

Seismicity Information & FAQs

WHAT IS SEISMICITY?

An earthquake, or seismic event, happens when pressure builds up along stress lines or faults in the rock underground. When the pressure gets to a certain point, the rocks can move or slip, and this releases energy. If enough energy is released, it can be felt at the surface.

In areas near the boundaries of tectonic plates, such as California or Japan, the pressures and movements can be great, as the Earth's plates push against each other, trying to move in different directions. In these areas, earthquakes can be very large and cause a lot of damage.

In other parts of the world, far from these major plate boundaries, mini-earthquakes or 'microseismic events' do happen, but because the pressures and movements are much smaller, they have a much smaller impact and we often don't notice them, only picking them up using sensitive measuring instruments.

Small natural earthquakes regularly happen in the UK. 28 natural seismic events, with magnitudes between 0.1 and 2.7, were recorded during the 50-day period between November 24th 2021 and January 9th 2022 by the British Geological Survey (BGS). Three of these events were felt. And Cornwall has recorded over 600 natural earthquakes with a magnitude greater than 0 since the mid-1990s, some of which have been felt. The largest was a magnitude 3.8 near Penzance in 1996. The most recent was a magnitude 2.3 near Helston in 2019, which was felt and heard but caused no damage.

HOW IS SEISMICITY MEASURED?

Most people think of the 'Richter scale' when they think of earthquakes, although we now usually just refer to the 'magnitude' of an event. Magnitude is a measure of the amount of energy released at the earthquake's source. A magnitude 2 event is 30 times bigger than a magnitude 1 event in terms of the amount of energy released. A magnitude 3 event is 30 times bigger again – so 900 times bigger than a magnitude 1. And so on. Destructive earthquakes usually have a magnitude of 6 or above.

The equipment used to detect and measure earthquakes is now so sensitive that really tiny

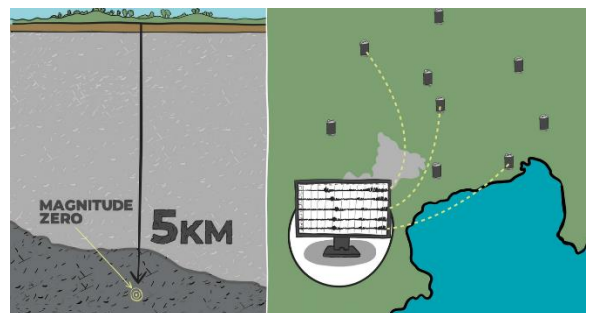
events can be picked up. When the magnitude scale was developed, such events could not have been detected. This is why it's possible to record events with a magnitude smaller than 0.

Seismicity is also measured using a 'ground velocity' scale. This tells us how much vibration occurs at the surface in millimetres per second. So it's a good indicator of how we experience an earthquake and the impact it has above ground – the extent to which we can feel it, or how much damage it causes.

CAN SEISMICITY BE LINKED TO GEOTHERMAL DEVELOPMENT? COULD THIS HAPPEN AT EDEN?

Seismic ground vibrations can be caused by human activity such as mining, drilling, quarrying, blasting - and sometimes geothermal development. This is known as induced seismicity.

During the successful drilling of the first geothermal well at the Eden Project, between May and October 2021, our seismic monitoring system recorded 95 microseismic events – with magnitudes ranging from -1.0 to 0.8 - linked to geothermal operations. It also detected seismic events related to other industrial activities, such as quarry blasting, as well as regional and global earthquakes (some of them thousands of miles away) and noise events linked to other human activity such as farming and road traffic. The geothermal-related events were all so small they were not recorded by the British Geological Survey, and none were felt. We only know they happened because they were mapped by our seismic monitoring system, which is extremely sensitive and can pick up the minutest of movements, from surface level to many kilometres below ground.



All the microseismic events linked to our drilling operation were associated with drilling in a permeable zone in the rock near the bottom of the well. Analysis of microseismic monitoring data related to this zone is a key part of our research, helping us to understand more about this and other geological structures at depth, about the geothermal resource at Eden and the likely heat and power outputs of our system.

We expect that microseismicity will be recorded during well testing, as pressures in the natural rock fractures of our target zone increase when water is introduced in injection tests. Here too, microseismicity data will be key in interpreting our tests, providing vital information about how water is stored and moves around the rock near the bottom of the geothermal well. But it's important to emphasize that we will not be working with high pressures, and that the operation will be carefully monitored and controlled, with the aim of getting the data we need, but avoiding disturbance to local residents.

WHAT ARE THE RISKS AROUND INDUCED SEISMICITY & GEOTHERMAL DEVELOPMENT?

The vast majority of microseismic events associated with geothermal development are tiny. More than 5,000 events were recorded during several years of research at the Hot Dry Rocks Project at Rosemanowes in Cornwall, but only two were felt at surface, and they were far too small to cause any damage. Likewise, at United Downs Deep Geothermal Project near Redruth, a small number of seismic events were felt (or more often heard) during well testing. But again, none of these were of a magnitude which could cause any damage.

While Eden Geothermal can't entirely rule out the possibility that an event could be felt or heard at surface during well testing, the risk of causing any damage at the surface is incredibly low. While relatively small seismic events can be felt or heard, they need to be much bigger to cause even cosmetic damage to buildings, or to be dangerous.

HOW IS SEISMICITY MONITORED & CONTROLLED AT EDEN GEOTHERMAL?

British Standards set guidelines for operational limits to ground vibrations caused by industrial processes such as mining, quarrying and blasting, and these underpin Cornwall Council's planning guidance in relation to geothermal and other renewable energy development. The operational limits use the Peak Ground Velocity (PGV) scale, which measures surface vibrations, rather than seismic event magnitude. At Eden Geothermal we work to very cautious levels, well within or below the thresholds set by the British Standards.

We measure both seismic magnitude (ML) and PGV, using a sophisticated seismic monitoring network made up of 9 seismometers and strong

motion sensors, all located within a 5km radius of our geothermal site.

The network was designed and installed, and is managed, by an independent seismology consultant, and enables us to locate even the tiniest microseismic events as soon as they occur. We know how big any event is, exactly where and when it's happened – and whether it's related to our programme, or to other activities.

Continuous monitoring of the real-time data from the network, and a system of immediate automatic alerts and updates, mean we can be very responsive, and can manage and control our operations rapidly and effectively. We will adopt a cautious approach, stopping if necessary while we investigate what's triggered an event, and changing our operating conditions in response to the data. It's worth noting that a similar system was used very successfully at United Downs Deep Geothermal Project.



IF YOU'D LIKE MORE INFORMATION OR HAVE QUESTIONS OR CONCERNS

- We've produced a video about seismicity in the context of the Eden Geothermal Project. It's on our 'well testing' web page at <https://www.edengeothermal.com/the-project/drilling-and-operations/well-testing/>
- If you have general queries or questions, please email info@edengeothermal.com or, from Friday 21st January, you can phone our dedicated well testing phone line: **01202 898150**. You'll speak to a receptionist, who will take a message, and we'll get in touch as soon as possible.
- If you have an urgent query, please phone **01202 898150**. This number will be answered 24/7 and we'll respond to urgent messages rapidly.
- If there's any news related to well testing, we'll post it first on our website at www.edengeothermal.com