

# Exploring opportunities to utilise microseismicity during geothermal energy exploitation.

Submitted by Jack Timmins, to the University of Exeter as a dissertation for the degree of Masters by Research in Geology, July 2024.

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## Abstract

This thesis explores the utilisation of microseismicity in geothermal energy exploitation, focusing on the Eden Geothermal Project in Cornwall, UK. The primary objective is to understand the characteristics and mechanisms of microseismic activity associated with geothermal operations and assess such activity's impact on geothermal energy production. The study employs various geophysical and geostatistical methods to analyse seismic data, including spatial distribution, volume estimation, and seismic event magnitude analysis.

Key findings indicate that the spatial density of seismic events can effectively delineate the geothermal reservoir's boundaries. The study identifies a correlation between fluid injection parameters and seismicity, highlighting the importance of optimising injection strategies to minimise induced seismicity. Additionally, geospatial analysis provides insights into the temporal and spatial development of seismic events, which are crucial for understanding the subsurface dynamics and planning future drilling operations.

Drilling below 4 kilometres has had a significant impact, revealing deeper seismic activity and providing a clearer picture of the reservoir's vertical extent. This drilling depth has allowed for a more comprehensive characterisation of the reservoir and its properties. The findings suggest that using a single or bifurcated well could optimise geothermal energy extraction, enhancing resource utilisation and efficiency.

The research also examines the temporal analysis of seismicity, its correlation with geological features, and the implications of pore pressure diffusion. A detailed assessment of fluid injection tests shows how different stages of operations influence microseismic events. Comparative analyses with other geothermal sites, such as those in Basel, Switzerland, and Pohang, South Korea, provide context and validation for the methodologies and results.

This research underscores the potential of microseismic monitoring to enhance geothermal energy exploitation. The results contribute to the broader understanding of geothermal reservoir behaviour, offering practical recommendations for mitigating risks associated with induced seismicity. The findings from the Eden Geothermal Project serve as a model for similar geothermal initiatives, particularly in regions with comparable geological settings. Continuous monitoring and advanced analytical techniques are recommended for sustainable and efficient geothermal energy production.

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# Introduction

## Scope

Geothermal energy (GE) has been harnessed by humans for thousands of years, and its utilisation has significantly increased in recent decades. Today, over 150 geothermal power plants operate globally, generating a combined capacity of approximately 14,800 MWe (Kamila et al., 2020). GE is a renewable energy source that provides continuous baseload power with low carbon emissions, making it a sustainable and reliable option for heat and energy production. Despite its potential, geothermal energy remains largely untapped.

One of the challenges geothermal energy production faces is the risk of inducing microseismic activity. Microseismic events occur due to changes in stress distribution within the rock mass, often caused by human activities such as fluid injection and extraction. When detected at the surface, these events are characterised by a magnitude of less than 2.0 and can result in ground destabilisation and infrastructure damage. Such risks can lead to public distrust and the cessation of operations, as seen in Pohang, South Korea, in 2017.

Microseismic monitoring is crucial for mitigating the risk of significant seismic activity. Geothermal exploration helps identify seismicity patterns related to production activities, such as drilling, fluid injection, and hydraulic stimulation. This monitoring allows for optimising production processes while minimising environmental impacts and reducing the risks associated with induced seismicity. Continuous tracking also enhances our understanding of naturally occurring events and provides insights into the long-term stability of the reservoir.

This report aims to understand the characteristics and mechanisms of microseismic activity in geothermal operations. By analysing clustering patterns and the propagation direction of individual events, we can better understand the spatial distribution of seismic events and their relationship with geological features. Geostatistical methods and Geostings will be employed to visualise these patterns in a block model, enhancing our understanding of the reservoir's permeability and fluid flow pathways.

The UK has the potential to lead advancements in engineered geothermal systems, with research sites like Eden Geothermal serving as flagship developments. Understanding and managing microseismicity is essential for ensuring the sustainable production of geothermal energy and the broader adoption of this renewable resource.

## Aims and Objectives

### Aim

To explore the utilisation of microseismicity in geothermal energy exploitation.

### Objectives

- Characterise the seismic cloud based on the data's clustering patterns and temporal variations.
- Identify lines of trajectory of hypocentre focal points to derive potential pathways for seismic activity.
- Generate a visual tool to show the spatial-temporal relationship of seismic clouds to the surrounding subsurface.
- Compare and correlate the seismic data to known geological structures and other site-specific information.
- Assess the impact of different stages of geothermal operations on microseismic occurrence.

## Outline of the Thesis

This thesis presents a preliminary analysis of microseismic events associated with the development and ongoing operations of the geothermal production at Eden Geothermal. The study employs various geophysical and geostatistical methods to evaluate and interpret seismic data, providing insights into the spatial and temporal dynamics of microseismicity in the context of geothermal energy production.

### *Literature Review*

The literature review section provides an overview of existing studies on microseismic monitoring in geothermal systems. It discusses the methodologies used for seismic data analysis and summarises the current understanding of induced seismicity and its impact on geothermal operations. This review establishes the foundation for the methods and analyses applied in this thesis.

### *Methodology*

The methodology section details the data collection, preprocessing, and analysis processes. It begins by describing the data acquisition process, including the types of sensors and monitoring equipment used. Then, it outlines the steps taken to clean and prepare the seismic data for analysis. The section also introduces the methods used for geostatistical analysis, explaining how it is employed to interpolate ML measurements and analyse the spatial density of seismic focal points.

### *Analysis of Microseismic Events*

The analysis of microseismic events is divided into temporal and spatial components. The temporal analysis examines seismic events over time to identify trends and patterns, while the spatial analysis evaluates the distribution of seismic events. This includes the interpolation of ML measurements within defined blocks and the analysis of spatial density. Additionally, geostings are created to map the trajectory of focal points, assessing spacing, time gaps, and orientation to correlate events and infer potential unseen geological structures.

### *Focal Mechanism Analysis*

The focal mechanism analysis focuses on determining the type of slip occurring during seismic events, categorising them into strike-slip, normal, thrust (reverse), or combinations. This analysis involves stacking focal mechanism data to provide insights into reactivated fault types and interpret sub-surface structures beyond the borehole vicinity. This section enhances the understanding of the mechanical behaviour of faults during geothermal operations.

### *Correlation with Operational Stages*

This section correlates seismic events with various stages of geothermal operations, including drilling and injection tests. The study aims to understand fluid circulation properties within the reservoir by examining time lags between fluid injection and seismic occurrences. The evolution of seismic events over time is assessed to infer the potential extent and dynamics of the geothermal resource. This correlation helps identify critical phases of operations that may influence seismic activity.

### *Discussion*

The discussion section interprets the size and shape of the geothermal reservoir based on seismic data. It offers operational recommendations to enhance geothermal production efficiency, including potential drilling of additional wells, bifurcation from the existing well, or employing a coaxial system with EG-1. These suggestions are based on analysing seismic events and their correlation with operational stages, aiming to optimise resource utilisation and mitigate risks.

### *Conclusion*

The conclusion summarises the key findings from the analysis of microseismic events. It discusses the implications for future geothermal energy production and reservoir management, highlighting the importance of continuous monitoring and research. The section also provides recommendations for ongoing monitoring and further research to optimise geothermal operations and mitigate the risks associated with induced seismicity.

### *Future Work*

The future work section identifies areas for further research to improve the understanding of induced seismicity in geothermal systems. It explores advanced monitoring techniques and predictive modelling to enhance geothermal energy production. This section emphasises the need for continuous innovation and development in monitoring and managing geothermal resources to ensure their sustainable and efficient use.

# Literature Review

## Geothermal Systems

Geothermal energy is a well-established energy source that functions by extracting heat stored in the Earth for use as heat and power. Shifting towards greener and more sustainable energy solutions is vital. Depending on various geological settings, different systems are required to create viable production.

### Temperature-Based Classification of Geothermal Systems

Geothermal systems are fundamentally classified based on temperature, a key variable determining the utilisation of geothermal reservoirs. These reservoirs yield two primary products: heat and power. Power generation typically requires eight times more thermal energy than heat usage. Reservoirs with higher temperatures also have higher pressures, necessitating more robust engineering installations to contain hydrothermal fluids, which in turn leads to higher installation costs for projects.

The basic classification of geothermal systems can be divided into three categories:

Low Temperature Reservoirs: <125°C

Medium Temperature Reservoirs: 125-250°C

High Temperature Reservoirs: >250°C

A more nuanced classification considers the viable thermal energy and its surface implementation. This can be further broken down into different standards of heat pumps based on their coefficient of performance, followed by varying standards for power generation.

### Depth-based classification and Geothermal Gradient

Geothermal systems are also categorised as shallow, intermediate, and deep. The average geothermal gradient is between 25-30°C/km; thus, deeper resources provide higher temperatures. However, other geological factors, such as proximity to granite intrusions, can alter the temperature gradient. For example, along the divergent Mid-Atlantic Ridge in Grímsnes, South Iceland, gradients can reach approximately 150°C/km due to fissures containing highly carbonated geothermal fluids (Ármannsson, 2015).

Shallow (Low grade)	10 to 25°C	<500m depth	Direct heating and cooling using ground-source heat pumps
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Deep (High grade)	Subsurface temperatures at 1000 m, 3000 m and 5000 m are around 40°C, 90°C and 140°C, respectively	>500m depth	Provides direct hot water heating. If drilled to economically viable drilling depth (5km) temperatures are high enough for electricity generation
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Table 1 Classification of Geothermal Systems

## Shallow Geothermal Resources in the UK

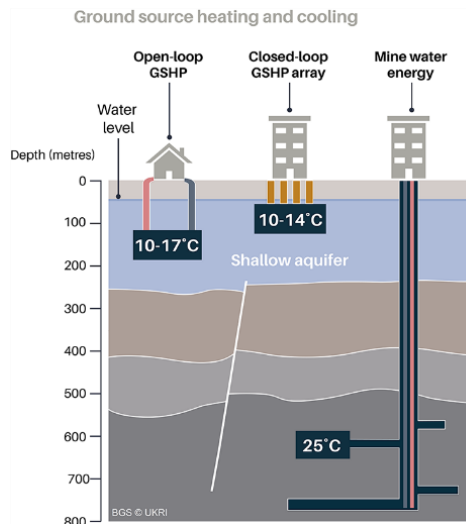


Figure 1 Schematic of a geothermal doublet for the exploitation of a hot sedimentary aquifer. Heat exchanger not to scale. BGS © UKRI.

Shallow geothermal resources are readily available for extraction across the UK in various systems, including flooded mines, aquifers, and subsurface rocks. These resources are viable because subsurface temperatures are relatively stable. Mine water energy typically utilises an open-loop configuration, distributing water to multiple areas within a mine or specifically drilled boreholes. Their proximity to many UK households makes them potentially useful for heat storage, a practice currently under investigation at the UK Geenergy Observatory in Glasgow.

## Open and Closed Loop Systems

Open and closed-loop systems differ by the flow of fluid and its contact with rock (Wang et al., 2020). In open-loop systems, fluid is injected into the subsurface, travels through the fracture network and fault planes, creating enhanced geothermal systems, and is then drawn back to the surface to extract heat energy (Song et al., 2018). In contrast, closed-loop systems circulate a fluid in a closed-loop pipe, extracting heat via the pipe walls in contact with high-temperature rocks without direct contact between the fluid and the rock (Wang et al., 2020). Closed-loop systems are increasingly popular due to reduced risk of destabilising the subsurface as the system matures. U-tube designed closed-loop systems are unsuitable for deep geothermal systems, so coaxial closed-loop geothermal systems (CCGS) are used. Most coaxial systems use vertical wells to reach higher temperatures more quickly, although comparisons between various CCGSs are unclear due to limited field application.

## Electricity Generation from Geothermal Systems

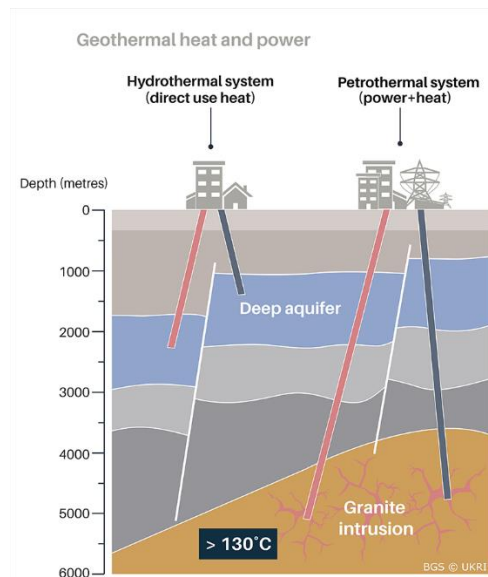


Figure 2 Geothermal doublet drilled into a deep fractured system. BGS © UKRI.

To generate electricity from geothermal systems, exploration wells must be drilled to sufficient depths. Hydrothermal systems extract fluids stored in deep aquifers. In the UK, these aquifers are reported to be located at depths of 1 to 3 km and vary between 40-80°C, making them suitable for district heating (British Geological Survey, 2023). Enhanced Geothermal Systems (EGS), such as the one at Eden Geothermal, are created by increasing the permeability in hot rocks like granites. Granite typically has limited porosity and permeability, except for naturally formed fractures and intersecting faults. Hydraulic stimulation is required to open pre-existing fractures and create connectivity through the geothermal reservoir. This method uses low-pressure injection to open fractures, posing less risk of abrupt geomechanical failure compared to fracking in oil and gas operations.

## Challenges in Geothermal Energy Production

Geothermal energy production faces challenges such as high costs and geographic restrictions. High costs arise from drilling wells and conducting extensive surveys. The sector's relatively small market makes it economically unviable for many countries to develop and install the necessary technology and infrastructure. Depending on geological conditions, geothermal gradient, and access to surface infrastructure, different geothermal systems are implemented to ensure economic viability and sustainability.

## Binary Power Plant

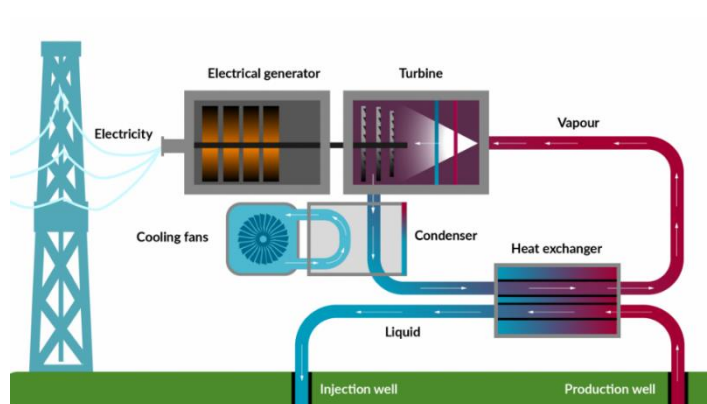


Figure 3 Binary power plant diagram Sourced from United Downs Deep Geothermal Project (United Downs – Geothermal Engineering Ltd, 2023)

In a binary power plant, heat energy is transferred through two separate systems. As shown in Fig. 3, hot brine passes through a heat exchanger to heat a secondary fluid that expands to drive the turbine, similar to steam. The secondary fluid is then condensed back into a liquid. The two circuits (geothermal and binary fluid) operate continuously (UDDGP, 2023).



## Microseismicity

Microseismicity refers to seismic waves generated in response to stress redistribution, typically with a magnitude of less than 2.0 (Matsumura, 2006). Microseismic events are caused by mechanical failure resulting in fault reactivation and the opening of fractures (Atkinson, 2020). In geothermal systems, the primary cause of this failure is the injection of fluid, which changes the pressure until it reaches a critical point, causing the solid rock to move to compensate for the stress. Microseismicity can signal early stages of cracking in rocks, which may eventually lead to macroscopic failures (Colombero et al., 2018). This progression can result in larger magnitude seismic events, negatively impacting the geothermal system.

The causes and triggers for seismic events are well documented. Various natural and anthropogenic factors, including tectonic stress, faulting, mining operations, hydraulic stimulation, fracking, and volcanic activity can trigger microseismic events. The pressure and stress regimes vary throughout the stages of seismic triggering, best understood in phases. During the build-up phase, stress accumulates in the subsurface due to increased pressure caused by tectonic movement and fluid injection. Once the stress reaches a critical point, the rock overcomes frictional resistance and deforms, typically faulting along a plane. The moment of the event then occurs; stress is released abruptly, generating the seismic event followed by elastic rebound. When rocks deform elastically under stress, and the stress exceeds the elastic limit, they suddenly rebound, generating seismic waves. After the seismic event, aftershocks may occur as surrounding rocks adjust to the stress changes. Residual stress left in the system can lead to future seismic events.

Surface orientation significantly impacts the characteristics and impact of seismic events. Fault orientation affects the direction of slip during an event. Events occurring on near-vertical faults have different characteristics compared to near-horizontal faults. The orientation of the fault or fracture system determines the propagation path of seismic waves to the surface, controlling energy release direction.

Extensive research has been conducted on the sensitivity of equipment (Ringler et al., 2020; Anthony et al., 2017; Sha'ameri et al., 2021), correlation to geological features (Gao et al., 2020; Kaven and Pollard, 2013; Zaccagnino et al., 2022), fracture geometry (Akram, 2020), hydraulic stimulation (Maity & Ciezobka, 2018; Atkinson, 2020; Ge & Saar, 2022; Keilegavlen, 2021; Feng et al., 2023), and numerical modelling (Anikiev et al., 2023; Faleide, 2021) to improve the reliability of microseismic monitoring and analysis.

Microseismicity has been an essential area of study in seismology. Over time, the understanding of microseismicity has evolved with technological advancements and clearer observations. In the late 19th century, the deployment of seismographs sensitive enough to record small seismic waves from distant earthquakes, such as John Milne's invention of the "horizontal pendulum seismograph," allowed for the detection of different types of earthquakes and estimates of wave velocities (Tietz, 2020).

The study of aftershocks and clusters of focal points has provided insight into microseismicity. "Introduction to Seismology" by Shearer (2009) discusses how earthquakes are followed by numerous smaller seismic events indicative of stress redistribution within the Earth's crust. Evidence

for the development of microseismic events due to stress redistribution is widely published (Thomas & Aki, 1984; Bürgmann et al., 1987; Shearer & Beroza, 1995; Marsan, 2005).

The sensitivity of equipment has significantly improved, allowing for the detection of smaller ground vibrations and more accurate determination of hypocentres and specific magnitudes. Extensive research has been conducted on developing appropriate seismometers (Li, 2021). The sensitivity of equipment is critical to the quality of recorded data. Seismometers record ground motion over time, with most based on the principle of inertia, where a suspended mass tends to remain still when the ground moves (BGS, 2021).

Seismometers must collect accurate data by maximising sensitivity while minimising noise. Sensitivity is affected by multiple factors, but various methods can improve it. For example, damping mechanisms such as magnetic damping prevent excessive oscillations of the mass. Using electromagnetic induction (Faraday's law), seismometers can convert mechanical motion into electrical signals. Seismic wave patterns are typically very small, so amplification circuits are used before recording. Additionally, filtering techniques remove unwanted frequencies, making equipment selective to desired wavelengths and cancelling out noise. Temperature fluctuations also significantly impact velocity and acceleration measurements, necessitating constant temperatures (Doody et al., 2017). Throughout the project, calibration of equipment is essential to ensure reliable data collection.

## **Epicentre**

There is an important distinction between the focus and the epicentre of an earthquake. The focus, also known as the hypocentre, is the precise location within the subsurface where the seismic event originates and ruptures occur. In contrast, the epicentre is the point on the Earth's surface directly above the focus. This distinction is crucial in seismology for understanding the distribution and impact of seismic waves.

The epicentre is commonly used in base maps to pinpoint the locations of seismic events. This information is essential for determining where the largest 'felt' effects of an earthquake will occur. Epicentral locations are critical components in the creation of seismic hazard maps and for conducting seismic hazard evaluations.

## **Focal Mechanisms**

The dispersion of energy from seismic events is not uniform in all directions. Depending on the subsurface conditions where the focal point occurs, seismic waves are emitted and subsequently detected differently. The deformation in the subsurface can be visualised using focal mechanism plots, commonly referred to as "beachballs." Focal mechanisms are based on waveform analyses from stations surrounding the earthquake (Oyvind, 2001). These plots describe the direction of slip in an earthquake and the orientation of the fault on which it occurs. Focal mechanisms are determined based on the motions of the first arriving P waves. When an earthquake occurs, seismic waves radiate away from the hypocentre in all directions. Depending on the fault's orientation, the seismic waves are either initially compressed or initially dilated.

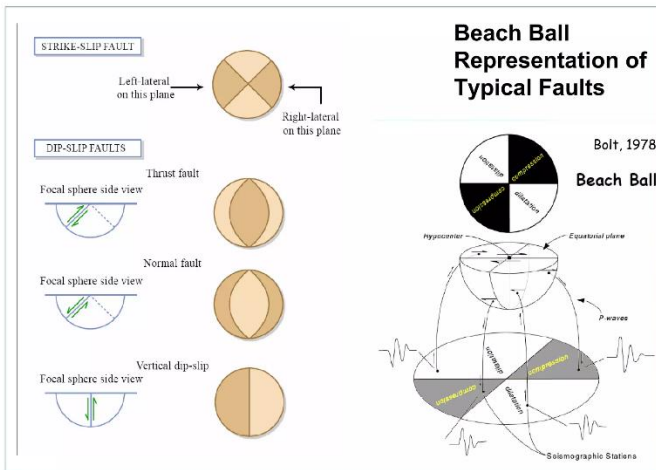
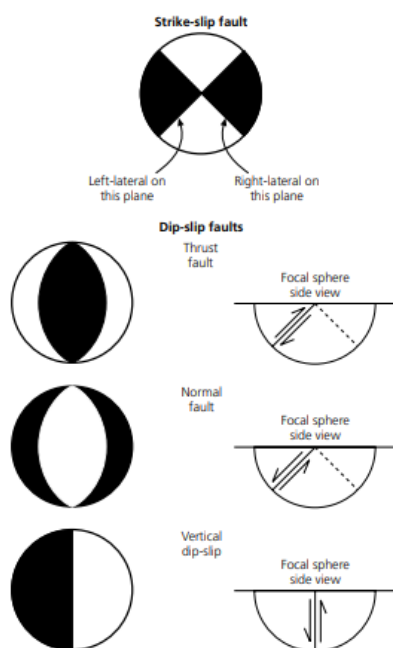


Figure 4 Beach ball representation of typical faults (Stein and Wysession, 2003; Bolt, 1978). Adapted from ÖNCEL AKADEMİ: SOLID EARTH GEOPHYSICS, Dec. 19, 2009. Available at: <https://www.slideshare.net/oncel/seismology-measuring-the-interior4> [Accessed 19 May 2024].

When the rock is compressed, the first arrivals are away from the epicentre, shown as an upward direction on a seismograph. In comparison, when the rock is stretched, the first P waves are “pulled” towards the epicentre, shown by the downward direction on the seismograph. The initial compression and dilation are often indicated as “+” and “-” signs respectively. Observations from multiple stations show quadrants of compressional and dilatational arrivals, separated by perpendicular nodal planes. To simplify diagrams, compressional quadrants are shaded.



A limitation of this method is the ambiguity in identifying the fault, requiring additional geological information to determine which nodal plane represents the fault plane. Beachball diagrams provide a visual depiction of fault types. Thrust faults display compressional waves at the centre and dilated waves on the plot's outer edges. Conversely, normal faults exhibit dilated waves in the middle, surrounded by compressional waves (Stein and Wysession, 2011). Focal mechanisms are used to determine whether a fault is normal, reverse (thrust), or strike-slip. In reality, faults often combine strike-slip and normal/thrust characteristics, making focal mechanism diagrams more complex.

Figure 5 Focal mechanisms for earthquakes with various fault geometries. Compressional quadrants are black. The strike-slip mechanism is for pure strike-slip motion on a vertical fault plane, which could be oriented either NE–SW or NW–SE. The pure dip-slip mechanisms are for faults striking N–S. (Stein & Wysession, 2011)

Focal mechanisms have significantly advanced our understanding of the subsurface, providing additional utility for seismic data. For example, focal mechanisms determined a strike-slip dominated stress regime at the DHM Project (Häring et al., 2008). Clusters of similar events, referred to as multiplets, can indicate discrete structures where repeated shearing occurred (Kumano et al., 2007).

Based on Häring et al.'s assumption, “the orientation of the multiplet cluster indicates the orientation of the active nodal plane and may be compared with the fault plane solutions of events within the cluster.” This method identified four multiplets, further developing the model of geological structures and their subsurface extent.

### Fractures and Fluid Flow Pathways

Fractures are breakages in rock formed in response to stress, originating from lithostatic pressure, high fluid pressure, tectonic forces, or thermal loading. These fractures can be observed at varying scales, from microscopic to continental. Fracture networks are critical for understanding fluid flow pathways, as fractures can act as hydraulic conductors, providing pathways for fluid flow, or create barriers that prevent fluid flow. Fractures represent void spaces in rock mass, and their characterisation is essential for determining how they affect fluid flow and physical properties.

To integrate fracture network characterisation and fluid flow pathways into useful models for hydrogeological projects, several questions need to be addressed:

How are hydraulic conductors and barriers identified?

How does fluid flow through a fractured system?

How can altered fracture networks be controlled and predicted?

These questions are answered through injection tests, observing wellhead pressure variations, hydraulic conductivity (K), and loss zones to assess responses to pumping and fracturing connectivity. Seismic surveys also provide valuable information about fracture orientation, extent, and location. In hard crystalline rocks like granites, fractures are necessary to create reservoirs. In low-porosity granite, fracture-related permeability may entirely control fluid transport.

### Safety Practices for Monitoring (UK Regulation)

Geothermal projects can pose environmental risks, impacting subsurface temperatures, groundwater resources, and gas emissions (Abesser & Walker, 2022). Additionally, there are risks associated with drilling and production activities. In response to these concerns, regulations have been established to outline good practices and guidelines for safe operations (Mosca et al., 2022). In April 2022, The Parliamentary Office of Science and Technology (POST) for the Houses of Parliament detailed the current state of developing geothermal schemes. According to Abesser and Walker (2022), the UK does not recognise geothermal energy as a natural resource, and there is currently no bespoke regulatory system for geothermal resources. Consequently, geothermal projects are guided by existing regulations used for petroleum exploration and water resource management. There is a consensus among stakeholders that streamlining regulations specifically targeted at geothermal technologies is necessary.

During local planning, the management of seismic risks must be implemented. However, POST brief 46 states that there are “no specific guidelines on the control or definition of acceptable levels of induced seismic ground-shaking for geothermal” (Abesser & Walker, 2022). In response, the United Downs Deep Geothermal Power (UDDGP) and Eden Geothermal projects have implemented a threshold system for controlling and mitigating induced seismicity (Rodríguez-Pradilla, 2021; Eden Geothermal, 2021). These thresholds are based on existing British Standards (BS 6472-2:2008) and Cornwall Council's planning guidelines for blasting, quarrying, and mining activity.

Threshold systems use peak ground velocity (PGV) rather than local magnitude (ML) recordings of seismic events as an indicator of the potential risk of structural damage at the surface. This is because magnitude relates to the size of the energy source, recorded at the same value irrespective of the distance to seismic receptors. In contrast, PGV measures ground vibrations at the surface, which are more directly linked to the risk assessment of structural damage. British Standard 6472-2:2008 considers a PGV of 2 mm/s as having a low probability of adverse comment. Below this threshold, literature widely accepts that vibrations are unlikely to be heard or felt. For comparison, Cornwall Council uses a PGV of 8.5 mm/s as the maximum permitted level of vibration from blasting operations during working hours.

During well testing, Eden Geothermal uses a PGV threshold of 0.5 mm/s (Eden Geothermal, 2022). When ground vibrations exceed this threshold, as occurred on 9th March 2022, operations are halted, and activities are reviewed to reduce the likelihood of inducing larger microseismic events that may be felt. Unlike geothermal operations, regulations for induced seismicity in shale gas operations are based on a national traffic light system, which is currently under review by the government (British Standards Institute, 2008).

## Case Study Sites

### Enhanced Geothermal Systems (EGS) in Cornwall

Enhanced Geothermal Systems (EGS) present a significant opportunity for renewable energy in Cornwall, leveraging the region's high heat flow and heat-producing granite batholith. Research into Cornwall's EGS began with the Hot Dry Rock project (1977-1991) at Rosemanowes Quarry, which targeted granite areas away from fault zones to understand rock mechanics for artificial reservoir production. Subsequent studies, particularly in the Upper Rhine Graben, demonstrated the advantages of naturally occurring fractures, leading to successful geothermal energy plants. Renewed interest in Cornwall resulted in the United Downs Deep Geothermal Project (2018-present), targeting sub-vertical fault zones as natural reservoirs and heat exchangers (Yeomans et al., 2019).

### Cornwall

Cornwall's unique geology has made it a significant area of interest for geothermal exploration. Several past projects, such as the United Downs Deep Geothermal Power project and Rosemanowes, have utilised seismic data to assess the region's geothermal potential. These studies have highlighted the importance of understanding the structural complexity and subsurface fluid pathways through the interpretation of microseismic events. By examining the methodologies, findings, and challenges faced in previous geothermal projects in Cornwall, valuable insights can be gained for future endeavours, such as the Eden Geothermal Project.

### Pohang, South Korea

In Pohang, South Korea, a geothermal power plant started in 2011 aimed to have a capacity of 1.2 MW and provide electricity for 1,000 households by 2017 (Richter, 2017). The project was an enhanced geothermal system intended to hydraulically stimulate a low-permeability granitic basement to create an artificial geothermal reservoir. The project used two exploration wells (PX-1 and PX-2), descending to approximately 4 km, spaced 600 m apart. Five hydraulic stimulations were conducted between January 29, 2016, and September 18, 2017 (Ellsworth et al., 2019; Kim et al., 2022). Fluids were injected at high pressures, reaching 46.83 l/s in PX-2 and 19.08 l/s in PX-1, with maximum wellhead pressures of 89.20 MPa and 27.71 MPa, respectively. However, in November 2017, an earthquake with a magnitude of 5.5 (MW, USGS) occurred, causing significant infrastructural damage costing over \$300 million and leading to the suspension of the Pohang Enhanced Geothermal System.

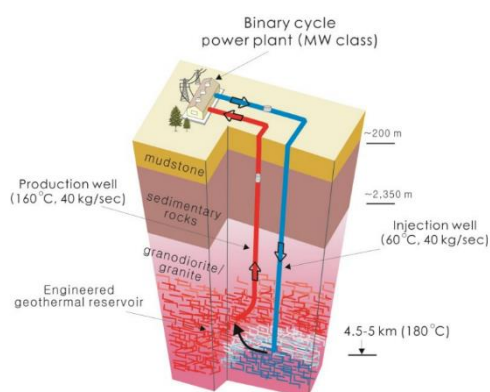


Figure 6 Conceptual model of the Korean EGS pilot plant project Song et al. (2015)

Scientists concluded that the earthquake resulted from Quaternary fault reactivation due to fluid injection. Most of the rupture propagated southwest, conforming to the rupture directivity analysis (Cho et al., 2023). The

induced seismic event was caused by injection activating a previously unknown fault, leading to the earthquake growing through the release of tectonic strain. This case further illustrates the potential for microseismic events induced by human activities to trigger significant seismic events.

## Basel, Switzerland

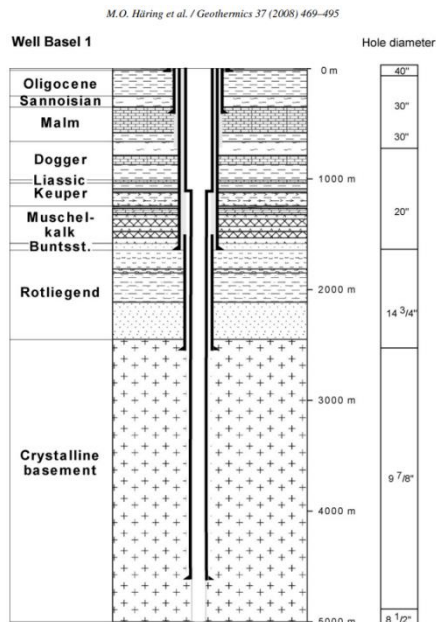


Fig. 2. Well Basel 1: Geological log and well completion. The open hole section extends from 4629 m to 5000 m depth.

Figure 7 Well Basel 1: Geological log and well completion. The open hole section extends from 4629 m to 5000 m depth (Häring et al., 2008)

The Deep Heat Mining (DHM) project developed a geothermal cogeneration plant in Basel, Switzerland, commencing in 2006. A microseismic monitoring array was installed in February 2006, followed by drilling activities between May and October 2006. The borehole, Basel 1, reached a depth of 5 km, with 2.4 km of sedimentary rock and the remainder in granitic basement (Häring et al., 2008). The stress regime of the basement is characterised by a strike-slip regime with a NW orientation of maximum horizontal principal stress. Its fracture network is characterised by a fracture density of 0.9/m in the upper part and 0.2-0.3/m in the lower part of the basement, with cataclastic fracture zones at 4700 m and 4835 m.

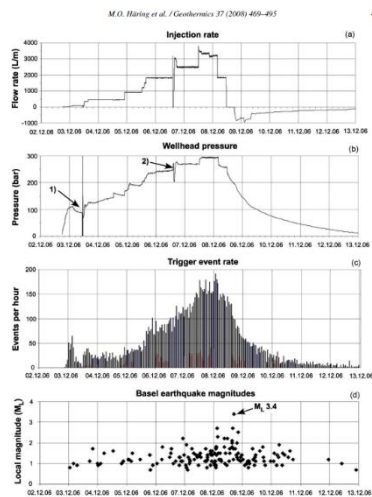


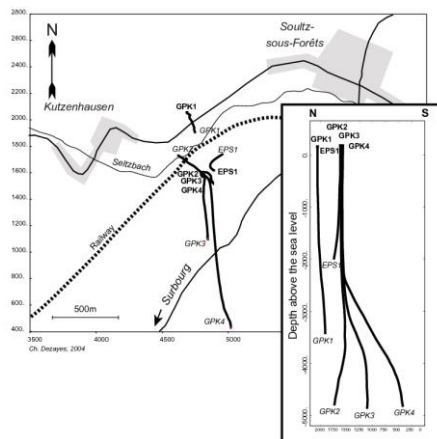
Fig. 5. Data on the hydraulic stimulation of well Basel 1. History of (a) injection rates, (b) wellhead pressures, (c) trigger event rates and (d) Basel earthquake magnitudes as determined by Swiss Seismological Survey (SED). In panel (b), Transient 1 is due to a change in injection pump, and Transient 2 to the repair of a leaking wireline blowdown preventer.

Figure 8 Data on the hydraulic stimulation of well Basel 1 depth (Häring et al., 2008)

The location appeared promising as temperature logs taken after drilling indicated the bottom of the well was 190°C. On December 2, 2006, the injection of cold water began. After six days of stimulation, unprecedented rates of microseismicity occurred, with the largest event recorded at ML 2.6. Injection was halted in accordance with previously established seismic response procedures. After five hours of shut-in, a 3.4 ML event occurred, followed by three further aftershocks with magnitudes of 3.0 over the next 56 days. Due to this seismic activity, the project was suspended in December 2006 and ultimately closed in December 2009.

## Soultz-sous-Forêts, France

In Soultz-sous-Forêts, France, a binary power plant based on an Organic Rankine Cycle (ORC) system



has been successfully extracting energy stored in deep crystalline rock masses since 1984, with drilling starting in 1987 (Gérard et al., 2006). The site targeted the Upper Rhine Graben due to its geothermal gradient reaching 100°C/km, attributed to convection loops in the Triassic sandstone and granitic basement (Vidal et al., 2015). The system uses three operational wells (GPK-2, GPK-3, GPK-4) oriented north-south to follow the maximum horizontal stress (Dezayes et al., 2009). The power plant taps into fluids at 150°C, reinjecting them at approximately 60°C to maintain sustainability (Baujard et al., 2021).

Figure 9 Map view and N-S cross-section of the trajectory of the EGS Soultz wells (Dezayes et al., 2009)

Microseismic data at Soultz have been utilised to identify permeability characteristics (Audigane et al., 2002). Analysis of induced microseismicity during fluid injection provided permeability tensors for the large-scale reservoir. These calculations, using the direct inversion of the spatial-temporal distribution of events, estimate permeability tensors prior to hydraulic stimulation at different reservoir depths and approximate the direction of induced fractures that tend to be planar.

## United Downs Deep Geothermal Project (UDDGP), Cornwall, UK

The United Downs Deep Geothermal Project (UDDGP) is located near Redruth, Cornwall, approximately 40 km southwest of Eden Geothermal. It is the first geothermal power plant in the United Kingdom. Two exploration wells (UD-1 and UD-2) have been drilled to depths of 5275 m (production well) and 2393 m (injection well), intersecting the Porthtowan Fault Zone approximately 800 m to the west (Farndale & Law, 2022). The project aimed to target the fault zone at two separate depths to utilise the natural fractured zones within the radiogenic Cornubian granite batholith, building on the concepts developed from the Hot Dry Rocks project in Rosemanowes, Cornwall.

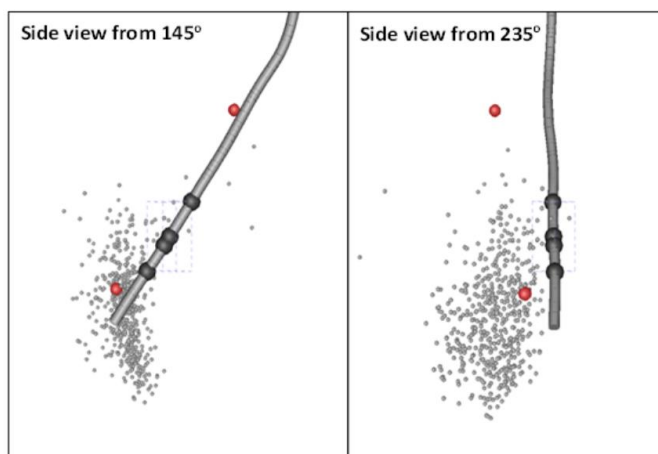


Figure 10 Location of the only two microseismic events which occurred during injection testing in July 2021.

(Red spheres), plotted against all previous seismic events during well testing at United Downs (grey spheres). The grey tube shows the well trajectory, with black sections indicating significant mud-loss zones during drilling. Images courtesy of Altcom Ltd. Sourced Farndale & Law, 2022.



During drilling, significant mud-loss zones indicated enhanced permeability. Temperatures recorded at 180°C and world-class lithium concentrations have made this project a successful example of developing efficient geothermal systems in Cornwall. The United Downs project involved drilling two boreholes to depths of approximately 2.5 km and 5 km, intersecting the granite-hosted segment of the NW-SE striking Porthtowan Fault Zone. This project underscores the region's potential for geothermal energy due to its anomalously high heat flow and favourable structural conditions.

Induced microseismic events were recorded throughout the project. Farndale & Law (2022) reported two microseismic events detected during the final injection tests in UD-1. The second small event occurred at a shallower depth, suggesting potential upward growth of the reservoir. The reservoir has been mapped using microseismic data, showing a minimum estimated volume of 50,900,000 m<sup>3</sup>.

#### Rosemanowes, Cornwall, UK

Rosemanowes was a pioneering project for geothermal energy production in the 1980s. In collaboration with the Camborne School of Mines, the project aimed to test the theory that inducing fractures within a granitic body could create a geothermal reservoir. The project consisted of three stages :

- Drilling 300 m boreholes to demonstrate that water circulation could be established between boreholes following hydraulic stimulation of natural fractures.
- Investigating reservoir development at approximately 2 km depth, with targets for a commercial system set at 210°C, a flow rate of approximately 100 l/s, and a maximum water loss of 10%.
- Investigating techniques for enhancing the deep reservoir to improve its performance.

Microseismic data assessed and interpreted that high water losses were associated with downward migration to depths of 3-3.5 km (Parker, 1999). Unfortunately, funding for the project was cut off before tests could prove permeability and circulation in granites at greater depths, leading to the project's shelving.

## Study Site: Eden Geothermal

Eden Geothermal Ltd (EGL) is a pioneering geothermal project located in Cornwall, UK, situated on the edge of the Eden Project estate. Established by three partners—Eden Project, EGS Energy Ltd, and Bestec (UK) Ltd—EGL aims to unlock the geothermal energy deep within the granite beneath Cornwall. The primary objective is to demonstrate how geothermal resources can be utilised in Cornwall to address the climate crisis and to develop a comprehensive understanding that can facilitate future geothermal developments in the region.

The project is co-funded by the European Union through the European Regional Development Fund and Cornwall Council, with additional commercial funding from Gravis Capital Management. The industrial research project aims to showcase the financial benefits of geothermal projects, including significant greenhouse gas savings achievable through deep geothermal heating.

EGL targets the Great Crosscourse, a NW-SE fault zone, at a depth of around 4500 meters. These steeply dipping fault zones are known for their high permeability and alignment with the maximum horizontal stress, making them ideal for deep geothermal reservoirs (Yeomans et al., 2020). The site was selected to target the Cornish batholiths, specifically intersecting the Great Crosscourse Fault in the open-hole section of the well below 4 km. The EGS plant is located on the southeastern periphery of the St Austell Granite, composed mainly of biotite granite, with less kaolinisation compared to the tourmaline and topaz granites found towards the west.

Drilling of the well, EG-1, commenced in May 2021 and was completed in October 2021. EG-1 is the longest deep geothermal well in the UK, reaching a vertical depth of 4,871 meters and a total length of 5,277 meters, using conventional rotary drilling with mud. The well was drilled in sections, with progressively smaller bit sizes and casing installed to protect the borehole. Below is a summary of the borehole diameter sizes and corresponding depths (Eden Geothermal Ltd, 2023):

34"-36"	Drilled until reaching competent bedrock; installed a steel conductor pipe and cemented it to create a stable start collar for drilling.
26"	Drilled to 240m depth and lined with 20" steel casing
17.5"	Drilled to 1510m depth with a 13 3/8" diameter casing
12.25"	Drilled and cased to just below 4000m, making it the longest section of the well. At 1706m, the well was deviated to target the Great Crosscourse fault.
8.5"	The final section is an open hole (not cased) to 5,277m (measured depth)

*Table 2 Borehole diameter sizes and corresponding depths (Eden Geothermal Ltd, 2023)*

EGS Energy Ltd commissioned a Reservoir Scoping Report (2011) for the EGS plant at the Eden Project, based on an output of approximately 7 MWe. To achieve this, the project aims to meet these parameters.

<b>Parameter</b>	<b>Value</b>
Number of wells	1 production, 1 injection
Well spacing	600 m
Maximum borehole length (MD)	5,000 m
Production interval length	750 - 1,000 m
Maximum well deviation from vertical	30°
Parasitic reservoir pumping losses (cost)	30%
Operational life of the reservoir	27 years
Thermal drawdown at producer	<10%
Reservoir impedance	<0.2 MPa/l/s
Nominal production flow rate	80 l/s
Wellbore diameter (ID)	8.5"
Re-injection temperature	75°C
Casing shoe depth (TVD)	4,000 m
Temperature gradient	40.5 ± 2.5°C/km
Surface temperature	10°C
Temperature drop in production well	5°C

Table 3 Project Parameters for Eden Geothermal

The initial phase of the operation focused on investigating the structural patterns within the subsurface. Following the planning phase, the following timeline was implemented for the operational stages, although the third injection test period is not defined in this report.

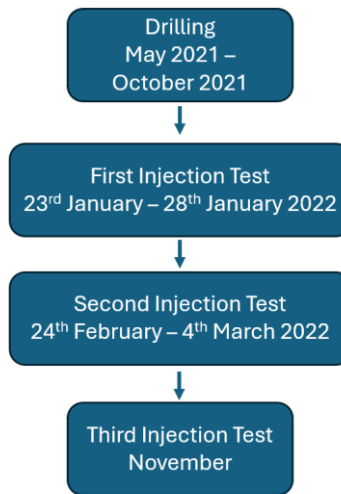


Figure 11 Stages of operation at EG-1

By targeting the Great Crosscourse Fault and utilising advanced drilling techniques, Eden Geothermal Ltd aims to demonstrate the potential for sustainable heat production. This project serves as a model for future geothermal systems and the potential benefits for Cornwall.

## Historic Seismicity

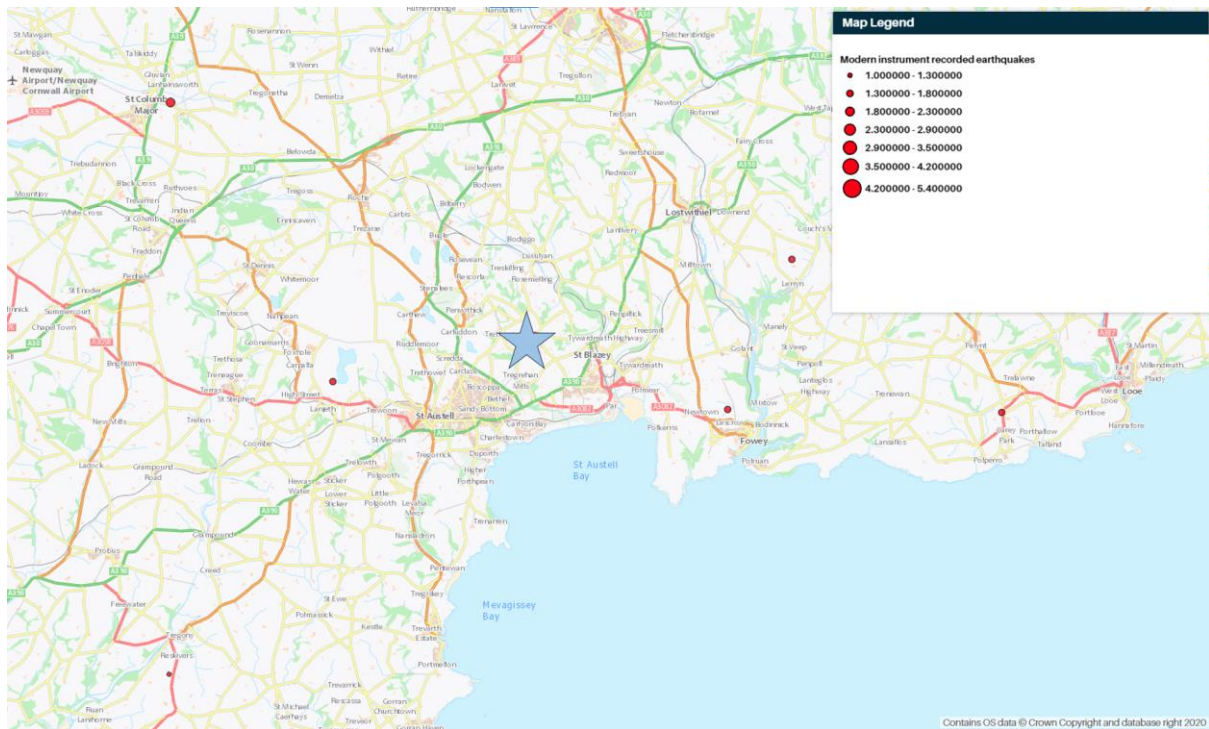


Figure 12 BGS Geoindex of recorded seismic events near Eden Geothermal (blue star)

Historically, the region has shown minimal significant seismic activity. This implies that all microseismic events observed during this study are induced.

## Geological History

The Eden Project, located in Cornwall, UK, is a testament to the region's rich geological heritage. This area, renowned for its diverse geological features, has undergone significant transformations over millions of years. Understanding the geological history of the Eden Project area is crucial for evaluating its potential for geothermal energy and other geological applications. This section provides a detailed account of the geological evolution of the Eden Project area, highlighting significant events, formations, and structural features (Simons et al., 2014; Manning et al., 2022).

### Precambrian

During the Precambrian, the oldest rocks of the Lizard Complex began to form. These rocks include the Man of War Gneiss, dated around 499 Ma, indicating a Cambrian age. This gneiss represents a fragment of the pre-Hercynian basement, providing crucial insights into the early geological history of the area (Styles et al., 2000).

### Devonian

The geological history of the Eden Project area spans several critical periods, each marked by significant geological events. During the Devonian period (410-360 Ma), the region experienced extensive marine sedimentation, leading to the formation of units such as the Gramscatho Basin, characterised by deep-water fan deposits and marine sediments (Harvey et al., 1994). This period also saw the development of the Meadfoot Group, consisting of fine-grained sandstones and mudstones deposited in a shallow marine environment (Shail, 1995).

Various significant geological formations and rock types characterise the Eden Project and the surrounding area. The Gramscatho Basin, a key stratigraphic unit, includes Frasnian deep-water fan deposits (Porthtowan Formation) and Famennian marine deposits (Mylor Slate Formation). These formations indicate a marine depositional environment during the Devonian period, later deformed during the Variscan orogeny (Harvey et al., 1994). The Meadfoot Group, formed in a shallow marine environment during the Lower Devonian, comprises thin- to medium-bedded fine-grained sandstones and mudstones. This group also contains tuff horizons and dolerite sheets, indicative of contemporaneous magmatic activity during sedimentation (Shail, 1995).

Hollick et al. (2006) provide detailed insights into Devonian rift-related sedimentation and Variscan tectonics in the Looe and Gramscatho basins. Their study highlights the transition from lacustrine/fluvial through shallow marine to outer shelf/slope depositional environments during Lower Devonian rifting. The Whitsand Bay Formation (Dartmouth Group) and the Bovisand Formation (Meadfoot Group) record this transition, while the Trendrean Mudstone Formation indicates a progressive deepening of the depositional environment, consistent with rift-related lithospheric thinning.

## **Variscan Orogeny**

The Variscan orogeny, occurring around 300-275 Ma, was a pivotal event that shaped the region's geological framework (Simons et al., 2014). This orogenic event resulted in intense compressional tectonics, leading to the formation of major thrusts and nappes. The Variscan deformation significantly influenced the structural evolution of the area, creating complex fold and fault systems (Alexander & Shail, 1996).

## **St Austell Granite/Cornubian Batholith**

The emplacement of the Cornubian Batholith marked a significant magmatic event in the post-Variscan period. The St Austell Granite, part of this batholith, formed through a series of magmatic and hydrothermal processes around 290-280 Ma (Manning et al., 2022). This granite is notable for its primary lithological variations, including biotite granites and tourmaline granites, which have undergone extensive hydrothermal alteration (Coggan et al., 2013).

The Early Permian Cornubian Batholith, a composite pluton, was formed during post-Variscan extension and intruded into low-grade regionally metamorphosed Devonian and Carboniferous rocks (Simons et al., 2014). This batholith is peraluminous with A/CNK values ranging from 1.5 to 1.9 and is enriched in metals such as As, B, F, Li, P, Sn, and Zn. The fractionation processes within these granites have concentrated metals like Li, Nb, Ta, Sn, In, and W, particularly within the tourmaline granites, indicating significant mineralisation potential (Simons et al., 2014).

Simons et al. (2017) further elaborate on the granitic formations within the Cornubian Batholith, detailing the distinct types of granites such as G1 (two-mica), G2 (muscovite), G3 (biotite), G4 (tourmaline), and G5 (topaz) granites. The G1 and G2 granites, derived from greywacke sources, underwent partial melting at moderate temperatures (731-806°C) and pressures (>5 kbar), leading to significant enrichment in rare metals. The G3 and G4 granites, formed at higher temperatures (768-847°C) and lower pressures (<5 kbar), are notable for their enrichment in metals facilitated by high fluorine content, which enhances the retention of trace metals in the melt (Simons et al., 2017). The G5 granites, exemplified by the Tregonning and St. Austell granites, are distinguished by their high levels of rare metals such as Li, Ga, Sn, W, Nb, and Ta, formed through fluid-fluxed melting during granulite facies metamorphism (Simons et al., 2017).

## **Kaolinisation**

Kaolinisation, a significant geological and economic process in Cornwall, involves the alteration of feldspar minerals in granite into kaolin, a valuable industrial mineral used in ceramics, paper, and other products. The kaolin deposits in Cornwall highlight the economic importance of this process, supporting numerous industries and providing employment opportunities (Smith, 2008). The formation of kaolin deposits through chemical weathering also offers valuable information about past environmental conditions (Exley, 1976).

Mueller et al. (1999) detail the kaolinisation, mineralisation, and structures in the biotite granite at Bodelva, St. Austell. The Bodelva China Clay Pit, located within the medium to coarse-grained biotite-rich facies of the eastern part of the St. Austell granite, was a significant source of kaolin until its closure in 1998. The study delineates four distinct stages of alteration: slightly, medium, highly, and completely altered biotite granite. The intense kaolinisation within these areas is predominantly structurally controlled, with iron oxide-stained fracture zones spatially related to completely altered biotite granite. The research highlights the importance of structural controls in the extreme kaolinisation and mineralisation observed at Bodelva, emphasising the role of fracture zones in the distribution and intensity of kaolinisation (Mueller et al., 1999).

Exley (1976) further investigates the formation of kaolinite in the St. Austell granite, providing insights into the chemical and mineralogical changes during the kaolinisation process. The study identifies that potash feldspar is hydrothermally altered to a micaceous mineral, while sodic plagioclase alters to mica, montmorillonite, and kaolinite. The intermediate products between feldspar and kaolinite suggest that the level of H<sup>+</sup> ion activity in the altering solutions controlled the removal of alkalis, Al<sub>2</sub>O<sub>3</sub>, and SiO<sub>2</sub>, leading to the reformation of mica or montmorillonite, and eventually kaolinite (Exley, 1976)

The kaolinisation of the granites, resulting from multiple episodes of fluid-rock interaction, has led to extensive geologically and economically significant kaolinite deposits. Mining these deposits has been a primary industry in Cornwall since the 18th century, generating substantial revenue and employment. The granites' high geothermal gradients, attributed to their thickness and elevated thorium, uranium, and potassium contents, present significant potential for deep geothermal energy development (Smith, 2008). Projected temperatures at depths of 5 km reach around 200°C, making SW England the most prospective region in the UK for geothermal energy (Downing & Gray, 1986).

The St Austell granite, in particular, is notable for its lithium resources. The occurrence of lithium-bearing micas within the granite and the development of fracture-hosted lithium-enriched brines present a significant opportunity for lithium extraction, essential for modern battery technologies (Smith, 2008). The granites' potential for coproduction of power, heat, and lithium brines aligns with the global shift towards low-carbon technologies and the energy transition (Simons et al., 2017).

## **Igneous Rocks**

Hutchings (1887) studied the altered igneous rocks around Tintagel, revealing significant geological processes. The "Greenstones" of the coast, primarily consisting of hornblende and plagioclase, show extensive alteration and mechanical metamorphism. The transition from massive epidiorite to chlorite-schist and the presence of calcite, chlorite, and quartz highlights the dynamic alteration processes influenced by pressure and shearing movements. This altered rock provides valuable information about the region's tectonic history and metamorphic processes.

## **Tectonic Activities/Crosscourses**

Tectonic activities have profoundly impacted the geological structure of the Eden Project area. The Variscan orogeny resulted in extensive thrusting and folding, creating complex structural features

such as the Great Crosscourse Fault (Fraser et al., 2021). This fault and other major fault lines have been reactivated during subsequent tectonic events, enhancing the region's permeability and geothermal potential (Kim et al., 2001). The reactivation of faults during the Permian, Triassic, and late Jurassic-Cretaceous periods has further influenced the structural framework of the area. These tectonic activities have shaped the region's geological evolution, affecting its mineralisation processes and suitability for geothermal energy extraction. The structural complexity and multiple phases of fault reactivation highlight the dynamic geological history of the Eden Project area (Yeomans et al., 2019).

Crosscourse faults, integral to Cornwall's geological landscape, have been extensively studied by Fraser et al. (2021). These NW-SE striking fault zones are significant in the structural framework and mineralisation processes. Crosscourses typically show extensional kinematics, reflecting regional ENE-WSW extension during the Triassic, facilitating the formation of vein quartz and the deposition of base metals within the fault zones. The reactivation of these faults during the late Jurassic to Neogene periods, characterised by oblique to strike-slip movements, further enhances their permeability, which is crucial for the potential extraction of lithium-enriched geothermal fluids.

