

# Surface Seismic Monitoring Plan Sulphur Mines Salt Dome

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# Seismic monitoring plan

- We plan a three phase seismic monitoring plan:
  - **Phase 1:** Seven “temporary” seismic boxes were installed at the end of January 2023 to start recording seismic data on Sulphur Mines dome.
    - The data is currently recorded on site and data disks are shipped out for data processing every Monday, Wednesday and Friday.
  - **Phase 2:** Install seven “semi-permanent” surface seismic stations.
    - We are reviewing the data quality from the “temporary array” to decide on the placement of a semi-permanent telemetered array.
    - The data for semi-permanent array will be sent directly to processing office via cell phone telemetry and seismic data will be recorded in real-time.
  - **Phase 3:** Install a borehole seismic network
    - We are starting some modeling work to explore the feasibility of running a borehole seismic network on Sulphur Mines salt dome using two existing well bores for a dual-array monitoring.
      - We plan to model two Well pairs: PPG 6X and PPG 20 and PPG 6X and Fee 1010 side track (an oil and gas well).
    - Depending on the seismic activity at Sulphur Mines dome, the surface array will likely be removed once the borehole array is up and running.

# Surface seismic recording at Sulphur Mines

Seven “temporary” surface seismic boxes deployed starting approximately Jan. 30, 2023 and are recording data continuously.

*Placement of monitors at Sites 1, 2 and 3 will require consent of Boardwalk. At this time, we suggest this configuration is optimal for earthquake locations: there is good azimuthal station coverage by surrounding cavern 7 with sensors. The sensor distances from Cavern 7 shall allow for more accurate locations, if events are detected and well-recorded.*

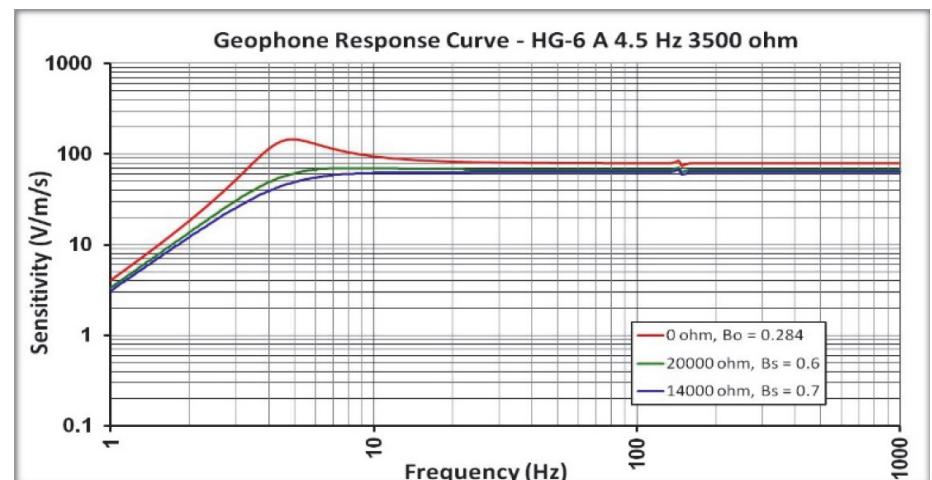
Photo of installed temporary station



# Temporary Seismic Boxes

- Vendor: Jarpe Data Solutions
- Sensor: Three component, 4.5 Hz HG-6HS geophone element (78.9 V/m/s)
- GPS timing
- Battery powered
- Recording at 200 samples per second
- Boxes record onsite on SD card.
  - The SD cards are swapped Monday, Wednesday and Friday and shipped overnight for data processing at JDS offices in Arizona.
  - Seismic data scanned for earthquakes.
  - If seismic event is detected, if data quality is sufficient, the event is located and a magnitude estimated.

These temporary seismic stations will be used to support the feasibility for a semi-permanent telemetered array.



Frequency response curve of geophone

# Semi-permanent surface monitoring

*Surface instrumentation will record until borehole system is installed and operational.*

- Seven semi-permanent stations will be deployed in mid February 2023.
  - Solar powered
  - Real-time data telemetry to Arizona JDS offices.
  - GPS timing
  - Pole-mounted digitizer/telemetry equipment (avoid flooding)
  - Sensor 3C, 4.5 Hz geophones, same sensor as temporary boxes.
    - Sensors will be buried about 6 inches.
  - 125 sample per second sample rate.
  - Magnitude range ~ 0.5 to 3.5
  - Data processing done by JDS.

