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LLNL-TR-586676

SPE3 Far--field Quicklook

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October 1, 2012

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This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Introduction. The purpose of this report is to provide an overview of the seismic data collected during the SPE3 chemical shot. Farfield seismic data includes data collected at distances of more than 100 m from the shot and instruments deployed for the experiments. This report does not address infrasound, remote sensing, or seismic data collected by regional permanent stations. The primary goal is a fast data check before extensive analysis.

The SPE3 shot was conducted on July 24, 2012 (DOY 206) at the SPE test site and in the same borehole as SPE1 and SPE2 (table 1). Data processing at LLNL primarily used mini-seed data volumes downloaded from the UNR server along with associated metadata. This is in contrast to earlier shots, where LLNL data was based on reformatted Reftek data.

Sensor deployment was similar to previous shots, with a few changes. Parts of lines 1 (13, 14, 15, 16), 3 (23,26,36), and 5 (1-12) were recorded by telemetry as well as to disk, which provided immediate access to the data. A small array (6 station) geophone array was deployed southeast of the shot near AF9 to measure particle motions. A new rotational sensor (ATA ARS-16) was deployed at station L3-20.

Table 1. *SPE shot parameters*

	TNT eq	***SHANFO***	***Depth (m)***	***Date/Time (GMT)***		
SPE1	100 (nom.)	220.92	55	05/03/11	22:00:00.011	2011:123
SPE2	992	2571.96	45	10/25/11	19:00:00.012	2011:298
SPE3	899	2332.76	45	07/24/12	18:00:00.448	2012:206

Timing and location. Timing and location appear good for all stations with no obvious gross errors (> 10 samples relative shift). Detailed measurements of P arrival time suggest a possible shift with respect to SPE2 of approximately 2 milliseconds at the geophone stations (500 Hz sample rate), with larger shifts at stations recorded on telemetry (250 Hz sample rate) [*Patton et al.*, 2012]. Investigations are under way to estimate the reliability of the signal timing at this level, both at the Reftek digitizer and during subsequent data reformatting.

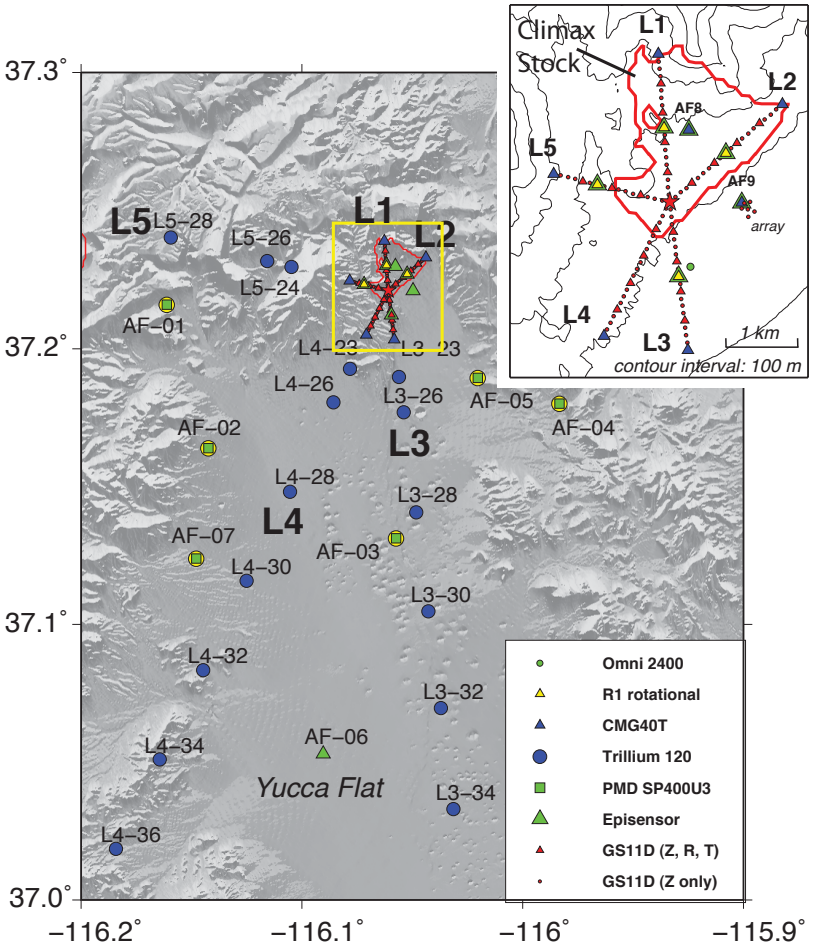

Figure 1. Map of SPE3 sensor deployment

Orientation, polarity, and gain.
L4-04 incorrect polarity?
Gains on episensors on L5-10 and L1-10 appear high.
L2-20 Guralp appear anomalous.
Gains on rotational sensor vary greatly.

Conclusions and recommendations.

- The data distribution system worked well and investigators had access to data quickly after the shot.
- Verify timing at the sample-rate level for Reftek timing and data re-formatting.
- Additional QC before shots to eliminate all errors and inconsistencies in gain setting.
- Develop plan for adjusting sample rates and recording data well beforehand to allow adequate preparation for data changes in the field or on telemetry.

Data summary comments. A series of figures (#2-9) have been prepared which display the data for each line and sensor type. Scaling is proportional to distance, which preserves anomalies. Red indicates possible problems.

Figures 10-14 show both SPE2 and SPE3 (red) data for comparison. In general, the waveforms are extremely similar in amplitude and in timing, although a possible delay is visible in Figure 10. As mentioned earlier, this is being investigated.

Comments:

Line 1
L1-17.CLZ, L1-18.CLZ, and L1-19.CLZ are very low amplitude with high noise; no moveout?

Line 2
L2-01.CLZ – low amplitude; same moveout as L2-02 (crosstalk?) [high noise]
L2-03.CLZ – low amplitude [high noise]
L2-12.CLR – low amplitude with respect to L2-12.CLZ and CLT
L2-13.CLZ, L2-14.CLZ – low amplitude, [high noise]
L2-10.CN* [all channels on episensor]

Line 3
L3-03.CLZ - low amplitude, [high noise] cross-talk?
L3-20.DHR – severe problem [high-frequency sinusoid]
L3-28.CLZ (Trillium) – no signal, noise only

Line 4
L4-07.CLZ – low amplitude, incorrect moveout, high noise [cross-talk?]

Line 5
L5-09.CLZ – low amplitude [high noise]
L5-10.CLZ – low amplitude [high noise]
L5-12.CLZ – no signal noise
L5-24.CHE – no signal
L5-26.CHN – no signal
L5-28.CHE – no signal

Small array
Responses (or possibly site) for center element appear anomalous (Figure 15).

Amplitudes
Some stations (e.g. L2-02) showed slightly anomalous amplitudes with respect to expected amplitudes based on empirical relationships. Examination of pre-event noise suggests that this may be due to the sensor. This is being further examined.

