

# SAA Newsletter



#2/2024

**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](mailto:mccue.kevin@gmail.com)

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## Major Earthquakes Worldwide, January - March 2024

The two major earthquakes so far in 2024 occurred in northern Japan and Central Asia.

The coastal earthquake in Japan killed at least 240 people, and injured 1000, many buildings were damaged or destroyed. Surface faulting generated a 4m high scarp and a large tsunami was generated, with max wave heights above 6m.

### Figure 1 Major earthquakes

The Earthquake in Central Asia caused severe damage and killed



Major earthquakes Worldwide, Jan-March 2024

Date UTC	Time UTC	Latitude	Longitude	Depth km	Mww	place
2024-01-01	07:10:09	37.49	137.27	10	7.5	Noto Peninsula Japan
2024-01-22	18:09:04	41.26	78.65	13	7.0	China/Kyrgyzstan border region

3 people, 76 were injured and nearly 2000 buildings were damaged or destroyed in China, Russia and Kyrgyzstan.

**Photo** (Al Jazeera). Damage in northern Japan.

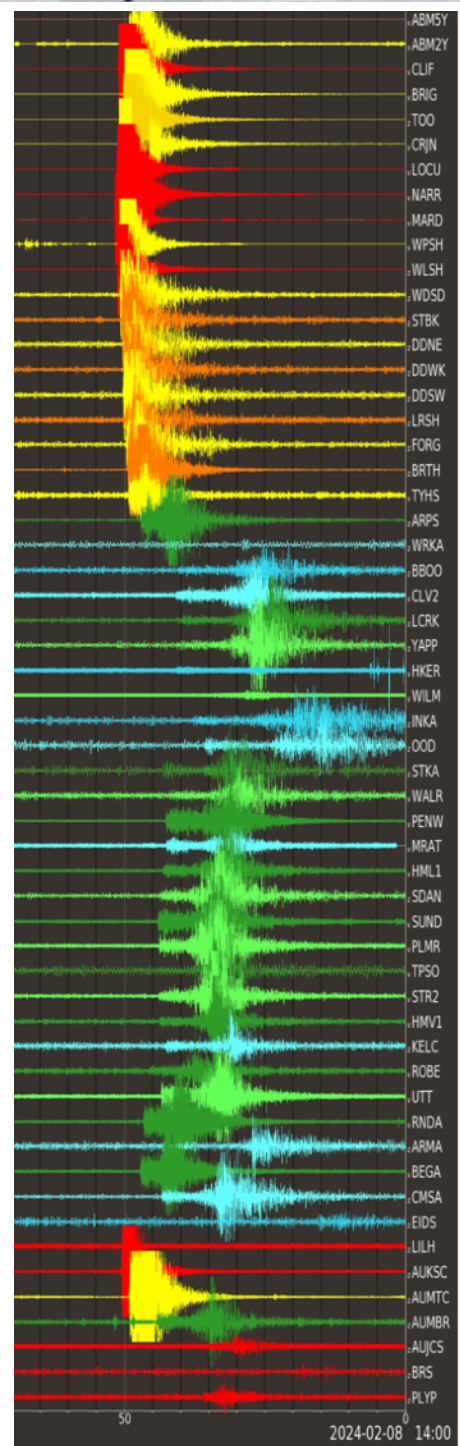


## PEISMO at work

Our last newsletter featured a new recorder designed by Colin Love, with help from Eric and David Love, dubbed the Peismo. A version of the hardware and software was built by ex-Rabaul hand, John Millard, and installed on test with an L4C seismometer on the floor of John's house in a bayside suburb of Adelaide. Within days, as luck would have it, the station recorded a small earthquake in Victoria as shown in the seismogram opposite. It is visible as PLYP joining station LILH on the Melbourne University server <https://meiproc.earthsci.unimelb.edu.au/eqserver/> PLYP is at the bottom of the list.

**Figure 2** Seismogram of a magnitude 4.2 earthquake at Leongatha, Victoria recorded across the SAA network and on PLYP, the bottom trace, with an L4C vertical seismometer attached.

Follow the project on <https://github.com/colinlove/peismo>



## Planning for Earthquakes

- **New Zealand** <https://www.wremo.nz/>

Wellington NZ will be cut off in the event of a great earthquake on the Wellington Fault. The roads and railway in and out of Wellington will be impassable, the tsunami will destroy ports and the airport, so how will they evacuate the city?

