Hoadley Flowback Microseismic Experiment (HFME)

By

Jubran Akram and David W. Eaton

Department of Geoscience, University of Calgary, Alberta, Canada

Short name: HFME-2012

Assembled Dataset Number: 21-005

Temporary Network Code: X3

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1. Introduction

The Hoadley field is a giant gas-condensate field, which was discovered in 1977 in central Alberta, Canada. The Glauconitic Formation of the Lower Cretaceous Upper Mannville Group is considered the main reservoir of this field that contains shallow-marine sandstone deposits, formed as an extensive northeast-southwest orienting barrier-bar complex and which cover an area of approximately 4000 km^2. Within the Hoadley shoreface complex, Lower Glauconite sands were deposited during the southward marine transgression of the Clear-water Sea during Early Cretaceous time whereas the Upper Glauconite sands were deposited during the subsequent retreat of the Clearwater Sea (Rafiq *et al.* 2016). Figure 1 shows the location of Hoadley barrier bar in south Central Alberta Canada.

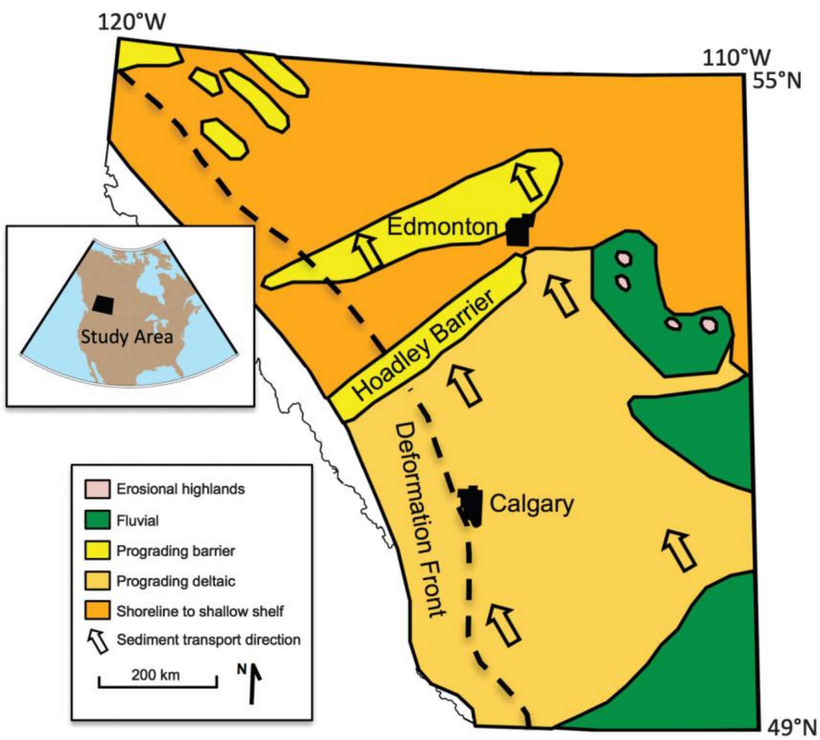

Figure 1: Hoadley barrier bar in south Central Alberta, Canada (from Rafiq et al. 2016).

In 2012, Hoadley Flowback Microseismic Experiment (HFME) was carried out to acquire continuous downhole microseismic data during and after an open-hole multi-stage hydraulic fracture treatment in two horizontal wells (1-18-43-2W5, 4-18-43-2W5) in the Glauconite zone of the Hoadley field (Eaton et al., 2014). In this open-hole completion setup, injection was isolated by packers into 12 distinct sections or stages for each of the treatment wells. A retrievable array of 12 receiver levels (15 Hz triaxial geophones) was placed in a nearby vertical well (6-18-43-2W5) to monitor this 24-stage hydraulic fracture treatment. The interpod spacing for the bottom 8 levels in the receiver array was 15.25 m, whereas it was 30.5 m for the top 4 levels. The coupling between geophone pods and wellbore steel well casing was achieved using magnets. The waveform data were recorded at a sampling rate of 4000 Hz. Figure 2 shows the HFME survey geometry.

