Processing report for the Alder Flats 3D, June 2007

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ABSTRACT

Two seismic surveys have been conducted for the Alder Flats project by the University of Calgary in the last year. A 3C-2D survey was acquired in March 2007 in order to test acquisition parameters for a 3D survey which was acquired the following June. The 3D survey was a primarily a conventional single component survey, but contained a single 3C receiver line. This report details processing results for the 3D survey, including the vertical component from the 3C geophones.

INTRODUCTION

The 3D survey was acquired using the equipment described by Bertram et al. (2005), and acquisition parameters as listed in Table 1. There was a single receiver patch of approximately 450x450 m size (Figure 1). All receivers were live for all shots. Figure 2 shows the CDP fold for this geometry. Results for the 2006 1C-2D have previously been presented by McCrank et al. (2006).

Table 1. Acquisition parameters.

Recording System (University)	ARAM
Source	Single vertical vibrator (IVI EnviroVibe). Source lines at 50 m spacing.
Source Array (3C-2D)	Stationary at 5 m VP interval, 4 sweeps per VP. Diversity stacked in the field.
Source Array (3D)	Stationary at 10 m VP interval, 4 sweeps per VP. Diversity stacked in the field.
Sweep (3C-2D)	10-250 Hz linear over 12 s with 2001 ms listen time
Sweep (3D)	10-180 Hz linear over 10 s with 2049 ms listen time
Sample Rate	1 ms
Receivers (3C-2D)	I/O SM24 10 Hz 3C marsh phones at 5 m spacing. Receiver lines at 50 m spacing.
Receivers (line 10)	I/O SM24 10 Hz 3C marsh phones at 10 m spacing
Receivers (all other lines)	I/O SM24 1C at 10 m spacing
Receiver Array	Single sensor per station.

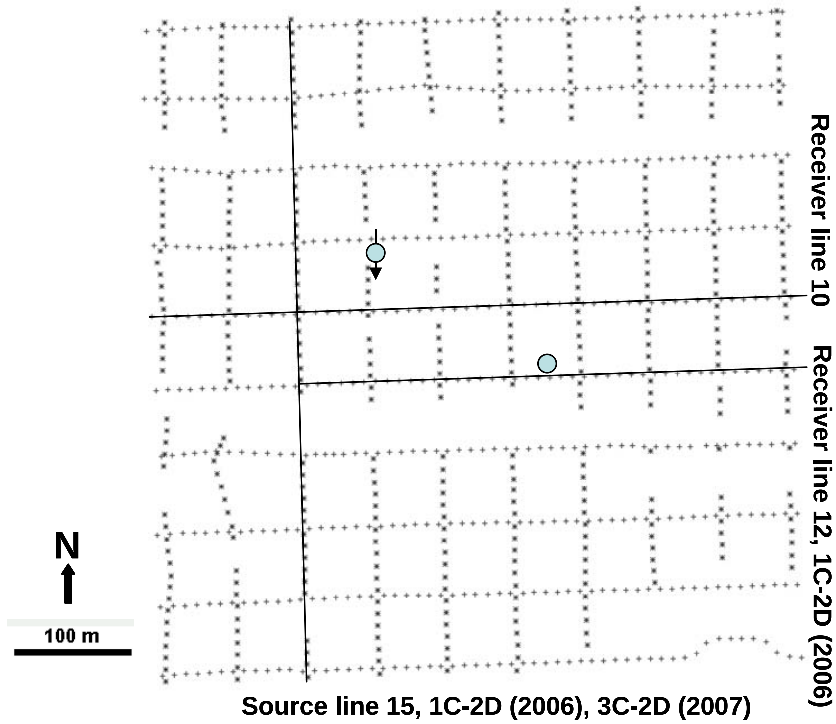


FIG. 1. Base map for the Alder Flats 3D survey; Circles show the approximate positions of the injection and observation wells located within the patch. Gaps in the source lines are due to wells, pipelines, and boggy conditions (SE corner). 3C geophones were laid out for receiver line 10.

