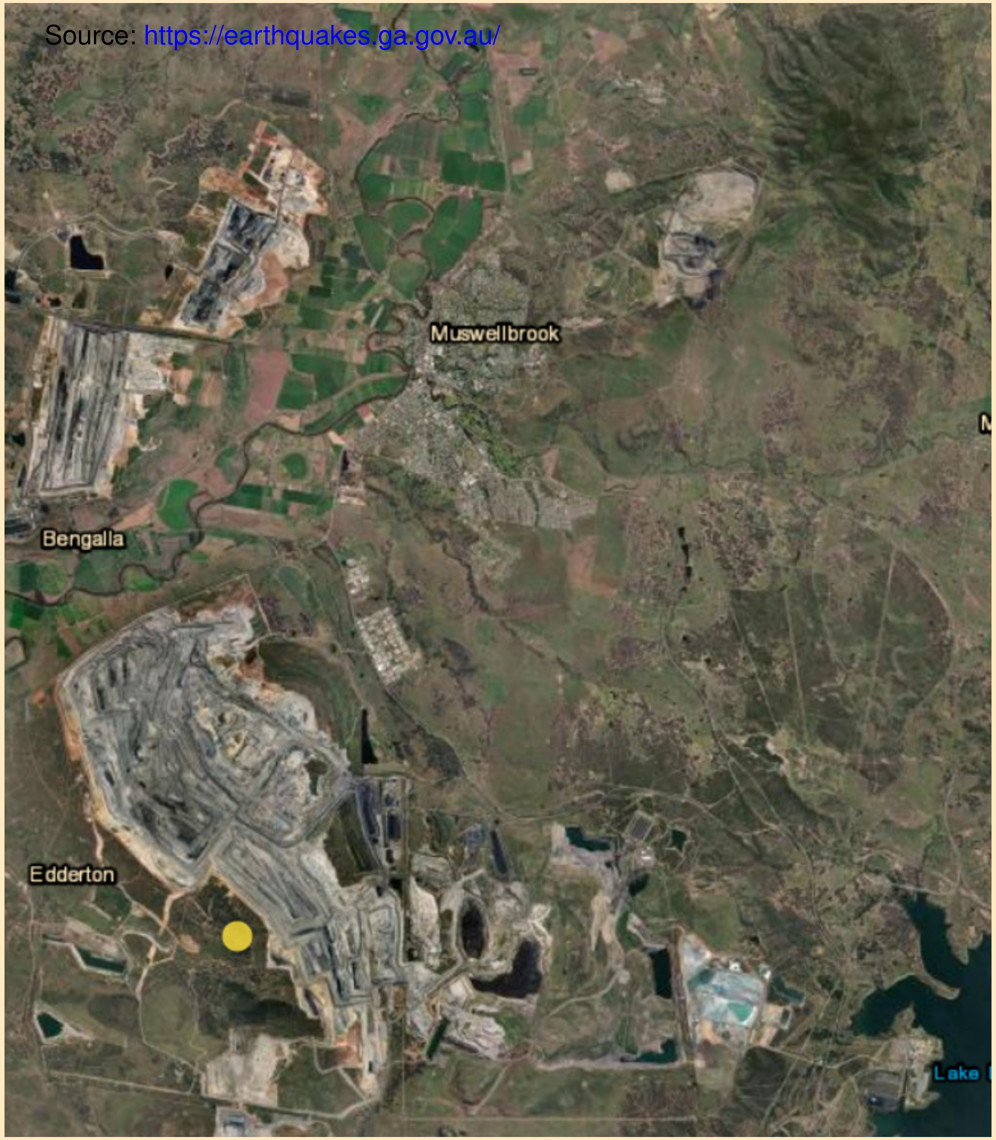
Front cover image of the Adelaide Uni's Schulz Building (the big one at the rear) courtesty of Jack Pappin.

Figure 2 David setting up an EchoPro and Guralp accelerometer

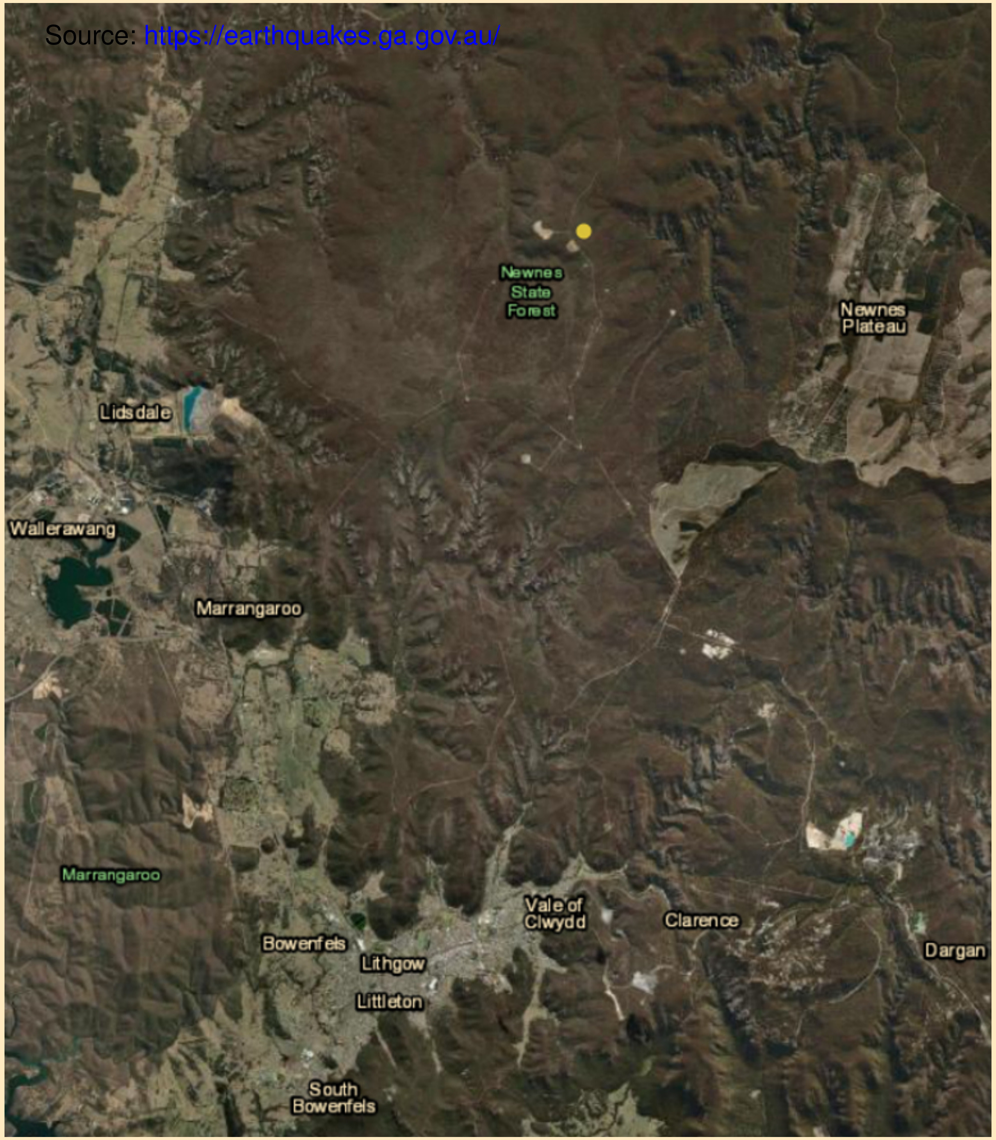
Figure 3 Quiet time in the basement, or is it the roof?

