

**Source and Instrumentation Tests in Preparation for East African
High-Resolution Data Acquisition: Tests in Higley Basin, AZ to
Evaluate Stratavisor and Geode Systems
(Assembled Dataset 15-017)**

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Experiment Description

This experiment was designed to test the feasibility and preference for using Stratavisor or Geode seismic recording systems in an experiment planned for 2008 in Ethiopia and Kenya, East Africa. It also provided a hands-on seismic field experience for students in an undergraduate-graduate reflection seismology class at the University of Arizona. In effect, the primary goal was to explore how easy it was to use each of the different systems to determine which of them would be preferable to use for near-surface seismic recording in a remote, very dry environment.

With the help of a core of my graduate students, we used the systems in a single, roughly east-west, profile and showed the students in the seismology class how geophones, sources, cables, batteries and recording systems were deployed in the field. We also conducted some source tests using a 20-pound sledge-hammer source striking a steel plate and a Remington cement nail gun fired into a steel baseplate. We quickly determined that the students were very inconsistent with the sledgehammer source and conducted the remainder of the experiment using the nail gun. As part of this field training, we acquired CDP data for much of the line, and had students do the system operation and note-taking (e.g., Fig. 1).



Figure 1. Students Chris Earnest, Clare Landowski, and Katylyz Anderson operating the Stratavisor and Geode systems and taking notes during recording.

General Data Acquisition Parameters

In the collection of the data, two “sublines” were recorded simultaneously: a 60-channel Stratavisor subline from Stations 41 to 100, and a 48-channel Geode subline from Stations 101 to 148. Station spacing for the Stratavisor subline was 2 m, whereas station spacing for the Geode subline was 5 m. Shots occurred between geophone stations. Shots for the CDP profile began at station 56.5 and proceeded to station 119.5, at which point the available trigger cables prevented further triggering of the Stratavisor system. Both the Stratavisor and Geode recording systems recorded these shots. Shots beyond Station 119.5 (from Stations 126 to 148) were recorded only on the Geode recording system. Details of the field geometries and other acquisition parameters are included in separate files.

Recording Equipment Stratavisor Subline:

- 60-Channel Stratavisor data logger.
- 48 Mark Products Model L-40 40 Hz vertical-component geophones

Recording Equipment Geode Subline:

- 24-Channel Geode data loggers, 2 Geodes used, total 48 channels.
- PC compatible software interface/controller
- 48 Mark Products Model L-40 40 Hz vertical-component geophones

Energy Source:

- Most recording was done using a Remington cement nail gun discharged into a steel plate (Fig. 2). A 20-lbs (0.9-kg) sledge-hammer was used for initial tests.
- For each nail-gun source position, one shot produced a shot record.



Figure 2. Left: Jason Stein holding cement-gun seismic source. Right: Paul Stockwell using the cement-gun source. Cement nails were shot into a steel plate covered by heavy-duty conveyor-belt material as a precaution to prevent the possibility of blowback.

Station Spacing

- Station spacing for the Stratavisor subline was 2 m. Station spacing for the Geode subline was 5 m. Stations were chained with each station flagged and labeled from a starting point set arbitrarily at Station 41. Approximate UTM coordinates for the survey were UTM 12S 3674160 m N, 466000 m E. The west-to-east line direction was determined using a Brunton compass and clear line of sight. Elevation of a base station was initially determined with a hand-held GPS system and the ground surface for the survey lines was very flat.

Source Spacing

- Normal source spacing for the Stratavisor subline was 2.0 m with shots located between stations (i.e., shifted +1 meter toward higher station numbers). Source spacing for the Geode subline, after recording on the Stratavisor line ended, was 5 m, with shots located between stations (i.e., shifted +2.5 meters toward higher station numbers).

General Comments

Shot records for the Stratavisor system were recorded with geophones located from Stations 41 to 100 and with many of the sources located within the Stratavisor spread (i.e., relatively small offsets). The Geode system, with geophones located from Stations 101 to 148, recorded the same shots, but many of the shots were at considerable distances from the Geode spread. Consequently, energy levels are notably higher on the Stratavisor records until the shots reached about Station 101 and beyond. The nail-gun source was not muffled, so air-blast noise is prominent in many of the records. Furthermore, analysis of the shot records showed that the nail-gun source tended to bounce on impact (perhaps due to an internal recoil) causing secondary source noise on the records. On a few of the records, noise from people walking near the line while moving equipment is present.

