Australian Earthquakes 2016

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Abstract

This poster displays the locations of 669 Australian earthquakes detected by Geoscience Australia (GA) in 2016, using data from the AU network. The AU network is comprised of 67 sites of the Australian National (broadband) Seismograph Network (ANSN) and 36 sites of the Urban Monitoring (short period & strong motion) network (UM), all operated and maintained by GA, and supplemented by stations operated and maintained by the Australian National University (WRA and Seismometers-in-Schools).

The most significant event of the year was a M6.1 earthquake in the Petermann Ranges, NT, with 42 aftershocks located in the first two days using data from the AU network. At the time of publication, GA had located 86 earthquakes above magnitude ML 2.4 from AU data in the Northern Territory, with seismic activity centred on the Petermann Ranges and Tennant Creek regions.

In Western Australia, 238 earthquakes were located in 2016, using data from the AU network. The most significant event was a M5.6 earthquake east of Norseman with extensive aftershock activity. Other significant earthquakes were a M5.1 earthquake SE of Hall's Creek in NE WA and a M5.3 offshore Broome, WA.

Queensland's seismicity remained elevated in 2016, with 75 earthquakes being recorded by GA from AU data. The most significant event was a M5.8 earthquake offshore Bowen, which is now Queensland's second largest earthquake on record. 21 aftershocks were detected on the same day, two of which were M4.0 and M4.1, respectively.

118 earthquakes were located in South Australia using data of the AU network. The largest event was a widely felt M4.5 earthquake west of Kangaroo Island.

GA also located 123 earthquakes in NSW including a M4.0 offshore Gosford, 23 earthquakes in Victoria, five earthquakes in Tasmania and one earthquake in the ACT, from data of the AU network.

Keywords: seismicity, Australian earthquakes, aftershocks

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Introduction

This poster displays the locations of 669 Australian earthquakes detected and located by Geoscience Australia (GA) in 2016 using data of the AU Network, with a background of Australian earthquakes that occurred over the past ten years (Figure 1). The AU network is comprised of 67 sites of the Australian National (broadband) Seismograph Network (ANSN) and 36 sites of the Urban Monitoring (short period & strong motion) network (UM), all operated and maintained by GA, and supplemented by stations operated and maintained by the Australian National University (WRA and Seismometers-in-Schools).

GA's standard procedure for locating Australian earthquakes includes seismic event solutions, generated by an automated system using Antelope® software, being evaluated in real time by the Duty Seismologist to determine validity, size and location, using the Antelope® software tool Dbloc2. The Duty Seismologist also manually locates any Australian earthquake that is reported felt in Australia and analyses the Australian seismic records for smaller events with at least five defining phases, using predominantly the default location algorithm dblocsat2 and velocity model iasp91. Beyond that, the arrivals and stations for each solution are reviewed by Seismic Analysts, who also search the Australian seismic records for smaller events.

In 2016, GA installed three rapid deployment kits, each consisting of a Kelunji EchoPro digitiser, a Lennartz LE-3D seismometer, nextG communications and a solar panel, in the epicentral regions of the magnitude 6.1 Petermann Ranges earthquake (NT), the magnitude 5.6 earthquake east of Norseman, WA, and the magnitude 5.8 earthquake offshore Bowen, QLD. Detailed analysis of the data obtained from these deployments is being undertaken by GA and a summary of each of these seismic event series will be included in GA's Annual Report for 2016.

Seismicity

The magnitudes of the earthquakes analysed in 2016 range between 1.1 and 6.1 (Figure 2). High levels of seismicity were recorded in three regional centres of the Australian continent in 2016: the Petermann Ranges in the Northern Territory (NT) (Figures 3, Insets A and B), offshore Bowen in Queensland (QLD) (Figure 3, Inset C), and the Norseman region in Western Australia (WA) (Figure 3, Inset D). Across these three regions, GA recorded five earthquakes with magnitudes ≥ 5 (Table 1) and 12 earthquakes with magnitudes ≥ 4 in 2016. In total, GA recorded seven Australian earthquakes with magnitudes ≥ 5 and 19 earthquakes with magnitudes ≥ 4 in 2016.





Figure 1 Map of 2016 Australian Earthquakes recorded by GA (circle size scales with magnitude).



Figure 2 Number of recorded Australian Earthquakes in 2016 (GA) by magnitude.