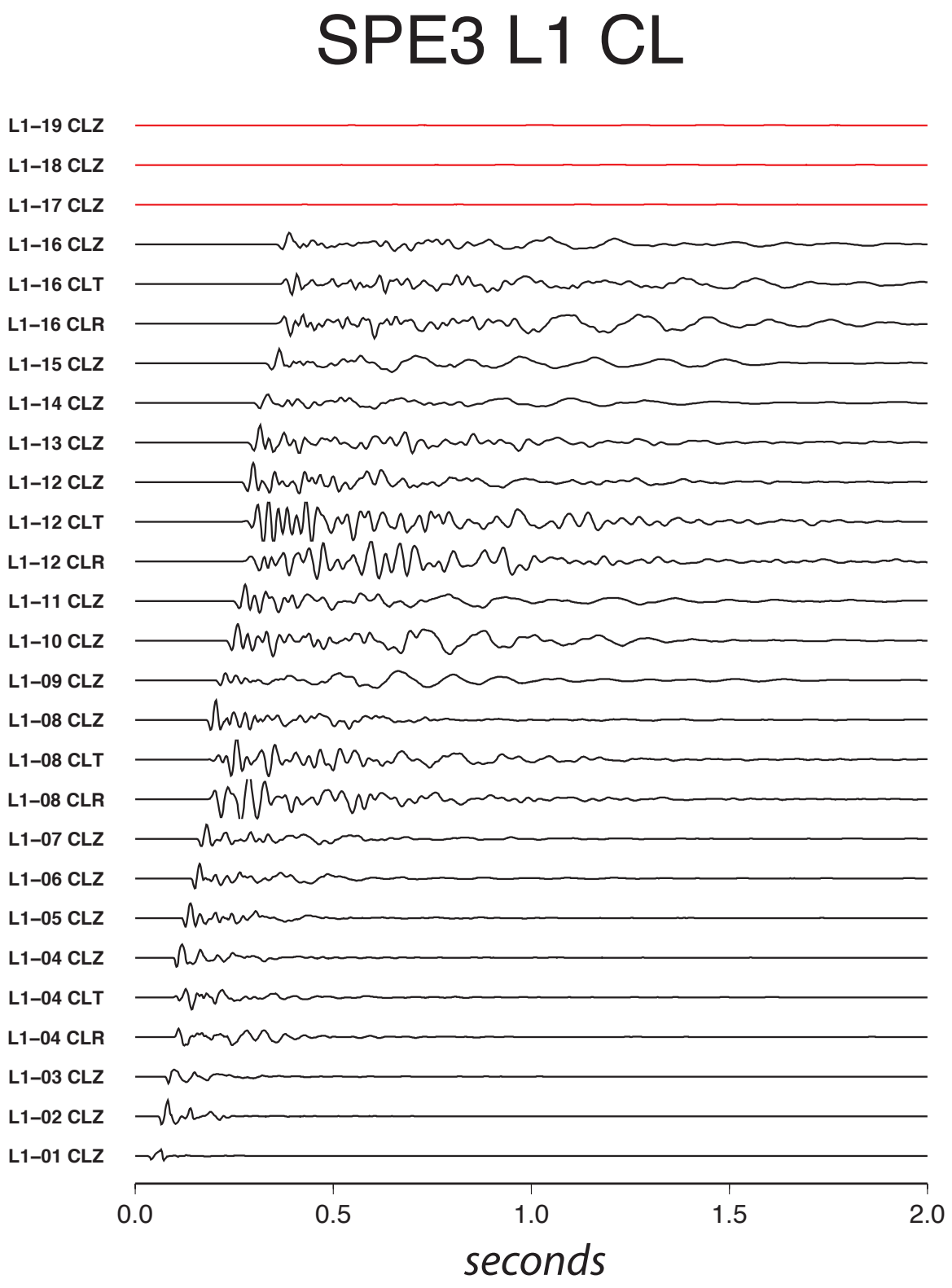

Figure 2. Line GS11D data

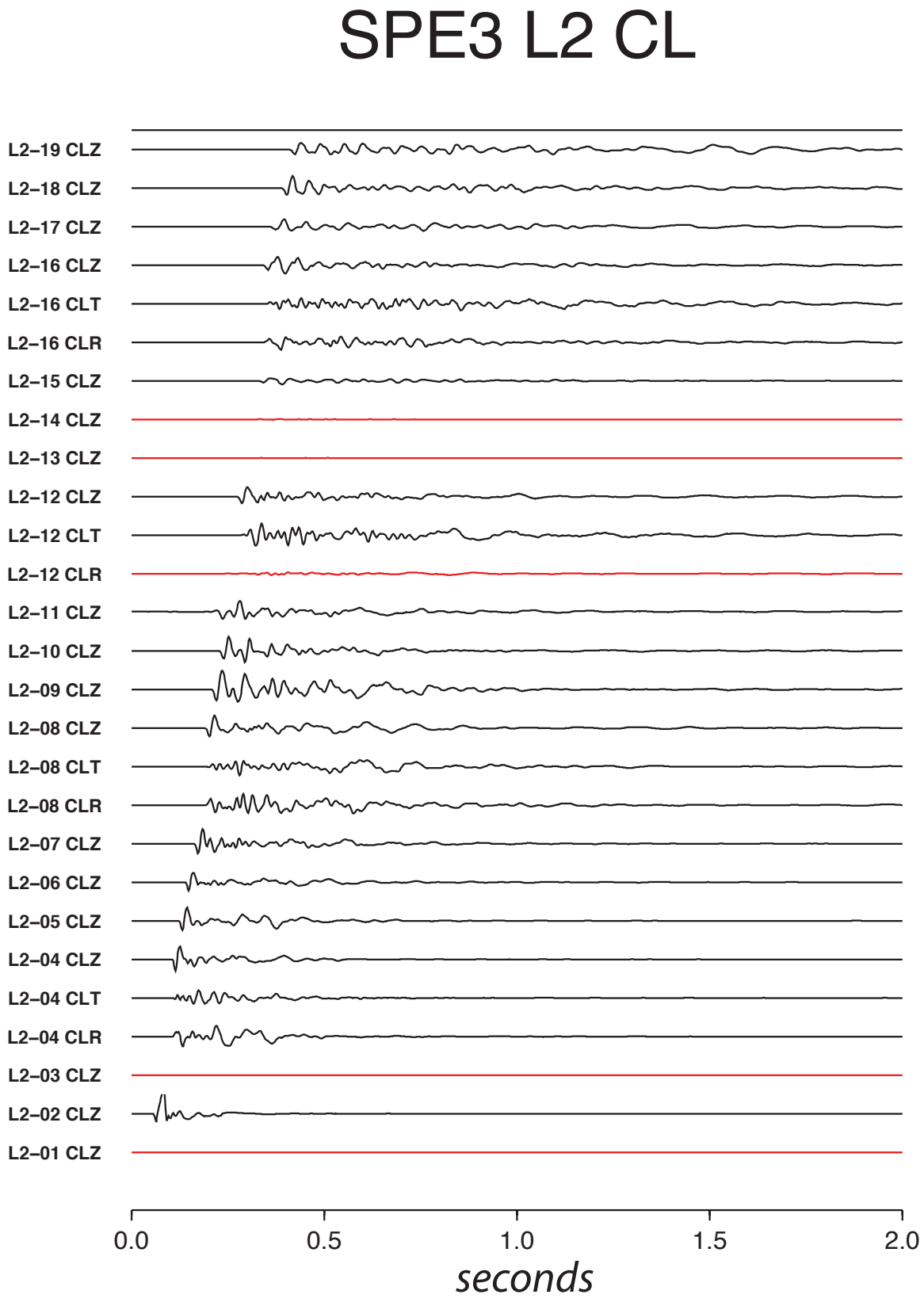

Figure 3. Line 2 GS11d data

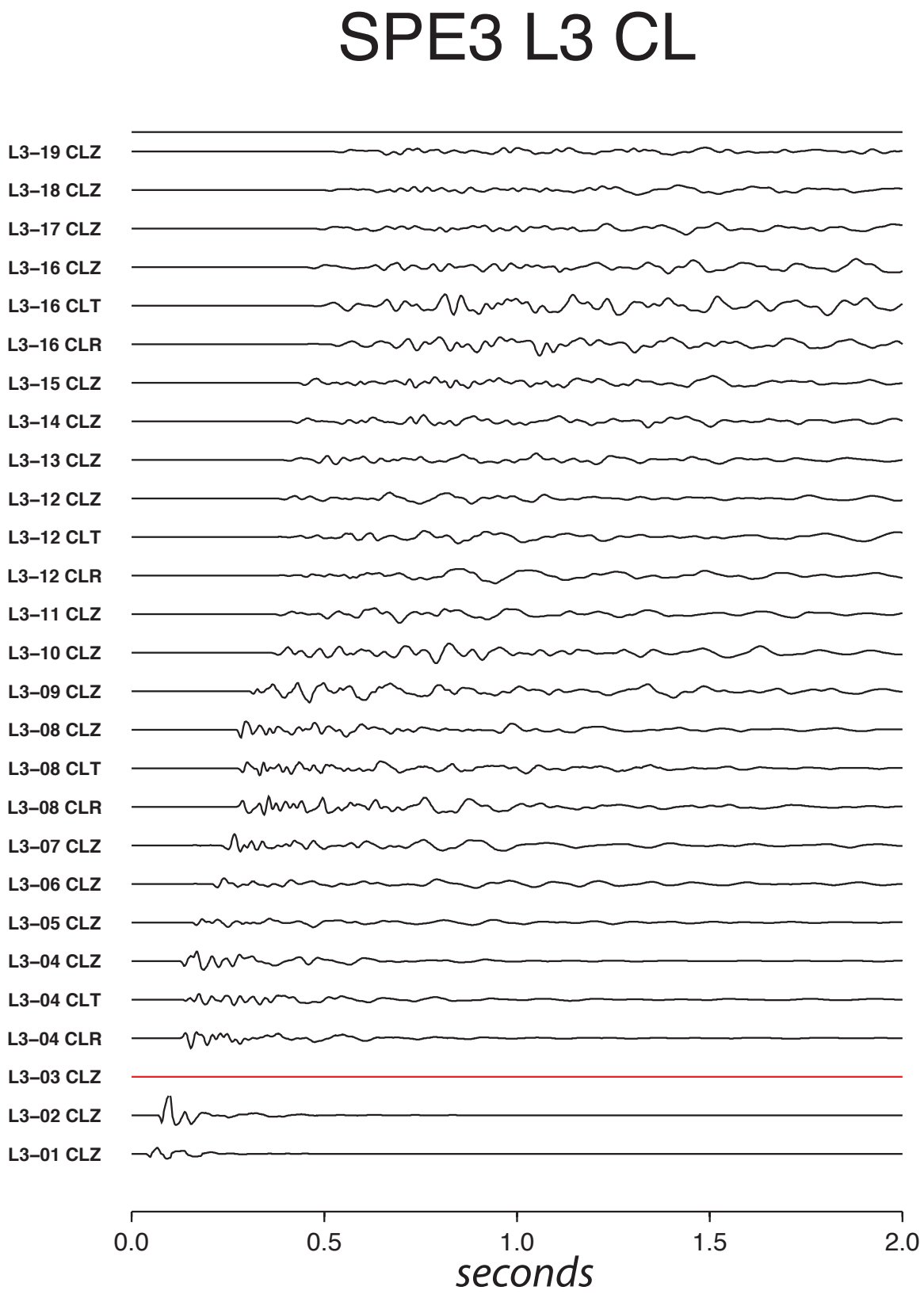

