Timing issues on the Hussar low-frequency experiment

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ABSTRACT

Nanometrics Trillium compact seismometers were deployed at a nominal 200 meter station spacing from flag 564 (southwest end of line) to flag 264 at the Hussar low-frequency experiment. Three component data was acquired continuously on Nanometrics Taurus recorders at a two millisecond sample rate for the duration of the survey. The Taurus recorders were synchronized to GPS time. Two INOVA (ARAM) Aries recorders and an INOVA Scorpion recorder logged dates and times for each shot in their respective observer's logs. However, the time of shot does not match between these recorders for a given shot, and is not consistent between recorders for the time difference between subsequent shots. We speculate that the Aries time of shot is a file creation time. It is shown that the times derived from the Scorpion shot identification number (UNIX time stamp) are the best choice for extracting shot gathers from the seismometer continuous data, by visual inspection of observer's log times (converted to Coordinated Universal Time) plotted over the vertical component of seismometer data recorded at flag 524 for all sources at flag 524.

FUTURE WORK

Based on these results, Aries times were discarded, and Scorpion times were used to extract shot gathers from the seismometer data assuming the second of two sweeps per vibe point started 34 seconds (24 second sweep plus 10 second listen time) after the first sweep. All extracted seismometer shots gathers have been correlated with synthetic sweeps for the three sweep types, and appear in other CREWES research reports from this year.

It is clear that CREWES needs to pay more attention to the time of shot in the recorders that we operate during future work, where instrumentation that is synchronized with GPS time is also used as part of an experiment.

No quality control work has been done at the time of writing, so future work will include scanning the shot gathers to ensure that we have extracted data that includes the entire uncorrelated sweep and listen time for each vibe source type, fine-tuning the extracted shot gathers to find which sample corresponds to zero-time for each shot by cross-correlating with data from other receivers that were at the same receiver station.

FIG. 1. Nanometrics Taurus recorder and Trillium compact seismometer (Nanometrics, 2011).

Table 1. Statistics are cruel.

	Source line	Max	Min	Mean	Median	Stdev	Nsamp
SPML 273 vs 295	2: 364 vibe, low-dwell	05:04	02:38	03:12	03:11	00:07	1586
	4: 364 vibe, linear	02:18	00:00	00:02	00:01	00:07	1586
	6: Failing vibe, low-dwell	09:09	00:00	00:04	00:01	00:33	1586
	8: Dynamite	02:00	00:00	00:02	00:01	00:08	1586
SPML 273 vs Scorpion	2: 364 vibe, low-dwell	07:52	00:16	01:48	01:54	00:36	1043
	4: 364 vibe, linear	06:18	00:13	00:39	00:22	00:50	1043
	6: Failing vibe, low-dwell	12:45	00:10	00:38	00:20	01:22	1043
	8: Dynamite	11:47	00:07	00:16	00:10	00:45	1043
SPML 295 vs Scorpion	2: 364 vibe, low-dwell	11:01	01:03	01:37	01:18	01:03	1043
	4: 364 vibe, linear	07:33	00:09	00:40	00:22	00:52	1043
	6: Failing vibe, low-dwell	12:53	00:10	00:43	00:21	01:30	1043
	8: Dynamite	11:46	00:07	00:16	00:11	00:45	1043