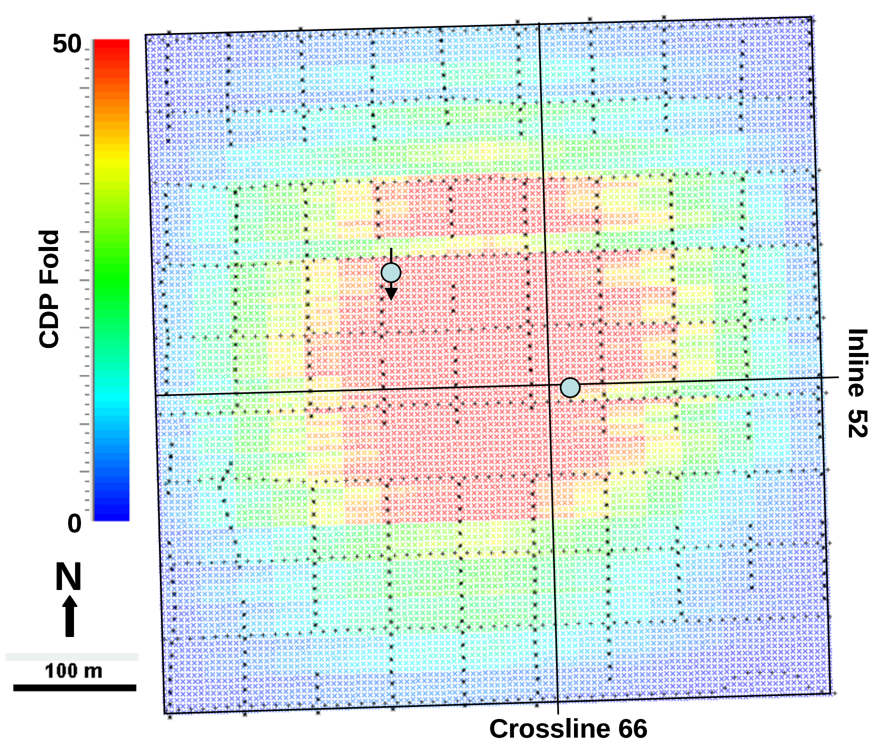


FIG. 2. CDP fold for the Alder Flats 3D survey. Inlines 51 and 52 and crosslines 65 and 66 are shown in Figure 6.

3D Processing

A sample raw shot gather from the 3D survey is shown in Figure 3. Prominent reflections can be observed at 300 and 600 ms. The reflections at 600 ms may be multiples. Correlation sidelobes can clearly be seen before the direct arrivals. This necessitates careful first-break picking in order to avoid refraction statics errors.

Spectral analysis was conducted, and one of the results is shown in Figure 4. The sweep was 10-180 Hz, but in this shot gather, the dB power at 10 Hz is -19 dB; at 90 Hz is -9 dB; at 120 Hz is -15 dB and at 180Hz is -35 dB. This implies that that the maximum sweep frequency could have been 110 Hz, since data in the 110-180 Hz band appears to be noise.

Processing followed the flows developed for the Blackfoot 1995 3C-3D as detailed in Lu and Magrave (1998). A refraction statics model was developed using GLI3D (Figure 5). Elevation statics were minimal for this survey, since most of the area is essentially flat, with a few narrow valleys meandering across it (eg. NE corner).

The observation well is approximately located at inline 52 and crossline 70 (Figure 2). Examples of migrated sections near this well are shown in Figure 6. Crosslines 65 and 66 are shown instead of crossline 70, due to slightly higher fold.

Amplitude time slice sections are shown for 262 ms and 457 ms (Figure 7). Some cross-hatching can be seen, possibly due to acquisition footprint.

