EXHIBIT "4"

ation / Nation Now

Message is mixed on fracking

pponents of hydraulic fracturing or hold placards during a rally in Lafayette Square, across from the White House. (Mandel Ngan \FP/Getty Images)

y **Neela Banerjee**

ILY 28, 2013, 6:13 AM

WASHINGTON -- One year ago, the Environmental Protection Agency finished testing drinking water in Dimock, Pa., after years of complaints by residents who suspected that nearby natural gas production had fouled their wells. The EPA said that for nearly all the 4 homes whose wells it sampled, the water was safe to drink.

et as the regulator moved to close its investigation, the staff at the mid-Atlantic EPA office in iiladelphia, which had been sampling the Dimock water, argued for continuing the assessment.

ı an internal EPA PowerPoint presentation obtained by the Tribune/Los Angeles Times Washington ureau, staff members warned their superiors that several wells had been contaminated with methane ıd substances such as manganese and arsenic, most likely because of local natural gas production.

ıe presentation, based on data collected over 4 1/2 years at 11 wells around Dimock, concluded that nethane and other gases released during drilling (including air from the drilling) apparently cause significant damage to the water quality." The presentation also concluded that "methane is at significantly higher concentrations in the aquifers after gas drilling and perhaps as a result of fracking [hydraulic fracturing] and other gas well work."

Critics say the decision in July 2012 by EPA headquarters in Washington to curtail its investigation at Dimock over the objection of its on-site staff fits a troubling pattern at a time when the Obama administration has used the sharp increase in natural gas production to rebut claims that it is opposed to fossil fuels.

In March 2012, the EPA closed an investigation of methane in drinking water in Parker County, Texas, although the geologist hired by the regulator confirmed that the methane was from gas production. In late June, the EPA dropped a study of possible contamination of drinking water in Pavillion, Wyo., despite its earlier findings of carcinogens, hydrocarbons and other contaminants in the water.

"We don't know what's going on, but certainly the fact that there's been such a distinct withdrawal from three high-profile cases raises questions about whether the EPA is caving to pressure from industry or antagonistic members of Congress," said Kate Sinding of the Natural Resources Defense Council, an environmental group.

The EPA confirmed the authenticity of the presentation about the Dimock wells but said it was the work of one employee.

"This presentation represents one [on-scene coordinator's] thoughts regarding 12 samples and was not shared with the public because it was a preliminary evaluation that requires additional assessment in order to ascertain its quality and validity," said EPA spokeswoman Alisha Johnson.

"The sampling and an evaluation of the particular circumstances at each home did not indicate levels of contaminants that would give EPA reason to take further action," Johnson said. "Throughout EPA's work in Dimock, the agency used the best available scientific data to provide clarity to Dimock residents and address their concerns about the safety of their drinking water."

At the same time, the energy industry and its congressional allies have hammered the EPA for undertaking the studies, which they say are a pretext for regulatory overreach.

"They have attempted to link fracking to water contamination in at least three cases, only to be forced to retract their statements after further scrutiny proved them to be unfounded," Rep. Lamar Smith (R-Texas), chairman of the House Science Committee, said at a recent hearing.

Robert B. Jackson, professor of environmental sciences at Duke University, who has researched methane contamination in the Dimock area and recently reviewed the presentation, said he was disappointed by the EPA's decision.

"What's surprising is to see this data set and then to see EPA walk away from Dimock," Jackson said. "The issue here is, why wasn't EPA interested in following up on this to understand it better?"

The EPA staff presentation about Dimock was an interim analysis of water sampling data collected by Pennsylvania regulators and, later, by the EPA, from 2008 to June 2012.

The presentation provides charts for nine of the 11 Dimock-area wells, tracking natural gas production work in the area and the concentration of methane and metals over a four- to five-year period, depending on the well. Some wells underwent a "short-term disruption," or a rise in methane in the water six to eight months after nearby gas development activity. Over two or three years, the concentration of methane fell.

Four other wells experienced long-term disruption to their water quality, according to the presentation. In those instances, methane levels did not fall over time but remained high after an initial increase or began to climb after a period of decline. The presence of metals such as manganese and arsenic also rose over time in some of those wells.

A study by Jackson and other Duke scientists published in June indicates that drinking water wells near natural gas production in northeastern Pennsylvania, including Dimock, are at greater risk of methane contamination than those farther away.

Methane is the primary component in natural gas. In enclosed spaces, such as sheds and basements, it poses the risk of asphyxiation and explosion. There is little research into the long-term effects on human health from prolonged exposure to methane in drinking water.

Scientists and regulators say that when methane ends up in well water, it is usually because of faulty metal casings inside a natural gas well that allow methane to seep out as it travels to the surface or shoddy concrete work that is supposed to keep gas and water from moving into the space between the well casings and the rock.

Though EPA officials concluded that Dimock water was safe to drink, the mid-Atlantic EPA office nevertheless asked the Centers for Disease Control and Prevention to evaluate the health risk.

Cabot Oil & Gas Corp., the company drilling in Dimock, asserts that the methane in the water is unrelated to oil and gas development. "Through our investigation, Cabot concluded that methane gas existed in groundwater and water wells in the Dimock and Springville townships long before Cabot began drilling in the area," said Dan O. Dinges, Cabot's chief executive, in a May 29 letter to the Senate Energy and Natural Resources Committee.

Although methane gas occurs naturally in the area's aquifers, the Duke study showed that the chemical "fingerprint" of methane in shallow water wells near the gas sites was the same as the natural gas extracted from deep underground.

The EPA PowerPoint presentation identified five wells contaminated with methane whose chemical fingerprint, or isotopic composition, was the same as methane from the Marcellus shale formation at the center of Pennsylvania's natural gas boom.

Fred Baldassare, a former official at the Pennsylvania Department of Environmental Protection who worked on the state's Dimock studies, disputed the presentation's assertion that some wells contained Marcellus methane. Now a consultant for industry and homeowners, Baldassare said there was not enough information about the composition of the methane in the wells to draw conclusions about the origin. "It's dangerous and inappropriate to interpret this data in a vacuum," he said.

Jackson disagreed, arguing that the methane found does not naturally occur in drinking water. "The burden of proof is different here," he said. "The question we're asking is, 'Was there enough evidence to warrant further study?' The EPA scientist clearly thought so."

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This article is related to: Conservation, Environmental Issues, U.S. Environmental Protection Agency, Natural Gas, Energy Resources, Science, Environmental Politics

Isotech - Stable Isotope Analysis

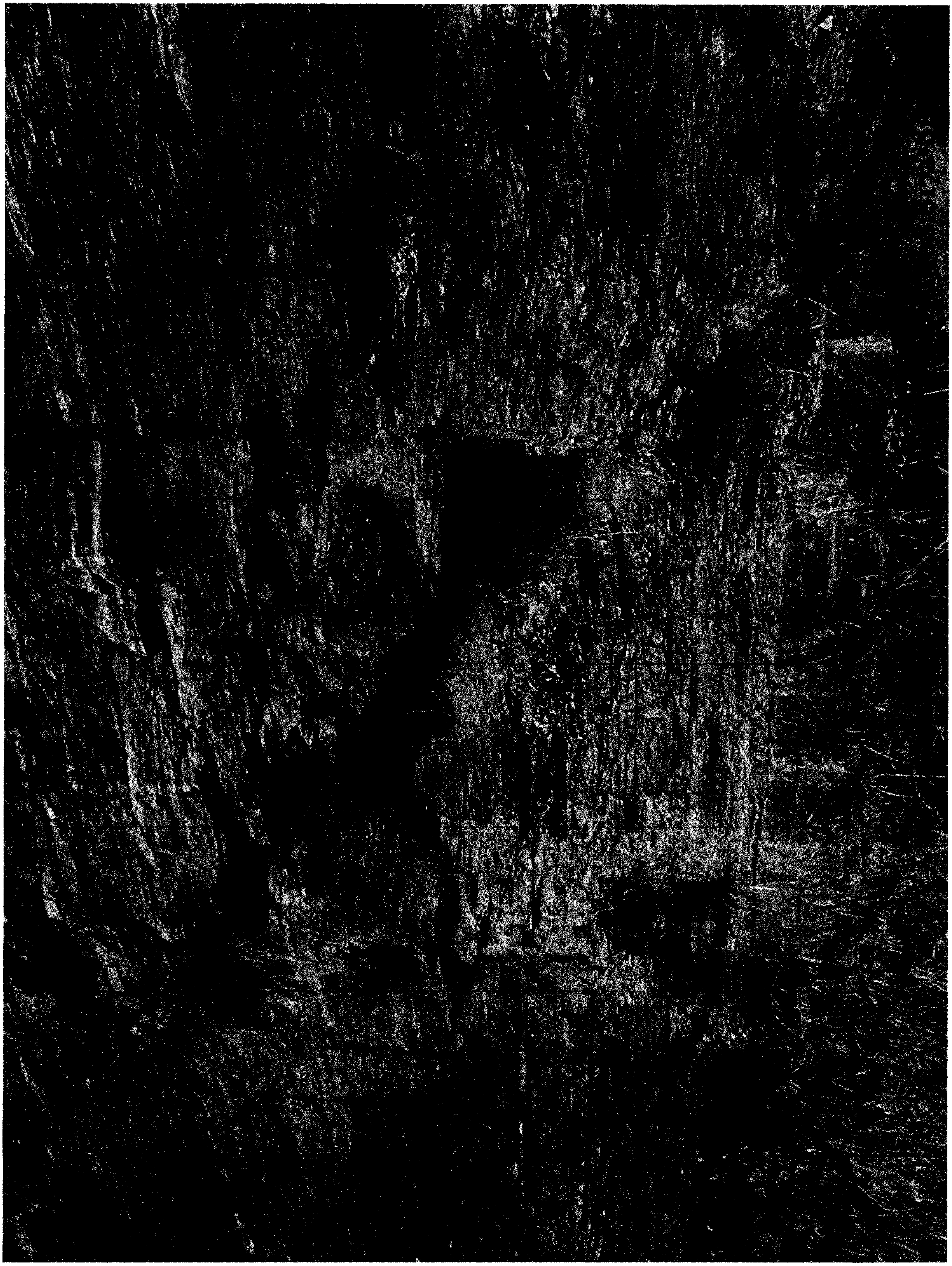
Determining the origin of methane and its effect on the aquifer.

Agenda

- Geologic history
- Methane characteristics
- The ratio of carbon isotopes in methane.
- The unique ratio of hydrocarbons in the Marcellus Formation
- Identifying the age of the methane.
- The effects methane and drilling have on the aquifer and trend over time.
- Conclusions.

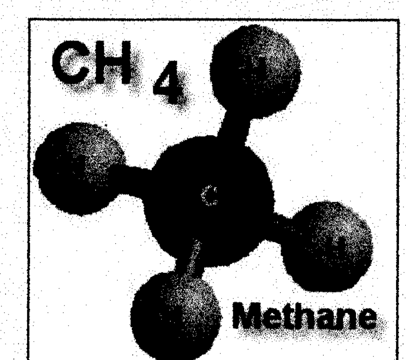
Environment of Deposition

Middle Devonian (385 MA)



Methane is the principal hydrocarbon detected in all stray natural gas migration incidents

- Exposure limit (gas phase): TLV-TWA: 1,000 ppm (ACGIH, 10/2009)
- Methane (CH_4) is the simplest paraffin hydrocarbon gas
- Methane is generated by microbial & thermogenic processes
- Flammable, colorless, odorless.
- Specific gravity: 0.555 (NTP) air = 1
- Explosive range: 5-15% in ambient air
- Solubility in water: 26-32 mg/l (1 atm.)
- Non toxic, no ingestion hazard
- Simple asphyxiant, explosion hazard



Methane can migrate as free gas or dissolved in the groundwater

Delta notation

- So by collecting numerous gas samples of known origin a database has been developed and fingerprinting of gas samples may performed.