To plan for this eventuality the Wellington Region Emergency Management Organisation WREMO has been organising managed walks for up to 300 participants to teach people working in the city how to get home on their own two feet.

Nothing like taking a bit of personal responsibility for your safety.

Note: There can't be many cities worldwide where this is such a serious threat. In Australia, the large October 1968 Meckering earthquake cut the railway line and main highway to the east, temporarily isolating Perth by land though the port and airport were undamaged.

## Macquarie Island Evacuation Drill

Australian expeditioners on the sub-Antarctic Research Station at Macquarie Island conducted a high-ground evacuation drill after a series of earthquakes in March some 500 kilometres south of Macquarie Island in the Southern Ocean, the biggest, magnitude 6.8.

Station Leader Justine Thompson says while the impact area was a long way from the island, it was still felt by many of the expeditioners.

“You could definitely hear and feel in your feet a deep rumbling,” she said.

When the alarm went off, expeditioners had to evacuate up a steep path nearby to what is known as the Ham (radio) Shack.

It's one of two muster points on the island. The other, Wireless Hill behind the seismograph hut, sits at around 100 metres elevation.

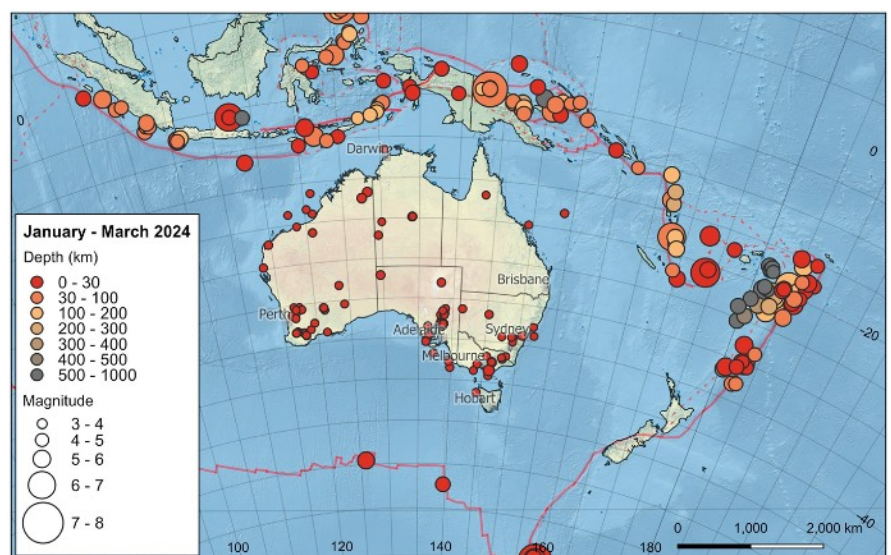
While the recent earthquakes didn't require expeditioners to go to higher ground, the muster site is well-equipped to support an emergency evacuation, with clothing, shelter and food to accommodate up to 40 expeditioners for 10 days should a damaging tsunami wash the base away. Macquarie Island is the only part of Australian Territory straddling a plate boundary. Several earthquakes are felt there each year.

## Maps of Earthquakes Jan to March 2024

The first map shows continental Australia in its plate tectonic setting, the plate boundaries are the thin red solid lines (USGS version). The intraplate earthquakes are mainly in the old, cold continental crust and smaller and less frequent, whereas the interplate earthquakes are larger and more frequent and in younger oceanic crust.

**Figure 3** Australian Plate region earthquakes (maps compliments of Clive Collins)

We have plotted everything above ~M4.5 on the plate



## The Seismological Association of Australia Inc.

PO Box 682, Mylor SA 5153

website: <https://earthquake.net.au/>

Membership of the SAA is open to anyone interested in earthquakes and applies for the calendar year (January through to December).