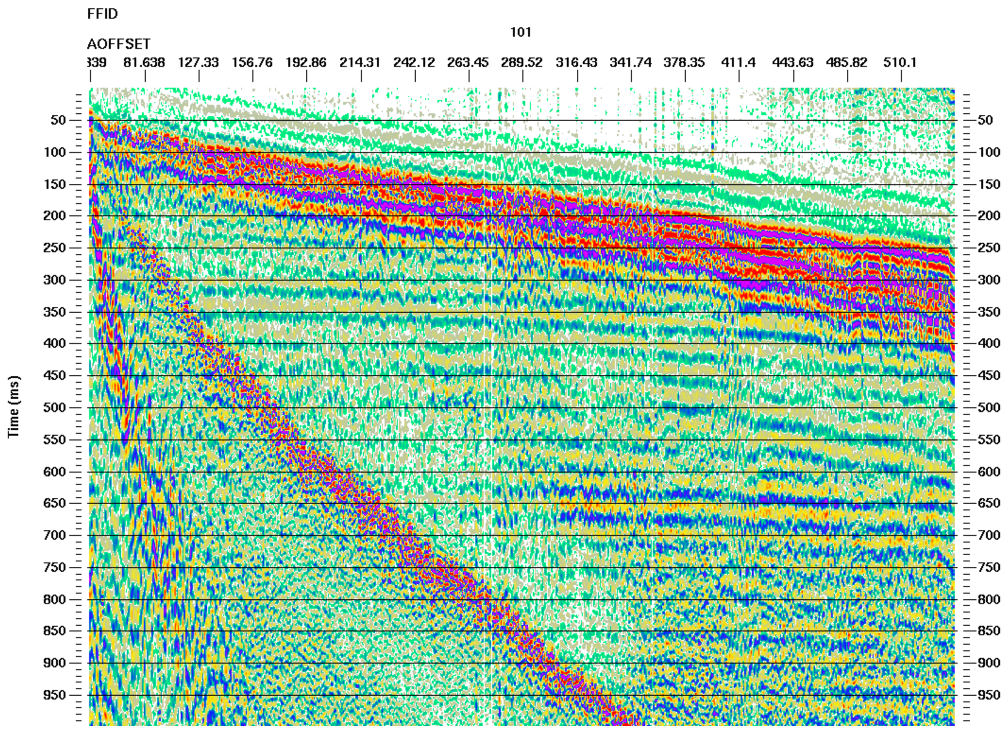


FIG. 3. Raw shot gather for FFID 101, sorted by absolute value of source-receiver offset.