Recent Seismic Activity - New South Wales

2021-12-27 16:34 Muswellbrook -32.35, 150.85 3.4ML

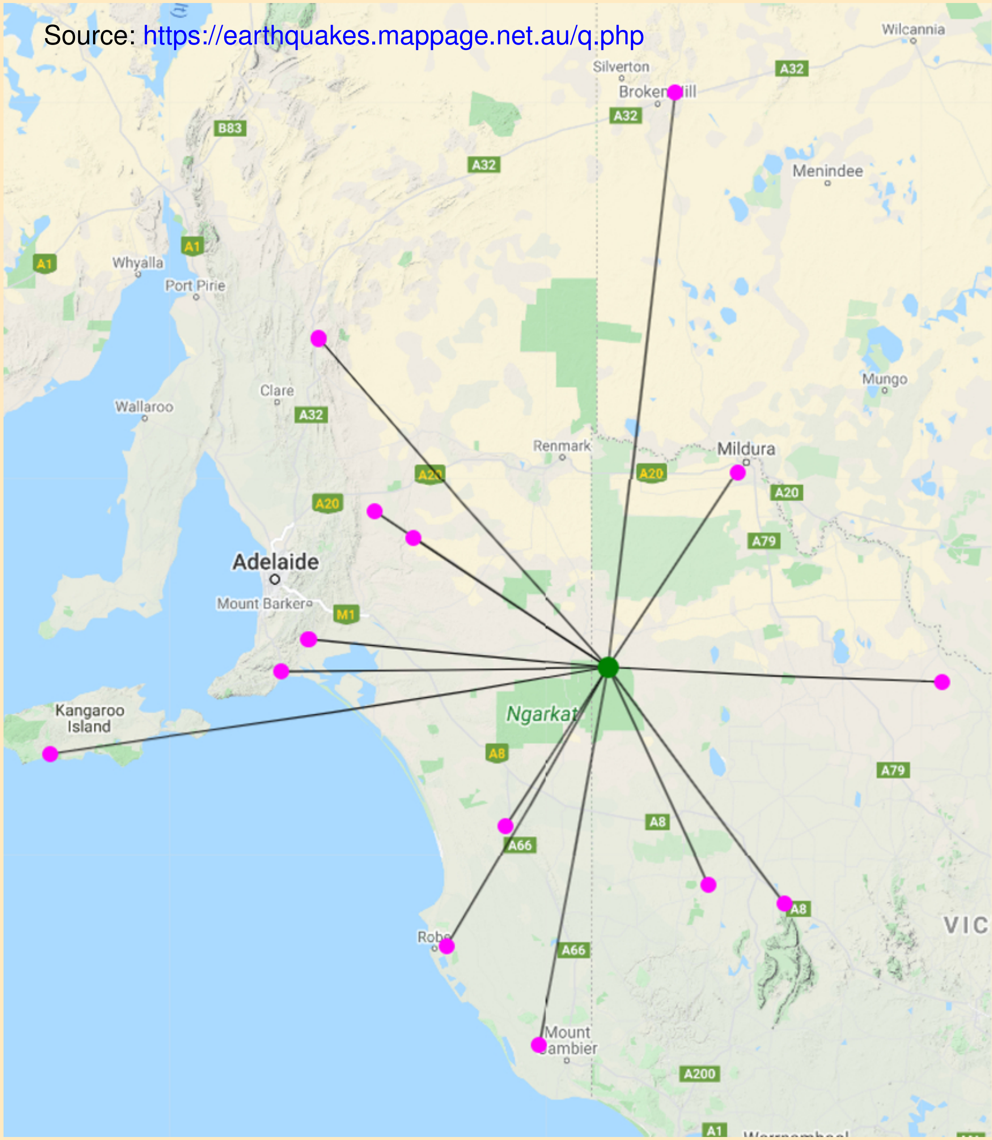


2021-11-10 09:46 N of Lithgow -33.36, 150.18 2.5ML

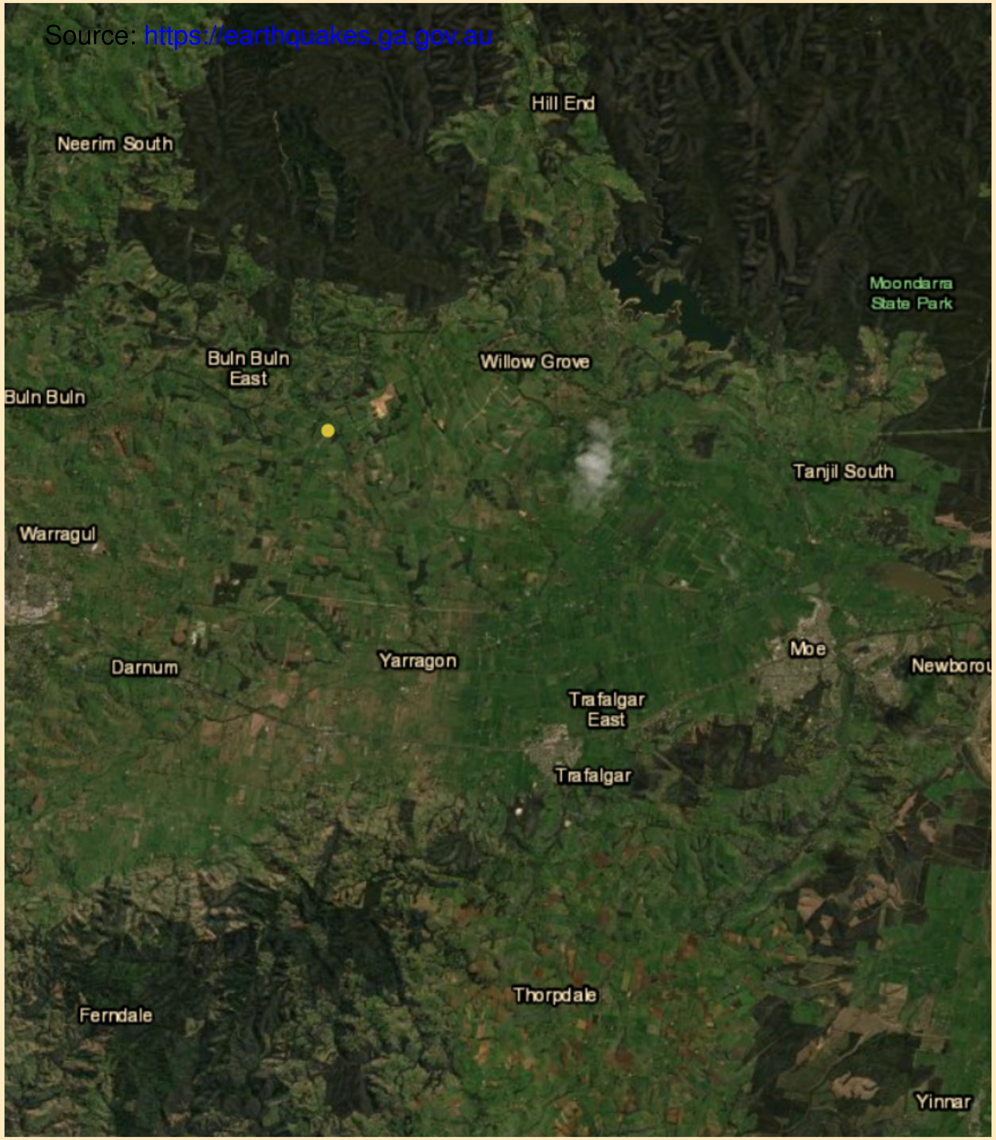


Recent Seismic Activity - Victoria