### Committee

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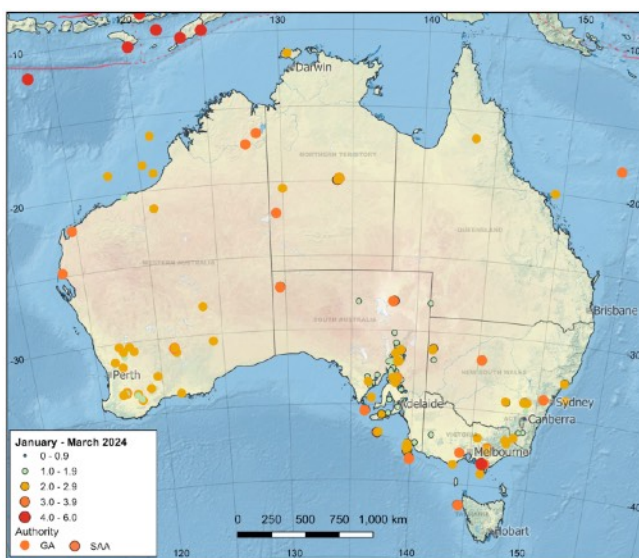
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Membership fees: Full member \$50/yr



boundary but down to M3 intraplate. These limits are about what is practicable with the existing seismograph networks. For the first time I can remember there has been an earthquake in every State and Territory, though the Canberra earthquake mentioned separately in this Newsletter was well below magnitude 3.

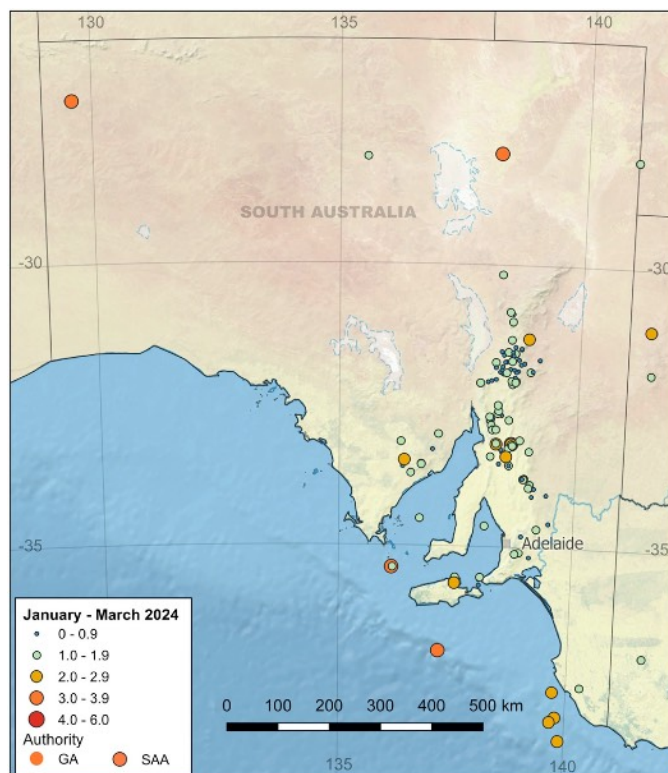
There were 3 magnitude 4 earthquakes, 2 in WA, the other and largest was in Victoria, and there were 35 above magnitude 2.9, nearly 1/3 of them in WA. The two onshore Queensland earthquakes were below the ML 3 threshold but are mentioned by Mike Turnbull. In this quarter, the least active States are Queensland and Tasmania but it hasn't always been so and hazard practitioners need to look at a longer time period (see also Mike Turnbull's article below). More earthquakes occurred in WA than in the other states or territories, comparable though with central Australia; South Australia and the Northern Territory combined.



**Figure 4** Australian earthquake (January to March 2024)

Interestingly New Zealand had a quiet year not a single epicentre blots the islands, and there is another large gap in the plate boundary through the Southern Ocean south of SA and WA.

Earthquakes were felt in parts of Sydney and Melbourne during the quarter causing anxiety if not fear in the suburbs, timely reminders.