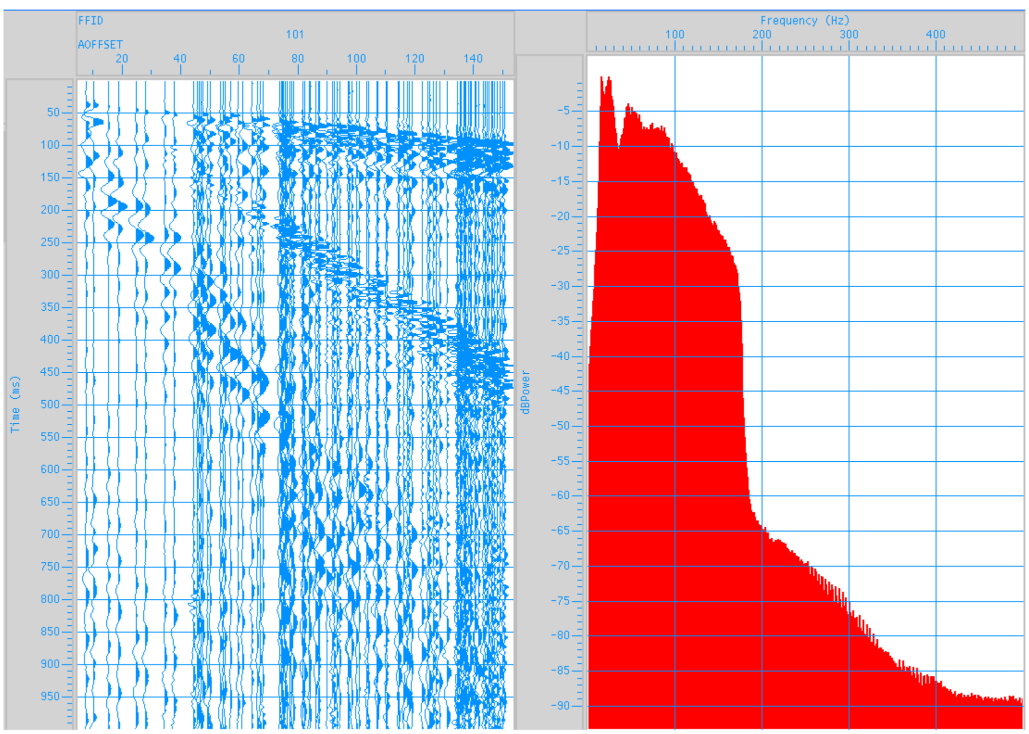


FIG. 4. Traces with source-receiver offsets between 0 and 150 m for FFID 101 (left; cf. Figure 1) and the associated amplitude spectrum (right).

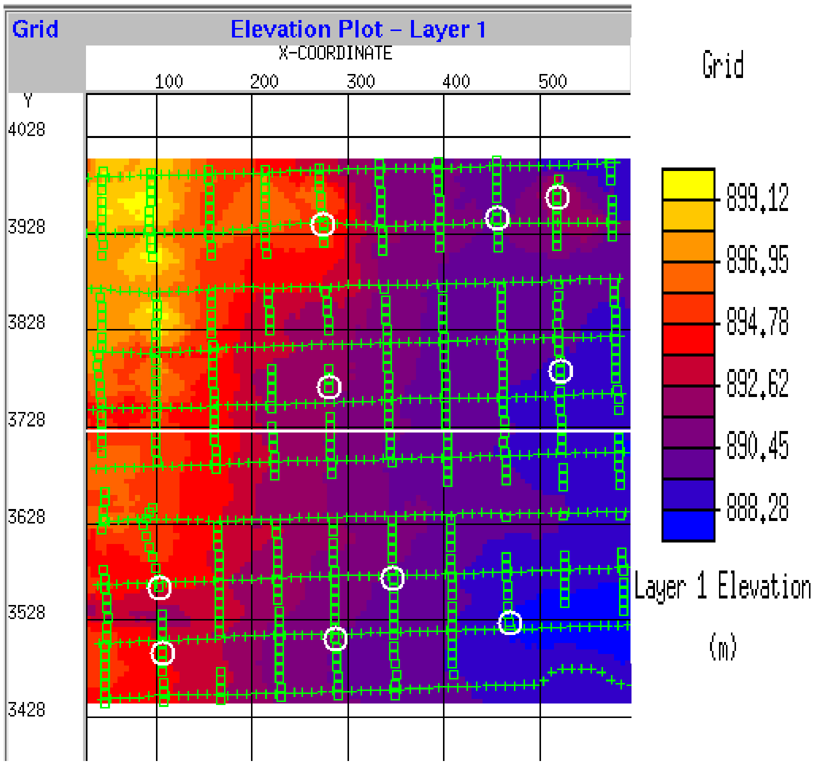


FIG. 5a. Elevation map for 3D survey area.