2021-12-16 11:29 SW of Murrayville -35.4604, 141.089 2.8ML

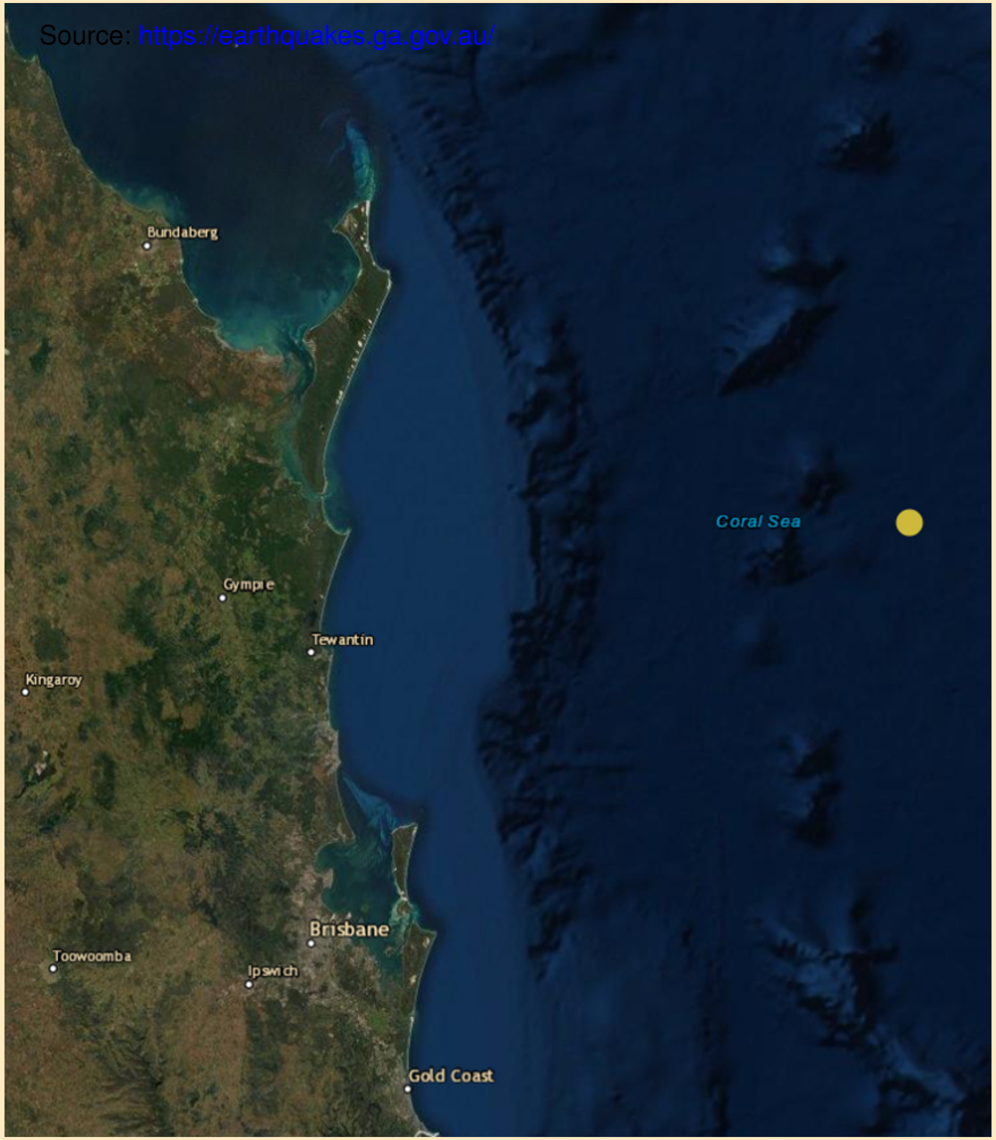


2021-12-28 04:24 NW of Moe -38.11, 146.06 2.7ML



Recent Seismic Activity - Queensland

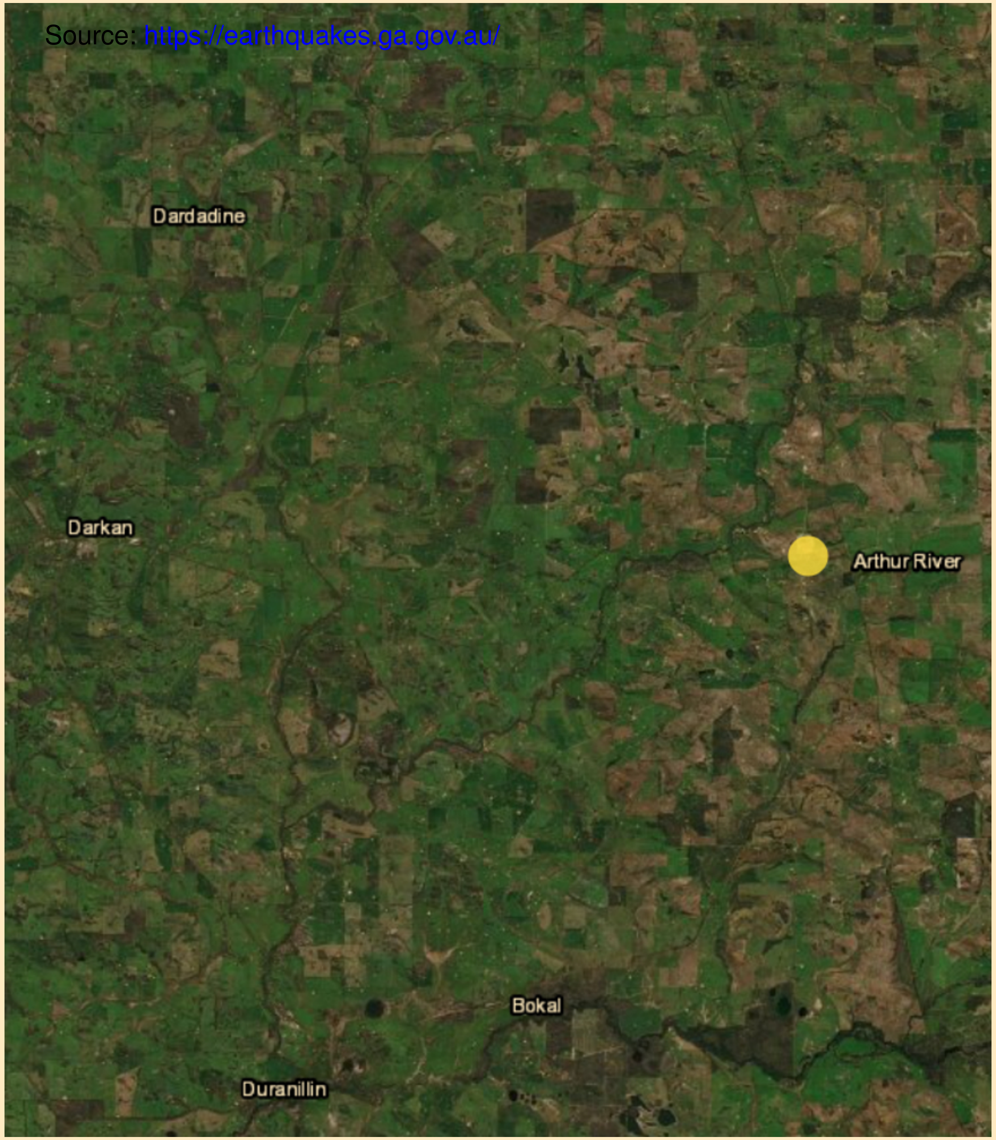
2022-01-01 14:24 Coral Sea -25.91, 155.51 3.6ML