Reactivated strike-slip faults in North Cornwall, as described by Kim et al. (2001), provide additional insights into the fault dynamics in the region. These faults exhibit both right-lateral and left-lateral movements, with tip cracks and dilatational jogs indicating multiple phases of tectonic activity. The presence of slickenside striae and the deformation of earlier-formed tip cracks suggest a complex history of fault reactivation influenced by varying stress distributions and fracture modes.

The Variscan orogeny, a defining event in Cornwall's geological history, involved multiple phases of deformation (D1, D2, D3) characterised by ductile thrusting, folding, and extensional collapse (Harvey et al., 1994; Alexander & Shail, 1996). This transition from compressional to extensional tectonics during the late Carboniferous to early Permian periods is evident in the structural evolution of basins such as the Plymouth Bay Basin. The Meadfoot Group's deformation, marked by folding, cleavage development, and faulting, reflects the intense tectonic activity during the Variscan period. The presence of rift-related magmatism within the Meadfoot Group, evidenced by tuff horizons and dolerite sheets, indicates volcanic processes concurrent with sedimentation, highlighting the dynamic geological environment of the Lower Devonian.

The structural complexity of Cornwall's fault systems, including multiple reactivation episodes during the Permian, Triassic, and late Jurassic-Cretaceous periods, adds to the geothermal potential of the region. Integrating remote-sensed data, including high-resolution airborne magnetic, radiometric, and LiDAR surveys from the Tellus South West project, has provided a comprehensive lineament map. This map aids in understanding the distribution, geometry, and kinematics of fault zones, enhancing target generation for future geothermal exploration (Yeomans et al., 2019).

### **Geothermal Potential and Crosscourse Faults**

Crosscourse faults, with their complex history of development and reactivation, play a crucial role in Cornwall's mineralisation and structural framework, making them a significant focus of geological studies and mineral exploration. The potential for geothermal energy extraction from these fault zones further enhances the economic significance of Cornwall's geological resources.



Yeomans et al. (2019) explored the tectonic history and structural characterisation of SW England NW-SE fault zones for profound geothermal energy. The study emphasised the significance of the Great Crosscourse and the Porthtowan Fault Zone, noting their high permeability and alignment with the maximum horizontal stress, which are ideal for geothermal reservoirs. These fault zones exhibit significant strike lengths, often exceeding 10 km, and are targeted due to their high permeability, essential for the circulation of geothermal fluids.

The characterisation and mapping of these fault zones, combined with modern structural mapping and historical data, have provided a detailed understanding of the tectonic evolution and structural characteristics of Cornwall's fault systems. The comprehensive lineament map derived from high-resolution airborne magnetic, radiometric, and LiDAR data has been instrumental in identifying and characterising these fault zones. This map, combined with outcrop scale data from field analogues like the Land's End-Porthgwarra Fault Zone (LEPFZ), has enhanced the understanding of fault zone geometry, kinematics, and permeability.

Integrating modern structural mapping with historical and new field data has been pivotal in generating improved models for the tectonic and structural evolution of Cornwall's fault zones. These models address the distribution, geometry, kinematics, and relative chronology of fault zones, enhancing understanding of their role in geothermal energy production. The combination of classical field mapping, metal mining data, and high-resolution geophysical surveys provides a comprehensive framework for assessing the geothermal potential of Cornwall's fault zones.

## **Mining**

The history of mining and quarrying in the Eden Project area has significantly impacted its geology. Cornwall has a long history of China clay (kaolin) extraction, particularly in the St Austell area (Smith, 2008). The kaolinisation process, driven by hydrothermal alteration of granites, has produced extensive deposits of high-quality China clay. These deposits have been economically significant since the 18th century, supporting numerous industries and providing employment opportunities (Coggan et al., 2013). Historical mining activities have altered the landscape, creating numerous pits and waste dumps. The extensive mining of kaolin and metals has also increased the permeability of fault zones, enhancing the area's geothermal potential (Smith, 2008). Technological advancements in extraction methods have further influenced the geological setting, contributing to the current understanding of the region's geology (Smith, 2008).

## **Summary**

The geology of Cornwall is characterised by a complex interplay of sedimentation, magmatism, and tectonic activity, shaped significantly by the Variscan orogeny. The Plymouth Bay Basin, Meadfoot Group, and other geological units offer valuable insights into the region's geological history, highlighting the various rock types, fault sequences, and magmatic processes that have influenced Cornwall's geological framework. The Variscan orogeny, with its multiple phases of deformation, has left a lasting impact on Cornwall's geology, creating a diverse and intricate structural landscape. The evolution of granite intrusions, such as the Cornubian granites, underscores the transition from

compressional to extensional tectonics, further enriching our understanding of the region's tectonic evolution.

Crosscourse faults, with their complex history of development and reactivation, play a crucial role in Cornwall's mineralisation and structural framework. The potential for geothermal energy extraction from these fault zones, particularly from the Great Crosscourse and the Porthtowan Fault Zone, further enhances the economic significance of Cornwall's geological resources. The kaolinisation of the granites, resulting in extensive kaolinite deposits, highlights the region's economic potential in industrial minerals. Moreover, the potential for lithium extraction from the St Austell granite aligns with the global shift towards low-carbon technologies and the energy transition, positioning Cornwall as a significant player in the future of sustainable energy.

Cornwall's geological framework, enriched by extensive research, highlights the interplay between tectonic activity, magmatic processes, and sedimentation patterns. The diverse rock types, significant fault sequences, and evolution of granite intrusions reveal a complex geological history shaped significantly by the Variscan orogeny. This comprehensive understanding provides a valuable context for assessing Cornwall's potential for mineral resources and geothermal energy.

The detailed studies of Cornwall's geology underscore the importance of structural controls in mineralisation and kaolinisation processes. Integrating modern technologies and historical data has advanced the understanding of fault zone characteristics and their implications for geothermal energy extraction. Exploring crosscourse faults and developing predictive mapping techniques further enhance the region's potential for sustainable resource utilisation.

Cornwall's geological evolution, from the Devonian through the Variscan orogeny to the present, is a testament to the dynamic processes that have shaped its landscape and resource potential. Continually refining geological models and exploration techniques promises to unlock further insights and opportunities for sustainable development in this historically rich region.

## Methodology

The primary aims of this study are to characterise the geothermal reservoir by analysing the extent and attributes of microseismic data and to determine the impact of geothermal operations, including drilling to a depth of 5 km and fluid injection testing, on inducing seismic activity. Additional analyses will focus on inferring reservoir properties, conducting temporal analysis, and comparing findings with geological features.

### Data Collection

*This is a copy of the outline for seismic data collection provided by Eden Geothermal Ltd, provided by Andy Jupe.*

The Eden Geothermal Limited (EGL) seismic monitoring network currently consists of six microseismic stations and two ground vibration (strong motion) sensing stations.

The microseismic stations use a combination of triaxial broad-band surface seismometers and low-frequency triaxial geophones. These are analogue instruments and digitisation takes place at the instrument using low noise 24-bit digitisers. The digitisers have dedicated GPS antenna for UTC timestamping, with an accuracy better than one millisecond. These instruments are deployed in relatively quiet and isolated locations for optimum system sensitivity. The equipment is therefore operated in off-grid power mode, using 12V deep cycle batteries, with continuous recharging via solar-panels.

The ground-vibration sensing (strong-motion) devices are triaxial force-balance accelerometers with a bandwidth from DC to 200Hz. These have integral 24-bit digitisers and timestamping via a GPS antenna. They operate on mains power and are deployed within residential buildings in order to provide accurate samples of ground-vibration within populated areas.

Data transmission from all stations is via a dedicated 4G/LTE mobile phone modem at each station. Data transfer uses the international standard SEEDlink protocol and continuous data records are stored in standard Headerless SEED format (miniSEED).

Data is transmitted in real-time from each station to a remote data acquisition and processing server. This collates and merges the SEEDlink data feeds from each station. An event detection algorithm is then run automatically on the data. When the system detects a trigger a short section of the waveform data is extracted around the detection times and these data undergo detailed analysis. Multiple archive copies of the original continuous data are maintained.

The table below provides the locations of each station in the EGL network.

Station	Type	Latitude	Longitude
EGL01	Microseismic	50° 23.682'N	4° 45.037'W
EGL02	Microseismic	50° 21.885'N	4° 44.995'W
EGL03	Microseismic	50° 22.703'N	4° 42.409'W

EGL04	Microseismic	50° 23.063'N	4° 47.550'W
EGL05	Microseismic	50° 21.333'N	4° 48.672'W
EGL06	Microseismic	50° 20.685'N	4° 42.787'W
EGL0A	Strong motion	50° 21.494'N	4° 41.622'W
EGL0B	Strong motion	50° 20.470'N	4° 45.132'W

Table 4 EGL seismic monitoring network station locations (April 2021)

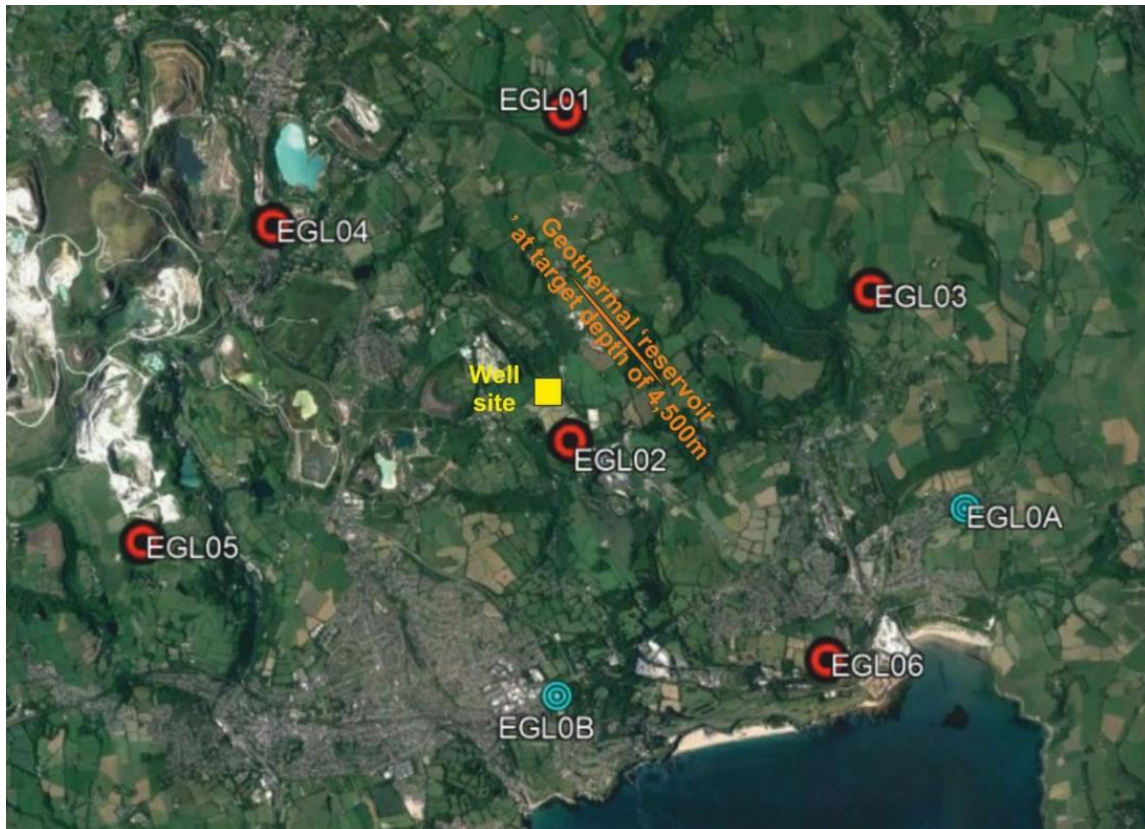


Figure 13 Satellite image showing locations of the EGL seismic network stations, the well site, and the estimated location of the geothermal reservoir at a depth of 4,500 m

## Data Analysis

The methodology is structured to achieve the following steps:

**Characterise the Geothermal Reservoir:** Utilise microseismic data to provide insights into reservoir characteristics, focusing on the extent and attributes of seismic activity to delineate the geothermal resource.

**Assess Operational Impacts:** Examine how drilling and fluid injection activities influence seismic events to infer causality and mitigate risks associated with induced seismicity.

**Reservoir Delineation:** Apply Geostatistics and Geospatial analysis for detailed reservoir modelling, emphasising the avoidance of excessive smoothing and accurately identifying resource blocks.

**Resource Model Optimisation:** Develop a comprehensive model to identify optimal drilling sequences and evaluate the feasibility of new drill sites or the potential for bifurcating from existing wells.

The work was divided into three stages to accomplish these tasks:

1. Reservoir Characterisation
2. Fluid Injection Impact Analysis
3. Additional Analysis

A summary of the work completed is outlined below:

## Reservoir Characterisation

### Spatial Distribution of Seismic Events

The initial work involves compiling the X, Y, and Z coordinates of seismic events from the dataset and ensuring all data is correctly formatted, including the corresponding Origin Time, Local Magnitude (ML), and Error Ellipsoid Values for each event. Seismic events are visualised on 3D scatter plots where points are differentiated by their Origin Time and the stage of operation the geothermal system was associated with. These stages are numerically defined by the "Series" assigned to each seismic occurrence. Additionally, events' local magnitudes (ML) are visualised in separate scatter plots.

Density analysis is performed using a grid-based approach, involving statistical analysis of the spatial distribution of points and clusters to determine if the spatial distribution of events is random or if there are significant patterns. Nearest-neighbour analysis is used for this purpose. Points are interpolated using kriging to locate hot spots, indicating the reservoir resource's potential central region. The spatial density of seismic events is also used to infer the approximate boundaries of the

geothermal reservoir, with adjustments made to incorporate geological maps showing known geological features.

Depth analysis focuses on the “Z-axis” values to determine the vertical extent of the reservoir. This is combined with wellbore location markers to assess the extent to which the reservoir has expanded beyond EG-1 and to evaluate the impact of drilling and each injection test on the downward propagation of seismic activity.

### **Volume Estimation**

Based on the spatial distribution analysis, the approximate lateral boundaries of the reservoir are determined. The depth range of seismic events associated with the reservoir and well data that provide the true vertical depth of the well are integrated to determine the theoretical vertical extent of the reservoir. Volume calculations involve geospatial modelling by dividing the space into small, manageable units and assuming their individual volumes. The error ellipsoid information quantifies uncertainty in the seismic event locations, thus the boundary delineation and the reservoir shape.

Reservoir properties like porosity and permeability are discussed to reflect their importance in determining the effective volume relevant for geothermal extraction. Available hydrological data is used to refine the reservoir model, as fluid pathways can impact the size and shape of the reservoir.

### **Seismic Event Magnitude Analysis**

Seismic event magnitude analysis is a critical stage in reservoir characterisation. It involves statistical analysis of the magnitudes of seismic events and their spatial and temporal distribution. Histograms and boxplots are used to visualise the distribution of ML values, providing basic statistics such as mean, median, standard deviation, minimum, and maximum ML values.

Spatial analysis examines how ML values vary across different spatial locations to identify patterns or trends. Temporal analysis focuses on how ML values change over time, particularly in relation to drilling and fluid injection activities. The relationship between ML and depth (bivariate analysis) is assessed to determine if deeper or shallower events tend to have different magnitudes. Correlations between ML values and the distance from injection wells or drilling sites are analysed to understand the influence of geothermal operations on seismicity within the zone of influence of the operating well.

The Gutenberg-Richter law for the frequency-magnitude distribution is applied to understand the relationship between the size of an event and its occurrence frequency. This distribution is adjusted to estimate b-values, which provide insights into the stress regime of the reservoir.

Cluster analysis is used to identify spatial concentrations of seismic events, which may correspond to active zones within a geothermal reservoir. Two methods are used: K-means clustering, suitable for partitioning  $n$  observations into  $k$  clusters, and DBSCAN (Density-Based Spatial Clustering of Applications with Noise), which groups closely packed points while marking isolated points in low-density regions as outliers.

Final comparisons of the magnitude distribution before, during, and after injection tests are made to assess the impact of these operations on seismicity. Outliers or anomalies in the magnitudes are noted as they could indicate unusual seismic activity or potential data errors.

### **Error Ellipsoids**

The parameters of the error ellipsoids are evaluated to assess the uncertainties associated with the hypocentres (locations) of seismic events. Each ellipsoid axis corresponds to the potential error in each spatial dimension (X, Y, and Z). Parameters include the lengths of the semi-major, semi-minor, and intermediate axes (eigenvalues), as well as the orientation of the ellipsoid in space (given by eigenvectors).

Average error ellipsoids are plotted for each “Series” and separately based on 100-meter depth intervals to visualise spatial uncertainty comprehensively. Suggestions are made regarding the range of uncertainty in location points and the most probable movement of the seismic cloud relative to the location of EG-1.

The analysis follows a clear workflow:

- Visualise the original seismic event locations and well location in the 3D scatter plot.
- Determine average error ellipsoids within each 100m interval.
- Visualise the 3D ellipsoids around averaged seismic events.
- Calculate the seismic centroid.
- Calculate the adjusted seismic location to minimise the total error ellipsoid.
- Visualise adjusted seismic location.

### **Mapping Geostrings**

Geostring analysis involves a detailed examination of the microseismic dataset to understand the temporal and spatial development of seismic events in relation to geothermal operations. Geostrings are conceptual representations of the progression of seismic events over time and space, connecting sequential seismic events to indicate the direction and rate of seismic activity migration.

Step 1: Data Segmentation by Well Test

Seismic events are identified and categorised by the assigned Series number corresponding to each fluid injection test.

### Step 2: Creation of Geostrings

An algorithm is developed to analyse the dataset and create Geostrings. The algorithm calculates the hypocentre location of events and connects them based on their temporal sequence, ensuring each connection represents a logical progression of seismic activity. This accounts for spatial and temporal proximity, linking events close in time.

#### Linking Events to Form Geostrings

Starting with the earliest event within the Series, the algorithm searches for the next event within defined temporal and spatial proximity thresholds, connecting them to form segments of a geostring. This process is repeated sequentially through the dataset. The most suitable event is selected if multiple events qualify as the following link. Geostrings are colour-coded for clarity.

### Step 3: Analysis and Interpretation

Directional trends and event clustering within Geostrings are identified, and correlations between local magnitude and their positions are analysed. The analysis includes comparing Geostrings generated for each fluid injection test to identify variations in seismic response, assessing how different injection parameters influence seismicity, and identifying thresholds beyond which seismicity becomes more pronounced or changes direction.

## Geostatistical Analysis

The geostatistical analysis is required to model geothermal reservoirs and estimate potential resources. Outputs include spatial maps of interpolated ML values, conditional simulation realisations, and measures of uncertainty derived from uniform conditioning. These results provide a nuanced understanding of the geothermal reservoir's potential and delineate areas warranting further exploration.

### Interpolation of ML Measurements Within Defined Blocks

The initial step involves compiling ML measurements and their corresponding spatial coordinates (X, Y, Z) from the seismic dataset. This data, including the Origin Time and Series for each seismic event, is meticulously formatted to facilitate accurate geostatistical analysis. The study area is partitioned into predefined blocks based on the dataset's resolution and study objectives.



## **Variograms**

Using variography, the spatial continuity of ML measurements is analysed. This involves calculating an experimental variogram for the ML data and fitting it with an appropriate theoretical model. The selected model is crucial for accurate spatial interpolation through kriging.

Ordinary kriging or kriging with a varying mean interpolates ML values within each block. This step provides estimates of ML in areas lacking direct measurements and yields kriging variances, offering a measure of uncertainty for each interpolated value.

## **Uniform Conditioning**

Uniform conditioning is applied to estimate the distribution of ML values within larger blocks by averaging over many conditional simulations. This method quantifies the uncertainty of the ML distribution within blocks, highlighting areas with significant uncertainty.

## **3D Modelling**

Based on the analysis, a 3D block model of the seismic events, theoretical reservoir boundary, and well position is produced to show the spatial distribution of EG-1 and the reservoir. The sequence of suggestions for the location of an endpoint for an additional well is provided with brief justifications.

## Fluid Injection Impact Analysis

### Correlation with Injection Phases

Aligning the temporal data of recorded seismic events with the dates and durations of fluid injection phases establishes the correlation of seismic events with distinct phases of fluid injection operations. This alignment reveals temporal relationships between injection activities and seismic occurrences, offering insights into how fluid injection might influence seismicity.

### Injection Parameters vs. Seismicity

Time-series data analysis examines the relationship between critical fluid injection parameters (flow rate and pressure) and the occurrence of seismic events. This analysis identifies patterns and correlations to discern fluid injection parameters' direct and indirect effects on seismic behaviour.

### Lag Time Analysis

The intervals between the initiation of injection activities and the subsequent occurrence of seismic events are calculated using statistical methods. Identifying consistent lag times is essential for inferring causality and understanding the time-dependent nature of induced seismicity.

### Additional Analyses

#### Reservoir Properties vs. Seismicity

Reservoir properties, such as porosity and permeability, are inferred based on the dataset's spatial distribution and magnitudes of seismic events. This involves analysing how variations in seismic activity correlate with areas of different geological properties, providing insights into the reservoir's characteristics, and potentially indicating regions critical for geothermal energy extraction.

### Temporal Analysis of Seismicity

A comprehensive study of the temporal evolution of seismic events is conducted, focusing on their occurrence throughout the phases of drilling and fluid injection operations. This analysis utilises time-series data to identify trends and patterns in seismicity over time, aiming to understand how seismic activity responds to operational interventions.

### Comparison with Geological Features

Seismic activity data and inferred reservoir boundaries are compared with existing geological information, such as the location of faults and lithological boundaries. This comparison is facilitated by overlaying seismic event distributions on geological maps, enabling the identification of

correlations between seismic clusters and geological structures. The objective is to enhance the understanding of how the geothermal reservoir interacts with its geological context.

## Results

Unless otherwise stated, the plots and figures in this section have been generated using OpenAI's ChatGPT (<https://chat.openai.com>).

### Reservoir Characterisation

#### Basic Statistical Tests

Operational Phase	Series	Mean ML	Standard Deviation	Minimum ML	Maximum ML	Count of Events
Drilling Operations	1	-0.480	0.362	-1.106	0.841	93
First Injection Test	2	-0.496	0.399	-1.239	1.216	191
Second Injection Test	3	-0.375	0.456	-1.132	1.686	152
September 2022 Operations	4	-0.425	0.320	-0.651	-0.199	2
Third Injection Test	5	-0.492	0.383	-1.317	1.114	199
Additional Operations	6	-0.083	0.707	-0.570	0.964	4
Total	-	-0.461	0.408	-1.317	1.686	641

Table 5 Basic Statistical Tests of Seismic Series

#### Spatial Distribution of Seismic Events

3D scatter plot of seismic event locations with points differentiated by Origin, Time, and Series.

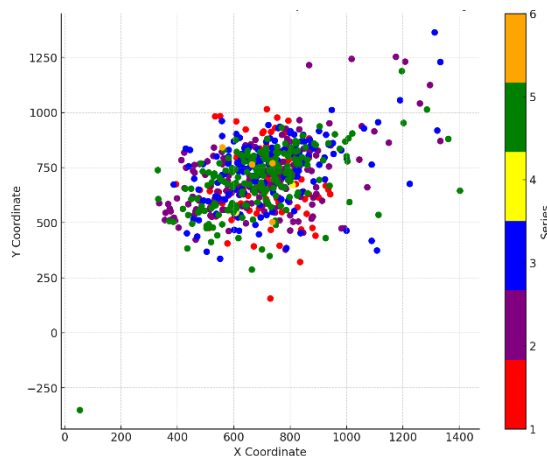


Figure 14 2D Scatter plot of microseismicity by Series

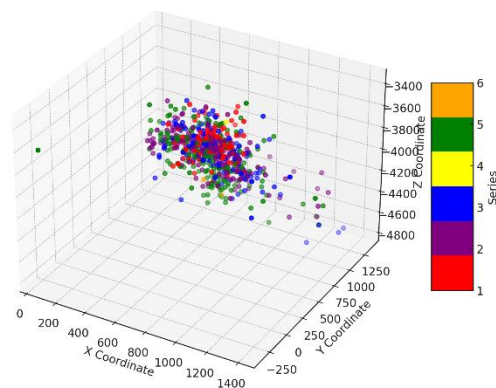


Figure 15 3D Scatter plot of microseismicity by Series

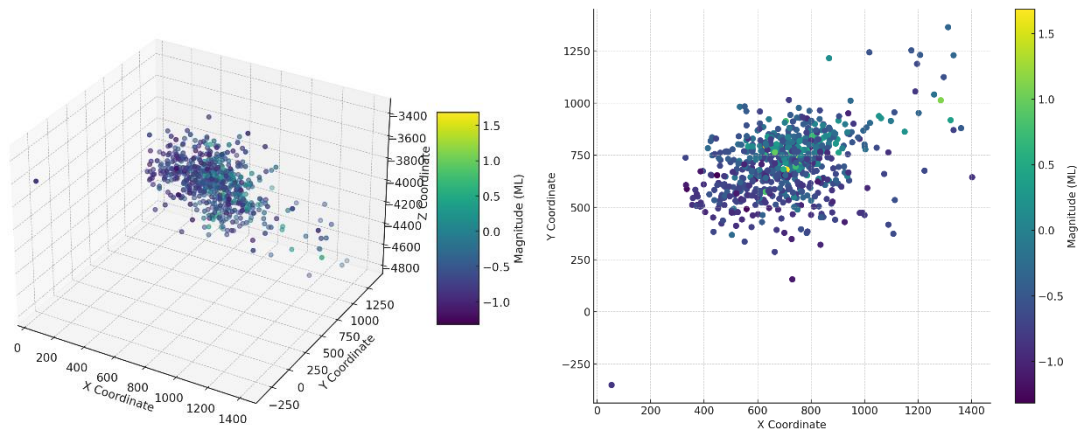


Figure 16 3D scatter plot of seismic event locations with points differentiated by Local Magnitude (ML).

Figure 17 2D scatter plot of seismic event locations with points differentiated by Local Magnitude (ML).

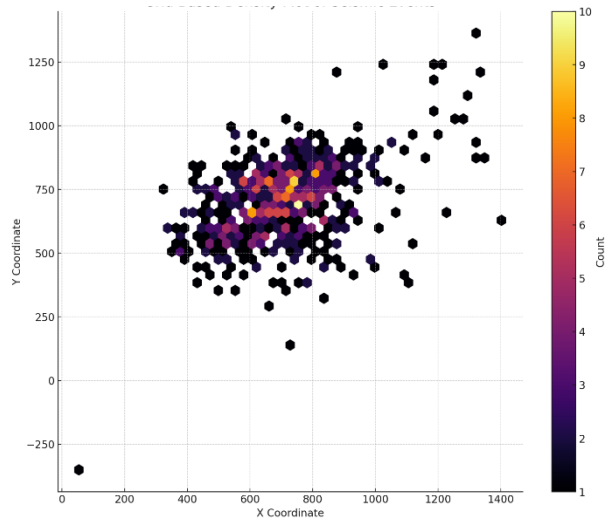


Figure 18 Grid-based density plot showing the spatial density of seismic events.

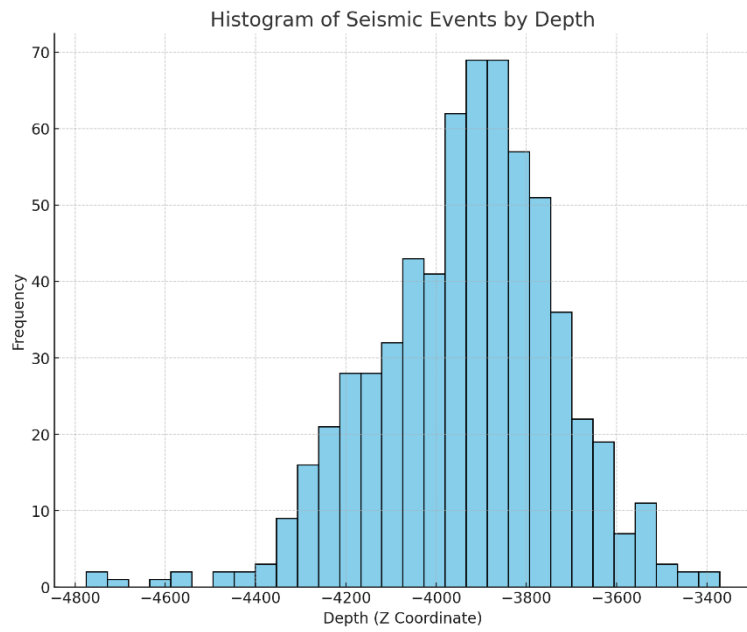


Figure 19 Depth histogram showing the vertical extent of seismic events along the Z-axis.

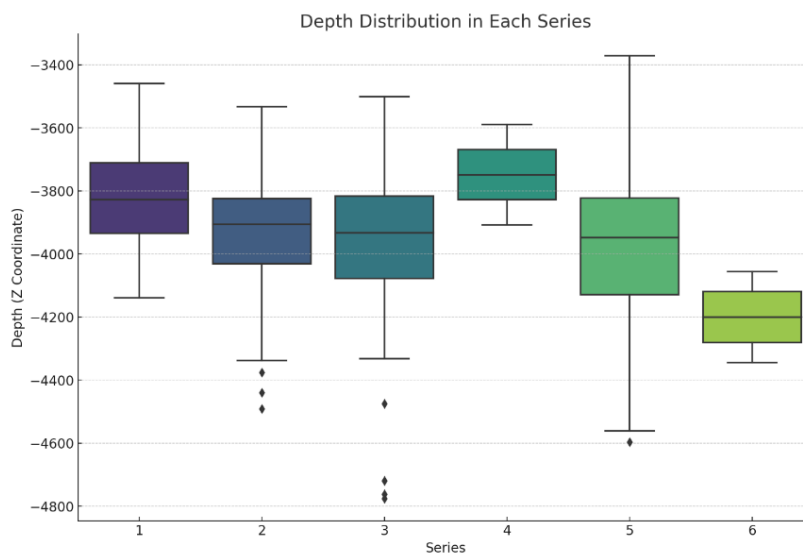


Figure 20 Box Plot of Depth (m) values showing the distribution, mean, median, standard deviation, minimum, and maximum values by Series.

## Volume Estimation

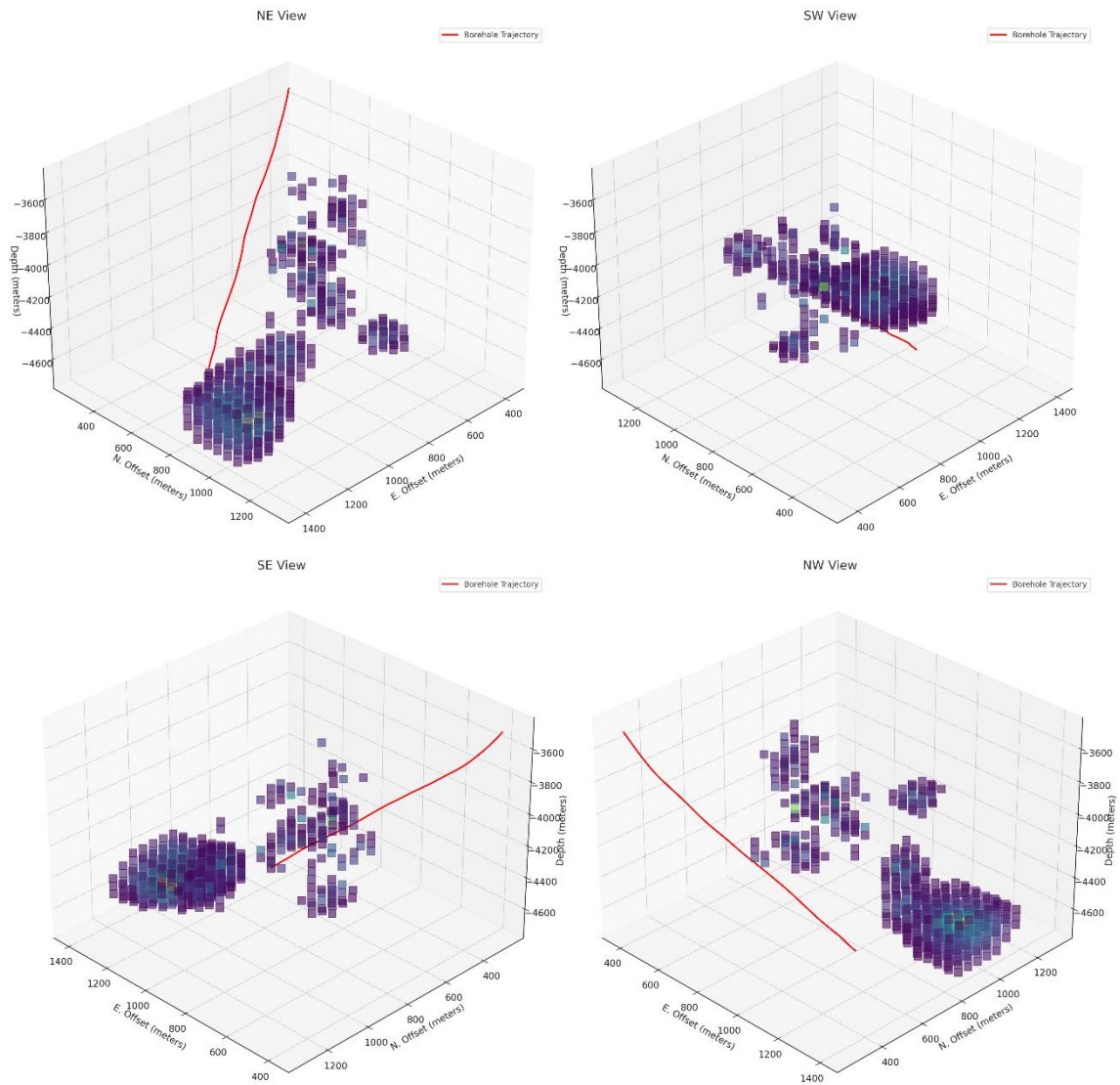


Figure 21 3D block model visualising seismic events, the theoretical reservoir boundary, and EG-1 position.

## Seismic Event Magnitude Analysis

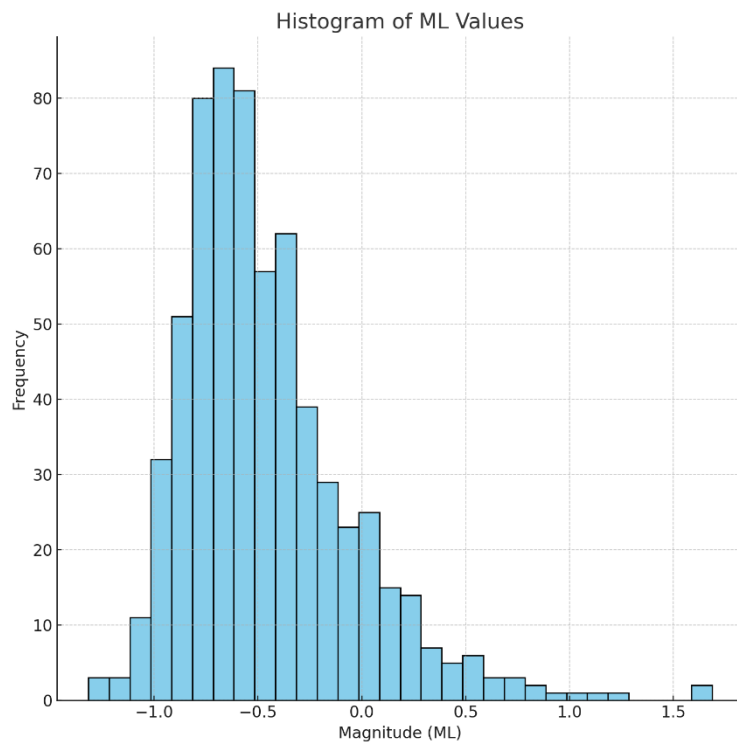


Figure 22 Histograms of ML.

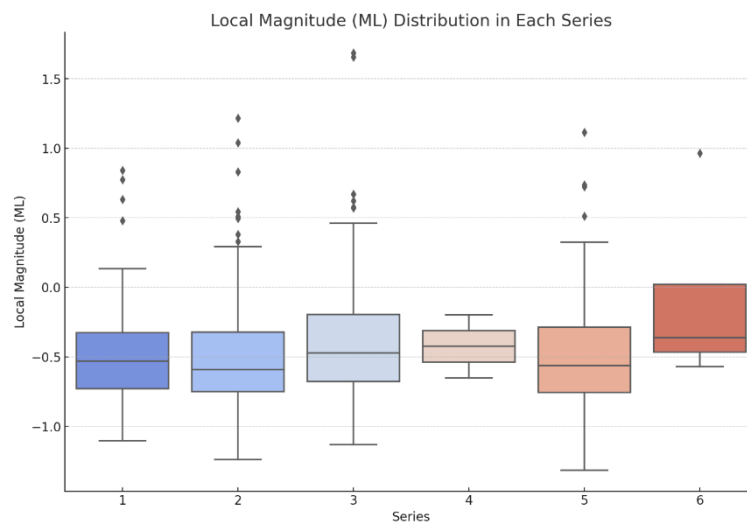


Figure 23 Boxplot of ML values showing the distribution, mean, median, standard deviation, minimum, and maximum values.



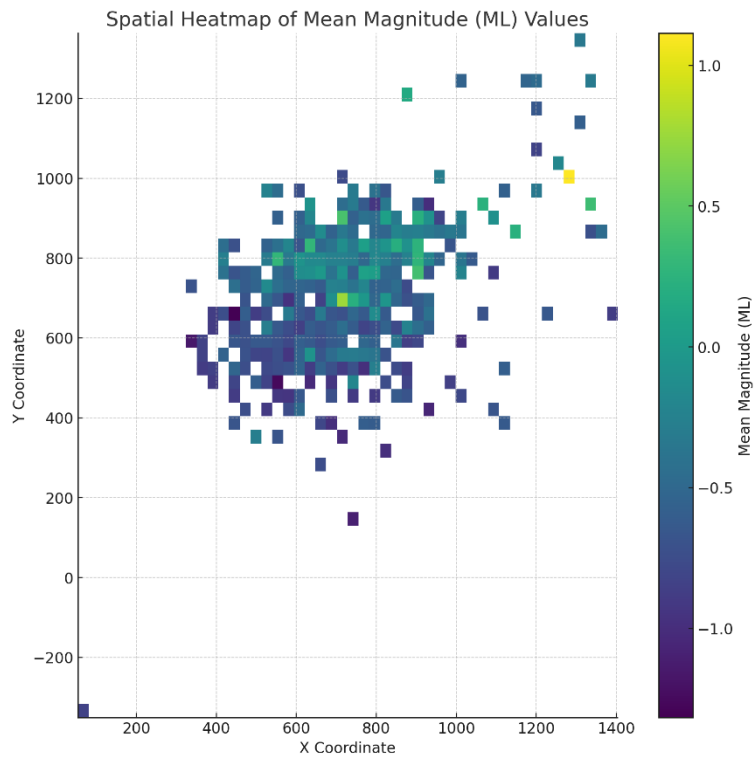


Figure 24 2D Spatial heatmap of ML values

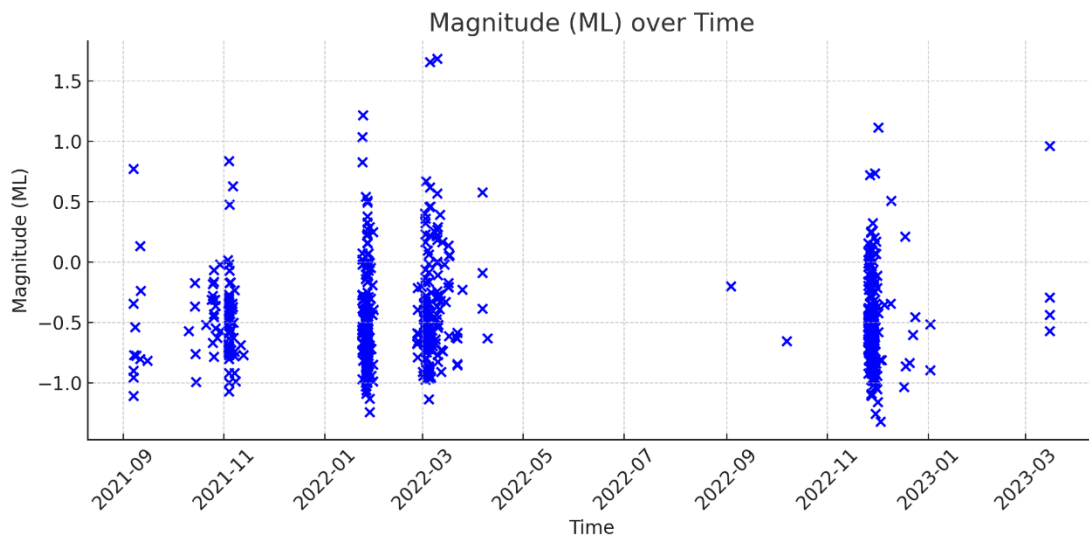


Figure 25 ML values over time

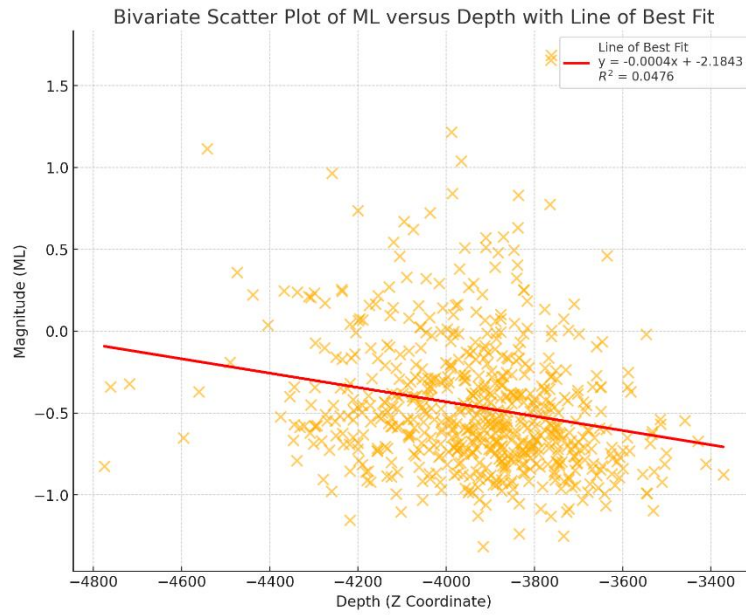


Figure 26 Bivariate scatter plot of ML versus depth.

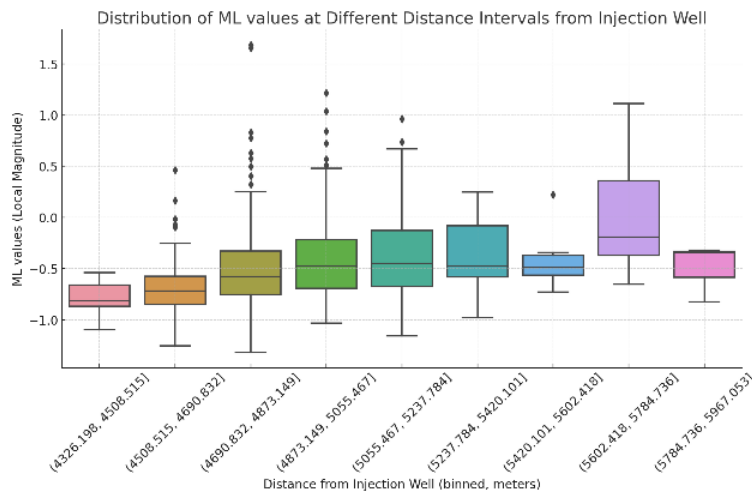


Figure 27 Boxplot distribution of ML at distance intervals from EG-1

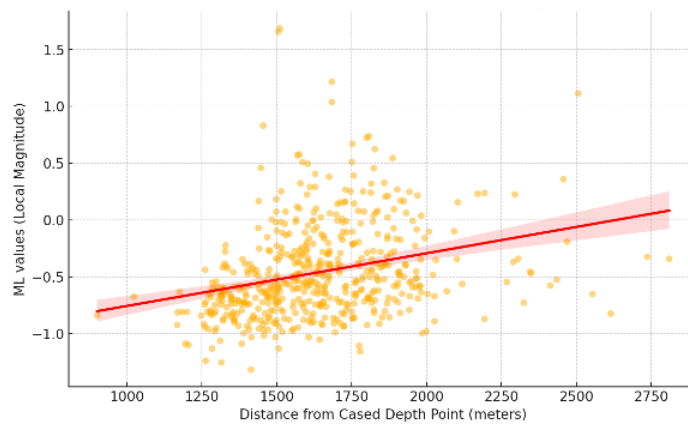


Figure 28 Correlation plot of ML at distance intervals from Cased Depth Point (Series 2, 3, 5)

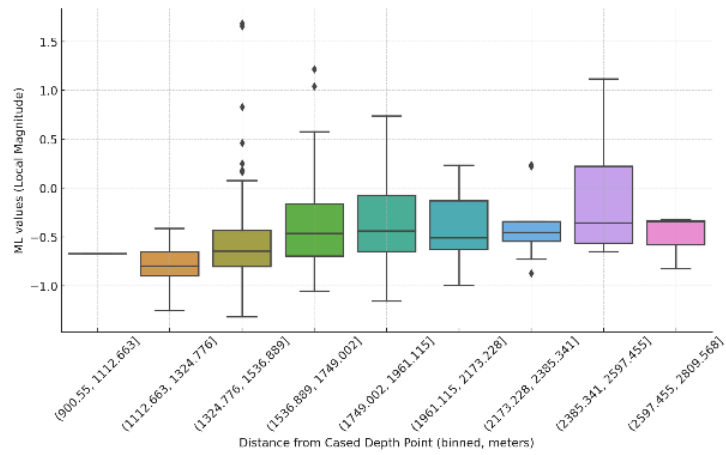


Figure 29 Distribution of ML values at different distance intervals from Cased Depth Point (Series 2, 3, 5)

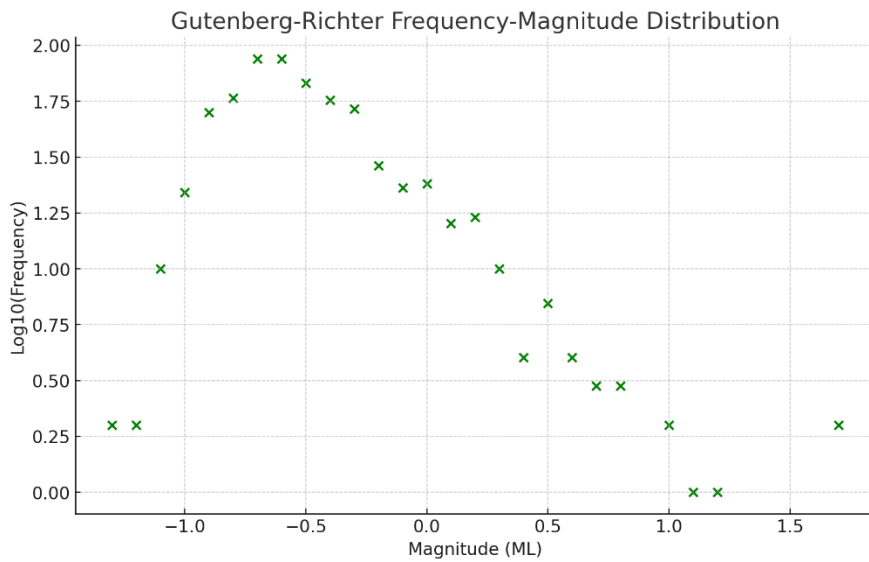


Figure 30 Gutenberg-Richter frequency-magnitude distribution plot to determine b-values.

### Error Ellipsoids

3D scatter plot of seismic event location with overlaid error ellipsoids to visualise spatial uncertainty.

### Error Ellipsoid for a Seismic Event

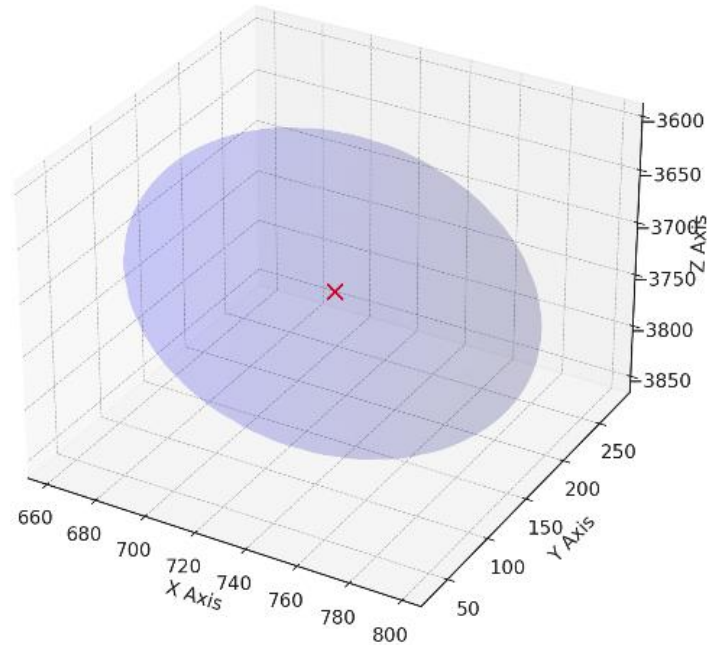


Figure 31 3D scatter plot of seismic event location with overlaid error ellipsoids to visualise spatial uncertainty.

Depth Interval	Average Axis 1	Average Axis 2	Average Axis 3	Notes
-3400m to -3300m	71	131	375	Largest Axis 3 value, indicating significant stress variation.
-3600m to -3500m	98.05	139.57	340.71	Unusually large Axis 3 values.
-3800m to -3700m	82.36	123.42	172.29	Reflects a zone of increased seismic activity.
-4000m to -3900m	77.52	114.81	160.12	High variability in seismic event locations.
-4200m to -4100m	81.06	128.75	178.54	Indicative of complex stress fields.
-4400m to -4300m	91	128.87	181.73	Significant increase in Axis 3 size.
-4600m to -4500m	39	85.33	120	Base size for scaling other ellipsoids.
-4800m to -4700m	114.33	154	178.67	Largest ellipsoid in the deepest interval.

Table 6 Average error ellipsoid sizes for different Series and depth intervals.

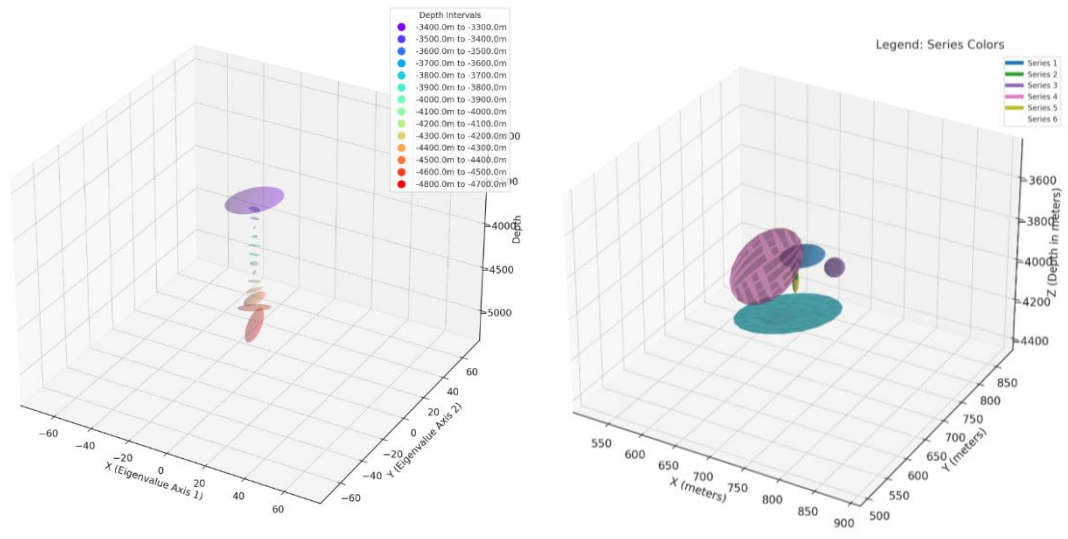


Figure 32 Error Ellipsoids by 100m Depth Interval

Figure 33 Focused Visualisation of Seismic Event Uncertainties by Series

The recalculated potential movement direction and amount for the seismic cloud, aimed at reducing the overall uncertainty in seismic point location relative to the well's endpoint, are as follows:

<b>X</b>	424.13 meters
<b>Y</b>	-75.86 meters
<b>Z</b>	-799.97 meters
<b>Movement Magnitude</b>	908.63 meters

Table 7 Summary of the movement vectors for seismic events.

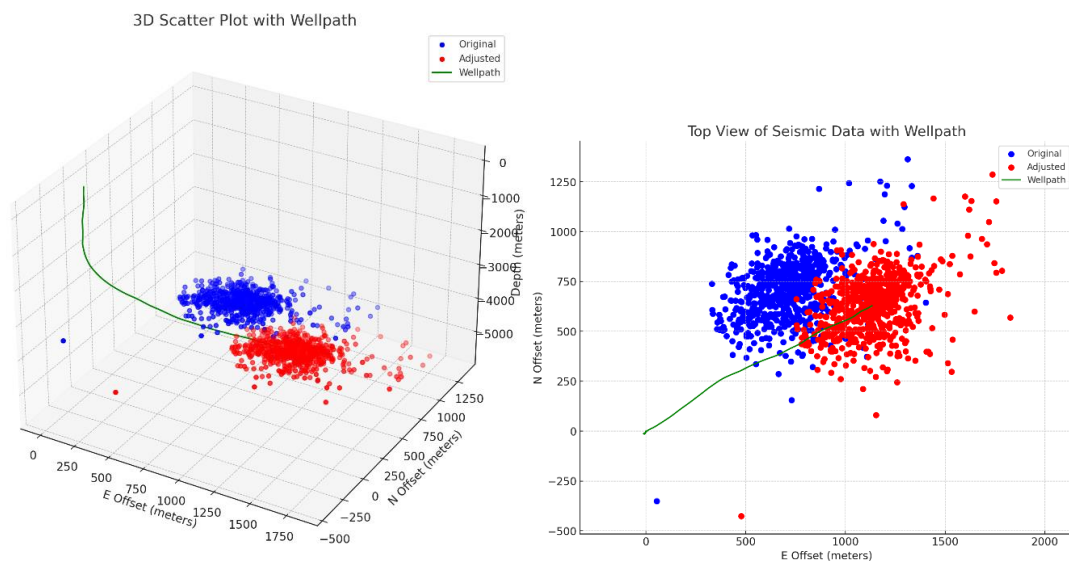


Figure 34 3D scatter plot of adjusted seismic locations and movement of the seismic cloud relative to EG-1.

Figure 35 2D scatter plot of adjusted seismic locations and movement of the seismic cloud relative to EG-1.

## Seismic Centroid

Series	ML weight Mean	ML weight min	ML weight max	Error weight mean	Error weight min	Error weight max
1	0.74	0.02	18.23	1.14e-6	1.13e-8	2.8e-5
2	1.05	0.01	66.74	2.99e-6	1.10e-8	2.11e-4
3	4.98	0.02	337.51	4.87e-7	4.20e-9	9.0e-6
5	0.73	0.01	46.94	8.28e-6	2.31e-9	1.08e-3

Table 8 Calculated Seismic Centroid

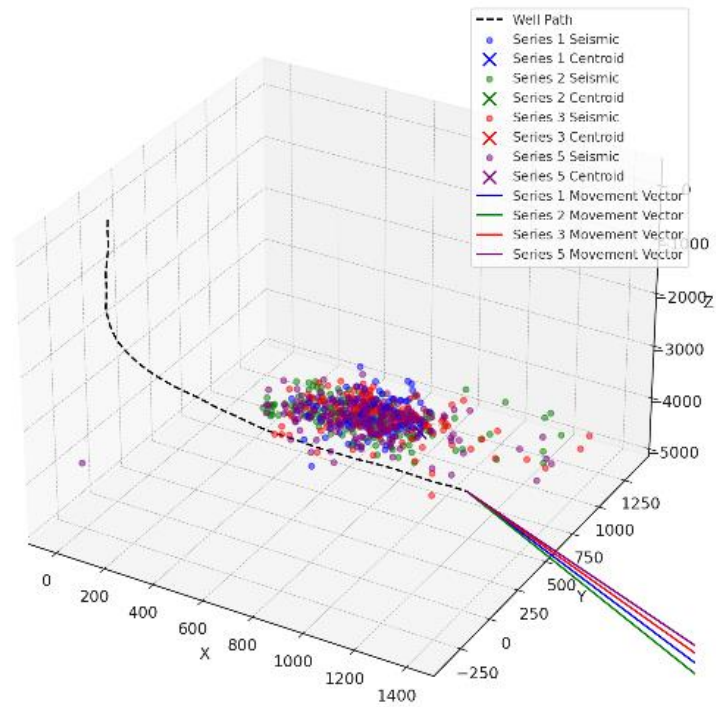


Figure 36 3D scatter plot showing the original and adjusted seismic centroids.