$R_{reference}$= VPDB (Vienna Pee Dee Belemnite)

$$\delta^{13}C = \delta\left({}^{13}C\right) = \delta\left({}^{13}C/{}^{12}C\right) = \frac{n_X\left({}^{13}C\right)/n_X\left({}^{12}C\right) - n_{ref}\left({}^{13}C\right)/n_{ref}\left({}^{12}C\right)}{n_{ref}\left({}^{13}C\right)/n_{ref}\left({}^{12}C\right)}$$

Shale Gas

- Increasing formation temperature leads to diagnostic

The normal sequence of carbon isotopic compositions is:

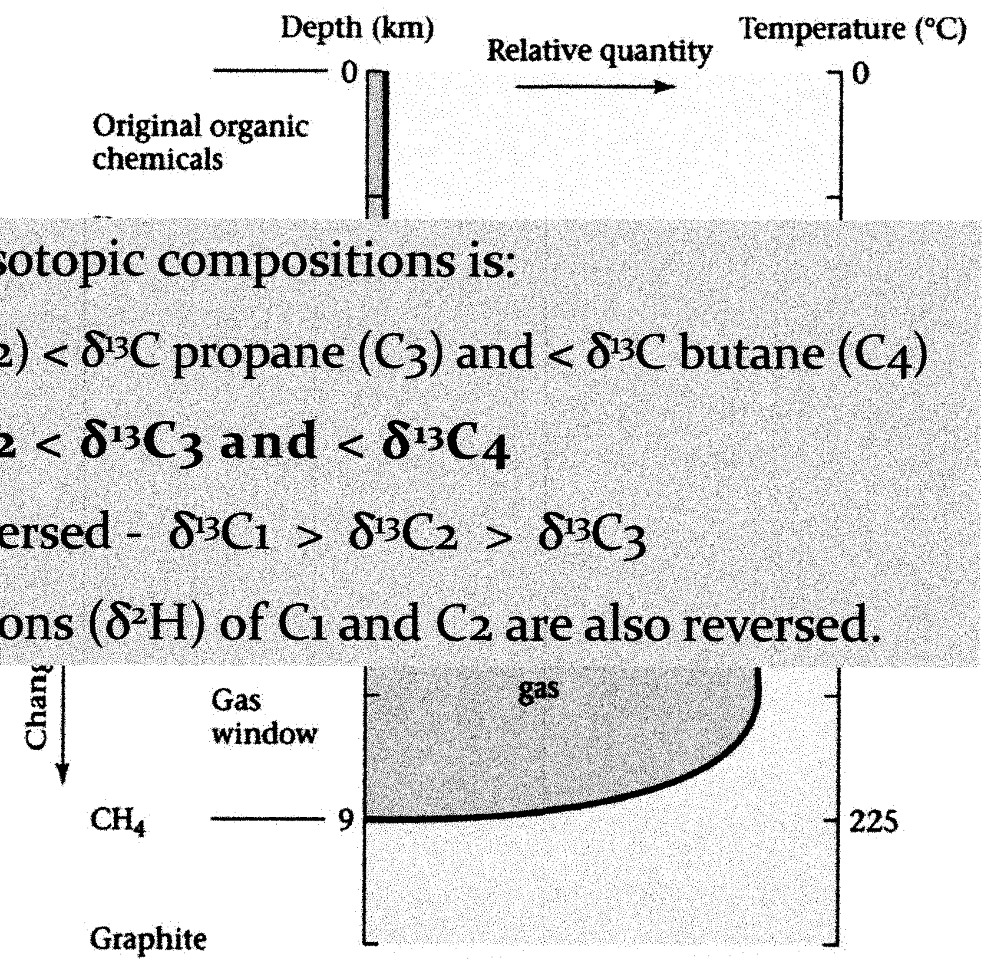
$\delta^{13}C$ methane (C_1) < $\delta^{13}C$ ethane (C_2) < $\delta^{13}C$ propane (C_3) and < $\delta^{13}C$ butane (C_4)

$$\delta^{13}C_1 < \delta^{13}C_2 < \delta^{13}C_3 \text{ and } < \delta^{13}C_4$$

In the Marcellus they are fully reversed - $\delta^{13}C_1 > \delta^{13}C_2 > \delta^{13}C_3$

Also hydrogen isotopic compositions (δ^2H) of C_1 and C_2 are also reversed.

- Uniquely identifiable when paired with additional proxies (e.g. noble gases)



Isotope Geochemistry

- ☐ Molecular: Methane/Ethane
- ☐ Isotopic: Carbon and Hydrogen isotopes ($\delta^{13}C$-CH_4, $\delta^{2}H$-CH_4, $\delta^{13}C$-C_2H_6)
- ☐ Noble Gases

Easily Distinguishes:

- ☑ Biogenic vs. Thermogenic
  (e.g. Schoell, 1983; Coleman et al, 1991; Baldassare and Laughrey, 1998)
- ☑ Distinguishing different thermogenic gases
  (e.g. Schoell et al, 1983; Jenden et al, 1993; Revesz et al, 2010; Tilley et al, 2010)
- ? What's best for distinguishing thermally mature gases?

ISOTECH

ANALYSIS REPORT

Lab #:	235488	Job #:	17407
Sample Name/Number:	HW02z		
Company:	TechLaw, Inc.		
Date Sampled:	1/25/2012		
Container:	Dissolved Gas Bottle		
Field/Site Name:	A3TA		
Location:			
Formation/Depth:			
Sampling Point:			
Date Received:	2/03/2012	Date Reported:	2/20/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰
Carbon Monoxide	nd			
Hydrogen Sulfide	na			
Helium	0.0112			
Hydrogen	nd			
Argon	0.628			
Oxygen	0.80			
Nitrogen	40.72			
Carbon Dioxide	0.094			
Methane	57.06	-29.30	-160.6	
Ethane	0.687			
Ethylene	nd			
Propane	nd			
Propylene	0.0001			
Iso-butane	nd			
N-butane	nd			
Iso-pentane	nd			
N-pentane	nd			
Hexanes +	nd			
Water			-64.6	-9.66