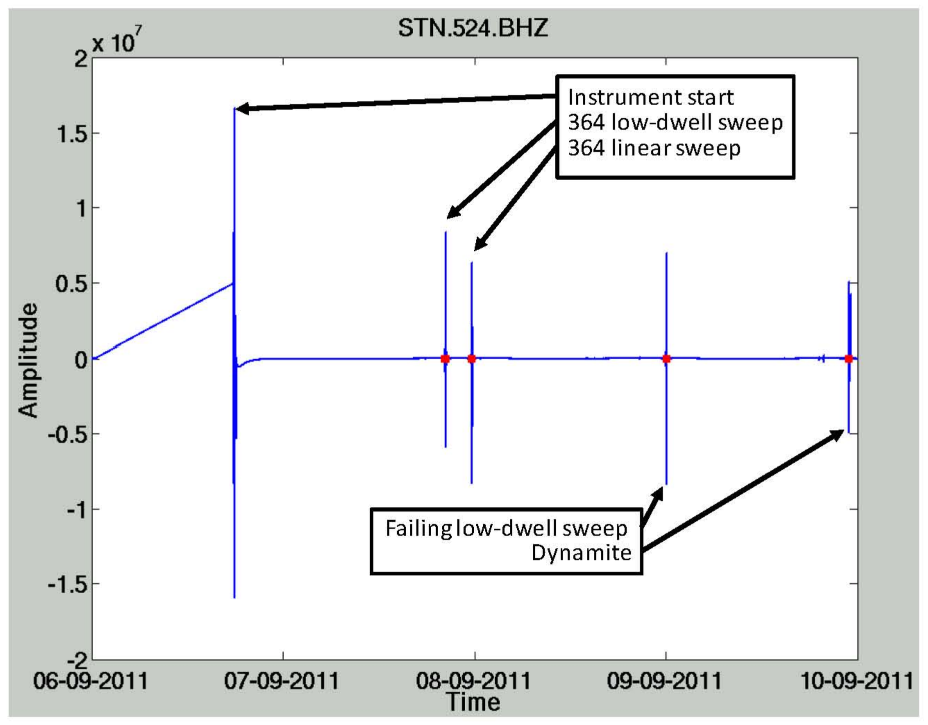

FIG. 6. All data for the vertical component of seismometer station 524 with no filtering and no scaling. Observer's notes times are plotted in red after being converted to UTC.

ACKNOWLEDGEMENTS

We would like to thank Neil Spriggs and Rick Moore from Nanometrics for supplying and deploying the seismometers for this experiment. Andrew Nichols (CREWES) assisted with deployment. We would also like to thank Geokinetics, Husky and INOVA, as this work would not have been possible without them. Finally, we would like to thank all CREWES sponsors for their support.

FIG. 2. Car battery and Taurus recorder inside a food cooler

FIG. 3. Cooler on the ground near VectorSeis and Aries equipment, during an INOVA 364 low-frequency vibe sweep (right).