**Figure 5** South Australian earthquakes (January to March 2024)

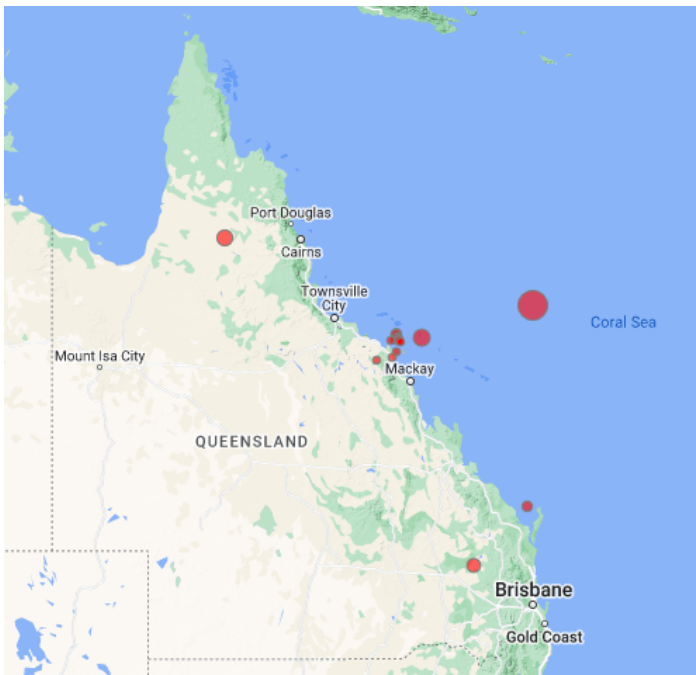
The year's largest earthquake, magnitude ML4.3, occurred near Leongatha in Gippsland, Vic. It struck at 1:55am local time and was reported felt by nearly 6000 Victorians, most of them residents of Melbourne. A magnitude 3.0 aftershock occurred 2 days later. This is well below the expected once-per-year earthquake of magnitude ML5.2. There were no real surprises in the Australian epicentral locations.

## SE Queensland earthquakes

Mike Turnbull

Here is a map of the Queensland seismicity for 2024 up to 23 March 2024, as observed by me. There are 25 earthquake events ranging from ML 0.9 to ML 3.4 (the one out in the Coral Sea).

The Whitsunday Passage sequence is continuing unabated ... well, in a stable fashion at least, as can be seen from the timeline graph. Since I have started uploading my locations to the International Seismological Centre (ISC) I have taken to including two station locations for the Bowen events. Experience, the first motions on



2016 when the main ML 5.8 event occurred that August, so that they can be included in my catalogue.

That ML 2.3 event in the south is just 8 km west of Durong. This area has generated enough earthquakes over the past couple of decades to be recorded on 3 widely spaced stations for an unambiguous location to be made.

The Wide Bay offshore area also continues to throw up the odd decent event.

**Figure 7** (below) The Whitsunday sequence

*Mike Turnbull*

**Figure 6** Earthquakes in Queensland

BW1H, and the relative arrival of the phases at the Bowen stations, shows that they are undoubtedly occurring in the target area even though the statistical locational errors are large. I am slowly working backwards in time to process all unlocated Whitsunday Passage events back to