## Mapping Geostrings

A threshold for each series, is based on the 90th percentile as a reasonable balance between including most events while excluding outliers. This ensures that the majority of the data points are considered without being overly influenced by extreme values.

Series	Delta X All Positive	Delta Y All Positive	Delta Z All Positive	Delta T
1	268.52	331.88	308.13	119442.50
2	365.00	313.13	495.63	7089.86
3	341.41	343.75	450.00	7028.13
4	240.63	243.75	328.13	904.23
5	243.75	243.75	495.63	12946.03
6	156.88	266.09	272.03	651.66

Table 9 90th Percentile spatial and temporal thresholds used

Series	Number of Geostrings
1	17
2	31
3	25
4	0
5	41
6	0

Table 10 Number of Geostrings per Series

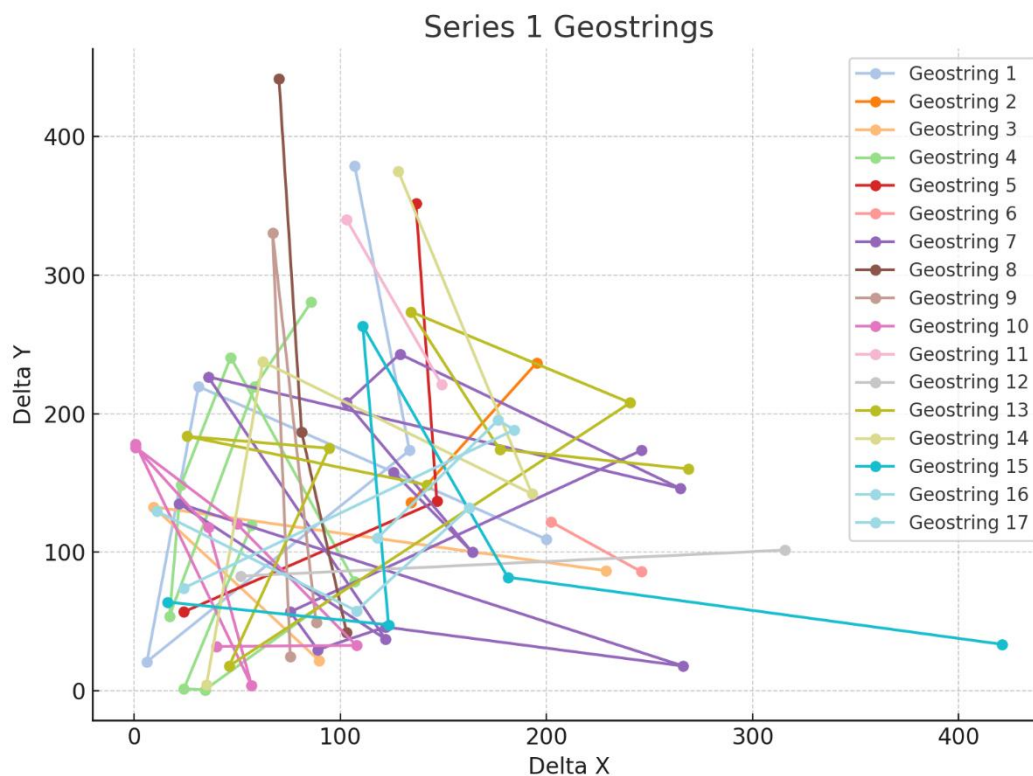


Figure 37 Plot of Geostrings for Series 1. Each geostring is color-coded, showing the progression of seismic events over time and space.

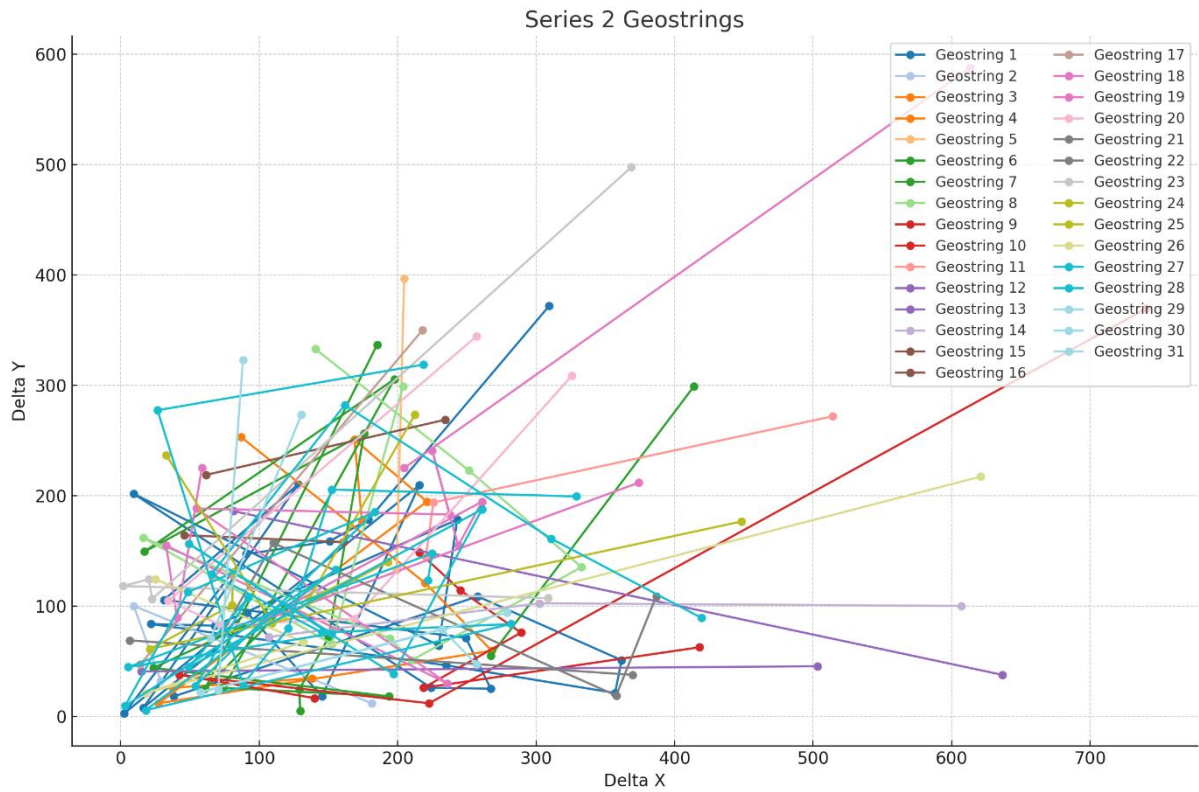


Figure 38 Plot of Geostrings for Series 2. Each geostring is color-coded, illustrating the spatial development of seismic events.

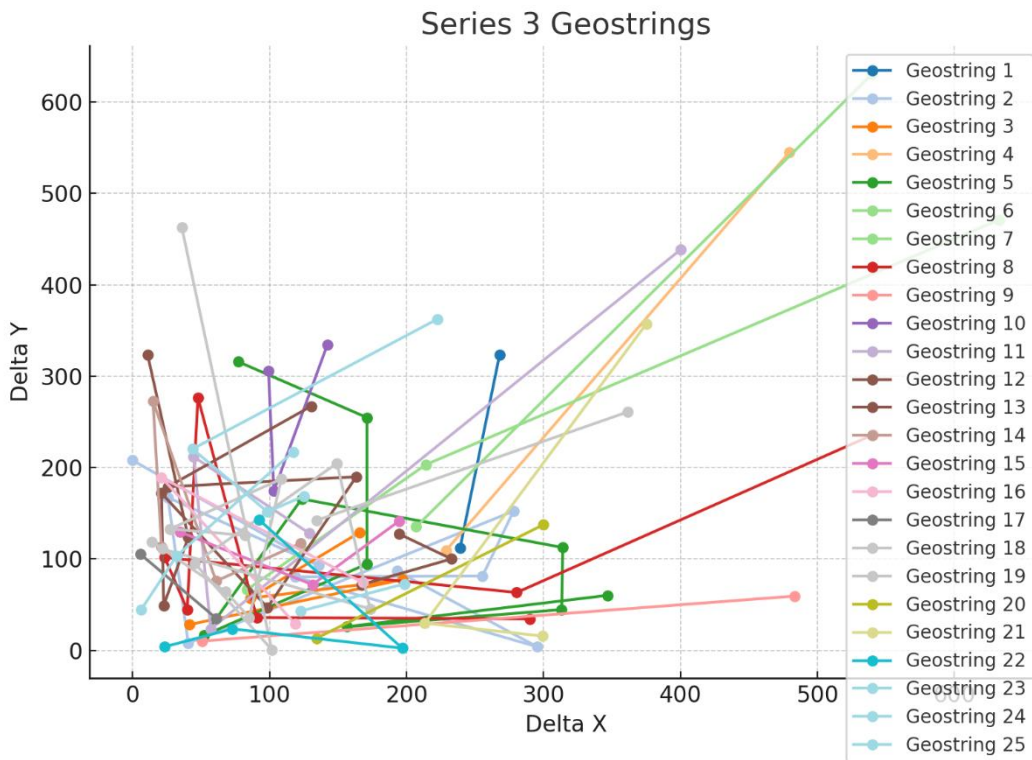


Figure 39 Plot of Geostrings for Series 3. Each geostring is color-coded, showing the progression of seismic events over time and space.



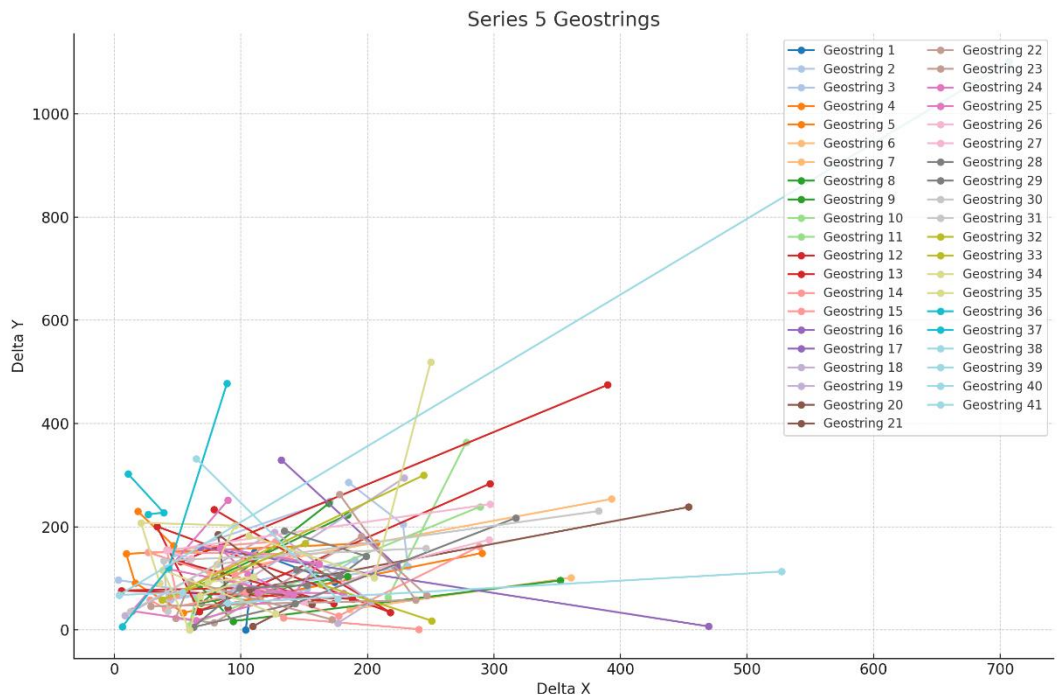


Figure 40 Plot of Geostrings for Series 5. Each geostring is color-coded, showing the progression of seismic events over time and space.

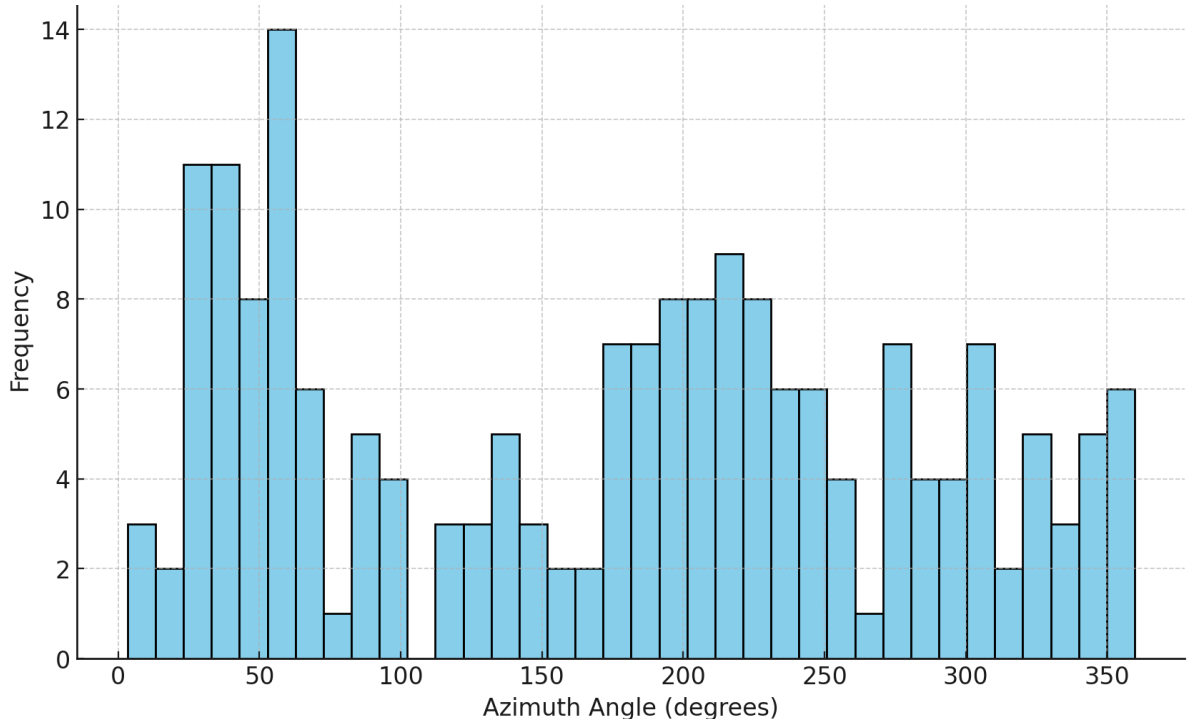


Figure 41 The histogram of azimuth angles for the geostrings is displayed above. This plot shows the distribution of the dominant directions in which the seismic events propagate across all geostrings. Each bin represents a 10-degree segment.

## Geostatistical Analysis

### Interpolation of ML Measurements Within Defined Blocks

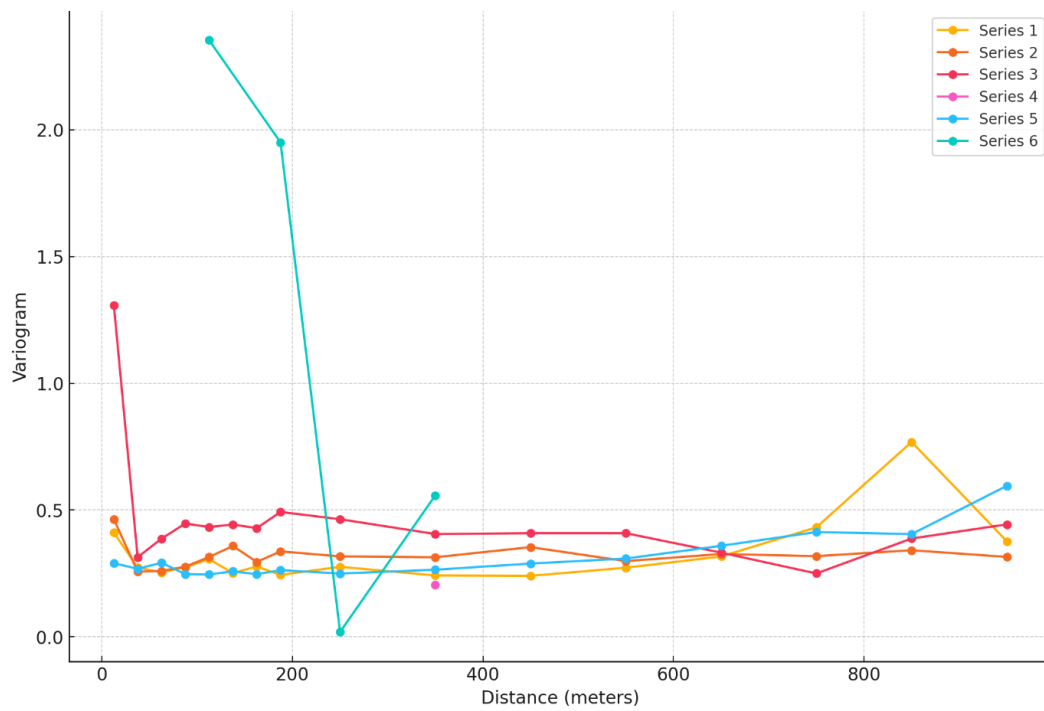


Figure 42 Experimental Variogram by Series.

Series	Optimal Range (meters)
1	850
2	12.5
3	12.5
4	350
5	950
6	112.5

Table 11 Optimal Ranges determined for the sill of theoretical variograms.

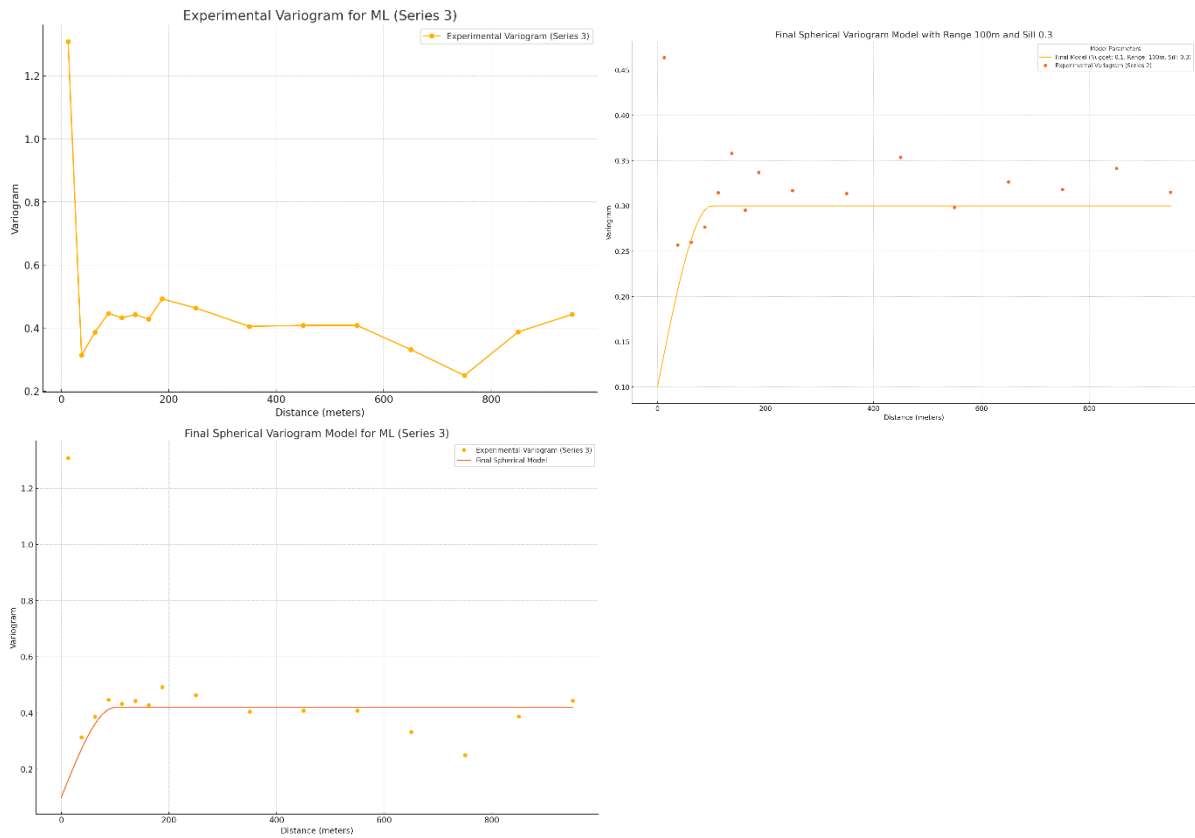


Figure 43 Experimental and Spherical Variogram Model for Series 3

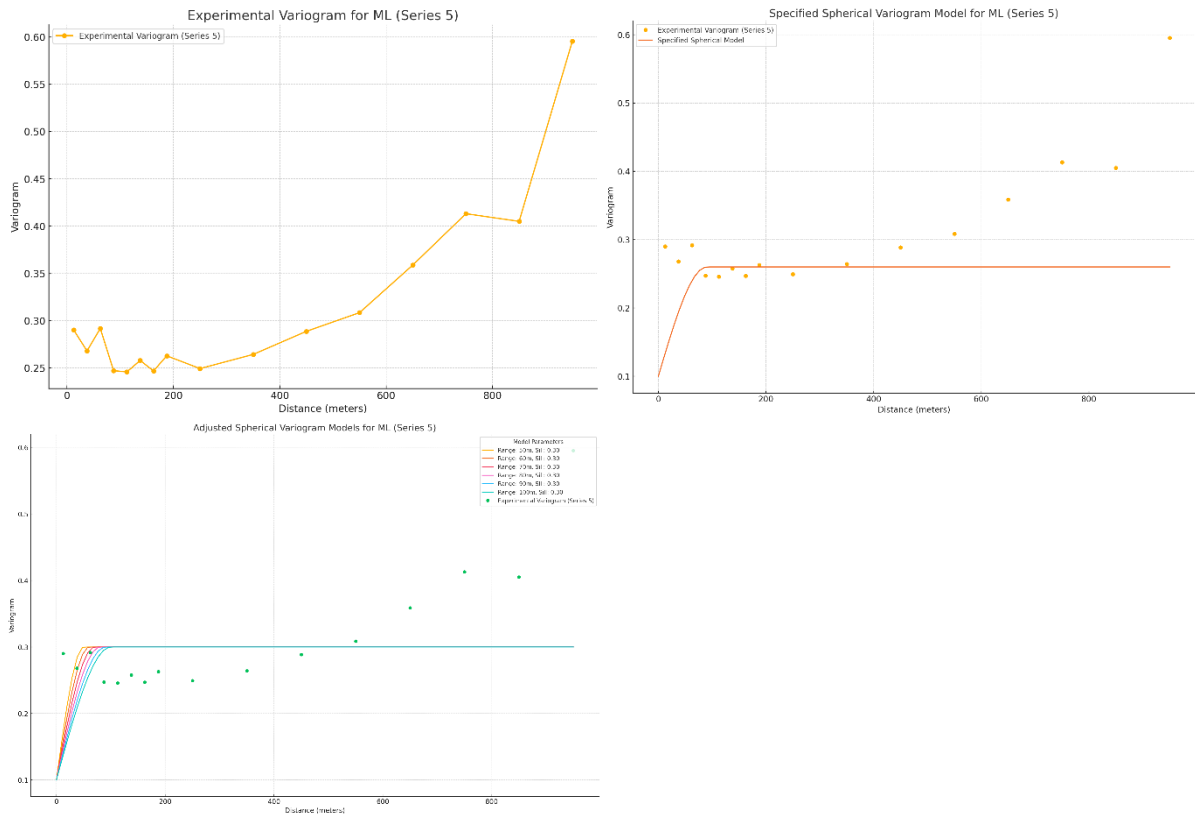


Figure 44 Experimental and Spherical Variogram Model for Serie 5

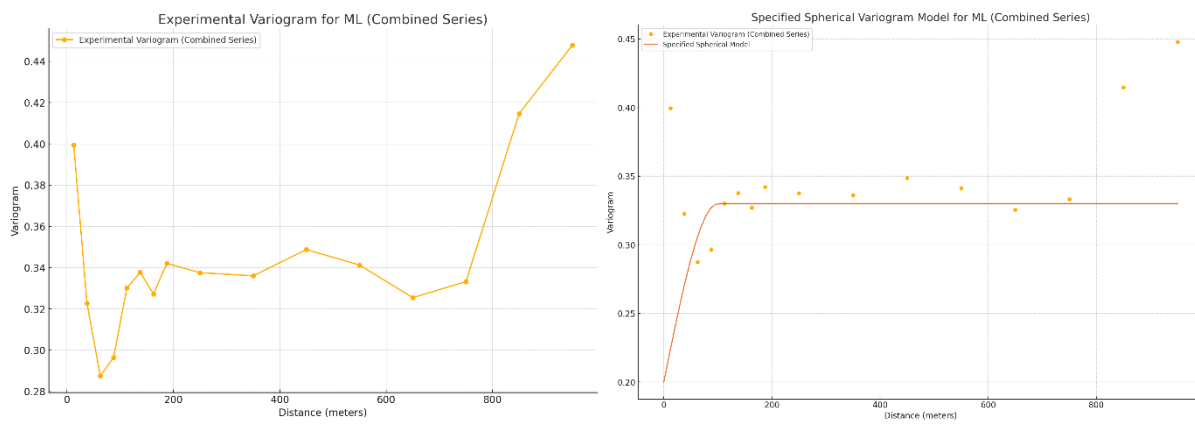


Figure 45 Experimental and Spherical Variogram Model for Series 2,3,5.

## Uniform Conditioning

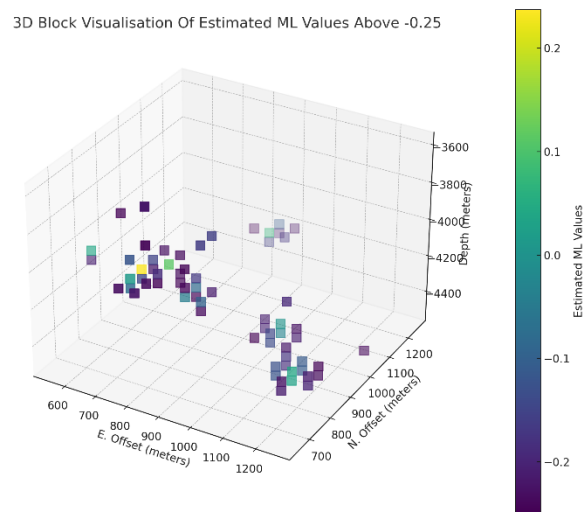


Figure 46 Block Model of estimated ML values, visualising above -0.25 (ML), Series 2

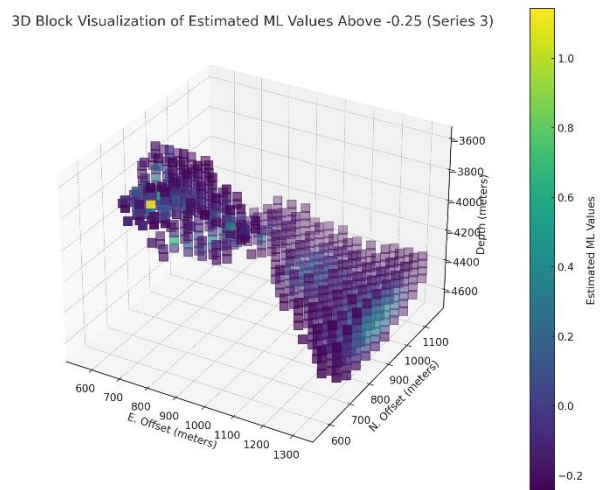


Figure 47 Block Model of estimated ML values, visualising above -0.25 (ML), Series 3

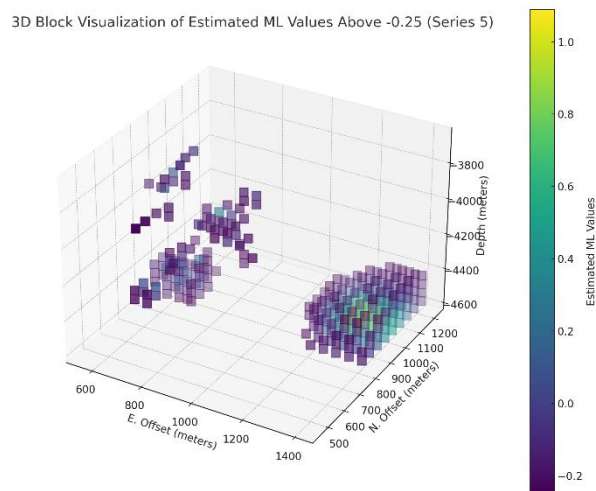


Figure 48 Block Model of estimated ML values, visualising above -0.25 (ML), Series 5

## 3D Modelling

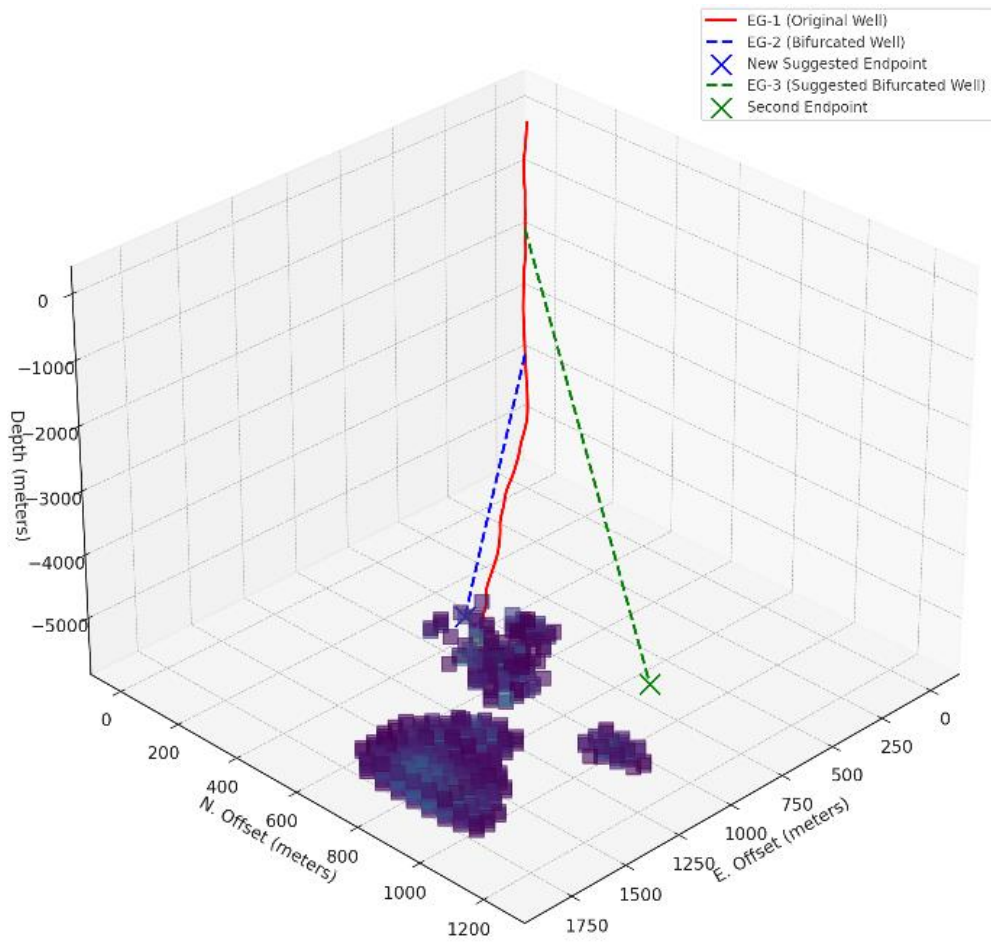


Figure 49 EG-1 (red),  $ML > -0.25$  reservoir block model based on adjusted seismic locations, and suggested locations of second well "EG-2."

### 3D Block Visualization with Original and Bifurcated Well Trajectories (ML > -0.3)

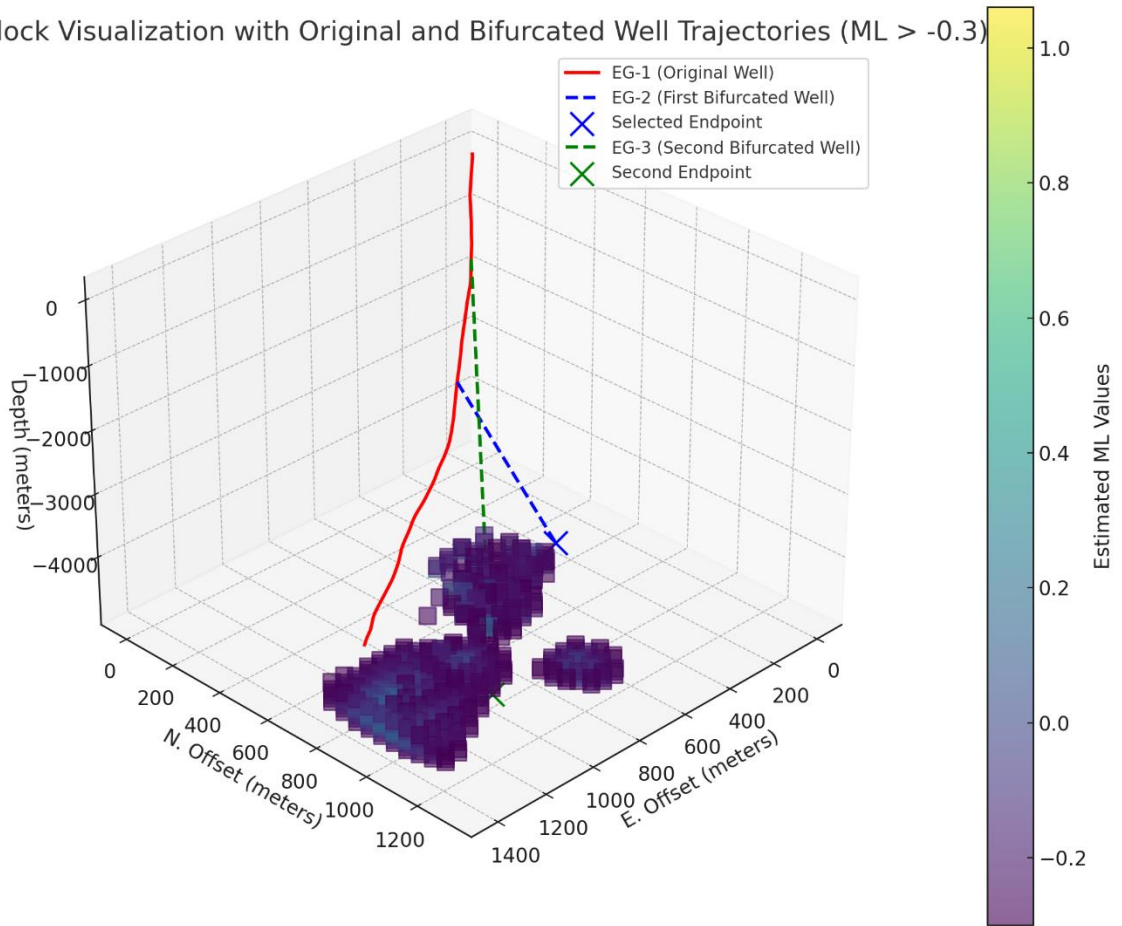


Figure 50 EG-1 (red), ML > -0.3 reservoir block model based on original seismic locations, and suggested locations of second well "EG-2."

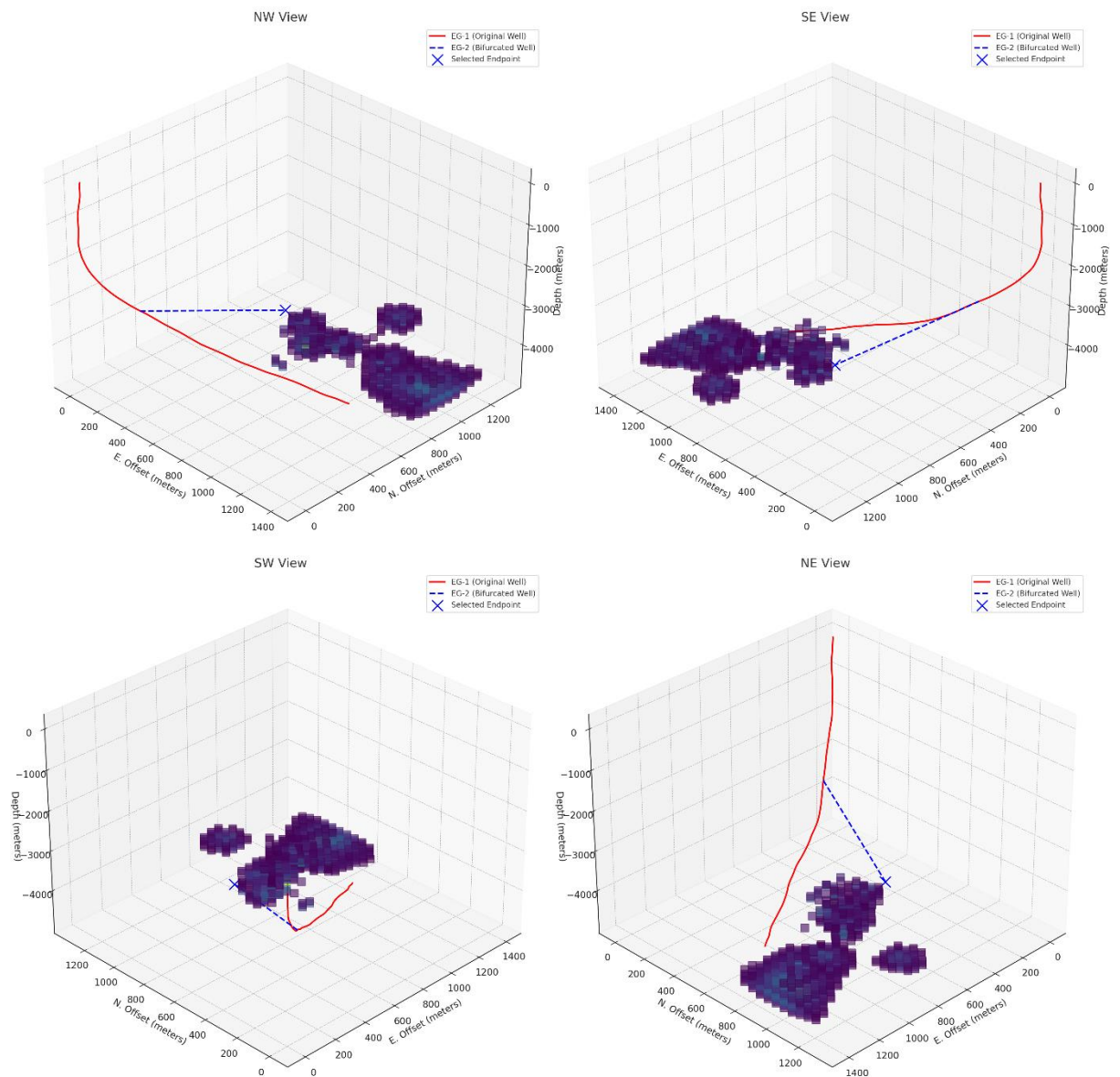


Figure 51 EG-1 (red), reservoir block model based on original seismic locations, and suggested location of second well "EG-2."



Top View: 3D Block Visualization with Original and Bifurcated Well Trajectories (ML > 3)

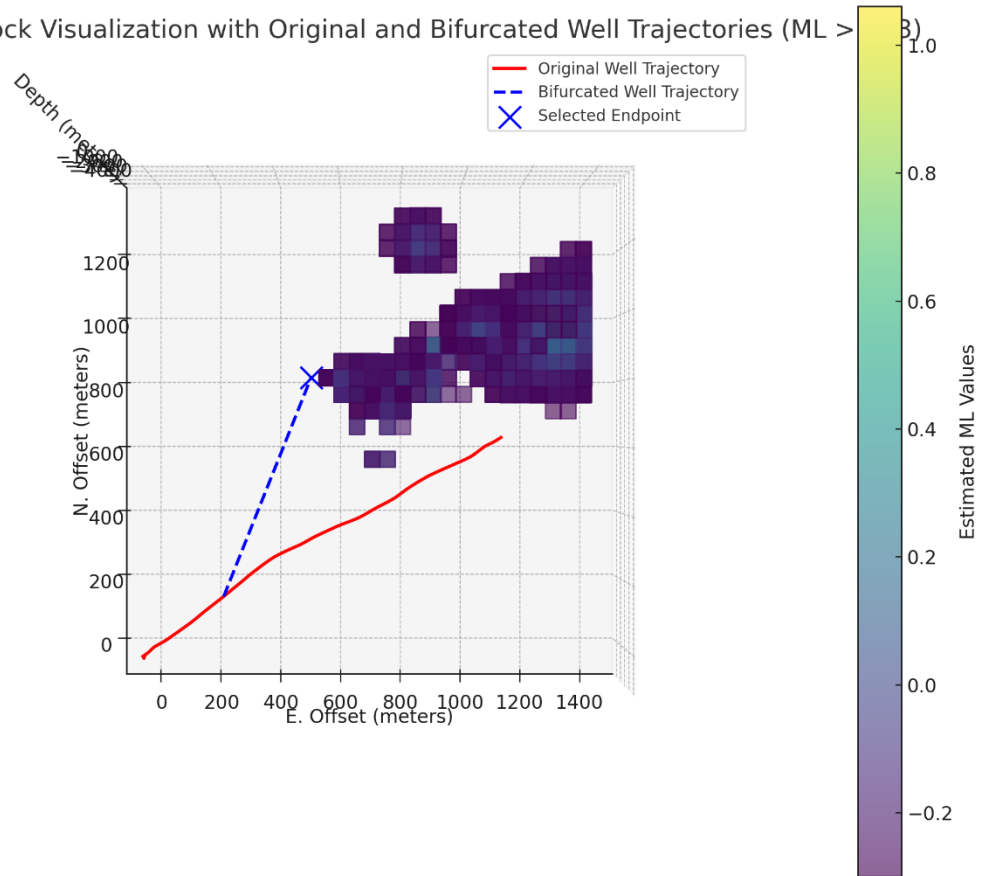


Figure 52 Top View, EG-1 (red), reservoir block model based on original seismic locations, and suggested location of second well "EG-2

# Fluid Injection Impact Analysis

## First Injection Test

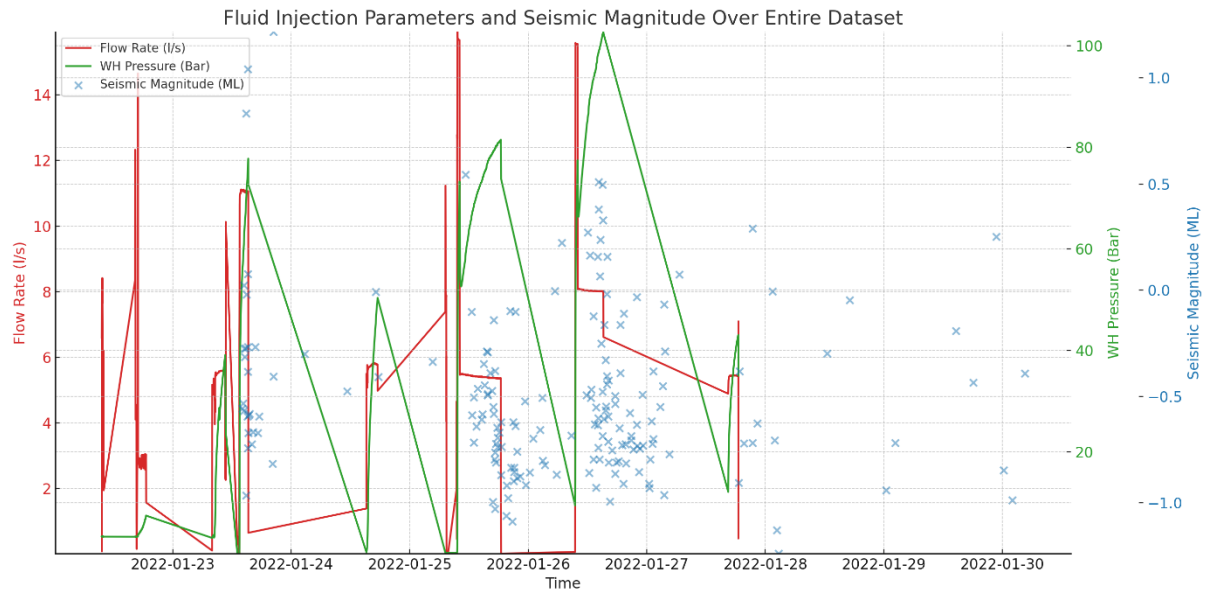


Figure 53 January Fluid Injection Parameters and Seismic Magnitude

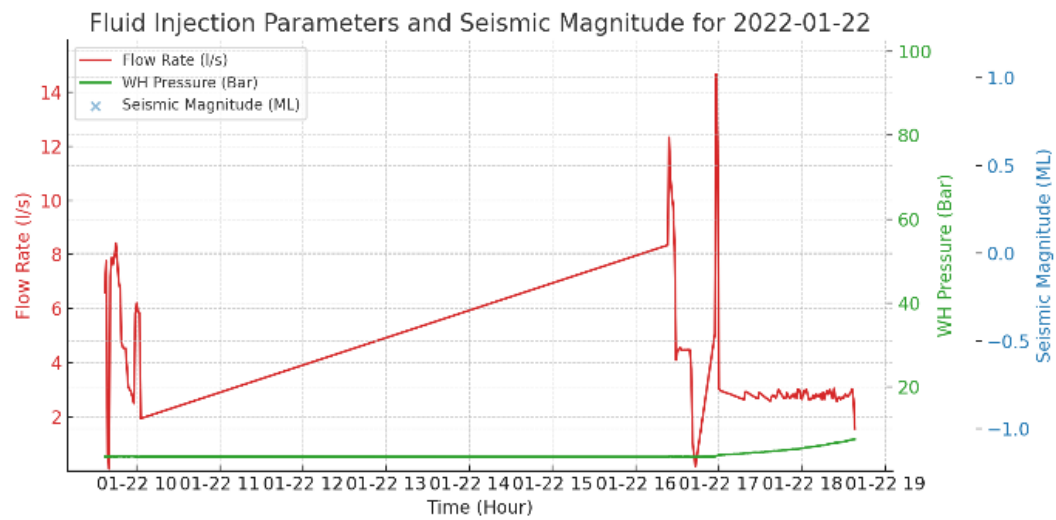


Figure 54 January Fluid Injection Parameters and Seismic Magnitude, 22nd January 2022

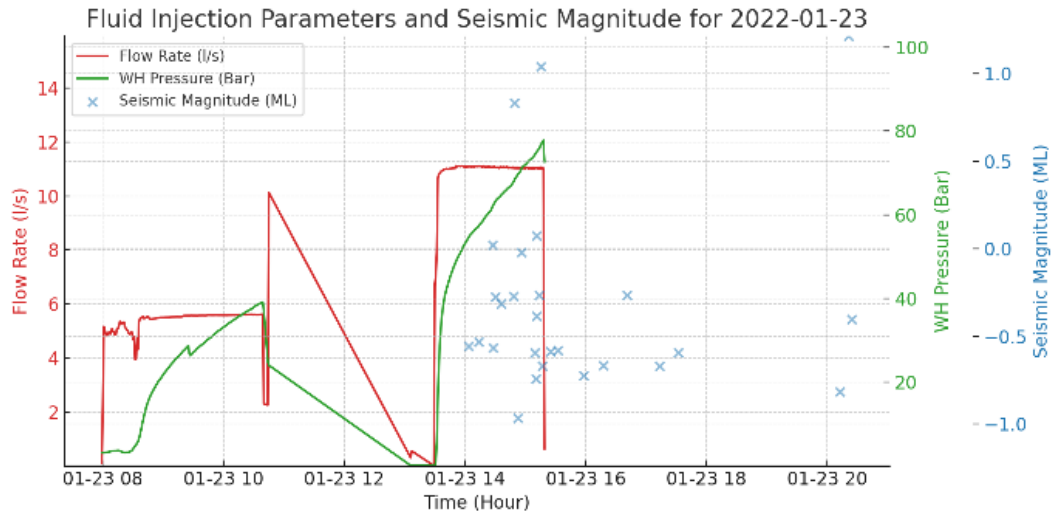


Figure 55 January Fluid Injection Parameters and Seismic Magnitude, 23rd January 2022

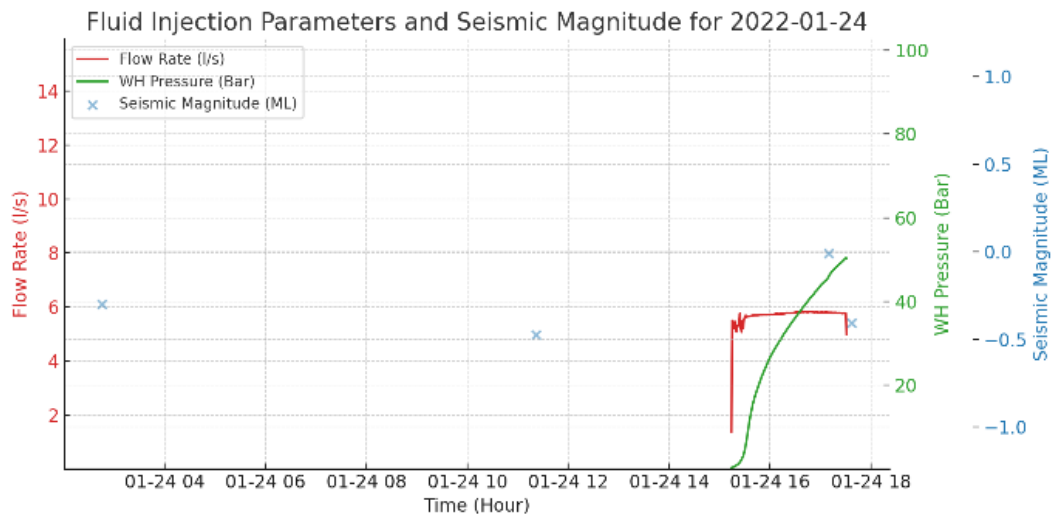


Figure 56 January Fluid Injection Parameters and Seismic Magnitude, 24th January 2022

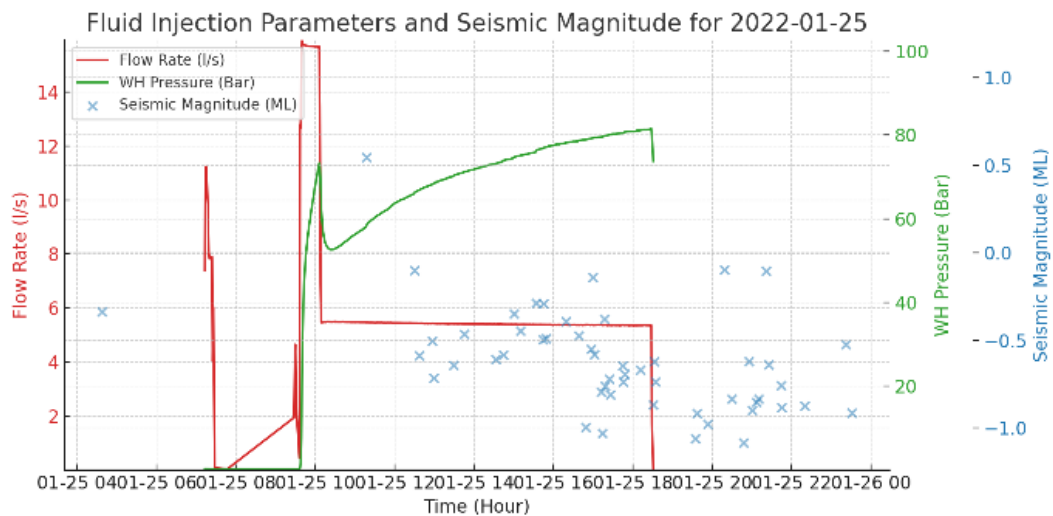


Figure 57 January Fluid Injection Parameters and Seismic Magnitude, 25th January 2022

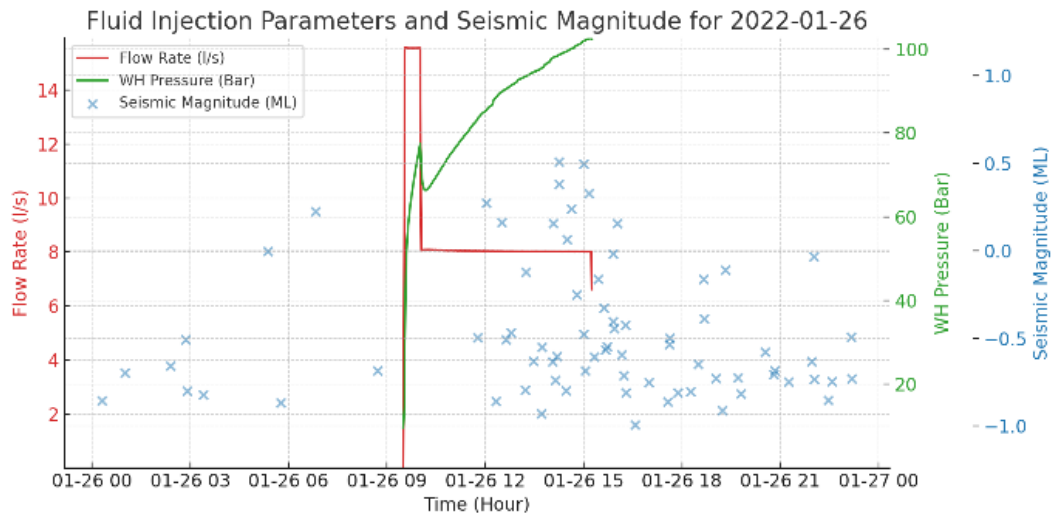


Figure 58 January Fluid Injection Parameters and Seismic Magnitude, 26th January 2022

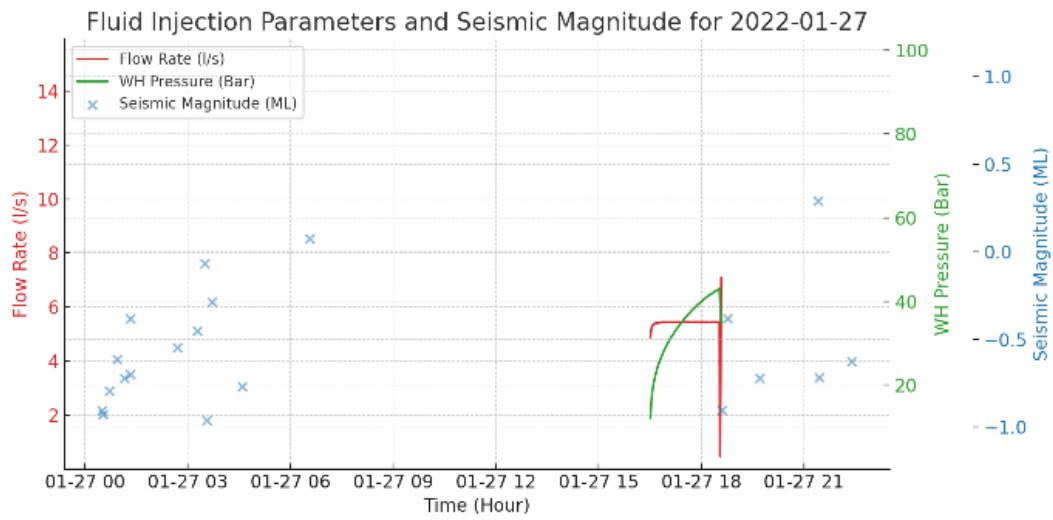


Figure 59 January Fluid Injection Parameters and Seismic Magnitude, 27th January 2022

## Second Injection Test

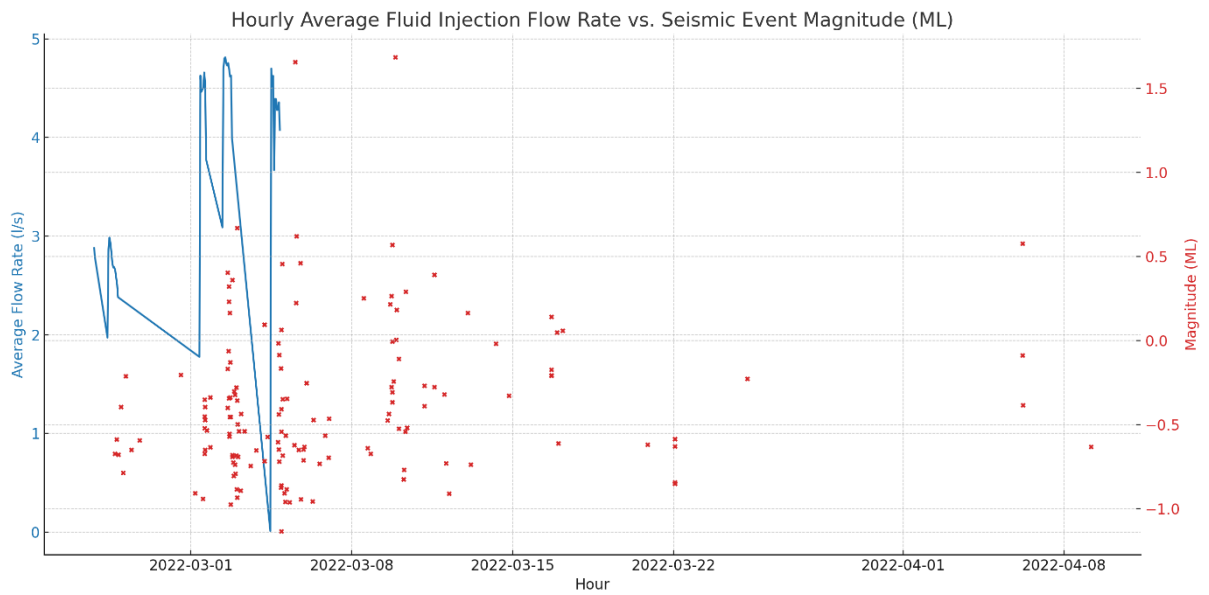


Figure 60 Hourly average March fluid injection flow rate (line plot) with the actual magnitudes (ML) of seismic events (scatter points) over the same time period.