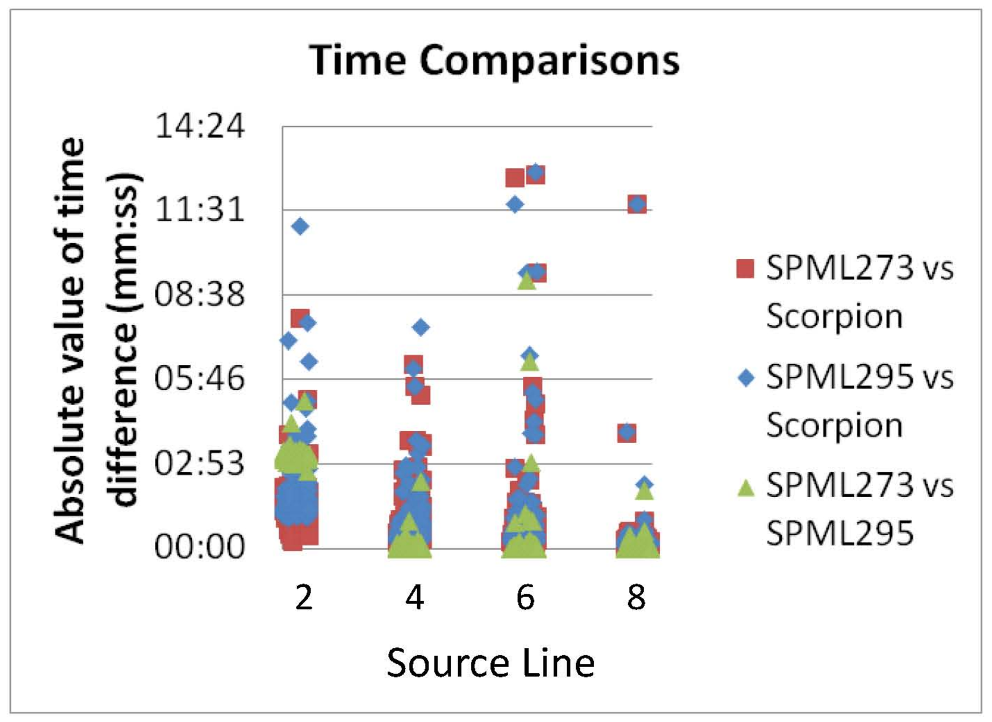

FIG. 4. Difference in time of shot between different recording systems for the same shot.

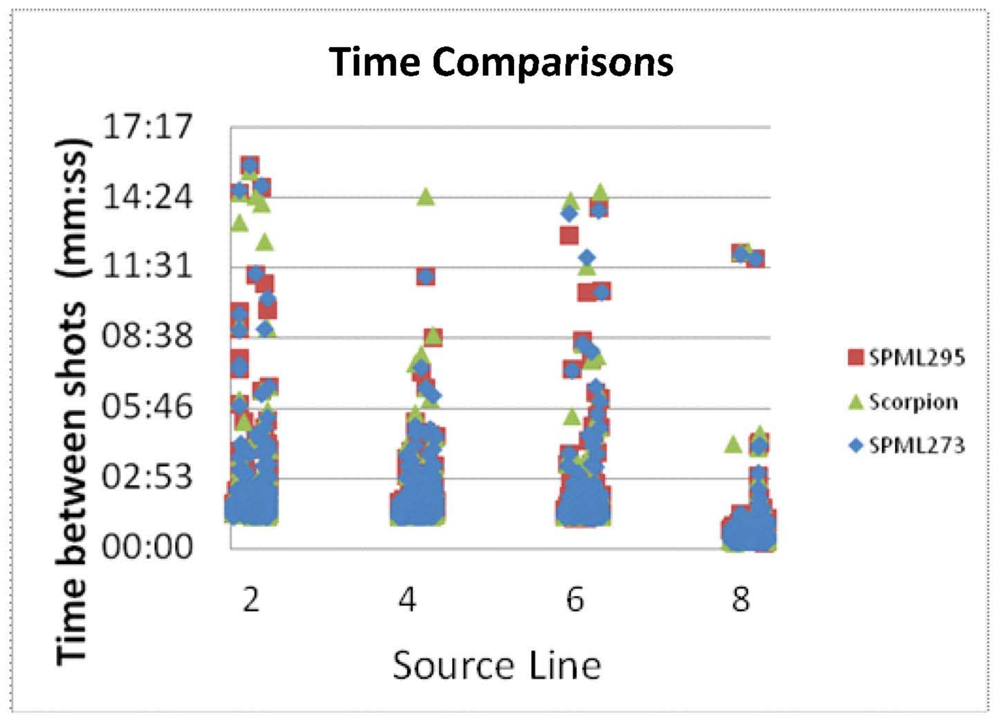

FIG. 5. Difference in time of shot between subsequent shots for each individual recorder.