**Regional Earthquakes from the USGS**

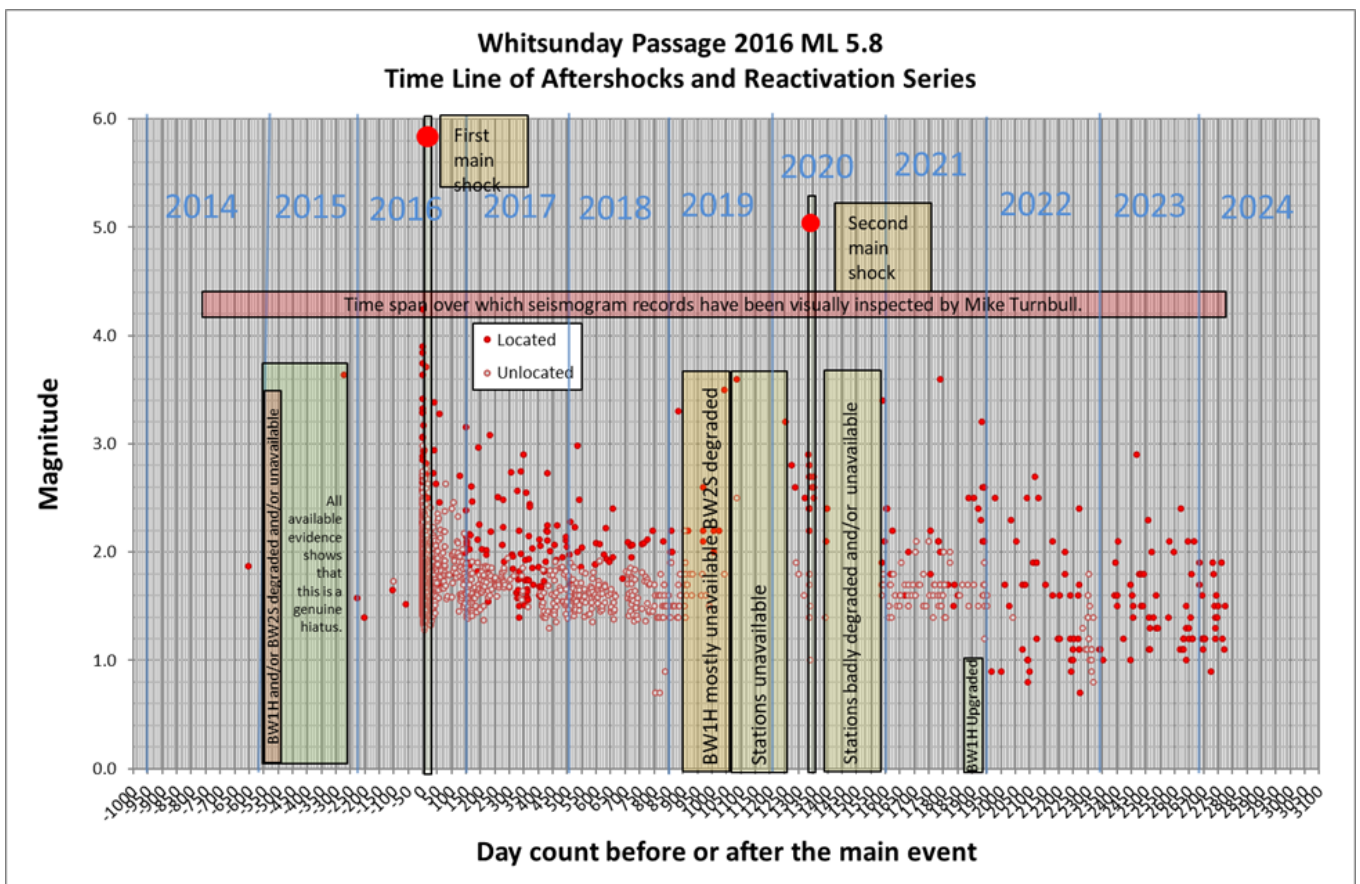
**Papua New Guinea**

**38 km ENE of Ambunti**

2024-03-23 20:22:04 (UTC)

4.139°S, 143.159°E, 40.2 km depth

The magnitude 6.8-7.0 earthquake in the Chambri Lakes region of the East Sepik Province of PNG

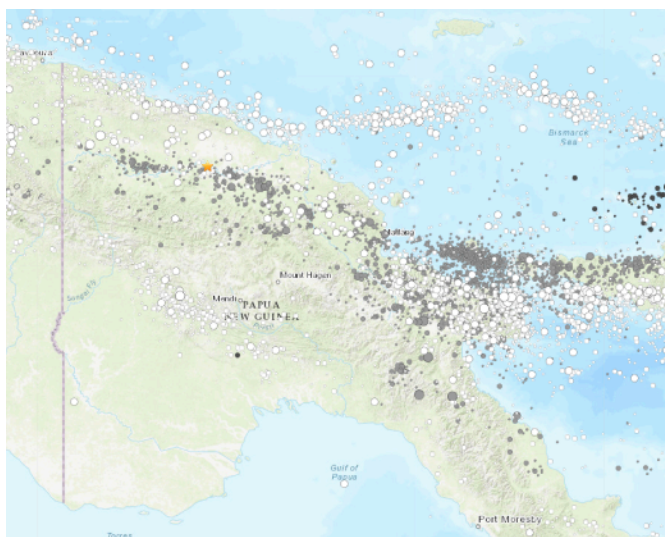




resulted in 4 deaths, 300 to 1000 houses damaged (photo) and 17 injuries according to reports in PNG newspapers. Many aftershocks were being felt in the epicentral region. The National Disaster Centre reported that the earthquake was felt in the Western Highlands, Enga and Eastern Highlands.



**Photo** House damage in the East Sepik Province.



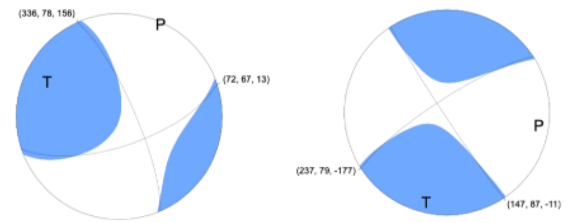
**Figure 8** Epicentre map, PNG, the orange dot the epicentre.

**Macquarie Island region**

2024-03-03 16:16:51 (UTC)

58.904°S 159.164°E, 10.0 km depth

The USGS has four different solutions with focal depths of 10.0, 10.0, 15.5 and 20.0 km. Their moment magnitudes vary from 6.6 to 6.8. An obvious problem is their mechanisms with two opposite solutions. The USGS has offered no explanation why these two mechanisms are so inconsistent.