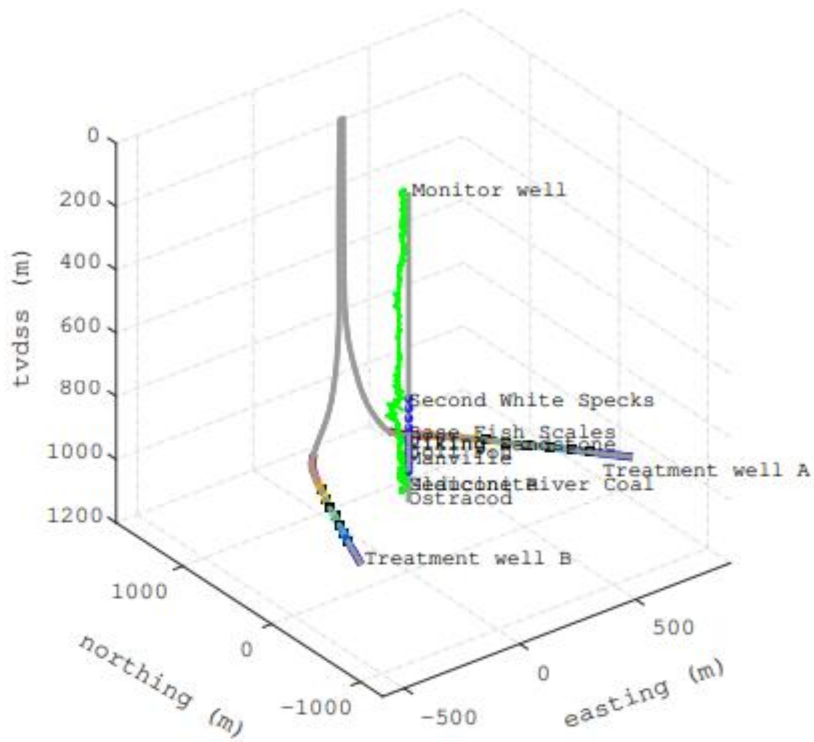

Figure 2: Survey geometry for the Hoadley Flowback Microseismic Experiment (HFME). Treatment well A is 1-18-43-2W5 whereas treatment well B is 4-18-43-2W5 (from Akram et al. 2018).

Acquisition of the microseismic survey was carried out in partnership with ESG Solutions, who also provided an initial analysis of the microseismic activity. Later, this dataset was re-analyzed and interpreted by numerous researchers at the University of Calgary and University of Alberta (e.g., Caffagni and Eaton, 2014; Eaton *et al.* 2014; Caffagni *et al.* 2015; Caffagni *et al.* 2016; Jones *et al.* 2016; Rafiq *et al.* 2016; Akram *et al.* 2018). Any publications that make use of this dataset are asked to acknowledge the University of Calgary and IRIS and should cite the following primary publication:

Eaton, D. W., E. Caffagni, A. Rafiq, M. van der Baan, and V. Roche, 2014, Passive seismic monitoring and integrated geomechanical analysis of a tight-sand reservoir during hydraulic-fracture treatment, flowback and production: Presented at the Unconventional Resources Technology Conference, August 2014. doi.org/10.15530/urtec-2014-1929223.

The current report explains the SEGY dataset and provides supplementary information for the HFME survey, that is being shared on the IRIS website for public access, courtesy of the University of Calgary (contact, Prof. Dr. David W. Eaton, eatond@ucalgary.ca).

2. Data details

The available data are described below.

SEGY data

The raw passive seismic data are in SEGY format (Barry et al., 1975) and contain the three-component waveform recordings from the hydraulic fracture monitoring for the period of three days (September 18-20, 2012). In total, there are 36,363 files, each containing 20,001 waveform samples. Other relevant and useful information about the waveform recordings is stored in the SEGY headers. Figure 3 shows the microseismic event epicentral distribution map from previous processing of this dataset (Eaton et al., 2014).