Figure 4. Line 3 GS11D data

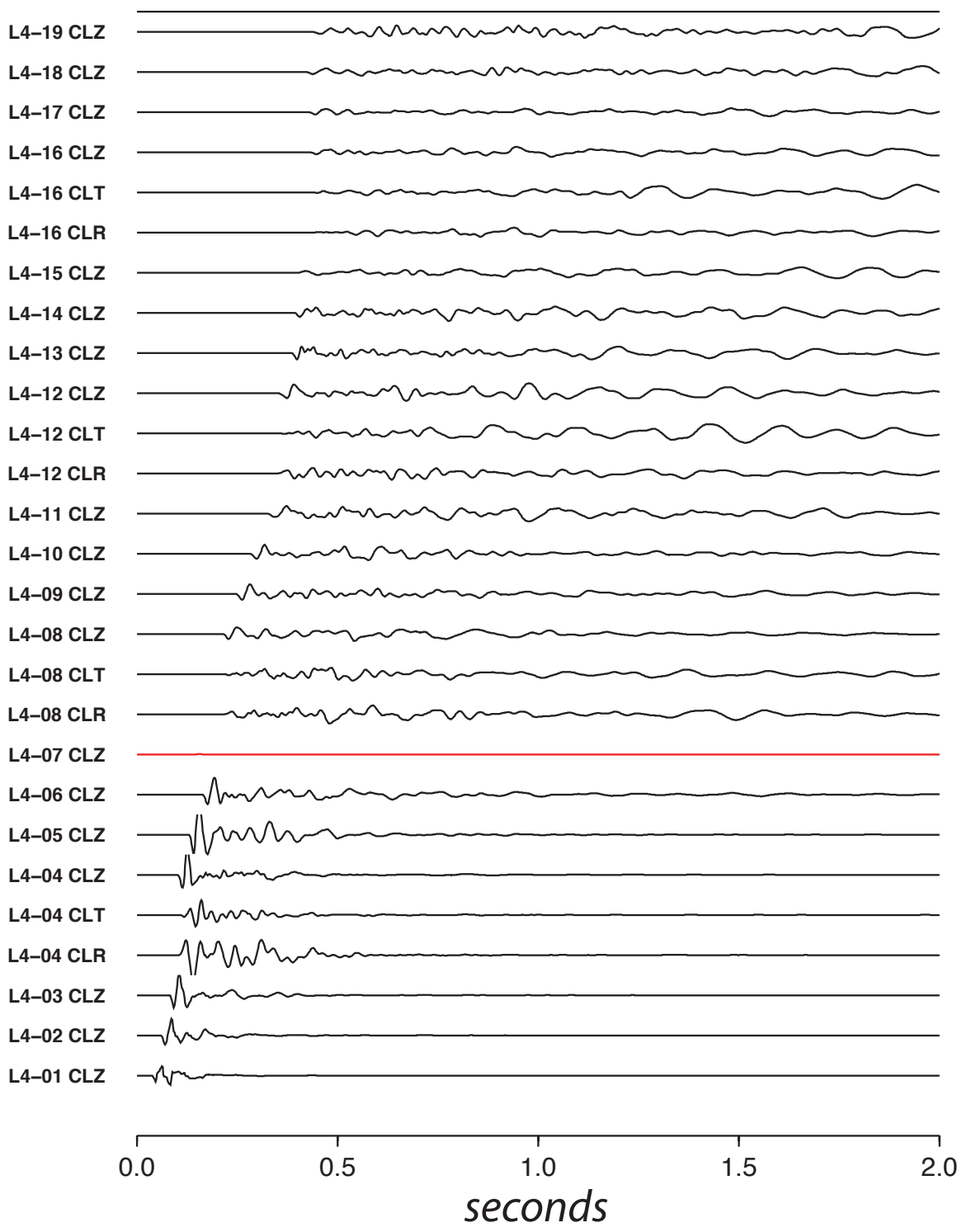

Figure 5. Line 4 GS11D data

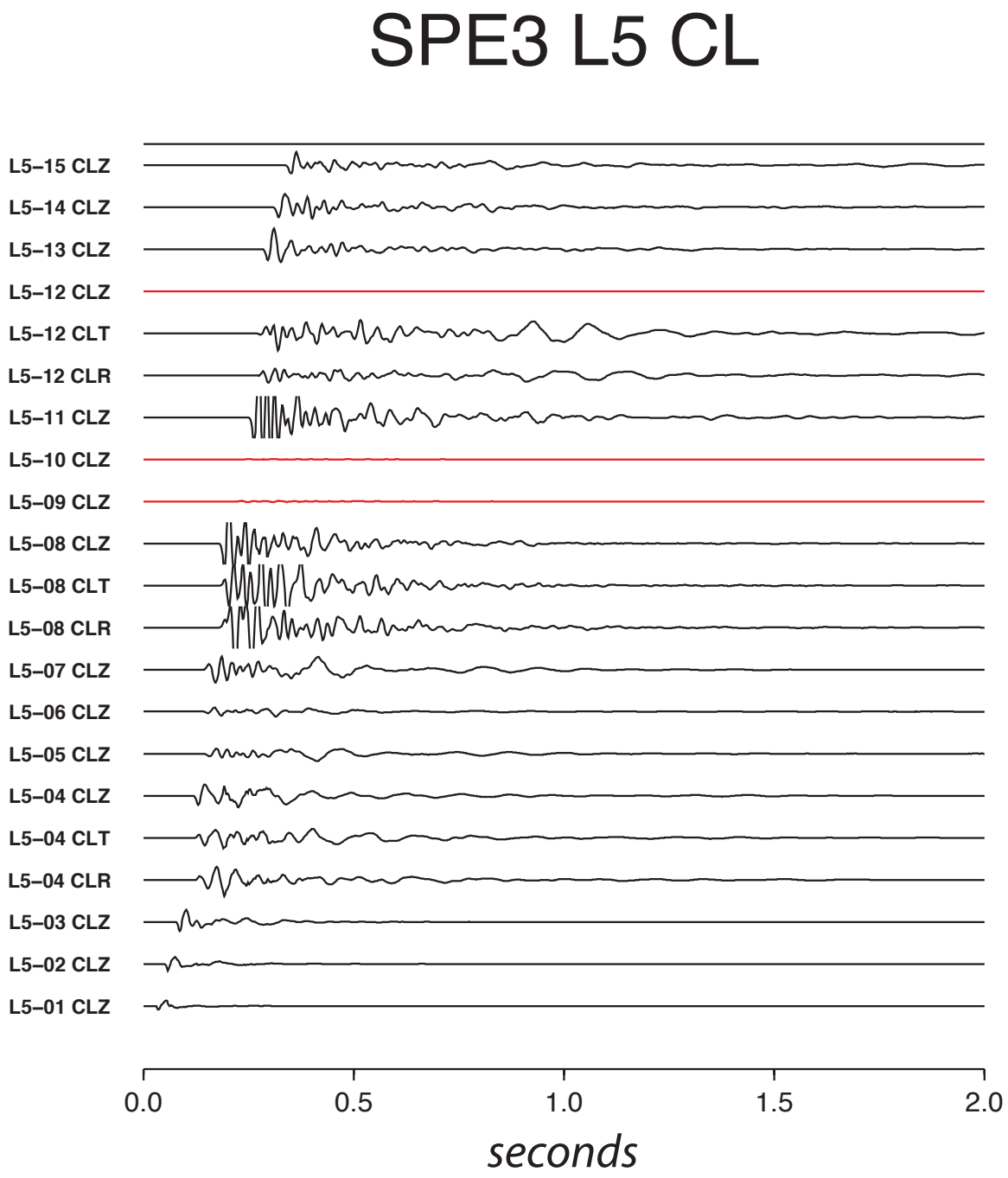

Figure 6. Line 5 GS11D