Total BTU/cu.ft. dry @ 60deg F & 14.7psia, calculated: 590

Specific gravity, calculated: 0.736

% argon

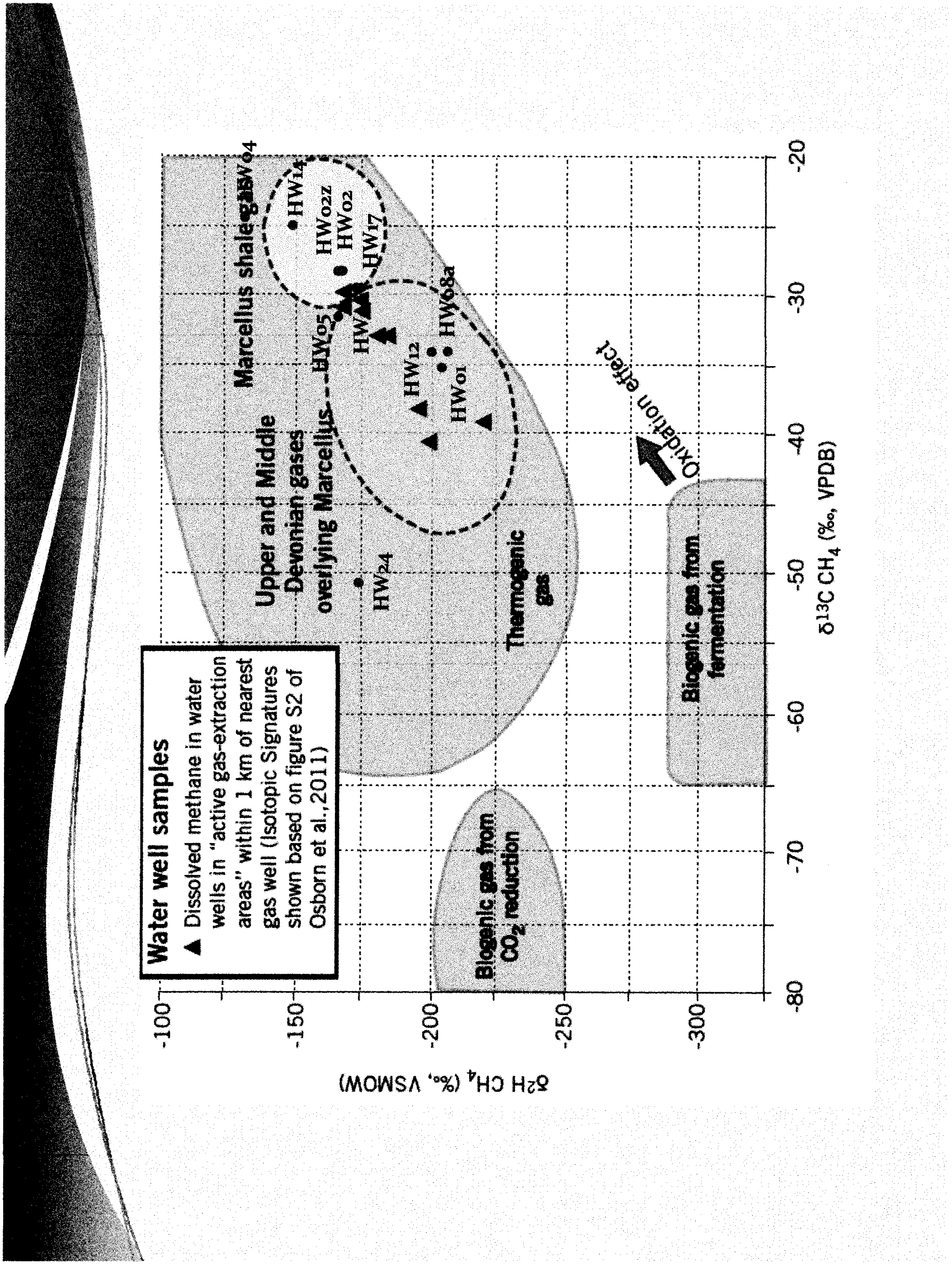
% nitrogen

^{13}C fractionation

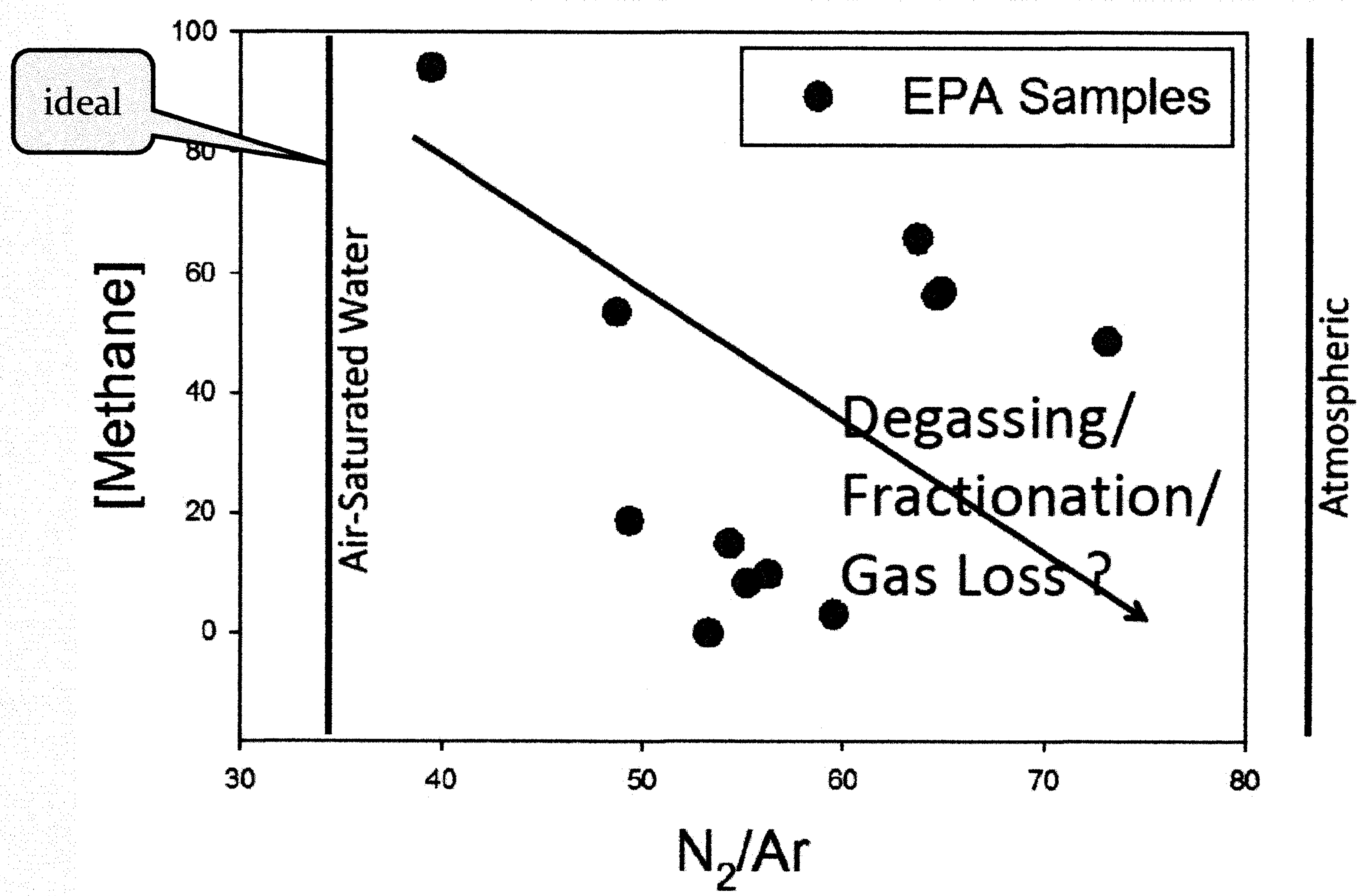
^{2}H fractionation

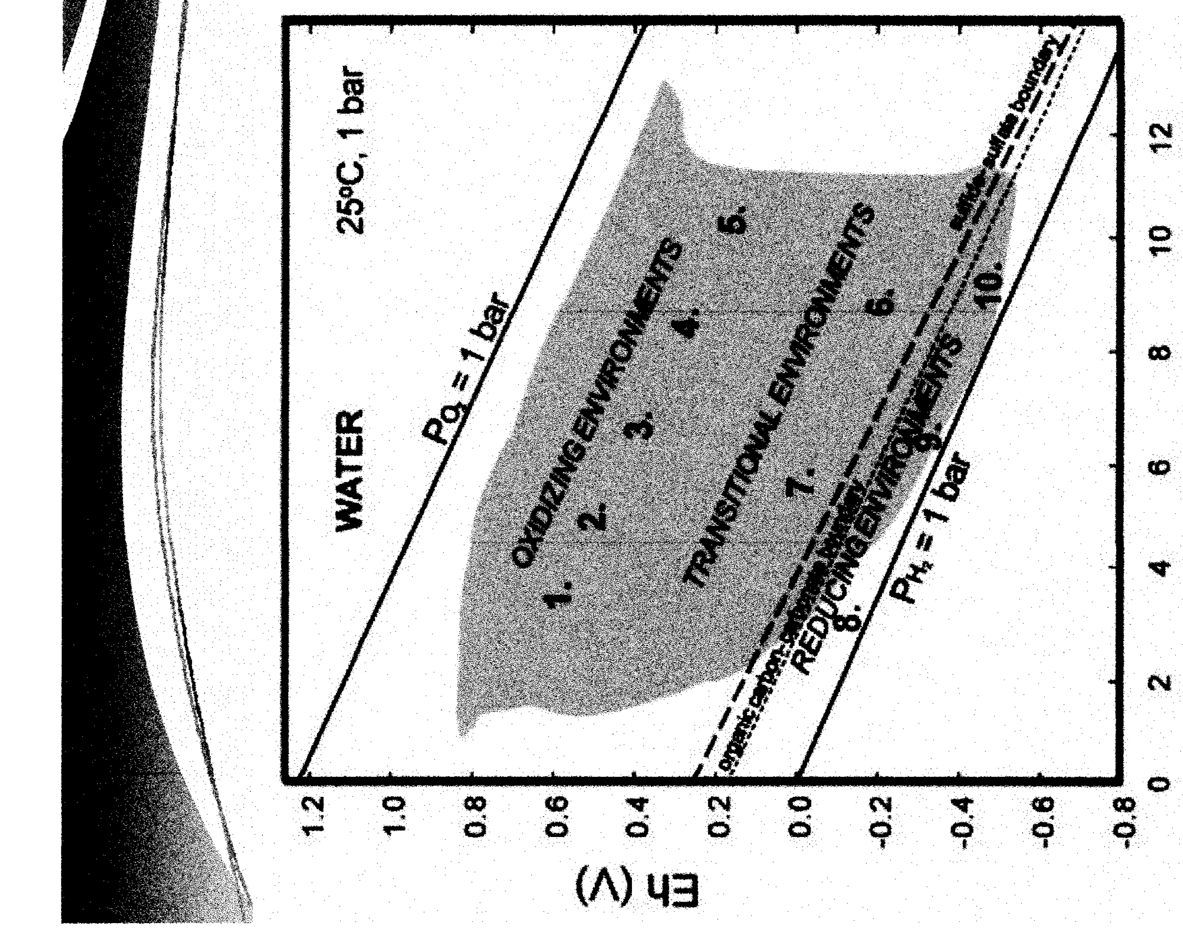
-29

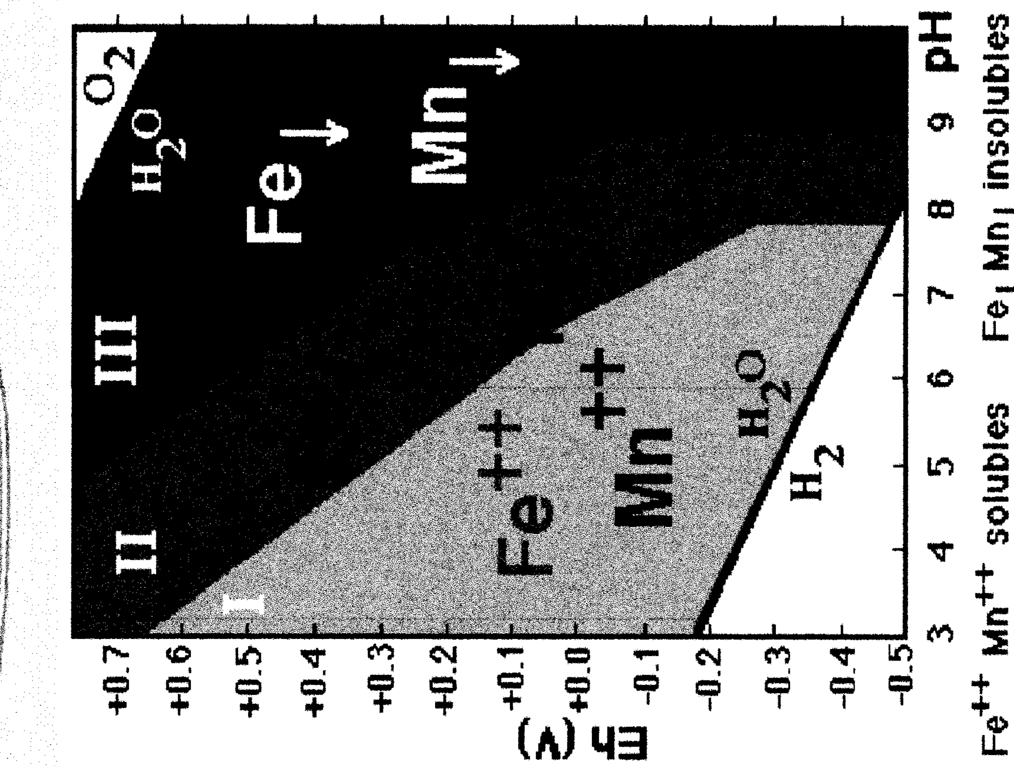
-160


Water well samples
▲ Dissolved methane in water wells in "active gas-extraction areas" within 1 km of nearest gas well (Isotopic Signatures shown based on figure S2 of Osborn et al., 2011)
Marcellus shale gas
Upper and Middle Devonian gases overlying Marcellus
Thermogenic gas
Biogenic gas from fermentation
Biogenic gas from CO2 reduction
Oxidation effect
HW04
HW14
HW02Z
HW02
HW17
HW05
HW68a
HW12
HW01
HW24
δ2H CH4 (‰, VSMOW)
δ13C CH4 (‰, VPDB)
-100
-150
-200
-250
-300
-80
-70
-60
-50
-40
-30
-20

Sample Quality - degassing?