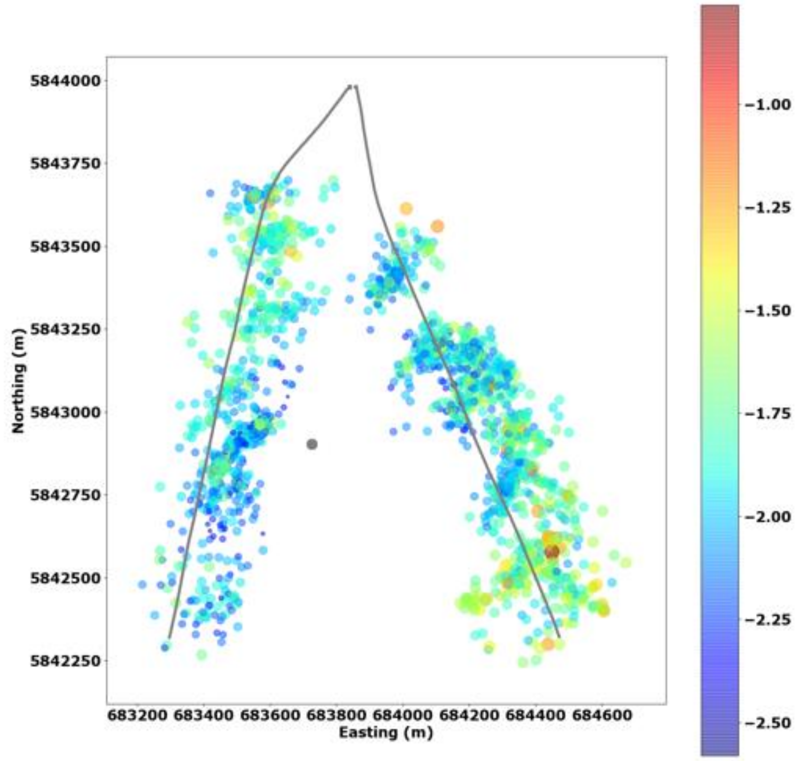

Figure 3: Event location map from one of the processing results. The color bar represents the estimated event magnitudes.

Receiver data

Table 1 gives the receiver depths and orientation of each receiver component (measured clockwise from north). The receiver depths are also stored in the SEGY headers. The receiver orientations were computed by ESG solutions, using the calibration shots in the treatment well. The vertical monitoring well is located at approximately 52.703492N 114.282659W.

Table 1: Receiver depths and orientations (measured clockwise from north). TVD denotes total vertical depth.

Receiver level	Channel	TVD (m)	Orientation (deg.)
1	1	1606	0.0
	2		38.3
	3		128.3
2	1	1637	0.0
	2		53.0

	3		143.0
3	1	1667	0.0
	2		57.6
	3		147.6
4	1	1698	0.0
	2		332.9
	3		62.9
5	1	1728	0.0
	2		262.8
	3		352.7
6	1	1743	0.0
	2		262.0
	3		351.9
7	1	1759	0.0
	2		255.8
	3		345.7
8	1	1774	0.0
	2		285.2
	3		15.2
9	1	1790	0.0
	2		26.2
	3		116.2
10	1	1804	0.0
	2		52.9
	3		142.9
11	1	1820	0.0
	2		117.7
	3		207.7
12	1	1835	0.0
	2		65.6
	3		155.6

Velocity model

Table 2 shows a 13- layer 1-D velocity model that was created by ESG solutions, using the 6 ball hits / sleeve openings from the 1-18-43-2W5 well for calibration. For this velocity inversion, sleeve locations were assumed to be in the middle of stage.

Table 2: 1D velocity mode (calibrated).

Depth to Layer Top (m)	V_P (m/s)	V_S (m/s)	Poisson's Ratio
1600	3441	2066	0.22
1615	3725	2117	0.26
1627	3474	1988	0.26
1655	3229	1976	0.2
1705	3337	1692	0.33
1734	3484	1652	0.35
1743	4217	2358	0.27
1766	3196	1337	0.39
1785	3783	2496	0.11
1865	2457	1140	0.36
1870	4157	2539	0.2
1900	4479	2649	0.23
1913	4384	2680	0.2

3. Key references

Akram, J., D. W. Eaton, and D. B. Peter, 2018, Advances in downhole microseismic processing: Some examples from the analysis of Hoadley data set: Microseismic Industry Consortium Annual Meeting Report, 1-8.

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