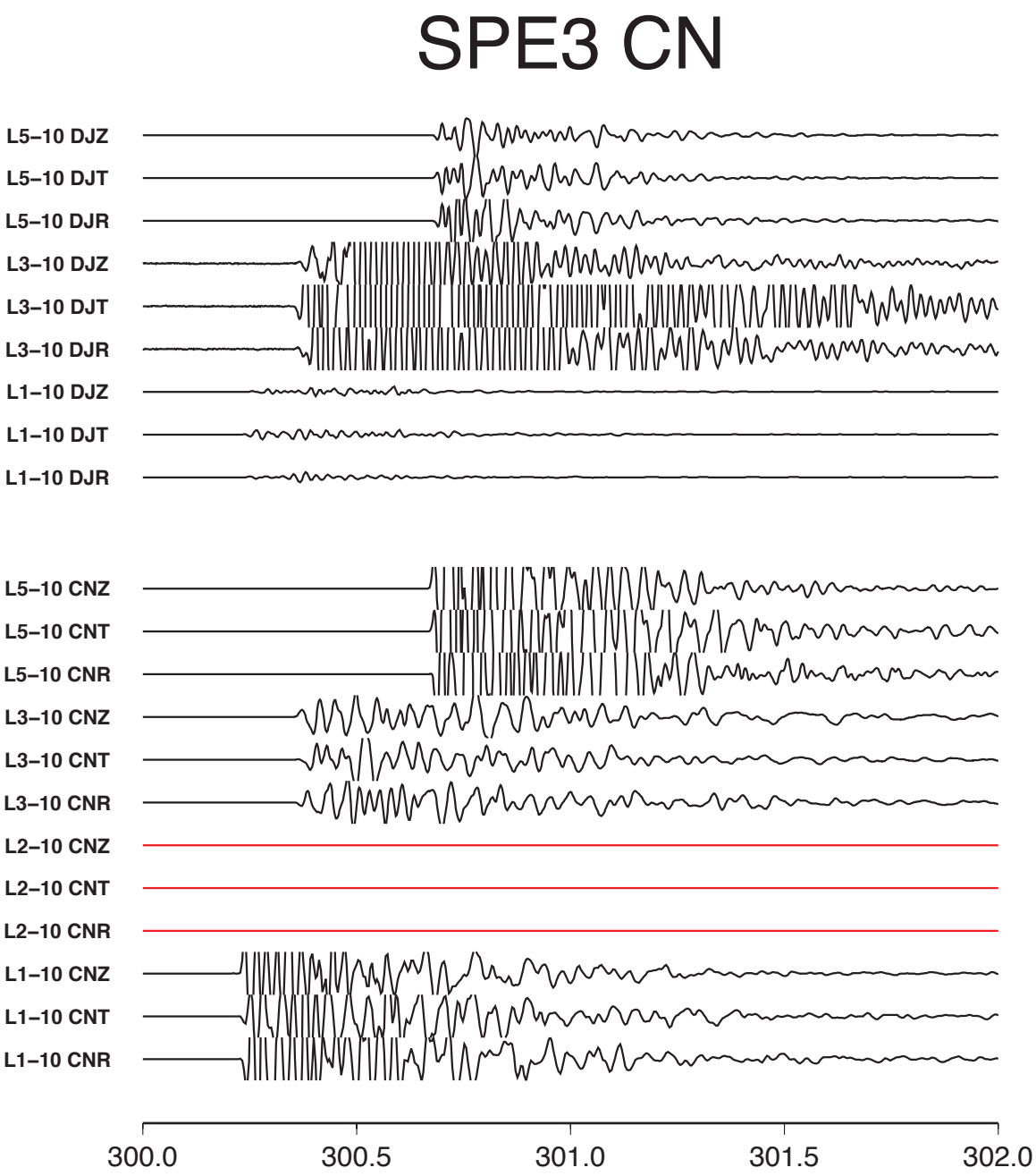

Figure 7. Episensor (CN) and rotational sensor (DJ) data. L1-10 and L5-10 are R1 rotationals; L3-10 is a different design.

