FIG. 2. 3C seismograms from surface geophones, plotted with 200ms AGC. For each display panel, vertical-component traces are the left-most gather. Top: acquired with accelerated weight drop source. Bottom: acquired with EnviroVibe vibrator driven by mseq14.

Controlling a land vibrator with m-sequences: a preliminary field test

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INTRODUCTION

CREWES has conducted an initial field experiment to evaluate m-sequences as viable pilot signals for controlling land vibrators. A successful demonstration of this idea would be a major advance in vibratory seismic acquisition technology.

In the experiment, seismograms were recorded for 3C geophones cemented in a well and placed on two perpendicular surface lines centred on the well.

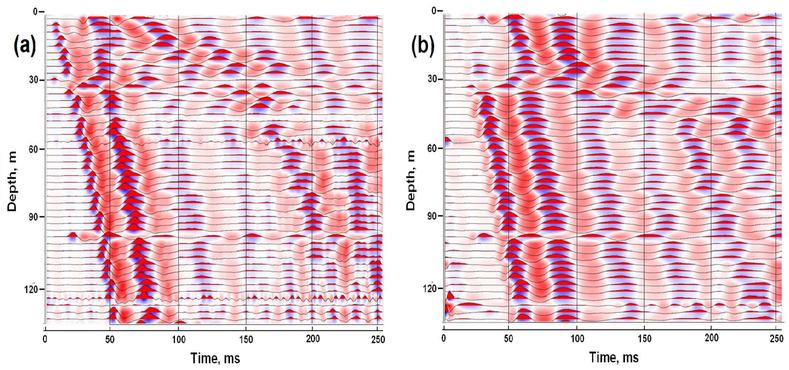

FIG. 1. Vertical-component seismograms from 3C geophones cemented in a well: acquired with: (a) accelerated weight drop source; (b) EnviroVibe vibrator driven by an m-sequence pilot.

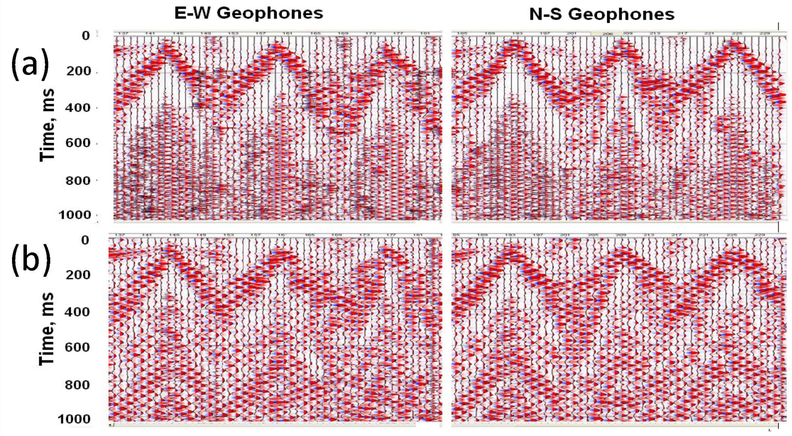

FIG. 2. 3C surface seismograms, acquired with (a) accelerated weight drop source; (b) EnviroVibe driven by m-sequence.

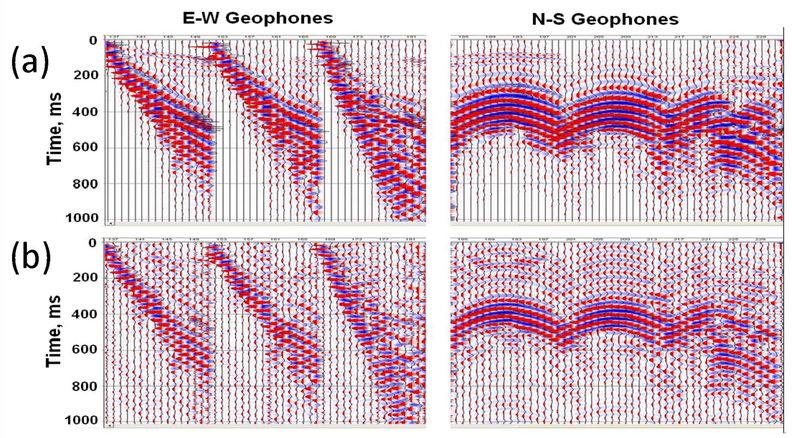

FIG. 3. 3C surface seismograms acquired with EnviroVibe source controlled by: (a) frequency sweep; (b) m-sequence.

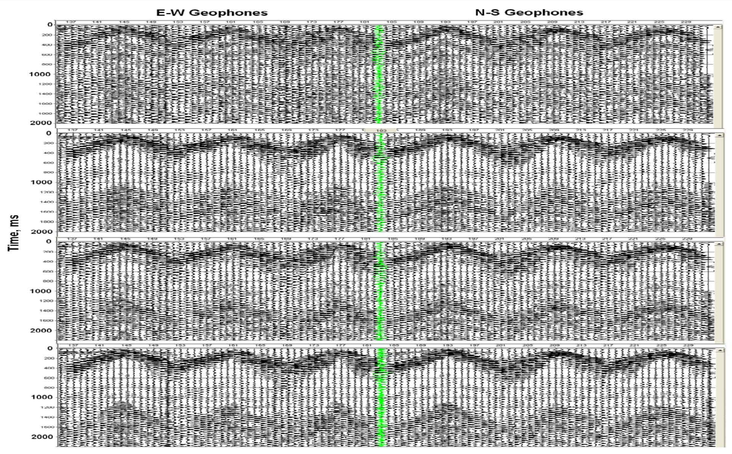

FIG. 4. Four repetitions of normalized seismograms recorded with the same m-sequence pilot on surface 3C geophones. Left-most gathers for both E-W and N-S lines are the vertical component traces.