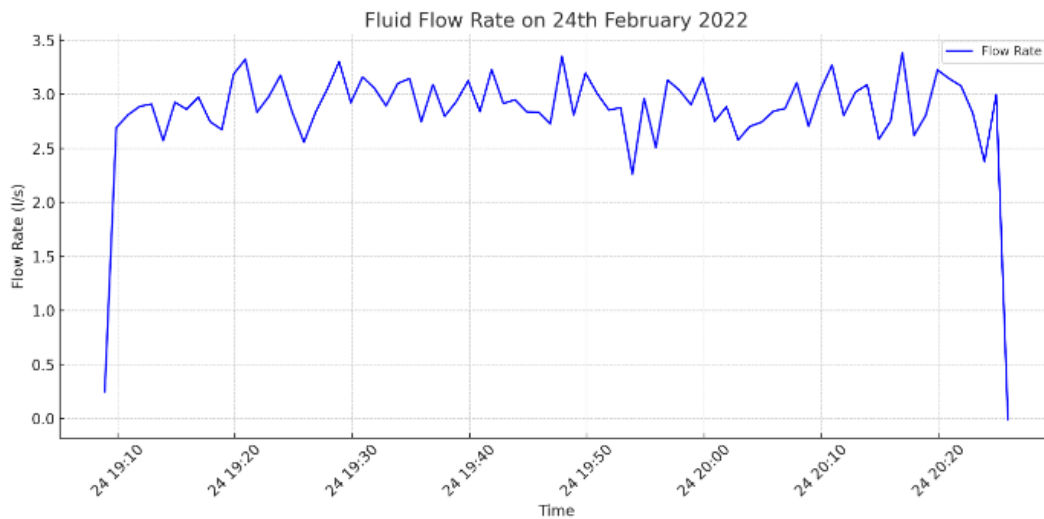


Figure 61 Second Injection Test fluid flow rate, 24th February 2022. No seismic activity observed.

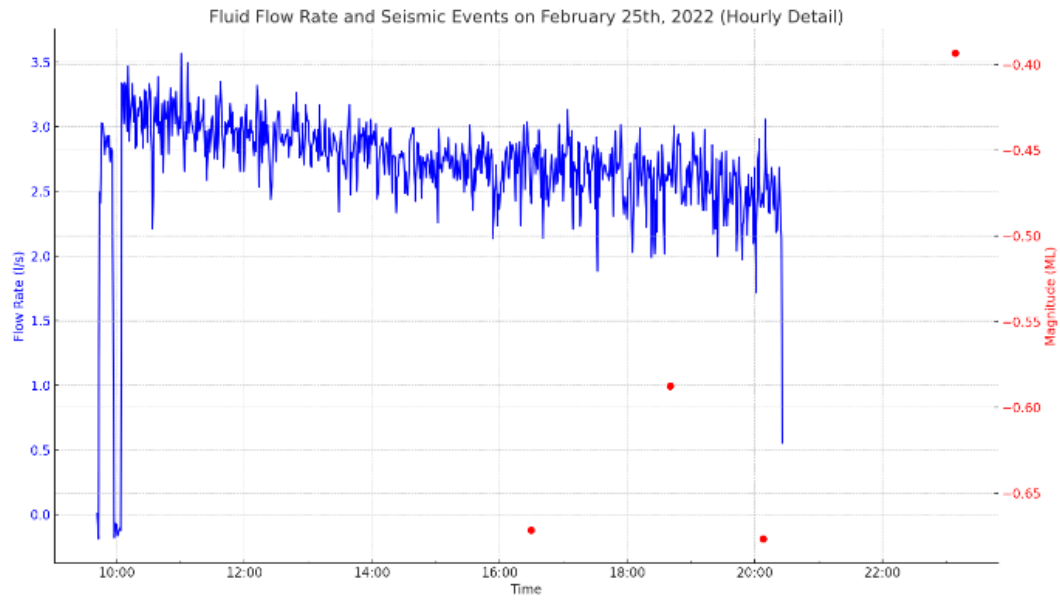


Figure 62 Second Injection Test fluid flow rate and seismic ML, 25th February 2022.

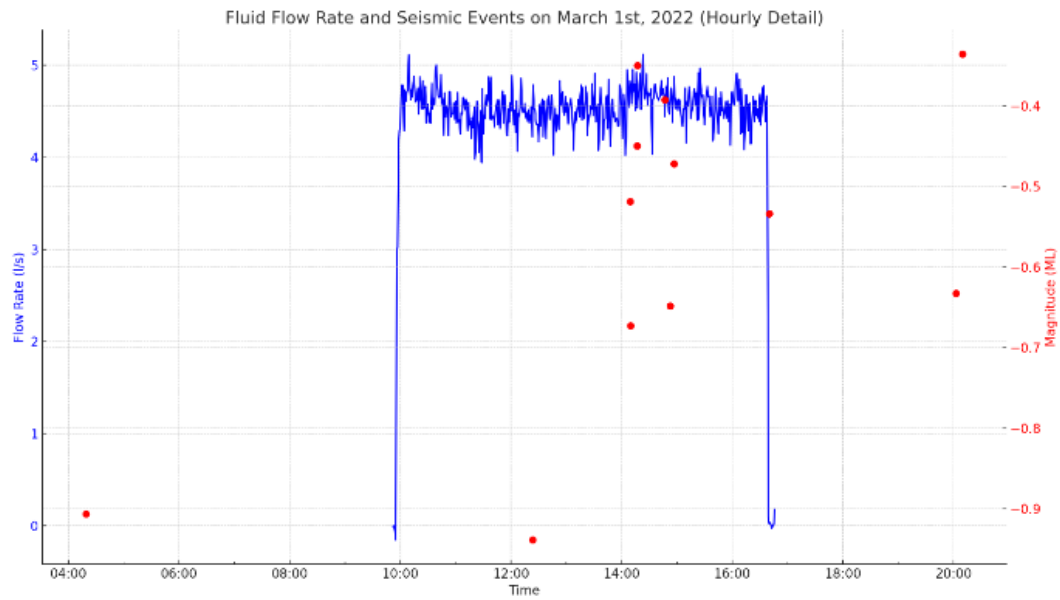


Figure 63 Second Injection Test fluid flow rate and seismic ML, 1st March 2022.

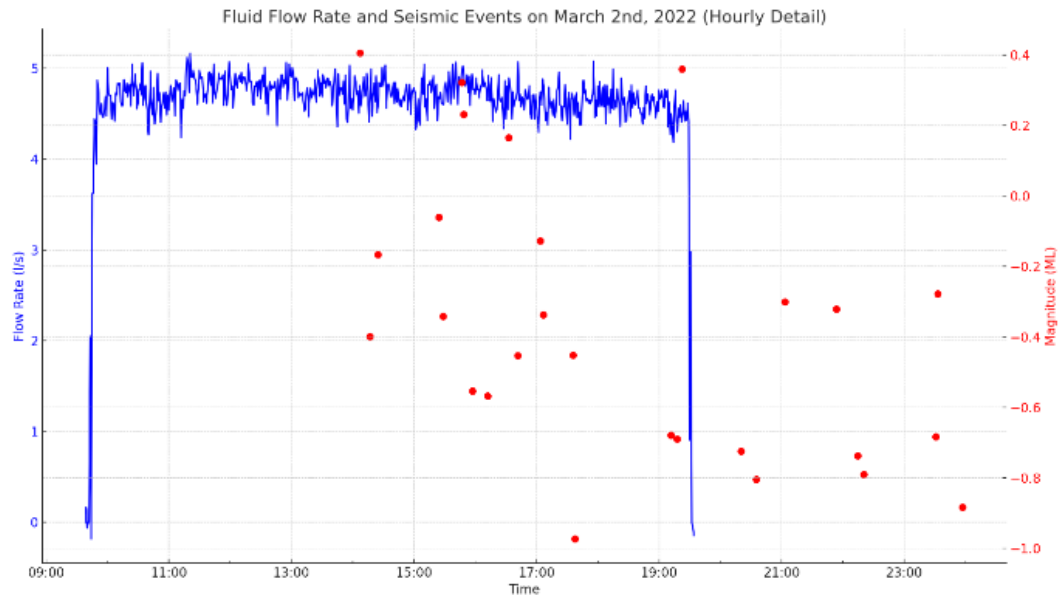


Figure 64 Second Injection Test fluid flow rate and seismic ML, 2nd March 2022

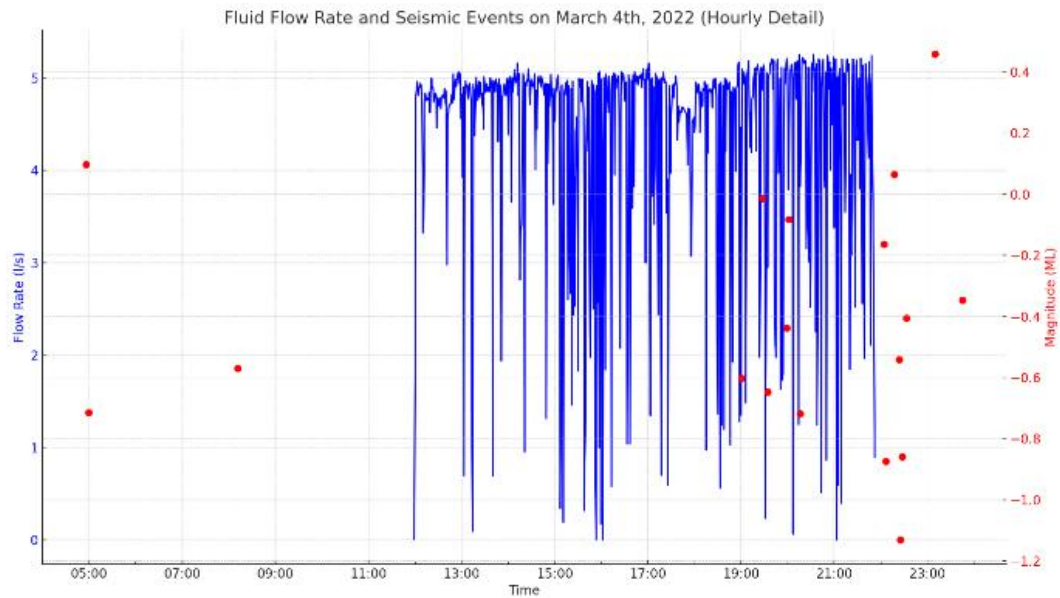


Figure 65 Second Injection Test fluid flow rate and seismic ML, 4th March 2022

## Injection Parameters vs. Seismicity

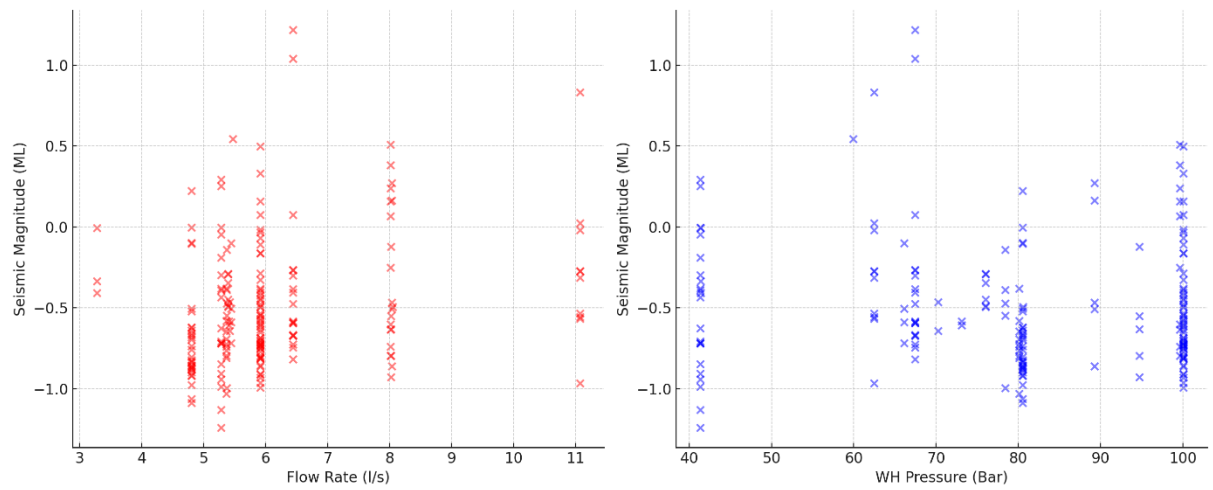


Figure 66 Pearson correlation coefficients between the January fluid injection parameters and seismic event magnitudes.

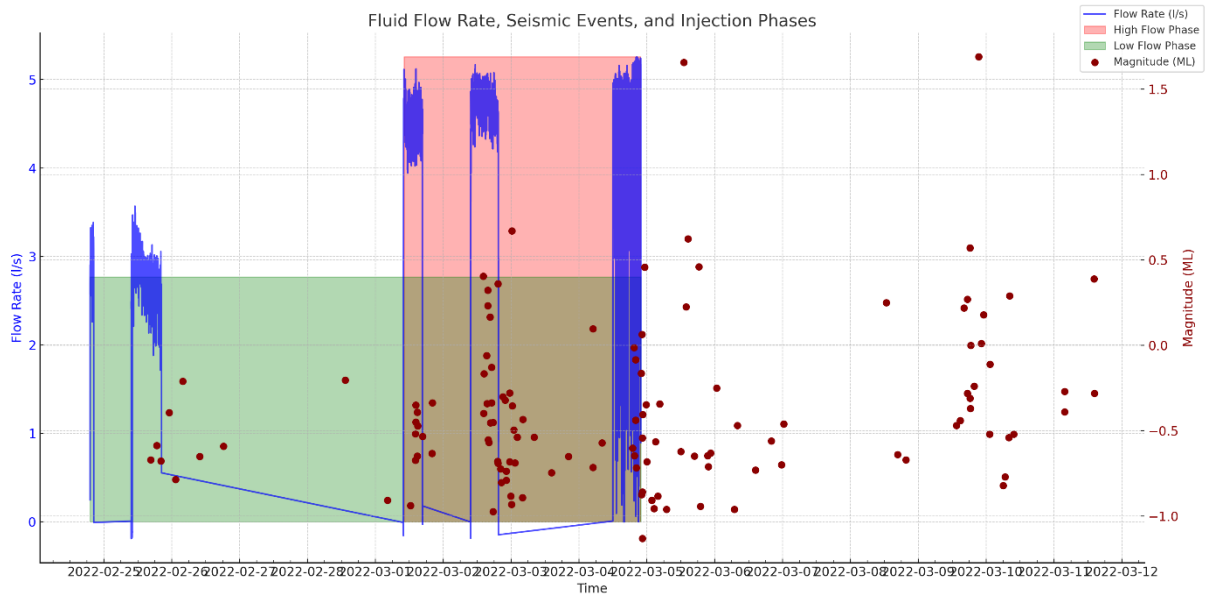


Figure 67 Patterns and correlations between injection parameters and seismic behaviour



## Lag Time Analysis

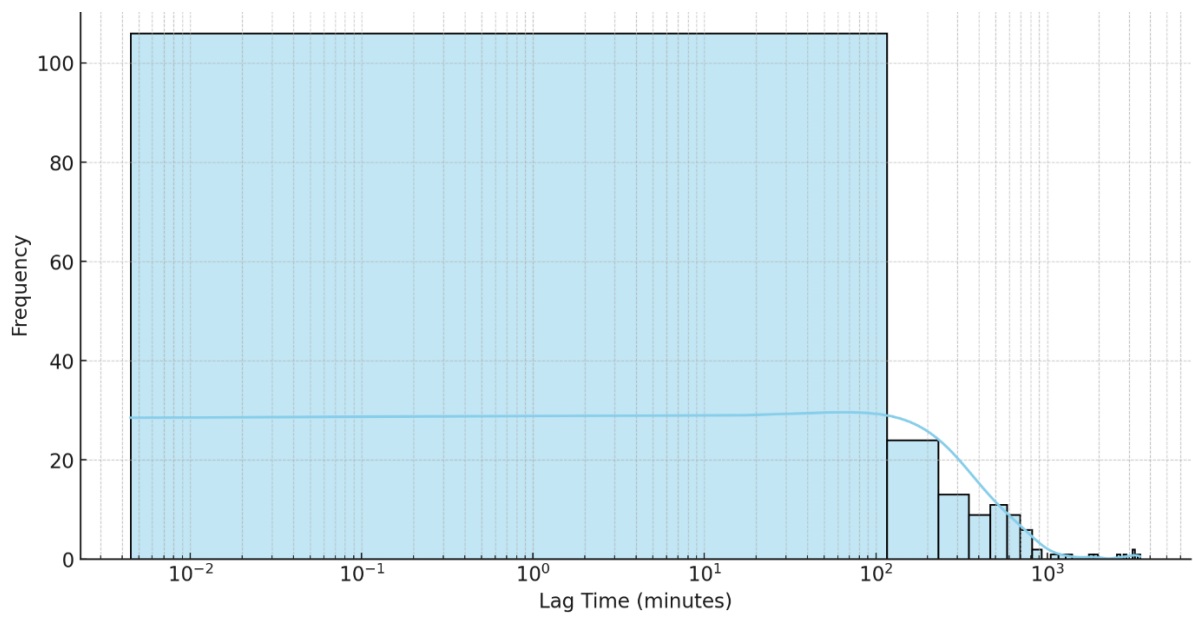


Figure 68 Histogram of intervals between initiating injection activities and subsequent seismic events.

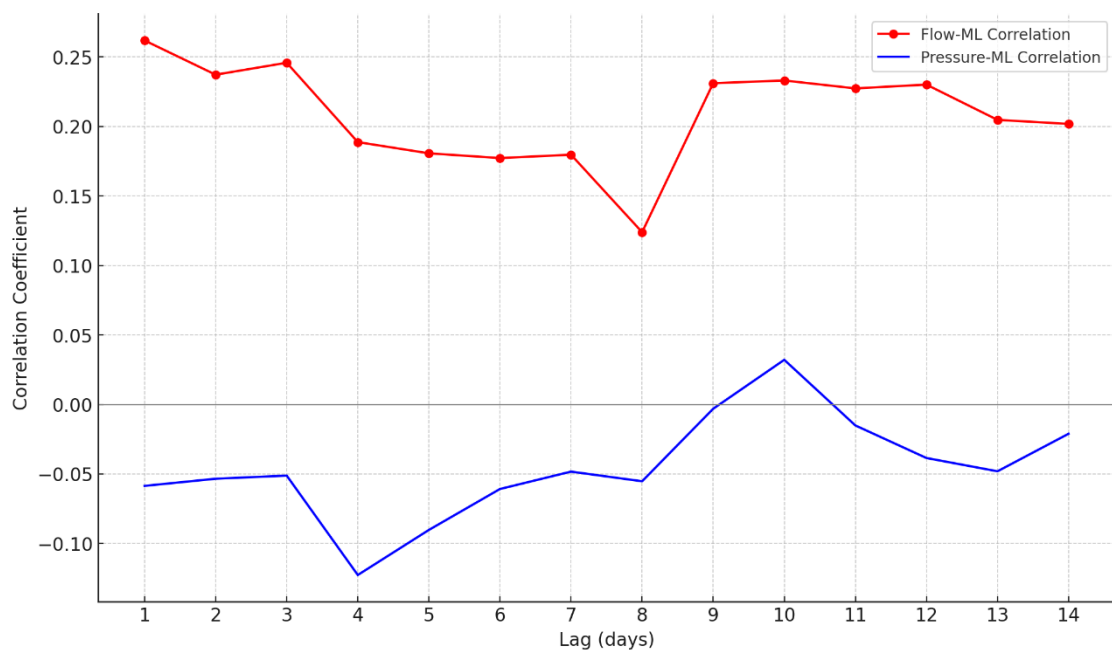


Figure 69 The Lagged Correlation Plot for January Injection Test (Series 2) visualizes how the correlation coefficients between fluid injection parameters (flow rate and wellhead pressure) and seismic event magnitude change with different lag times, ranging from 1 to 14 days: Flow-ML Correlation (red line), Pressure-ML Correlation (blue line).

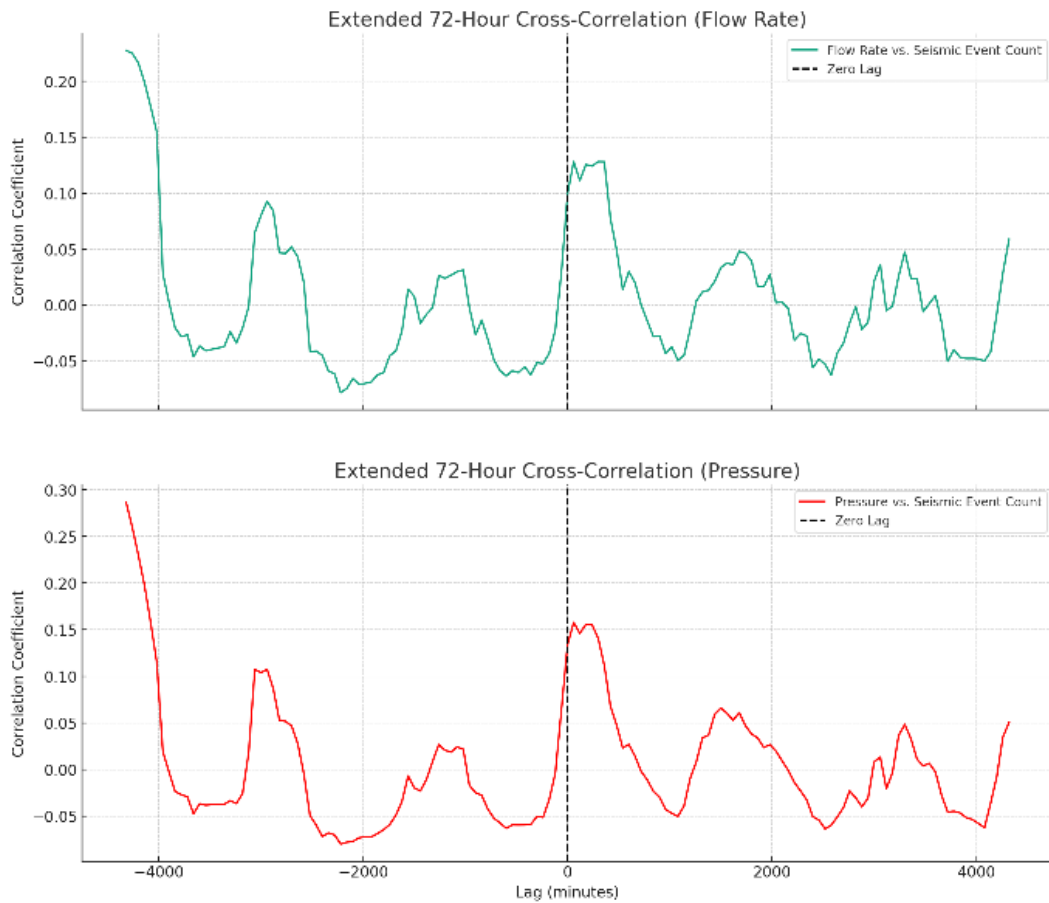


Figure 70 Cross-correlation plots for the January Injection Test fluid flow rate and wellhead pressure against the seismic event count, calculated over different time lags (ranging up to 72 hours)

Key observation points are that the Zero Lag Line (Marked by a dashed line) indicates where the injection parameters and seismic activity are aligned in time. In addition, any peaks in these plots indicate time lags with a stronger relationship between injection parameters and seismic activity. Positive lags suggest that changes in seismic activity follow changes in injection parameters after the lag period. Negative lags would indicate that seismic activity precedes changes in injection parameters. In order to calculate confidence intervals, Fisher transformation is used to stabilise the variance of the correlation coefficients, allowing us to approximate confidence intervals based on the transformed values.

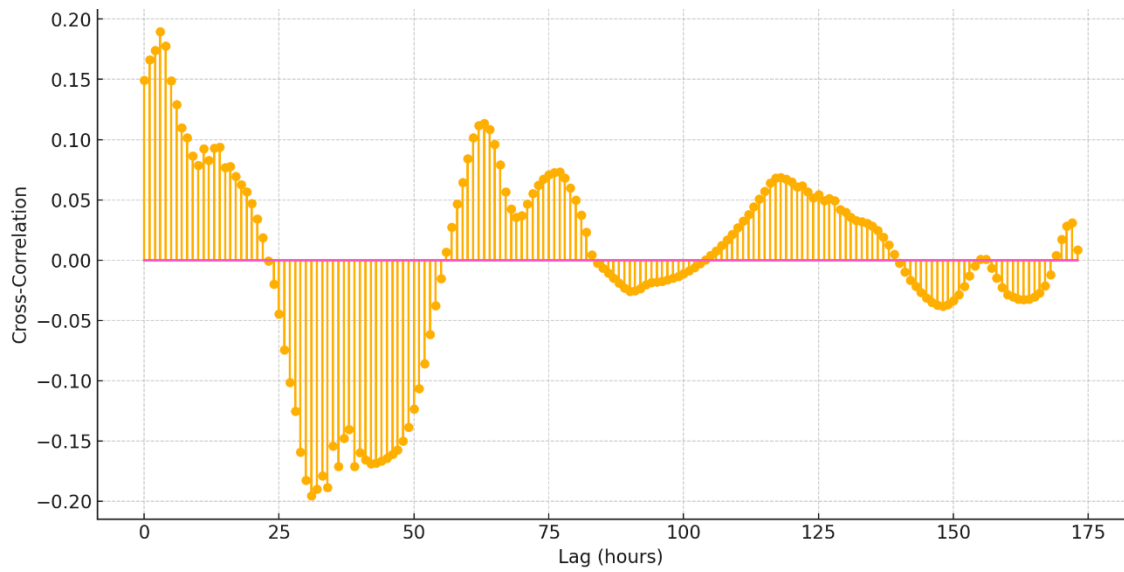


Figure 71 Cross Correlation between Flow Rate and Seismic Magnitudes

## Additional Analyses

### Correlation Matrix of Seismic Characteristics

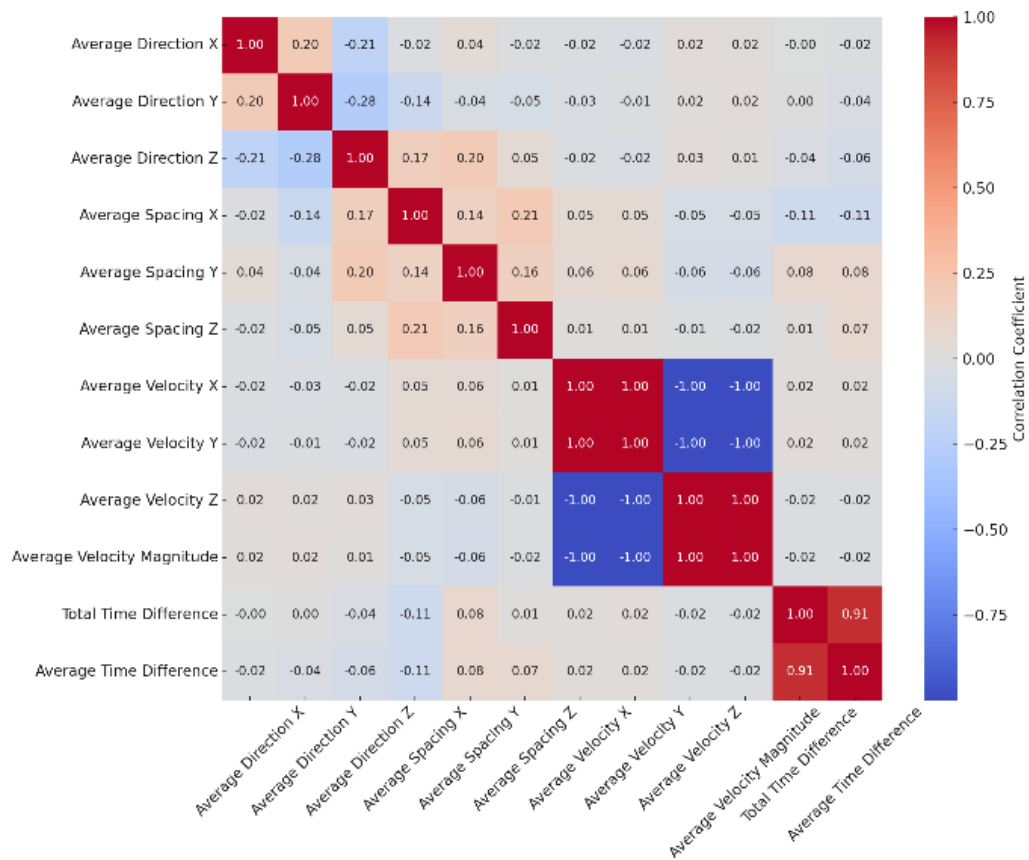


Figure 72 Correlation Matrix of Seismic Event Characteristics

Each cell shows the correlation coefficient between pairs of variables, where:

- A value close to 1.0 indicates a strong positive correlation (as one variable increases, the other tends to increase).
- A value close to -1.0 indicates a strong negative correlation (as one variable increases, the other tends to decrease).
- A value around 0 indicates no linear correlation between the variables.

### FMI Logs (Rose Diagrams)

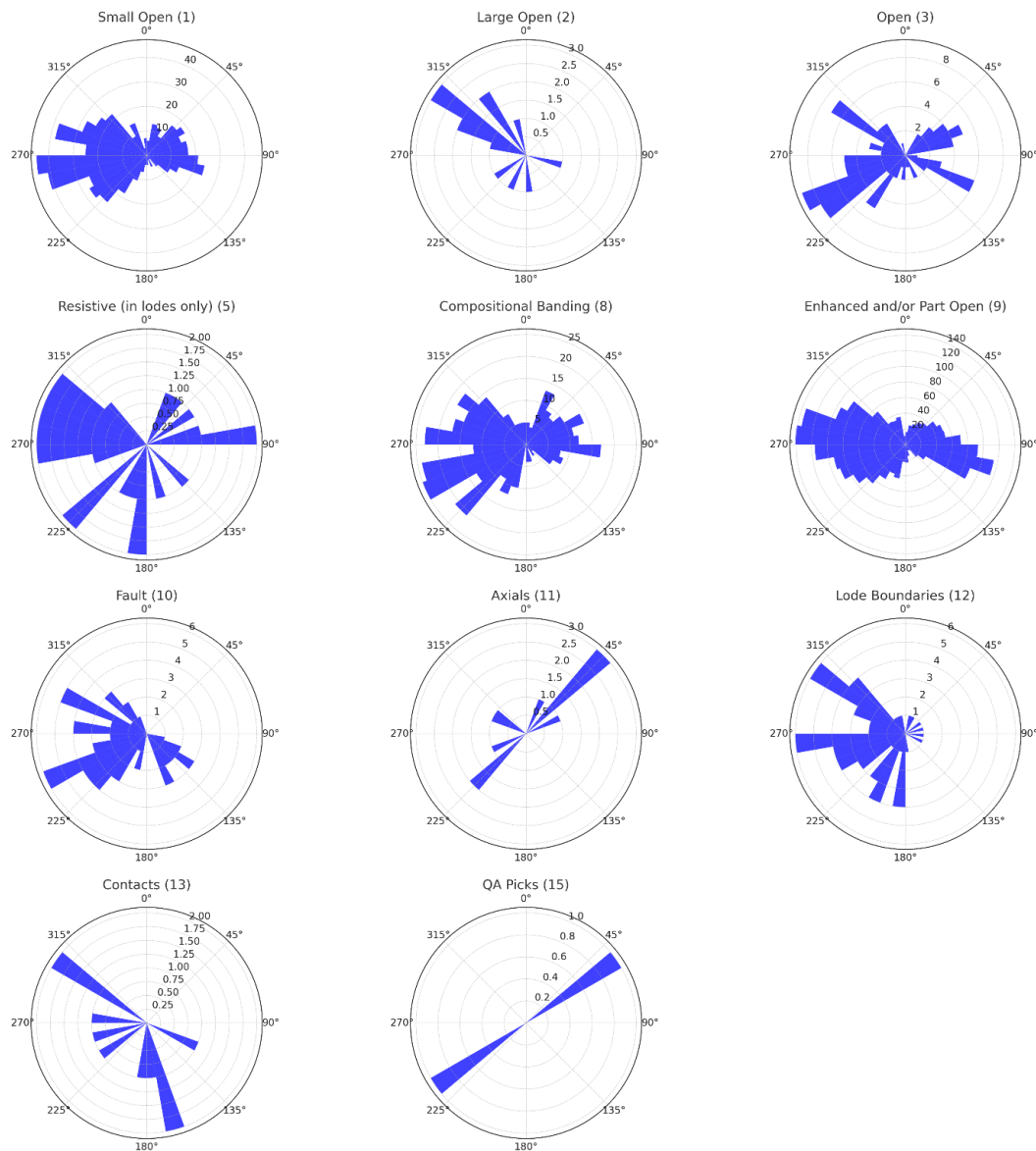


Figure 73 Orientations of fractures observed downhole of EG-1. This study does not detail determining the process of categorisation of fractures into groups and relies on the work of Andy Jupe.

Category	Depth Range Min	Depth Range Max	Number of Samples	Predominant Orientation
Small open	3270.2	3953.8	585	South-West (S-W)
Large open	3259.8	3267.2	13	West-North (W-N)
Open	3147.0	3259.4	94	South-West (S-W)
Resistive (in lodes only)	3124.6	3145.8	26	South-West (S-W)
Compositional banding	2711.5	3122.0	377	South-West (S-W)
Enhanced and/or part open	1588.8	2710.1	1983	West-North (W-N)
Fault	1555.5	1588.2	56	South-West (S-W)
Axials	1551.2	1554.1	10	North-East (N-E)
Lode boundaries	1527.6	1550.3	57	South-West (S-W)
Contacts *	1526.7	1526.7	10	East-South (E-S)
QA picks *	—	—	2	North-East (N-E)

Table 12 Fracture types observed along EG-1 using FMI Logs.

### Drilling and Associated Seismicity

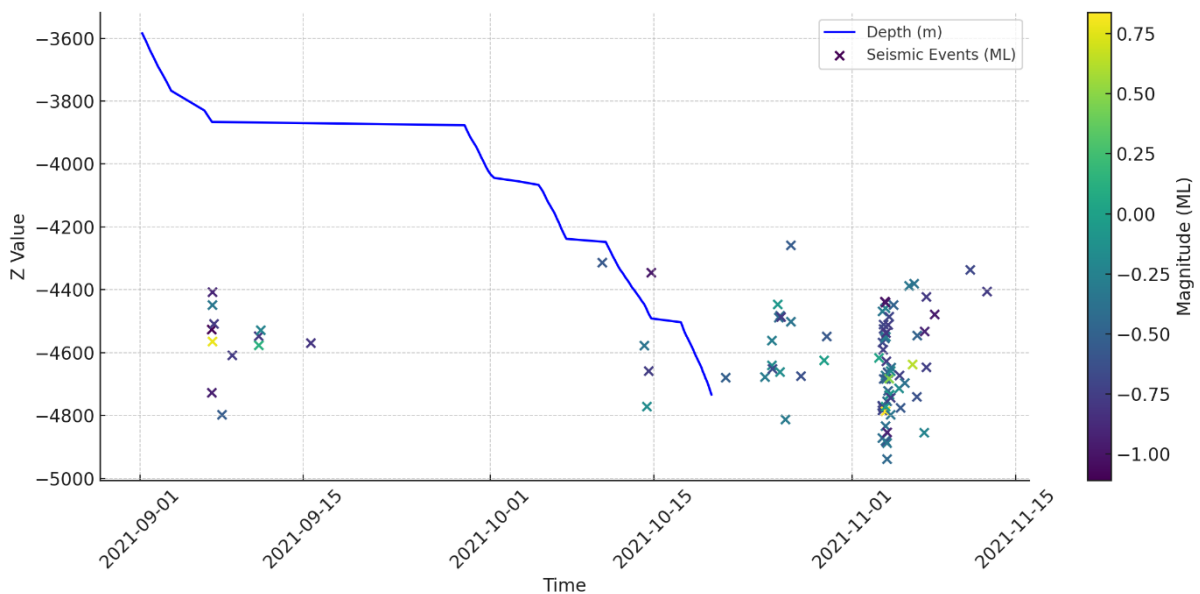


Figure 74 Series 1, Seismic activity associated with drilling EG-1

### Comparison with Geological Features

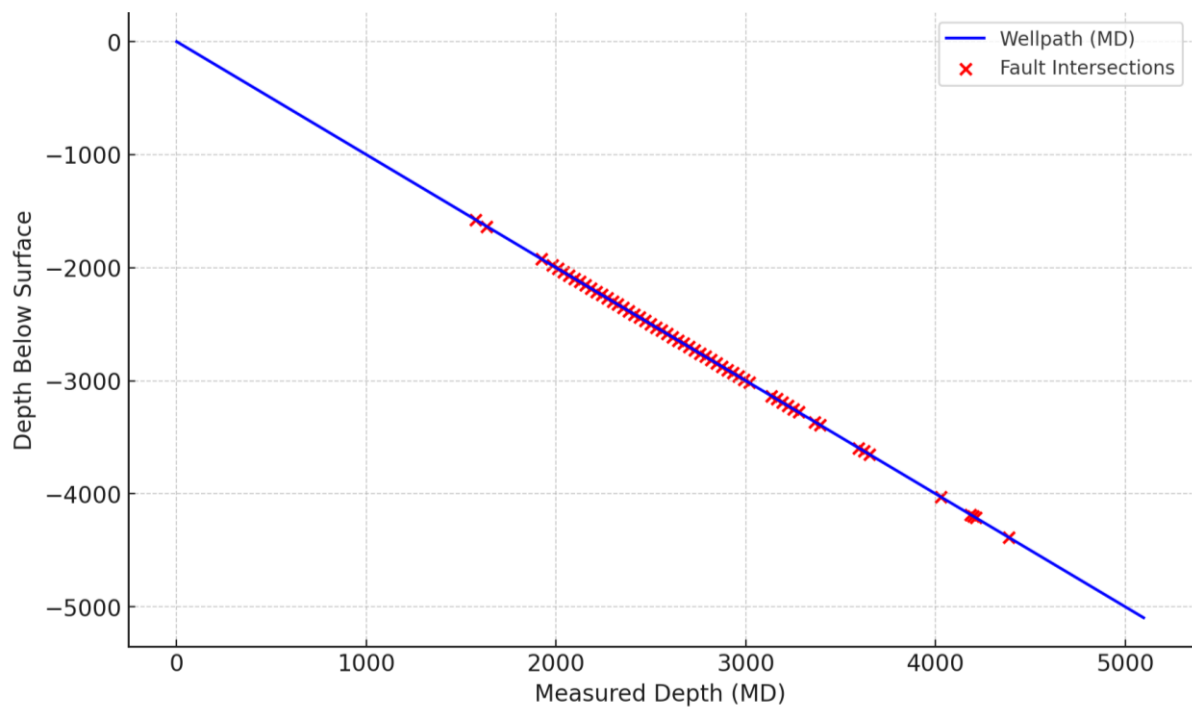


Figure 75 Wellpath and Fault Intersections. The blue line represents the well as a measured depth (MD) function, plotted against depth below the surface.

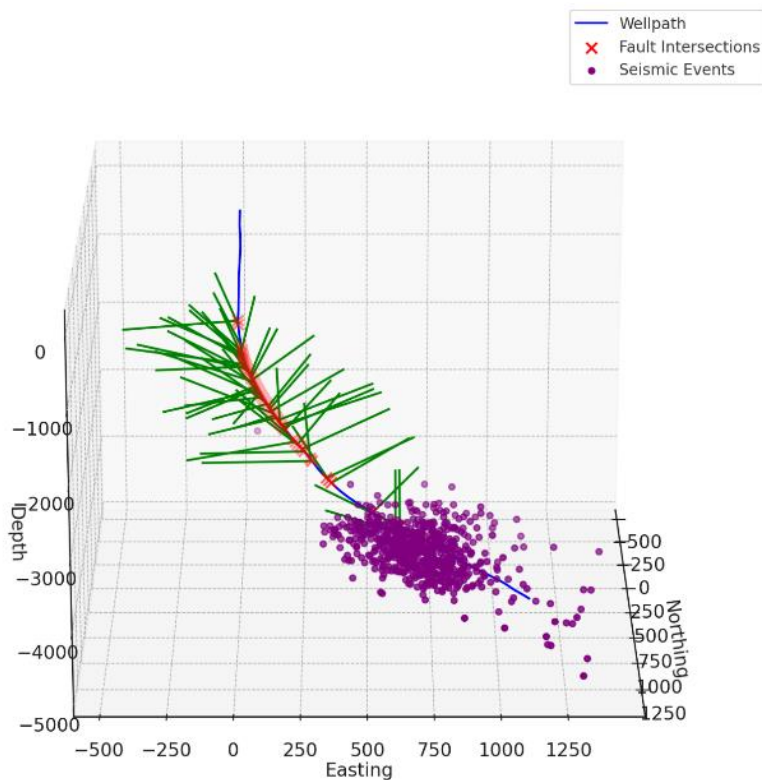


Figure 76 3D view with wellpath, intersecting faults and seismic events, facing East

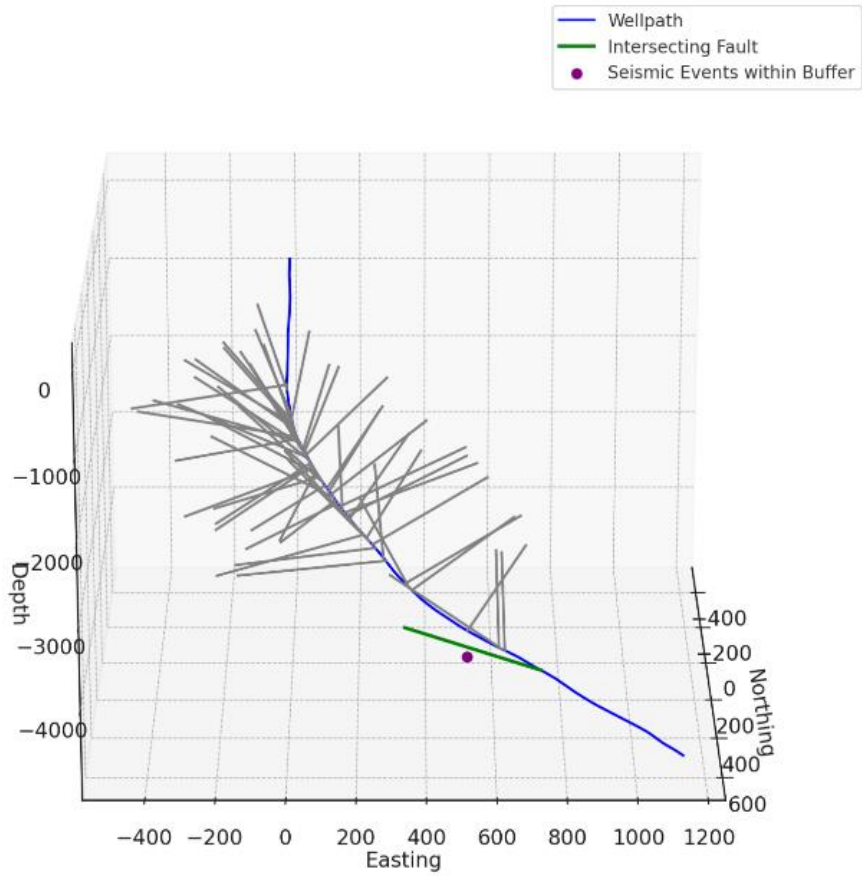


Figure 77 3D view of wellpath, faults, and nearby seismic events

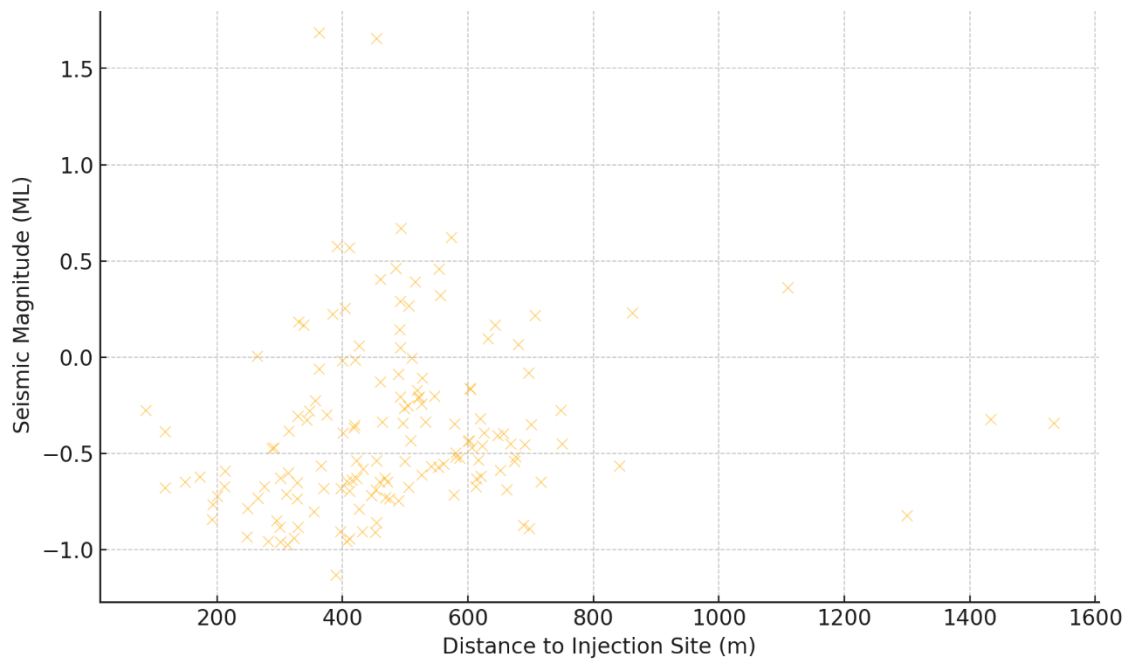


Figure 78 Relationship between the seismic magnitude (ML) and the distance of each event from the injection site

In addition to Figure xx, Pearson (0.142) and Spearman (0.289) correlation coefficients calculated for these variables. There is a weak positive correlation between the distance to the injection site and the seismic magnitude. A higher distance slightly correlates with a higher (less negative) magnitude, indicating weaker seismic activity as distance increases. Spearman correlation indicates a weak to moderate positive rank correlation. This suggests that as the distance increases, generally, the seismic events tend to be of lesser intensity, which supports the idea that closer events might be responding more strongly to the injections.



## Discussion

### Reservoir Characterisation:

#### Spatial Distribution of Seismic Events

Data collection during the operation was extensive despite the limitations due to technical difficulties. However, in this report, the following data sets are provided and utilised for experimentation: seismic event hypocentre's locations and their associated attributes; fluid injection rates and limited wellhead pressure data; location of the location and trajectory of the borehole and available information for faults intersected observed by FMI logs. As a result, this study assesses the fundamental relationships associated with seismic event occurrence and the available information on operational produce at the time.

#### Volume Estimation

The depth distribution within each series (Figure 19) shows some variability. However, between each fluid injection test, seismic events have generally stayed between 3800m and 4100m depth, suggesting this is the primary location for the reservoir where fluid can be transported through the subsurface. Volume calculations for different ML thresholds indicated substantial reservoir potential. Specifically, the volumes calculated for ML values above -0.4, -0.2, and 0.0 were 602.625 million cubic metres, 44.375 million cubic metres, and 13.25 million cubic metres, respectively (Figures 46, 47, and 48). These findings underscore the extensive impact of fluid injection and the significant size of the affected reservoir areas.

When analysing the connectivity of the reservoir, the plots indicate a highly connected reservoir at lower thresholds (ML > -0.4), suggesting extensive hydraulic connectivity across the subsurface. This connected network implies fluid injection at strategic points could efficiently stimulate the reservoir. However, as the thresholds tighten, revealing higher ML values (e.g., ML > -0.2 or ML > 0.0), the plots demonstrate isolated pockets of seismic activity. These pockets indicate regions with significant energy release but lack extensive connectivity to other parts of the reservoir. This fragmentation suggests that additional hydraulic stimulation may be required to link these isolated high-ML regions and develop the reservoir effectively.

The adjusted block model, shown in Figure 49, incorporates movement vectors and provides a refined spatial representation. This model identifies potential endpoints for new bifurcated wells, enhancing the strategy for future drilling operations. The seismic centroid analysis, visualised in Figure 36, reveals shifts in the central point of the seismic cloud, indicating dynamic responses to fluid injection. These shifts necessitate careful monitoring and adjustment of operational strategies to manage changes in the stress regime within the reservoir effectively.

#### Seismic Event Magnitude Analysis

Seismic event magnitude analysis is a critical stage in reservoir characterisation. It involves statistical analysis of the magnitudes of seismic events and their spatial and temporal distribution. Histograms and boxplots are used to visualise the distribution of ML values, providing basic statistics such as mean, median, standard deviation, minimum, and maximum ML values (Figures 22 and 23).

Spatial analysis examines how ML values vary across different spatial locations to identify patterns or trends. Temporal analysis focuses on how ML values change over time, particularly in relation to drilling and fluid injection activities. The relationship between ML and depth (bivariate analysis) is assessed to determine if deeper or shallower events tend to have different magnitudes. Correlations between ML values and the distance from injection wells or drilling sites are analysed to understand the influence of geothermal operations on seismicity within the zone of influence of the operating well. Figures 24 and 25 illustrate these spatial and temporal variations.

The Seismic Magnitude vs Depth plot (Figure 26) visually indicates how magnitude varies with depth across the seismic events. The Pearson correlation coefficient between magnitude (ML) and depth (Z) is approximately  $-0.218$ . This indicates a weak negative linear relationship; as depth increases, magnitude slightly decreases, though the correlation is not very strong.

The heatmap (Figure 24) reveals several notable correlations among the seismic event characteristics. Strong positive correlations include average velocity magnitude and average spacing and average velocity components and direction components.

Analysis shows a strong positive correlation between velocity magnitude and average spacing in the X, Y, and Z directions. This suggests that seismic events spaced further apart tend to move faster. This relationship may be due to energy accumulation and release dynamics, where larger spaces indicate more energy build-up, leading to faster movements when released.

A strong correlation exists between the average velocity components (X, Y, Z) and their respective direction components. This indicates that the direction of an event's movement closely aligns with its velocity vector, as expected since velocity is a vector quantity describing both speed and direction of movement.

A notable negative correlation is observed between downward movement (Direction Z) and vertical spacing (Spacing Z). This suggests that deeper seismic events with a significant downward component tend to be closer together vertically. This pattern may be related to geological layering and subsurface material properties that restrict vertical movements, keeping events closely packed. In geothermal areas, geological stress due to heat and fluid movement can cause rocks to fracture and slip, leading to seismic events. The correlation between spacing and velocity magnitude may reflect the dynamics of stress accumulation and release, where larger distances can accumulate more stress, resulting in faster and potentially more energetic events. The subsurface geology, including rock types, fault lines, and fluid pathways, significantly influences seismic behaviour.

Euclidean distances are calculated from each seismic point to all points along the wellpath to find the minimum. In addition, the distance to the nearest fault line segment is calculated. Pearson correlation coefficients are used to calculate the statistical relationship between seismic magnitudes (ML) and these attributes as well as the depth of hypocentres. A weak positive correlation is found between the local magnitude of seismic events and their distance from the well. This implies events occurring farther from EG-1 have slightly larger ML values (Figures 27 and 28).

The Gutenberg-Richter law for the frequency-magnitude distribution is applied to understand the relationship between the size of an event and its occurrence frequency. This distribution is adjusted to estimate b-values, which provide insights into the stress regime of the reservoir. The Gutenberg-Richter frequency-magnitude distribution plot (Figure 30) is utilised for this purpose.

Cluster analysis is used to identify spatial concentrations of seismic events, which may correspond to active zones within a geothermal reservoir. Two methods are used: K-means clustering, suitable for partitioning  $n$  observations into  $k$  clusters, and DBSCAN (Density-Based Spatial Clustering of Applications with Noise), which groups closely packed points while marking isolated points in low-density regions as outliers.

Final comparisons of the magnitude distribution before, during, and after injection tests are made to assess the impact of these operations on seismicity. Outliers or anomalies in the magnitudes are noted as they could indicate unusual seismic activity or potential data errors (Figures 29 and 30).

### Error Ellipsoids

The parameters of the error ellipsoids are evaluated to assess the uncertainties associated with the hypocentres (locations) of seismic events. Each ellipsoid axis corresponds to the potential error in each spatial dimension (X, Y, and Z). Parameters include the lengths of the semi-major, semi-minor, and intermediate axes (eigenvalues), as well as the orientation of the ellipsoid in space (given by eigenvectors).

Average error ellipsoids are plotted for each series and separately based on 100-metre depth intervals to visualise spatial uncertainty comprehensively. Suggestions are made regarding the range of uncertainty in location points and the most probable movement of the seismic cloud relative to the location of EG-1. The error ellipsoids for Series 1, associated with drilling the wellbore, are notably present in shallower ranges, while the fluid injection-induced events (Series 2, 3, and 5) span a broader depth range. This might suggest different seismic triggering mechanisms between drilling and fluid injection-related seismic events (Figures 31 and 32).

The size of the error ellipsoids generally decreases with increasing depth. This could suggest that the precision of seismic event localisation is higher at greater depths or reflects a higher confidence level in the data obtained from deeper events. The error ellipsoids' sizes, particularly the Axis 3 dimension, serve as a proxy for the variability and uncertainty in event locations. Larger Axis 3 values at shallower depths (-3600m to -3400m) could indicate areas with greater stress variations or complexities in geological formations. These areas may be more susceptible to induced seismicity due to fluid injection pressures and volumes (Figure 33).