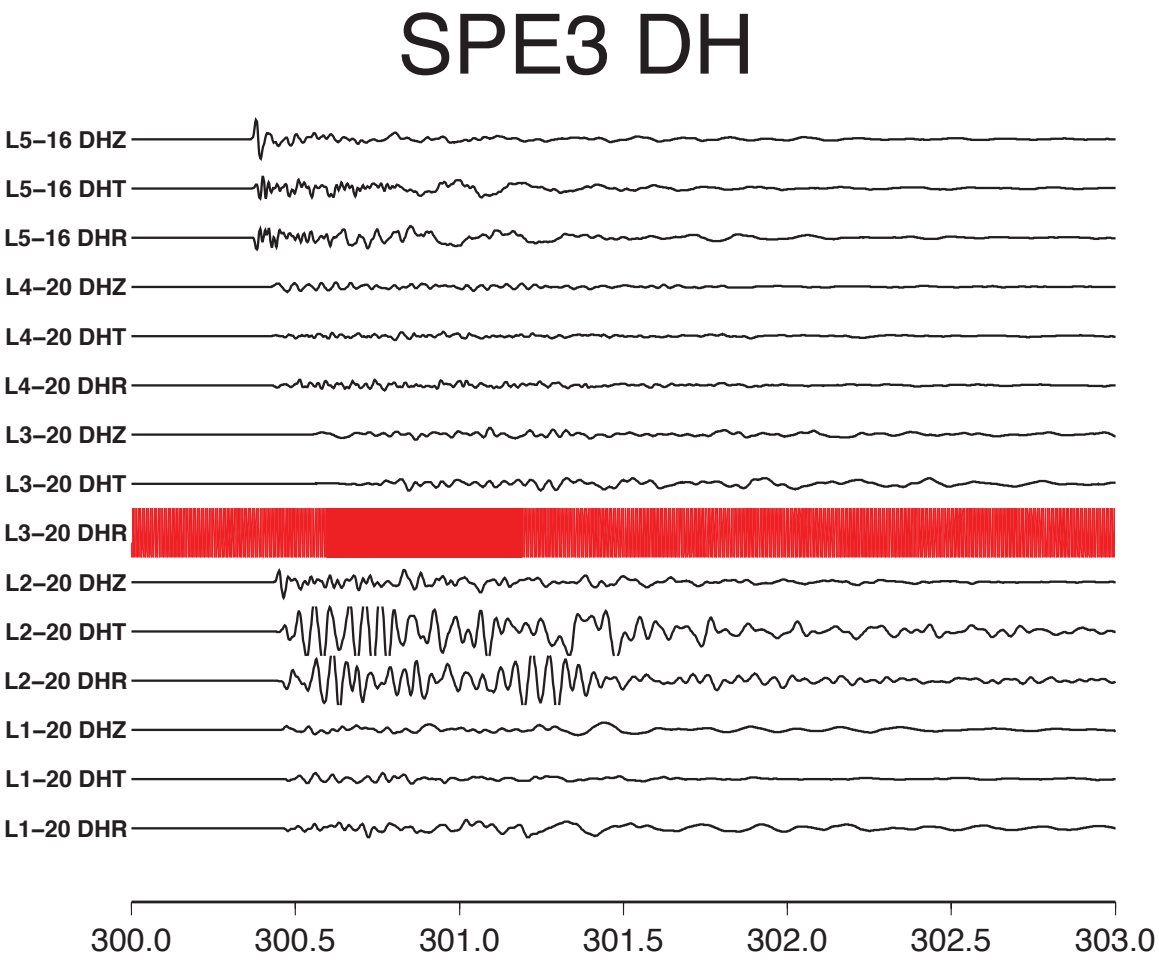

Figure 8. Guralp CMG data.