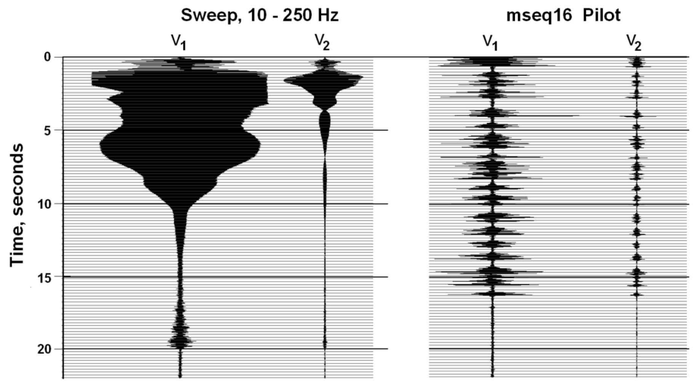

FIG. 5. Uncorrelated vertical-component vibrator signals from two geophones at the west end of the E-W line, for frequency sweep and m-sequence pilots. The V1 geophone is within a meter or two from the vibrator, while the V2 geophone is 10m away. Amplitude plotting scales are identical, so visual comparison of relative signal strengths is valid.

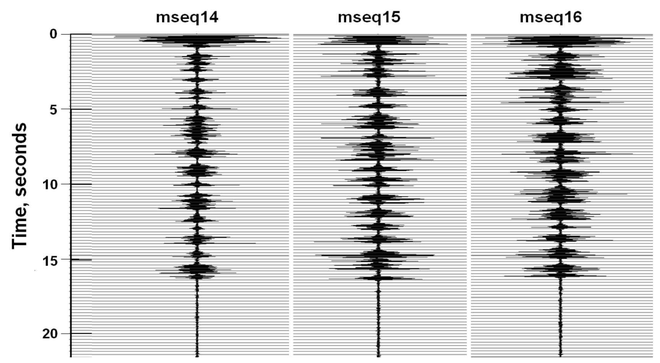

Fig. 6. Uncorrelated V_1 signals of the nearest geophone to the vibrator at the west end of the E-W line, for pilots with m-sequence drive levels equal to 9%, 18% and 35% of maximum. The V_1 signals, representative of the source waveform, are erratic in time and are not repeatable in detail.

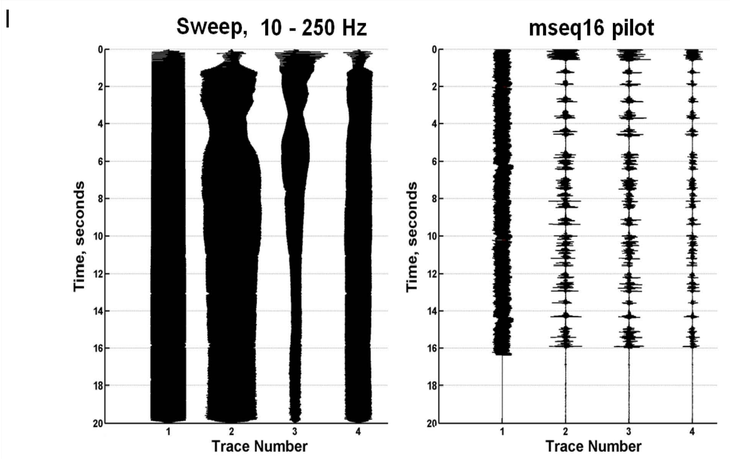

Fig. 7. Uncorrelated signals recorded on the vibrator using a Geometrics Geode. Trace 1 is the pilot signal. Trace 2 is from an accelerometer on the reaction mass. Trace 3 is from an accelerometer on the base plate. Trace 4 is a "phase-corrected drive signal" that is a linear combination of Traces 2 and 3.

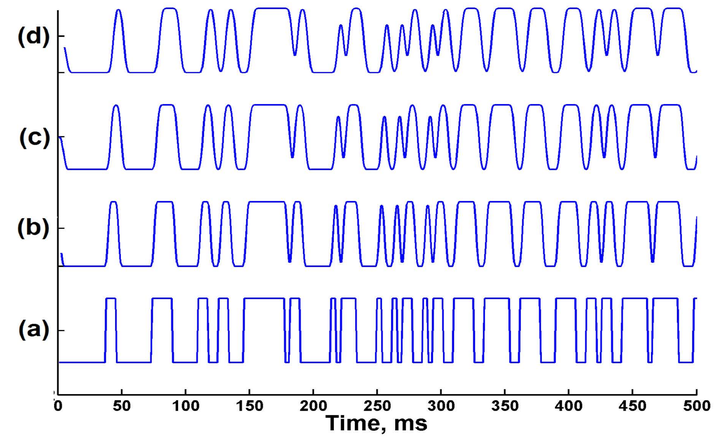

FIG. 8. Filtered m-sequences. (a) Unfiltered m-sequence; filtered (b) once; (c) twice; (d) 3 times. With each application of the filter, we increase the rise and fall times at the transitions between -1 and 1. Time domain filter is (1, 4, 6, 4, 1)/16.

SUMMARY AND DISCUSSION

Initial field testing has indicated that seismograms acquired with pure m-sequence pilots are plagued by artifacts and non-repeatability. We believe the sharp transitions on the pure m-sequences are the cause for these problems, and for the erratic spiky appearance of the signals on Figures 5, 6, and 7.

If this is true, the sharp transitions must be changed to more moderate ramps before they can be used reliably as pilots for driving land vibrators. We will repeat the field tests using the filtered m-sequences shown on Figure 8, to see if the erratic vibrator behaviour and repeatability issues are cured by the increased rise and fall times.

ACKNOWLEDGEMENT

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