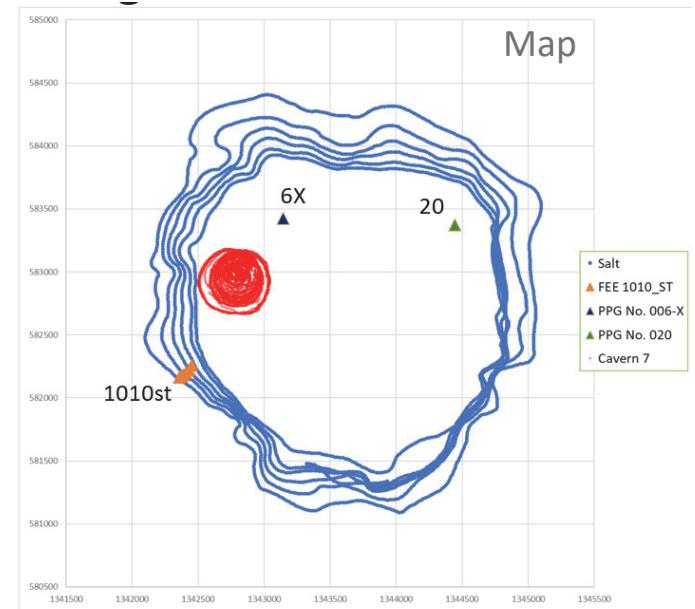
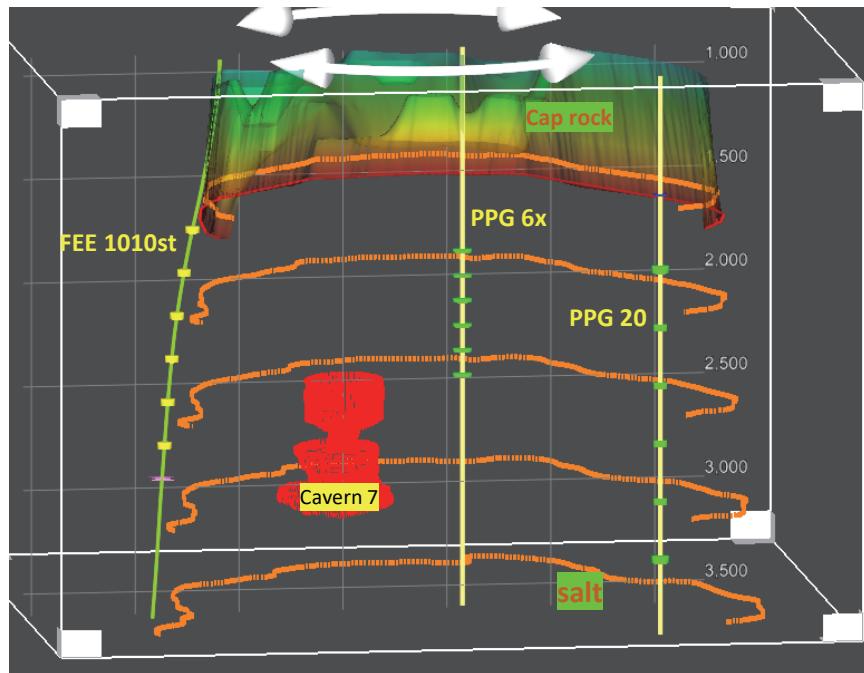
Example of a JDS Semi-permanent seismic box with pole installation.



This surface array may be decommissioned once the borehole arrays are operational, depending on what seismic activity is observed.

# Borehole monitoring: In planning stages

- We are currently starting modeling three different existing wellbores for possible dual-array borehole monitoring.
- PPG 6x, PPG 20 and FEE 1010 (st) are possible observation wells.
- Well pairs under consideration are dual wells with sensors: PPG 6x – PPG 20 or dual PPG 6x - FEE 1010 (ST)
- If seismicity recorded and located on the surface array, it may help guide the sensor locations for the borehole arrays.
- The surface array will likely be decommissioned after the borehole array is operational (depending on what seismic activity we observe)



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