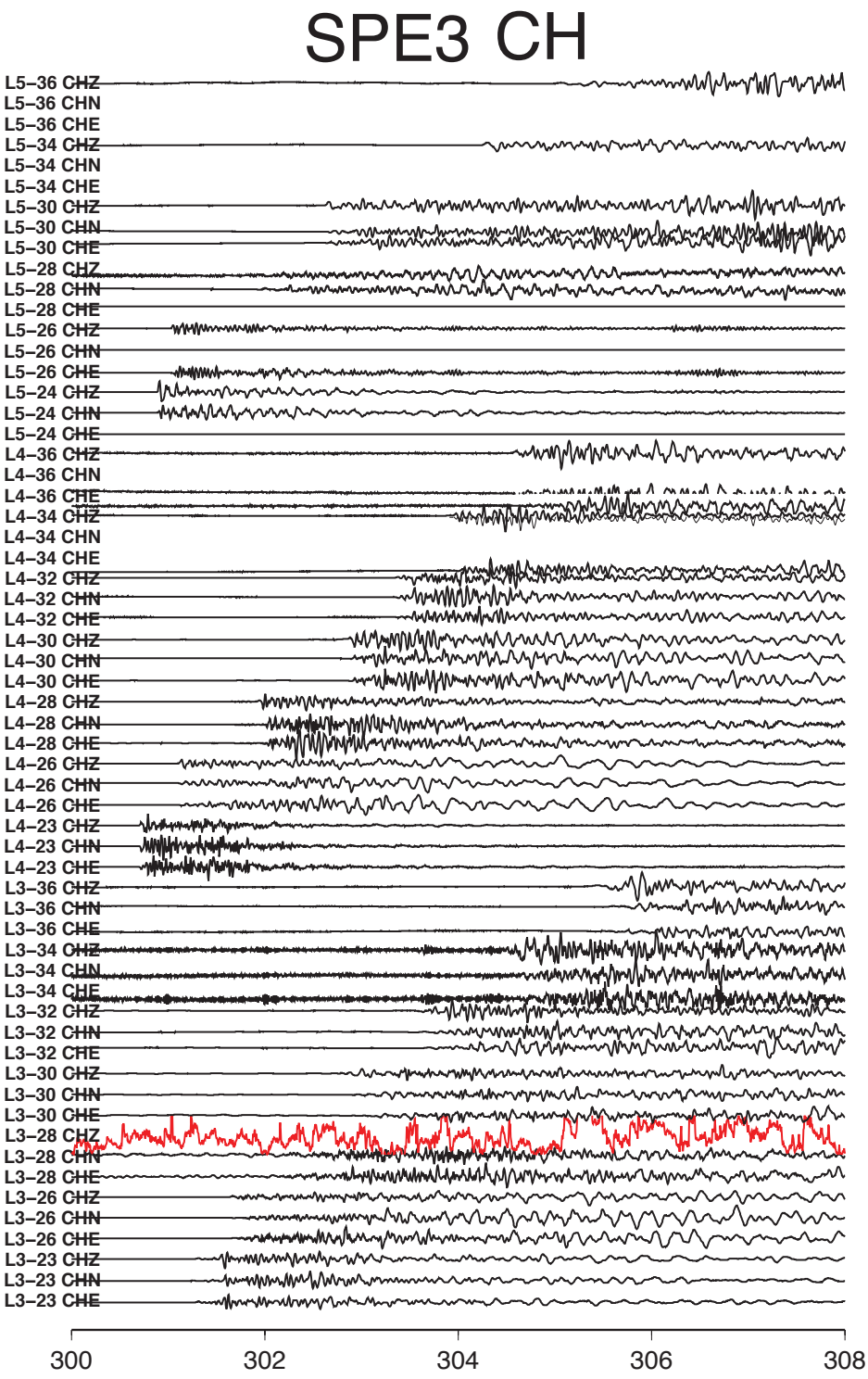

Figure 9. Trillium (CH) data

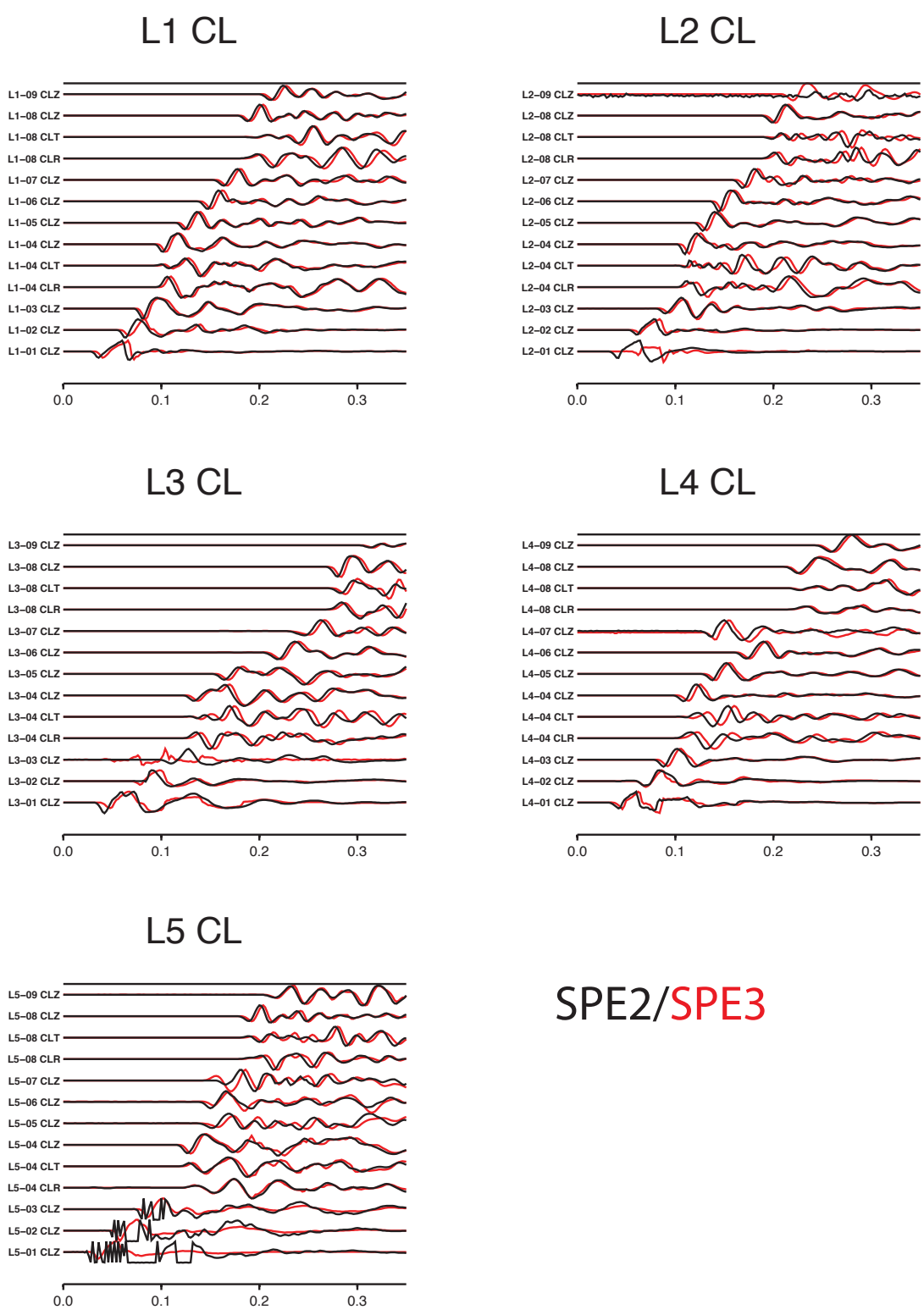

Figure 10. Comparision of SPE2 (black) and SPE3 (red) for the geophones. Note apparent delay of SPE3 with respect to SPE2. Traces are normalized.

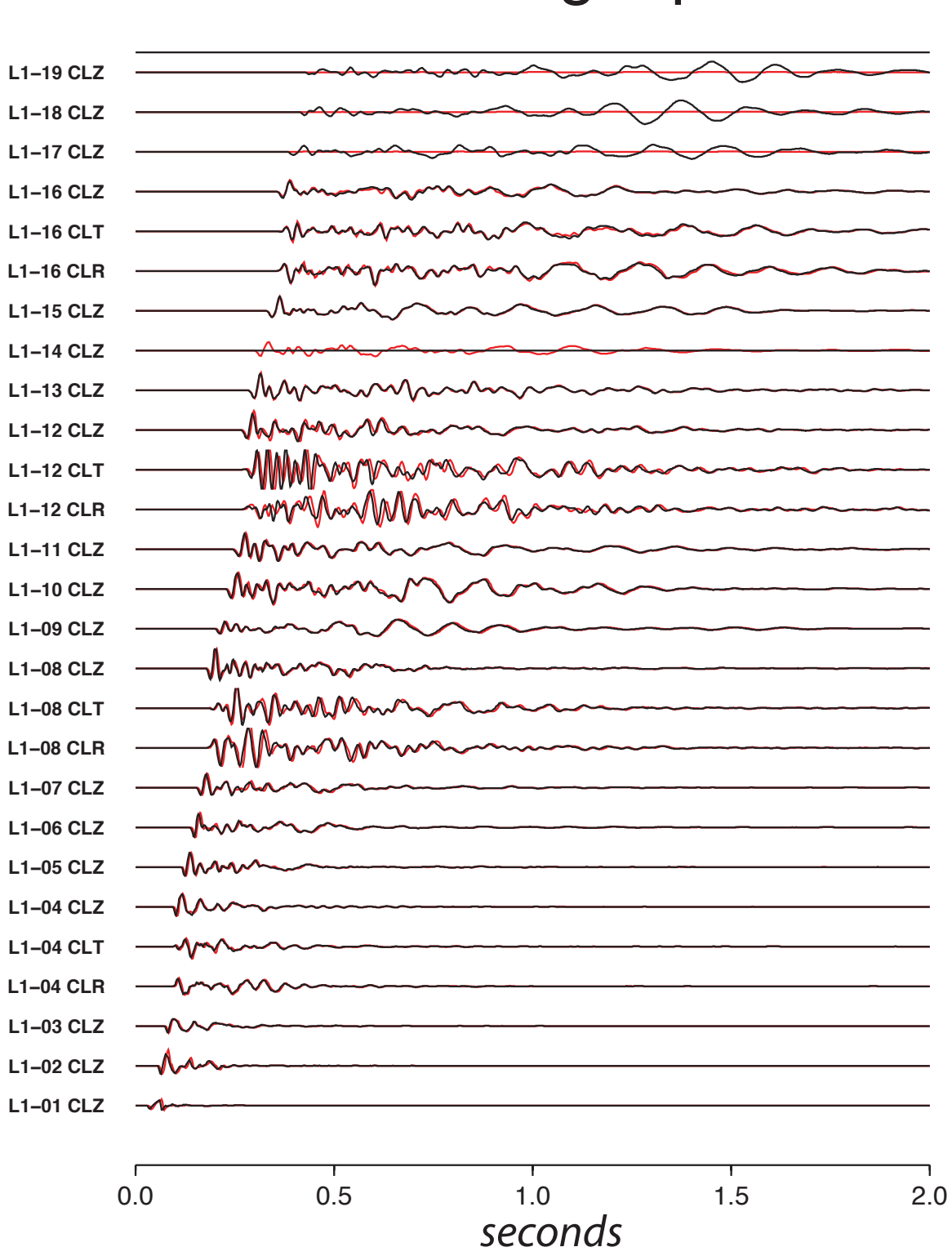

Figure 11. SPE2/SPE3 with relative scaling.