2021-12-03 04:16 Offshore NE of Bowen -19.84, 148.74 3.1ML

Recent Seismic Activity - Western Australia

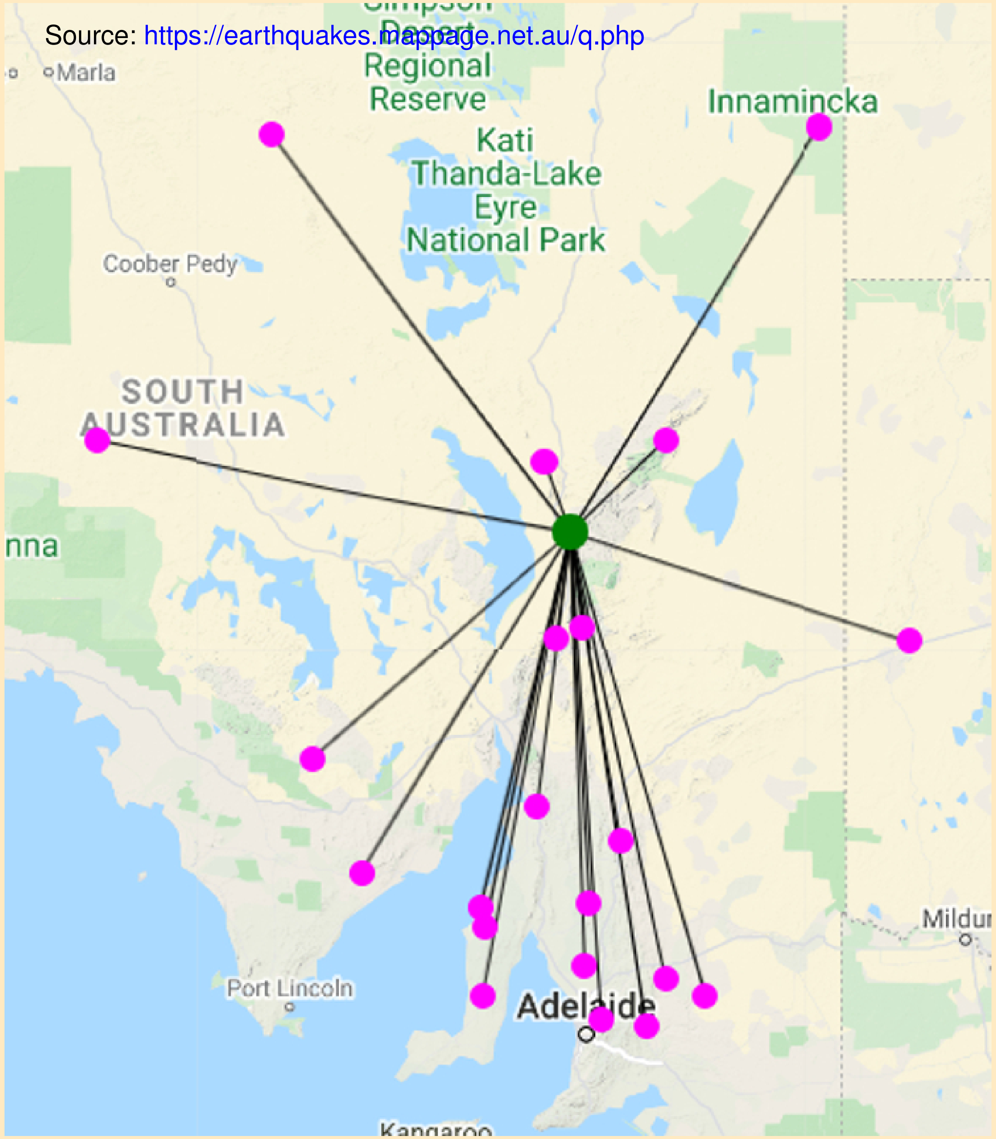
2022-01-05 11:37 E of Darkan -33.34, 117.02 4.0ML



2022-01-22 07:40 W of Wagin -33.29, 117.15 3.8ML

Recent Seismic Activity - South Australia

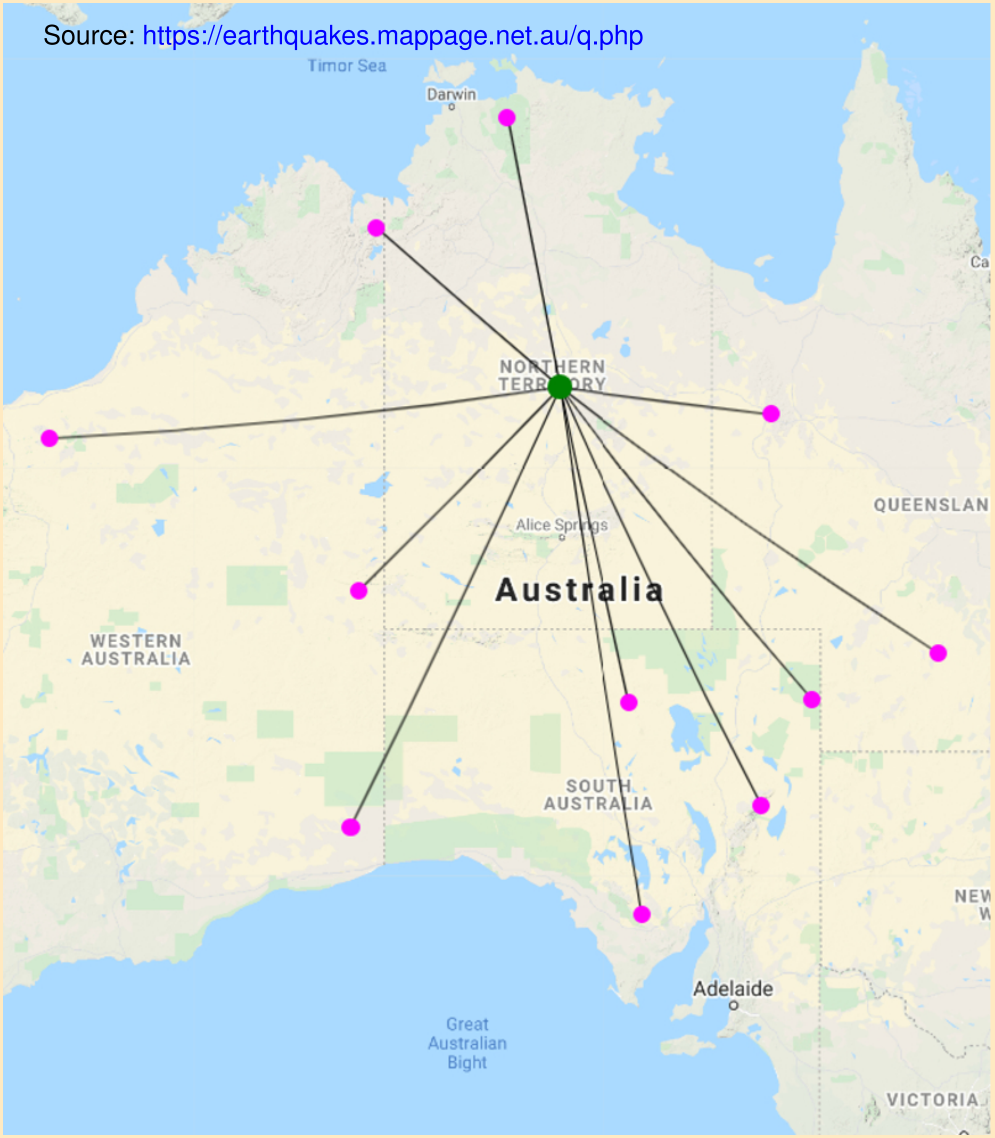
2022-01-07 15:53 N of Parachilna -31.0143, 138.442 3.3MLv