**Figure 9** Two conflicting focal mechanism solutions (USGS), they can't both be right.

**Taiwan** (details next newsletter)

2024-04-02 23:58:11 (UTC)

23.819°N 121.562°E, 34.8 km depth

At magnitude 7.4, Taiwan's strongest earthquake since the 1999 Chi Chi earthquake and the World's largest earthquake so far this year has killed nine people and injured at least 900, causing building collapses, power outages and landslides on the island, and triggering a small tsunami.

Taroko national park in Hualien said nearly 1,000 tourists and staff were stranded in its mountains. Local media reported that three hikers and one driver died after rockslides in the park.

Taiwan's Centre for Science and Technology (CST) said people and vehicles were trapped in the Dachingshui tunnel. Train lines were damaged, and schools and workplaces were closed across large areas of the city. Tens of thousands of homes were without power. Witnesses in Hualien described driving while rocks dislodged from nearby mountains fell down around them, while others rushed outside after feeling the strength of the tremors.

**Japan's 13th Anniversary of Fukushima**

Now 13 years have passed since a great magnitude 9.0 earthquake and consequent tsunami hit Japan's east coast. Nearly 20,000 people died, towns were destroyed and the Fukushima Daiichi nuclear power plant was smashed.

The northern coastal towns of Iwate, Miyagi and Fukushima prefectures bore the brunt of the

impact. The 15m high tsunami, not the shaking, destroyed the Fukushima nuclear plant's power supply and fuel cooling systems, causing meltdowns at reactors 1, 2 and 3 of 4.

Subsequent hydrogen explosions caused massive radiation leaks and contamination in the area.

The Tokyo Electric Power Company Holdings maintains that the tsunami couldn't have been anticipated but Government and independent investigators have said the accident was the result of human error, safety negligence, lax oversight by regulators and collusion.

Geomorphological evidence of a previous similar sized earthquake and tsunami had been discovered several years before.

Japan has since introduced stricter safety standards but the government reversed its initial nuclear energy phaseout policy and has accelerated reboots of workable reactors to maintain nuclear power as the main source of Japan's energy supply.

About 20,000 of more than 160,000 evacuated residents across Fukushima still haven't returned home.

Decontamination work to showcase Fukushima's recovery led to the elimination of some no-go zones, but they remain in seven of 12 towns that had been fully or partially off-limits.

In Futaba, the hardest-hit town and a co-host of the Fukushima Daiichi plant, a small area was opened in 2022. About 100 people, or 1.5% percent of the pre-disaster population, have returned to live. The other host town, Okuma, which along with Futaba sacrificed part of its land to build an interim storage site for nuclear waste gathered from the decontamination, has seen 6% of its former residents return.

Annual surveys show the majority of evacuees have no intention of returning home. The disaster-hit towns, including those in Iwate and Miyagi prefectures, have seen sharp population drops.

Last August, Fukushima Daiichi began discharging treated water into the sea, and has recently released a fourth 7,800-ton batch of treated water causing protests from local fisheries

**ESC General Assembly 2024**

**Date: 22-27 September, 2024**

**Venue: Corfu, Greece**

**Submission Guidelines:**

**You can submit your abstracts by April 12th. For submission guidelines and more information, visit <https://lnkd.in/efimMxvX>**

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and neighboring countries, especially China, which has banned Japanese seafood imports.

Despite earlier fears that the water discharge would further hurt Fukushima's hard-hit fishing industry, they have not damaged its reputation domestically. China's ban on Japanese seafood, which mostly hit scallop exporters in Hokkaido, apparently prompted Japanese consumers to eat more Fukushima seafood.

Fukushima fishing returned to normal operations in 2021, and the local catch is now about one-fifth of its pre-disaster level because of a decline in the fishing population and smaller catch sizes. The government has earmarked 10 billion yen (\$680 million) to support Fukushima fisheries.

The contents of the three reactors is still largely a mystery. Little is known, for instance, about the melted fuel's condition or exactly where it's located in the reactors. Not even a spoonful of the fuel has been removed.

About 880 tons of melted nuclear fuel remain inside the three damaged reactors, and Japanese officials say removing it would take 30-40 years. Experts call that timeline overly optimistic. The amount of melted fuel is 10 times that removed

from Three Mile Island following its 1979 partial core melt.