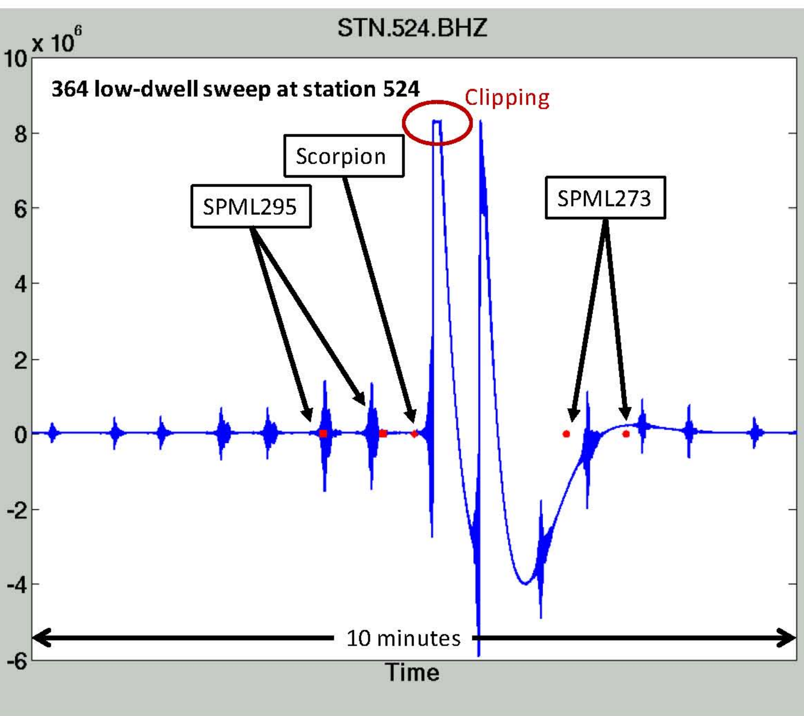

FIG. 7. INOVA 364 low-dwell sweep. SPML295 times are early and SPML273 times are late, but the Scorpion time appears to be correct. SPML times were not synchronized for this source line.

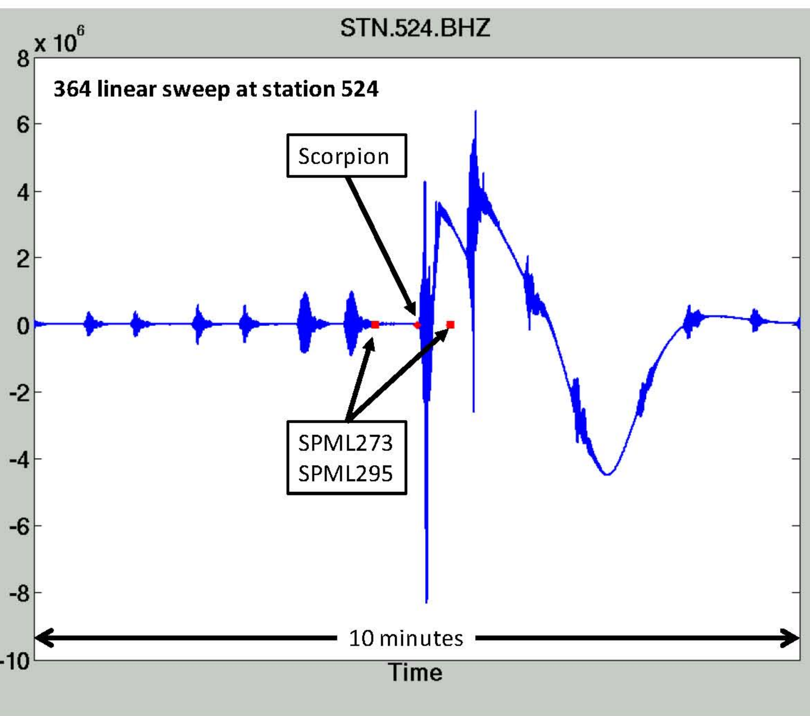

FIG. 8. INOVA 364 linear sweep. SPML times are early, but do occur before each of the two sweeps. Scorpion time appears to be correct. SPML times were synchronized to cell phone time.

