

GEODES Kilbourne Hole Active Seismic Experiment 2021–2023

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Experiment Name: GEODES (Geophysical Exploration of the Dynamics and Evolution of the Solar System) Kilbourne Hole Active Seismic Experiment

Experiment Nickname: GEODES Kilbourne Hole

Description: The main purpose is to study the near-surface structure of the maar eruption deposits in the Potrillo Volcanic Field, New Mexico, using active source seismology. The field site is located near Kilbourne Hole and Hunt's Hole maar volcanoes, and the project has the goal of determining the thickness and subsurface variation in the ash and surge deposits found around the rim of the craters. Volumes of eruption material are essential for understanding the volatile budget and evolution of the eruption sequence. The project builds upon past exploration activities by NASA at Kilbourne Hole, and the active source seismology will also be used to understand how similar investigations can be conducted on the Moon and Mars. We test the resolution of traditional geophone lines against three-component nodal investigations (archived as a separate dataset). The data will be made available to the public through the Planetary Analogs website at USGS and at the IRIS DMC.

Survey Layout: The surveys were conducted in three field seasons: November 2021, April 2022, and March-April 2023, using Geometrics Geode recording system(s), vertical-component geophones, and a sledgehammer as the source. We used a mix of 4.5 Hz and 14 Hz geophones in the surveys. During November 2021, four rim-parallel lines were completed. Two seismic lines on the crater floor were conducted in April 2022. The field expedition in March-April 2023 included three rim-perpendicular lines. Readers are referred to Excel spreadsheets for details on source and receiver coordinates and survey parameters (e.g., sampling rate, recording length, etc.) of each seismic line. A summary of the Excel sheets is given below. In addition to the Excel sheets, Google Earth KML files of the source and receiver locations are provided.

- Line1-2021.xlsx: geometry and experiment details of Line 1 (on top of ash-fall deposits, rim, SE of Kilbourne Hole) collected in Nov 2021
- Line2-2021.xlsx: geometry and experiment details of Line 2 (on top of basal surge deposits, rim, SE of Kilbourne Hole) collected in Nov 2021
- Line3-2021.xlsx: geometry and experiment details of Line 3 (on top of Afton basalt flow, rim, SE of Kilbourne Hole) collected in Nov 2021
- Line4-2021.xlsx: geometry and experiment details of Line 4 (on top of ash sediments, rim, SW of Kilbourne Hole) collected in Nov 2021
- LineSR-2022.xlsx: geometry and experiment details of Line SR (near the southern margin of the rim, crater floor) collected in Apr 2022
- LineD2-2022.xlsx: geometry and experiment details of Line D2 (near the center of Kilbourne Hole, crater floor) collected in Apr 2022
- Rim3-2023.xlsx: geometry and experiment details of Rim 3 (rim, E of Kilbourne Hole) collected in Mar 2023
- Rim5-2023.xlsx: geometry and experiment details of Rim 5 (rim, SE of Kilbourne Hole) collected in Apr 2023

- Rim12-2023.xlsx: geometry and experiment details of Rim 12 (rim, N of Kilbourne Hole) collected in Apr 2023

Map:

