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 stronger than a magnitude 1 event in terms of the amount of energy released. A magnitude 3 event is 30 times stronger again – so 900 times bigger than a magnitude 1. And so on. Destructive earthquakes usually have a magnitude of 6 or above – so they're millions of times more intense than a magnitude 1 in terms of energy released!

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 (mm/s). 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? HAS THIS HAPPENED 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.

In geothermal development, induced seismicity can happen during drilling but is most likely to happen during well testing, as pressures in natural rock fractures increase when water is introduced, in injection tests particularly.

The vast majority of microseismic events associated with geothermal development can't be felt or heard – in fact they're so tiny that we only know they've happened because they are mapped by extremely sensitive seismic monitoring systems that can pick up the minutest of movements, from surface level to many kilometres below ground. So, 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.

Analysis of microseismic data related to drilling or well testing is a key part of geothermal research, providing information about how water is stored in, or moves around, the rock surrounding a geothermal well. It helps us to understand more about the geological structures at depth and the likely heat and power outputs of the geothermal system.

During injection testing at Eden Geothermal (January - March 2022) around 300 microseismic events were recorded by our seismic monitoring system. Some of these were 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. Two of the events related to geothermal operations were heard and felt at surface. The largest of these had a magnitude of 1.7 and a peak ground velocity of 1.56mm/s, so both were much too small to cause any damage.

WHAT ARE THE RISKS AROUND INDUCED SEISMICITY & GEOTHERMAL DEVELOPMENT?

While Eden Geothermal can't entirely rule out the possibility of microseismic events being felt or heard at surface during its operations, the risk of causing any damage at the surface is incredibly low. The largest felt microseismic event at Eden Geothermal had a peak ground velocity of 1.56mm/s, but the vibration level at which cosmetic damage could occur to buildings is nearly ten times greater than this at 15mm/s. While relatively small seismic events can be felt or heard, they need to be much bigger to cause damage to buildings or structures, or to be dangerous.

That said, we understand that hearing or feeling seismicity can cause concern, so it's important to emphasize that we don't work with high pressures at Eden Geothermal, and that our operations are carefully monitored and controlled, with the aim of getting the data we need, but avoiding disturbance to local residents.

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.
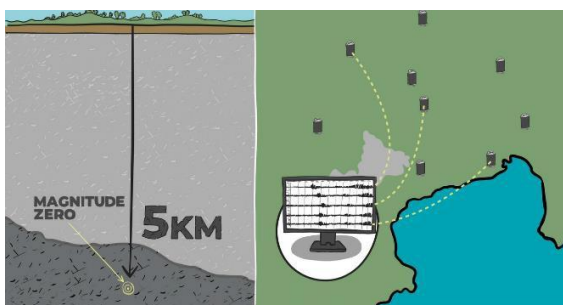

We measure both seismic magnitude (ML) and PGV, using a sophisticated seismic monitoring

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. A similar system was used very successfully at United Downs Deep Geothermal Project too.
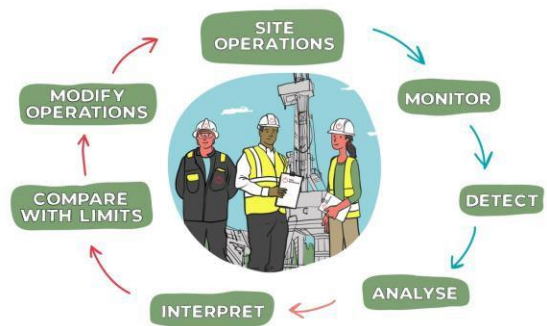
IF YOU'D LIKE MORE INFORMATION OR HAVE QUESTIONS OR CONCERNS

➢ 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 during well testing operations you can phone our dedicated 24-hour 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 seismicity, we'll post it first on our website at www.edengeothermal.com