Event distribution by depth shows an increase in the number of events as the depth decreases from -4800m to around -4100m, after which the number decreases towards shallower depths. This pattern could be related to the geomechanical properties of the rock strata, which may be more prone to fracturing or slipping due to fluid injection at specific depths. The absence of events in certain depth ranges, such as -4600m to -4700m, could indicate gaps in data coverage or genuinely inactive seismic zones. Further investigation with additional geophysical data could help clarify these observations (Table 6).

The recalculated potential movement direction and magnitude for the seismic cloud aim to reduce the overall uncertainty in seismic point locations relative to the well's endpoint. The movement

vector components are as follows: X: 424.13 meters, Y: -75.86 meters, Z: -799.97 meters, with a movement magnitude of 908.63 meters. This vector indicates the direction and extent by which the seismic cloud could be "shifted" to minimise the overall location uncertainty relative to the well's endpoint position (Figures 34 and 35). The positive X value suggests movement towards the northeast, the negative Y value indicates a southwest adjustment, and the negative Z value signifies a deeper adjustment into the Earth. This recalibration aligns the seismic cloud more accurately with the well's endpoint depth, enhancing the precision of the seismic data interpretation.

### Seismic Centroid

The recalculated potential movement direction and magnitude for the seismic cloud aim to reduce the overall uncertainty in seismic point locations relative to the well's endpoint. The movement vector components are as follows: X: 424.13 meters, Y: -75.86 meters, Z: -799.97 meters, Movement Magnitude: 908.63 meters. This vector indicates the direction and extent by which the seismic cloud could be "shifted" to minimise the overall location uncertainty relative to the well's endpoint position. The positive X value suggests movement towards the northeast, the negative Y value indicates a southwest adjustment, and the negative Z value signifies a deeper adjustment into the Earth. This recalibration aligns the seismic cloud more accurately with the well's endpoint depth, enhancing the precision of the seismic data interpretation.

The movement from the original to the adjusted positions aims to align the seismic cloud more closely with EG-1's location, thereby reducing the spatial uncertainty associated with the seismic events. This visualisation helps in understanding how the calculated adjustment could potentially improve the interpretation of seismic data in relation to subsurface structures and operations. As shown in Figure 36, the 3D scatter plot highlights the shifts in the seismic centroid, providing a clear visual representation of these adjustments.

Arrows depict movement vectors starting from the well's endpoint to the centroid of each series. These vectors illustrate the directional shifts from the well's endpoint towards the adjusted locations (centroids) of seismic activities, considering the combined influence of magnitude and error ellipsoid weights for each series (Figure 35). The differences in weights between the series reflect the inherent variability in the magnitude of seismic events and the precision of their location estimates. Series with higher magnitude events and/or more precise location estimates (smaller error ellipsoids) will have higher weights, influencing the analysis and interpretation of seismic activity relative to their location concerning the well location.

Additionally, the adjusted seismic centroids are plotted to visualise the relationship between the seismic cloud and subsurface structures better. By comparing the original and adjusted centroids, as illustrated in Figure 36, it becomes evident how the adjustments improve the spatial alignment of the seismic events with known geological features and operational targets. This comparison helps in validating the accuracy of the recalibration process and its effectiveness in reducing uncertainties.

The analysis of the seismic centroid provides critical insights into the dynamic responses of the geothermal reservoir to fluid injection and other operational activities. The recalculated movement vectors and their impact on the spatial distribution of seismic events highlight the importance of precise monitoring and adjustment of operational strategies. Figures 34 and 35 further illustrate

these findings, emphasising the need for ongoing refinement of seismic data interpretation techniques to enhance geothermal reservoir management.

### Geostrings Analysis

This section presents the findings of the geostring analysis conducted to understand the temporal and spatial development of seismic events in relation to geothermal operations. The analysis focuses on the progression of seismic events over time and space, connecting sequential seismic events to indicate the direction and rate of seismic activity migration. The study examines the differences between geostrings formed during the drilling of the well (Series 1) and those formed during fluid injection periods (Series 2, 3, and 5). The plots of geostrings for these series are visualised in Figures 37, 38, 39, and 40.

Across all series, the time lapses between the start of one geostring and the next show wide variability, ranging from a few seconds to several days or even weeks. There is no consistent pattern or typical time-lapse observed, suggesting that the initiation of new geostrings may depend on various factors such as injection parameters, geological conditions, and the natural variability of seismic activity. The geostrings for each series, displayed in Figures 37 through 40, show distinct patterns and orientations, indicating diverse influencing factors.

#### Series Analysis:

Series 1: Drilling Operations - 17 geostrings were identified, indicating moderate seismic activity with spatial and temporal clustering of events. The movement analysis showed mixed trends in geostring orientation. The geostrings predominantly indicate complex interactions between drilling and geological structures, without a consistent directional trend (Figure 37).

Series 2: January Injection - This series contained 31 geostrings, reflecting significant clustering influenced by fluid injection. Movement analysis revealed both towards and away trends, indicating fluid injection is a significant but not sole determinant of event directions. The spatial development of seismic events during this period is illustrated in Figure 38, showing the influence of fluid injection on seismic activity.

Series 3: Second Injection - Had 25 geostrings, showing considerable seismic activity with significant clustering. The geostrings exhibited a mix of southwest (SW) and west (W) orientations, suggesting multiple geological influences. Figure 39 depicts the progression of seismic events over time and space, highlighting the complex interplay between geological structures and fluid injection.

Series 5: Third Injection - Had 41 geostrings, indicating high seismic activity with significant clustering influenced by fluid injection. The geostrings during this period predominantly show NE and SW orientations, reflecting strong geological control as well as the impact of fluid injection on seismic event directions. The detailed spatial development of these geostrings is shown in Figure 40.

Geostrings relative to EG-1 are also assessed. During drilling, seismic events showed no consistent directional trend, reflecting complex interactions between drilling and geological structures. Fluid injection resulted in diverse directional trends, with many geostrings aligning with the expected NE orientation, suggesting an influence of fluid pathways on seismic activity. Series 2 and Series 5

showed notable numbers of NE-oriented geostrings. Additionally, SW-oriented geostrings were prevalent during both the drilling and injection phases, indicating strong geological control (Figure 41).

The analysis reveals varying levels of seismic activity and clustering across the series. Fluid injection periods (Series 2, 3, and 5) exhibit higher seismic activity than the drilling period (Series 1), as evidenced by the more significant number of geostrings. The predominant southwest (SW) orientation is consistent across all series with significant geostrings, indicating strong geological control over seismic event directions. However, fluid injection introduces additional variability in event directions. The consistent northeast (NE) orientations across several geostrings suggest substantial geological control, while mixed movement trends indicate the complex interplay between operational activities and geological features.

#### Geostatistical Analysis:

The geostatistical analysis is essential for modelling geothermal reservoirs and estimating potential resources. The outputs include spatial maps of interpolated ML values, conditional simulation realisations, and measures of uncertainty derived from uniform conditioning. These results provide a nuanced understanding of the geothermal reservoir's potential and delineate areas warranting further exploration.

Variograms are crucial for understanding the spatial continuity of ML values. For this study, experimental variograms were calculated for each series and the combined dataset. A spherical variogram model was fitted to the experimental data to characterise spatial autocorrelation, and the variogram model parameters (nugget, sill, and range) were iteratively adjusted for optimal fit. For Series 2, the variogram parameters were a nugget of 0.1, a range of 100 metres, and a sill of 0.3. Series 3 and Series 5 exhibited a nugget of 0.1, a range of 75 metres and a sill of 0.29. The combined series variogram had a nugget of 0.2, a range of 100 metres, and a sill of 0.33. The experimental variograms and fitted models revealed the spatial characteristics of ML values, with the combined series variogram showing higher nugget and sill values, indicating more significant spatial variability and noise compared to the individual series (Figures 42, 43, 44, and 45).

A 3D grid was defined to encompass all spatial points of the seismic events, with a grid cell size set at 50x50x50 metres to balance resolution and computational efficiency. For the combined data, the grid parameters were as follows: the X-axis ranged from 330.47 to 1402.34 with 23 cells, the Y-axis ranged from 286.72 to 1363.28 with 23 cells, and the Z-axis ranged from -4775.78 to -3371.88 with 30 cells. Inverse Distance Weighting (IDW) was applied to interpolate ML values across the grid, with the power parameter set to 3 to reduce smoothing and better capture higher ML values.

3D visualisations of the estimated ML values were created for different thresholds (-0.5, -0.4, -0.25, and 0.0). The borehole trajectory was overlaid on the visualisations to provide context for the fluid injection process. The volume of the reservoir blocks was calculated for ML thresholds above -0.4, -0.2, and 0.0. The volume of each block was 125,000 cubic metres, and the total volumes were calculated based on the number of blocks above each threshold. For  $ML > -0.4$ , there were 4,821 blocks, totalling 602,625,000 cubic metres. For  $ML > -0.2$ , there were 355 blocks, totalling 44,375,000

cubic metres; for  $ML > 0.0$ , there were 106 blocks, totalling 13,250,000 cubic metres (Figures 46, 47, and 48).

The variograms for individual series displayed distinct spatial correlations, with Series 2 showing the least variability. The combined variogram had a higher nugget effect, indicating increased noise and spatial variability due to data aggregation from different fluid injection tests. The experimental variogram for Series 2 showed a smooth increase in variogram values with distance, indicating good spatial correlation, with a spherical model fit characterised by a nugget of 0.1, a range of 100 metres, and a sill of 0.3. The relatively low nugget suggests minimal measurement error or microscale variability. Series 3 exhibited more variability than Series 2, with spherical model parameters of a nugget of 0.1, a range of 75 metres, and a sill of 0.29. This increased variability may be attributed to differences in geological characteristics or fluid injection patterns. The variogram for Series 5 was similar to that of Series 3, with a nugget of 0.1, a range of 75 metres, and a sill of 0.29, suggesting similar geological or operational factors may have influenced the microseismic event occurrence. However, this is a theoretical proposition without additional information on the third injection test's flow rates or wellhead pressure. The combined variogram, with a higher nugget (0.2) and sill (0.33) and a range of 100 metres, indicated greater noise and spatial variability, likely due to data aggregation from different injection tests with varying fluid injection rates. This combined variogram also showed a broader range of distances over which spatial correlation was observed, reflecting the integration of different spatial scales from the individual series (Figures 42, 43, 44, and 45).

The shape and size of block models varied significantly with ML thresholds. Higher ML thresholds resulted in fewer blocks, concentrated around regions with intense seismic activity, while lower thresholds exhibited a broader spatial distribution of blocks, presenting a more connected reservoir. The numerical analysis revealed critical insights into the geothermal reservoir, such as high spatial variability and noise in ML values, particularly in the combined dataset, suggesting complex interactions between fluid injection and the granite formation. The volume calculations indicated significant reservoir potential at different ML thresholds, with the large volume for  $ML > -0.4$  suggesting extensive areas affected by fluid injection. Higher ML values were concentrated around specific regions, potentially indicating zones of intense seismic activity or higher permeability in the granite formation. These regions are likely viable for future injection tests and ongoing production operations, and targeting these regions could increase the likelihood of creating a fracture-dominated fluid-connected reservoir (Figures 50 and 51).

Based on the analysis, several suggestions and ideas emerge. Focus on regions with higher ML values for detailed exploration and potential drilling, as these areas may indicate higher permeability and fluid flow. Implement enhanced monitoring around regions with high spatial variability and noise better to understand the interactions between fluid injection and seismicity. Consider adaptive fluid injection strategies to manage seismicity and optimise geothermal energy extraction, particularly in regions with concentrated high ML values. Additionally, further geostatistical analyses, such as kriging, will be performed to refine the spatial model and improve the accuracy of ML value estimation.

Detailed modelling of seismic events, reservoir boundaries, and well positions.

## Fluid Injection Impact Analysis

Detailed modelling of seismic events begins with the precise location and magnitude data for each event. The spatial distribution of these events is analysed to identify patterns and clusters indicative of active zones within the geothermal reservoir. Figures 51 and 52 illustrate the 3D scatter plots of seismic event locations, which provide a clear visual representation of the spatial extent and intensity of seismic activity within the reservoir.

The reservoir boundaries are delineated based on the spatial distribution of seismic events and geological data. This involves integrating seismic event data with geological maps and fault line information to produce a comprehensive model of the reservoir. The boundaries are adjusted to reflect areas of higher seismic activity and geological features that may influence fluid flow. Figure 50 shows the top view of the EG-1 reservoir block model based on original seismic locations and the suggested location for a second well, "EG-2." This visualisation helps in understanding the reservoir's spatial extent and potential pathways for fluid flow. Determining the optimal positions for new wells is crucial for efficient geothermal energy extraction. The model considers the spatial distribution of seismic events, reservoir boundaries, and geological features to identify potential well locations. The suggested endpoints for new wells, such as "EG-2," are chosen to maximise hydraulic connectivity and target high ML value regions. Figures 49 and 50 illustrate the positions of EG-1 and the proposed EG-2, providing a clear visualisation of the well's trajectory and its relationship with the seismic events and reservoir boundaries. A 3D block model is created to visualise the seismic events, theoretical reservoir boundaries, and well positions. This model helps in understanding the spatial relationships between seismic activity and reservoir characteristics. It also aids in planning future drilling operations by highlighting areas with higher seismic activity and potential fluid pathways. The block model, as shown in Figure 51, provides a detailed spatial representation of the reservoir, aiding in the strategic placement of new wells to optimise geothermal energy extraction. Based on the detailed modelling, several recommendations are made. Focus should be on regions with higher ML values for detailed exploration and potential drilling, as these areas may indicate higher permeability and fluid flow. Enhanced monitoring around regions with high spatial variability and noise is suggested to better understand the interactions between fluid injection and seismicity. Adaptive fluid injection strategies should be considered to manage seismicity and optimise geothermal energy extraction, particularly in regions with concentrated high ML values. Further geostatistical analyses, such as kriging, will be performed to refine the spatial model and improve the accuracy of ML value estimation.

## Correlation with Injection Phases

The relationship between fluid injection into the subsurface and the occurrence of seismic activity is complex. Many factors impact the likelihood and severity of generated seismic events and their location. Figures 27 to 29 explore the correlation between seismic event magnitudes (ML values) and their distances from EG-1 and the cased depth point on the well. The seismic events were analysed overall and specifically for Series numbers 2, 3, and 5, associated with fluid injection activities.

Average spatial and temporal differences between drilling and fluid injection tests vary. A smaller spatial difference between seismic events associated with drilling operations is presumed to result from a more direct impact on the subsurface surrounding the progression of the well development.



In comparison, fluid injection allows for fluid migration throughout the reservoir, increasing the radius of potentially affected fractures that may slip under stress. This is illustrated in Figure 53, which shows the correlation between January fluid injection parameters and seismic magnitude, indicating that seismic events are more widely distributed during fluid injection phases.

The visualisation and data suggest a nuanced relationship between the stages of operations and induced seismicity. Specifically, the depth intervals with the most substantial seismic response (-3800m to -3600m) coincide with the depths associated with fluid injection tests (Series 2, 3, and 5). This observation supports the hypothesis that fluid injection significantly impacts the subsurface stress regime, leading to increased seismic activity. Figures 54 and 55 highlight this relationship by showing fluid injection parameters and corresponding seismic magnitudes for different days.

The data suggest distinct patterns of seismicity associated with different operational stages. While drilling (Series 1) is not explicitly highlighted, the fluid injection stages (Series 2, 3, and 5) show a clear correlation with increased seismic event sizes and counts, particularly in-depth zones where larger ellipsoids are observed. This pattern may reflect the influence of operational pressures on the subsurface environment, highlighting areas of potential risk for induced seismicity. For example, Figures 60 to 65 depict the second injection test fluid flow rates and corresponding seismic ML values, demonstrating the operational impacts on seismic activity.

Seismic events from Series 2, 3, and 5 are predominantly present in deeper depth ranges, consistent with fluid injection-induced seismicity. Conversely, Series 1 events are observed at shallower depths, particularly in the -3300m to -3500m range, potentially indicating seismic events triggered by drilling activities. The error ellipsoids for Series 1, associated with drilling the wellbore, are notably present in shallower ranges, while the fluid injection-induced events (Series 2, 3, and 5) span a broader depth range. This suggests different mechanisms of seismic triggering between drilling and fluid injection-related seismic events. Figure 32 shows the error ellipsoids for different series, illustrating the spatial uncertainty and distribution of seismic events related to both drilling and fluid injection activities.

### [Injection Parameters vs. Seismicity](#)

This analysis would be better suited to a series of injection tests in which the fluid injection rate is held at a low constant rate with intermittent increases in the flow rate to assess the changes in wellhead pressure and allow for potential trends to be observed. Additional issues arose from the analysis regarding assessing the relationship. Events also need to be considered based on their distance from the borehole. The further away the fluid is from the borehole, the less the wellhead pressure at the borehole shows a representative understanding of the pressure the fluid is under.

The scatter plot with a trend line (Figure 27) reveals the relationship between ML values and the distance from the injection well. The linear regression analysis shows the slope of the trend line is 0.00045, and the intercept of the trend line is -2.65, representing the ML value when the distance from the well is zero. The correlation coefficient (R-squared value) is 0.062, suggesting a weak positive correlation between ML values and distance from the well. Despite the weak correlation, the p-value of  $1.76 \times 10^{-10}$  indicates that this relationship is statistically significant. The standard error of the slope is 0.0000686, reflecting the average deviation of the observed values from the regression line.

The weak positive correlation implies that seismic event magnitudes slightly increase as the distance from the well increases. This suggests that the injection activities have a more significant impact on seismicity at greater distances. The box plot of ML values at different distance intervals (Figure 28) provides a detailed view of the distribution across various distances from the well. Summary statistics for each distance interval highlight the ML values have a mean of -0.801 and a standard deviation of 0.176, indicating relatively low seismic activity close to the well. As the distance increases, the mean ML values become less negative, suggesting slightly stronger seismic events at greater distances. This pattern could indicate that faults or fractures farther from the well are more susceptible to stress changes caused by injection activities.

Focusing on seismic events associated with fluid injection (Series 2, 3, and 5), the analysis of the correlation between ML values and the distance from the cased depth point provides the following results: The slope is 0.00046, and the intercept is -1.22. The correlation coefficient (R-squared) is 0.081, suggesting a weak positive correlation between ML values and distance from the cased depth point. The p-value of  $1.69 \times 10^{-11}$  indicates that the correlation is statistically significant. The standard error is 0.0000674, reflecting the average deviation of the observed values from the regression line. Figure 29 indicates that the weak positive correlation indicates that seismic event magnitudes slightly increase with distance from the cased depth point. The box plot for ML values at different distance intervals from the cased depth point for Series 2, 3, and 5 (Figure 28) reveals the central tendency and spread of ML values within each bin. For example, in the interval closest to the cased depth point, ML values have a mean of -0.801 and a standard deviation of 0.176, suggesting relatively low seismic activity. As the distance increases, the mean ML values become less negative, indicating slightly stronger seismic events.

Both sets of analyses (overall seismic events and those specifically related to fluid injection) reveal a weak positive correlation between ML values and distance from the well or cased depth point. The correlation coefficients are low but statistically significant, suggesting a consistent, albeit weak, pattern of increasing ML values with distance. The local magnitude of events has remained consistently below 0.0 before outliers. All outliers with an ML above 1.0 are during fluid injection tests, which supports the theory that these periods of operations are most likely to result in relatively larger microseismic events.

The Pearson correlation coefficients between the fluid January injection parameters and seismic magnitudes are as follows: Flow Rate vs. Seismic Magnitude: The correlation coefficient is approximately 0.24 with a p-value of 0.00084. This indicates a weak positive correlation between the flow rate of fluid injection and the magnitude of seismic events, which is statistically significant. It suggests that as the flow rate increases, there might be a slight increase in the magnitude of seismic events. Pressure vs. Seismic Magnitude: The correlation coefficient is approximately -0.05, with a p-value of 0.455. This indicates a very weak negative correlation between wellhead pressure and the magnitude of seismic events, which is not statistically significant. It suggests no clear relationship exists between the fluid injection pressure and the magnitude of seismic events.

Although weak, the positive correlation between flow rate and seismic magnitude suggests that higher flow rates of fluid injection could be associated with slightly larger seismic events. This finding aligns with the hypothesis that increased fluid injection might influence seismicity. The lack of a significant correlation between wellhead pressure and seismic magnitude suggests that pressure alone may not directly affect the magnitude of seismic events. Other factors, including the geological

characteristics of the injection site and the total volume of injected fluid, might play a more significant role.

There appears to be a temporal correlation between periods of increased fluid flow rate and the occurrence of seismic events, suggesting that changes in injection rates may influence seismic activity. The magnitudes of seismic events (ML) show variation throughout the test period. Notably, some larger magnitude events occur during or shortly after periods of higher fluid flow rates, indicating a potential link between the injection process and the strength of seismic events. While pressure data varies, it's less clear how wellhead pressure is directly correlated with the occurrence of seismic events compared to flow rate. However, periods of high pressure may also correspond with increased seismic activity, suggesting a complex relationship that might require further analysis to fully understand.

### March Fluid Injection

Similar to the January test, there's an observable pattern where seismic events often follow changes in the volume flow rate. This suggests a linkage between the fluid injection rate and induced seismicity. The magnitudes of seismic events in March seem to have less variability compared to January. While there are fluctuations in the flow rate, the magnitudes of seismic events do not show a strong correlation with these changes in the plotted data. The distribution of seismic events across time appears somewhat uniform, with no evident clustering around specific flow rate changes. This could indicate that while fluid injection may trigger seismicity, other factors not visible in this graph also play significant roles in determining when and how strong these events will be.

Using Pearson correlation coefficients, the linear correlation between flow rate and seismic magnitudes for high and low phases shows little or no statistically significant correlation. This indicates that extreme rates may not directly linearly influence seismic event magnitudes. However, during Normal Flow (Correlation Coefficient: 0.2933, P-value: 0.0152), there appears to be a meaningful correlation between flow rate and seismic event magnitudes, suggesting some influence or interaction at these rates. This is an expanded correlation analysis across the entire dataset for a holistic view. The very low, positive correlation coefficient implies a weak linear relationship between fluid flow rate and seismic magnitudes of Series 3. The high p-value (0.38) indicates this correlation is not statistically significant. As a result, this suggests that a linear model may not be suitable for determining the relationship between flow rate and seismic magnitudes, and the data may require a more complex model or consideration of additional variables.

The Cross Correlation Function (CCF) between the fluid flow rate and seismic magnitudes shows variation over various time lags. Positive values indicate a direct relationship where an increase in flow rate is correlated with an increase in seismic magnitude at a given lag interval. These results indicate that the strongest correlation occurs at a lag of 3 hours, suggesting that changes in flow rate might most significantly influence seismic magnitudes around this time frame. Other notable correlations appear at lags of 11, 14, and 63 hours, which might indicate more delayed influences or feedback mechanisms in the system. Figure 69 illustrates the lagged correlation plot, showing how the correlation coefficients between fluid injection parameters and seismic event magnitudes change with different lag times.

The scatter plot above (Figure 71) displays the relationship between the seismic magnitude (ML) and the distance of each event from the injection site. The plot is complemented by the Pearson (0.142) and Spearman (0.289) correlation coefficients calculated for these variables. There is a weak positive correlation between the distance to the injection site and the seismic magnitude. A higher distance slightly correlates with a higher (less negative) magnitude, indicating weaker seismic activity as distance increases. Spearman correlation indicates a weak to moderate positive rank correlation. This suggests that as the distance increases, the seismic events tend to be of lesser intensity, which supports the idea that closer events might respond more strongly to the injections.

The scatter plot (Figure 70) visualises the relationship between the distance of seismic events from the injection site and the corresponding time lags, with Pearson (0.126) and Spearman (0.210) correlation coefficients. There is a weak, negative relationship suggesting non-linear or more complex dynamics between distance and lag times, which are shown in this plot. The relationship between the time lags and the distances from the injection site using the adjusted location of the seismic data also suggests a weak negative correlation of  $-0.0558$  for the Pearson linear model and  $-0.2264$  Spearman rank correlation, indicating that greater distances do not necessarily correspond with longer time lags.

Using Pearson correlation coefficients, the linear correlation between flow rate and seismic magnitudes for high and low phases shows little or no statistically significant correlation. This indicates that extreme rates may not directly influence seismic event magnitudes in a linear fashion. However, during Normal Flow (Correlation Coefficient: 0.2933, P-value: 0.0152), there appears to be a meaningful correlation between flow rate and seismic event magnitudes, suggesting some influence or interaction at these rates. This further analysis provides a more comprehensive view of the correlation, indicating that fluid flow rate may have a more significant impact on seismic magnitudes during normal flow conditions than during extreme rates.

### Lag Time Analysis

Events that occur further away from the borehole are likely to be the result of fluid injected a significant time before. Lag Time Analysis calculates the intervals between fluid injection activities and seismic events. This involves identifying each seismic event nearest to the preceding injection activity and calculating the time difference. The varied lag times underscore the complexity of induced seismicity, with both immediate and delayed responses to fluid injection. Immediate responses might be attributed to direct increases in pore pressure or stress changes near the injection point. In contrast, delayed responses could involve more complex mechanisms like slow pore pressure diffusion or the reactivation of pre-existing faults.

Analysis suggests a delay in the response to seismic occurrence and the fluid injection. The first injection test (Series 2) had a shorter temporal difference due to fewer post-fluid injection seismic events. This implies that initial fluid injection had a less delayed response than later testing. The Flow-ML Correlation (Figure 68) shows a peak at a lag of 1 day, suggesting a mild positive correlation between fluid injection flow rate and seismic event magnitude shortly after injection. The correlation generally decreases with longer lags. The Pressure-ML Correlation (Figure 69) remains near zero or negative across all lag times, indicating no significant linear relationship between wellhead pressure changes and seismic event magnitudes within the tested lag range. This plot highlights the temporal

aspect of the relationship between fluid injection activities and seismicity, suggesting that the effects of fluid flow rate on seismic event magnitude are more immediate, whereas wellhead pressure does not show a significant correlation at any lag.

The relationship between the time lags and the distances from the injection site using the adjusted location of the seismic data also suggests a weak negative correlation of  $-0.0558$  for the Pearson linear model and  $-0.2264$  for the Spearman rank correlation, indicating that greater distances do not necessarily correspond with longer time lags.

The wide range of lag times suggests that the relationship between fluid injection activities and seismic events is complex, with seismic responses occurring immediately and several days after injection activities. The significant variation (high standard deviation) and the presence of very short and long lag times indicate that other factors, such as geological conditions, injection volume, and historical stress state, may influence the timing of seismic events. The median lag time of about 62 minutes suggests that, for many events, there is a relatively short delay between injection activities and seismic responses, which might indicate a direct influence of fluid injection on inducing seismic events in susceptible geological settings. The plots (Figures 70 and 71) show that within an hour for the lag time response, the correlation coefficient is highest, which falls for the next 18 hours, then rises again, showing some statistical significance. In addition, at the +24-hour interval, the confidence interval is (0.0388, 0.0789), suggesting that the positive correlation observed at +24 hours lag is statistically significant. These results indicate that changes in the injection parameters (flow rate and pressure) have a statistically significant correlation with seismic activity, observed 24 hours before and after the parameter changes.

### Pore Pressure Diffusion Analysis

The complexity of the fracture network also has an impact on the movement of fluid throughout the subsurface. Long, near, linear fractures such as large faults are expected to provide a clearer pathway for fluid migration. However, if there are a series of fractures in multiple orientations, then the fluid flow will slow down around these kinks, which will result in blockages as fluid from behind continues to insist on travelling that particular course of direction. At this moment, the pressure is expected to build up, which may increase pressure on the surrounding rocks, stimulating the fractures to open or create additional fractures along previous planes of weakness. As the fractures open, the pore pressure will reduce as a large surface area is allowed for fluid to flow through, which will decrease the pressure. The following relaxation of the rocks may cause void spaces to be quickly filled by rock movement, which is likely to result in seismic energy being released and recorded at the surface.

The weak positive correlation of increased ML values with distance might indicate the presence of critically stressed faults or fractures that are more prone to slippage when subjected to pressure changes from injection activities. The slight increase in ML values with distance suggests that injected fluids might be causing a redistribution of geological stress, leading to seismic activity in regions not immediately adjacent to the well or beginning of the open hole. This is likely due to the migration of injected fluids following permeable pathways or fault zones. The observed patterns might reflect the reservoir's permeability and the connectivity of fractures. A weak correlation might imply a complex network of fractures and faults with varying degrees of permeability and connectivity, leading to differential stress distribution.

## Additional Analyses:

### Temporal Analysis of Seismicity

A comprehensive study of the temporal evolution of seismic events is conducted, focusing on their occurrence throughout the phases of drilling and fluid injection operations. This analysis utilises time-series data, including Origin Time and Series classifications, to identify trends and patterns in seismicity over time. The goal is to understand how seismic activity responds to operational interventions, revealing any temporal patterns that may indicate induced seismicity or natural seismic evolution.

Evidence suggests that during fluid injection tests, the seismic events across the whole operation were separated by approximately even spacings (Figure 68). However, the temporal distribution varies significantly between stages of operation (Series), which can be accounted for by variations in the fluid injection rate fluctuations. The time-series plot (Figure 69) shows how seismic events are distributed across different operational phases, indicating distinct patterns that correlate with periods of fluid injection.

The scatter plot (Figure 70) illustrates the relationship between seismic event occurrence and operational phases, highlighting how seismic activity clusters around certain phases, particularly during fluid injection. Additionally, the correlation plot (Figure 71) indicates the relationship between fluid injection rate and seismic activity over time, providing insights into how changes in injection rates influence seismicity.

The larger temporal difference for the overall dataset can be explained by the lengthy periods of seismic inactivity between fluid injection tests. These findings suggest that the timing and rate of fluid injection play a crucial role in determining the temporal patterns of induced seismicity, with periods of higher injection rates correlating with increased seismic activity.

### Comparison with Geological Features

Due to technical errors, the fault sequences could not be recorded below 400m depth. Unfortunately, this limits the ability to cross-reference proposed fault ligaments based on linear patterns within the seismic data to factual data on known fault orientations and sizes at this depth. One of the main ways we interpret structures within the subsurface is by drawing comparisons observed at the surface and tracing them to depth to develop structural models. A similar method is implied when assessing patterns in the focal mechanism of seismic events. Focal mechanisms can be used to determine the approximate strike of a fault. With enough information, this can be useful to determine a preliminary observation of the overall sense of motion in the region (Billen, 2021).

By assessing which focal mechanisms are similar, we determine any potential trajectories (lines) with which they match up to show potential faults. Events showing the same orientation may occur on separate faults; however, this also supports the model in determining the larger picture of fault sequences influencing the subsurface structural constraints, which are likely to affect fluid flow pathways. For example, Figure 75 illustrates the alignment of focal mechanisms with observed surface fault patterns.

Faults and fractures are critical indicators of the types of stress regimes that have affected a region. These features' patterns, orientations, and types are used to determine historic and present tectonic stresses. These stress regimes are categorised into three groups: extensional, compressional, and strike-slip. Extensional stress regimes are defined by normal faulting, horizontal stretching, and vertical thinning, commonly associated with divergent plate boundaries. Compressional stress regimes, characterised by reverse faulting, horizontal shortening, and vertical thickening, are typical of convergent plate boundaries. Strike-slip stress regimes are characterised by horizontal shearing, where the movement is mainly lateral, indicating shear stress regimes with lateral movement along the fault plane (Figure 76).

Using Anderson's Theory of Faulting, seismic focal mechanisms can be used to preliminarily study the stress regime. Analysis of the focal mechanisms indicates that most seismic events are associated with extensional regimes. For example, Trigger ID 612 is within the 50-meter buffer zone of a fault, approximately 17.95 meters away. Seismic events with adjusted hypocentres do not appear to be within the vicinity of observed intersecting fault trajectories. As a result, the original seismic hypocentres are used for further analysis. According to the specified buffer distance, there are two fault intersections within 100 meters of seismic events. These intersections are located at: 'X=521.53, Y=325.91, Z=-3912.38' and 'X=629.76, Y=369.54, Z=-4055.23' associated with Trigger ID 428 and Trigger ID 628 respectively (Figures 77 and 78).

This close proximity suggests significant geological interactions or correlations at these specific points. The visualisation highlights the interactions between fault intersections and their nearest seismic events. The closest seismic events to the fault intersections are marked in dark green, while all other seismic data points are shown in light green. Figure 79 shows the spatial relationship between seismic events and fault intersections.

Comparison of the fault orientation and the seismic error ellipsoids is as follows:

Fault near Trigger ID 428: Figure 80

Fault Orientation		Seismic Vector Orientation		
Dip	Azimuth	Vector 1	Vector 2	Vector 3
85.2	291.82	0.87, 0.43, -0.22	-0.36, -0.89, 0.28	0.32, 0.16, 0.93

Fault near Trigger ID 628:

Fault Orientation		Seismic Vector Orientation		
Dip	Azimuth	Vector 1	Vector 2	Vector 3
62.75	270.22	-0.55, 0.83, -0.05	-0.83, -0.54, 0.16	0.11, 0.13, 0.99

An assessment of the alignment, the orientation of the vectors of the seismic events (Vector 1 to 3) and fault plane orientations is made. This is calculated as the angles between the fault dip direction (converted from azimuth and dip) and each seismic vector to assess if they are potentially aligned or influenced by similar stress regimes. In the fault near Trigger ID 428, the seismic vectors do not closely align with the fault orientation, suggesting different stress regimes. The angles are relatively large, particularly for Vector 1, which is nearly antipodal. In addition, for the fault near Trigger ID 628, the angles between the fault and seismic vectors are smaller, especially for Vector 2 (36.21°). This closer alignment may indicate that similar stress regimes could influence this fault and the seismic event. The smaller angles for the fault near Trigger ID 628 suggest a potential correlation in their stress orientations, which might indicate a shared or related stress regime. Further geological analysis is required to confirm this observation of aligned tectonic stresses.

Dip angles and azimuths of fault planes can be used to infer the underlying stress regime at varying depths. Using Anderson's Theory of Faulting along with seismic data, the stress regime and variations can be calculated. Initial work observing the dip angle and azimuth of fault planes can be used to suggest fault classification. A hypothesis for stress regime variations is calculated by assessing the modal classification (Figures 82 and 83).

- Normal Faults: Predominantly occur where the minimum principal stress ( $\sigma_3$ ) is vertical, indicative of extensional tectonic regimes. Faults dip significantly (often  $> 45^\circ$ ).
- Reverse/Thrust Faults: Characterized by the maximum principal stress ( $\sigma_1$ ) being vertical, found in compressional regimes. These faults have shallower dips.
- Strike-Slip Faults: Occur where the intermediate principal stress ( $\sigma_2$ ) is vertical, indicating a lateral or shear stress regime. These are perpendicular or nearly vertical faults.

Most observed intersecting faults are initially defined as normal, suggesting an extensional stress regime at these depths. The change to thrust faulting between -2200m and -2400m is potentially a result of stress accumulation. Seismic event orientation supports the region's trend of being part of an extensional stress regime.

The plots (Figures 84 and 85) show an array of fracture orientations observed downhole of EG-1. Faults appear to be predominantly oriented toward SW. This study does not detail the process of categorising fractures into groups and has relied on Andy Jupe's work.



## Conclusion

There is a statistical significance of the injection of fluid aligning with periods of microseismic activity, as shown by their occurrence during fluid injection intervals and periods between tests whereby there is little to no microseismic activity (Figure 53). Lag time analysis suggests that there is a delay in the response of microseismic activity associated with fluid injection. Analysis shows an approximate lag time of between 1 hour and one day, which suggests that there is a delay for fluid flow propagation through the subsurface through the fracture network whereby pore pressure builds up, resulting in hydraulic stimulation of those fractures and the release of microseismic energy (Figure 68). This is supported by an assessment of the models used to determine the distance between microseismic events and the initial point of the open hole at 3860m (Figure 69). There is an expected variability in fluid flow velocity for the fracture network, but it supports the theory of fluid being transported through the reservoir. However, the available data cannot determine the exact directions of the fluid flow pathways (Figure 70).

Assessment of error ellipsoids has determined that the accuracy of hypocentre locations varies. An amalgamation of the error ellipsoid data has been used to determine an approximate shift in the hypocentre locations in a southeast direction downwards by a movement magnitude of 900 meters (Figure 71). From the surface, the seismic cloud has shifted approximately 500 meters east. Additional visualisations of the newly calculated hypocentre locations were produced. These plots indicate that the microseismic cloud has shifted towards EG-1 (Figures 72 and 73).

Geostatistics is valuable to understanding the spatial distribution of microseismic events. Clustering of the X, Y, and Z positions of microseismic events are formed to determine spaces where there is a concentration of microseismic events. Clustering patterns have been used to produce a block model whereby the magnitude of individual events and their spatial distribution are interpolated (Figure 74). The block model estimates the delineated shape and size of the resource. The block model shows evidence of increasing in size over time. However, this is not a continuous, gradual development. Instead, it primarily focuses on a small area with repeated microseismic activity with additional hotspots of clusters occurring over time and different stages of operations (Figures 75 and 76). Volume estimations vary depending on inclusion of varying ML values. The block model shows a partially connected reservoir. A clear connection between the main body of the reservoir and the deepest parts is currently not observed (Figure 77).

Geostrating analysis involves grouping microseismic events based on predetermined thresholds for spatial distancing and temporal gaps between consecutive events. Exploratory Data Analysis (EDA) was used to determine the thresholds. Thresholds have been set depending on the 90th percentile of individual Series. Analysis of the propagation trajectories shows large variability in both the spacing and predominant direction (Figure 78). Further work for Geostrating associated with the first and second injection tests (Series 2 and 3) do not show clear pathways of microseismic events propagation out from EG-1 into the surrounding subsurface. This suggests that the microseismic occurrences are not solely a result of direct impact from fluid flow and changes in pore pressure within those fractures (Figure 79).

Instead, a potential theory is that the surrounding rock mass is affected by this, leading to locations separate from fluid flow pathways that undergo geomechanical failure and generate microseismic activity. This report suggests multiple proposed locations for the endpoint of EG-2. Future decisions

for the proposed secondary well should include the endpoint within the vicinity of the prominent hotspot region observed with the block model (Figures 80 and 81). Additional work is required to focus on the approximate location of the second well. However, this goes beyond the scope of this study. All drilling activity, in particular at depth, has a risk of generating microseismic activity. It is suggested that a second well should not exceed a 4km depth as this is likely to induce additional microseismic activity (Figure 82).

Relative to the surrounding rock mass and geothermal reservoir size, the seismic event locations are precise. Analyses of the spatial autocorrelation on ML have been used to provide the probable extent of influence each event has. This is used to define the approximate size of the geothermal resource that is theoretically accessible. The size of the resource is determined to be conservatively 13.25 million cubic meters, which is oriented downwards towards NE (Figures 83 and 84). Structural constraints are likely to be present even when not observed.

Drilling operations and seismic occurrence show a critical point in which, at 4km depth, drilling seismic activity begins. The region is typically seismically inactive, suggesting that this is the first seismic event to be induced by these geothermal operational activities (Figure 85). This work has involved multiple methodologies to cover a range of factual and interpretative descriptions of the microseismic events. An advantage of this process to perform the analysis is that all datasets included have been easily accessible via Microsoft Excel which, with appropriate geostatistical software and refined Python code, can be reproduced. This allows for future data from EG-1 or other sites to be incorporated to develop a more comprehensive understanding of seismic characteristics in Cornwall and provide suggestions for the probable cause of their activation.

## Limitations and Future Work

Complications during data collection have led to additional challenges in understanding the fracture network at the subsurface. The poor FMI readings below 4,000 meters have led to uncertainty in the orientations of fractures at the lowest depths of the hole, which has resulted in an inability to correlate these with the deepest seismic events. There has been limited availability of some datasets required to continue this study. Each injection test requires fluid flow rate and wellhead pressure readings to make comparable assessments between each test and their corresponding seismic activity. Another flaw is the assessment of utilising the error ellipsoids to redefine hypocentre locations. This method provides an averaging shift in the location, which will create the risk of not providing a true location for these events. This is largely a result of the depth of recorded events, in which significant rock mass lies between their trigger location and the seismographs recording them. It should be noted that these recorded events are still within the approximate location of their actual occurrence, and their distribution between each other is reliable.

The geostatistical and Geostings analysis in this study is based solely on the seismic events related to EG-1 between this particular timeframe. In order to improve the study, additional work should be used, including other projects such as Utah Forge, Basel Enhanced Geothermal System, United Downs, and Rosemanowes. This analysis requires expansion to multiple locations that have a similar

geological setting to comparable arguments for how different stages of operations lead to the occurrence of seismic activity.

Risk assessments are extremely challenging to produce accurately due to the large variability in seismic event locations and their additional attributes (ML). This study attempts to assess the potential extent of the resource. However, we are unable to predict when, where, or the magnitude of future seismic events.

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Trigger ID	Origin Time	Series	X	Y	Z	ML	Axis 1	Axis 2	Axis 3	Vector 1 X	Vector 1 Y	Vector 1 Z	Vector 2 X	Vector 2 Y	Vector 2 Z	Vector 3 X	Vector 3 Y	Vector 3 Z
1	2021/09/07 03:49:57.801	1	730	155	-3727	-1	61	117	128	-1	0	0	0	1	1	0	1	-1
2	2021/09/07 04:02:10.147	1	623	534	-3928	-1	61	92	128	1	0	0	0	-1	0	0	0	1
3	2021/09/07 05:14:20.228	1	756.3	707.8	-3649.2	-0.34	97	144	245	0.88	-0.43	-0.21	-0.40	-0.90	0.15	-0.25	-0.05	-0.97
4	2021/09/07 05:21:03.656	1	762.5	686.7	-3764.8	0.78	85	124	184	0.75	-0.66	-0.07	-0.66	-0.75	-0.01	0.05	-0.05	1.00
5	2021/09/07 05:21:41.842	1	731.3	467.2	-3607.8	-0.90	130	197	248	-0.78	0.61	0.11	-0.59	-0.78	0.20	0.21	0.10	0.97
6	2021/09/07 08:27:39.581	1	531.3	576.6	-3708.6	-0.77	36	36	64	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
7	2021/09/08 00:57:37.868	1	814.1	736.7	-3997.7	-0.54	99	128	185	0.66	-0.72	-0.21	-0.74	-0.67	-0.02	0.13	-0.17	0.98
8	2021/09/08 22:00:59.436	1	536.7	528.1	-3809.4	-0.77	19	20	46	0.63	-0.77	-0.05	-0.75	-0.63	0.22	-0.20	-0.10	-0.98
9	2021/09/11 04:28:52.067	1	671.1	392.2	-3747.7	-0.80	190	289	342	-0.76	0.63	0.12	0.60	0.77	-0.23	0.24	0.10	0.96
10	2021/09/11 04:36:58.240	1	866.4	628.9	-3776.6	0.13	71	102	142	0.75	-0.66	-0.07	-0.66	-0.75	0.01	0.06	-0.04	1.00
11	2021/09/11 08:37:42.355	1	533.6	982.0	-3728.9	-0.24	48	59	65	-0.98	-0.13	0.12	-0.17	0.86	-0.48	-0.05	-0.49	-0.87
12	2021/09/15 15:34:54.673	1	878.9	475.8	-3770.3	-0.81	203	271	384	-0.96	0.24	0.13	-0.21	-0.96	0.20	0.17	0.16	0.97
13	2021/10/10 14:30:24.298	1	942.2	628.9	-3514.1	-0.57	175	247	328	0.91	-0.37	-0.19	0.38	0.92	0.06	-0.15	0.13	-0.98
14	2021/10/14 04:55:59.628	1	852.3	607.0	-3778.1	-0.36	116	125	200	0.48	-0.86	-0.19	-0.86	-0.50	0.11	0.19	-0.11	0.98
15	2021/10/14 10:14:40.538	1	861.7	739.8	-3971.9	-0.17	98	145	207	0.93	-0.36	0.01	0.36	0.93	0.08	-0.03	-0.07	1.00
16	2021/10/14 13:59:08.581	1	632.8	653.1	-3859.4	-0.76	115	139	189	-0.52	0.73	0.44	-0.65	-0.67	0.36	0.55	-0.10	0.83
17	2021/10/14 19:11:09.440	1	835.2	321.1	-3546.1	-0.99	154	225	346	-0.94	0.35	0.04	0.35	0.94	0.02	0.03	-0.03	1.00
18	2021/10/21 04:13:22.816	1	839.8	696.1	-3880.5	-0.52	104	141	220	0.87	-0.46	-0.17	-0.42	-0.88	0.20	-0.24	-0.11	-0.96
19	2021/10/24 12:52:53.874	1	753.9	976.6	-3878.1	-0.31	87	120		0.84	-0.53	-0.10	-0.53	-0.84	-0.04	0.06	-0.09	0.99
20	2021/10/25 03:09:20.068	1	695.3	757.0	-3762.5	-0.28	92	172	210	0.80	-0.59	-0.06	-0.60	-0.79	-0.14	-0.04	-0.14	0.99
21	2021/10/25 03:09:34.498	1	678.1	703.1	-3841.4	-0.18	78	143	169	0.83	-0.55	-0.10	0.55	0.83	-0.10	-0.14	-0.03	-0.99
22	2021/10/25 04:15:41.604	1	655.5	554.7	-3852.3	-0.66	84	147	180	0.87	-0.43	-0.23	-0.30	-0.85	0.43	-0.38	-0.31	-0.87
23	2021/10/25 15:05:59.081	1	608.6	795.3	-3646.9	-0.07	57	86	179	0.94	-0.34	0.01	0.34	0.93	0.14	0.06	0.13	-0.99
24	2021/10/25 17:23:57.923	1	715.6	716.4	-3689.1	-0.43	76	120	187	-0.97	0.24	-0.01	-0.23	-0.92	-0.31	0.09	0.30	-0.95
25	2021/10/25 19:46:07.542	1	750.0	715.6	-3862.5	-0.16	64	93	141	0.88	-0.47	-0.07	-0.46	-0.88	0.10	-0.11	-0.05	-0.99
26	2021/10/25 19:55:55.168	1	774.2	717.2	-3682.8	-0.45	99	183	251	0.80	-0.59	-0.04	-0.60	-0.80	-0.10	-0.02	-0.10	0.99
27	2021/10/25 21:59:21.642	1	717.2	597.7	-3686.7	-0.78	99	170	227	0.81	-0.56	-0.17	-0.58	-0.80	-0.11	0.08	-0.19	0.98
28	2021/10/26 06:55:58.241	1	746.9	929.7	-4013.3	-0.31	90	122	179	0.87	-0.48	-0.09	-0.49	-0.87	-0.04	0.06	-0.08	0.99
29	2021/10/26 18:09:17.006	1	610.2	578.1	-3459.4	-0.55	78	128	180	0.77	-0.58	-0.27	-0.56	-0.81	0.16	0.31	-0.03	0.95
30	2021/10/26 18:11:17.970	1	757.0	714.8	-3702.3	-0.36	109	181	236	0.76	-0.62	-0.21	-0.56	-0.78	0.28	0.34	0.09	0.94
31	2021/10/27 14:53:09.203	1	732.8	771.9	-3875.0	-0.63	98	157	221	0.90	0.39	0.19	0.32	-0.90	0.30	0.28	-0.21	-0.93
32	2021/10/29 14:27:44.900	1	935.2	650.0	-3825.0	-0.02	88	126	180	-0.96	0.27	0.00	-0.26	-0.96	-0.13	0.03	0.12	-0.99
33	2021/10/29 19:51:48.327	1	689.1	564.1	-3749.2	-0.57	113	195	254	0.84	-0.51	-0.17	0.48	0.86	-0.19	-0.24	-0.07	-0.97

34	2021/11/03 07:12:18.546	1	814.8	721.9	-3817.2	0.02	72	117	162	-0.69	0.72	0.12	0.67	0.69	-0.28	-0.28	-0.11	-0.95
35	2021/11/03 13:58:51.969	1	650.8	621.9	-3968.8	-0.68	21	33	37	0.76	-0.64	-0.13	0.61	0.76	-0.21	0.24	0.08	0.97
36	2021/11/03 14:10:25.529	1	753.9	829.7	-4071.9	-0.40	72	112	150	0.61	-0.77	-0.20	-0.71	-0.64	0.30	0.36	0.05	0.93
37	2021/11/03 14:22:57.526	1	625.0	586.7	-3984.4	-0.71	26	39	66	-0.76	0.62	0.21	0.60	0.78	-0.14	-0.25	0.02	-0.97
38	2021/11/03 14:30:24.598	1	889.8	440.6	-3768.0	-0.69	110	206	255	-0.90	0.41	0.15	-0.33	-0.87	0.36	0.27	0.27	0.92
39	2021/11/03 14:31:03.547	1	925.8	667.2	-3668.8	-0.34	144	182	291	-0.46	0.88	0.12	0.86	0.48	-0.16	-0.20	0.03	-0.98
40	2021/11/03 15:18:48.569	1	803.9	704.7	-3972.7	-0.72	88	133	155	0.71	-0.63	-0.33	-0.59	-0.78	0.23	0.40	-0.03	0.92
41	2021/11/03 15:50:07.825	1	825.8	569.5	-3791.4	-0.75	137	251	306	0.87	-0.47	-0.12	0.46	0.88	-0.12	-0.16	-0.05	-0.99
42	2021/11/03 16:28:39.769	1	559.4	587.5	-3976.6	-0.73	71	105	131	0.84	-0.47	-0.28	-0.33	-0.83	0.44	-0.44	-0.28	-0.85
43	2021/11/03 16:37:03.259	1	681.3	541.4	-3710.9	-0.70	144	187	246	-0.79	0.35	0.51	-0.26	-0.94	0.24	0.56	0.05	0.83
44	2021/11/03 16:42:11.594	1	592.2	511.7	-3725.0	-0.70	46	50	87	-0.74	0.59	0.31	0.58	0.80	-0.13	0.33	-0.08	0.94
45	2021/11/03 16:58:32.582	1	516.4	568.8	-3884.4	-0.57	12	19	38	-0.75	0.64	0.16	-0.61	-0.76	0.21	0.25	0.06	0.97
46	2021/11/03 19:16:10.393	1	762.5	395.3	-3747.7	-0.59	121	186	217	0.88	-0.43	-0.20	0.35	0.87	-0.35	0.32	0.24	0.92
47	2021/11/03 19:17:32.927	1	692.2	836.7	-3755.5	-0.46	82	152	195	0.83	-0.55	-0.10	0.55	0.83	-0.06	-0.12	0.00	-0.99
48	2021/11/03 19:26:57.576	1	610.9	650.0	-3638.3	-1.07	22	22	91	0.39	-0.92	0.06	-0.91	-0.37	0.19	-0.15	-0.13	-0.98
49	2021/11/03 20:32:25.584	1	714.1	607.8	-3659.4	-0.27	71	131	146	-0.88	0.45	0.11	0.47	0.87	0.18	0.02	-0.21	0.98
50	2021/11/03 20:33:34.425	1	638.3	582.8	-4081.3	-0.31	64	96	146	0.92	-0.36	-0.18	-0.27	-0.89	0.37	0.29	0.29	0.91
51	2021/11/03 20:42:02.554	1	705.5	913.3	-3986.7	0.84	71	97	140	0.92	-0.39	-0.01	0.39	0.90	0.17	-0.06	-0.16	0.99
52	2021/11/03 20:43:11.802	1	793.8	962.5	-4034.4	-0.40	101	145	211	0.73	-0.68	-0.05	-0.68	-0.72	-0.10	-0.03	-0.11	0.99
53	2021/11/03 20:43:40.640	1	794.5	784.4	-3641.4	-1.00	157	188	329	0.99	-0.02	-0.17	0.07	0.95	0.29	0.15	-0.30	0.94
54	2021/11/03 20:45:02.124	1	737.5	788.3	-3873.4	-0.33	91	149	186	0.80	-0.59	-0.10	-0.59	-0.77	-0.23	-0.06	-0.24	0.97
56	2021/11/03 20:56:52.844	1	701.6	906.3	-3971.9	-0.02	86	126	165	0.76	-0.64	-0.10	-0.65	-0.76	-0.01	0.06	-0.07	1.00
57	2021/11/03 21:26:19.850	1	702.3	730.5	-3750.0	-0.29	81	149	169	-0.83	0.55	0.08	0.54	0.83	-0.14	-0.14	-0.07	-0.99
58	2021/11/03 21:26:37.637	1	752.3	610.2	-3738.3	-0.80	82	142	174	0.83	-0.50	-0.24	0.52	0.86	0.01	0.20	-0.13	0.97
60	2021/11/03 21:46:54.349	1	712.5	642.2	-3883.6	-0.48	10	15	59	0.76	-0.63	-0.15	0.61	0.78	-0.17	-0.22	-0.04	-0.98
59	2021/11/03 21:46:57.271	1	820.3	675.0	-4084.4	-0.63	123	193	234	0.85	-0.29	-0.44	-0.43	-0.86	-0.27	-0.30	0.42	-0.86
61	2021/11/03 22:19:12.010	1	717.2	1014.8	-3828.1	-0.77	80	109	150	-0.69	0.72	0.06	0.72	0.69	0.05	0.01	-0.08	1.00
62	2021/11/03 23:46:24.000	1	866.4	793.8	-4088.3	-0.33	78	103	149	-0.67	0.71	0.21	0.71	0.70	-0.09	0.21	-0.09	0.97
63	2021/11/03 23:48:17.664	1	551.6	983.6	-4139.1	-0.44	66	101	134	-0.50	0.82	0.29	-0.87	-0.47	-0.15	0.01	-0.32	0.95
64	2021/11/03 23:48:49.223	1	867.2	882.0	-3954.7	-0.46	120	170	257	-0.71	0.69	0.13	0.69	0.72	-0.02	0.11	-0.08	0.99
65	2021/11/03 23:57:23.544	1	815.6	799.2	-4053.9	-0.92	124	228	276	0.81	-0.57	-0.14	-0.42	-0.72	0.55	-0.42	-0.39	-0.82
66	2021/11/04 00:53:27.459	1	546.9	639.1	-3863.3	-0.59	35	51	70	-0.98	0.19	-0.02	-0.16	-0.73	0.67	0.11	0.66	0.74
67	2021/11/04 01:56:47.502	1	724.2	813.3	-3921.9	-0.47	88	165	202	0.83	-0.55	-0.08	-0.55	-0.83	0.05	0.09	0.00	1.00
68	2021/11/04 02:04:32.303	1	858.6	539.8	-3711.7	-0.76	112	208	226	-0.88	0.47	0.12	-0.48	-0.81	-0.34	0.06	0.35	-0.93