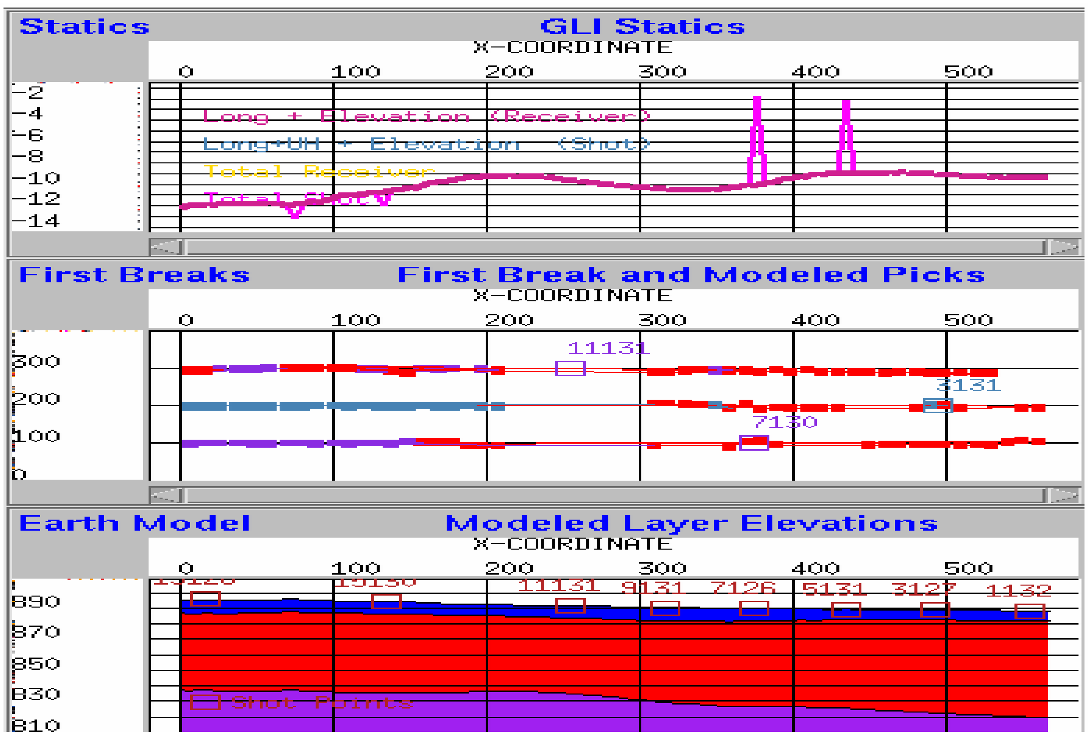
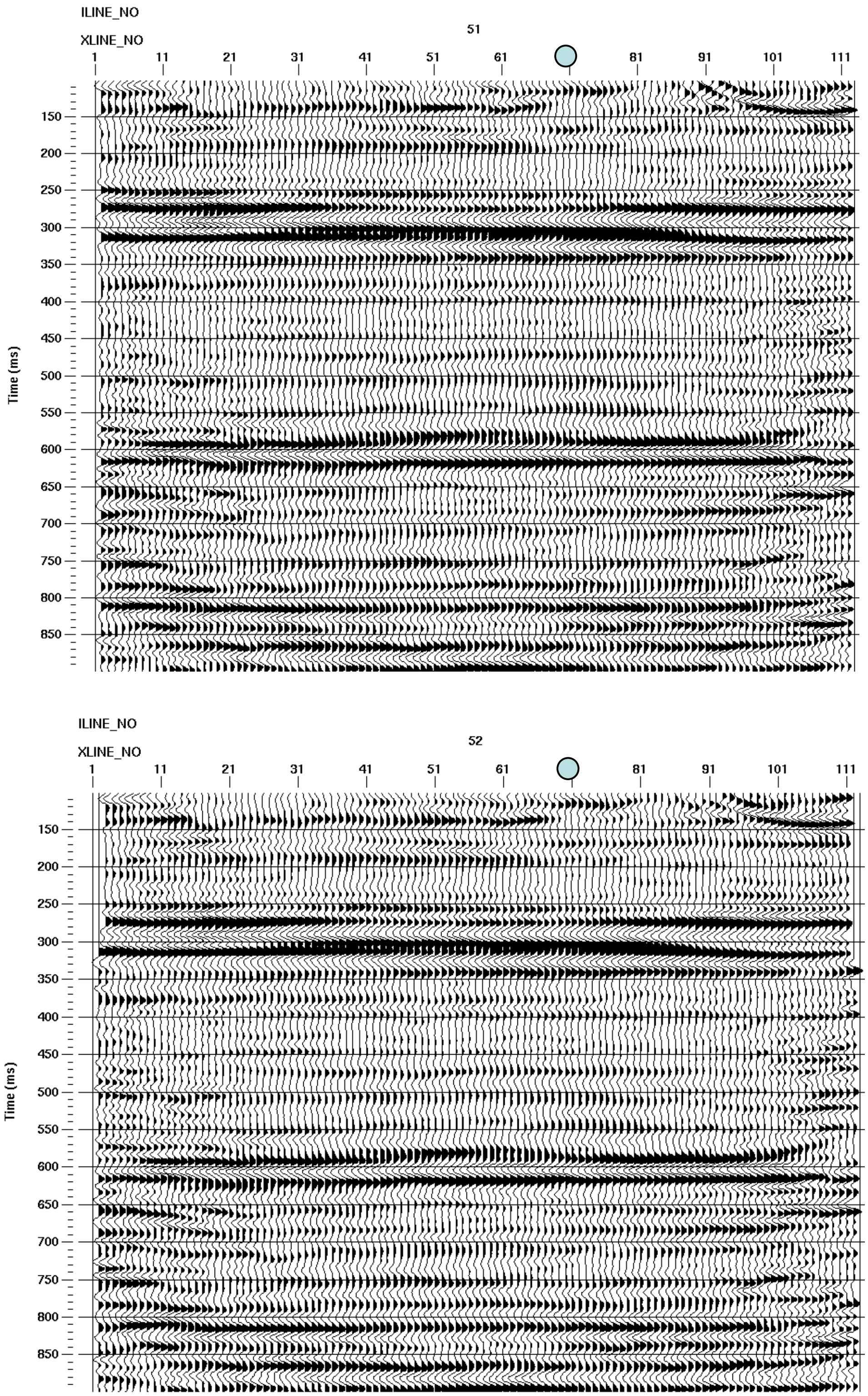