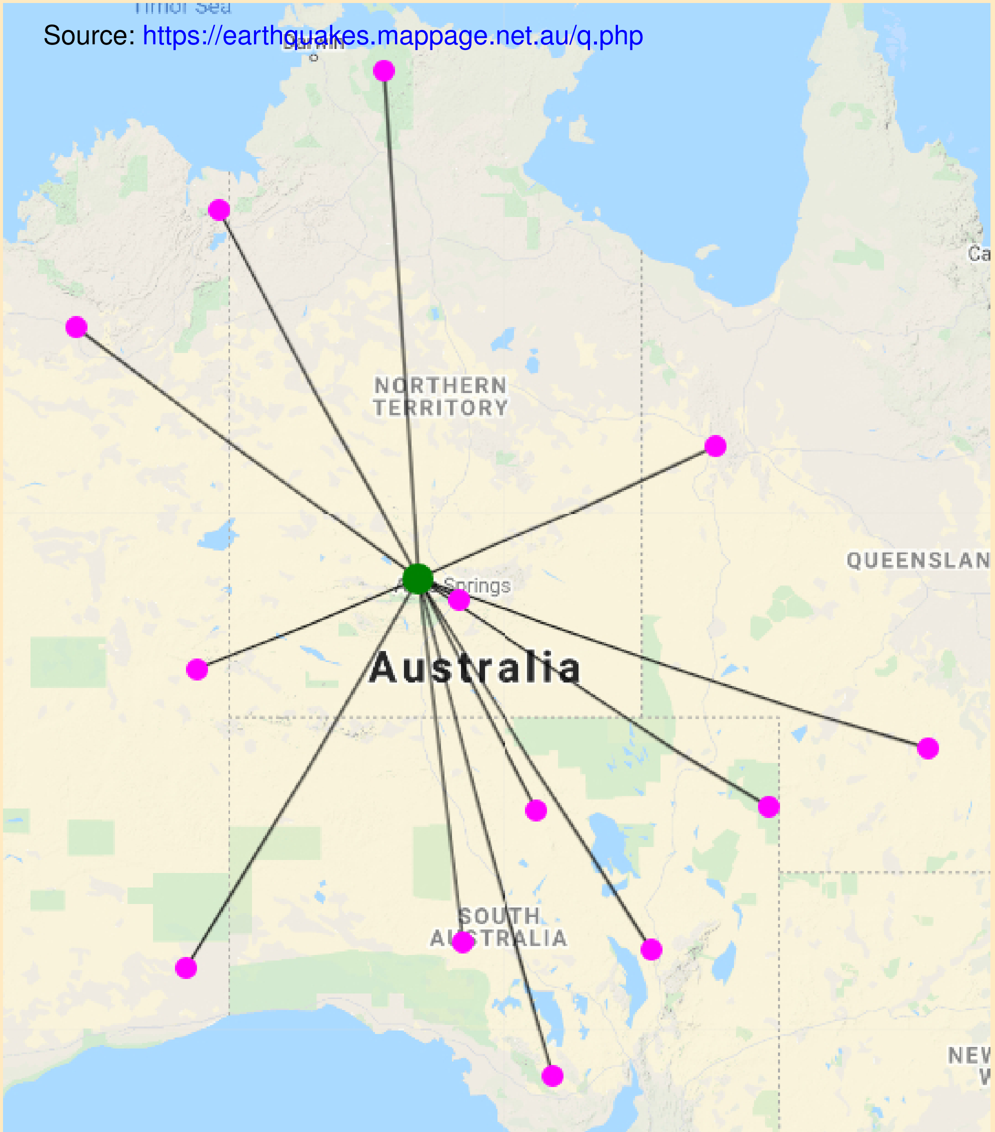
2021-11-05 09:33 NE of Port Pirie -32.8919, 138.283 3.1MLv

Recent Seismic Activity - Northern Territory

2022-01-20 02:12 SW of Tennant Creek -19.8673, 133.799 3.6MLv



2022-01-04 17:06 NW of Alice Springs -23.2242, 133.116 3.0MLv



Recent Seismic Activity - Tasmania

2022-01-05 18:00 Walker Island -40.62, 144.95 2.5ML

2022-01-08 14:56 Central Plateau -41.94, 146.48 2.3ML

The WWSSN Seismograph at Mundaring Geophysical Observatory, WA

Kindly submitted by
Kevin McCue, CQSRG

Seismologists had long recognised the need for a global network of accurately calibrated and accurately timed seismographs in the years before the World-Wide Standardised Seismographic Network was installed. The opportunity to fill that need came as a result of nuclear test ban discussions held in 1958. A panel on seismic improvement, chaired by Dr. Lloyd Berkner, was formed in the United States to consider research needs for improving the national capability in the detection and discrimination of underground nuclear explosions. The panel's report formed the basis of Project Vela Uniform, a program of fundamental and applied research managed by the Defense Advanced Research Projects Agency (DARPA). One of the panel recommendations was for the installation of standardised seismographs, with accurate clocks, at 100 to 200 existing seismograph stations.

The new network was not intended for the surveillance of nuclear tests; its role was to produce the data needed for fundamental research in seismology.
The recommendation of the project was adopted and implemented as the World-Wide Standardised Seismographic Network. The WWSSN was a technological milestone in seismology, producing abundant high quality data for research. The precedent-setting program also created a global network infrastructure, including the data-exchange procedures and station technical capabilities needed to support the establishment of the more advanced networks in operation (Peterson and Hutt, 2014).

In June 1962, the Mundaring Observatory became one in the World Network of Standardised Seismographic stations, MGO. See Plate 4 on Page 36.