Robotic probes have glimpsed inside the three reactors, but their investigation has been hampered by technical glitches, high radiation and other complications.

TEPCO has been trying to get samples using a robotic arm but struggled to get the robot past the wreckage, and hope by October to succeed using a new tool.

The fuel in the worst-damaged reactor 1 penetrated the base of its primary containment vessel and mixed with the concrete foundation, making its removal extremely difficult.

In February, the plant made its first drone flight into the primary containment vessel to investigate the melted debris and examine how the fuel initially fell from the core. But a second day of exploration was canceled because a data transmission robot failed.

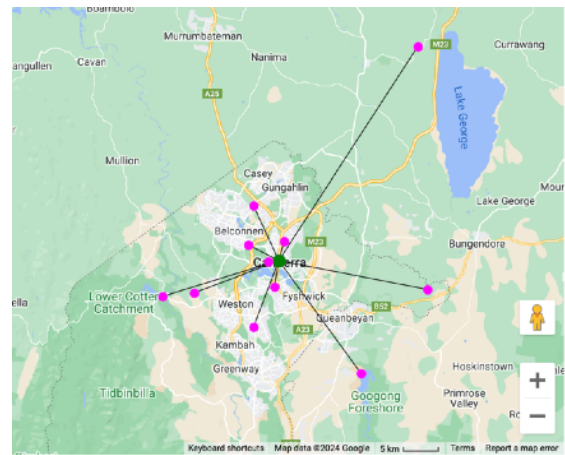
The government maintains its initial target to complete decommissioning by 2051, but what does that mean?

The lack of data, technology and plans on what to do with the radioactive melted fuel and other nuclear waste makes it difficult to understand what's in store for the plant and surrounding areas when the cleanup ends.

### Canberra earthquake

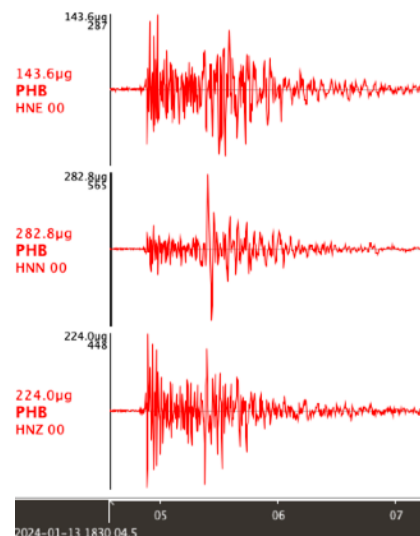
A small earthquake occurred under the centre of the city (Civic) at 5:30am on 14th January local time. It was first noticed on the RNSA seismogram and, on investigation, was found to have been recorded on 11 seismographs operated by SAA, ANU, SRC, GA and Raspberry Shake owners. Talk about effective citizen science. A very consistent location was determined, 16 P and S phase arrivals with residuals  $\leq 0.1$ s. There were no reports that it was felt, despite the very shallow depth of 2km, but it was 5:30am AEDT.

In the map, the green dot is the epicentre, the pink dots are the stations recording the earthquake and used in the location and mechanism.



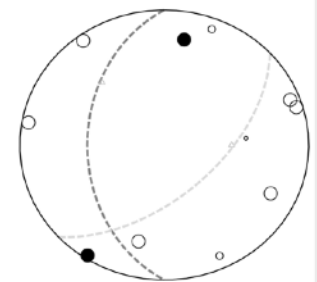
**Figure 10** Canberra earthquake pinned down

The initial P phase was so clear that the editor and David Love independently attempted focal mechanism solutions with similar results indicating NW-SE compression. The principal stress directions are consistent with those from the majority of other solutions in the broader region.



**Figure 11** Accelerogram from the nearest station PHB (compliments GA).

**Figure 12** David's solution is appended, far prettier than my back-of-the-envelope version. Black dots are compressions, dashed lines the possible focal planes. The only non-compliant station is AUMHS.