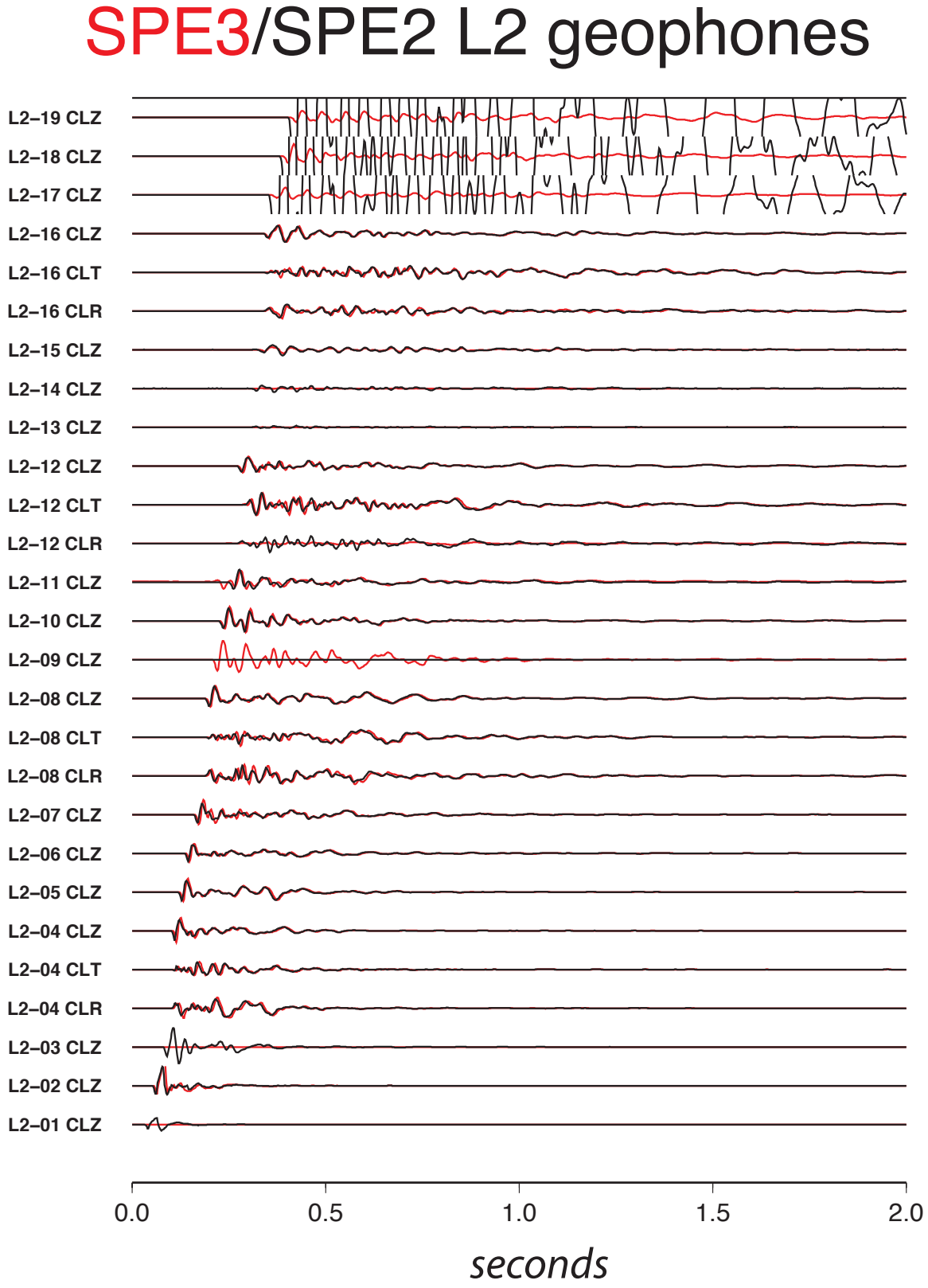

Figure 12. SPE2/SPE3 with relative scaling.

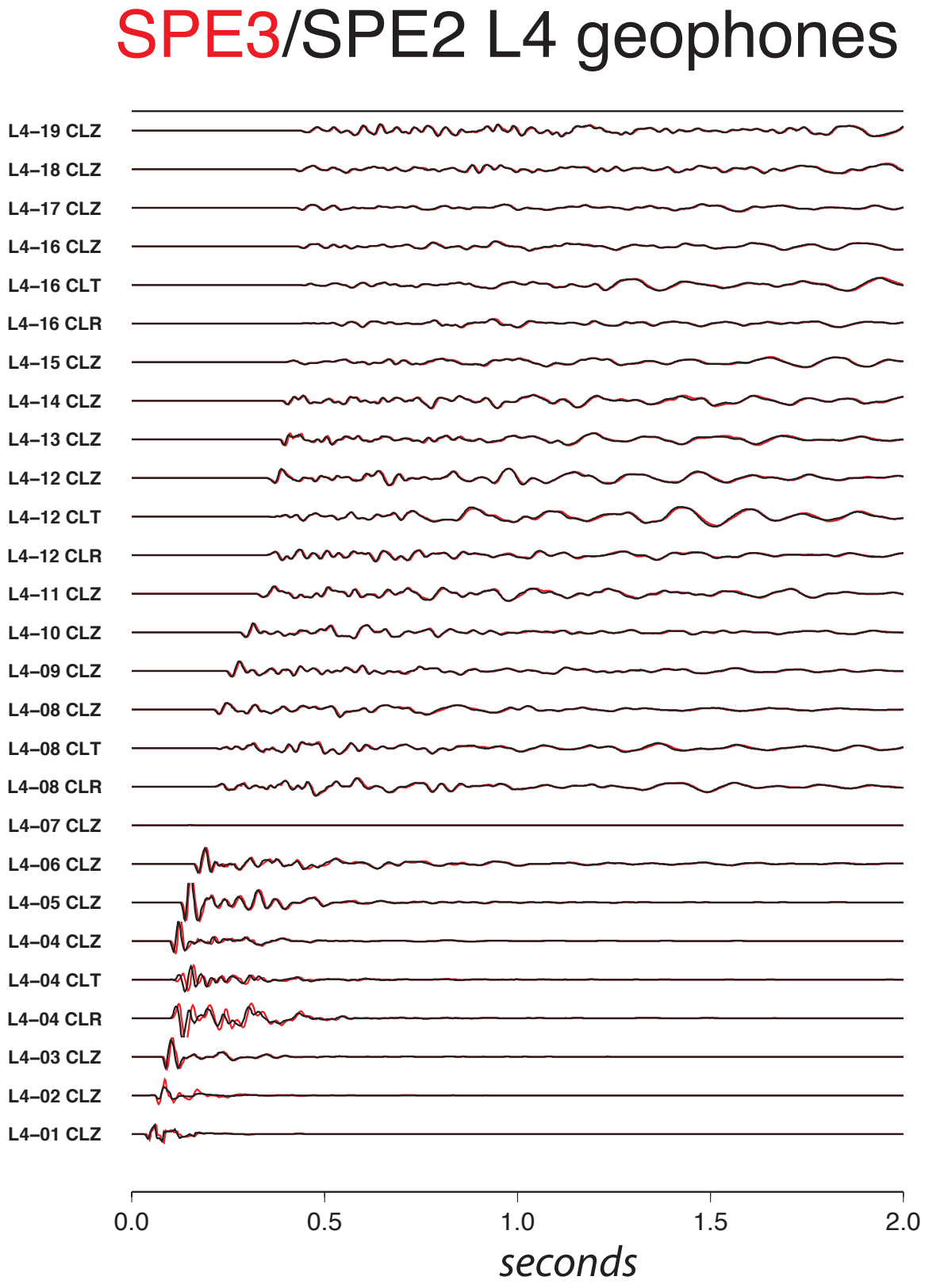

Figure 13. SPE2/SPE3 with relative scaling.