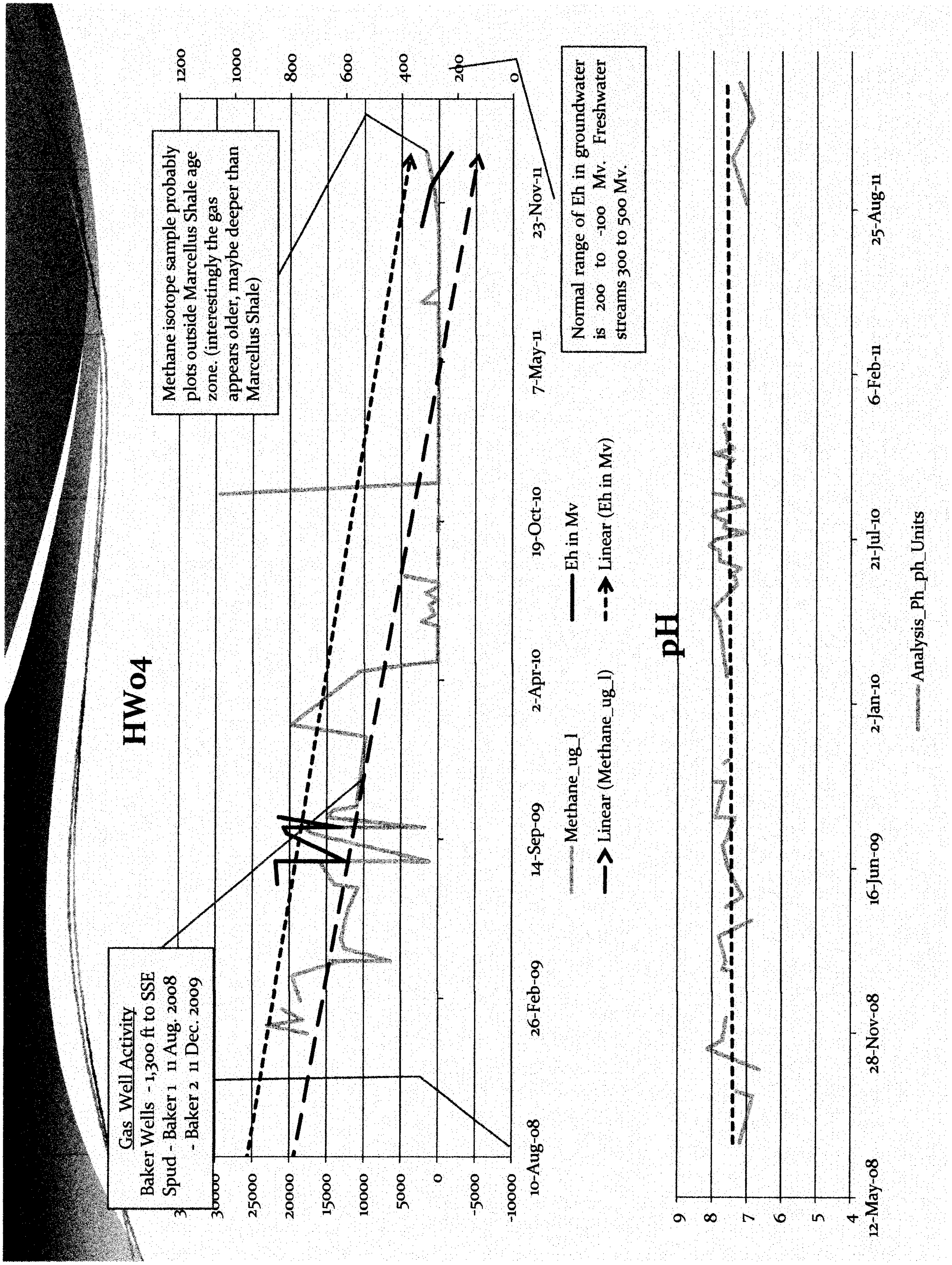

WATER
25ºC, 1 bar
P_{O_2} = 1 bar
OXIDIZING ENVIRONMENTS
TRANSITIONAL ENVIRONMENTS
REDUCING ENVIRONMENTS
organic carbon-carbonate boundary
sulfide-sulfate boundary
P_{H_2} = 1 bar
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
Eh (V)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
pH

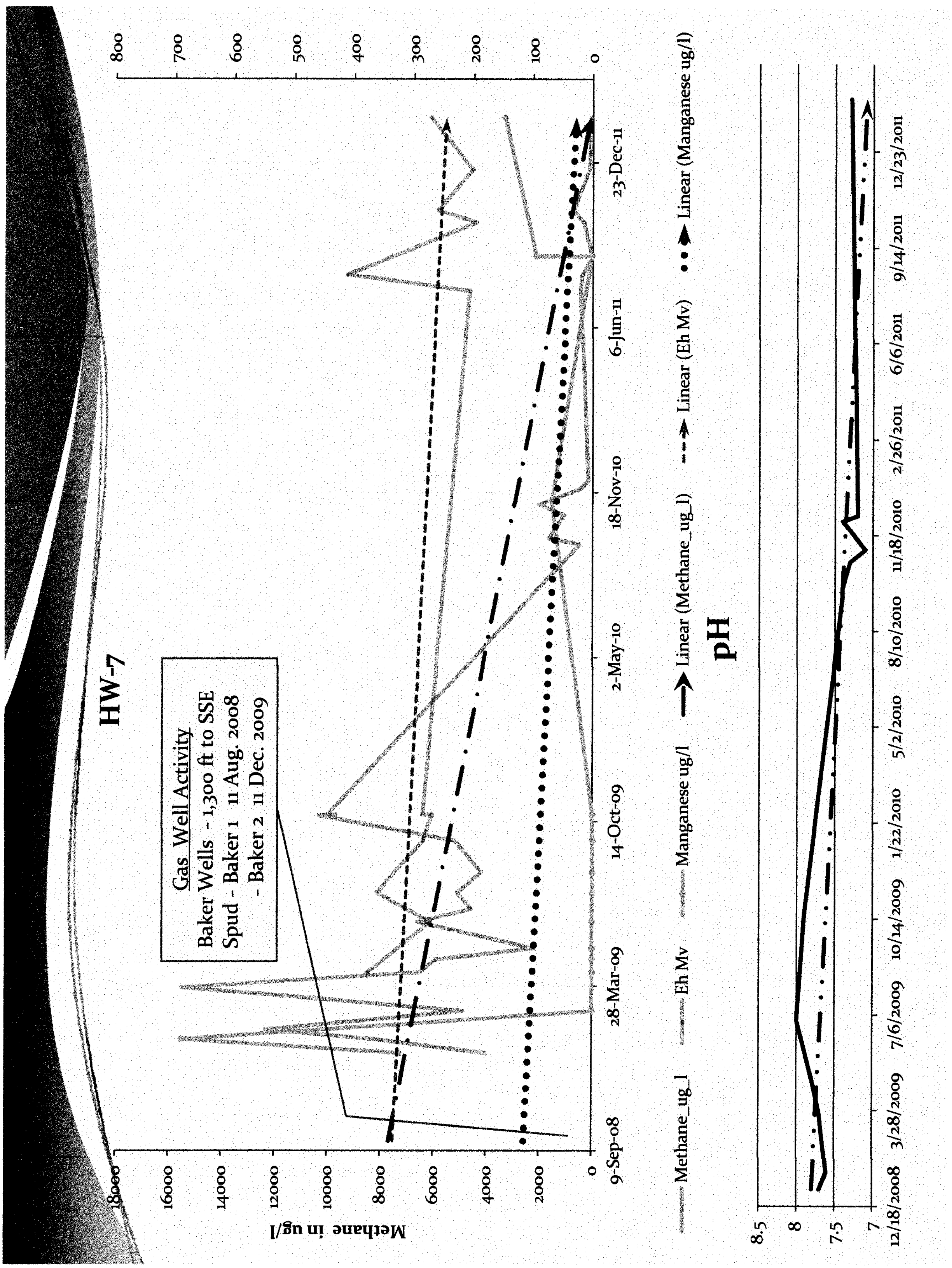

I
II
III
O_2
H_2O
Fe↓
Mn↓
Fe^{++}
Mn^{++}
H_2O
H_2
Eh (V)
+0.7
+0.6
+0.5
+0.4
+0.3
+0.2
+0.1
+0.0
-0.1
-0.2
-0.3
-0.4
-0.5
3
4
5
6
7
8
9
pH
Fe^{++} Mn^{++} solubles
Fe↓ Mn↓ insolubles

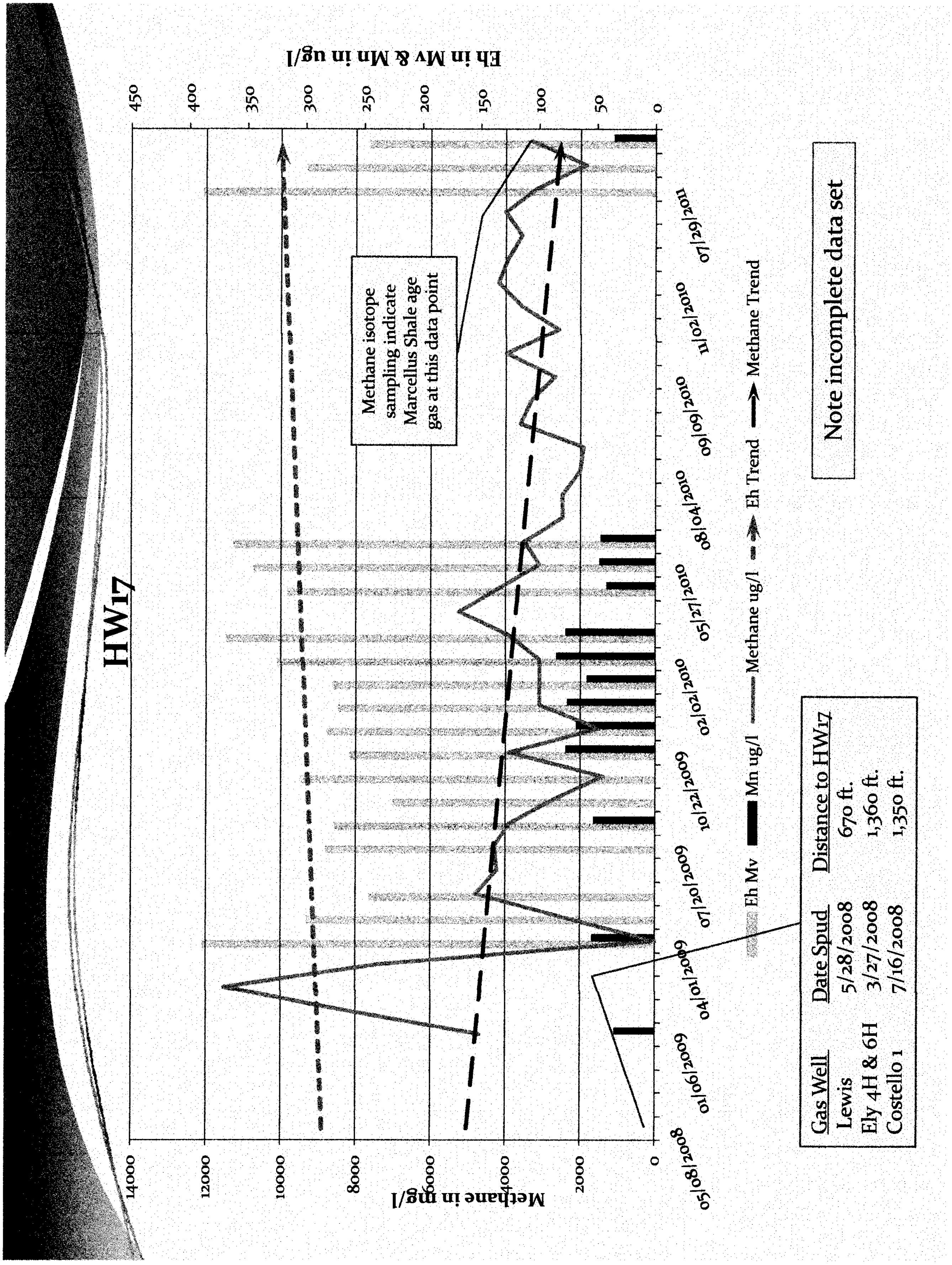
Three Patterns of Contamination

1. **Short term** (< 1 year) disruption to the aquifer caused by drilling.
2. **Long term** (> 3-4 year) disruption or contamination of the aquifer caused by drilling/fracking, releases or other situations.
3. **Natural Background Conditions** with high levels of metals and anions.