Magnitude (ML)	Date	Time (UTC)	Latitude	Longitude	Depth (km)	Location
6.1	20 May	18:14:02	-25.579	129.832	0	Petermann Ranges, NORTHERN TERRITORY
5.8	18 Aug	04:30:07	-19.768	148.863	0	Offshore northeast of Bowen, QUEENSLAND
5.6	8 July	09:40:50	-32.458	122.511	0	East of Norseman, WESTERN AUSTRALIA
5.3	10 May	09:44:35	-16.397	118.690	10	Offshore northwest Australia
5.1	6 Nov	09:54:31	-19.106	127.987	10	Southeast of Hall's Creek, WESTERN AUSTRALIA
5.1	28 May	16:38:44	-32.460	122.438	0	Southeast of Norseman, WESTERN AUSTRALIA
5.0	28 May	15:30:26	-32.497	122.466	0	Southeast of Norseman, WESTERN AUSTRALIA
4.5	19 Jun	01:54:09	-35.916	136.450	10	West of Kangaroo Island, SOUTH AUSTRALIA
4.4	13 Aug	15:31:13	-23.821	152.867	10	Offshore northeast of Bundaberg, QUEENSLAND
4.4	8 Jun	02:01:09	-32.506	122.493	0	Southeast of Norseman, WESTERN AUSTRALIA

Table 1 Australia's Top 10 Earthquakes in 2016 (GA)



Figure 3 Petermann Ranges Earthquake Sequence 2016, Northern Territory (Inset A), Fault Scarp created by the M6.1 Petermann Ranges Earthquake 2016(Inset B), Offshore Bowen Earthquake Sequence 2016, Queensland (Inset C), and the Norseman Earthquake Sequence 2016 (Inset D).

The most significant national earthquake in 2016 was a magnitude 6.1 earthquake in the Petermann Ranges, NT, on 21 May (AEST), which is now listed as one of the Top 10 Australian earthquakes since instrumental recording. This earthquake was characterised by extensive aftershock activity, with 42 earthquakes with magnitudes \geq 2.7 located from data of the AU network in the first two days. GA located 86 earthquakes in the Northern Territory in 2016 from data of the AU network, with seismic activity centred on the Petermann Ranges and Tennant Creek regions.

During the year, GA located 237 earthquakes in WA from data of the AU network. 85 of these earthquakes had magnitudes \geq 3.0, ten earthquakes had magnitudes \geq 4 and five earthquakes had

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magnitudes \geq 5. The largest earthquake recorded in WA in 2016 was a magnitude 5.6 earthquake located east of Norseman on 8 July (AEST), which was followed by a large number of aftershocks (54 at the time of publication, Figure 3, Inset D). Two earthquakes of magnitude 5.0 and magnitude 5.1 occurred on 29 May (AEST), less than two hours apart, followed by the larger magnitude 5.6 earthquake on 8 July (AEST). Other significant earthquakes were a magnitude 5.1 earthquake southeast of Hall's Creek in northeast WA on 6 November and a magnitude 5.3 earthquake offshore Broome on 10 May (AEST). Please refer to Table 1.

Queensland's seismicity remained elevated in 2016, with 75 earthquakes being located by GA using data of the AU network. The most significant event was a magnitude 5.8 earthquake offshore northeast of Bowen on 18 August (AEST), which is now Queensland's second largest earthquake on record. 21 aftershocks were recorded within 24 hours of the main event, including two earthquakes with magnitudes \geq 4.0. (Figure 3, Inset C). The second largest Queensland earthquake recorded by GA in 2016 was of a magnitude 4.4 offshore Bundaberg on 14 August (AEST).

GA located 118 earthquakes in South Australia in 2016, using data from the AU network. The state's largest event in 2016 was a widely felt magnitude 4.5 earthquake west of Kangaroo Island on 19 June (AEST), with GA receiving 40 felt reports from the community within one hour of the earthquake and 121 felt reports in total. In 2016, a notably larger number of earthquakes were recorded in an approximately 450 km long and 200 km wide region between Marree and Oodnadatta than in previous years (21 earthquakes in 2016 compared with an average of 3 to 4 earthquakes per year in the preceding 20 years, with the number of earthquakes in a specific year not exceeding 9). The state's second largest earthquake in 2016, a magnitude 3.7 earthquake west of Marree on 4 November (AEST), occurred in this region.

In 2016, using data from the AU network, GA located 123 earthquakes in New South Wales. The two most significant earthquakes were a magnitude 4.0 event offshore Gosford on 7 June 2016 and a magnitude 3.6 earthquake north of Cooma on 31 January 2016 (AEST).

In other parts of the country, from data of the AU network, GA located 23 earthquakes in Victoria ranging in magnitudes between 1.4 and 3.2; five earthquakes of magnitude \leq 3.0 in Tasmania and one earthquake in the Australian Capital Territory (M 1.5).

Compiled by Andrea Thom, Duty Seismologist, Community Safety and Earth Monitoring Division, Geoscience Australia.

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