69	2021/11/04 02:21:39.164	1	618.0	747.7	-3864.8	-0.57	86	101	154	-0.53	0.80	0.28	0.73	0.60	-0.32	0.42	-0.04	0.91
70	2021/11/04 03:38:38.667	1	664.1	765.6	-3936.7	-0.53	96	127	189	0.66	-0.72	-0.22	-0.72	-0.69	0.09	0.22	-0.10	0.97
71	2021/11/04 04:11:53.339	1	758.6	590.6	-3685.9	-0.71	47	88	126	0.90	-0.42	-0.12	0.41	0.91	-0.09	-0.15	-0.03	-0.99
72	2021/11/04 04:14:48.502	1	784.4	774.2	-3882.8	0.48	69	88	140	0.93	-0.36	0.04	-0.35	-0.93	-0.14	0.09	0.11	-0.99
73	2021/11/04 04:54:19.378	1	642.2	922.7	-3934.4	-0.07	85	98	138	-0.99	-0.15	-0.01	0.15	-0.96	-0.25	0.03	-0.25	0.97
74	2021/11/04 07:15:05.327	1	770.3	547.7	-3998.4	-0.35	78	145	154	-0.88	0.46	0.12	-0.43	-0.67	-0.61	0.20	0.58	-0.79
75	2021/11/04 07:15:24.080	1	577.3	405.5	-3943.8	-0.75	65	99	133	-0.97	0.25	0.05	-0.24	-0.95	0.21	-0.10	-0.19	-0.98
76	2021/11/04 07:17:35.885	1	514.8	643.0	-3859.4	-0.17	69	103	123	0.76	-0.57	-0.30	0.58	0.81	-0.08	-0.29	0.11	-0.95
77	2021/11/04 08:09:48.261	1	479.7	647.7	-3848.4	-0.38	67	100	114	0.76	-0.56	-0.33	0.56	0.82	-0.10	-0.33	0.10	-0.94
78	2021/11/04 13:13:47.063	1	900.8	614.1	-3649.2	-0.49	140	237	328	-0.74	0.67	0.11	0.66	0.75	-0.07	0.13	-0.02	0.99
79	2021/11/05 00:31:32.957	1	719.5	696.1	-3914.1	-0.16	66	82	118	-1.00	0.05	-0.05	0.04	0.98	0.17	0.06	0.17	-0.98
80	2021/11/05 01:21:21.807	1	608.6	959.4	-3873.4	-0.73	85	103	157	0.88	-0.47	-0.07	-0.47	-0.88	-0.05	0.04	-0.08	1.00
81	2021/11/05 03:36:11.860	1	732.0	911.7	-3975.8	-0.57	90	110	164	0.89	-0.45	-0.04	-0.45	-0.89	-0.06	0.01	-0.07	1.00
82	2021/11/05 12:19:15.746	1	715.6	847.7	-3896.9	-0.39	73	120	159	0.90	-0.42	-0.07	-0.42	-0.91	0.00	-0.07	0.03	-1.00
83	2021/11/05 21:09:01.988	1	726.6	718.0	-3588.3	-0.34	78	112	161	0.75	-0.65	-0.09	-0.65	-0.76	-0.01	0.06	-0.06	1.00
84	2021/11/06 04:15:35.785	1	618.8	775.8	-3838.3	0.63	65	87	130	0.92	-0.39	-0.02	-0.39	-0.91	-0.15	0.04	0.15	-0.99
85	2021/11/06 07:30:34.603	1	781.3	907.8	-3581.3	-0.37	91	168	248	0.80	-0.59	-0.06	-0.59	-0.80	-0.11	-0.02	-0.13	0.99
86	2021/11/06 13:06:45.514	1	395.3	674.2	-3940.6	-0.62	113	171	249	-0.70	0.68	0.20	-0.67	-0.73	0.15	-0.25	0.03	-0.97
87	2021/11/06 13:47:40.637	1	786.7	738.3	-3746.1	-0.50	111	191	247	0.80	-0.57	-0.20	-0.60	-0.79	-0.15	0.07	-0.24	0.97
89	2021/11/07 04:09:23.798	1	721.1	738.3	-4055.5	-0.23	79	119	173	0.76	-0.65	-0.09	-0.65	-0.76	-0.05	0.04	-0.09	1.00
90	2021/11/07 05:04:22.290	1	696.9	664.1	-3732.8	-0.92	101	122	170	0.72	-0.64	-0.29	-0.50	-0.75	0.42	0.49	0.16	0.86
91	2021/11/07 08:39:13.189	1	512.5	475.8	-3623.4	-0.78	46	69	126	-0.76	0.63	0.14	-0.60	-0.77	0.24	-0.26	-0.10	-0.96
92	2021/11/07 08:40:05.584	1	689.1	671.1	-3846.9	-0.74	123	219	278	0.83	-0.53	-0.17	-0.55	-0.82	-0.18	0.05	-0.24	0.97
93	2021/11/08 01:42:23.365	1	571.1	781.3	-3678.9	-0.98	75	120	187	0.54	-0.82	-0.16	0.81	0.56	-0.16	0.22	-0.05	0.97
94	2021/11/11 02:48:06.662	1	834.4	758.6	-3537.5	-0.69	95	148	219	-0.93	0.30	0.20	0.33	0.93	0.17	0.13	-0.22	0.97
95	2021/11/12 13:19:38.143	1	839.1	468.8	-3606.3	-0.77	145	217	275	0.65	-0.73	-0.18	-0.75	-0.66	-0.05	0.08	-0.17	0.98
96	2022/01/23 14:03:47.571	2	529.7	840.6	-4010.9	-0.56	72	115	166	-0.37	0.92	0.12	0.91	0.38	-0.16	-0.20	0.05	-0.98
97	2022/01/23 14:13:58.385	2	708.6	662.5	-3885.2	-0.53	39	58	76	-0.73	0.66	0.18	0.68	0.74	0.00	0.13	-0.13	0.98
98	2022/01/23 14:27:37.372	2	557.8	821.1	-4057.8	0.02	76	120	186	0.51	-0.84	-0.20	-0.81	-0.55	0.23	-0.30	0.04	-0.95
99	2022/01/23 14:27:53.569	2	648.4	674.2	-3900.8	-0.57	58	65	92	0.36	-0.91	-0.18	0.90	0.39	-0.18	-0.23	0.09	-0.97
100	2022/01/23 14:29:57.354	2	650.8	671.9	-3926.6	-0.27	41	50	65	0.49	-0.79	-0.36	-0.79	-0.58	0.20	0.37	-0.19	0.91
101	2022/01/23 14:35:59.562	2	559.4	765.6	-3993.8	-0.31	65	104	124	-0.37	0.92	0.12	0.91	0.38	-0.16	-0.19	0.05	-0.98
102	2022/01/23 14:48:31.857	2	414.1	783.6	-3957.0	-0.27	92	144	165	-0.43	0.88	0.21	-0.71	-0.48	0.52	0.55	0.07	0.83
103	2022/01/23 14:49:34.423	2	629.7	574.2	-3836.7	0.83	61	93	101	-0.94	0.35	0.04	-0.35	-0.91	-0.22	0.05	0.22	-0.97

104	2022/01/23 14:52:45.054	2	646.1	566.4	-3849.2	-0.96	78	79	139	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
105	2022/01/23 14:56:04.543	2	774.2	776.6	-3985.2	-0.02	69	84	146	0.18	-0.97	-0.18	0.98	0.20	-0.08	0.11	-0.17	0.98
106	2022/01/23 15:09:46.359	2	743.0	671.1	-3985.2	-0.59	90	104	141	0.75	-0.62	-0.25	-0.66	-0.73	-0.19	0.06	-0.31	0.95
107	2022/01/23 15:10:33.476	2	493.8	600.0	-3747.7	-0.74	18	19	32	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
108	2022/01/23 15:11:00.269	2	760.9	575.0	-3734.4	0.08	83	151	187	0.86	-0.51	-0.07	-0.50	-0.78	-0.38	0.14	0.36	-0.92
109	2022/01/23 15:11:05.846	2	536.7	600.8	-3829.7	-0.38	23	31	43	-0.98	0.21	0.03	-0.14	-0.74	0.66	0.16	0.64	0.75
110	2022/01/23 15:13:37.425	2	527.3	802.3	-3822.7	-0.27	72	90	118	-0.75	0.66	-0.09	-0.65	-0.70	0.29	0.13	0.28	0.95
111	2022/01/23 15:15:16.991	2	757.0	738.3	-3966.4	1.04	57	104	121	-0.96	0.27	-0.03	-0.27	-0.95	0.15	-0.01	-0.15	-0.99
112	2022/01/23 15:17:12.917	2	514.1	560.2	-3882.8	-0.67	24	37	65	-0.76	0.63	0.16	-0.60	-0.77	0.21	-0.25	-0.06	-0.97
113	2022/01/23 15:24:46.451	2	582.0	642.2	-3896.1	-0.59	25	36	49	-0.99	0.08	0.13	0.02	-0.79	0.62	0.15	0.61	0.77
114	2022/01/23 15:32:28.557	2	560.2	558.6	-3799.2	-0.58	22	34	53	-0.76	0.63	0.16	0.60	0.77	-0.21	0.25	0.06	0.97
116	2022/01/23 15:57:59.265	2	795.3	604.7	-4039.1	-0.72	84	133	215	-0.97	0.22	-0.09	-0.23	-0.96	0.16	0.05	-0.17	-0.98
117	2022/01/23 16:17:30.330	2	438.3	583.6	-3826.6	-0.67	36	53	72	-0.69	0.69	0.21	0.69	0.72	-0.11	0.23	-0.07	0.97
118	2022/01/23 16:41:10.042	2	800.0	532.8	-3851.6	-0.27	125	248	305	0.89	-0.46	-0.01	-0.46	-0.89	0.05	0.04	0.04	1.00
119	2022/01/23 17:13:23.537	2	542.2	641.4	-3717.2	-0.67	38	72	90	0.88	-0.47	-0.07	0.47	0.84	0.26	0.06	0.26	-0.96
120	2022/01/23 17:32:16.760	2	580.5	623.4	-3755.5	-0.59	26	28	65	0.51	-0.86	-0.04	-0.84	-0.51	0.21	-0.20	-0.07	-0.98
121	2022/01/23 20:12:35.983	2	761.7	611.7	-3828.9	-0.82	71	108	165	-0.75	0.64	0.17	0.64	0.76	-0.09	-0.19	0.04	-0.98
122	2022/01/23 20:21:20.214	2	752.3	711.7	-3988.3	1.22	58	79	116	0.92	-0.39	-0.01	0.39	0.91	0.15	0.05	0.14	-0.99
123	2022/01/23 20:24:34.647	2	781.3	743.8	-3864.1	-0.40	75	139	168	0.83	-0.55	-0.08	-0.54	-0.84	0.08	-0.11	-0.02	-0.99
124	2022/01/24 02:45:19.166	2	710.2	793.8	-3959.4	-0.30	65	93	121	-0.73	0.69	0.01	0.67	0.72	-0.18	0.13	0.12	0.98
125	2022/01/24 11:21:42.121	2	626.6	760.9	-4011.7	-0.47	72	110	131	0.71	-0.68	-0.21	-0.60	-0.73	0.33	0.38	0.10	0.92
126	2022/01/24 17:09:52.575	2	764.8	726.6	-4046.1	-0.01	69	101	141	0.76	-0.65	-0.09	-0.65	-0.76	-0.02	0.05	-0.07	1.00
127	2022/01/24 17:37:12.974	2	727.3	752.3	-3914.8	-0.41	62	115	125	-0.83	0.55	0.08	0.53	0.83	-0.18	-0.17	-0.11	-0.98
128	2022/01/25 04:37:19.177	2	694.5	646.1	-3784.4	-0.34	66	89	135	0.92	-0.39	-0.02	0.39	0.91	0.13	-0.03	-0.13	0.99
129	2022/01/25 11:17:31.493	2	868.8	822.7	-4119.5	0.54	60	82	118	0.92	-0.39	0.00	0.38	0.91	0.16	0.06	0.15	-0.99
130	2022/01/25 12:29:56.833	2	700.0	571.9	-4171.9	-0.10	83	156	181	0.83	-0.56	-0.07	0.55	0.83	-0.07	0.10	0.03	0.99
131	2022/01/25 12:37:49.331	2	478.9	766.4	-3957.0	-0.59	103	146	185	-0.41	0.89	0.20	0.67	0.44	-0.60	-0.62	-0.11	-0.78
132	2022/01/25 12:56:59.459	2	506.3	778.1	-3903.1	-0.50	83	115	183	0.52	-0.84	-0.18	-0.80	-0.55	0.23	-0.29	0.02	-0.96
133	2022/01/25 12:59:22.680	2	774.2	718.8	-4133.6	-0.72	110	182	260	0.84	-0.50	-0.23	-0.44	-0.86	0.27	-0.33	-0.12	-0.94
134	2022/01/25 13:29:33.179	2	554.7	597.7	-3925.0	-0.64	32	49	62	0.87	-0.44	-0.23	-0.37	-0.89	0.28	-0.32	-0.16	-0.93
135	2022/01/25 13:45:29.833	2	641.4	850.8	-4055.5	-0.46	163	237	338	0.61	-0.76	-0.23	-0.69	-0.65	0.32	-0.39	-0.04	-0.92
136	2022/01/25 14:33:05.509	2	846.1	453.9	-3776.6	-0.61	109	200	231	-0.90	0.39	0.17	-0.32	-0.89	0.33	0.28	0.24	0.93
137	2022/01/25 14:44:51.799	2	646.9	586.7	-4125.8	-0.58	159	295	324	-0.91	0.40	0.09	-0.07	-0.38	0.92	0.41	0.83	0.38
138	2022/01/25 15:00:27.646	2	832.0	923.4	-4240.6	-0.35	111	138	212	0.51	-0.84	-0.20	0.80	0.55	-0.26	-0.32	0.03	-0.95

139	2022/01/25 15:10:05.123	2	771.1	898.4	-4058.6	-0.45	114	198	258	0.77	-0.64	-0.02	-0.63	-0.75	-0.21	-0.12	-0.17	0.98
140	2022/01/25 15:34:03.783	2	652.3	799.2	-4025.0	-0.29	85	143	177	0.78	-0.59	-0.22	-0.54	-0.81	0.25	0.33	0.07	0.94
141	2022/01/25 15:44:28.201	2	675.8	843.0	-3969.5	-0.49	135	229	289	0.72	-0.67	-0.18	-0.66	-0.74	0.12	0.21	-0.03	0.98
142	2022/01/25 15:44:45.296	2	869.5	825.0	-4107.0	-0.29	117	192	248	0.73	-0.65	-0.23	-0.58	-0.76	0.31	0.37	0.09	0.92
143	2022/01/25 15:49:00.956	2	943.8	850.8	-4050.0	-0.49	93	135	216	-0.75	0.63	0.17	-0.60	-0.77	0.21	0.26	0.05	0.96
144	2022/01/25 16:19:26.315	2	746.1	545.3	-4113.3	-0.39	82	150	179	0.81	-0.57	-0.14	0.54	0.82	-0.18	-0.21	-0.07	-0.97
145	2022/01/25 16:38:48.313	2	763.3	694.5	-3797.7	-0.47	103	177	230	0.75	-0.65	-0.13	-0.65	-0.76	0.09	0.15	-0.02	0.99
146	2022/01/25 16:49:19.157	2	939.1	950.8	-4114.1	-1.00	82	161	194	0.89	-0.45	-0.09	0.45	0.89	0.02	0.07	-0.06	1.00
147	2022/01/25 16:57:30.657	2	789.1	879.7	-4252.3	-0.55	88	131	151	-0.59	0.80	0.11	0.72	0.58	-0.37	0.36	0.14	0.92
148	2022/01/25 16:59:16.813	2	660.2	855.5	-3946.1	-0.14	67	91	138	0.89	-0.45	-0.08	0.45	0.89	0.06	-0.05	0.09	-0.99
149	2022/01/25 17:01:44.780	2	789.8	850.8	-4321.9	-0.58	138	230	250	-0.93	0.35	-0.08	-0.33	-0.73	0.59	-0.15	-0.58	-0.80
150	2022/01/25 17:12:06.659	2	375.8	551.6	-3846.1	-0.79	24	36	50	0.74	-0.65	-0.17	-0.61	-0.75	0.24	0.28	0.07	0.96
151	2022/01/25 17:14:26.368	2	643.0	496.9	-3925.0	-1.03	116	179	280	-0.98	0.18	0.07	-0.16	-0.97	0.20	0.10	0.18	0.98
152	2022/01/25 17:17:36.801	2	783.6	829.7	-4123.4	-0.38	69	115	143	0.91	-0.41	-0.07	0.41	0.91	-0.02	-0.07	0.02	-1.00
153	2022/01/25 17:18:08.188	2	532.0	607.0	-4069.5	-0.76	148	177	269	0.97	-0.22	-0.08	-0.19	-0.94	0.28	-0.13	-0.26	-0.96
154	2022/01/25 17:24:53.590	2	864.8	742.2	-4200.0	-0.72	115	187	251	0.80	-0.58	-0.17	-0.61	-0.76	-0.25	-0.02	-0.30	0.95
155	2022/01/25 17:26:29.540	2	654.7	691.4	-3972.7	-0.81	132	250	294	0.88	-0.46	-0.13	0.45	0.89	-0.10	-0.16	-0.03	-0.99
156	2022/01/25 17:44:48.159	2	460.2	761.7	-3801.6	-0.65	83	131	189	0.43	-0.90	-0.10	0.90	0.44	-0.07	0.10	-0.06	0.99
157	2022/01/25 17:45:26.359	2	476.6	600.0	-3821.9	-0.74	37	56	68	0.67	-0.71	-0.23	-0.73	-0.68	0.00	0.15	-0.17	0.97
158	2022/01/25 17:47:53.522	2	628.9	665.6	-3977.3	-0.69	177	215	281	-0.53	0.70	0.48	0.62	0.70	-0.35	0.58	-0.11	0.81
159	2022/01/25 18:11:28.713	2	832.8	964.8	-4283.6	-0.67	107	151	199	0.57	-0.75	-0.33	0.55	0.65	-0.52	-0.61	-0.12	-0.79
160	2022/01/25 18:31:16.894	2	464.1	550.8	-3822.7	-0.87	17	25	51	-0.74	0.65	0.14	-0.61	-0.75	0.23	0.26	0.09	0.96
162	2022/01/25 18:32:25.299	2	882.0	613.3	-4050.0	-0.62	80	135	184	-0.97	0.21	0.08	-0.22	-0.97	-0.08	-0.06	0.10	-0.99
163	2022/01/25 18:33:49.822	2	663.3	587.5	-3995.3	-0.74	23	26	35	0.70	-0.66	-0.28	-0.62	-0.75	0.21	-0.35	0.02	-0.94
165	2022/01/25 19:35:00.256	2	374.2	511.7	-3910.2	-1.06	35	36	60	0.26	-0.96	0.09	-0.95	-0.23	0.20	0.18	0.14	0.97
166	2022/01/25 19:37:23.914	2	619.5	625.8	-3813.3	-0.92	36	56	80	0.83	-0.56	0.01	-0.56	-0.83	0.07	0.03	0.07	1.00
167	2022/01/25 19:53:35.816	2	403.9	477.3	-3875.0	-0.98	90	135	154	0.75	-0.64	-0.14	0.59	0.76	-0.27	0.28	0.12	0.95
168	2022/01/25 20:18:44.426	2	1098.4	914.1	-4128.9	-0.10	128	204	259	0.77	-0.58	-0.27	-0.52	-0.82	0.24	-0.36	-0.05	-0.93
169	2022/01/25 20:30:05.580	2	357.8	544.5	-3867.2	-0.83	26	27	47	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
171	2022/01/25 20:47:20.961	2	580.5	556.3	-3785.9	-1.09	52	78	133	-0.77	0.64	0.04	0.63	0.77	-0.11	0.11	0.06	0.99
172	2022/01/25 20:55:52.437	2	538.3	593.8	-3721.1	-0.62	6	9	21	-0.76	0.63	0.14	-0.60	-0.77	0.20	0.24	0.07	0.97
173	2022/01/25 21:00:33.993	2	398.4	610.2	-3905.5	-0.90	36	38	61	0.26	-0.96	0.09	-0.95	-0.23	0.20	0.17	0.14	0.97
174	2022/01/25 21:06:53.844	2	782.0	660.2	-3868.0	-0.85	165	283	387	0.85	-0.51	-0.16	-0.48	-0.86	0.17	-0.22	-0.06	-0.97
175	2022/01/25 21:10:31.570	2	367.2	584.4	-3909.4	-0.83	38	40	65	0.26	-0.96	0.09	-0.95	-0.23	0.20	0.17	0.14	0.97

176	2022/01/25 21:21:20.601	2	881.3	856.3	-4276.6	-0.10	69	93	135	0.86	-0.51	-0.09	0.51	0.86	0.01	0.07	-0.05	1.00
177	2022/01/25 21:25:51.125	2	655.5	662.5	-4085.9	-0.64	19	27	39	0.93	-0.12	-0.35	0.25	0.90	0.35	-0.27	0.42	-0.87
178	2022/01/25 21:44:01.400	2	875.8	518.0	-3874.2	-0.76	87	153	207	0.91	-0.31	-0.26	0.38	0.88	0.27	0.15	-0.35	0.92
179	2022/01/25 21:45:07.785	2	372.7	563.3	-3900.0	-0.88	26	38	72	-0.75	0.65	0.14	0.61	0.75	-0.23	0.26	0.09	0.96
180	2022/01/25 22:19:36.476	2	387.5	522.7	-3962.5	-0.88	37	39	63	-0.26	0.96	-0.09	-0.95	-0.23	0.20	0.17	0.14	0.97
181	2022/01/25 23:22:13.758	2	1175.0	1252.3	-4375.8	-0.52	125	180	254	-0.69	0.71	0.15	0.71	0.70	-0.04	0.13	-0.08	0.99
182	2022/01/25 23:31:16.531	2	355.5	511.7	-3851.6	-0.92	24	25	43	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
183	2022/01/26 00:18:08.839	2	992.2	474.2	-3932.0	-0.86	170	266	334	0.80	-0.59	-0.09	0.58	0.80	-0.16	-0.17	-0.08	-0.98
184	2022/01/26 01:00:39.407	2	1073.4	660.2	-3965.6	-0.70	81	140	197	0.85	-0.47	-0.22	-0.52	-0.74	-0.43	-0.04	-0.48	0.88
185	2022/01/26 02:24:25.438	2	466.4	560.2	-3737.5	-0.66	28	42	55	0.74	-0.65	-0.17	0.61	0.75	-0.24	-0.28	-0.08	-0.96
187	2022/01/26 02:51:15.224	2	768.8	662.5	-3774.2	-0.51	72	121	156	-0.95	0.30	0.10	-0.31	-0.93	-0.19	-0.04	0.21	-0.98
188	2022/01/26 02:54:22.275	2	875.8	734.4	-4125.0	-0.80	77	154	168	-0.90	0.43	0.02	-0.42	-0.87	-0.26	0.09	0.24	-0.97
189	2022/01/26 03:23:53.038	2	392.2	508.6	-3865.6	-0.82	22	23	38	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
190	2022/01/26 05:22:34.821	2	626.6	777.3	-3982.8	0.00	72	98	147	0.92	-0.38	-0.02	0.38	0.91	0.15	-0.04	-0.15	0.99
191	2022/01/26 05:46:03.152	2	564.8	558.6	-4022.7	-0.87	19	29	35	0.76	-0.63	-0.14	0.60	0.77	-0.21	-0.24	-0.07	-0.97
192	2022/01/26 06:49:50.808	2	1150.0	862.5	-4439.1	0.22	78	108	171	0.91	-0.40	0.04	-0.39	-0.90	-0.18	0.10	0.15	-0.98
193	2022/01/26 08:43:13.395	2	685.2	799.2	-4200.8	-0.68	91	115	133	-0.32	0.88	0.36	0.91	0.39	-0.14	0.26	-0.28	0.92
194	2022/01/26 11:46:32.451	2	846.1	641.4	-3860.9	-0.49	63	95	116	0.78	-0.54	-0.31	-0.52	-0.84	0.16	-0.35	0.03	-0.93
195	2022/01/26 12:01:49.547	2	892.2	805.5	-4129.7	0.27	67	91	134	-0.92	0.39	0.00	-0.38	-0.91	-0.16	-0.06	-0.15	0.99
196	2022/01/26 12:19:13.611	2	982.0	473.4	-3754.7	-0.86	168	308	401	0.86	-0.50	-0.10	-0.51	-0.84	-0.18	-0.01	-0.21	0.98
197	2022/01/26 12:29:58.209	2	764.1	823.4	-3974.2	0.16	82	106	166	0.94	-0.35	0.04	0.34	0.93	0.14	0.09	0.11	-0.99
198	2022/01/26 12:38:35.958	2	750.0	776.6	-3931.3	-0.51	115	191	261	-0.70	0.69	0.17	0.68	0.72	-0.11	0.20	-0.03	0.98
199	2022/01/26 12:46:53.091	2	1207.8	1230.5	-4200.0	-0.47	52	119	193	0.89	-0.46	0.00	0.27	0.53	0.80	-0.37	-0.71	0.60
200	2022/01/26 13:13:25.730	2	594.5	643.0	-3875.8	-0.80	43	66	80	0.76	-0.63	-0.14	0.60	0.77	-0.21	-0.24	-0.07	-0.97
201	2022/01/26 13:14:51.917	2	799.2	868.0	-4084.4	-0.12	75	93	139	0.50	-0.85	-0.18	-0.85	-0.52	0.10	-0.18	0.11	-0.98
202	2022/01/26 13:27:58.885	2	425.0	656.3	-3534.4	-0.63	82	122	229	0.73	-0.66	-0.18	-0.61	-0.75	0.25	0.30	0.07	0.95
203	2022/01/26 13:43:19.569	2	522.7	571.9	-3872.7	-0.93	11	11	20	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
204	2022/01/26 13:43:43.147	2	783.6	377.3	-3706.3	-0.55	160	265	305	-0.98	0.19	-0.07	-0.17	-0.96	-0.20	-0.11	-0.18	0.98
205	2022/01/26 14:03:15.252	2	539.8	532.0	-3740.6	-0.63	52	52	91	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
206	2022/01/26 14:04:13.524	2	764.8	772.7	-3979.7	0.16	93	176	224	0.86	-0.51	-0.04	0.47	0.82	-0.34	0.21	0.27	0.94
207	2022/01/26 14:08:26.930	2	527.3	589.8	-3831.3	-0.74	37	55	77	0.76	-0.63	-0.15	0.60	0.77	-0.21	-0.25	-0.07	-0.97
208	2022/01/26 14:11:24.287	2	582.0	778.1	-3950.0	-0.60	75	121	143	-0.56	0.82	0.14	0.81	0.57	-0.12	0.18	-0.05	0.98
209	2022/01/26 14:15:22.525	2	818.0	807.8	-3958.6	0.51	87	129	173	0.84	-0.54	-0.02	-0.53	-0.82	0.20	-0.13	-0.16	-0.98
210	2022/01/26 14:15:26.822	2	785.2	653.1	-3970.3	0.38	80	118	162	0.82	-0.56	-0.02	0.55	0.81	-0.17	-0.11	-0.13	-0.99

211	2022/01/26 14:27:32.848	2	744.5	564.1	-3750.8	-0.80	62	95	143	0.78	-0.62	-0.13	0.59	0.79	-0.17	-0.21	-0.06	-0.98
212	2022/01/26 14:29:40.171	2	685.9	789.1	-3912.5	0.07	80	100	152	0.84	-0.52	-0.15	0.53	0.85	0.01	-0.12	0.08	-0.99
213	2022/01/26 14:37:44.910	2	1053.9	937.5	-4337.5	0.24	85	137	175	-0.94	0.34	-0.02	-0.32	-0.90	-0.29	0.11	0.27	-0.96
214	2022/01/26 14:47:20.174	2	796.9	593.0	-3864.1	-0.25	90	172	182	-0.92	0.38	0.06	-0.28	-0.76	0.59	0.27	0.52	0.81
215	2022/01/26 15:00:22.335	2	762.5	697.7	-3846.9	0.50	91	123	190	0.92	-0.40	0.00	-0.39	-0.91	-0.13	0.05	0.12	-0.99
216	2022/01/26 15:00:37.805	2	690.6	614.8	-3922.7	-0.48	74	113	160	-0.73	0.66	0.19	-0.66	-0.75	0.10	0.21	-0.06	0.98
217	2022/01/26 15:03:14.592	2	521.9	526.6	-3814.1	-0.69	25	25	44	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
218	2022/01/26 15:10:06.545	2	847.7	835.2	-4089.8	0.33	66	105	142	-0.94	0.33	0.00	-0.32	-0.92	-0.24	0.08	0.23	-0.97
219	2022/01/26 15:19:21.189	2	460.9	726.6	-3953.9	-0.60	97	156	173	-0.54	0.83	0.14	0.82	0.56	-0.11	0.17	-0.06	0.98
220	2022/01/26 15:26:31.581	2	818.8	707.8	-3768.0	-0.16	90	131	187	0.76	-0.65	-0.09	-0.65	-0.76	-0.01	0.06	-0.07	1.00
221	2022/01/26 15:37:20.938	2	708.6	550.8	-3912.5	-0.33	82	157	165	-0.92	0.39	0.06	-0.25	-0.71	0.66	-0.30	-0.59	-0.75
222	2022/01/26 15:40:47.327	2	634.4	628.1	-3765.6	-0.57	99	148	185	0.87	-0.43	-0.24	-0.36	-0.89	0.29	-0.33	-0.17	-0.93
223	2022/01/26 15:43:10.905	2	1018.0	1243.0	-4270.3	-0.55	61	142	247	0.97	-0.21	0.09	0.04	0.55	0.83	-0.23	-0.81	0.54
224	2022/01/26 15:53:53.220	2	800.0	711.7	-3546.9	-0.02	121	235	297	0.90	-0.44	-0.04	-0.35	-0.76	0.56	0.28	0.48	0.83
225	2022/01/26 15:54:00.767	2	430.5	749.2	-3732.0	-0.40	71	114	151	0.53	-0.83	-0.16	0.81	0.56	-0.17	0.23	-0.04	0.97
226	2022/01/26 15:56:27.941	2	424.2	818.0	-3851.6	-0.44	101	162	207	0.54	-0.83	-0.16	0.81	0.56	-0.17	0.23	-0.04	0.97
227	2022/01/26 16:02:00.129	2	867.2	1214.8	-4174.2	0.16	165	268	343	0.92	-0.38	0.03	-0.21	-0.44	0.87	-0.32	-0.81	-0.49
228	2022/01/26 16:09:44.219	2	498.4	717.2	-3652.3	-0.59	50	69	98	-0.99	0.06	0.15	0.03	-0.82	0.57	0.16	0.56	0.81
229	2022/01/26 16:13:34.424	2	475.8	610.9	-3767.2	-0.71	37	56	88	-0.74	0.65	0.17	0.61	0.75	-0.24	0.29	0.07	0.96
230	2022/01/26 16:16:38.213	2	455.5	735.2	-3725.0	-0.42	78	126	172	0.53	-0.83	-0.17	0.81	0.56	-0.18	0.24	-0.04	0.97
231	2022/01/26 16:17:53.967	2	453.9	617.2	-3703.9	-0.81	42	63	81	-0.68	0.70	0.22	0.70	0.71	-0.08	0.21	-0.10	0.97
232	2022/01/26 16:34:45.848	2	762.5	510.2	-3544.5	-0.99	225	227	424	-0.99	0.13	0.09	-0.11	-0.98	0.16	-0.11	-0.14	-0.98
233	2022/01/26 17:00:09.735	2	729.7	746.9	-4074.2	-0.75	47	53	74	-0.43	0.88	0.20	0.88	0.45	-0.11	-0.19	0.14	-0.97
234	2022/01/26 17:34:13.623	2	620.3	662.5	-3825.8	-0.86	115	194	268	-0.84	0.52	0.18	0.49	0.85	-0.19	0.25	0.07	0.96
235	2022/01/26 17:37:25.059	2	813.3	802.3	-3991.4	-0.53	93	172	210	0.75	-0.65	-0.12	-0.66	-0.74	-0.16	-0.01	-0.20	0.98
236	2022/01/26 17:38:12.450	2	677.3	696.1	-3869.5	-0.50	35	55	69	-0.37	0.93	0.09	0.91	0.38	-0.19	-0.21	0.02	-0.98
237	2022/01/26 17:52:17.303	2	464.8	422.7	-3666.4	-0.81	117	188	235	-0.36	0.93	0.07	0.90	0.37	-0.25	-0.26	-0.02	-0.96
238	2022/01/26 18:16:25.076	2	913.3	599.2	-3967.2	-0.80	199	203	442	-0.49	0.87	0.07	0.87	0.49	-0.02	-0.05	0.05	-1.00
239	2022/01/26 18:30:16.876	2	892.2	660.2	-3987.5	-0.65	78	123	158	-0.96	0.27	0.03	-0.27	-0.95	-0.15	0.01	0.15	-0.99
240	2022/01/26 18:40:01.591	2	811.7	760.9	-3834.4	-0.16	102	149	205	0.76	-0.65	-0.09	-0.65	-0.76	0.00	0.06	-0.06	1.00
241	2022/01/26 18:40:42.585	2	893.0	630.5	-3846.1	-0.39	127	234	305	0.84	-0.53	-0.07	0.53	0.80	0.28	-0.09	-0.27	0.96
242	2022/01/26 19:02:10.752	2	1332.8	870.3	-4265.6	-0.73	101	150	190	-0.94	-0.35	-0.03	0.35	-0.94	0.08	-0.05	0.06	1.00
243	2022/01/26 19:13:33.887	2	711.7	653.1	-3753.1	-0.91	135	194	273	0.88	-0.45	-0.14	0.47	0.87	0.14	-0.06	0.19	-0.98
244	2022/01/26 19:19:40.363	2	729.7	674.2	-3889.8	-0.11	61	80	121	-0.96	0.28	0.03	-0.28	-0.94	-0.20	0.03	0.20	-0.98

245	2022/01/26 19:42:44.299	2	861.7	741.4	-4062.5	-0.72	78	157	235	0.90	-0.43	-0.03	-0.43	-0.90	-0.03	0.01	-0.04	1.00
246	2022/01/26 19:48:41.934	2	836.7	617.2	-3998.4	-0.81	122	219	263	0.86	-0.49	-0.15	0.46	0.87	-0.16	-0.21	-0.07	-0.97
247	2022/01/26 20:32:42.959	2	1296.1	1124.2	-4293.0	-0.58	57	81	119	0.65	-0.75	-0.14	-0.74	-0.66	0.13	0.19	-0.02	0.98
248	2022/01/26 20:48:10.639	2	459.4	532.8	-3876.6	-0.70	25	38	45	0.74	-0.65	-0.16	0.61	0.75	-0.24	-0.28	-0.08	-0.96
249	2022/01/26 20:50:08.048	2	937.5	754.7	-4056.3	-0.68	38	65	96	0.88	-0.46	-0.13	0.47	0.79	0.38	0.07	0.40	-0.92
250	2022/01/26 21:15:48.143	2	518.0	665.6	-3627.3	-0.75	105	124	169	0.32	-0.93	-0.20	0.91	0.36	-0.20	-0.26	0.12	-0.96
251	2022/01/26 21:57:06.105	2	828.9	504.7	-4079.7	-0.63	170	315	366	0.87	-0.47	-0.14	0.46	0.88	-0.14	-0.19	-0.06	-0.98
252	2022/01/26 22:01:06.813	2	667.2	786.7	-3761.7	-0.03	67	90	135	0.92	-0.39	-0.03	-0.38	-0.91	-0.15	0.03	0.15	-0.99
253	2022/01/26 22:02:08.936	2	732.8	657.8	-4156.3	-0.73	21	29	35	0.80	-0.59	0.10	-0.59	-0.78	0.18	0.03	0.20	0.98
254	2022/01/26 22:27:43.236	2	878.1	582.0	-4218.8	-0.85	157	228	324	0.90	-0.43	-0.02	-0.41	-0.88	0.25	-0.13	-0.22	-0.97
255	2022/01/26 22:34:19.966	2	596.1	665.6	-3889.1	-0.75	24	34	46	0.78	-0.62	0.00	-0.61	-0.77	0.20	0.13	0.16	0.98
256	2022/01/26 23:09:36.689	2	578.1	671.1	-3810.2	-0.49	89	130	164	0.81	-0.51	-0.27	-0.36	-0.81	0.46	-0.46	-0.28	-0.84
257	2022/01/26 23:11:10.866	2	733.6	803.9	-3898.4	-0.73	82	96	155	0.50	-0.86	-0.06	-0.84	-0.50	0.21	0.22	0.05	0.97
258	2022/01/27 00:29:14.773	2	736.7	813.3	-3875.0	-0.91	102	119	211	0.17	-0.98	0.06	-0.98	-0.17	0.05	-0.04	-0.07	-1.00
259	2022/01/27 00:31:58.867	2	785.2	925.8	-3853.9	-0.93	157	185	332	0.19	-0.98	0.01	-0.98	-0.19	0.04	-0.04	-0.02	-1.00
260	2022/01/27 00:42:48.436	2	601.6	740.6	-3612.5	-0.79	72	86	133	0.86	-0.51	-0.08	-0.45	-0.82	0.35	-0.25	-0.26	-0.93
261	2022/01/27 00:56:02.313	2	655.5	713.3	-3532.8	-0.62	72	85	140	0.01	0.99	0.12	0.99	0.00	-0.11	0.11	-0.12	0.99
262	2022/01/27 01:09:16.440	2	563.3	605.5	-3791.4	-0.72	70	84	113	-0.73	0.60	0.33	0.66	0.75	0.09	0.19	-0.28	0.94
263	2022/01/27 01:19:08.180	2	612.5	650.0	-3873.4	-0.70	45	64	85	0.79	-0.62	0.01	-0.61	-0.77	0.20	0.12	0.16	0.98
264	2022/01/27 01:19:29.605	2	873.4	837.5	-3901.6	-0.38	99	166	226	-0.70	0.69	0.17	0.68	0.72	-0.11	0.20	-0.03	0.98
265	2022/01/27 02:42:00.866	2	676.6	875.8	-3862.5	-0.55	81	116	189	0.07	-0.99	-0.11	-1.00	-0.07	-0.03	0.02	0.11	-0.99
266	2022/01/27 03:16:57.689	2	725.8	719.5	-3932.8	-0.45	96	111	165	-0.04	0.99	0.12	-1.00	-0.04	0.06	-0.06	0.12	-0.99
267	2022/01/27 03:29:39.556	2	573.4	644.5	-3832.8	-0.07	63	90	159	-0.76	0.64	0.12	0.65	0.76	0.02	0.08	-0.10	0.99
268	2022/01/27 03:33:07.509	2	578.9	689.1	-3739.8	-0.96	46	69	123	-0.76	0.63	0.16	-0.60	-0.77	0.21	0.25	0.06	0.97
269	2022/01/27 03:43:11.028	2	803.9	836.7	-4042.2	-0.29	77	99	150	0.63	-0.75	-0.22	0.75	0.66	-0.09	0.22	-0.11	0.97
270	2022/01/27 04:35:12.374	2	582.0	713.3	-4017.2	-0.77	104	107	180	0.48	-0.88	0.02	-0.86	-0.47	0.17	0.14	0.10	0.99
271	2022/01/27 06:33:59.581	2	581.3	782.8	-3876.6	0.07	64	86	150	0.91	-0.42	-0.06	-0.42	-0.90	-0.11	0.01	-0.12	0.99
272	2022/01/27 18:36:06.415	2	800.0	464.1	-3722.7	-0.91	161	245	330	0.27	0.96	-0.11	0.96	-0.28	-0.07	-0.09	-0.08	-0.99
273	2022/01/27 18:46:41.429	2	773.4	741.4	-3810.2	-0.38	94	127	196	0.88	-0.47	-0.07	-0.47	-0.88	-0.05	0.04	-0.08	1.00
274	2022/01/27 19:42:35.017	2	685.2	712.5	-3746.9	-0.72	56	105	126	0.90	-0.41	-0.12	-0.41	-0.91	0.01	-0.11	0.04	-0.99
275	2022/01/27 21:24:52.447	2	564.1	792.2	-4016.4	0.29	76	91	134	-0.99	0.13	0.00	-0.12	-0.98	-0.17	0.02	0.17	-0.99
276	2022/01/27 21:26:53.289	2	716.4	586.7	-3807.8	-0.72	97	142	162	0.89	-0.44	-0.14	-0.46	-0.86	-0.22	0.02	-0.26	0.97
277	2022/01/27 22:24:04.511	2	1045.3	785.9	-4235.2	-0.63	71	113	160	-0.97	0.22	0.04	-0.22	-0.90	-0.38	0.05	0.38	-0.93
278	2022/01/28 01:28:03.183	2	766.4	692.2	-3876.6	0.00	75	101	161	0.92	-0.40	0.00	0.39	0.91	0.14	0.05	0.13	-0.99



279	2022/01/28 01:54:16.440	2	824.2	714.1	-4138.3	-0.71	92	149	212	-0.98	0.17	-0.08	-0.19	-0.96	0.19	0.05	-0.20	-0.98
280	2022/01/28 02:20:32.287	2	592.2	635.2	-3928.1	-1.13	94	155	171	-0.92	-0.39	0.08	0.39	-0.92	0.01	-0.07	-0.04	-1.00
281	2022/01/28 02:42:15.045	2	335.2	588.3	-3834.4	-1.24	17	18	31	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
282	2022/01/28 12:33:49.362	2	596.9	656.3	-4035.9	-0.30	99	152	214	0.89	-0.42	-0.19	0.42	0.91	-0.02	-0.18	0.06	-0.98
283	2022/01/28 17:05:41.340	2	712.5	735.2	-3886.7	-0.05	115	158	236	-0.73	0.66	0.17	0.67	0.74	-0.03	0.15	-0.09	0.98
284	2022/01/29 00:31:14.801	2	582.0	461.7	-3618.0	-0.94	49	74	103	0.77	-0.62	-0.14	-0.59	-0.77	0.24	0.26	0.10	0.96
285	2022/01/29 02:21:08.200	2	517.2	532.0	-3671.9	-0.72	19	28	43	-0.76	0.64	0.15	0.60	0.77	-0.21	0.25	0.07	0.96
286	2022/01/29 14:37:12.878	2	1260.2	1040.6	-4490.6	-0.19	52	86	125	-0.60	0.79	0.13	-0.80	-0.60	0.02	0.09	-0.09	0.99
287	2022/01/29 18:06:28.814	2	604.7	530.5	-3825.0	-0.43	98	146	173	0.66	-0.72	-0.22	-0.75	-0.65	-0.12	0.06	-0.25	0.97
288	2022/01/29 22:46:30.265	2	898.4	826.6	-3825.0	0.25	72	98	150	0.92	-0.39	-0.01	0.39	0.91	0.15	0.05	0.14	-0.99
289	2022/01/30 00:13:51.517	2	810.2	503.9	-3650.8	-0.85	158	239	428	-0.97	0.23	-0.04	0.23	0.96	-0.17	0.00	0.17	0.99
290	2022/01/30 02:01:03.722	2	880.5	527.3	-3950.0	-0.99	140	242	319	0.90	-0.43	-0.02	0.41	0.88	-0.22	-0.11	-0.19	-0.97
291	2022/01/30 04:33:37.507	2	724.2	813.3	-3940.6	-0.39	61	79	118	0.95	-0.31	-0.06	-0.31	-0.93	-0.20	0.00	-0.21	0.98
292	2022/02/25 16:29:50.942	3	582.0	628.9	-3887.5	-0.67	27	28	49	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
293	2022/02/25 18:40:28.802	3	821.1	740.6	-4332.0	-0.59	148	159	217	0.93	0.14	-0.34	0.19	-0.97	0.14	-0.31	-0.19	-0.93
294	2022/02/25 20:07:44.135	3	1089.1	417.2	-3885.9	-0.68	118	209	298	0.93	-0.29	-0.24	0.35	0.90	0.26	0.14	-0.32	0.94
296	2022/02/25 23:08:28.008	3	639.8	744.5	-3939.1	-0.39	84	110	165	0.94	-0.33	-0.12	0.35	0.93	0.12	0.08	-0.15	0.99
298	2022/02/26 01:20:23.212	3	692.2	580.5	-3854.7	-0.79	112	194	254	0.84	-0.51	-0.18	-0.48	-0.86	0.19	-0.25	-0.07	-0.97
299	2022/02/26 03:51:03.580	3	829.7	807.8	-3949.2	-0.21	44	58	87	0.90	-0.41	-0.13	-0.42	-0.90	-0.09	-0.08	0.14	-0.99
300	2022/02/26 09:52:49.064	3	1224.2	675.8	-3932.8	-0.65	130	175	268	0.58	-0.81	-0.04	-0.78	-0.56	0.27	-0.24	-0.13	-0.96
301	2022/02/26 18:19:00.585	3	457.0	514.8	-3814.8	-0.59	61	64	109	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
303	2022/02/28 13:17:43.076	3	621.1	885.2	-3989.8	-0.20	148	225	265	0.71	-0.68	-0.21	-0.59	-0.73	0.35	0.39	0.12	0.91
304	2022/03/01 04:19:07.163	3	601.6	467.2	-4278.9	-0.91	163	254	369	0.77	-0.62	-0.14	-0.59	-0.78	0.22	0.24	0.09	0.97
305	2022/03/01 12:23:27.367	3	601.6	675.0	-3893.8	-0.94	48	49	87	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
306	2022/03/01 14:09:19.454	3	737.5	768.0	-4241.4	-0.52	38	59	96	0.57	-0.80	-0.21	0.73	0.60	-0.33	0.39	0.04	0.92
307	2022/03/01 14:09:53.387	3	763.3	935.2	-3943.8	-0.67	141	167	256	0.53	-0.84	-0.08	-0.82	-0.54	0.22	0.23	0.05	0.97
308	2022/03/01 14:16:49.417	3	722.7	943.0	-4307.0	-0.45	149	180	224	-0.99	-0.02	0.12	0.08	-0.87	0.48	0.10	0.49	0.87
309	2022/03/01 14:17:12.565	3	1000.8	790.6	-4224.2	-0.35	136	237	259	-0.92	0.35	0.15	-0.33	-0.93	0.15	-0.19	-0.09	-0.98
310	2022/03/01 14:47:01.430	3	745.3	871.9	-4176.6	-0.39	135	201	233	-0.59	0.80	0.11	0.73	0.58	-0.37	-0.36	-0.13	-0.92
311	2022/03/01 14:52:44.545	3	626.6	791.4	-4035.2	-0.65	63	108	118	-0.57	0.81	0.13	0.78	0.48	0.40	-0.26	-0.33	0.91
312	2022/03/01 14:56:54.394	3	921.9	795.3	-4111.7	-0.47	94	184	190	-0.79	0.61	0.05	0.21	0.19	0.96	0.57	0.77	-0.28
313	2022/03/01 16:40:17.593	3	728.9	882.0	-4148.4	-0.53	75	119	159	-0.47	0.88	0.06	-0.88	-0.47	-0.06	-0.02	-0.08	1.00
314	2022/03/01 20:02:44.365	3	1107.8	373.4	-4188.3	-0.63	95	104	294	-0.95	0.30	-0.06	0.31	0.93	-0.18	0.00	0.19	0.98
315	2022/03/01 20:09:46.992	3	796.1	811.7	-4037.5	-0.34	92	131	205	-0.68	0.70	0.20	-0.64	-0.71	0.29	0.35	0.07	0.93

316	2022/03/02 14:07:20.134	3	754.7	783.6	-3839.1	0.41	59	74	108	-1.00	0.08	-0.04	0.07	0.98	0.19	-0.05	-0.18	0.98
317	2022/03/02 14:16:52.086	3	951.6	860.9	-4068.8	-0.40	131	211	284	0.70	-0.71	-0.07	-0.71	-0.70	0.00	0.05	-0.05	1.00
318	2022/03/02 14:24:47.087	3	865.6	803.9	-4155.5	-0.17	88	126	177	0.75	-0.64	-0.16	-0.59	-0.77	0.24	0.28	0.09	0.96
319	2022/03/02 15:24:28.375	3	700.0	675.0	-3989.8	-0.06	80	115	198	0.73	-0.68	-0.06	-0.68	-0.73	-0.03	0.02	-0.07	1.00
320	2022/03/02 15:28:23.692	3	1312.5	1363.3	-4761.7	-0.34	180	250	294	0.49	-0.72	-0.49	-0.29	-0.67	0.68	0.82	0.19	0.54
321	2022/03/02 15:46:55.918	3	832.8	818.0	-4046.1	0.32	65	89	134	0.92	-0.39	-0.01	0.39	0.91	0.16	-0.06	-0.15	0.99
323	2022/03/02 15:48:36.713	3	1061.7	927.3	-4299.2	0.23	78	107	156	0.86	-0.51	-0.08	-0.51	-0.86	-0.03	0.06	-0.07	1.00
324	2022/03/02 15:57:10.564	3	714.8	867.2	-4052.3	-0.55	68	102	142	-0.49	0.86	0.11	-0.84	-0.51	0.19	-0.22	0.00	-0.97
325	2022/03/02 16:12:12.170	3	558.6	893.0	-3910.2	-0.57	158	253	295	0.37	-0.92	-0.12	0.91	0.38	-0.16	0.19	-0.05	0.98
326	2022/03/02 16:32:37.364	3	871.9	848.4	-4160.2	0.17	75	102	146	0.93	-0.38	0.00	0.37	0.91	0.16	0.06	0.15	-0.99
327	2022/03/02 16:41:50.964	3	557.8	960.9	-4190.6	-0.45	61	75	258	-0.96	-0.11	0.27	0.02	-0.95	-0.32	0.29	-0.30	0.91
328	2022/03/02 17:03:33.632	3	681.3	795.3	-3954.7	-0.13	68	99	131	0.75	-0.65	-0.10	-0.66	-0.76	0.01	0.08	-0.06	0.99
329	2022/03/02 17:06:47.684	3	628.9	811.7	-3927.3	-0.34	109	161	210	-0.71	0.67	0.22	-0.63	-0.74	0.25	0.33	0.04	0.94
330	2022/03/02 17:35:56.592	3	800.0	906.3	-4172.7	-0.45	123	179	241	-0.70	0.71	0.04	0.70	0.70	-0.15	0.14	0.08	0.99
331	2022/03/02 17:37:41.187	3	628.9	651.6	-3948.4	-0.97	54	55	92	0.50	-0.86	0.05	0.85	0.49	-0.19	0.14	0.14	0.98
333	2022/03/02 19:11:45.727	3	551.6	335.9	-3752.3	-0.68	215	247	341	0.64	-0.60	-0.47	0.56	0.79	-0.24	-0.52	0.11	-0.85
334	2022/03/02 19:17:43.944	3	843.8	778.1	-4301.6	-0.69	122	189	222	0.62	-0.75	-0.22	-0.78	-0.59	-0.22	-0.03	-0.31	0.95
335	2022/03/02 19:22:29.975	3	1321.9	918.0	-4474.2	0.36	58	84	134	0.75	-0.66	-0.04	-0.66	-0.74	-0.12	-0.05	-0.12	0.99
336	2022/03/02 20:20:11.414	3	689.1	446.9	-3715.6	-0.72	106	195	247	0.89	-0.38	-0.24	0.44	0.86	0.25	-0.12	0.33	-0.94
337	2022/03/02 20:35:20.967	3	475.0	650.0	-3703.1	-0.80	43	57	80	0.94	-0.30	-0.17	0.27	0.94	-0.20	-0.22	-0.14	-0.96
338	2022/03/02 21:03:19.365	3	558.6	716.4	-3956.3	-0.30	80	99	135	-0.46	0.87	0.19	0.86	0.49	-0.15	-0.22	0.09	-0.97
339	2022/03/02 21:53:24.439	3	1332.8	1228.9	-4718.8	-0.32	56	88	105	-0.56	0.82	0.11	-0.22	-0.28	0.93	0.79	0.50	0.34
340	2022/03/02 22:14:24.023	3	793.0	598.4	-3941.4	-0.74	181	205	357	0.14	-0.99	-0.08	-0.99	-0.14	-0.01	0.00	0.08	-1.00
341	2022/03/02 22:20:21.238	3	1000.0	463.3	-3873.4	-0.79	223	319	408	-0.97	0.13	0.18	-0.06	-0.93	0.36	0.21	0.34	0.91
342	2022/03/02 23:30:56.258	3	459.4	699.2	-3901.6	-0.68	74	92	154	0.70	-0.68	-0.20	0.58	0.71	-0.39	-0.41	-0.16	-0.90
343	2022/03/02 23:32:52.675	3	739.8	635.9	-3997.7	-0.28	91	121	170	0.84	-0.53	-0.07	-0.53	-0.85	-0.02	0.05	-0.05	1.00
344	2022/03/02 23:57:01.160	3	716.4	534.4	-3659.4	-0.88	136	225	329	0.90	-0.43	-0.02	-0.41	-0.89	0.21	-0.11	-0.18	-0.98
345	2022/03/03 00:07:18.937	3	676.6	489.8	-3674.2	-0.93	95	217	241	-0.96	0.24	0.15	-0.01	-0.56	0.83	0.29	0.79	0.54
346	2022/03/03 00:16:28.731	3	724.2	766.4	-4096.1	0.67	64	87	132	0.92	-0.39	-0.01	0.39	0.91	0.16	-0.06	-0.15	0.99
347	2022/03/03 00:28:48.759	3	633.6	730.5	-4042.2	-0.35	105	133	234	-0.47	0.87	0.18	0.87	0.48	-0.07	-0.15	0.12	-0.98
348	2022/03/03 00:57:59.148	3	923.4	696.1	-4191.4	-0.50	111	223	236	-0.90	0.43	-0.01	-0.38	-0.82	-0.43	0.19	0.38	-0.90
349	2022/03/03 01:24:49.758	3	439.8	755.5	-4013.3	-0.69	95	113	168	0.38	-0.92	-0.04	-0.88	-0.37	0.28	0.28	0.07	0.96
350	2022/03/03 02:10:15.595	3	490.6	765.6	-4027.3	-0.54	80	96	162	0.03	0.99	0.12	0.99	-0.01	-0.14	0.14	-0.12	0.98
351	2022/03/03 04:02:06.191	3	1089.1	763.3	-4125.0	-0.89	160	352	374	-0.01	0.99	0.15	0.96	-0.04	0.28	0.28	0.15	-0.95

352	2022/03/03 04:11:01.264	3	429.7	835.9	-3899.2	-0.43	89	141	181	0.00	0.99	0.11	-1.00	-0.01	0.08	0.08	-0.11	0.99
353	2022/03/03 08:11:17.776	3	580.5	767.2	-3774.2	-0.54	95	150	197	0.48	-0.87	-0.07	0.88	0.48	0.03	0.01	-0.07	1.00
354	2022/03/03 14:15:35.322	3	543.0	681.3	-3500.8	-0.74	44	66	115	-0.73	0.66	0.18	0.64	0.75	-0.16	0.24	0.00	0.97
355	2022/03/03 20:14:01.240	3	546.1	612.5	-3664.8	-0.65	31	46	78	-0.73	0.66	0.18	0.64	0.75	-0.15	0.24	-0.01	0.97
356	2022/03/04 04:56:02.024	3	840.6	869.5	-4127.3	0.10	64	87	126	0.92	-0.39	0.00	-0.38	-0.91	-0.16	0.06	0.15	-0.99
357	2022/03/04 04:59:26.123	3	444.5	829.7	-4156.3	-0.71	99	136	207	-0.78	-0.62	-0.01	-0.53	0.65	0.54	-0.33	0.43	-0.84
358	2022/03/04 08:11:27.507	3	608.6	902.3	-3935.2	-0.57	64	102	122	-0.51	0.86	0.07	-0.85	-0.50	-0.15	-0.10	-0.14	0.99
360	2022/03/04 19:00:22.745	3	509.4	596.9	-3680.5	-0.60	38	56	102	-0.74	0.66	0.16	0.64	0.75	-0.15	0.22	0.01	0.98
361	2022/03/04 19:27:40.492	3	612.5	771.1	-3907.8	-0.01	57	77	119	0.92	-0.38	-0.02	0.38	0.91	0.16	0.04	0.15	-0.99
362	2022/03/04 19:34:31.865	3	470.3	436.7	-3900.8	-0.65	59	61	98	0.19	-0.97	0.15	0.97	0.16	-0.21	0.18	0.18	0.97
363	2022/03/04 19:58:41.701	3	870.3	875.0	-3960.9	-0.44	99	140	216	-0.69	0.71	0.12	0.70	0.70	-0.16	0.20	0.02	0.98
364	2022/03/04 20:01:13.766	3	927.3	898.4	-4134.4	-0.08	71	120	173	0.88	-0.47	-0.03	-0.48	-0.88	-0.03	0.01	-0.04	1.00
365	2022/03/04 20:15:52.168	3	882.8	686.7	-3898.4	-0.72	83	145	200	-0.86	0.50	0.08	0.50	0.85	0.13	0.00	-0.15	0.99
367	2022/03/04 22:04:11.401	3	753.9	814.8	-4215.6	-0.16	91	127	182	0.65	-0.76	-0.03	-0.76	-0.64	-0.12	-0.07	-0.10	0.99
368	2022/03/04 22:06:18.542	3	981.3	828.1	-3554.7	-0.87	152	174	302	-0.12	0.98	0.18	0.99	0.14	-0.06	0.08	-0.17	0.98
369	2022/03/04 22:17:23.448	3	814.1	900.0	-4199.2	0.06	74	109	151	0.76	-0.64	-0.10	-0.64	-0.76	-0.04	0.05	-0.09	0.99
370	2022/03/04 22:23:54.292	3	581.3	800.0	-4086.7	-0.54	106	138	199	0.56	-0.81	-0.17	0.82	0.58	-0.05	0.14	-0.11	0.98
371	2022/03/04 22:25:12.905	3	386.7	672.7	-3763.3	-1.13	96	100	172	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
372	2022/03/04 22:27:48.178	3	768.8	605.5	-3528.9	-0.86	133	148	273	-0.60	0.76	0.25	0.74	0.65	-0.17	0.29	-0.08	0.95
373	2022/03/04 22:32:52.227	3	757.8	928.9	-4107.8	-0.41	110	164	278	-0.62	0.76	0.18	-0.74	-0.65	0.19	0.26	-0.01	0.97
375	2022/03/04 23:10:02.204	3	798.4	805.5	-4105.5	0.46	71	97	139	0.92	-0.39	0.00	-0.38	-0.91	-0.16	0.06	0.15	-0.99
376	2022/03/04 23:45:07.908	3	821.1	854.7	-4034.4	-0.35	84	120	188	0.73	-0.68	-0.05	-0.69	-0.72	-0.08	-0.02	-0.09	1.00
377	2022/03/05 00:02:44.434	3	800.0	682.8	-3937.5	-0.68	91	173	202	0.88	-0.46	-0.12	-0.45	-0.89	0.10	-0.15	-0.03	-0.99
378	2022/03/05 01:44:52.533	3	701.6	729.7	-3924.2	-0.91	98	129	191	0.48	-0.86	-0.16	-0.84	-0.50	0.20	-0.25	0.04	-0.97
379	2022/03/05 02:29:58.370	3	538.3	539.8	-3655.5	-0.96	34	50	67	-0.70	0.68	0.20	0.69	0.72	-0.06	0.19	-0.10	0.98
380	2022/03/05 03:01:52.613	3	564.1	718.8	-3882.8	-0.56	68	84	124	0.36	-0.92	-0.15	0.89	0.38	-0.23	-0.27	0.05	-0.96
381	2022/03/05 03:53:50.466	3	433.6	451.6	-4135.2	-0.88	87	134	149	0.76	-0.64	-0.14	0.59	0.76	-0.26	0.28	0.11	0.95
382	2022/03/05 04:31:46.115	3	539.1	800.0	-3650.0	-0.34	85	98	161	0.59	0.79	0.15	0.76	-0.48	-0.44	-0.27	0.38	-0.88
383	2022/03/05 06:56:23.701	3	635.9	636.7	-3957.0	-0.96	25	29	38	0.70	-0.66	-0.28	-0.62	-0.75	0.21	-0.35	0.02	-0.94
384	2022/03/05 12:03:44.081	3	614.8	523.4	-3889.1	-0.62	37	55	68	0.76	-0.63	-0.14	0.60	0.77	-0.21	-0.24	-0.07	-0.97
385	2022/03/05 13:01:43.982	3	629.7	796.1	-3763.3	1.66	66	89	134	0.92	-0.39	-0.03	0.38	0.91	0.15	0.03	0.15	-0.99
386	2022/03/05 13:56:13.961	3	690.6	720.3	-3918.8	0.22	80	89	131	0.43	-0.85	-0.29	-0.86	-0.49	0.14	0.26	-0.19	0.95
387	2022/03/05 14:30:17.357	3	813.3	837.5	-4075.0	0.62	59	81	127	0.92	-0.39	-0.01	0.39	0.91	0.16	0.06	0.15	-0.99
388	2022/03/05 16:47:25.481	3	778.9	707.8	-4084.4	-0.65	104	162	213	-1.00	-0.07	-0.05	-0.07	0.99	-0.11	-0.05	0.11	0.99