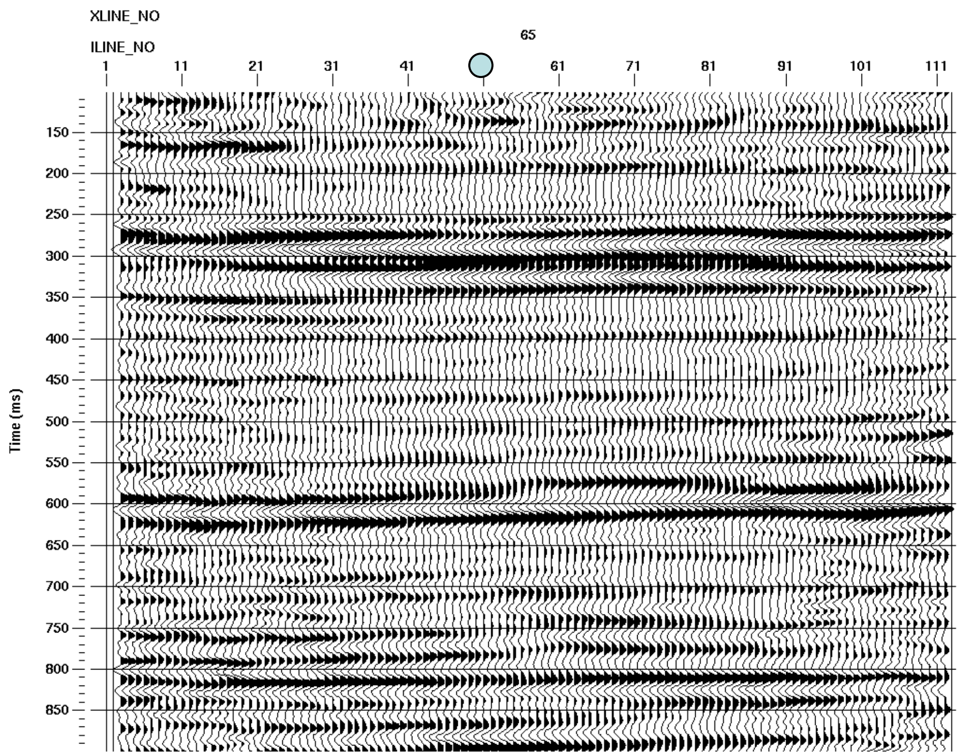