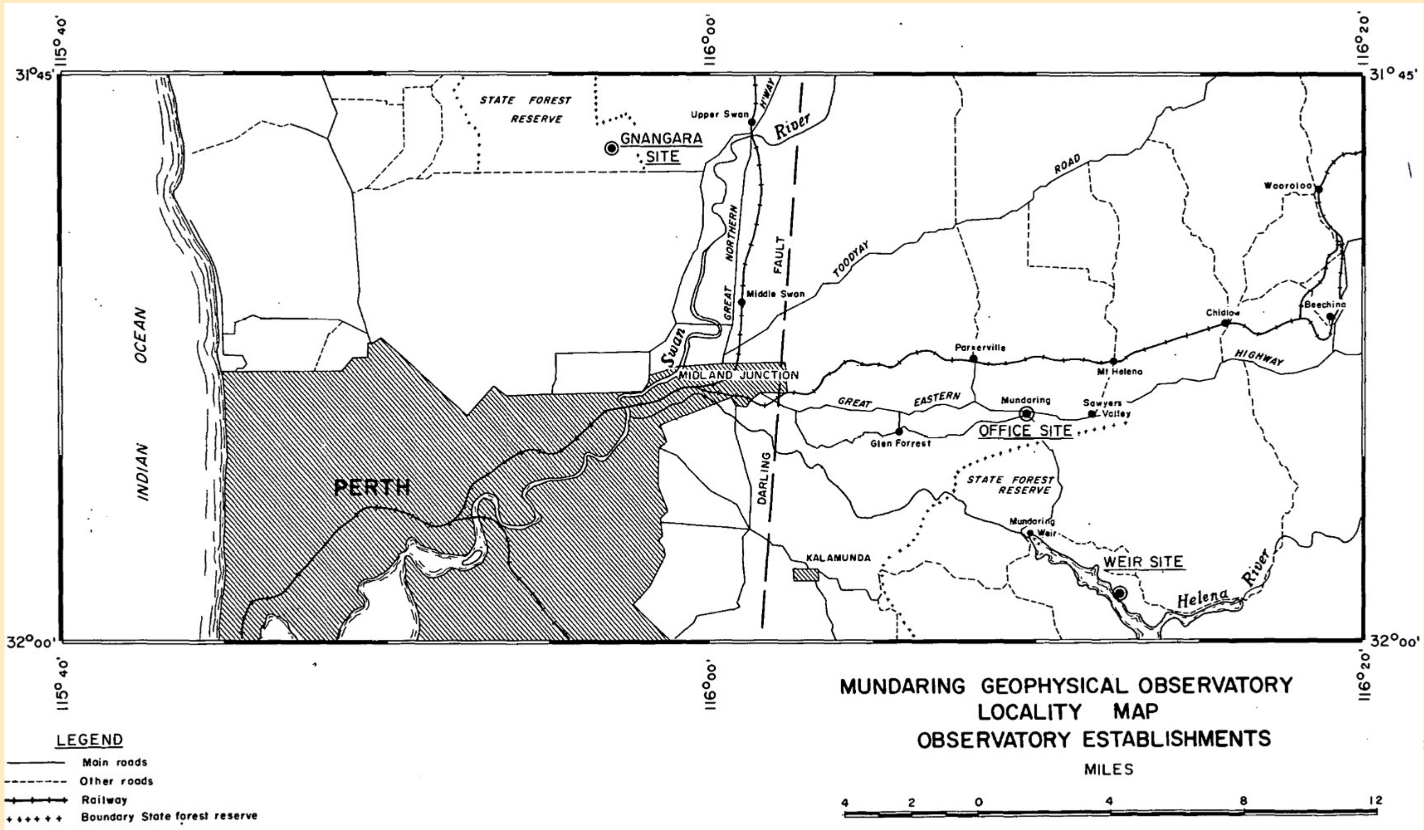


Plate 1 Location of the MGO office and seismograph at the Weir Site

The WWSSN Seismograph at Mundaring Geophysical Observatory, WA

The site was chosen considering the world wide distribution and the existence of a reliable operating station. The Observer-in-Charge at the time was Peter McGregor assisted by geophysicists Ian Everingham and Peter Gregson. Plate 1 shows the location of the seismic station at the Mundaring Weir Site.

Plate 2 shows the floor plan of the vault, which is built into an excavation on the side of a ridge. The excavation penetrates into solid granite. The walls and arched roof consist of an inner shell of concrete, a waterproof membrane, and an outer covering of brick to a total thickness of 11 inches (280mm). The vault floor floats on a layer of rubble through which agricultural drains are laid, discharging onto the surface below the excavation. The excavation is filled with gravel and the roof is covered with three feet of gravel. Concrete seismometer piers are isolated from the floor and bedded into the granite. Recorder and galvanometer piers rest on the floor and are built of brick with concrete slab tops. A plywood partition and door were placed between the seismometer and recording sections in June. The annexe, consisting of a porch and console room, provides a light and thermal barrier to the vault proper. Note: Item 7 should be SP Galvos.

Short-period seismographs. Three Benioff-type seismometers were coupled to short-period galvanometers recording on a triple-drum recorder.

Long-period seismographs. Three Sprengnether-type seismometers were coupled to long-period galvanometers recording on a triple-drum recorder.

Power and timing. A console unit provides 60 c/s power for the drum motors, clock, and programmer. The unit is quartz-crystal controlled and is supposedly stable to 5 parts in 10^7 equivalent to 50 milliseconds per day.