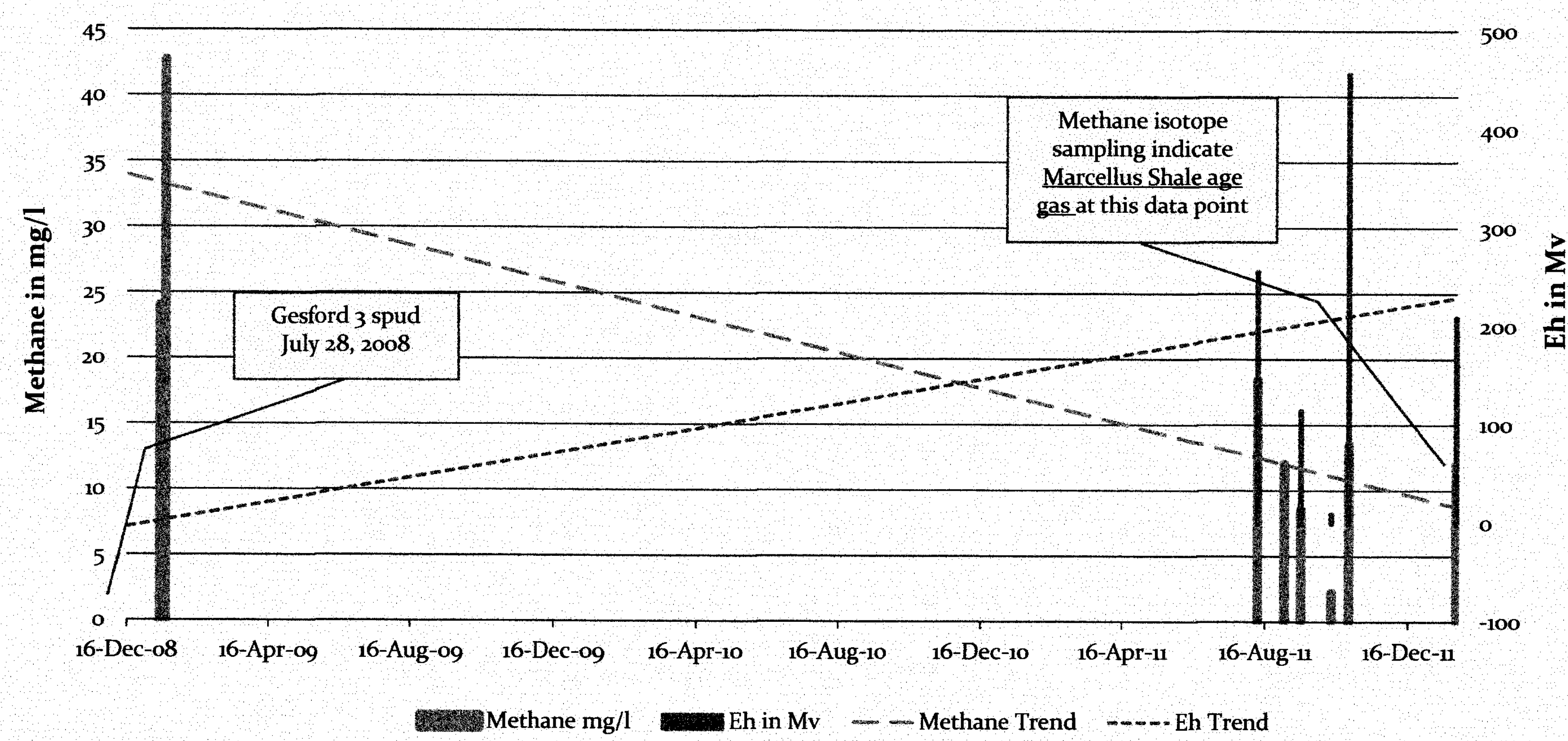
Type 1: Short Term Disruption


HW04
Gas Well Activity
Baker Wells - 1,300 ft to SSE
Spud - Baker 1 11 Aug. 2008
- Baker 2 11 Dec. 2009
Methane isotope sample probably plots outside Marcellus Shale age zone. (interestingly the gas appears older, maybe deeper than Marcellus Shale)
Normal range of Eh in groundwater is 200 to -100 Mv. Freshwater streams 300 to 500 Mv.
30000
25000
20000
15000
10000
5000
0
-5000
-10000
1200
1000
800
600
400
200
0
10-Aug-08
26-Feb-09
14-Sep-09
2-Apr-10
19-Oct-10
7-May-11
23-Nov-11
Methane_ug_l
Eh in Mv
Linear (Methane_ug_l)
Linear (Eh in Mv)
pH
9
8
7
6
5
4
12-May-08
28-Nov-08
16-Jun-09
2-Jan-10
21-Jul-10
6-Feb-11
25-Aug-11
Analysis_Ph_ph_Units


HW-7
Gas Well Activity
Baker Wells - 1,300 ft to SSE
Spud - Baker 1 11 Aug. 2008
- Baker 2 11 Dec. 2009
Methane in ug/l
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
800
700
600
500
400
300
200
100
0
9-Sep-08
28-Mar-09
14-Oct-09
2-May-10
18-Nov-10
6-Jun-11
23-Dec-11
Methane_ug_l
Eh Mv
Manganese ug/l
Linear (Methane_ug_l)
Linear (Eh Mv)
Linear (Manganese ug/l)
pH
8.5
8
7.5
7
12/18/2008
3/28/2009
7/6/2009
10/14/2009
1/22/2010
5/2/2010
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011

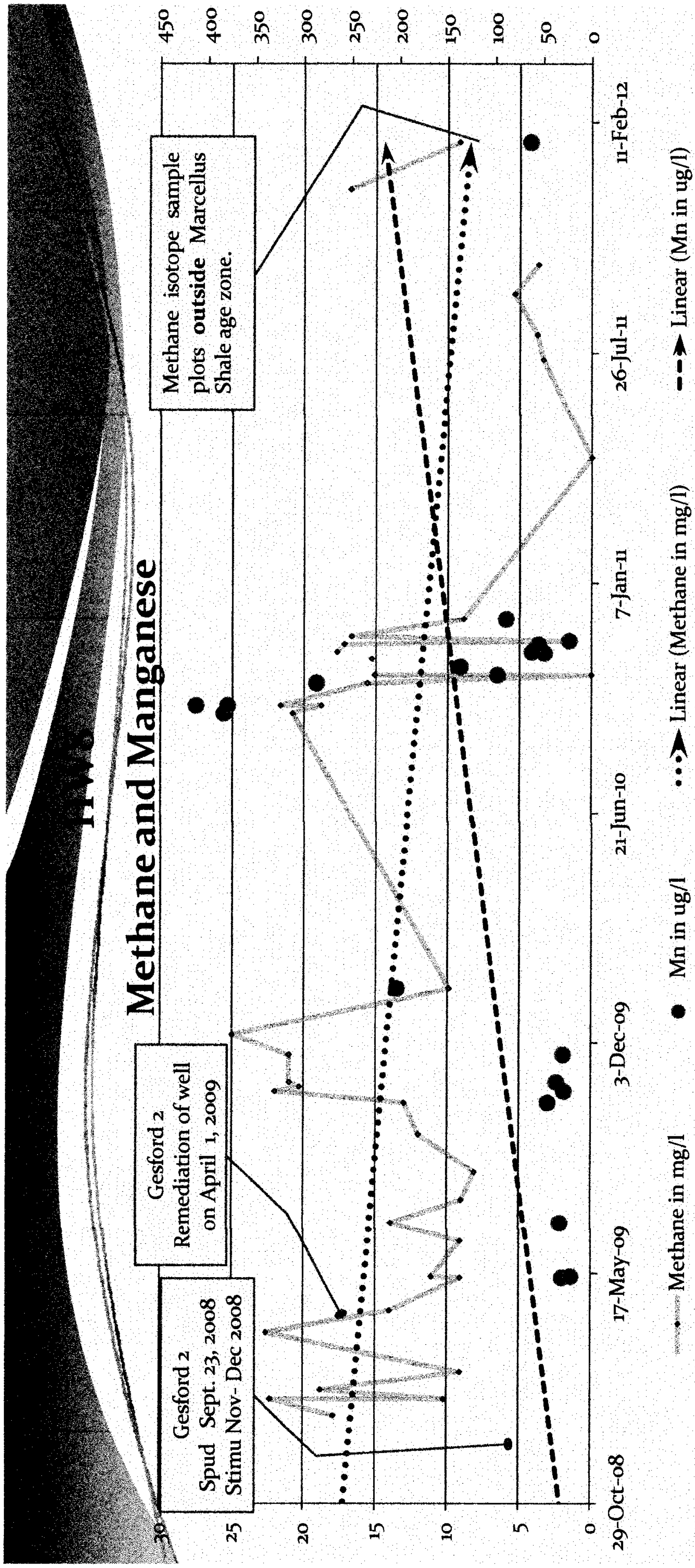

HW17
Eh in Mv & Mn in ug/l
Methane in mg/l
Methane isotope sampling indicate Marcellus Shale age gas at this data point
Eh Mv
Mn ug/l
Methane ug/l
Eh Trend
Methane Trend
Note incomplete data set
Gas Well | Date Spud | Distance to HW17
Lewis | 5/28/2008 | 670 ft.
Ely 4H & 6H | 3/27/2008 | 1,360 ft.
Costello 1 | 7/16/2008 | 1,350 ft.
05/08/2008
01/06/2009
04/01/2009
07/20/2009
10/22/2009
02/02/2010
05/27/2010
08/04/2010
09/09/2010
11/02/2010
07/29/2011

HW1 - Hubert

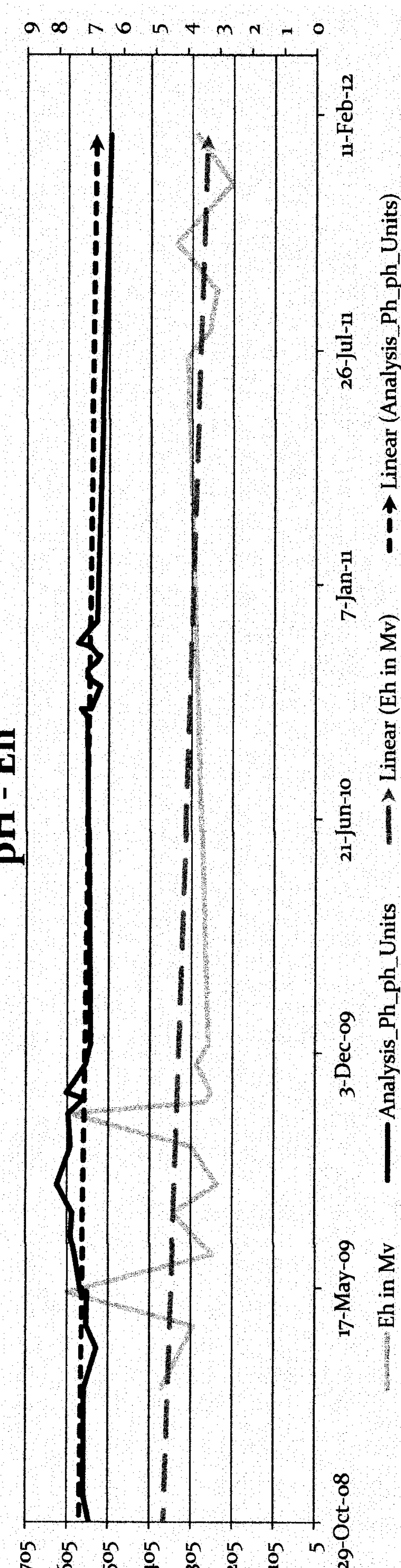


HW1 lacked data for nearly all constituents, particularly for the years 2009-2010