389	2022/03/05 18:26:49.161	3	647.7	779.7	-3635.9	0.46	53	71	120	0.92	-0.39	-0.03	0.39	0.91	0.15	0.03	0.15	-0.99
390	2022/03/05 18:59:14.617	3	842.2	638.3	-3707.0	-0.94	105	154	228	0.93	-0.37	-0.07	-0.38	-0.92	-0.09	-0.03	0.11	-0.99
391	2022/03/05 21:27:37.339	3	674.2	712.5	-3689.8	-0.65	81	134	190	-0.71	0.68	0.18	0.67	0.73	-0.12	0.21	-0.04	0.98
392	2022/03/05 21:44:48.691	3	695.3	523.4	-3624.2	-0.71	89	155	204	0.82	-0.54	-0.18	-0.57	-0.82	-0.12	0.08	-0.20	0.98
393	2022/03/05 22:35:22.398	3	814.1	552.3	-3846.1	-0.63	65	111	147	-0.79	0.58	0.19	0.61	0.79	0.11	0.09	-0.20	0.98
394	2022/03/06 00:37:09.509	3	677.3	768.0	-3587.5	-0.25	74	106	154	0.74	-0.66	-0.12	-0.66	-0.75	0.01	0.10	-0.07	0.99
395	2022/03/06 06:54:14.360	3	616.4	732.8	-3714.8	-0.96	158	227	310	0.21	0.97	-0.11	0.97	-0.23	-0.11	-0.13	-0.08	-0.99
396	2022/03/06 08:02:30.403	3	621.9	627.3	-3767.2	-0.47	58	65	107	0.90	-0.39	-0.17	-0.41	-0.91	-0.04	-0.13	0.11	-0.99
397	2022/03/06 14:22:15.907	3	491.4	599.2	-3828.9	-0.73	106	132	177	-0.45	0.79	0.41	-0.66	-0.60	0.45	0.61	-0.07	0.79
398	2022/03/06 20:03:37.536	3	1111.7	955.5	-4130.5	-0.56	83	114	175	0.94	-0.29	-0.19	-0.31	-0.95	-0.06	-0.16	0.11	-0.98
400	2022/03/06 23:37:06.333	3	750.0	694.5	-4028.1	-0.70	97	176	209	0.86	-0.48	-0.15	0.46	0.87	-0.16	-0.21	-0.07	-0.98
401	2022/03/07 00:28:24.279	3	884.4	836.7	-4121.9	-0.46	96	137	193	-0.75	0.64	0.17	-0.59	-0.77	0.25	0.29	0.09	0.95
402	2022/03/08 12:40:42.637	3	622.7	755.5	-3824.2	0.25	70	95	147	0.86	-0.50	-0.10	0.51	0.86	0.02	-0.08	0.07	-0.99
403	2022/03/08 16:41:02.853	3	653.9	747.7	-3976.6	-0.64	177	228	346	-0.80	0.59	0.11	-0.51	-0.76	0.41	0.32	0.27	0.91
404	2022/03/08 19:37:06.196	3	786.7	384.4	-3796.1	-0.67	157	246	288	-0.97	0.21	-0.09	-0.22	-0.95	0.21	0.04	-0.22	-0.97
405	2022/03/09 13:30:19.569	3	836.7	452.3	-3970.3	-0.47	175	207	381	0.97	-0.23	-0.13	-0.20	-0.96	0.19	0.17	0.16	0.97
406	2022/03/09 14:47:35.663	3	800.8	914.8	-3803.9	-0.44	214	337	788	-0.97	0.25	-0.05	-0.25	-0.96	0.13	0.02	-0.14	-0.99
407	2022/03/09 16:09:24.956	3	902.3	915.6	-4154.7	0.22	85	146	170	0.87	-0.49	-0.04	-0.48	-0.85	-0.19	-0.05	-0.19	0.98
408	2022/03/09 17:18:14.873	3	947.7	1010.9	-3874.2	-0.28	91	149	202	0.76	-0.62	-0.21	-0.58	-0.78	0.21	0.30	0.04	0.95
409	2022/03/09 17:24:24.748	3	798.4	806.3	-3949.2	0.27	95	160	208	-0.72	0.67	0.16	0.67	0.74	-0.11	0.19	-0.03	0.98
410	2022/03/09 18:14:02.422	3	625.0	760.9	-3910.2	0.57	72	135	149	0.83	-0.55	-0.10	-0.53	-0.83	0.15	-0.17	-0.07	-0.98
411	2022/03/09 18:14:15.512	3	603.1	650.0	-4005.5	-0.31	19	28	55	-0.78	0.60	0.17	-0.59	-0.80	0.14	0.22	0.01	0.98
412	2022/03/09 18:27:05.009	3	617.2	768.8	-3914.1	-0.37	77	115	167	0.87	-0.44	-0.23	-0.40	-0.90	0.19	0.29	0.08	0.95
413	2022/03/09 18:32:33.872	3	685.2	832.8	-4012.5	0.00	88	133	164	-0.62	0.75	0.23	-0.61	-0.65	0.46	0.49	0.15	0.86
414	2022/03/09 19:43:36.626	3	600.0	868.8	-3752.3	-0.24	120	187	251	0.75	-0.64	-0.15	0.62	0.77	-0.16	-0.22	-0.02	-0.98
415	2022/03/09 21:22:35.734	3	708.6	681.3	-3761.7	1.69	59	80	123	0.92	-0.40	0.00	0.39	0.91	0.13	-0.05	-0.12	0.99
416	2022/03/09 22:16:50.171	3	735.9	548.4	-3760.9	0.01	99	196	220	-0.90	0.42	0.07	0.33	0.80	-0.51	0.27	0.43	0.86
417	2022/03/09 23:03:12.969	3	653.9	674.2	-3817.2	0.18	95	195	209	-0.79	0.61	0.08	0.61	0.78	0.11	-0.01	-0.13	0.99
418	2022/03/10 01:12:24.886	3	953.9	811.7	-3830.5	-0.52	105	218	249	0.83	-0.56	-0.06	-0.47	-0.75	0.47	-0.30	-0.36	-0.88
419	2022/03/10 01:17:12.232	3	819.5	825.0	-3914.1	-0.11	74	139	197	0.81	-0.59	-0.05	-0.59	-0.80	-0.10	-0.02	-0.11	0.99
420	2022/03/10 06:02:47.958	3	1189.8	1055.5	-4775.8	-0.82	107	124	137	0.86	0.15	-0.50	0.32	-0.90	0.29	-0.41	-0.41	-0.82
421	2022/03/10 06:36:51.433	3	475.8	510.9	-3848.4	-0.77	45	47	80	0.18	-0.98	0.11	0.97	0.15	-0.20	-0.18	-0.14	-0.97
422	2022/03/10 07:58:04.074	3	850.8	868.0	-4210.9	-0.54	113	176	222	-0.71	0.69	0.15	-0.65	-0.72	0.25	-0.29	-0.08	-0.96
423	2022/03/10 08:15:01.870	3	637.5	838.3	-3938.3	0.29	61	97	132	-0.95	0.32	0.02	-0.31	-0.92	-0.25	0.06	0.24	-0.97

424	2022/03/10 09:45:19.020	3	936.7	853.9	-4154.7	-0.52	109	155	233	-0.70	0.70	0.10	0.69	0.71	-0.15	0.18	0.03	0.98
425	2022/03/11 03:42:07.688	3	685.2	832.0	-3968.0	-0.27	94	152	206	0.80	-0.59	-0.09	0.57	0.80	-0.21	-0.19	-0.12	-0.97
426	2022/03/11 03:44:09.273	3	618.8	463.3	-3832.0	-0.39	114	218	229	-0.92	0.39	0.08	-0.20	-0.63	0.75	0.34	0.67	0.66
427	2022/03/11 14:06:00.984	3	903.1	762.5	-3889.8	0.39	64	86	134	0.95	-0.31	-0.02	0.31	0.93	0.21	0.05	0.21	-0.98
428	2022/03/11 14:14:41.238	3	503.9	368.0	-3870.3	-0.28	88	135	177	0.87	-0.43	-0.22	-0.36	-0.89	0.28	0.32	0.16	0.93
429	2022/03/12 00:53:54.739	3	735.9	839.8	-4218.0	-0.32	43	60	113	0.78	-0.62	-0.08	-0.62	-0.78	-0.04	0.04	-0.08	1.00
430	2022/03/12 02:42:37.396	3	621.1	740.6	-3599.2	-0.73	76	120	147	0.55	-0.82	-0.14	-0.81	-0.57	0.13	0.19	-0.04	0.98
431	2022/03/12 05:32:03.174	3	830.5	735.2	-3886.7	-0.91	75	131	170	0.85	-0.49	-0.16	0.48	0.87	-0.13	0.21	0.03	0.98
432	2022/03/13 00:56:44.504	3	668.0	646.1	-3710.2	0.17	68	93	130	0.79	-0.60	-0.15	-0.61	-0.79	-0.04	0.09	-0.12	0.99
433	2022/03/13 04:17:28.032	3	830.5	751.6	-3959.4	-0.74	83	105	150	0.15	-0.98	-0.14	-0.99	-0.14	-0.07	0.05	0.15	-0.99
435	2022/03/14 06:39:00.583	3	753.9	679.7	-3699.2	-0.02	34	46	74	0.92	-0.40	-0.01	0.40	0.91	0.13	0.05	0.12	-0.99
436	2022/03/14 20:07:40.496	3	674.2	686.7	-3875.8	-0.33	68	108	145	-0.93	0.36	0.04	-0.33	-0.81	-0.49	0.14	0.47	-0.87
437	2022/03/16 16:30:48.263	3	582.0	829.7	-3990.6	-0.21	78	118	148	0.70	-0.68	-0.21	-0.62	-0.73	0.28	0.34	0.06	0.94
438	2022/03/16 16:30:52.503	3	778.9	832.0	-3933.6	-0.17	104	148	226	0.67	-0.73	-0.13	0.70	0.68	-0.20	-0.24	-0.04	-0.97
439	2022/03/16 16:31:43.992	3	706.3	808.6	-4008.6	0.14	74	114	151	0.79	-0.61	-0.06	0.59	0.78	-0.19	-0.17	-0.11	-0.98
440	2022/03/16 16:31:51.826	3	729.7	812.5	-4068.8	-0.20	108	172	226	0.76	-0.65	-0.05	-0.65	-0.76	0.05	0.07	0.01	1.00
441	2022/03/16 22:16:36.914	3	852.3	769.5	-3845.3	0.05	48	65	103	0.89	-0.45	-0.06	-0.46	-0.89	-0.07	0.03	-0.09	1.00
442	2022/03/16 23:44:02.433	3	653.9	842.2	-3676.6	-0.61	85	141	180	0.74	-0.68	-0.01	-0.66	-0.72	-0.22	-0.14	-0.16	0.98
443	2022/03/17 04:24:09.865	3	825.0	708.6	-3889.1	0.06	64	86	133	0.88	-0.47	-0.07	-0.47	-0.88	-0.05	0.04	-0.08	1.00
444	2022/03/20 21:06:07.905	3	846.1	898.4	-4010.9	-0.62	101	200	207	-0.80	0.59	0.06	-0.52	-0.64	-0.57	0.29	0.49	-0.82
446	2022/03/22 01:34:31.222	3	623.4	535.9	-3810.2	-0.84	21	32	58	-0.76	0.63	0.16	0.60	0.77	-0.21	-0.25	-0.06	-0.97
447	2022/03/22 01:37:26.613	3	667.2	756.3	-3758.6	-0.63	79	95	140	-0.08	0.98	0.18	0.99	0.10	-0.12	0.13	-0.17	0.98
448	2022/03/22 01:39:48.352	3	568.8	604.7	-3707.8	-0.85	24	36	65	-0.74	0.65	0.18	0.63	0.76	-0.16	-0.24	-0.01	-0.97
449	2022/03/22 01:40:06.374	3	693.8	773.4	-3873.4	-0.58	102	117	172	-0.29	0.91	0.29	-0.90	-0.37	0.24	-0.33	0.19	-0.92
450	2022/03/25 04:56:22.620	3	678.1	689.1	-3775.8	-0.22	53	76	108	-0.74	0.66	0.09	0.66	0.75	-0.02	0.08	-0.05	1.00
452	2022/04/06 04:33:51.467	3	684.4	733.6	-3871.1	0.58	61	69	97	0.87	-0.50	-0.03	0.49	0.84	0.22	0.08	0.21	-0.97
453	2022/04/06 04:34:01.370	3	652.3	836.7	-3912.5	-0.09	95	122	161	-0.25	0.96	0.14	0.96	0.26	-0.11	-0.14	0.11	-0.98
454	2022/04/06 04:57:24.063	3	535.2	619.5	-3702.3	-0.38	39	59	71	0.69	-0.70	-0.21	-0.72	-0.69	-0.05	0.11	-0.19	0.98
455	2022/04/09 04:03:15.703	3	629.7	805.5	-3745.3	-0.63	80	100	162	0.89	-0.44	-0.12	0.45	0.89	0.05	0.08	-0.10	0.99
457	2022/09/03 13:40:46.415	4	607.8	544.5	-3907.8	-0.20	52	83	114	0.72	-0.68	-0.09	-0.60	-0.69	0.41	0.34	0.24	0.91
458	2022/10/07 06:44:35.734	4	808.6	670.3	-3589.8	-0.65	89	97	193	0.63	-0.74	-0.22	0.74	0.66	-0.11	0.22	-0.09	0.97
459	2022/11/25 14:06:46.828	5	885.2	858.6	-4250.0	-0.16	102	136	204	-0.37	0.92	0.07	-0.93	-0.38	0.00	0.03	-0.06	1.00
460	2022/11/25 14:19:46.885	5	821.1	822.7	-4046.1	-0.50	81	95	157	-0.18	0.94	0.30	0.97	0.22	-0.10	-0.16	0.27	-0.95
461	2022/11/25 14:32:30.775	5	646.9	729.7	-3696.9	-0.72	64	125	170	0.62	-0.78	-0.11	-0.75	-0.63	0.20	0.22	0.04	0.97

462	2022/11/25 15:16:51.450	5	535.9	578.9	-3778.9	-0.46	33	54	72	-0.69	0.71	0.14	-0.64	-0.69	0.34	0.34	0.15	0.93
463	2022/11/25 15:27:53.392	5	639.8	579.7	-3903.1	-0.72	21	39	72	-0.89	-0.42	0.19	-0.30	0.84	0.45	-0.35	0.34	-0.87
464	2022/11/25 15:39:12.873	5	825.0	865.6	-4098.4	-0.38	81	105	175	-0.80	0.60	0.00	0.59	0.79	0.20	0.12	0.15	-0.98
465	2022/11/25 15:43:28.003	5	596.9	660.9	-4075.0	-0.54	114	178	235	-0.53	0.84	0.03	-0.76	-0.50	0.42	0.37	0.20	0.91
466	2022/11/25 15:45:00.276	5	828.9	783.6	-4001.6	-0.19	54	70	118	-0.46	0.89	0.07	-0.89	-0.46	0.00	0.03	-0.06	1.00
467	2022/11/25 15:49:37.604	5	784.4	724.2	-4057.8	-0.10	54	87	125	0.79	-0.61	-0.07	-0.60	-0.79	0.09	0.11	0.03	0.99
468	2022/11/25 15:52:25.774	5	594.5	588.3	-3947.7	-0.59	69	123	139	0.61	-0.77	-0.17	-0.53	-0.56	0.64	-0.59	-0.30	-0.75
469	2022/11/25 16:03:58.933	5	746.9	508.6	-3981.3	-0.71	49	81	90	0.52	-0.83	-0.18	-0.80	-0.55	0.25	0.31	-0.01	0.95
470	2022/11/25 16:04:57.466	5	607.8	575.8	-3936.7	-0.59	37	66	76	0.67	-0.74	0.06	-0.74	-0.66	0.17	0.08	0.16	0.98
471	2022/11/25 16:06:05.989	5	854.7	842.2	-4038.3	0.08	56	75	125	0.79	-0.61	0.01	-0.60	-0.79	-0.09	-0.06	-0.06	1.00
472	2022/11/25 16:10:05.030	5	684.4	592.2	-3957.0	-0.47	30	58	71	-0.64	0.76	0.09	0.75	0.65	-0.14	0.16	0.02	0.99
473	2022/11/25 16:18:43.927	5	732.0	740.6	-4062.5	0.16	60	74	118	0.86	-0.50	-0.01	0.47	0.80	0.37	0.18	0.32	-0.93
474	2022/11/25 16:19:21.161	5	841.4	796.9	-3864.1	-0.39	56	90	140	0.78	-0.62	-0.04	-0.62	-0.78	-0.03	0.02	-0.05	1.00
475	2022/11/25 16:28:19.730	5	844.5	893.8	-4205.5	-0.01	60	92	122	0.44	-0.89	-0.09	-0.88	-0.45	0.15	-0.17	0.02	-0.98
476	2022/11/25 16:35:43.165	5	541.4	442.2	-3510.9	-0.92	75	101	162	0.50	-0.86	0.06	-0.85	-0.48	0.22	0.17	0.16	0.97
477	2022/11/25 16:55:35.984	5	903.1	693.8	-3985.2	-0.61	76	141	206	-0.69	0.72	0.05	0.72	0.69	0.05	0.00	-0.07	1.00
478	2022/11/25 17:02:28.058	5	449.2	607.0	-3797.7	-0.66	52	54	137	0.04	0.99	-0.10	-0.98	0.06	0.21	0.21	0.09	0.97
479	2022/11/25 17:02:50.832	5	739.8	756.3	-3943.8	-0.38	37	50	86	0.82	-0.57	0.04	-0.55	-0.81	-0.20	-0.15	-0.14	0.98
480	2022/11/25 17:07:41.933	5	794.5	722.7	-3863.3	-0.63	61	116	178	0.69	-0.72	-0.06	-0.72	-0.69	-0.02	0.02	-0.06	1.00
481	2022/11/25 17:20:45.519	5	778.1	814.1	-4133.6	-0.49	68	118	151	-0.57	0.81	0.14	-0.67	-0.55	0.49	-0.48	-0.18	-0.86
482	2022/11/25 17:29:25.104	5	768.8	666.4	-3917.2	-0.65	50	97	131	0.70	-0.71	-0.08	-0.71	-0.70	0.03	0.07	-0.04	1.00
483	2022/11/25 17:49:18.479	5	975.8	835.2	-4210.2	-0.48	76	146	175	-0.67	0.74	0.12	0.72	0.68	-0.15	0.19	0.01	0.98
484	2022/11/25 18:37:58.000	5	645.3	576.6	-3925.0	-0.80	19	21	36	-0.58	0.71	0.40	0.76	0.65	-0.07	-0.31	0.26	-0.91
485	2022/11/25 18:53:08.236	5	626.6	806.3	-3411.7	-0.81	43	52	133	-0.78	0.62	-0.01	0.62	0.78	0.12	-0.08	-0.09	0.99
486	2022/11/25 20:10:15.026	5	673.4	643.0	-3794.5	-0.67	35	36	88	0.34	-0.94	-0.04	-0.92	-0.34	0.19	-0.19	-0.03	-0.98
487	2022/11/25 21:23:48.880	5	1003.1	778.1	-4114.1	-0.23	68	80	139	0.79	-0.60	-0.08	-0.61	-0.78	-0.16	-0.04	-0.18	0.98
488	2022/11/25 23:31:21.228	5	642.2	676.6	-3934.4	-0.38	53	74	119	-0.66	0.75	0.01	-0.74	-0.65	-0.18	-0.13	-0.13	0.98
489	2022/11/26 01:37:24.349	5	828.1	636.7	-3998.4	0.01	65	86	126	0.69	-0.72	-0.07	-0.72	-0.67	-0.18	-0.08	-0.17	0.98
490	2022/11/26 16:23:09.578	5	435.2	382.8	-3428.9	-0.67	47	84	146	0.66	-0.75	-0.01	0.71	0.63	-0.33	-0.25	-0.21	-0.94
491	2022/11/26 16:27:43.839	5	510.9	493.0	-3813.3	-0.22	44	71	90	0.66	-0.74	0.13	-0.75	-0.64	0.19	0.06	0.22	0.97
492	2022/11/26 16:27:55.878	5	680.5	738.3	-3904.7	-0.55	91	153	224	0.51	-0.86	0.06	-0.83	-0.47	0.29	-0.22	-0.20	-0.96
493	2022/11/26 16:31:19.742	5	749.2	790.6	-4084.4	0.08	58	79	133	-0.58	0.80	0.13	0.79	0.60	-0.11	0.16	-0.04	0.99
494	2022/11/26 17:19:35.249	5	564.8	686.7	-3762.5	-0.58	65	89	159	-0.67	0.74	0.06	0.73	0.67	-0.17	0.17	0.07	0.98
495	2022/11/26 17:42:26.021	5	917.2	782.8	-4060.2	0.02	63	93	147	0.51	-0.86	-0.04	0.85	0.50	0.16	-0.12	-0.11	0.99

496	2022/11/26 17:42:26.028	5	823.4	765.6	-4032.8	-0.03	58	90	120	0.61	-0.79	-0.07	-0.79	-0.62	0.06	0.09	-0.02	1.00
497	2022/11/26 17:49:19.509	5	890.6	852.3	-3960.2	-0.27	73	115	148	-0.41	0.91	0.10	0.88	0.42	-0.21	-0.23	0.00	-0.97
498	2022/11/26 18:03:39.230	5	706.3	628.9	-4354.7	-0.40	74	104	203	0.55	-0.83	0.08	0.83	0.53	-0.15	0.08	0.15	0.98
499	2022/11/26 18:12:45.173	5	995.3	868.0	-4298.4	-0.34	88	156	199	-0.70	0.70	0.12	0.69	0.71	-0.15	0.19	0.02	0.98
500	2022/11/26 18:15:07.232	5	935.9	860.2	-3887.5	-0.01	63	98	137	-0.62	0.79	0.06	-0.79	-0.62	0.04	0.06	-0.02	1.00
501	2022/11/26 18:18:11.367	5	1000.0	801.6	-4045.3	-0.39	96	152	195	0.70	-0.71	-0.08	-0.71	-0.70	0.00	0.05	-0.06	1.00
502	2022/11/26 18:19:33.259	5	525.8	477.3	-3982.0	-0.88	59	120	145	-0.55	0.83	-0.06	0.68	0.40	-0.62	-0.49	-0.38	-0.78
503	2022/11/26 18:25:58.767	5	803.9	841.4	-4036.7	0.72	51	66	104	-0.76	0.64	0.03	-0.64	-0.76	-0.11	-0.05	-0.11	0.99
504	2022/11/26 18:28:51.466	5	1020.3	904.7	-3763.3	-0.28	70	111	172	-0.56	0.82	0.09	-0.83	-0.56	-0.01	0.04	-0.08	1.00
505	2022/11/26 19:23:23.473	5	1196.1	1187.5	-4596.1	-0.65	47	108	149	-0.81	0.59	0.05	0.28	0.30	0.91	0.52	0.75	-0.40
506	2022/11/26 19:34:26.472	5	806.3	712.5	-4179.7	-0.91	85	163	197	-0.78	0.62	0.08	0.62	0.78	0.11	0.00	-0.13	0.99
507	2022/11/26 19:46:09.131	5	753.9	844.5	-3878.1	-0.41	135	138	248	-0.75	0.66	0.01	-0.66	-0.74	0.15	0.11	0.10	0.99
508	2022/11/26 20:05:30.307	5	580.5	793.0	-3932.8	0.12	56	75	124	0.59	-0.79	-0.14	0.79	0.61	-0.12	0.18	-0.04	0.98
509	2022/11/26 22:16:46.882	5	679.7	711.7	-3984.4	0.10	52	67	107	0.76	-0.64	-0.05	-0.64	-0.76	-0.11	-0.03	-0.11	0.99
510	2022/11/26 22:46:58.360	5	674.2	635.2	-3975.0	-0.73	60	113	137	0.75	-0.65	-0.10	-0.59	-0.73	0.35	-0.30	-0.20	-0.93
511	2022/11/26 22:52:28.321	5	485.9	575.0	-3910.9	-0.47	59	101	115	0.62	-0.76	-0.18	-0.65	-0.63	0.43	0.44	0.15	0.89
512	2022/11/26 23:03:57.505	5	782.8	858.6	-4157.0	-0.73	93	155	194	-0.38	0.87	0.30	0.89	0.44	-0.13	-0.25	0.22	-0.94
513	2022/11/26 23:17:45.158	5	715.6	822.7	-4404.7	0.04	59	76	122	0.77	-0.64	-0.03	-0.63	-0.76	-0.12	-0.06	-0.11	0.99
514	2022/11/26 23:43:25.893	5	749.2	621.9	-4014.1	-0.76	53	94	120	-0.62	0.78	0.11	0.79	0.60	0.14	-0.04	-0.17	0.98
515	2022/11/27 00:02:16.211	5	531.3	587.5	-3804.7	-0.70	6	6	17	-0.52	-0.84	0.17	-0.84	0.54	0.10	-0.17	-0.09	-0.98
516	2022/11/27 03:11:12.686	5	610.2	821.1	-3700.0	-0.68	63	84	138	-0.59	0.81	0.06	-0.81	-0.59	0.02	0.05	-0.04	1.00
517	2022/11/27 03:12:27.100	5	521.1	566.4	-3531.3	-1.10	42	58	120	-0.51	0.86	-0.08	0.85	0.48	-0.20	-0.13	-0.17	-0.98
518	2022/11/27 03:41:58.645	5	821.9	860.2	-3646.1	-0.82	123	132	260	-0.03	0.99	0.15	-0.92	-0.09	0.37	0.38	-0.13	0.92
519	2022/11/27 03:53:13.733	5	718.0	787.5	-4368.0	0.25	50	64	97	0.77	-0.64	-0.03	-0.63	-0.76	-0.12	-0.06	-0.11	0.99
520	2022/11/27 04:23:40.353	5	677.3	746.9	-4250.0	-0.64	70	97	150	0.70	-0.71	-0.07	-0.71	-0.70	-0.03	0.03	-0.07	1.00
521	2022/11/27 04:42:23.652	5	649.2	805.5	-4219.5	-0.69	49	73	108	-0.97	0.25	-0.03	-0.25	-0.97	-0.04	0.04	0.03	-1.00
522	2022/11/27 05:10:00.944	5	605.5	741.4	-3990.6	-0.23	52	67	105	0.76	-0.64	-0.05	-0.64	-0.76	-0.11	-0.03	-0.11	0.99
523	2022/11/27 05:35:57.783	5	732.8	570.3	-4237.5	0.25	47	61	106	0.77	-0.64	-0.01	-0.64	-0.76	-0.11	-0.06	-0.09	0.99
524	2022/11/27 05:45:49.937	5	691.4	725.8	-4233.6	-0.69	77	116	160	0.85	-0.52	-0.03	-0.51	-0.84	0.17	-0.12	-0.13	-0.98
525	2022/11/27 06:02:01.228	5	740.6	657.0	-4107.8	-0.58	57	83	122	-0.72	0.69	-0.04	0.68	0.72	0.16	-0.14	-0.09	0.99
526	2022/11/27 06:11:25.667	5	452.3	495.3	-3796.9	-0.81	56	57	145	-0.31	-0.93	0.19	0.93	-0.34	-0.16	-0.21	-0.13	-0.97
527	2022/11/27 06:20:25.937	5	629.7	522.7	-3872.7	-0.82	32	33	58	0.34	-0.94	0.09	0.93	0.32	-0.18	0.14	0.14	0.98
528	2022/11/27 06:41:23.437	5	656.3	673.4	-4033.6	-0.47	45	81	118	-0.65	0.75	0.12	0.68	0.64	-0.34	0.33	0.14	0.93
529	2022/11/27 07:02:06.941	5	800.0	820.3	-3975.0	-0.87	78	125	192	0.93	-0.37	0.09	-0.37	-0.93	-0.03	0.09	-0.01	-1.00

530	2022/11/27 07:07:59.620	5	704.7	713.3	-4235.9	0.24	42	54	83	0.77	-0.64	-0.03	-0.64	-0.76	-0.12	-0.05	-0.11	0.99
531	2022/11/27 07:25:45.589	5	571.1	736.7	-3896.1	-0.28	51	63	115	0.72	-0.69	-0.06	-0.70	-0.71	-0.11	-0.03	-0.12	0.99
532	2022/11/27 07:38:58.773	5	330.5	738.3	-3800.8	-0.70	47	90	95	-0.95	-0.15	0.29	0.28	0.09	0.96	-0.17	0.98	-0.04
533	2022/11/27 07:39:22.389	5	800.0	731.3	-4076.6	-0.40	46	66	105	0.85	-0.52	0.00	0.51	0.84	0.20	0.11	0.17	-0.98
534	2022/11/27 07:46:44.248	5	732.0	571.1	-4010.2	-0.60	90	147	189	-0.95	-0.29	-0.13	0.31	-0.90	-0.31	0.02	0.33	-0.94
535	2022/11/27 07:46:55.527	5	607.0	875.8	-3939.1	-0.74	64	88	210	0.94	-0.33	0.05	0.31	0.93	0.22	-0.12	-0.19	0.97
536	2022/11/27 07:57:39.600	5	475.0	546.1	-4010.9	-0.97	60	62	103	0.26	-0.96	0.09	-0.95	-0.23	0.20	0.17	0.14	0.97
537	2022/11/27 08:54:53.985	5	698.4	669.5	-3625.0	-0.87	52	93	173	-0.67	0.74	0.04	-0.72	-0.66	0.24	0.21	0.13	0.97
538	2022/11/27 09:39:09.528	5	521.9	682.8	-4125.0	-0.53	56	75	128	-0.74	0.67	-0.09	-0.65	-0.74	-0.15	0.17	0.05	-0.98
539	2022/11/27 09:44:39.213	5	725.0	737.5	-4218.0	0.04	36	46	77	-0.76	0.65	0.01	0.65	0.75	0.14	-0.09	-0.11	0.99
540	2022/11/27 10:14:51.744	5	598.4	547.7	-3743.8	-0.82	67	76	111	0.35	-0.93	-0.15	0.91	0.37	-0.19	-0.23	0.07	-0.97
541	2022/11/27 10:16:57.370	5	589.8	575.8	-3807.8	-0.74	52	54	125	0.34	-0.94	-0.05	-0.92	-0.34	0.19	-0.20	-0.02	-0.98
542	2022/11/27 10:51:36.820	5	818.8	870.3	-4171.9	-0.55	83	124	188	0.77	-0.64	0.02	-0.64	-0.77	-0.05	-0.05	-0.03	1.00
543	2022/11/27 10:53:14.740	5	904.7	936.7	-4110.9	-0.59	69	124	168	-0.68	0.73	-0.02	0.72	0.67	0.20	-0.16	-0.12	0.98
544	2022/11/27 10:54:46.236	5	1402.3	644.5	-4039.1	-0.87	74	115	201	-0.97	0.19	-0.13	0.21	0.97	-0.13	0.10	-0.15	-0.98
545	2022/11/27 10:54:48.744	5	1113.3	535.2	-4122.7	-0.58	59	70	93	0.39	0.91	-0.16	-0.92	0.37	-0.11	-0.04	0.19	0.98
546	2022/11/27 10:55:32.724	5	659.4	773.4	-4028.9	-0.29	34	49	82	0.86	-0.51	-0.01	0.50	0.84	0.18	0.08	0.16	-0.98
547	2022/11/27 11:20:47.816	5	552.3	695.3	-4070.3	-0.28	46	65	105	0.86	-0.50	0.00	0.50	0.85	0.17	0.09	0.15	-0.98
548	2022/11/27 11:21:38.202	5	703.1	754.7	-3686.7	-0.49	61	92	157	0.76	-0.64	-0.08	-0.64	-0.77	0.00	0.07	-0.05	1.00
549	2022/11/27 11:32:48.062	5	593.8	747.7	-4168.8	-0.29	39	56	87	0.86	-0.51	-0.01	0.50	0.84	0.20	-0.09	-0.18	0.98
550	2022/11/27 11:38:45.007	5	750.0	698.4	-3659.4	-0.09	59	76	147	-0.74	0.67	0.00	0.66	0.74	0.11	-0.08	-0.08	0.99
551	2022/11/27 11:53:51.300	5	668.0	513.3	-3514.8	-0.54	63	84	156	-0.99	0.08	-0.07	0.07	0.98	0.18	0.08	0.18	-0.98
552	2022/11/27 12:25:28.560	5	578.1	556.3	-3880.5	-0.78	13	13	82	0.40	-0.92	0.06	0.91	0.38	-0.19	0.15	0.13	0.98
553	2022/11/27 12:34:52.296	5	825.0	623.4	-4102.3	-1.11	18	25	46	-0.30	0.93	-0.19	0.93	0.33	0.13	-0.19	0.14	0.97
554	2022/11/27 12:47:53.821	5	629.7	804.7	-4104.7	-0.14	40	51	86	0.76	-0.65	-0.02	-0.65	-0.75	-0.13	-0.07	-0.11	0.99
555	2022/11/27 13:06:02.917	5	708.6	790.6	-4171.9	-0.92	88	124	248	-0.50	0.86	-0.09	-0.87	-0.50	0.04	-0.01	0.10	1.00
556	2022/11/27 13:27:57.535	5	660.2	768.0	-3876.6	0.10	57	73	140	-0.75	0.66	0.03	0.66	0.74	0.12	-0.06	-0.11	0.99
557	2022/11/27 13:35:52.891	5	600.0	674.2	-3889.8	-0.57	40	57	128	0.87	-0.49	0.01	-0.49	-0.86	-0.16	-0.09	-0.13	0.99
558	2022/11/27 13:49:27.082	5	428.1	653.9	-3669.5	-0.84	44	65	103	-0.73	0.66	0.17	-0.61	-0.75	0.25	-0.29	-0.07	-0.95
559	2022/11/27 14:13:51.309	5	750.8	819.5	-3766.4	-0.35	70	85	152	-0.47	0.88	0.03	0.87	0.46	0.15	0.12	0.10	-0.99
560	2022/11/27 14:34:20.491	5	332.0	607.0	-3722.7	-1.09	293	302	764	-0.04	-0.99	0.10	0.98	-0.06	-0.21	0.21	0.09	0.97
561	2022/11/27 14:47:18.727	5	861.7	633.6	-4177.3	-0.86	111	154	202	0.89	-0.45	0.09	-0.45	-0.89	0.04	0.06	-0.08	-1.00
562	2022/11/27 14:54:58.815	5	549.2	769.5	-3786.7	-0.63	70	104	164	-0.64	0.77	0.08	-0.77	-0.64	0.04	0.09	-0.03	1.00
563	2022/11/27 15:13:10.294	5	371.1	507.0	-3920.3	-0.68	27	51	61	-0.66	0.75	-0.02	0.73	0.64	-0.23	0.16	0.17	0.97



564	2022/11/27 15:42:19.790	5	609.4	564.8	-3843.8	-0.61	61	118	132	0.58	-0.80	-0.12	-0.81	-0.57	-0.14	-0.05	-0.18	0.98
566	2022/11/27 17:24:33.058	5	699.2	816.4	-4144.5	-0.50	77	111	182	0.86	-0.51	-0.01	0.50	0.85	0.19	0.09	0.17	-0.98
565	2022/11/27 17:24:36.402	5	728.1	770.3	-4198.4	-0.79	67	116	143	0.64	-0.77	-0.02	-0.76	-0.63	-0.16	-0.10	-0.12	0.99
567	2022/11/27 17:36:19.480	5	714.1	807.0	-3821.1	-0.20	62	81	143	-0.75	0.67	0.01	0.66	0.74	0.13	-0.08	-0.11	0.99
568	2022/11/27 18:07:35.617	5	649.2	825.8	-3960.2	-0.75	37	62	138	-0.99	0.14	-0.03	-0.13	-0.98	-0.17	-0.06	-0.17	0.98
569	2022/11/27 18:36:13.338	5	790.6	757.0	-3838.3	-0.38	63	95	170	0.83	-0.56	-0.02	-0.56	-0.82	-0.10	-0.04	-0.09	0.99
570	2022/11/27 20:30:14.392	5	628.9	628.9	-3828.1	-0.68	79	150	185	0.69	-0.71	-0.15	-0.71	-0.70	0.04	0.13	-0.07	0.99
571	2022/11/27 23:02:59.382	5	712.5	787.5	-4296.9	-0.07	60	86	132	0.86	-0.52	0.01	0.50	0.84	0.21	-0.11	-0.18	0.98
572	2022/11/28 00:35:00.698	5	607.0	679.7	-3939.8	-0.12	57	66	121	-0.80	0.59	0.09	0.60	0.79	0.12	0.00	-0.15	0.99
573	2022/11/28 00:59:38.971	5	469.5	608.6	-3836.7	-0.69	47	85	99	0.79	-0.60	-0.13	0.59	0.80	-0.09	0.16	0.00	0.99
574	2022/11/28 01:16:23.062	5	510.9	727.3	-3988.3	-0.56	76	113	190	0.58	-0.79	-0.19	0.81	0.58	0.03	0.09	-0.18	0.98
575	2022/11/28 02:44:07.564	5	784.4	730.5	-4339.1	-0.79	53	74	148	0.91	-0.41	0.11	0.42	0.90	-0.11	0.05	-0.15	-0.99
576	2022/11/28 04:53:24.577	5	671.1	803.1	-3840.6	0.32	50	63	114	0.75	-0.66	-0.03	-0.66	-0.74	-0.12	-0.06	-0.11	0.99
577	2022/11/28 05:21:42.130	5	489.8	732.0	-3802.3	-0.44	64	90	152	0.86	-0.51	-0.03	0.50	0.85	0.17	0.06	0.16	-0.98
578	2022/11/28 08:24:59.692	5	785.9	557.0	-3853.9	-0.38	62	115	150	0.80	-0.60	-0.05	-0.60	-0.78	-0.16	-0.06	-0.16	0.99
579	2022/11/28 08:55:24.642	5	578.9	675.8	-3775.0	-0.42	64	126	165	-0.62	0.78	0.09	0.74	0.63	-0.23	0.24	0.08	0.97
580	2022/11/28 09:10:09.057	5	728.9	730.5	-4072.7	-0.59	79	145	184	-0.86	0.49	0.14	0.51	0.83	0.24	0.00	-0.28	0.96
581	2022/11/28 09:53:58.617	5	1010.2	593.0	-4260.2	-0.98	29	80	227	0.05	-0.99	0.16	-0.09	0.16	0.98	-0.99	-0.06	-0.08
582	2022/11/28 11:07:30.812	5	713.3	836.7	-3723.4	0.01	54	78	130	0.85	-0.53	0.00	0.52	0.84	0.19	0.10	0.16	-0.98
583	2022/11/28 12:33:56.949	5	754.7	682.8	-4120.3	0.15	43	62	95	0.86	-0.51	0.02	-0.50	-0.85	-0.19	0.11	0.16	-0.98
584	2022/11/28 13:16:18.590	5	693.8	821.1	-4296.9	-0.58	71	135	186	-0.70	0.71	0.00	0.70	0.68	0.23	-0.16	-0.16	0.97
585	2022/11/28 13:36:49.358	5	503.1	485.2	-3868.0	-0.59	65	91	108	-0.52	0.85	-0.11	-0.84	-0.49	0.22	0.13	0.20	0.97
586	2022/11/28 18:22:22.566	5	637.5	677.3	-3932.0	-0.72	38	73	92	0.70	-0.71	-0.04	0.64	0.66	-0.40	-0.31	-0.25	-0.92
587	2022/11/28 19:48:22.390	5	438.3	534.4	-3764.1	-0.44	49	94	102	0.59	-0.80	-0.13	-0.80	-0.56	-0.22	-0.10	-0.23	0.97
588	2022/11/28 20:17:43.902	5	616.4	429.7	-3944.5	-0.48	61	121	126	0.43	-0.90	-0.06	-0.90	-0.43	-0.04	-0.01	-0.07	1.00
589	2022/11/28 20:50:12.969	5	472.7	546.9	-3755.5	-0.63	48	88	102	-0.59	0.80	0.06	0.80	0.58	0.16	-0.10	-0.15	0.98
590	2022/11/28 21:19:26.136	5	718.8	880.5	-4207.0	-0.14	43	62	97	0.86	-0.52	0.01	-0.50	-0.84	-0.21	0.11	0.17	-0.98
591	2022/11/28 21:28:42.252	5	419.5	562.5	-3802.3	-0.55	33	64	75	0.62	-0.78	-0.11	-0.77	-0.62	0.12	0.16	-0.01	0.99
592	2022/11/28 21:42:38.916	5	736.7	779.7	-4297.7	-0.58	75	105	168	0.91	-0.41	0.00	0.41	0.90	0.15	0.06	0.13	-0.99
593	2022/11/28 21:49:04.732	5	593.8	728.1	-3905.5	-0.13	63	96	154	0.80	-0.60	-0.01	0.58	0.76	0.29	0.17	0.24	-0.96
594	2022/11/28 21:58:48.361	5	531.3	722.7	-3873.4	-0.15	69	101	167	-0.75	0.67	-0.03	0.62	0.71	0.33	0.24	0.23	-0.94
595	2022/11/28 22:10:53.880	5	630.5	641.4	-3889.8	-0.32	57	88	130	0.79	-0.60	-0.09	0.59	0.73	0.33	0.13	0.32	-0.94
596	2022/11/28 22:13:37.731	5	478.1	554.7	-3800.8	-0.41	36	70	89	-0.63	0.77	0.10	0.75	0.63	-0.20	0.22	0.05	0.97
597	2022/11/28 22:25:04.504	5	860.9	785.2	-4274.2	-0.51	66	122	144	0.77	-0.63	-0.09	0.59	0.67	0.44	0.21	0.39	-0.89

598	2022/11/28 23:50:57.434	5	779.7	657.8	-4223.4	-0.52	55	103	127	0.80	-0.60	-0.05	-0.59	-0.76	-0.26	0.12	0.24	-0.96
599	2022/11/28 23:51:08.506	5	792.2	693.8	-4210.9	-0.42	62	115	137	0.77	-0.63	-0.08	-0.60	-0.68	-0.42	0.21	0.37	-0.91
600	2022/11/28 23:57:55.521	5	546.1	535.2	-3788.3	-0.83	46	88	100	0.67	-0.74	-0.05	0.70	0.65	-0.31	-0.26	-0.17	-0.95
601	2022/11/29 01:14:28.920	5	507.0	669.5	-3754.7	-0.88	63	81	104	-0.72	0.66	-0.18	0.64	0.75	0.19	0.26	0.02	-0.96
602	2022/11/29 03:12:58.499	5	549.2	706.3	-3850.0	-1.01	61	99	133	0.44	-0.89	-0.09	-0.87	-0.45	0.21	-0.23	-0.02	-0.97
603	2022/11/29 03:26:50.662	5	800.0	688.3	-4346.9	-0.67	83	124	181	0.94	-0.34	0.00	0.34	0.94	0.08	-0.02	-0.08	1.00
604	2022/11/29 03:53:18.582	5	636.7	776.6	-3947.7	-0.89	93	184	222	-0.64	0.76	0.11	0.73	0.65	-0.23	0.25	0.07	0.97
605	2022/11/29 04:20:20.455	5	958.6	900.8	-3823.4	-0.81	60	112	165	0.51	-0.86	-0.06	0.84	0.52	-0.18	0.18	0.04	0.98
606	2022/11/29 05:00:54.309	5	714.1	600.8	-3832.0	-0.55	61	66	124	0.60	-0.80	-0.06	0.80	0.59	0.12	-0.06	-0.12	0.99
607	2022/11/29 05:17:24.600	5	676.6	658.6	-3914.8	-0.60	56	92	145	-0.36	0.93	0.06	0.93	0.36	-0.04	-0.06	0.04	-1.00
608	2022/11/29 05:42:10.045	5	827.3	826.6	-4211.7	-0.65	58	96	145	0.83	-0.56	-0.08	-0.56	-0.82	-0.10	0.01	-0.13	0.99
609	2022/11/29 05:43:35.357	5	939.8	667.2	-3371.9	-0.88	71	131	375	0.70	-0.72	-0.01	-0.70	-0.68	0.23	0.18	0.16	0.97
610	2022/11/29 05:51:04.076	5	503.1	475.0	-3782.0	-0.95	23	36	61	-0.77	0.63	0.13	-0.59	-0.77	0.25	0.25	0.12	0.96
611	2022/11/29 06:00:32.789	5	660.9	780.5	-4307.0	0.21	45	58	94	0.76	-0.65	-0.02	-0.64	-0.75	-0.13	-0.07	-0.11	0.99
612	2022/11/29 06:04:18.564	5	519.5	411.7	-4036.7	-0.90	81	130	209	-0.97	0.22	-0.07	-0.23	-0.96	0.13	0.04	-0.14	-0.99
613	2022/11/29 06:04:46.861	5	769.5	931.3	-4190.6	-0.82	76	129	172	0.81	-0.58	0.07	0.57	0.81	0.11	0.13	0.05	-0.99
614	2022/11/29 06:06:34.263	5	564.1	829.7	-4110.9	-0.86	81	146	209	-0.59	0.80	-0.07	0.61	0.50	0.61	-0.53	-0.32	0.79
615	2022/11/29 06:20:02.502	5	670.3	646.9	-4309.4	-0.62	95	150	241	-0.97	0.22	-0.06	-0.23	-0.97	0.11	0.04	-0.12	-0.99
616	2022/11/29 08:45:31.873	5	797.7	615.6	-3584.4	-0.73	50	92	132	0.78	-0.62	-0.07	-0.62	-0.79	0.01	0.06	-0.04	1.00
617	2022/11/29 10:33:36.595	5	759.4	732.0	-3840.6	-0.41	55	78	136	0.89	-0.45	-0.09	-0.46	-0.88	-0.13	0.02	-0.15	0.99
618	2022/11/29 12:30:57.565	5	700.0	732.0	-4196.9	0.07	42	54	108	-0.76	0.65	0.01	0.65	0.75	0.14	-0.08	-0.11	0.99
619	2022/11/29 13:08:00.553	5	632.0	798.4	-3897.7	-0.24	85	140	192	-0.36	0.93	0.07	-0.93	-0.36	0.00	0.03	-0.07	1.00
620	2022/11/29 14:19:50.306	5	742.2	695.3	-4200.0	0.74	50	64	111	-0.76	0.65	-0.01	-0.65	-0.75	-0.12	-0.09	-0.09	0.99
621	2022/11/29 16:03:02.829	5	816.4	788.3	-4236.7	-0.17	43	68	95	-0.60	0.80	0.04	-0.80	-0.59	-0.07	-0.03	-0.08	1.00
622	2022/11/29 17:45:57.133	5	721.1	585.9	-3763.3	-0.62	71	145	161	-0.56	0.83	0.04	0.82	0.56	-0.10	0.11	0.02	0.99
623	2022/11/29 19:17:25.597	5	700.0	378.1	-3940.6	-0.98	30	46	87	-0.90	-0.39	0.18	-0.29	0.87	0.41	-0.31	0.32	-0.90
624	2022/11/29 20:40:42.580	5	664.1	286.7	-3821.9	-0.74	58	83	133	0.67	-0.74	-0.02	0.66	0.58	0.48	-0.34	-0.34	0.88
625	2022/11/29 20:55:21.525	5	753.1	764.8	-4089.1	-0.54	74	129	185	0.67	-0.74	-0.02	-0.74	-0.67	0.08	0.08	0.04	1.00
626	2022/11/29 21:32:50.751	5	710.2	644.5	-3921.9	-0.88	24	44	59	-0.73	0.68	0.00	-0.39	-0.42	0.82	0.56	0.60	0.57
627	2022/11/29 22:13:21.842	5	716.4	650.8	-4014.1	-0.92	77	147	170	0.84	-0.54	-0.03	0.52	0.81	0.28	0.13	0.25	-0.96
628	2022/11/29 22:23:47.785	5	727.3	348.4	-4053.9	-1.03	44	60	74	-0.55	0.83	-0.05	-0.83	-0.54	0.16	0.11	0.13	0.99
629	2022/11/29 23:08:02.738	5	766.4	575.8	-3911.7	-0.54	50	95	116	-0.66	0.75	-0.02	-0.70	-0.62	-0.36	-0.29	-0.23	0.93
630	2022/11/30 00:19:37.383	5	793.0	800.0	-3914.1	-0.34	51	63	111	-0.80	0.60	0.05	0.60	0.78	0.16	-0.06	-0.15	0.99
631	2022/11/30 02:19:04.713	5	558.6	492.2	-3734.4	-1.25	163	164	288	0.45	0.86	-0.23	0.88	-0.47	-0.04	0.15	0.18	0.97

632	2022/11/30 08:28:33.617	5	53.9	-350.8	-3600.0	-0.84	133	270	2876	0.82	-0.58	0.01	-0.36	-0.52	-0.77	-0.45	-0.63	0.63
633	2022/11/30 10:05:02.928	5	760.9	750.0	-4189.8	0.07	56	74	137	-0.80	0.60	0.02	0.59	0.78	0.21	0.11	0.18	-0.98
634	2022/11/30 11:33:46.202	5	757.0	818.0	-4275.0	0.17	64	87	145	0.82	-0.58	-0.02	0.56	0.79	0.24	0.12	0.21	-0.97
635	2022/11/30 20:01:07.566	5	690.6	750.8	-4139.1	-0.21	23	33	65	0.86	-0.51	0.02	0.50	0.85	0.17	0.10	0.14	-0.99
636	2022/12/01 01:33:04.119	5	860.9	761.7	-3886.7	-0.94	19	32	79	-0.76	0.65	0.06	-0.62	-0.75	0.21	0.19	0.12	0.97
637	2022/12/01 01:47:06.822	5	925.8	429.7	-3834.4	-1.05	51	83	129	-0.98	0.20	-0.02	-0.20	-0.98	0.01	0.02	-0.01	-1.00
638	2022/12/01 02:18:24.649	5	749.2	489.8	-3836.7	-0.11	40	50	92	-0.75	0.66	-0.02	0.65	0.75	0.10	-0.08	-0.06	1.00
639	2022/12/01 03:13:58.102	5	1007.0	882.8	-4560.9	-0.37	29	94	129	-0.33	0.87	0.36	0.52	0.48	-0.71	0.79	0.05	0.61
640	2022/12/01 04:17:16.536	5	700.0	653.1	-4218.0	-1.16	58	94	202	-1.00	-0.06	-0.06	0.07	-0.98	-0.18	-0.05	-0.18	0.98
641	2022/12/01 13:49:27.375	5	749.2	767.2	-3823.4	-0.58	62	87	143	-0.70	0.71	0.11	0.70	0.71	-0.11	0.16	0.00	0.99
642	2022/12/01 15:23:04.501	5	1285.2	1013.3	-4542.2	1.11	41	54	82	-0.76	0.66	-0.01	0.64	0.74	0.18	-0.13	-0.13	0.98
643	2022/12/01 19:40:35.133	5	528.1	709.4	-4075.8	-0.42	41	53	92	0.75	-0.66	-0.02	-0.65	-0.75	-0.13	-0.07	-0.11	0.99
644	2022/12/02 18:17:26.813	5	385.2	503.9	-3743.0	-0.81	36	68	99	-0.65	0.76	0.11	-0.71	-0.65	0.28	0.28	0.11	0.95
645	2022/12/03 03:11:20.428	5	448.4	653.9	-3916.4	-1.32	4	5	11	0.17	-0.98	0.12	0.98	0.15	-0.14	-0.12	-0.14	-0.98
646	2022/12/03 15:17:32.858	5	496.1	553.1	-3504.7	-0.81	35	46	133	0.55	-0.83	0.09	0.82	0.51	-0.26	-0.17	-0.22	-0.96
647	2022/12/05 08:05:29.926	5	703.9	653.9	-3778.1	-0.35	51	99	123	0.72	-0.70	-0.02	-0.69	-0.71	-0.10	-0.05	-0.08	1.00
648	2022/12/08 23:08:29.424	5	1202.3	952.3	-4345.3	-0.34	29	38	63	-0.77	0.63	-0.03	0.63	0.77	0.13	-0.11	-0.08	0.99
649	2022/12/09 10:41:17.983	5	696.9	682.0	-3910.9	0.51	56	68	120	0.81	-0.58	-0.05	-0.58	-0.80	-0.13	-0.04	-0.13	0.99
650	2022/12/17 01:48:11.611	5	614.8	706.3	-3691.4	-1.03	22	33	57	0.77	-0.63	-0.10	-0.63	-0.78	-0.01	0.07	-0.06	1.00
651	2022/12/17 23:32:28.602	5	668.8	778.9	-4312.5	0.21	49	63	102	0.76	-0.65	-0.02	-0.64	-0.75	-0.13	-0.07	-0.11	0.99
652	2022/12/18 01:15:57.758	5	664.8	710.9	-4182.8	-0.86	65	122	144	-0.78	0.63	0.02	-0.62	-0.76	-0.21	-0.11	-0.17	0.98
653	2022/12/20 17:16:04.477	5	739.1	724.2	-4061.7	-0.83	48	70	144	-0.53	0.85	-0.06	-0.85	-0.52	0.13	0.08	0.12	0.99
654	2022/12/22 13:09:09.467	5	483.6	768.8	-3637.5	-0.60	63	132	188	0.53	-0.84	-0.10	0.82	0.54	-0.20	0.22	0.03	0.97
655	2022/12/24 00:34:07.847	5	1360.9	879.7	-4256.3	-0.45	45	61	98	0.86	-0.48	0.20	0.46	0.88	0.15	-0.24	-0.04	0.97
656	2023/01/01 23:33:01.116	5	833.6	766.4	-3722.7	-0.89	62	120	152	-0.65	0.76	0.09	0.73	0.65	-0.18	0.20	0.05	0.98
657	2023/01/02 02:58:20.997	5	743.8	714.1	-3789.8	-0.51	48	68	133	-0.49	0.87	0.10	0.87	0.49	-0.06	-0.10	0.06	-0.99
658	2023/03/15 08:01:51.140	6	664.8	764.1	-4259.4	0.96	77	104	178	-0.96	0.27	-0.06	0.25	0.95	0.20	0.11	0.18	-0.98
659	2023/03/15 08:04:16.312	6	736.7	502.3	-4055.5	-0.29	121	197	251	0.75	-0.66	0.00	-0.65	-0.75	-0.14	-0.09	-0.11	0.99
660	2023/03/15 08:04:38.139	6	737.5	769.5	-4344.5	-0.57	120	183	255	0.89	-0.44	0.13	-0.46	-0.87	0.16	-0.04	0.21	0.98
661	2023/03/15 08:17:36.419	6	559.4	841.4	-4140.6	-0.43	82	99	155	0.94	-0.32	0.07	-0.32	-0.95	-0.06	0.09	0.04	-1.00