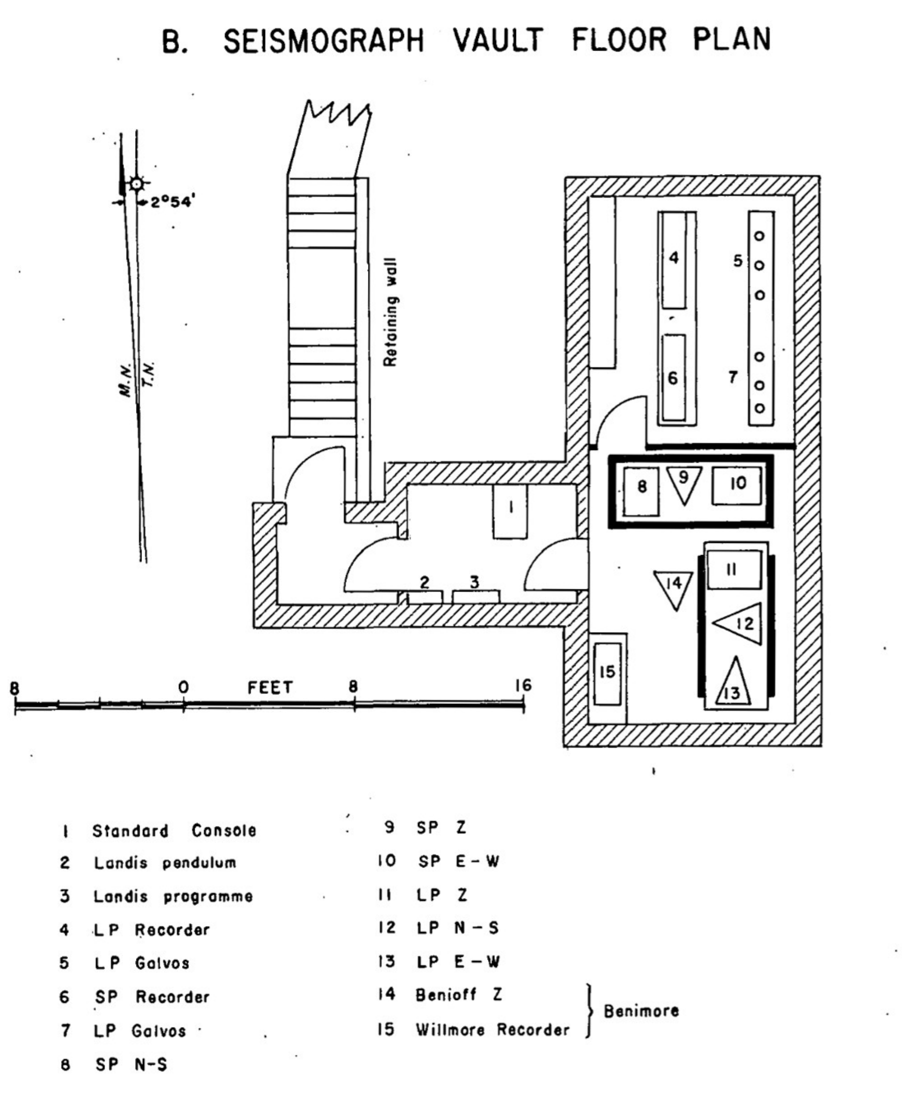


Plate 2 Seismic vault floor plan at MGO

The WWSSN Seismograph at Mundaring Geophysical Observatory, WA

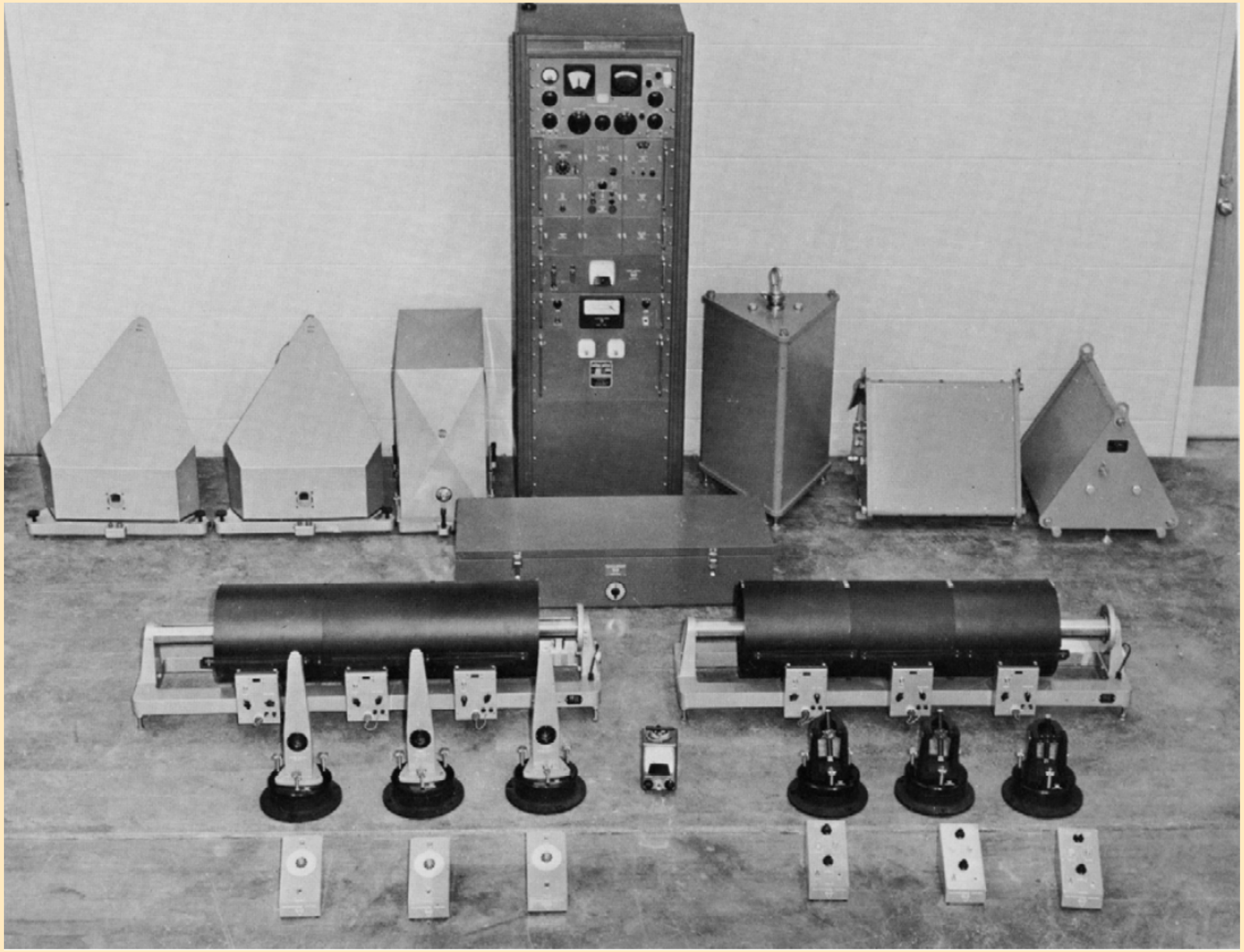
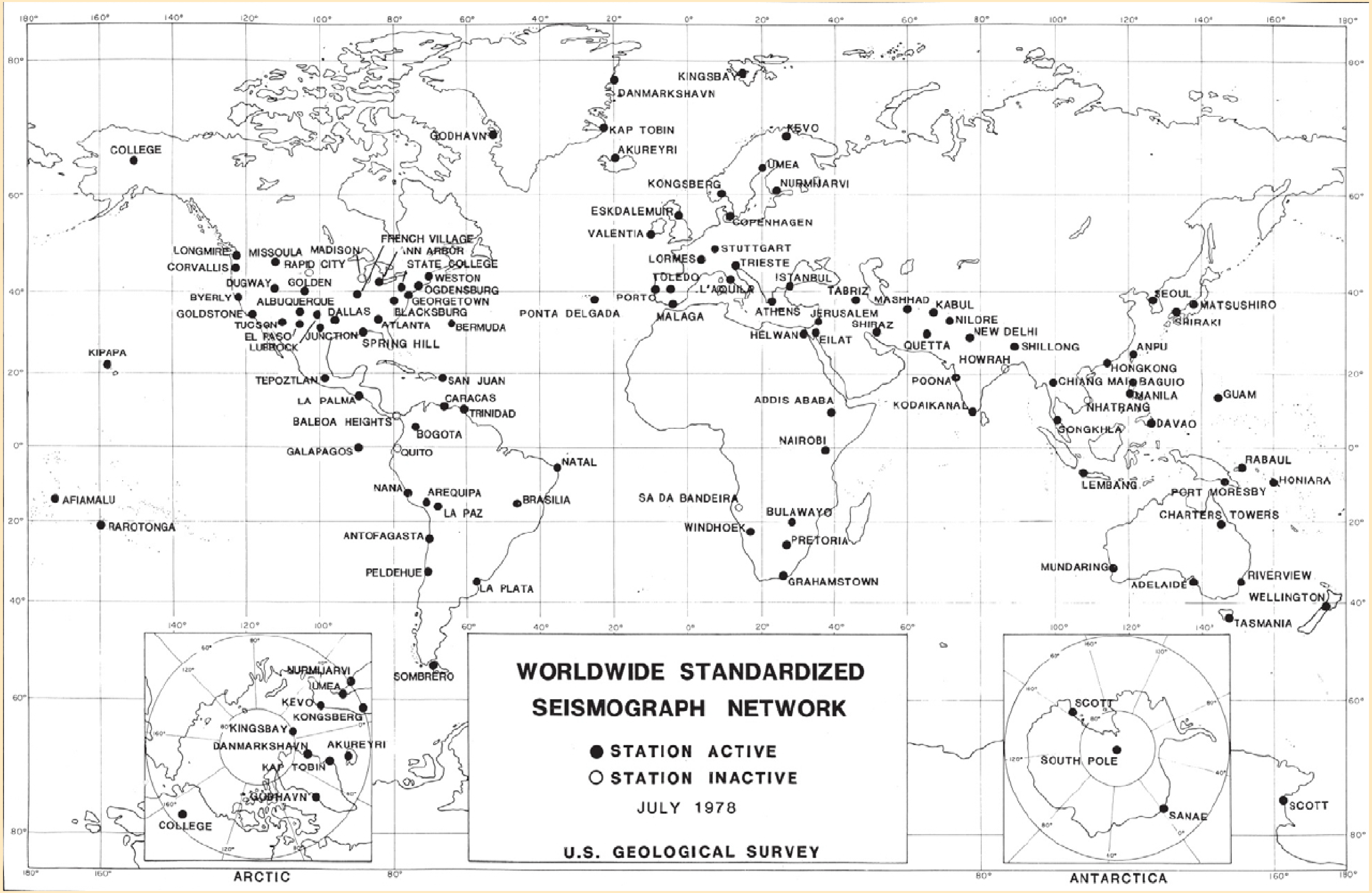


Plate 3 Components of the World Wide Standard Seismograph

During 1962 it was not generally possible to achieve this performance, daily rates ranged from zero to several hundred milliseconds, with occasional values exceeding two seconds. It is not known whether this erratic behaviour was due to defects in the frequency standard or frequency divider modules (as seems most likely), or to some other obscure cause. The console power is derived from a 28 Volt bank of nickel-cadmium batteries, charged from the station supply. This provides about twelve hours' standby power if the supply fails. In the event of failure of the frequency standard an electronic inverter provides regulated power for the drums and programmer. Radio time signals are recorded on the short-period north-south seismogram, through the programmer, at six-hourly intervals. The clock correction was determined daily; until 8th December the comparison of clock and radio was made on a Phase Shifter module. This provided visual indication of the relation of the two time pulses, the phase-shift required to bring them to coincidence giving the correction. On 8th December during the visit of the first USCGS modification team this was replaced by the direct-reading stroboscope unit. The clock correction was reduced to zero each morning during the record change. (McGregor, 1966).