FIG. 5b. GLI3D refraction statics solution; Statics (top), picked and modeled first-breaks (middle) and velocity model (bottom).

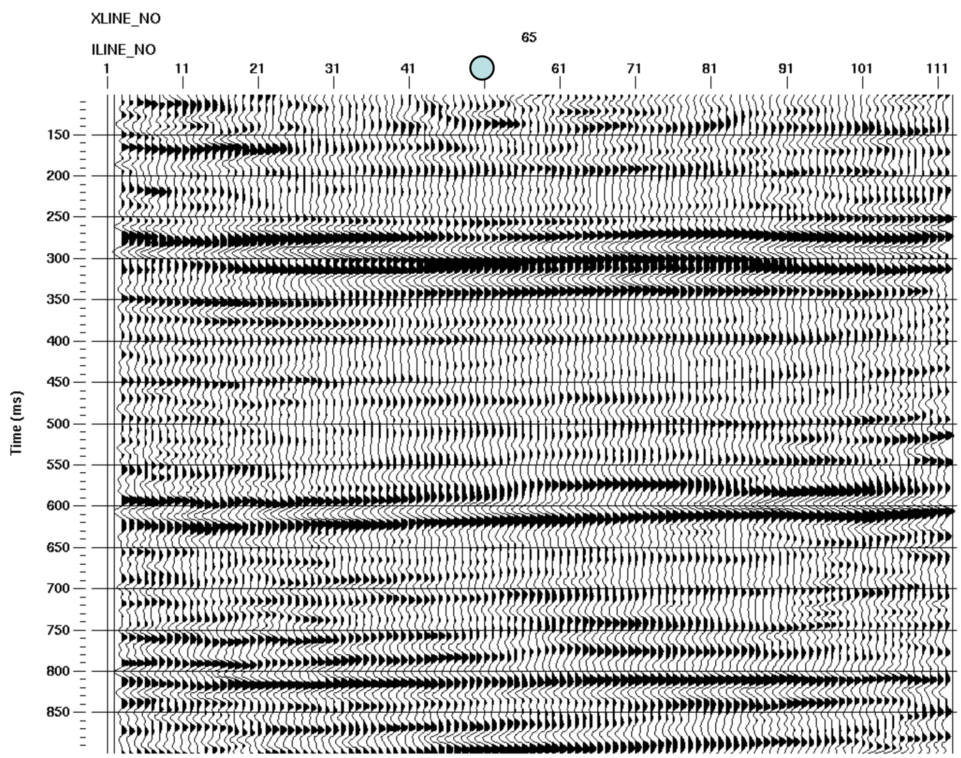


a) b)

FIG. 6. Caption on next page.



c)



d)

FIG. 6. Migrated inline sections 51 (a) and 52 (b) and crossline sections 65 (c) and 66 (d).