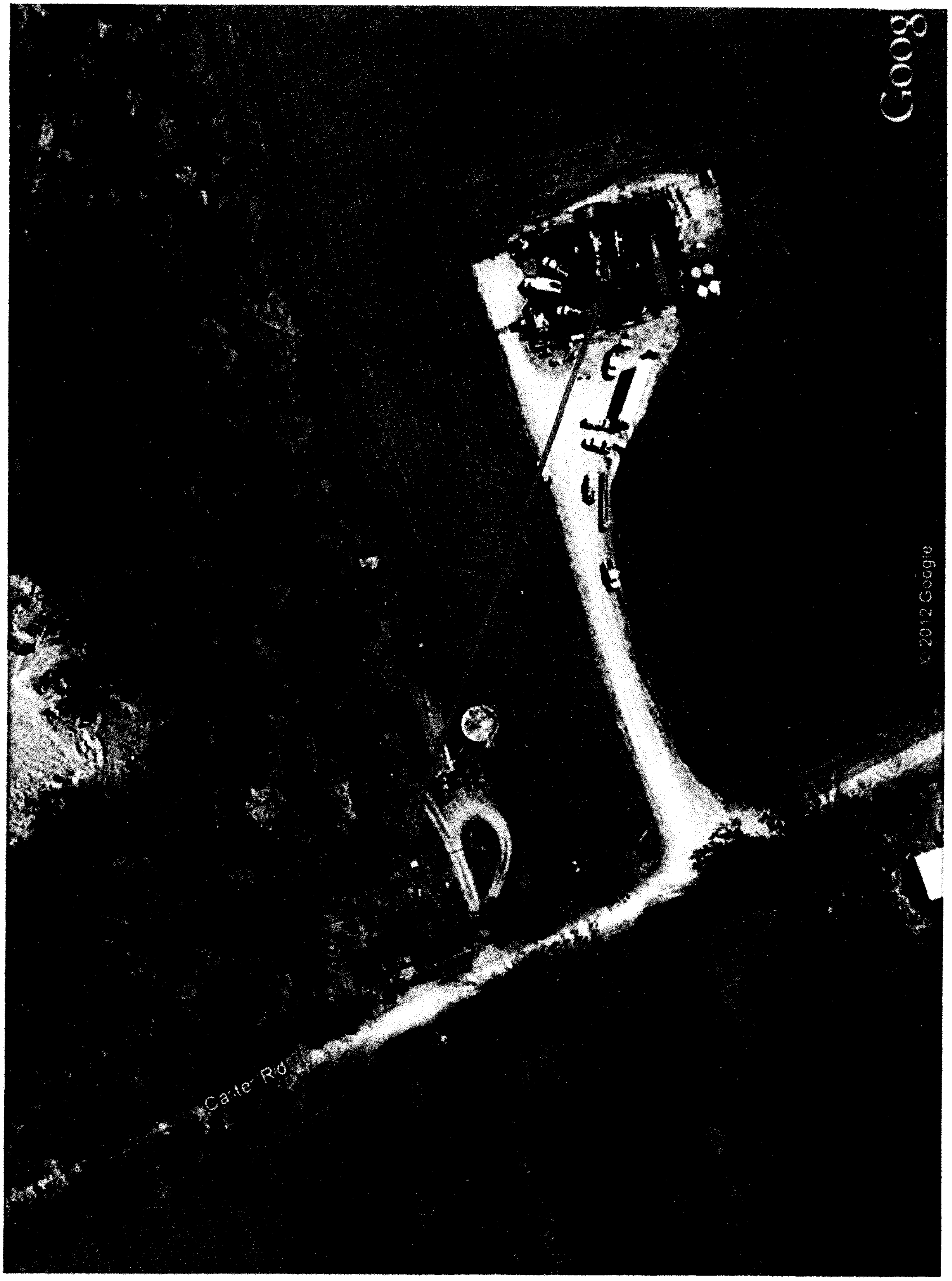
Type 2: Long Term Disruption



Methane and Manganese
Gesford 2
Spud Sept. 23, 2008
Stimu Nov - Dec 2008
Gesford 2
Remediation of well
on April 1, 2009
Methane isotope sample
plots outside Marcellus
Shale age zone.
29-Oct-08
17-May-09
3-Dec-09
21-Jun-10
7-Jan-11
26-Jul-11
11-Feb-12
Methane in mg/l
Mn in ug/l
Linear (Methane in mg/l)
Linear (Mn in ug/l)

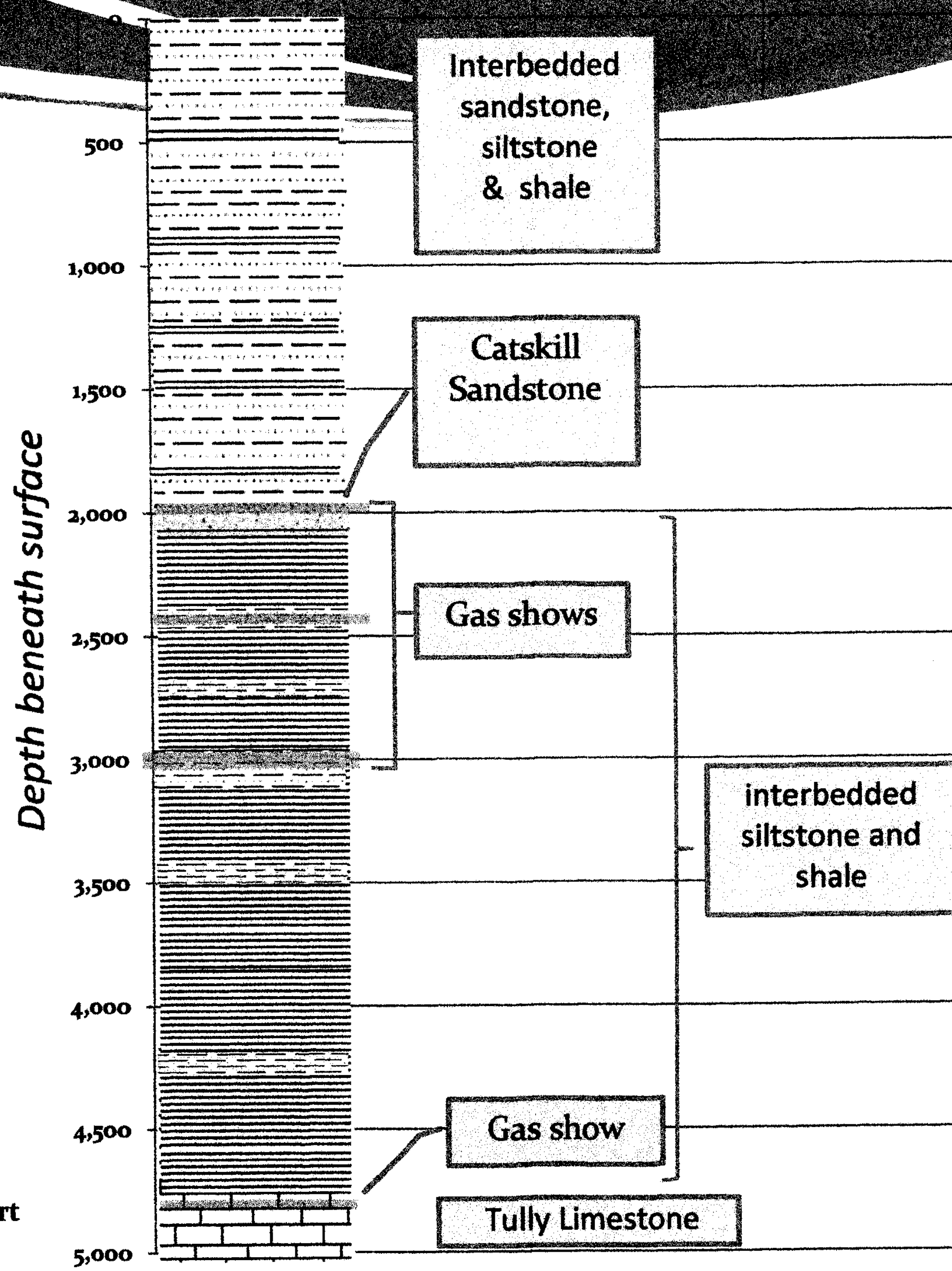


pH - Eh
29-Oct-08
17-May-09
3-Dec-09
21-Jun-10
7-Jan-11
26-Jul-11
11-Feb-12
Eh in Mv
Analysis_Ph_ph_Units
Linear (Eh in Mv)
Linear (Analysis_Ph_ph_Units)