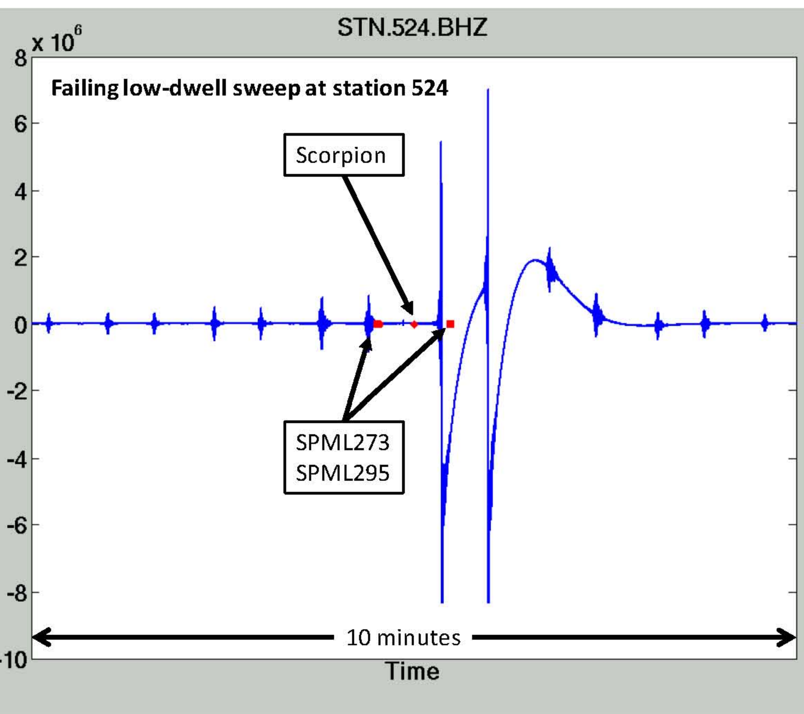

FIG. 9. Failing low-dwell sweep. All times are early, but Scorpion time appears to be closest to being the correct time. SPML times synced to cell phone time.

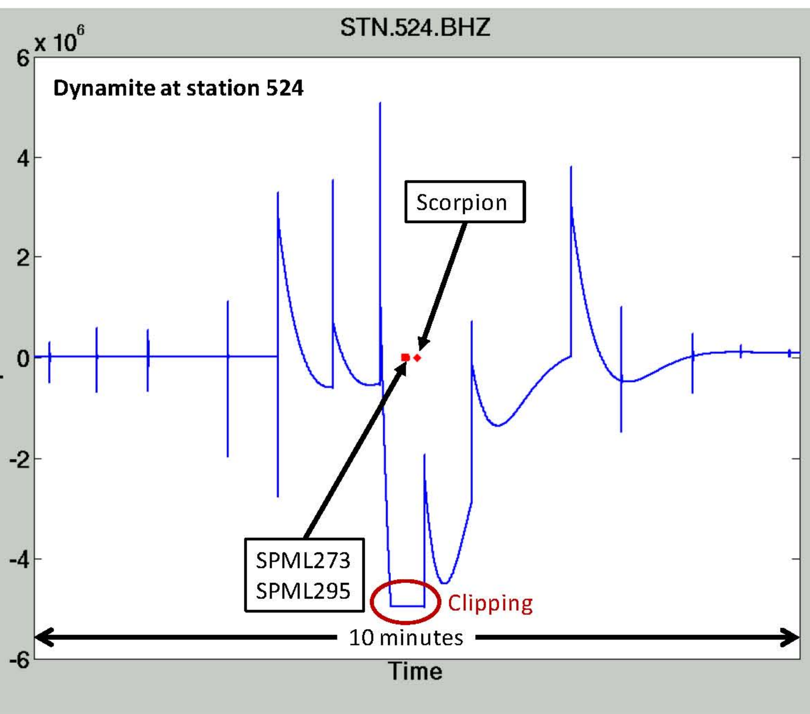

FIG. 10. Dynamite. Scorpion time appears to be correct, but previous nearby shots have pushed the seismometer off scale. SPML times synced to cell phone time.