SPE3/SPE2 L5 geophones

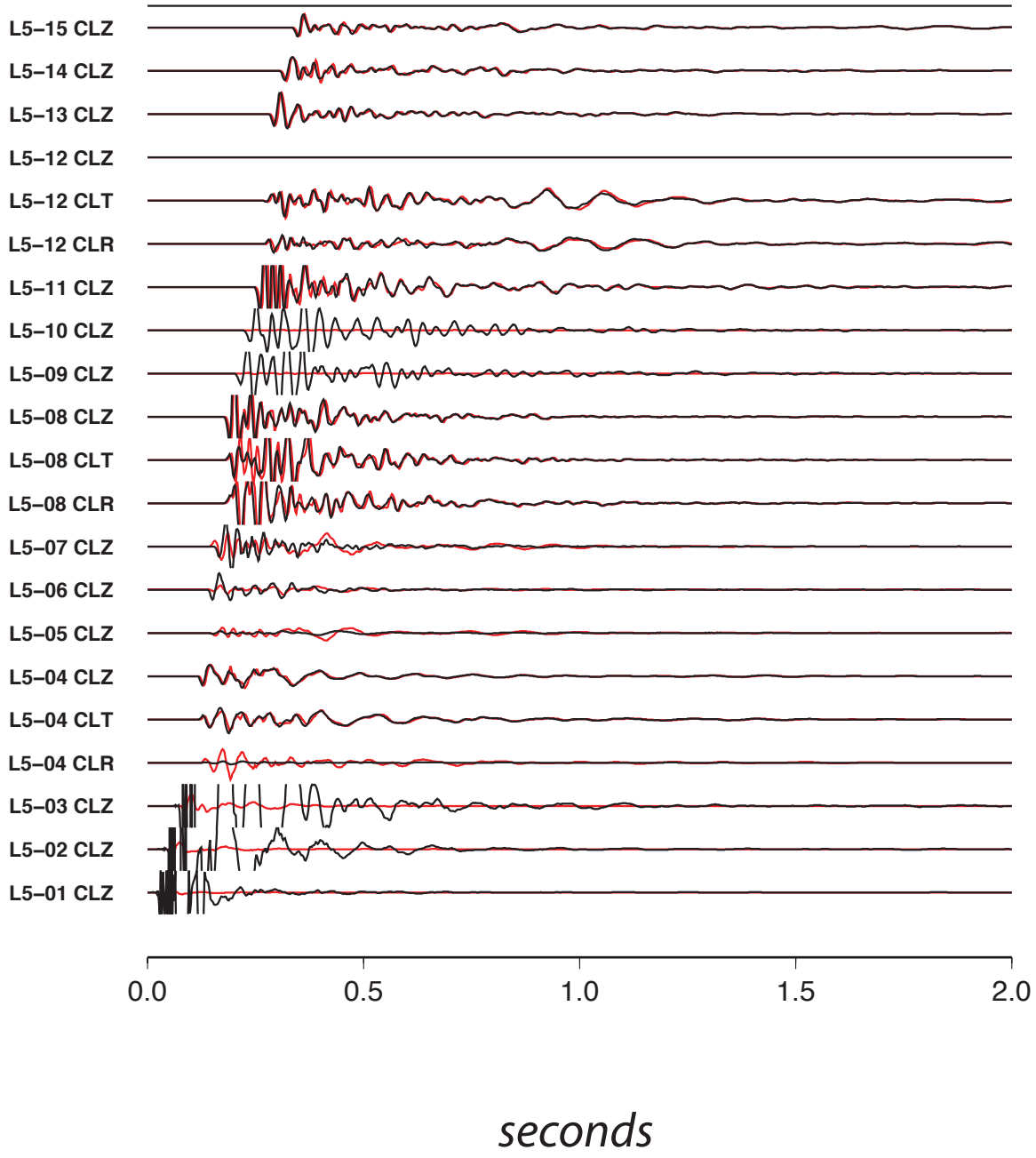

Figure 14. SPE2/SPE3 with relative scaling.

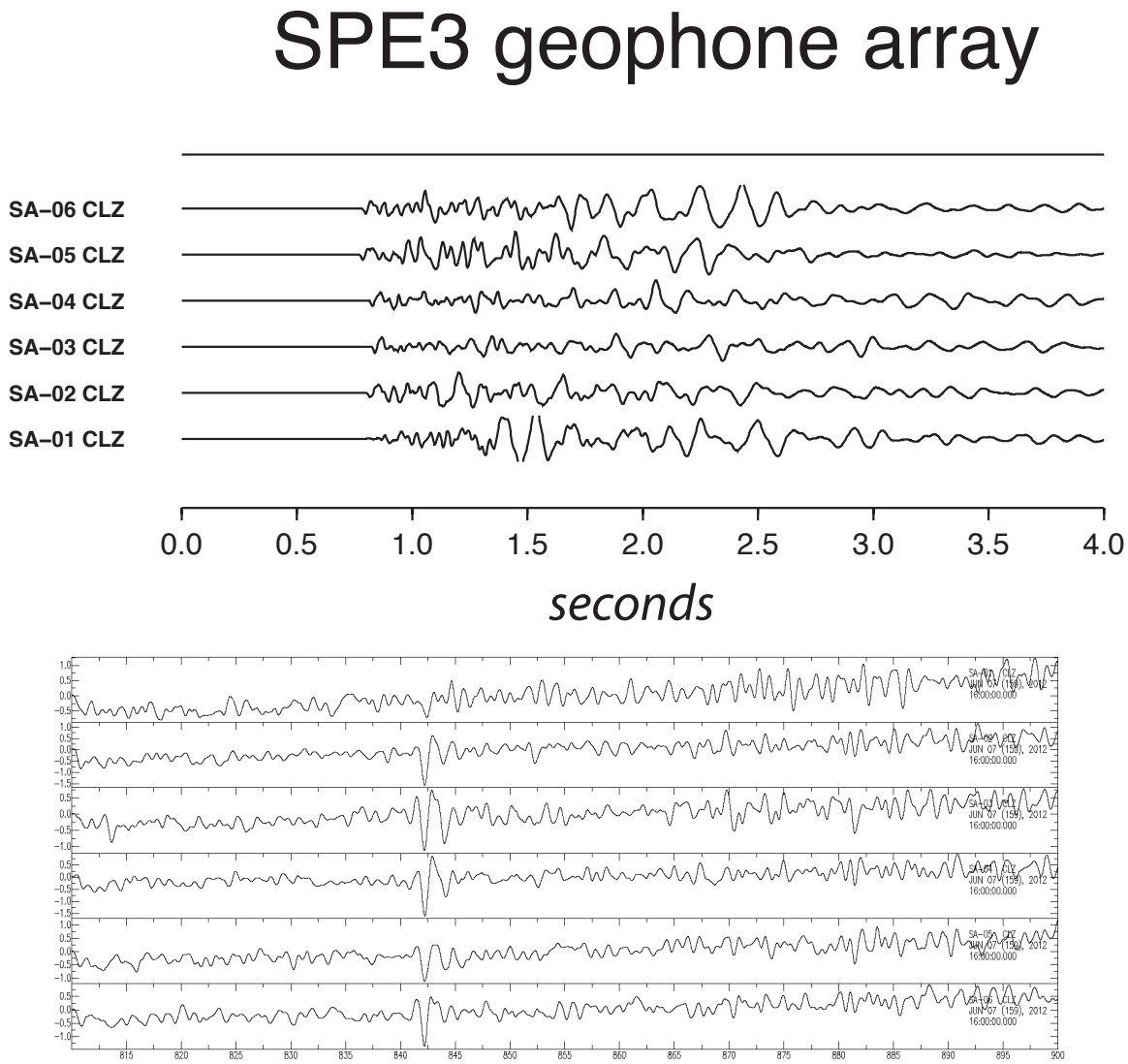

Figure 15. (top) SPE3 geophone array located SE of GZ. (bottom). Teleseismic recorded at small array. Note anomlaous appearance of top trace which is the center sensor indicating possible sensor/site problem.

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.