WORLDWIDE STANDARDIZED
SEISMOGRAPH NETWORK
● STATION ACTIVE
○ STATION INACTIVE
JULY 1978
U.S. GEOLOGICAL SURVEY
COLLEGE
KIPAPA
AFIAMALU
RAROTONGA
LONGMIRE
CORVALLIS
MISSOULA
RAPID CITY
MADISON
FRENCH VILLAGE
ANN ARBOR
STATE COLLEGE
WESTON
OGDENSBURG
GEORGETOWN
BLACKSBURG
ATLANTA
BERMUDA
DUGWAY
GOLDEN
BYERLY
ALBUQUERQUE
GOLDSTONE
DALLAS
TUCSON
EL PASO
JUNCTION
LUBBOCK
SPRING HILL
TEPOZTLAN
SAN JUAN
LA PALMA
CARACAS
TRINIDAD
BALBOA HEIGHTS
BOGOTA
GALAPAGOS
QUITO
NANA
AREQUIPA
LA PAZ
BRASILIA
NATAL
ANTOFAGASTA
PELDEHUE
LA PLATA
SOMBRERO
GODHAVN
DANMARKSHAVN
KAP TOBIN
AKUREYRI
KINGSBAY
KEVO
UMEA
NURMIJARVI
KONGSBERG
ESKDALEMUIR
COPENHAGEN
VALENTIA
STUTTGART
LORMES
TRIESTE
TOLEDO
L'AQUILA
PORTO
PONTA DELGADA
MALAGA
ISTANBUL
ATHENS
TABRIZ
MASHHAD
KABUL
JERUSALEM
SHIRAZ
NILORE
NEW DELHI
HELWAN
EILAT
QUETTA
SHILLONG
HOWRAH
POONA
KODAIKANAL
ADDIS ABABA
NAIROBI
SA DA BANDEIRA
BULAWAYO
WINDHOEK
PRETORIA
GRAHAMSTOWN
SEOUL
MATSUSHIRO
SHIRAKI
ANPU
HONGKONG
CHIANG MAI
BAGUIO
MANILA
NHATRANG
GUAM
SONGKHLA
DAVAO
RABAUL
HONIARA
LEMBANG
PORT MORESBY
CHARTERS TOWERS
MUNDARING
ADELAIDE
RIVERVIEW
WELLINGTON
TASMANIA
SCOTT
ARCTIC
ANTARCTICA
SOUTH POLE
SANAE

The WWSSN Seismograph at Mundaring Geophysical Observatory, WA

By 1978, there were 115 World Wide Stations (Plate 3) not all of which were operational.

The seismograph at Mundaring continued operation with minor changes until 1992 when photographic recording of the SP-N and SP-E ceased operation (Gregson et al. 1994). Digital transmission of data to Geoscience Australia commenced on 26 February 2000.

Other Australian WWSSN stations were at Adelaide (ADE), Tasmania University (TAU), Riverview (RIV) in Sydney and Charters Towers (CTA).

References

Gregson P.J. and others, 1994.
Mundaring Geophysical Observatory Annual Report, 1962. BMR Record 1994/47.

McGregor, P.M., 1966.
Mundaring Geophysical Observatory Annual Report, 1962. BMR Record 1966/35.

Peterson J, and Hutt C.R, 2014.
Open-File Report 2014-1218 U.S. Department of the Interior U.S. Geological Survey

UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
CERTIFICATE OF TITLE

This is to certify that subject to the conditions of the agreement establishing a World-Wide Network of Standardized Seismographs, title to Standard Seismograph System Number 44 is hereby transferred from the Government of the United States of America to the Department of National Development, Bureau of Mineral Resources, Mundaring Geophysical Observatory, Mundaring, Australia

The Coast and Geodetic Survey welcomes the Observatory into this international program and looks forward to many years of close scientific cooperation between our organizations.

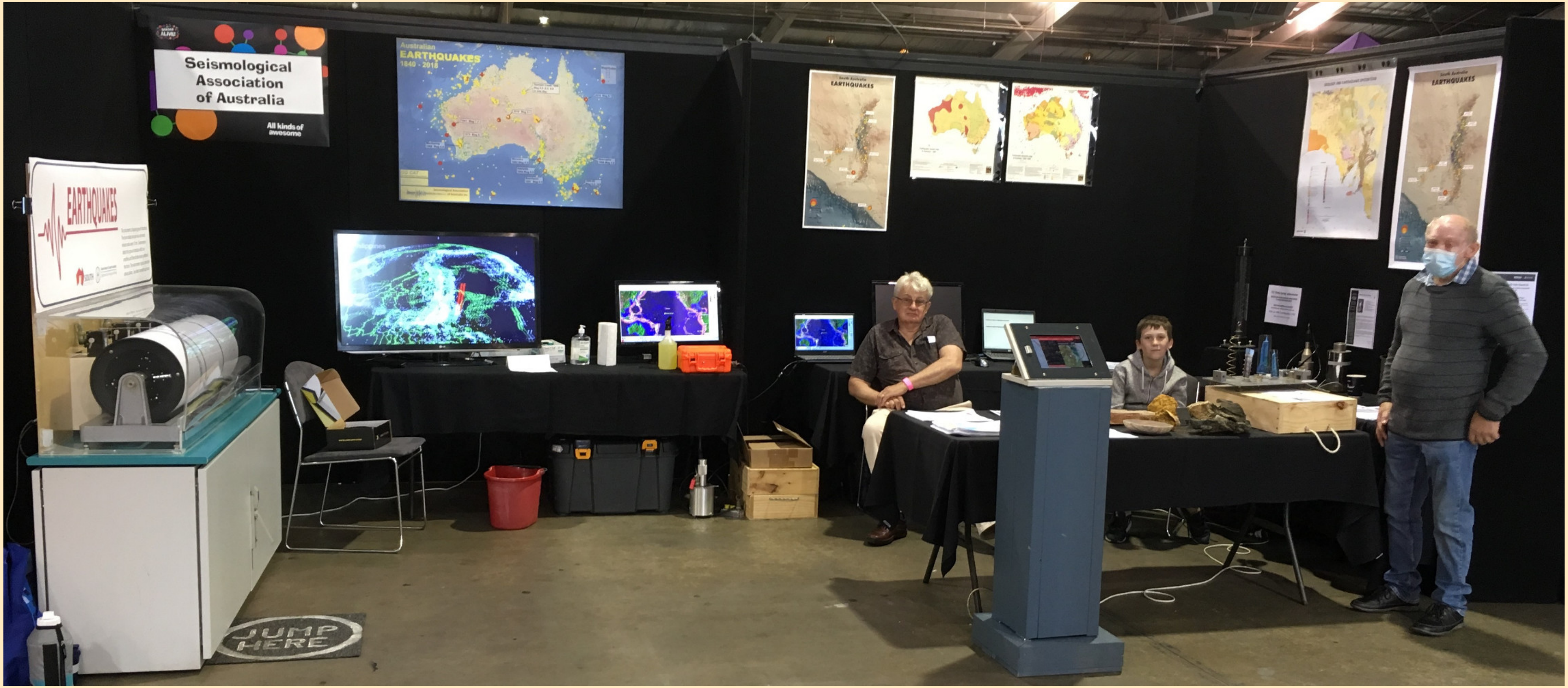
Done at Washington, D.C.
this 14th day of Dec. 1965

Rear Admiral
Director, U.S. Coast and Geodetic Survey

Plate 4 Certificate of Title

Adelaide Science Alive - 2021

Adelaide Science Alive - 2021



Resources & useful links

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