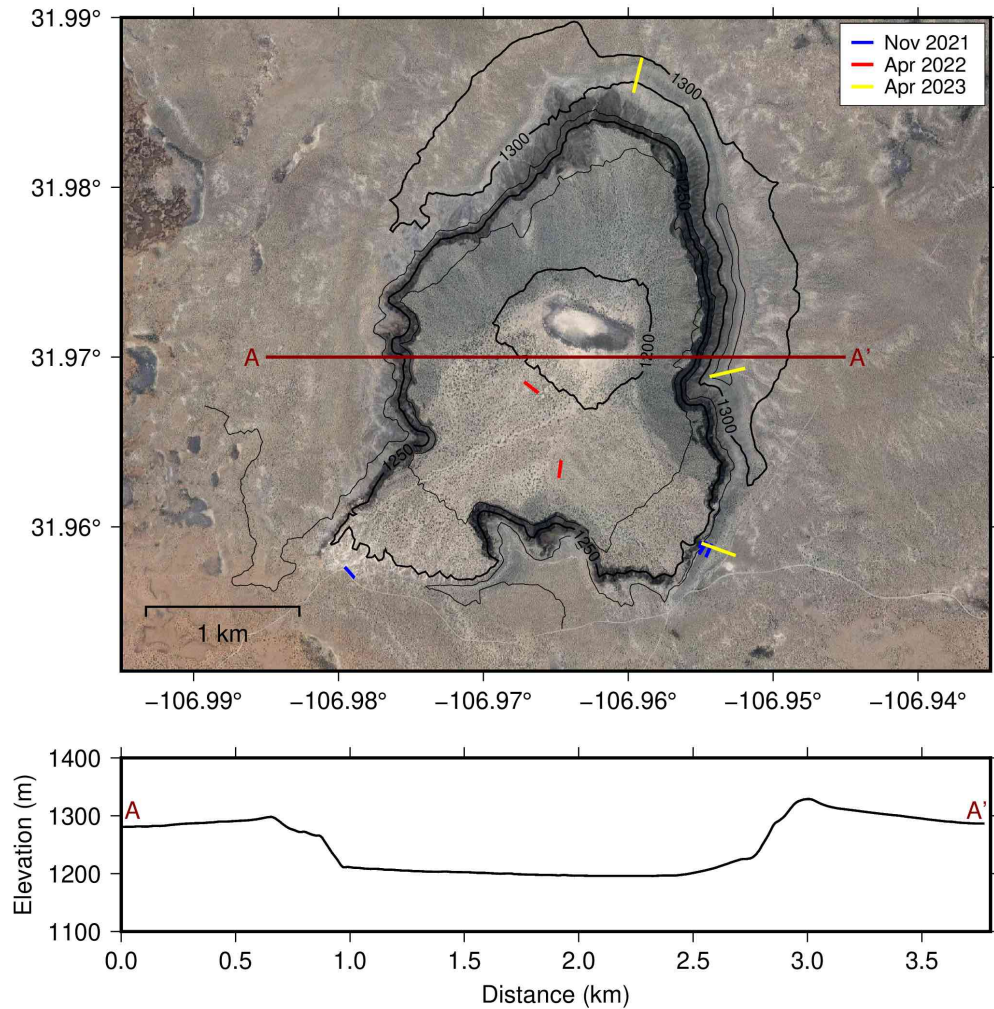


Figure 1. A map view of Kilbourne Hole. The thick lines indicate the locations of the active seismic lines, colored by date. The thin and thick black contours indicate elevations at 50 m and 100 m intervals, respectively. The lower panel shows a cross-section of the topographic variation of the crater along profile A-A'.

Shot gather example:

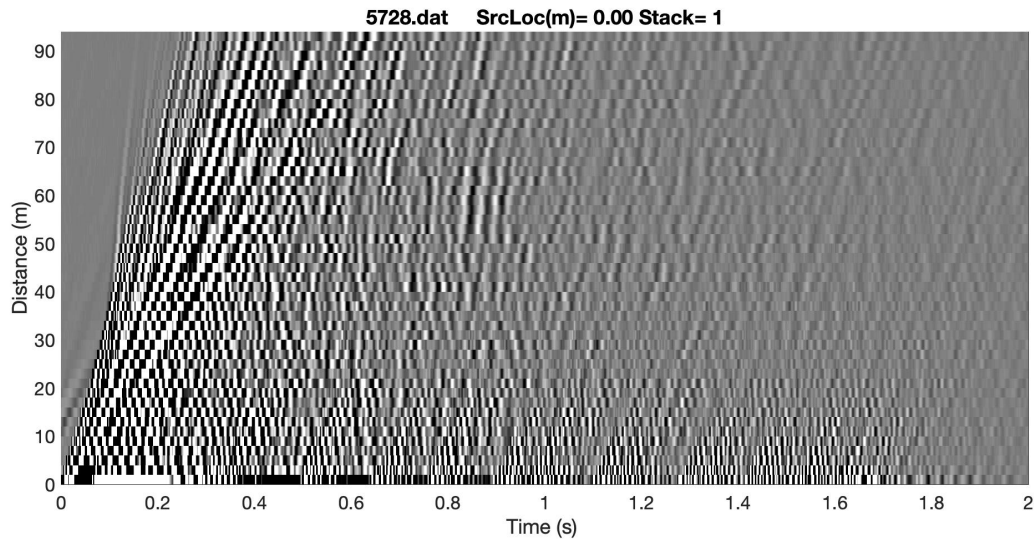


Figure 2. An example of the original shot gather collected along Line 1.

Note: 1. The header information of SEG-Y files may be incorrect, particularly the sampling rate (as SEG-Y files cannot handle floating point sampling rates), source and receiver locations (as those stored in the original SEG2 files are incorrect). Please doublecheck with the corresponding Excel spreadsheet before processing. 2. We also provide the original SEG2 files alongside the SEG-Y files. The filenames and headers are the same as those of the SEG-Y files except the “DAT” file extension. The SEG2 files are stored in a structured directory, with each folder containing the SEG2 files collected along each seismic line.