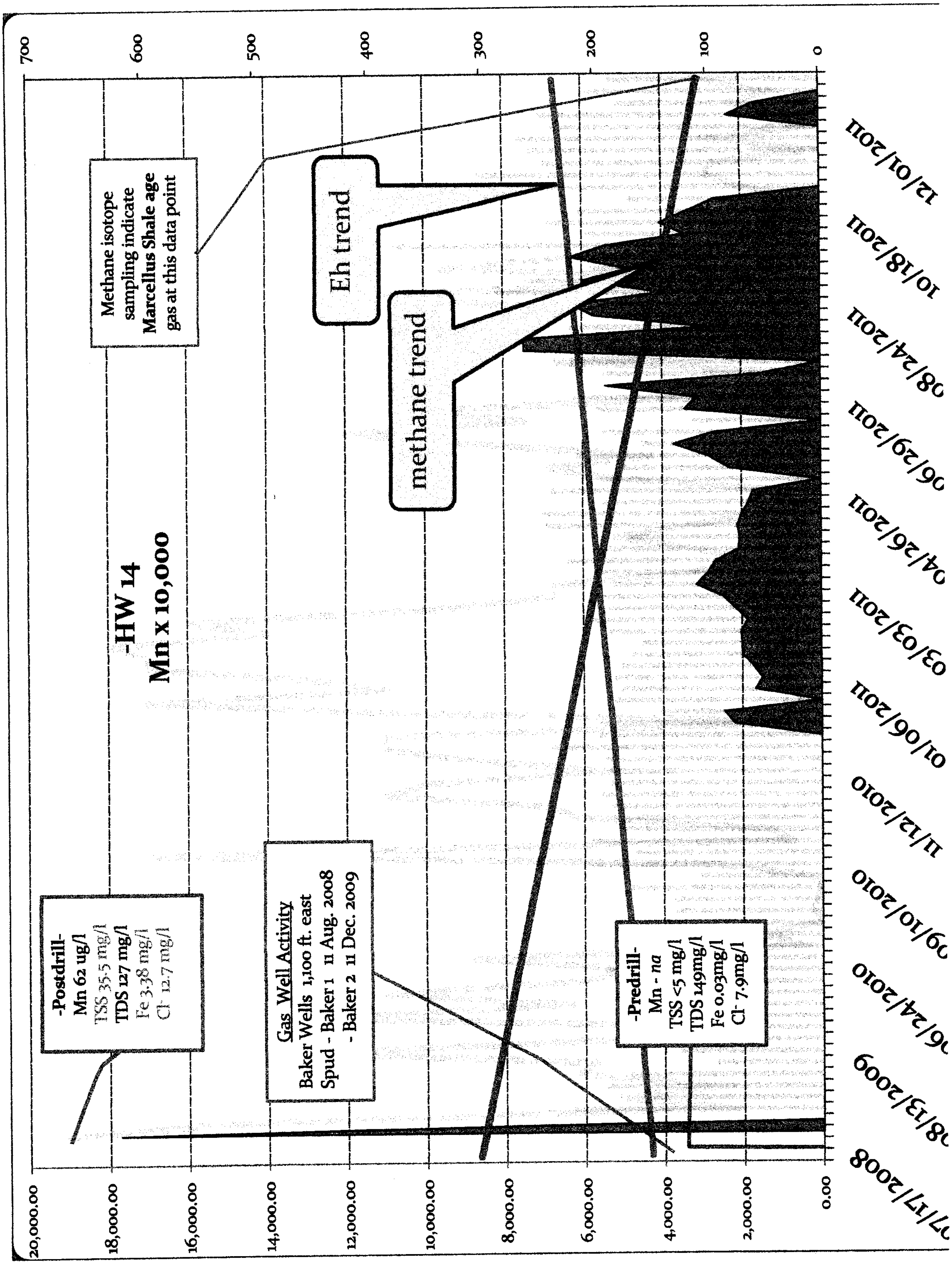

Carter Rd
© 2012 Google

Gas is Gas

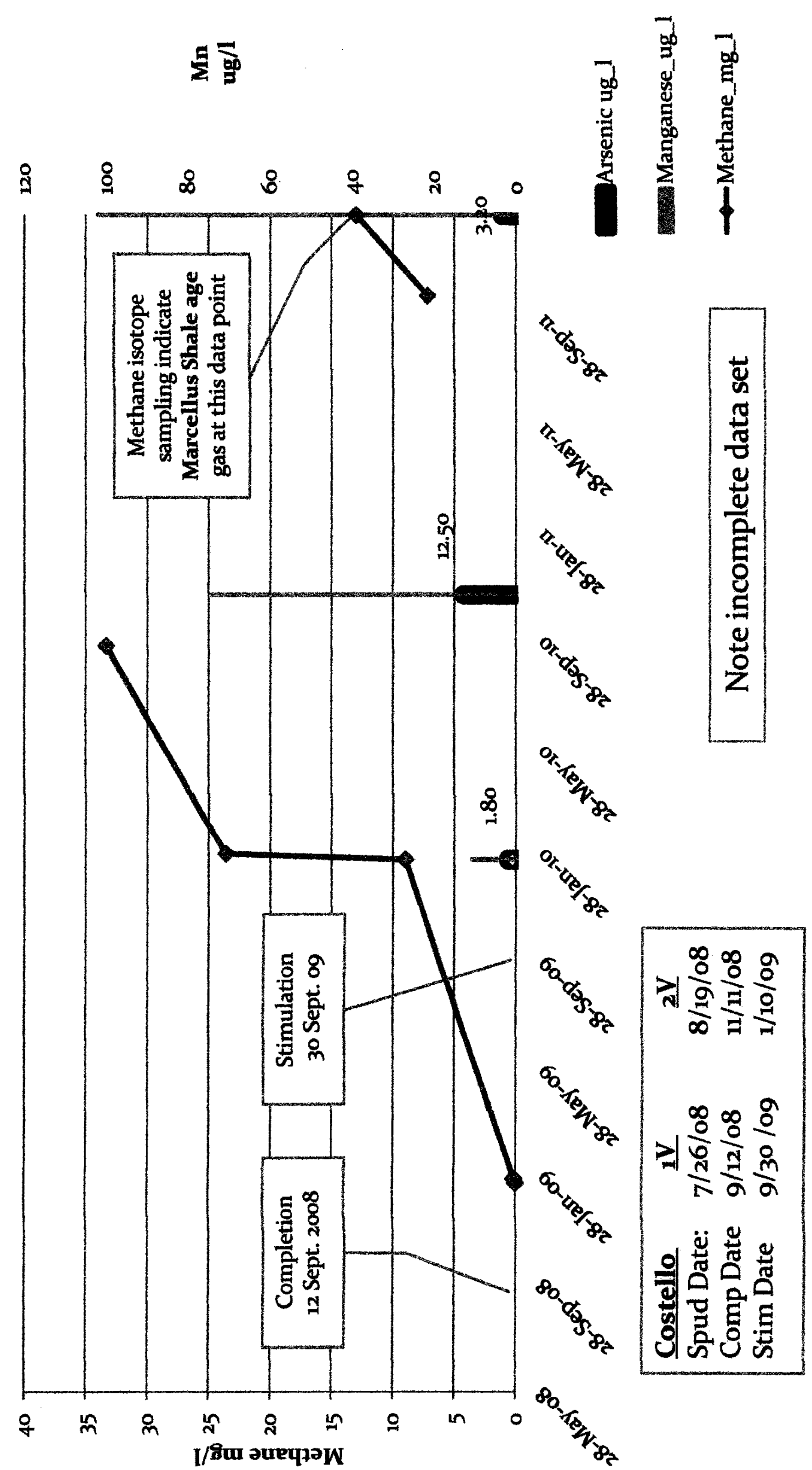
- Thermogenic gas is present throughout the upper Devonian formations. Drilling creates pathways, either temporary or permanent, that allows gas to migrate to the shallow aquifer near surface.
- Shallower (non Marcellus) gas may also include higher amounts of H2S which can have a greater impact on groundwater.
- In some cases, these gases disrupts groundwater quality