Time	Flow_L_per_s	WH_Pressure_Bar	Series	Time	Flow_L_per_s	WH_Pressure_Bar	Series
2022/01/22 09:31:00.000	0	3.282144541	2	2022/01/24 17:53:00.000	0	29.44163372	2
2022/01/22 09:32:00.000	0	3.26764069	2	2022/01/24 17:54:00.000	0	29.16780656	2
2022/01/22 09:33:00.000	0	3.311236062	2	2022/01/24 17:55:00.000	0	28.94662036	2
2022/01/22 09:34:00.000	0	3.279832538	2	2022/01/24 17:56:00.000	0	28.7397281	2
2022/01/22 09:35:00.000	0	3.31597619	2	2022/01/25 07:06:00.000	0	0.268493444	2
2022/01/22 09:36:00.000	0	3.370797791	2	2022/01/25 07:07:00.000	0	0.220687096	2
2022/01/22 09:37:00.000	6.603623321	3.356500152	2	2022/01/25 07:08:00.000	0	0.194660336	2
2022/01/22 09:38:00.000	7.762843781	3.31974399	2	2022/01/25 07:09:00.000	0	0.181434462	2
2022/01/22 09:39:00.000	0.634100828	3.344393336	2	2022/01/25 07:10:00.000	0	0.156401694	2
2022/01/22 09:40:00.000	0.088752916	3.40176311	2	2022/01/25 07:11:00.000	0	0.188104183	2
2022/01/22 09:41:00.000	7.185629579	3.352114316	2	2022/01/25 07:12:00.000	0	0.153427755	2
2022/01/22 09:42:00.000	7.885641809	3.375273051	2	2022/01/25 07:13:00.000	7.386470171	0.195578868	2
2022/01/22 09:43:00.000	7.641252886	3.383342805	2	2022/01/25 07:14:00.000	10.77786654	0.219890942	2
2022/01/22 09:44:00.000	7.900842541	3.337728403	2	2022/01/25 07:15:00.000	11.23364448	0.178519318	2
2022/01/22 09:45:00.000	8.419984831	3.328340429	2	2022/01/25 07:16:00.000	10.83743998	0.20461656	2
2022/01/22 09:46:00.000	7.795541744	3.361676395	2	2022/01/25 07:17:00.000	10.12676892	0.208429745	2
2022/01/22 09:47:00.000	7.005355977	3.408431107	2	2022/01/25 07:18:00.000	9.837307956	0.201962078	2
2022/01/22 09:48:00.000	6.753878344	3.392816588	2	2022/01/25 07:19:00.000	8.064980602	0.170324703	2
2022/01/22 09:49:00.000	4.75942208	3.41763945	2	2022/01/25 07:20:00.000	7.821960855	0.129331717	2
2022/01/22 09:50:00.000	4.57437847	3.374395136	2	2022/01/25 07:21:00.000	7.844515282	0.176854808	2
2022/01/22 09:51:00.000	4.530844881	3.332989408	2	2022/01/25 07:22:00.000	7.852148724	0.190378304	2
2022/01/22 09:52:00.000	4.535607498	3.394134249	2	2022/01/25 07:23:00.000	7.869513564	0.161320724	2
2022/01/22 09:53:00.000	3.799106254	3.410800034	2	2022/01/25 07:24:00.000	7.892450832	0.144981674	2
2022/01/22 09:54:00.000	3.086447642	3.300623307	2	2022/01/25 07:25:00.000	4.035537781	0.184891417	2
2022/01/22 09:55:00.000	3.016612787	3.396237929	2	2022/01/25 07:26:00.000	6.028094839	0.143920263	2
2022/01/22 09:56:00.000	2.929295285	3.428080787	2	2022/01/25 07:27:00.000	2.91554471	0.143176012	2
2022/01/22 09:57:00.000	2.71197319	3.417904705	2	2022/01/25 07:28:00.000	0.091932917	0.168391298	2
2022/01/22 09:58:00.000	2.497720694	3.382816301	2	2022/01/25 07:29:00.000	0	0.11874577	2
2022/01/22 09:59:00.000	5.824265679	3.360183304	2	2022/01/25 07:30:00.000	0	0.176554504	2
2022/01/22 10:00:00.000	6.205527068	3.350798962	2	2022/01/25 07:31:00.000	0	0.116953325	2
2022/01/22 10:01:00.000	5.872650264	3.307378825	2	2022/01/25 07:32:00.000	0	0.130018895	2
2022/01/22 10:02:00.000	5.855285411	3.328869973	2	2022/01/25 07:33:00.000	0	0.198196004	2
2022/01/22 10:03:00.000	1.947035968	3.342550327	2	2022/01/25 07:34:00.000	0	0.123761517	2
2022/01/22 10:04:00.000	0	3.294130734	2	2022/01/25 07:35:00.000	0	0.102597477	2
2022/01/22 10:05:00.000	0	3.343691801	2	2022/01/25 07:36:00.000	0	0.162157861	2
2022/01/22 10:06:00.000	0	3.40115062	2	2022/01/25 07:37:00.000	0	0.148225466	2
2022/01/22 10:07:00.000	0	3.452116114	2	2022/01/25 07:38:00.000	0	0.141259077	2
2022/01/22 10:08:00.000	0	3.420095889	2	2022/01/25 07:39:00.000	0	0.163126767	2
2022/01/22 10:09:00.000	0	3.380275389	2	2022/01/25 07:40:00.000	0	0.198451495	2
2022/01/22 10:10:00.000	0	3.43650178	2	2022/01/25 07:41:00.000	0	0.159000637	2
2022/01/22 10:11:00.000	0	3.388078735	2	2022/01/25 07:42:00.000	0	0.132332278	2
2022/01/22 10:12:00.000	0	3.347202194	2	2022/01/25 07:43:00.000	0	0.132005543	2
2022/01/22 10:13:00.000	0	3.384834734	2	2022/01/25 07:44:00.000	0	0.13977115	2
2022/01/22 10:14:00.000	0	3.395974382	2	2022/01/25 07:45:00.000	0	0.202061668	2
2022/01/22 10:15:00.000	0	3.392554388	2	2022/01/25 07:46:00.000	0	0.16255546	2
2022/01/22 10:16:00.000	0	3.39570874	2	2022/01/25 07:47:00.000	0.04418875	0.165060938	2
2022/01/22 10:17:00.000	0	3.425453119	2	2022/01/25 07:48:00.000	0	0.166672204	2

2022/01/22 10:18:00.000	0	3.326763621	2	2022/01/25 07:49:00.000	0	0.134311265	2
2022/01/22 10:19:00.000	0	3.366412896	2	2022/01/25 07:50:00.000	0	0.11583216	2
2022/01/22 10:20:00.000	0	3.357727248	2	2022/01/25 07:51:00.000	0	0.150711986	2
2022/01/22 10:21:00.000	0	3.362113444	2	2022/01/25 07:52:00.000	0	0.128401308	2
2022/01/22 10:22:00.000	0	3.306149069	2	2022/01/25 07:53:00.000	0	0.183536406	2
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2022/01/22 10:25:00.000	0	3.405711508	2	2022/01/25 07:56:00.000	0	0.1724797	2
2022/01/22 10:26:00.000	0	3.406148943	2	2022/01/25 07:57:00.000	0	0.150367438	2
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2022/01/22 10:30:00.000	0	3.311849879	2	2022/01/25 08:01:00.000	0	0.150595157	2
2022/01/22 10:31:00.000	0	3.407290976	2	2022/01/25 08:02:00.000	0	0.14724143	2
2022/01/22 10:32:00.000	0	3.422463092	2	2022/01/25 08:03:00.000	0	0.163631425	2
2022/01/22 10:33:00.000	0	3.374045781	2	2022/01/25 08:04:00.000	0	0.139503595	2
2022/01/22 10:34:00.000	0	3.356850835	2	2022/01/25 08:05:00.000	0	0.15246019	2
2022/01/22 10:35:00.000	0	3.360887131	2	2022/01/25 08:06:00.000	0	0.152569356	2
2022/01/22 10:36:00.000	0	3.326760944	2	2022/01/25 08:07:00.000	0	0.17107087	2
2022/01/22 10:37:00.000	0	3.321763219	2	2022/01/25 08:08:00.000	0	0.145193688	2
2022/01/22 10:38:00.000	0	3.3936949	2	2022/01/25 08:09:00.000	0	0.145489204	2
2022/01/22 10:39:00.000	0	3.404219759	2	2022/01/25 08:10:00.000	0	0.131406083	2
2022/01/22 10:40:00.000	0	3.37001043	2	2022/01/25 08:11:00.000	0	0.149213141	2
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2022/01/22 10:42:00.000	0	3.447901884	2	2022/01/25 08:13:00.000	0	0.148489192	2
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2022/01/22 10:45:00.000	0	3.460097551	2	2022/01/25 08:16:00.000	0	0.123057869	2
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2022/01/22 10:50:00.000	0	3.371324263	2	2022/01/25 08:21:00.000	0	0.14802322	2
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2022/01/22 11:10:00.000	0	3.365446106	2	2022/01/25 08:41:00.000	0	0.092722456	2
2022/01/22 11:11:00.000	0	3.361674675	2	2022/01/25 08:42:00.000	0	0.095833526	2
2022/01/22 11:12:00.000	0	3.411413866	2	2022/01/25 08:43:00.000	0	0.128437123	2
2022/01/22 11:13:00.000	0	3.439569947	2	2022/01/25 08:44:00.000	0	0.111745865	2
2022/01/22 11:14:00.000	0	3.421237931	2	2022/01/25 08:45:00.000	0	0.153793559	2
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2022/01/22 11:16:00.000	0	3.438693359	2	2022/01/25 08:47:00.000	0	0.162355128	2
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2022/01/22 11:25:00.000	0	3.394394329	2	2022/01/25 08:56:00.000	0	0.120170496	2
2022/01/22 11:26:00.000	0	3.383604036	2	2022/01/25 08:57:00.000	0	0.167490766	2
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2022/01/22 11:30:00.000	0	3.364660102	2	2022/01/25 09:01:00.000	0	0.126103245	2
2022/01/22 11:31:00.000	0	3.391939412	2	2022/01/25 09:02:00.000	0	0.12311207	2
2022/01/22 11:32:00.000	0	3.424042578	2	2022/01/25 09:03:00.000	0	0.107865648	2
2022/01/22 11:33:00.000	0	3.426238547	2	2022/01/25 09:04:00.000	0	0.150331049	2
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2022/01/22 11:35:00.000	0	3.278165336	2	2022/01/25 09:06:00.000	0	0.162229874	2
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2022/01/22 11:40:00.000	0	3.278254012	2	2022/01/25 09:11:00.000	0	0.154944602	2
2022/01/22 11:41:00.000	0	3.244044527	2	2022/01/25 09:12:00.000	0	0.140209543	2
2022/01/22 11:42:00.000	0	3.286675583	2	2022/01/25 09:13:00.000	0	0.103809614	2
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2022/01/22 11:44:00.000	0	3.331061174	2	2022/01/25 09:15:00.000	0	0.108701255	2
2022/01/22 11:45:00.000	0	3.328957498	2	2022/01/25 09:16:00.000	0	0.146682956	2
2022/01/22 11:46:00.000	0	3.378603989	2	2022/01/25 09:17:00.000	0	0.119213082	2
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Time	Flow (l/s)	Series	Time	Flow (l/s)	Series
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2022/02/24 19:10:53.000	2.80963	3	2022/03/02 10:06:00.000	4.60405	3
2022/02/24 19:11:53.000	2.8877	3	2022/03/02 10:07:00.000	4.41724	3
2022/02/24 19:12:53.000	2.90908	3	2022/03/02 10:08:00.000	4.72587	3
2022/02/24 19:13:53.000	2.57095	3	2022/03/02 10:09:00.000	4.70938	3
2022/02/24 19:14:53.000	2.9254	3	2022/03/02 10:10:00.000	4.83751	3
2022/02/24 19:15:53.000	2.86072	3	2022/03/02 10:11:00.000	4.81792	3
2022/02/24 19:16:53.000	2.97413	3	2022/03/02 10:12:00.000	4.83439	3
2022/02/24 19:17:53.000	2.7459	3	2022/03/02 10:13:00.000	4.62567	3
2022/02/24 19:18:53.000	2.67277	3	2022/03/02 10:14:00.000	4.58675	3
2022/02/24 19:19:53.000	3.18483	3	2022/03/02 10:15:00.000	4.58897	3
2022/02/24 19:20:53.000	3.32347	3	2022/03/02 10:16:00.000	4.87492	3
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2022/02/24 19:22:53.000	2.9778	3	2022/03/02 10:18:00.000	4.7331	3
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2022/03/01 15:16:05.000	4.50212	3	2022/03/04 19:56:00.000	5.1029	3
2022/03/01 15:17:05.000	4.52455	3	2022/03/04 19:57:00.000	4.93813	3
2022/03/01 15:18:05.000	4.6936	3	2022/03/04 19:58:00.000	5.15993	3
2022/03/01 15:19:05.000	4.74489	3	2022/03/04 19:59:00.000	5.20954	3
2022/03/01 15:20:05.000	4.57045	3	2022/03/04 20:00:00.000	5.08612	3
2022/03/01 15:21:05.000	4.69956	3	2022/03/04 20:01:00.000	3.79042	3
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2022/03/01 15:24:05.000	4.41136	3	2022/03/04 20:04:00.000	5.08021	3
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2022/03/01 15:27:05.000	4.64923	3	2022/03/04 20:07:00.000	0.06404	3
2022/03/01 15:28:05.000	4.67475	3	2022/03/04 20:08:00.000	5.00235	3
2022/03/01 15:29:05.000	4.4698	3	2022/03/04 20:09:00.000	5.16098	3
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2022/03/01 15:35:05.000	4.66536	3	2022/03/04 20:15:00.000	5.25181	3
2022/03/01 15:36:05.000	4.44441	3	2022/03/04 20:16:00.000	3.82808	3
2022/03/01 15:37:05.000	4.45423	3	2022/03/04 20:17:00.000	4.11099	3
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2022/03/01 15:40:05.000	4.27105	3	2022/03/04 20:20:00.000	5.20539	3
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2022/03/01 15:45:05.000	4.25822	3	2022/03/04 20:25:00.000	3.45957	3
2022/03/01 15:46:05.000	4.64397	3	2022/03/04 20:26:00.000	5.11112	3
2022/03/01 15:47:05.000	4.45433	3	2022/03/04 20:27:00.000	3.01064	3
2022/03/01 15:48:05.000	4.70831	3	2022/03/04 20:28:00.000	5.1116	3
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2022/03/01 16:03:06.000	4.64916	3	2022/03/04 20:43:00.000	0.513319	3
2022/03/01 16:04:06.000	4.89867	3	2022/03/04 20:44:00.000	4.90018	3
2022/03/01 16:05:06.000	4.9106	3	2022/03/04 20:45:00.000	5.18811	3
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2022/03/01 16:08:06.000	4.84565	3	2022/03/04 20:48:00.000	3.81517	3
2022/03/01 16:09:06.000	4.25211	3	2022/03/04 20:49:00.000	5.06101	3
2022/03/01 16:10:06.000	4.74357	3	2022/03/04 20:50:00.000	0.865022	3
2022/03/01 16:11:06.000	4.26801	3	2022/03/04 20:51:00.000	5.24296	3

2022/03/01 16:12:06.000	4.54723	3	2022/03/04 20:52:00.000	5.21894	3
2022/03/01 16:13:06.000	4.08186	3	2022/03/04 20:53:00.000	4.87978	3
2022/03/01 16:14:06.000	4.37684	3	2022/03/04 20:54:00.000	5.17203	3
2022/03/01 16:15:06.000	4.68209	3	2022/03/04 20:55:00.000	4.003	3
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2022/03/01 16:18:06.000	4.57715	3	2022/03/04 20:58:00.000	4.78714	3
2022/03/01 16:19:06.000	4.5881	3	2022/03/04 20:59:00.000	5.22494	3
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2022/03/01 16:22:06.000	4.51521	3	2022/03/04 21:02:00.000	5.19984	3
2022/03/01 16:23:06.000	4.66053	3	2022/03/04 21:03:00.000	0	3
2022/03/01 16:24:06.000	4.38634	3	2022/03/04 21:04:00.000	5.00745	3
2022/03/01 16:25:06.000	4.61955	3	2022/03/04 21:05:00.000	0.594459	3
2022/03/01 16:26:06.000	4.45732	3	2022/03/04 21:06:00.000	5.02084	3
2022/03/01 16:27:06.000	4.52907	3	2022/03/04 21:07:00.000	5.09719	3
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2022/03/01 16:29:06.000	4.39421	3	2022/03/04 21:09:00.000	0.401204	3
2022/03/01 16:30:06.000	4.68858	3	2022/03/04 21:10:00.000	5.20245	3
2022/03/01 16:31:06.000	4.35052	3	2022/03/04 21:11:00.000	4.98133	3
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2022/03/01 16:35:06.000	4.5941	3	2022/03/04 21:15:00.000	4.6484	3
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2022/03/01 16:38:06.000	4.56936	3	2022/03/04 21:18:00.000	5.06399	3
2022/03/01 16:39:06.000	0.1055	3	2022/03/04 21:19:00.000	5.14734	3
2022/03/01 16:40:06.000	0.0198968	3	2022/03/04 21:20:00.000	1.84364	3
2022/03/01 16:41:06.000	0.0345444	3	2022/03/04 21:21:00.000	3.9545	3
2022/03/01 16:42:06.000	0.00240372	3	2022/03/04 21:22:00.000	3.07834	3
2022/03/01 16:43:06.000	-0.0287267	3	2022/03/04 21:23:00.000	4.69655	3
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2022/03/01 16:45:06.000	0.0117752	3	2022/03/04 21:25:00.000	5.15074	3
2022/03/01 16:46:06.000	0.179761	3	2022/03/04 21:26:00.000	3.77933	3
2022/03/02 09:39:00.000	-0.000588901	3	2022/03/04 21:27:00.000	2.5231	3
2022/03/02 09:39:00.000	0.164958	3	2022/03/04 21:28:00.000	5.13786	3
2022/03/02 09:40:00.000	-0.0624353	3	2022/03/04 21:29:00.000	5.19311	3
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2022/03/02 09:44:00.000	-0.184812	3	2022/03/04 21:33:00.000	3.79995	3
2022/03/02 09:45:00.000	3.62023	3	2022/03/04 21:34:00.000	5.21255	3
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2022/03/02 09:47:00.000	4.44158	3	2022/03/04 21:36:00.000	2.55746	3
2022/03/02 09:48:00.000	4.41689	3	2022/03/04 21:37:00.000	5.13357	3
2022/03/02 09:49:00.000	3.94461	3	2022/03/04 21:38:00.000	2.70748	3
2022/03/02 09:50:00.000	4.86836	3	2022/03/04 21:39:00.000	1.96532	3

2022/03/02 09:51:00.000	4.77731	3	2022/03/04 21:40:00.000	5.15642	3
2022/03/02 09:52:00.000	4.54273	3	2022/03/04 21:41:00.000	5.14247	3
2022/03/02 09:53:00.000	4.4947	3	2022/03/04 21:42:00.000	4.90512	3
2022/03/02 09:54:00.000	4.61167	3	2022/03/04 21:43:00.000	4.6984	3
2022/03/02 09:55:00.000	4.46775	3	2022/03/04 21:44:00.000	4.13512	3
2022/03/02 09:56:00.000	4.46313	3	2022/03/04 21:45:00.000	5.17443	3
2022/03/02 09:57:00.000	4.54401	3	2022/03/04 21:46:00.000	4.88399	3
2022/03/02 09:58:00.000	4.68952	3	2022/03/04 21:47:00.000	2.10813	3
2022/03/02 09:59:00.000	4.47874	3	2022/03/04 21:48:00.000	5.24175	3
2022/03/02 10:00:00.000	5.00671	3	2022/03/04 21:49:00.000	4.35806	3
2022/03/02 10:01:00.000	4.7248	3	2022/03/04 21:50:00.000	3.51575	3
2022/03/02 10:02:00.000	4.70156	3	2022/03/04 21:51:00.000	2.69686	3
2022/03/02 10:03:00.000	4.70145	3	2022/03/04 21:52:00.000	0.898528	3

MD	Inc (°)	Az (°)	Z	Y	X	Time	Series	Fault DIPI	Fault AZI
0	0	0	0	0	0	2021-05-17 14:21:06	1	0	0
5.83	0.4	266.3	-5.83	0	-0.02	2021-05-17 14:21:06	1	0	0
15.02	0.51	257.8	-15.02	-0.01	-0.09	2021-05-17 14:21:06	1	0	0
24.05	0.59	257.4	-24.05	-0.03	-0.18	2021-05-17 14:21:06	1	0	0
33.15	0.62	257.2	-33.15	-0.05	-0.27	2021-05-17 13:56:40	1	0	0
42.37	0.63	255.5	-42.37	-0.08	-0.37	2021-05-17 16:32:22	1	0	0
51.51	0.62	252.7	-51.51	-0.1	-0.46	2021-05-18 08:39:25	1	0	0
60.68	0.59	249.1	-60.68	-0.13	-0.56	2021-05-19 04:12:38	1	0	0
69.89	0.59	247	-69.89	-0.17	-0.64	2021-05-19 18:23:57	1	0	0
79.06	0.59	245.6	-79.06	-0.21	-0.73	2021-05-20 04:59:44	1	0	0
88.31	0.59	243.5	-88.31	-0.25	-0.82	2021-05-20 10:44:44	1	0	0
97.25	0.61	242.6	-97.25	-0.29	-0.9	2021-05-21 00:48:52	1	0	0
106.67	0.62	242.7	-106.66	-0.34	-0.99	2021-05-21 08:55:39	1	0	0
115.9	0.62	242.7	-115.89	-0.38	-1.08	2021-05-21 13:54:32	1	0	0
125.31	0.64	242	-125.3	-0.43	-1.17	2021-05-22 16:39:16	1	0	0
134.45	0.62	238.4	-134.44	-0.48	-1.26	2021-05-23 07:05:08	1	0	0
164.37	0.65	224.4	-164.36	-0.69	-1.51	2021-05-23 19:43:25	1	0	0
193.26	0.59	198.7	-193.25	-0.95	-1.68	2021-05-24 19:29:48	1	0	0
221.92	0.65	132.7	-221.91	-1.2	-1.6	2021-05-27 02:38:30	1	0	0
250.85	0.89	113.9	-250.84	-1.4	-1.28	2021-06-03 22:48:12	1	0	0
279.55	0.97	111.3	-279.53	-1.58	-0.85	2021-06-04 16:10:39	1	0	0
308.47	0.8	115.6	-308.45	-1.75	-0.44	2021-06-05 03:20:12	1	0	0
337.37	0.71	120.1	-337.35	-1.93	-0.1	2021-06-05 14:52:08	1	0	0
366.16	0.6	130.7	-366.13	-2.12	0.17	2021-06-06 01:24:36	1	0	0
395.04	0.65	151.6	-395.01	-2.36	0.36	2021-06-06 14:00:52	1	0	0
423.83	0.69	163.4	-423.8	-2.67	0.49	2021-06-07 09:10:33	1	0	0
452.79	0.71	170.3	-452.76	-3.01	0.57	2021-06-07 18:01:22	1	0	0
481.64	1.11	187.1	-481.6	-3.47	0.56	2021-06-08 02:09:54	1	0	0
510.42	1.67	199.7	-510.38	-4.14	0.39	2021-06-08 12:30:52	1	0	0
539.16	1.93	207.8	-539.1	-4.96	0.02	2021-06-08 23:33:06	1	0	0
567.97	2.32	207.6	-567.89	-5.91	-0.48	2021-06-09 10:27:39	1	0	0
596.88	2.15	207.4	-596.78	-6.91	-1	2021-06-10 13:23:26	1	0	0
625.8	1.87	208.7	-625.68	-7.8	-1.47	2021-06-11 00:45:42	1	0	0
654.5	1.94	210.4	-654.37	-8.63	-1.94	2021-06-11 09:00:30	1	0	0
683.3	2.18	208.1	-683.15	-9.53	-2.45	2021-06-11 15:41:11	1	0	0
712.01	2.28	205.8	-711.84	-10.53	-2.95	2021-06-12 04:26:10	1	0	0
740.89	1.83	199.7	-740.7	-11.48	-3.36	2021-06-12 17:06:58	1	0	0
769.75	1.83	208.6	-769.54	-12.32	-3.74	2021-06-13 06:02:32	1	0	0
798.6	1.7	218.6	-798.38	-13.06	-4.22	2021-06-14 18:17:31	1	0	0
827.42	1.71	227.7	-827.19	-13.68	-4.81	2021-06-15 12:55:41	1	0	0
856.32	1.53	239.6	-856.07	-14.17	-5.46	2021-06-18 11:16:39	1	0	0
885.18	1.5	249.6	-884.92	-14.5	-6.15	2021-06-19 02:36:11	1	0	0
913.99	1.27	266.6	-913.73	-14.65	-6.82	2021-06-19 21:41:59	1	0	0
942.82	0.65	310.5	-942.55	-14.56	-7.26	2021-06-22 09:31:14	1	0	0
971.67	0.56	346.4	-971.4	-14.32	-7.42	2021-06-22 23:49:32	1	0	0
1000.5	0.5	358.3	-1000.19	-14.05	-7.46	2021-06-23 14:35:44	1	0	0
1029.3	0.51	349.7	-1029.02	-13.8	-7.48	2021-06-24 02:52:47	1	0	0

1058.1	0.51	333.3	-1057.85	-13.56	-7.56	2021-06-24 13:55:55	1	0	0
1087	0.56	311.5	-1086.73	-13.35	-7.73	2021-06-25 00:33:43	1	0	0
1115.8	0.57	307	-1115.54	-13.17	-7.95	2021-06-26 22:01:41	1	0	0
1144.6	0.65	331.8	-1144.33	-12.94	-8.14	2021-06-27 07:33:36	1	0	0
1173.4	0.76	2.05	-1173.11	-12.61	-8.21	2021-06-27 18:26:57	1	0	0
1202.2	0.88	352.6	-1201.9	-12.2	-8.23	2021-06-28 05:34:59	1	0	0
1231	1.05	303.7	-1230.75	-11.83	-8.48	2021-06-28 15:44:14	1	0	0
1259.8	0.96	255.8	-1259.52	-11.74	-8.93	2021-06-30 03:51:27	1	0	0
1288.7	0.6	219.7	-1288.43	-11.92	-9.26	2021-06-30 15:30:58	1	0	0
1317.5	0.46	204.2	-1317.19	-12.14	-9.41	2021-07-01 04:18:35	1	0	0
1346.2	0.39	212.2	-1345.93	-12.33	-9.51	2021-07-01 14:51:33	1	0	0
1375	0.4	234	-1374.75	-12.47	-9.64	2021-07-02 00:32:12	1	0	0
1403.8	0.56	229.8	-1403.54	-12.62	-9.83	2021-07-02 11:56:03	1	0	0
1432.7	0.73	228.2	-1432.35	-12.83	-10.07	2021-07-02 23:51:11	1	0	0
1461.5	0.94	242.7	-1461.19	-13.07	-10.42	2021-07-04 15:48:33	1	0	0
1490.4	0.87	266	-1490.06	-13.19	-10.85	2021-07-05 03:36:33	1	0	0
1519.2	0.98	254.4	-1518.93	-13.27	-11.31	2021-07-15 19:08:17	1	0	0
1548.1	0.97	258.6	-1547.74	-13.39	-11.78	2021-07-16 02:57:39	1	0	0
1577	0.52	260.5	-1576.69	-13.46	-12.15	2021-07-16 10:40:54	1	77.33988	155.7139
1605.9	0.53	68.93	-1605.55	-13.43	-12.16	2021-07-16 20:26:19	1	0	0
1634.8	1.68	60.38	-1634.49	-13.17	-11.66	2021-07-18 03:51:26	1	60.25688	256.3282
1663.6	2.36	58.73	-1663.27	-12.65	-10.79	2021-07-18 11:43:40	1	0	0
1692.4	2.07	57.35	-1692.07	-12.07	-9.84	2021-07-18 22:10:43	1	0	0
1721.2	1.95	57.89	-1720.79	-11.53	-8.99	2021-07-21 00:15:27	1	0	0
1749.9	2.34	57.16	-1749.49	-10.95	-8.09	2021-07-21 10:02:47	1	0	0
1778.6	2.51	57.63	-1778.22	-10.29	-7.06	2021-07-21 20:09:40	1	0	0
1807.5	2.57	55.46	-1807.02	-9.59	-6	2021-07-22 06:27:40	1	0	0
1836.3	2.57	60.33	-1835.84	-8.9	-4.9	2021-07-22 16:51:53	1	0	0
1865.1	2.96	56.81	-1864.57	-8.18	-3.72	2021-07-23 04:06:33	1	0	0
1893.8	3.15	53.08	-1893.23	-7.3	-2.47	2021-07-23 16:27:39	1	0	0
1922.6	3.37	49.57	-1921.97	-6.27	-1.19	2021-07-24 02:44:08	1	53.054	252.7829
1951.3	3.88	46.01	-1950.67	-5.05	0.15	2021-07-24 09:28:15	1	0	0
1980.1	4.7	45.58	-1979.35	-3.55	1.69	2021-07-24 17:03:58	1	59.03664	275.6736
2008.8	4.81	48.1	-2007.96	-1.92	3.43	2021-07-26 02:26:05	1	67.49203	241.1839
2037.7	4.89	46.99	-2036.73	-0.27	5.23	2021-07-26 08:17:50	1	79.09966	226.0899
2066.6	4.91	49.56	-2065.56	1.37	7.07	2021-07-26 16:04:12	1	71.45422	241.6618
2095.5	4.99	53.35	-2094.35	2.92	9.02	2021-07-27 01:39:30	1	71.47598	229.0138
2124.4	5.48	54.54	-2123.08	4.47	11.15	2021-07-27 08:22:21	1	62.96874	256.1671
2153.2	6.04	59.95	-2151.79	6.03	13.59	2021-07-27 14:55:58	1	59.81157	245.48
2182	6.84	65.38	-2180.37	7.5	16.46	2021-07-27 22:26:45	1	77.17149	191.6594
2210.9	7.84	65.93	-2209.03	9.02	19.82	2021-07-28 05:05:49	1	59.04641	143.8472
2239.7	8.37	64.91	-2237.53	10.71	23.51	2021-07-28 11:48:39	1	79.3142	205.1668
2268.4	8.74	64.35	-2265.96	12.55	27.37	2021-07-28 22:40:23	1	70.6532	225.5163
2297.3	9.38	62.11	-2294.45	14.59	31.43	2021-07-29 07:08:13	1	55.55988	246.1381
2326	10.27	63.89	-2322.76	16.82	35.8	2021-07-29 17:31:58	1	79.57879	277.9301
2354.7	10.4	61.88	-2351	19.16	40.38	2021-07-31 05:02:24	1	76.05033	281.0635
2383.5	10.44	60.69	-2379.34	21.67	44.95	2021-07-31 14:12:00	1	75.94971	299.4816
2412.3	10.64	59.58	-2407.6	24.29	49.51	2021-07-31 22:38:43	1	80.11446	215.4668

2441.2	10.78	58.17	-2435.99	27.06	54.11	2021-08-01 08:05:15	1	69.61713	232.1308
2470	11.22	56.21	-2464.28	30.04	58.73	2021-08-01 17:51:00	1	75.79076	122.5105
2498.8	11.55	56.17	-2492.57	33.21	63.46	2021-08-02 03:54:43	1	79.35709	122.7047
2527.6	11.63	58.28	-2520.78	36.34	68.32	2021-08-04 08:23:12	1	78.00896	137.9771
2556.6	11.77	58.2	-2549.12	39.43	73.31	2021-08-04 19:05:19	1	72.20809	100.9488
2585.4	12.46	58.16	-2577.35	42.63	78.46	2021-08-05 07:45:06	1	59.38536	214.4481
2614.3	13.11	56.55	-2605.48	46.07	83.84	2021-08-05 19:33:29	1	58.31441	133.8081
2643	13.71	57.07	-2633.43	49.72	89.41	2021-08-06 07:44:25	1	64.66577	247.4373
2671.8	14.11	57.44	-2661.35	53.46	95.23	2021-08-06 22:10:42	1	72.96325	236.2543
2700.6	14.7	56.98	-2689.28	57.35	101.26	2021-08-07 12:44:48	1	58.79707	118.1213
2729.4	15.24	56.73	-2717.1	61.41	107.49	2021-08-08 04:34:34	1	49.95953	295.2162
2758.3	15.29	56.12	-2744.96	65.62	113.82	2021-08-10 18:25:43	1	84.6882	287.1042
2787.1	15.74	54.78	-2772.74	69.99	120.17	2021-08-12 13:44:38	1	76.98666	305.7762
2815.9	15.9	54.31	-2800.43	74.54	126.56	2021-08-13 00:03:04	1	72.1375	217.94
2844.8	16.66	53.73	-2828.15	79.3	133.11	2021-08-13 10:02:17	1	53.77041	111.7027
2873.7	17.16	52.37	-2855.78	84.35	139.83	2021-08-13 23:24:43	1	62.74704	125.007
2902.5	17.24	53.05	-2883.33	89.52	146.61	2021-08-14 15:29:54	1	64.76989	326.0328
2931.3	17.73	51.69	-2910.8	94.8	153.46	2021-08-15 06:21:00	1	39.60723	266.9195
2960.1	18.04	52.48	-2938.21	100.2	160.44	2021-08-17 02:42:45	1	59.69694	336.1779
2988.8	18.56	53.19	-2965.49	105.7	167.63	2021-08-17 13:10:13	1	58.70478	326.7962
3017.7	18.87	55.18	-2992.86	111.1	175.15	2021-08-17 23:28:53	1	70.85397	291.9855
3046.7	19.34	54.37	-3020.19	116.6	182.88	2021-08-18 10:57:46	1	0	0
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3104.4	20.8	54.02	-3074.4	128.2	198.95	2021-08-19 13:15:41	1	0	0
3133.3	21.88	54.68	-3101.31	134.3	207.49	2021-08-20 00:33:43	1	58.88935	236.9179
3162.2	22.45	53.89	-3128.08	140.7	216.34	2021-08-20 12:08:39	1	81.88046	148.0253
3191.1	22.38	53.18	-3154.78	147.2	225.2	2021-08-22 02:56:51	1	68.28799	290.5795
3219.9	22.74	51.84	-3181.42	153.9	233.98	2021-08-22 11:10:45	1	71.02829	238.1643
3248.8	22.22	52.61	-3208.11	160.7	242.71	2021-08-22 19:19:23	1	68.37206	318.1402
3277.6	21.41	52.79	-3234.9	167.2	251.24	2021-08-23 01:22:06	1	63.67632	153.9797
3306.5	20.92	53.59	-3261.76	173.4	259.57	2021-08-23 08:47:38	1	0	0
3335.3	20.18	53.21	-3288.81	179.5	267.71	2021-08-23 18:14:53	1	0	0
3364.2	18.72	53.04	-3316.06	185.3	275.41	2021-08-24 06:08:19	1	60.11266	266.1931
3392.9	18.73	51.88	-3343.23	190.9	282.71	2021-08-24 16:40:37	1	67.1273	158.3231
3421.8	19.2	51.25	-3370.49	196.7	290.05	2021-08-25 08:24:00	1	0	0
3450.6	18.56	50.7	-3397.82	202.6	297.31	2021-08-27 11:37:17	1	0	0
3479.5	19.46	52.74	-3425.07	208.4	304.68	2021-08-27 21:38:31	1	0	0
3508.3	20.96	54	-3452.15	214.3	312.68	2021-08-28 06:06:51	1	0	0
3537.2	22.37	54.59	-3478.98	220.6	321.34	2021-08-28 14:42:32	1	0	0
3566.1	23.25	54.96	-3505.59	227	330.48	2021-08-28 23:00:05	1	0	0
3594.8	23.91	54.55	-3531.95	233.6	339.87	2021-08-29 07:36:55	1	65.54553	319.7836
3623.7	24.53	55.38	-3558.28	240.4	349.57	2021-08-31 20:53:44	1	54.66441	248.7674
3652.5	24.35	56.86	-3584.55	247.1	359.48	2021-09-01 04:50:34	1	60.44445	315.2335
3681.4	23.21	57.17	-3610.93	253.4	369.23	2021-09-01 13:09:27	1	0	0
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3825.7	26.78	65.79	-3741.59	281.2	423.81	2021-09-03 07:59:49	1	0	0
3854.7	28.98	69.28	-3767.16	286.4	436.31	2021-09-03 16:28:35	1	0	0
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3970.5	34.46	62.01	-3866.32	310.6	490.94	2021-09-07 04:18:06	1	0	0
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4027.9	38.58	65.11	-3912.38	325.9	521.53	2021-09-29 06:20:53	1	85.19699	291.8217
4041.3	39.13	66.15	-3922.82	329.4	529.19	2021-09-29 10:15:06	1	0	0
4058.5	39.66	66.87	-3936.11	333.7	539.2	2021-09-29 15:37:28	1	0	0
4069.1	39.86	67.02	-3944.26	336.4	545.44	2021-09-29 18:58:16	1	0	0
4084.4	39.62	66.56	-3956.02	340.2	554.43	2021-09-29 22:47:28	1	0	0
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4113.6	39.02	66.54	-3978.67	347.6	571.32	2021-09-30 05:39:19	1	0	0
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4171.5	38.55	69.76	-4023.85	361	604.97	2021-09-30 20:42:03	1	0	0
4184.7	39.78	70.61	-4034.08	363.8	612.81	2021-10-01 01:23:07	1	71.97373	270.3326
4198.3	40.34	71.63	-4044.49	366.7	621.09	2021-10-01 08:21:10	1	79.13662	228.3088
4212.4	40.42	71.53	-4055.23	369.5	629.76	2021-10-03 09:52:33	1	62.74716	270.2178
4227.4	40.74	69.83	-4066.62	372.8	638.97	2021-10-05 03:27:26	1	0	0
4241.6	41.39	68.5	-4077.33	376.1	647.68	2021-10-05 08:10:58	1	0	0
4256.4	41.63	67.99	-4088.41	379.7	656.79	2021-10-05 12:40:37	1	0	0
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4285.3	40.96	62.62	-4110.07	387.6	674.25	2021-10-05 19:22:18	1	0	0
4300	40.85	61.54	-4121.18	392.1	682.76	2021-10-05 22:56:47	1	0	0
4314.2	41.04	61.67	-4131.9	396.5	690.94	2021-10-06 03:05:25	1	0	0
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4343.1	40.82	61.82	-4153.73	405.6	707.56	2021-10-06 11:18:46	1	0	0
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4370.7	41.94	63.54	-4174.47	413.9	723.76	2021-10-06 17:18:14	1	0	0
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4400.3	40.99	65.3	-4196.64	422.3	741.49	2021-10-06 23:56:20	1	0	0
4414.3	40.24	64.68	-4207.27	426.1	749.75	2021-10-07 02:46:50	1	0	0
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4598.6	39.88	60.76	-4349.37	486.9	850	2021-10-12 09:24:58	1	0	0
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4712.6	41.09	66.74	-4435.37	520.3	916.82	2021-10-13 23:21:12	1	0	0
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4801.7	39.94	67.88	-4503.5	542.2	969.92	2021-10-17 08:00:05	1	0	0
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4830.1	40.4	68.25	-4525.24	549	986.87	2021-10-17 13:13:44	1	0	0
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4930.3	38.11	55.35	-4602.27	576.5	1044.6	2021-10-18 12:17:01	1	0	0
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4959.4	38.77	54.15	-4625.07	587	1059.4	2021-10-18 19:17:43	1	0	0
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5003	38.21	63.67	-4659.04	602	1082.2	2021-10-19 04:44:57	1	0	0
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5032.5	37.68	65.71	-4682.35	609.3	1098.7	2021-10-19 10:50:26	1	0	0
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5061	37.37	62.07	-4705.02	617	1114.2	2021-10-19 16:46:11	1	0	0
5097	38.37	57.78	-4733.45	628.1	1133.3	2021-10-19 22:46:26	1	0	0

Geostring ID	Series	No. of Seismic Events	Trigger IDs	Total Delta X	Total Delta Y	Total Delta Z	Total Delta T
Geostring 1	1	5	1, 2, 3, 4, 5	478.1	902.3	853.1	16661.8
Geostring 2	1	2	8, 9	329.7	372.7	90.6	196558.8
Geostring 3	1	3	13, 14, 15	328.1	241.4	570.3	343724.3
Geostring 4	1	9	18, 19, 20, 21, 22, 23, 24, 25, 26	453.9	1143.8	812.5	409558.8
Geostring 5	1	3	28, 29, 30	307.8	545.3	969.5	115031.0
Geostring 6	1	2	31, 32	448.4	207.8	125.8	190719.1
Geostring 7	1	13	33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45	1765.6	1578.1	1971.9	429862.1
Geostring 8	1	3	46, 47, 48	254.7	670.3	146.1	4575.2
Geostring 9	1	3	49, 50, 51	231.3	404.7	564.1	646.2
Geostring 10	1	7	52, 53, 54, 55, 56, 57, 58	292.2	660.9	1303.1	3825.5
Geostring 11	1	2	59, 60	252.3	560.9	516.4	7166.7
Geostring 12	1	2	62, 63	367.2	184.4	283.6	545.9
Geostring 13	1	8	64, 65, 66, 67, 68, 69, 70, 71	1129.7	1340.6	1183.6	17815.8
Geostring 14	1	4	72, 73, 74, 75	418.8	759.4	214.1	11728.9
Geostring 15	1	5	76, 77, 78, 79, 80	853.1	490.6	685.9	101367.5
Geostring 16	1	3	81, 82, 83	281.3	319.5	815.6	69078.9
Geostring 17	1	4	87, 88, 89, 90	503.1	568.0	823.4	77579.6
Geostring 1	2	24	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23	3922.7	2478.1	2599.2	6235958.6
Geostring 2	2	3	24, 25, 26	219.5	143.8	357.0	10337.9
Geostring 3	2	2	29, 30	175.8	60.2	165.6	22530.9
Geostring 4	2	7	32, 33, 34, 35, 36, 37, 38	1165.6	1067.2	1225.8	32890.7
Geostring 5	2	2	39, 40	403.9	529.7	628.1	3562.0
Geostring 6	2	12	41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52	1455.5	1359.4	2096.1	8213.0
Geostring 7	2	2	53, 54	681.3	353.9	554.7	761.6
Geostring 8	2	8	55, 56, 57, 58, 59, 60, 61, 62	1502.3	1338.3	1263.3	3422.3
Geostring 9	2	5	64, 65, 66, 67, 68	1386.7	426.6	525.8	4938.9
Geostring 10	2	4	70, 71, 72, 73	1145.3	435.2	592.2	2509.6
Geostring 11	2	3	76, 77, 78	960.2	610.2	769.5	2009.8
Geostring 12	2	2	79, 80	518.0	85.9	88.3	2135.1
Geostring 13	2	2	83, 84	718.0	223.4	114.1	5362.9
Geostring 14	2	3	85, 86, 87	1016.4	274.2	615.6	6822.9

Geostring 15	2	2 89, 90	296.1	487.5	157.0	8530.1
Geostring 16	2	2 93, 94	207.0	321.9	608.6	11916.2
Geostring 17	2	2 96, 97	232.0	396.9	262.5	1162.3
Geostring 18	2	2 99, 100	818.0	812.5	532.8	1678.8
Geostring 19	2	11 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111	1861.7	1755.5	1996.9	4488.3
Geostring 20	2	5 113, 114, 115, 116, 117	857.8	928.9	950.8	1941.6
Geostring 21	2	4 118, 119, 120, 121	928.9	361.7	613.3	1840.8
Geostring 22	2	2 124, 125	375.8	106.3	304.7	154.7
Geostring 23	2	5 127, 128, 129, 130, 131	721.9	953.1	859.4	1965.7
Geostring 24	2	5 132, 133, 134, 135, 136	683.6	840.6	1268.8	4651.5
Geostring 25	2	4 137, 138, 139, 140	631.3	468.8	485.9	2905.3
Geostring 26	2	4 142, 143, 144, 145	796.1	429.7	885.9	2791.2
Geostring 27	2	21 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169	3100.8	2218.0	3517.2	27904.3
Geostring 28	2	6 171, 172, 173, 174, 175, 176	935.9	1109.4	1210.2	57004.9
Geostring 29	2	4 177, 178, 179, 180	825.8	241.4	924.2	15490.5
Geostring 30	2	2 183, 184	195.3	343.8	322.7	33326.9
Geostring 31	2	2 188, 189	158.6	346.1	473.4	11673.5
Geostring 1	3	2 0, 1	507.0	435.2	890.6	13073.2
Geostring 2	3	9 9, 10, 11, 12, 13, 14, 15, 16, 17	1343.0	880.5	1778.9	44470.4
Geostring 3	3	4 20, 21, 22, 23	489.8	291.4	680.5	69281.4
Geostring 4	3	2 25, 26	708.6	654.7	968.8	1213.0
Geostring 5	3	9 27, 28, 29, 30, 31, 32, 33, 34, 35	1725.8	1089.8	1598.4	12189.0
Geostring 6	3	3 38, 39, 40	930.5	740.6	1024.2	6049.4
Geostring 7	3	2 42, 43	746.9	765.6	845.3	1616.8
Geostring 8	3	7 44, 45, 46, 47, 48, 49, 50	1312.5	792.2	1102.3	9457.9
Geostring 9	3	2 51, 52	534.4	69.5	192.2	4336.4
Geostring 10	3	3 61, 62, 63	344.5	814.1	489.1	40984.4
Geostring 11	3	4 64, 65, 66, 67	630.5	801.6	786.7	8979.5
Geostring 12	3	3 69, 70, 71	594.5	299.2	1080.5	1134.4
Geostring 13	3	8 73, 74, 75, 76, 77, 78, 79, 80	513.3	1350.8	1510.9	19562.3
Geostring 14	3	4 83, 84, 85, 86	219.5	578.9	505.5	27233.7
Geostring 15	3	3 87, 88, 89	360.2	343.0	528.9	16137.3

Geostring 16	3	3 90, 91, 92	307.8	292.2	304.7	12967.8
Geostring 17	3	2 94, 95	66.4	140.6	179.7	26720.9
Geostring 18	3	2 98, 99	496.1	403.1	196.1	15886.7
Geostring 19	3	12 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115	912.5	1584.4	1523.4	34373.4
Geostring 20	3	2 116, 117	434.4	150.8	96.9	8039.3
Geostring 21	3	3 120, 121, 122	887.5	402.3	851.6	11307.6
Geostring 22	3	4 134, 135, 136, 137	385.2	172.7	307.0	159851.3
Geostring 23	3	2 138, 139	321.1	115.6	392.2	25930.6
Geostring 24	3	4 142, 143, 144, 145	489.8	903.1	468.8	102838.5
Geostring 25	3	3 147, 148, 149	155.5	364.8	346.9	1036861.4
Geostring 1	5	4 0, 1, 2, 3	453.1	280.5	759.4	4866.6
Geostring 2	5	7 4, 5, 6, 7, 8, 9, 10	1171.1	955.5	536.7	2224.1
Geostring 3	5	4 12, 13, 14, 15	330.5	551.6	726.6	1333.7
Geostring 4	5	5 19, 20, 21, 22, 23	578.1	590.6	1006.3	2810.4
Geostring 5	5	2 25, 26	65.6	393.0	896.1	5537.0
Geostring 6	5	2 28, 29	546.9	141.4	243.8	15215.5
Geostring 7	5	2 30, 31	468.8	364.1	953.9	53419.5
Geostring 8	5	3 32, 33, 34	422.7	401.6	593.0	3111.4
Geostring 9	5	4 35, 36, 37, 38	697.7	423.4	792.2	2644.0
Geostring 10	5	3 39, 40, 41	412.5	305.5	625.0	872.1
Geostring 11	5	2 43, 44	494.5	427.3	328.1	558.2
Geostring 12	5	6 46, 47, 48, 49, 50, 51	908.6	876.6	897.7	12544.8
Geostring 13	5	5 52, 53, 54, 55, 56	694.5	788.3	1198.4	15524.4
Geostring 14	5	7 59, 60, 61, 62, 63, 64, 65	434.4	631.3	1475.8	8402.6
Geostring 15	5	7 66, 67, 68, 69, 70, 71, 72	1105.5	618.8	1302.3	5817.5
Geostring 16	5	2 73, 74	537.5	167.2	342.2	465.5
Geostring 17	5	2 76, 77	355.5	453.1	457.8	4078.5
Geostring 18	5	4 78, 79, 80, 81	514.8	285.9	1131.3	4923.4
Geostring 19	5	2 82, 83	314.8	360.9	425.0	2177.4
Geostring 20	5	4 86, 87, 88, 89	821.1	382.8	1000.8	2279.3
Geostring 21	5	3 90, 91, 92	328.1	277.3	1019.5	3160.5
Geostring 22	5	6 93, 94, 95, 96, 97, 98	801.6	399.2	820.3	5038.5

Geostring 23	5	3 103, 104, 105	445.3	366.4	264.1	2844.3
Geostring 24	5	9 106, 107, 108, 109, 110, 111, 112, 113, 114	839.8	960.2	2029.7	34439.9
Geostring 25	5	2 116, 117	294.5	143.8	536.7	9454.6
Geostring 26	5	3 118, 119, 120	653.1	348.4	428.1	13706.9
Geostring 27	5	3 122, 123, 124	399.2	535.9	1110.2	12140.0
Geostring 28	5	4 126, 127, 128, 129	655.5	557.0	601.6	26003.6
Geostring 29	5	5 132, 133, 134, 135, 136	774.2	442.2	1025.0	2695.5
Geostring 30	5	3 137, 138, 139	476.6	393.8	536.7	5850.8
Geostring 31	5	3 140, 141, 142	327.3	329.7	551.6	12110.0
Geostring 32	5	2 143, 144	414.1	106.3	896.1	2420.1
Geostring 33	5	3 146, 147, 148	432.8	525.8	388.3	4909.6
Geostring 34	5	3 153, 154, 155	561.7	803.9	432.0	943.9
Geostring 35	5	9 156, 157, 158, 159, 160, 161, 162, 163, 164	629.7	911.7	2745.3	51640.1
Geostring 36	5	3 165, 166, 167	138.3	604.7	526.6	5559.3
Geostring 37	5	3 168, 169, 170	76.6	753.9	184.4	7575.5
Geostring 38	5	2 173, 174	710.9	1168.8	675.0	11112.6
Geostring 39	5	2 177, 178	241.4	392.2	54.7	2720.5
Geostring 40	5	2 191, 192	57.8	140.6	750.8	84466.1
Geostring 41	5	2 196, 197	617.2	165.6	600.8	786253.2

Percentile	Delta X All Positive	Delta Y All Positive	Delta Z All Positive	Delta T	Series
0	0.78125	0	2.34375	2.922	1
10	21.953125	22.890625	40.703125	68.8817	1
20	35.3125	47.96875	59.21875	412.1568	1
30	57.5	79.84375	85.3125	698.708	1
40	83.125	118.59375	110.625	1958.7122	1
50	107.03125	139.453125	155.078125	3581.979	1
60	127.1875	173.4375	187.03125	8270.4296	1
70	158.515625	193.671875	208.75	18576.2419	1
80	201.875	236.09375	256.25	37653.3014	1
90	268.515625	331.875	308.125	119442.4897	1
100	421.09375	506.25	553.90625	2156129.625	1
0	0.78125	2.34375	0	4.297	2
10	23.59375	25.078125	26.015625	76.6309	2
20	55.3125	45.46875	53.90625	152.6206	2
30	88.75	70.3125	80.703125	273.8336	2
40	140.15625	88.59375	119.84375	520.3418	2
50	182.421875	113.28125	148.828125	682.1445	2
60	219.21875	154.6875	188.75	995.8894	2
70	250.859375	194.296875	238.828125	1490.3589	2
80	328.28125	252.65625	305.46875	2536.0468	2
90	447.890625	336.328125	412.421875	7089.8634	2
100	836.71875	740.625	818.75	6223449.428	2
0	0	0.78125	0.78125	4.24	3
10	22.734375	23.4375	29.0625	152.3858	3
20	43.90625	44.6875	58.28125	394.9498	3
30	78.046875	71.875	88.125	885.3632	3
40	106.71875	93.59375	123.125	1706.602	3
50	134.375	121.09375	166.015625	3019.3905	3
60	167.65625	148.125	211.5625	5104.917	3
70	220.078125	189.84375	248.515625	7892.0008	3
80	294.0625	265.9375	295.9375	17070.0672	3
90	398.90625	368.203125	445.9375	47561.4455	3
100	774.21875	688.28125	927.34375	12735450.71	3
0	76.5625	125.78125	317.96875	2912629.319	4
10	88.984375	132.03125	352.1875	3047379.497	4
20	101.40625	138.28125	386.40625	3182129.674	4
30	113.828125	144.53125	420.625	3316879.852	4
40	126.25	150.78125	454.84375	3451630.029	4
50	138.671875	157.03125	489.0625	3586380.207	4
60	151.09375	163.28125	523.28125	3721130.384	4
70	163.515625	169.53125	557.5	3855880.562	4
80	175.9375	175.78125	591.71875	3990630.739	4
90	188.359375	182.03125	625.9375	4125380.917	4
100	200.78125	188.28125	660.15625	4260131.094	4
0	3.125	0	2.34375	0.007	5
10	38.125	26.09375	43.28125	105.5056	5
20	57.5	52.03125	67.1875	398.5354	5

30	78.90625	67.5	93.28125	633.195	5
40	105.625	91.71875	134.6875	816.8834	5
50	142.96875	116.40625	187.5	1193.375	5
60	176.40625	148.28125	269.6875	1759.843	5
70	212.96875	184.21875	340.78125	2801.5742	5
80	279.375	240.9375	401.40625	5559.64	5
90	361.09375	300.46875	495.625	12946.0312	5
100	877.34375	1100.78125	839.84375	6239010.143	5
0	0.78125	71.875	203.90625	21.827	6
10	15	109.84375	203.90625	46.496	6
20	29.21875	147.8125	203.90625	71.165	6
30	43.4375	185.78125	203.90625	95.834	6
40	57.65625	223.75	203.90625	120.503	6
50	71.875	261.71875	203.90625	145.172	6
60	93.125	262.8125	220.9375	271.7936	6
70	114.375	263.90625	237.96875	398.4152	6
80	135.625	265	255	525.0368	6
90	156.875	266.09375	272.03125	651.6584	6
100	178.125	267.1875	289.0625	778.28	6