Overall, data quality is rather low due to the low energy of the nail gun used, the secondary-source effects due to source bounce and the strong airwave energy. Thus, the data probably are of limited practical use for real analysis of subsurface structure, but with its goal as a student-training exercise and as a test of the Stratavisor and Geode systems, the experiment was very successful. Both the Stratavisor and Geode systems worked well, but we liked the greater flexibility possible with the Geode systems and the modular nature of its digitizers and laptop controller. Ultimately, we decided to use Geode systems for our subsequent East African deployments based on our experience in the field with the Higley Basin Test experiment. We also opted to use a higher-energy accelerated-weight-drop source for the African deployments.

Example EBCDIC header for SEG-Y files

The individual records for each line have geometry information entered in the trace headers with entries as shown in the SEG-Y EBCDIC header (example below). Each SEG-Y file contains all shot records for a particular line.

C 1 University of Arizona, Reflection Seismology
C 2 LINE: 11-03-07 Stratavisor AREA: Higley Basin, SE Arizona MAP ID: UTM 12S
C 3 INSTRUMENTS: 60-Channel Geometrics Stratavisor System from PASSCAL
C 4 DATA TRACES/RECORD: 60
C 5 SAMPLE INTERNAL: 0.5 ms SAMPLES/TRACE: 2048
C 6 RECORDING FORMAT: SEG Y MEASUREMENT SYSTEM: Meters
C 7 SAMPLE CODE: IBM REAL GAIN TYPE: FIXED
C 8 SOURCE: 20-lbs Sledge & Cement Nail Gun into steel plate
C 9 SPREAD: Channels 1-60 GROUP INTERVAL: 2 m
C10 GEOPHONES/GROUP: 1 FREQ: 40 Hz MFG: Mark Prod. MODEL: L-40,
C11 LOCATION: Desert Wells Multi-Use Area, Higley Basin NW of Florence, AZ
C12 MAP PROJECTION: UTM ZONE ID: 12S COORDINATE UNITS: Meters
C13 LINE COORDS: Relative to first station. West to East Transect.
C14 APPROX AREA COORDS: UTM 12S 3674160 N, 466000 E
C15 TRACE HEADERS BELOW: Header, Format, Start Byte
C16 Trace sequence number in line: Int (4-byte) Start: 1
C17 Trace sequence number in SEG Y file: Int (4-byte) Start: 5
C18 Original field record number (FFID): Int (4-byte) Start: 9
C19 Trace number in original field record: Int (4-byte) Start: 13
C20 Energy source point number: Int (4-byte) Start: 17
C21 CDP ensemble number: Int (4-byte) Start: 21
C22 Trace identification code (1 = data): Int (2-byte) Start: 29
C23 Number of source impacts this trace: Int (2-byte) Start: 33
C24 Distance source point to receiver: Int (4-byte) Start: 37
C25 Receiver elevation: Int (4-byte) Start: 41
C26 Surface elevation at source: Int (4-byte) Start: 45
C27 Scalar for elevations in bytes 41-68: Int (2-byte) Start: 69
C28 Scalar for coords in bytes 73-88 and 181-188: Int (2-byte) Start: 71
C29 Source coordinate X (times 10000): Int (4-byte) Start: 73
C30 Source coordinate Y (times 10000): Int (4-byte) Start: 77
C31 Group coordinate X (times 10000): Int (4-byte) Start: 81
C32 Group coordinate Y (times 10000): Int (4-byte) Start: 85
C33 Number of samples in trace: Int (2-byte) Start: 115
C34 Sample interval in microseconds (us): Int (2-byte) Start: 117
C35 Low-cut frequency (Hz): Int (2-byte) Start: 149
C36 X coordinate of CDP position of trace: Int (4-byte) Start: 181
C37 Y coordinate of CDP position of trace: Int (4-byte) Start: 185
C38 Shot-point number: Int (4-byte) Start: 197
C39 SEG Y REV1
C40 END EBCDIC