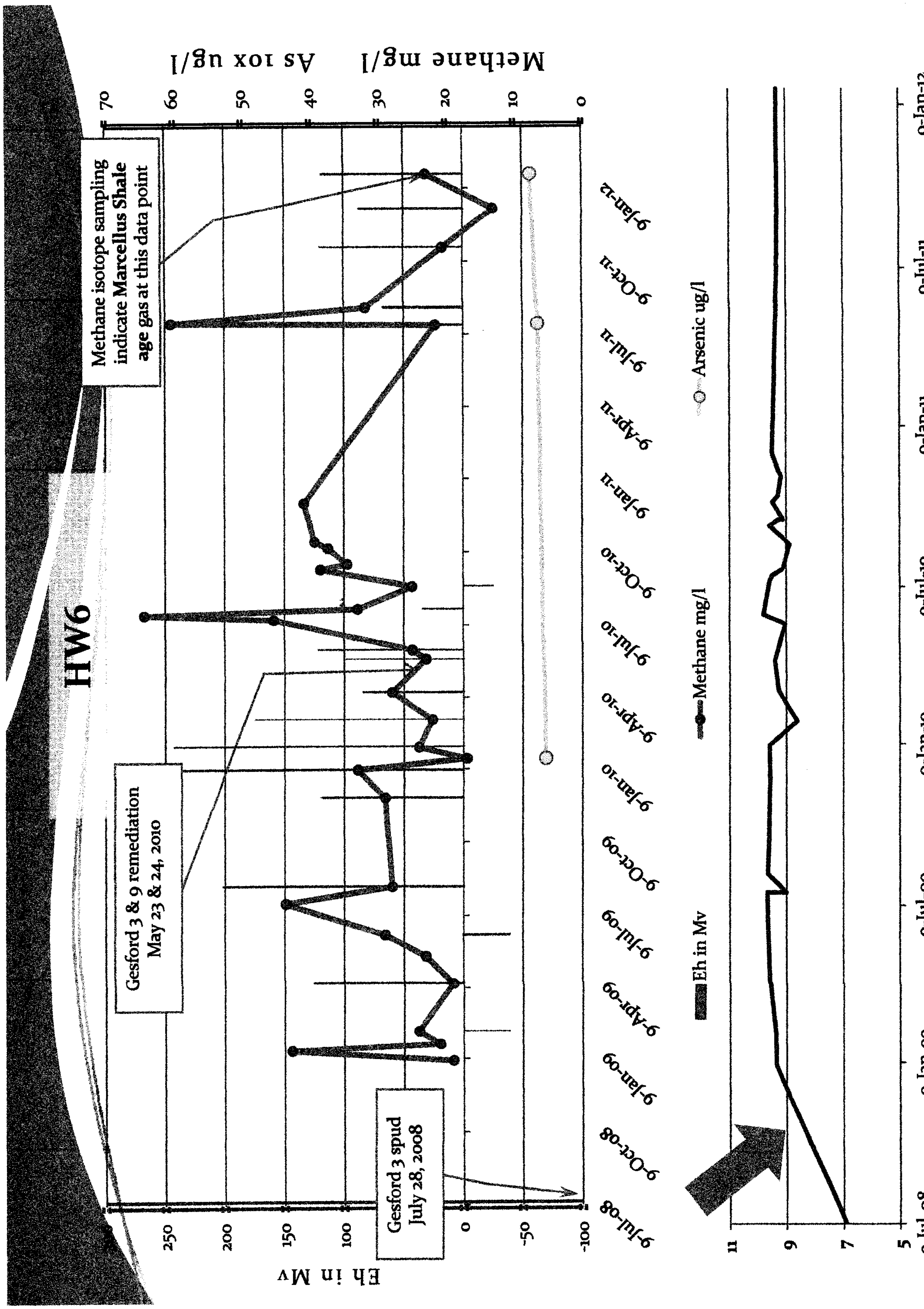


From Gesford 2 Well Record and Completion Report

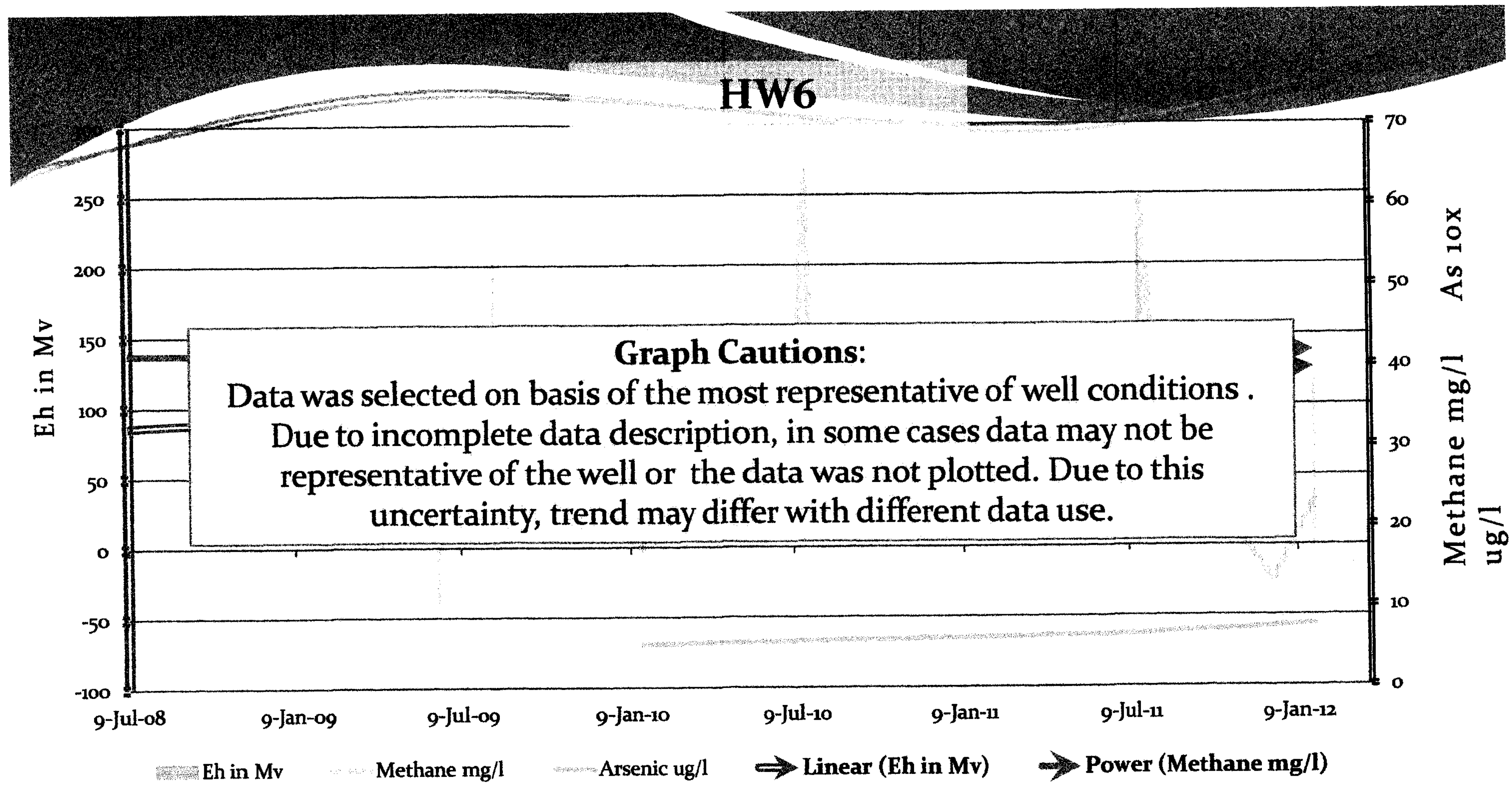

-HW 14
Mn x 10,000
Methane isotope sampling indicate Marcellus Shale age gas at this data point
Eh trend
methane trend
-Postdrill-
Mn 62 ug/l
TSS 35.5 mg/l
TDS 127 mg/l
Fe 3.38 mg/l
Cl- 12.7 mg/l
Gas Well Activity
Baker Wells 1,100 ft. east
Spud - Baker 1 11 Aug. 2008
- Baker 2 11 Dec. 2009
-Predrill-
Mn - na
TSS <5 mg/l
TDS 149mg/l
Fe 0.03mg/l
Cl- 7.9mg/l
700
600
500
400
300
200
100
0
20,000.00
18,000.00
16,000.00
14,000.00
12,000.00
10,000.00
8,000.00
6,000.00
4,000.00
2,000.00
0.00
12/01/2011
10/18/2011
08/24/2011
06/29/2011
04/26/2011
03/03/2011
01/06/2011
11/12/2010
09/10/2010
06/24/2010
08/13/2009
07/17/2008

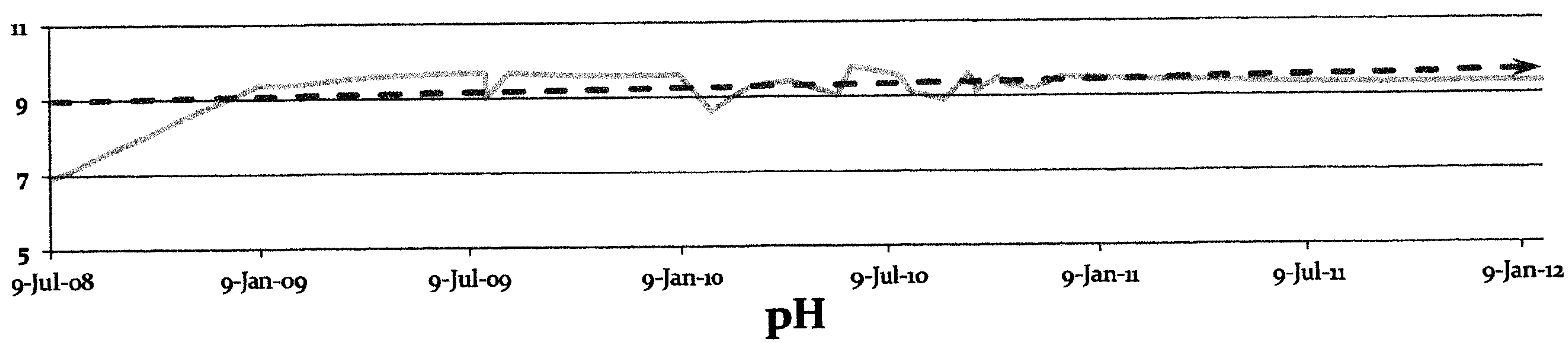
HW-2


Methane mg/l
40
35
30
25
20
15
10
5
0
Mn ug/l
120
100
80
60
40
20
0
28-May-08
28-Sep-08
28-Jan-09
28-May-09
28-Sep-09
28-Jan-10
28-May-10
28-Sep-10
28-Jan-11
28-May-11
28-Sep-11
3.20
12.50
1.80
Completion 12 Sept. 2008
Stimulation 30 Sept. 09
Methane isotope sampling indicate Marcellus Shale age gas at this data point
Arsenic ug_l
Manganese_ug_l
Methane_mg_l
Note incomplete data set
Costello 1V 2V
Spud Date: 7/26/08 8/19/08
Comp Date 9/12/08 11/11/08
Stim Date 9/30/09 1/10/09

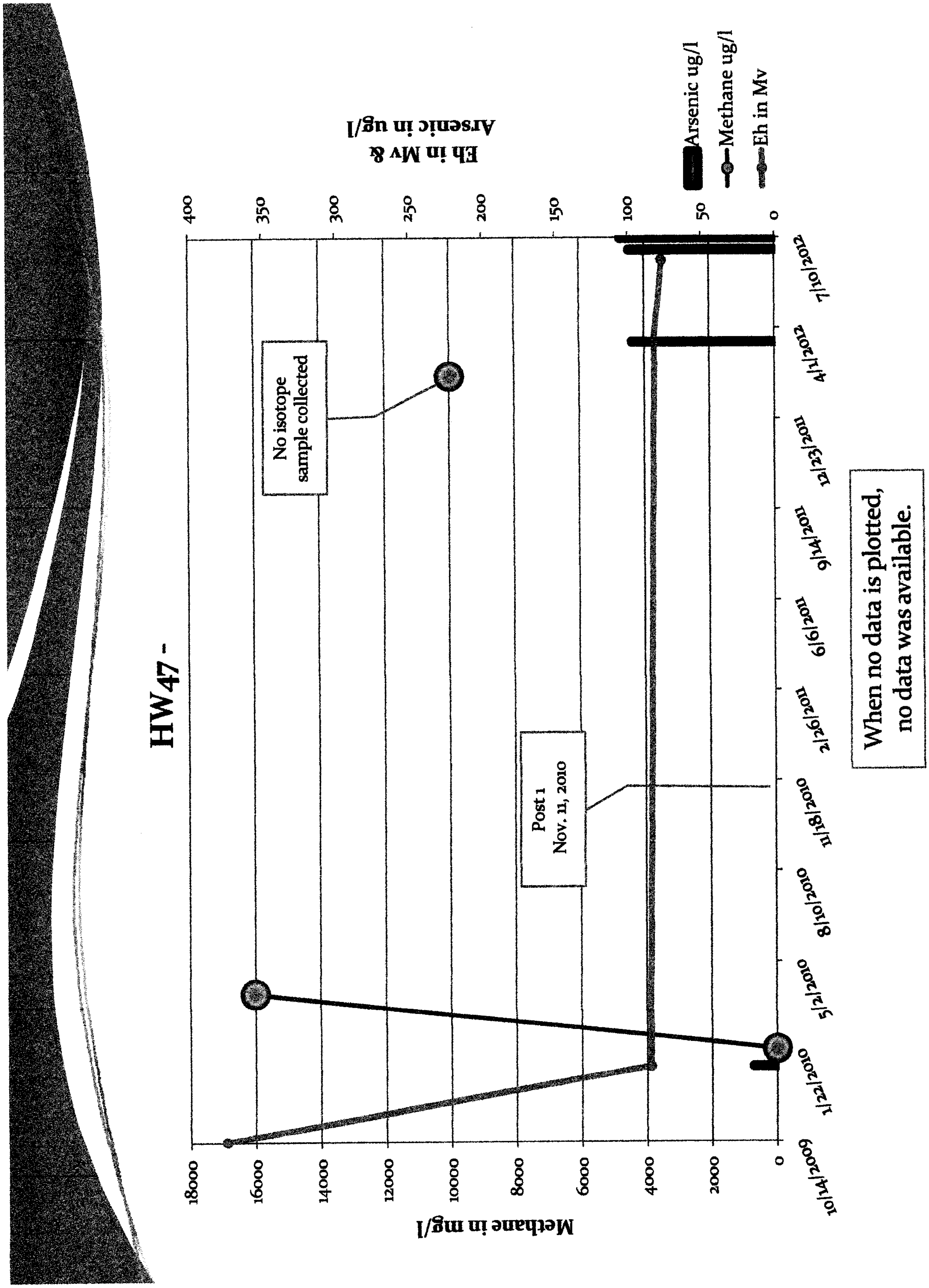


HW6
Methane mg/l
As 10x ug/l
Eh in Mv
Methane isotope sampling indicate Marcellus Shale age gas at this data point
Gesford 3 & 9 remediation May 23 & 24, 2010
Gesford 3 spud July 28, 2008
Eh in Mv
Methane mg/l
Arsenic ug/l
pH


HW6
Graph Cautions:
Data was selected on basis of the most representative of well conditions . Due to incomplete data description, in some cases data may not be representative of the well or the data was not plotted. Due to this uncertainty, trend may differ with different data use.
Eh in Mv
250
200
150
100
50
0
-50
-100
Methane mg/l
ug/l
As 10x
70
60
50
40
30
20
10
0
9-Jul-08
9-Jan-09
9-Jul-09
9-Jan-10
9-Jul-10
9-Jan-11
9-Jul-11
9-Jan-12
Eh in Mv
Methane mg/l
Arsenic ug/l
Linear (Eh in Mv)
Power (Methane mg/l)


11
9
7
5
9-Jul-08
9-Jan-09
9-Jul-09
9-Jan-10
9-Jul-10
9-Jan-11
9-Jul-11
9-Jan-12
pH

Type 3: Naturally Occurring Contamination



HW47 -
Eh in Mv &
Arsenic in ug/l
Methane in mg/l
Arsenic ug/l
Methane ug/l
Eh in Mv
No isotope sample collected
Post 1 Nov. 11, 2010
When no data is plotted, no data was available.
400
350
300
250
200
150
100
50
0
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
10/14/2009
1/22/2010
5/2/2010
8/10/2010
11/18/2010
2/26/2011
6/6/2011
9/14/2011
12/23/2011
4/1/2012
7/10/2012

Conclusions

- Methane is released during the drilling and perhaps during the fracking process and other gas well work.
- Methane is at significantly higher concentrations in the aquifers after gas drilling and perhaps as a result of fracking and other gas well work.
- The methane migrating into the aquifer is both from the shallower (younger age) formations and older Marcellus Shale (and perhaps even older formations).
- Methane and other gases released during drilling (including air from the drilling) apparently cause significant damage to the water quality.
- In some cases the aquifers recover (under a year) but, in others cases the damage is long term (greater than 3 years).