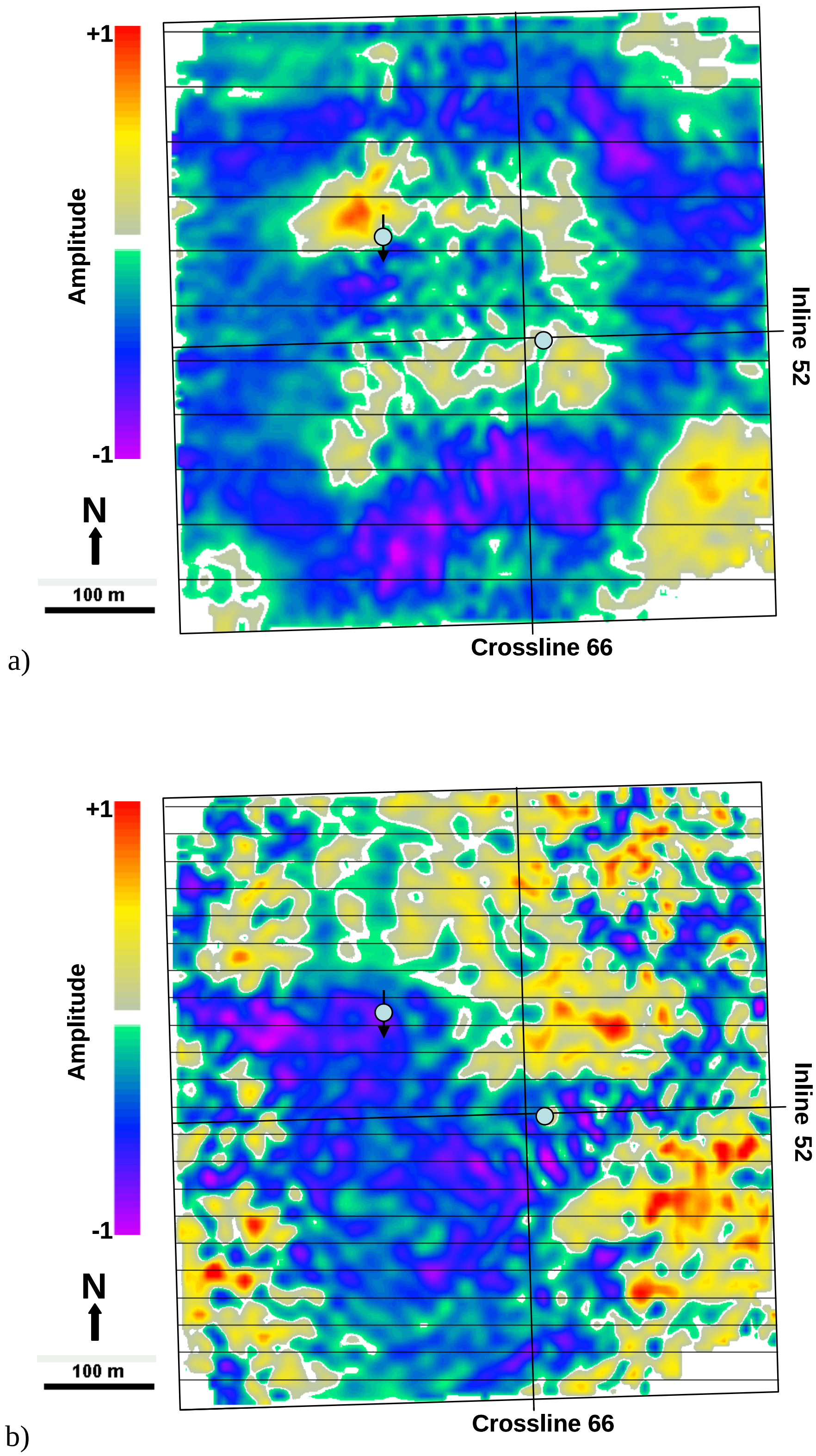


FIG. 7. The amplitude distribution at time of 262 ms is shown in (a); at 457 ms is shown in (b).

DISCUSSION

Processing results from Sensor Geophysical and further discussion and analysis of this dataset can be found in McCrank (2007).

FUTURE WORK

We plan to process the 3C data, either as a single receiver line 3D, or as a sparse 2D, possibly combined with the 3C-2D data which was acquired in March 2007.

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REFERENCES

Bertram, M.B., Lawton, D.C., Gallant, E.V., Stewart, R.R., New seismic reflection and other geophysical equipment available to CREWES: CREWES Research Report **17**.

Lu, H., and Margrave, G.F., 1998, Reprocessing the Blackfoot 3C-3D seismic data: CREWES Research Report, **10**.

McCrank, J., Lawton, D.C., 2007, 3D base line time-lapse seismic survey of an ECBM and carbon sequestration project: CREWES Research Report, **19**.

McCrank, J., Lu, H., Hall, K.W., Lawton, D.C., 2006, Well log study and seismic survey of a coal-bed methane site: Alder Flats, Alberta: CREWES Research Report, **18**.