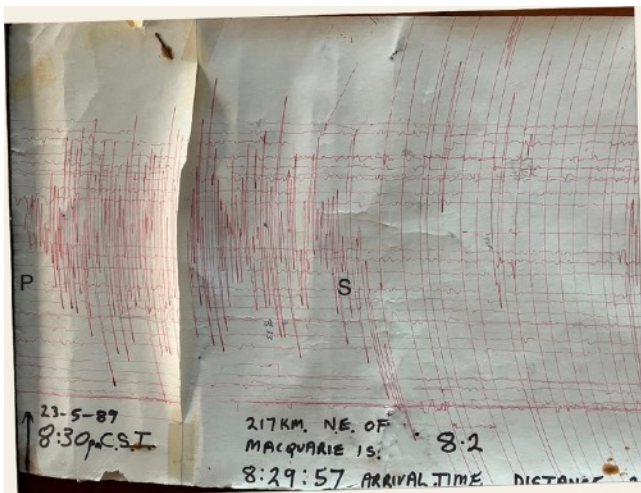


## How did I become a Seismologist?

by Paul Hutchinson

As a 7yo in Adelaide, I was awakened early on 1st March 1954 by an earthquake, that I thought was someone trying to break in through my bedroom window.

Much later, back at Victor Harbour in the 1980s I built my own amplifier and a 7-sec period seismometer from scratch using 20kg of lead as the mass, a fine copper wired coil from the dump and a strong magnet supported on a 1.3m long pipe with a nail as pivot. Damping was provided by a vane in an oil bath. As sometimes happens this was all tweaked just days before the 23 May 1989 Macquarie Island earthquake, magnitude 8.2, the P and S waves faithfully recorded with a biro on paper stretched around a kerosene drum.



**Figure 13** A photo of the critical seismogram and opposite a young Paul and the seismogram still on the drum, featured in the local media.

My interest in seismology was stimulated by several adventurous years in the 1970s, flying light planes for Mission Aviation Fellowship in New Guinea, from the Sepik River to Bougainville. I saw massive landslides in the Highlands as a result of a big earthquake, the landslides totally damming the raging river in the valley below or flattening a large area of jungle in the Sepik River area. I saw the ground ripple along the taxiway at Mount Hagen, and daylight underneath the galvanized rainwater tanks as

they bounced up and down on their stands. Once I felt the ground rising upwards for 10 seconds before falling downwards for 10 seconds as the waves of a large quake passed underneath our feet.

Three times volcanoes nearly got the better of me in my aircraft. Once when serenely flying along at 12,000 ft over a pure white flat cloud base that went from horizon to horizon, a scream from one of my passengers made me turn around to see a dirty brown column rising higher and higher out of the pure white cloud below. It ended up towering way way above us, very close. Mount Langila the volcano on the western end of New Britain was erupting again belching forth ash and steam, not nice for an aircraft to get mixed up in.



Years later, again near Mount Langila, I had to overnight in my aircraft at the Cape Gloucester airstrip, due to weather closing in and forcing me to land. This WWII vintage, almost abandoned, dilapidated airstrip had no facilities, was just above high tide level, stretching right along the beach. In the middle of the night, lying fast

asleep on the floor of my aircraft I was awakened by very heavy bumping and banging noises coming from afar. In the pitch black night I opened a window and heard the noise of rushing water and smelt a funny sulphur smell. I turned on the aircraft landing lights and was stunned to see the parking bay had dirty muddy water rushing across it with steam coming off. I looked out the window down at the aircraft's port wheel. It was fully under this rushing muddy hot steaming water, indeed the bottom of the fuselage was too. Sufficient to say, I was very concerned that the aircraft, with me in it, would be just washed off the airstrip and out into the Bismarck sea. Fortunately it all dissipated within a few minutes. The banging and rumbling noise I heard was large boulders bouncing along in the flood.

So, back to the Macquarie Island earthquake. Curious as to the cause of my recording I rang the ABC who knew nothing about it. Later David Love was interviewed by the ABC who mentioned to him that an amateur seismologist at Victor Harbour had recorded the shaking on his home made seismograph. The ABC gave David my phone number so David drove down to investigate and that is how we met, the beginnings of the SAA.

### **Comment**

Members of SAA have followed many different paths to end up promoting an understanding of earthquakes or recording and analysing the ground shaking or its effects.

Articles like Paul's or David's (in the last edition of the newsletter) are aimed at encouraging young people to develop an interest in seismology, whether in computing, instrumentation, engineering or the social impact of earthquakes.

Progress with a series of decade-by decade histories of the seismicity of South Australia can be read on the SAA website. These follow on from Katherine Dix (2013) MSc. thesis at the University of Adelaide.

<https://earthquake.net.au/>

Dix, K. (2013) South Australian Historical Earthquakes in the Pre-Instrumental Period 1837-1963: A Comprehensive Chronicle and Analysis of Available Intensity Data.