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THE STATE



OF WYOMING

RETURN TO

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GOVERNOR

PDR

# Department of Environmental Quality

LAND QUALITY DIVISION - DISTRICT II

210 LINCOLN STREET

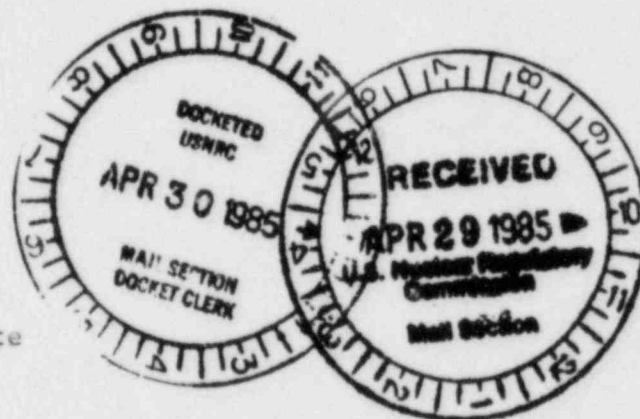
TELEPHONE 307-332-3047

LANDER, WYOMING 82520

April 21, 1985

Ms. Sandra Westler  
USNRC, Uranium Recovery Field Office  
P. O. Box 25325  
Denver, Colorado 80225

RE: Minerals Exploration A-3 In Situ Site  
DEQ/LQD License to Explore No. 17



Dear Sandy:

As we discussed, Land Quality Division does not believe MEC's data is showing improving or stable uranium concentrations in wells at the A-3 site. The trend for radium in the wells appears inconclusive. Attached is a memorandum on this subject.

Please let me know what you think. Perhaps it would be in order to meet and discuss this before any direction is given to Minerals Exploration.

Sincerely,

Rick Engelmann  
District II Engineer

RE:fi

xc: Roger Shaffer - Cheyenne DEQ/LQD w/o attachment  
Kathy Ogle - Cheyenne DEQ/LQD w/o attachment

Attachment

8505310424 850421  
PDR ADOCK 04008348  
C PDR

DESIGNATED ORIGINAL

Certified By Mary C. Hood

FEE EXEMPT

Add Info  
00572

MEMORANDUM

TO FILE : License to Explore No. 17  
Minerals Exploration Co. (MEC)

FROM : Rick Engelmann *RE*

SUBJECT : Analysis of Recent Water Quality Data from  
Wells at the A-3 In Situ site; Acceptability of  
Restoration Work

DATE : April 4, 1985

Acceptability of groundwater restoration is being judged on the basis of my letter of November 22, 1982 to John Abramo, Union Energy Vice President. See my memo of September 7, 1984.

Assumptions

For the analysis below, it is assumed that data provided by MEC was collected and analyzed in a consistent manner over the years, i.e. it is comparable. Further, it is assumed the uranium and radium concentrations measured are independently distributed with normal distributions with a common variance. Please note that this last assumption is admittedly not a good one for radium analysis results, but was made so that some statistical analysis could be performed.

Uranium

Using MEC data (see attached data sheets), linear regressions were performed for each A Field well for data starting in 1981\*. Attached are two graphical plots of MEC's uranium data plotted vs. time, along with the fitted lines. Below are the equations with the 95% confidence intervals for the slopes:

Well 1A      $y = -0.00014x + 0.073$   
              $m = -0.00014 \pm 0.0019$

Well 2A      $y = 0.040x + 3.7$   
              $m = 0.040 \pm 0.11$

Well 3A      $y = 0.038x + 2.21$   
              $m = 0.038 \pm 0.035$

Well 4A      $y = -0.0062x + 0.86$   
              $m = -0.0062 \pm 0.011$

\* 1981 was chosen because this date appears to form a break point in the data.

Well 5A       $y = 0.048x + 3.72$   
                   $m = 0.048 \pm 0.033$

Well 6A       $y = -0.023x + 6.17$   
                   $m = -0.023 \pm 0.057$

Well 7A       $y = 0.14x + 5.78$   
                   $m = 0.14 \pm 0.11$

Well 8A       $y = 0.06x + 1.64$   
                   $m = 0.06 \pm 0.05$

It is also possible to view each well field as a whole, averaging all uranium values from a given sampling date and plotting the average values vs. time. This is shown on the first of the two A Field uranium plots. Averaged data was as follows.

$U_{38}, \text{mg/l}$	3.11	3.24	3.59	3.00	4.95	5.16	4.45	y
Date	4/81	7/81	10/81	9/83	3/84	6/84	9/84	x

The fitted line is:

$$y = 0.038x + 2.96$$

$$m = 0.038 \pm 0.039 \text{ within } 95\%$$

$$= 0.038 \pm 0.031 \text{ within } 90\%$$

The B field was analyzed only for averaged MEC values, as immediately above. Averaged data was as follows (raw data is on the attached sheets).

$U_{38}, \text{mg/l}$	2.27	2.52	2.83	2.23	3.26	3.76	3.52	y
	4/81	7/81	10/81	9/83	3/84	6/84	9/84	x

The fitted line is

$$y = 0.025x + 2.28$$

$$m = 0.025 \pm 0.027 \text{ within } 95\%$$

$$= 0.025 \pm 0.021 \text{ within } 90\%$$

and is plotted on the Field B uranium plot.

As may be seen, the trends for the data show clearly an increasing uranium concentration trend. This is true for five of the eight A Field wells, for the averaged A Field data and for averaged B Field data. Furthermore, for the fitted lines for averaged data for both fields, it can be stated with 90 +% confidence that the slopes are positive (i.e.,  $U_3O_8$  increasing with time).

It is possible that very recently uranium began trending downward. This was evaluated on a well by well basis for the A Field for MEC data collected since January 1983. If anything, this showed a higher rate of increase in  $U_3O_8$ , which is readily evident on the graphs. Well Field B MEC data was not analyzed on a well by well basis, but it is readily evident from the data plots that the recent trend (since January 1983) is up.

#### Radium

Radium concentration trends were analyzed for Fields A & B as a whole. In each case, data from January 1981 to present was used, averaging all sample results from a given sampling date.

For Field A, averaged data was as follows (raw data is shown on the attached sheets):

Ra-226, pCi/l	23.2	20.9	17.1	9.3	13.7	14.7	y
Date	4/81	10/81	9/83	3/84	6/84	9/84	x

A linear regression of this data yields the equation

$$y = -0.253 + 23.7$$

$$m = -0.253 \pm 0.19 \text{ within 95\% confidence}$$

which is plotted on the A Field radium plot.

It may therefore be said with 95% confidence that radium concentrations in the A Field as a whole have been decreasing since January 1981.

For Field B, averaging of data gives this table (raw data is on attached sheets):

Ra-226, pCi/l	19.18	11.82	17.62	18.3	16.5	14.5	9.7	y
Date	4/81	7/81	10/81	9/83	3/84	6/84	9/84	x

Linear regression yields

$$y = 0.078x + 17.5$$

$$m = -0.078 \pm 0.130 \text{ within 80\% confidence}$$

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Page Four

The trend of the B Field radium concentrations since 1981 is down, but this cannot be said with a great degree of confidence. However, an examination of the data plot shows an encouraging overall trend since January 1983.

Conclusions

Uranium concentrations are continuing to climb in both the A & B Well Field. Radium concentrations are decreasing in both fields, although not conclusively in the B Field.

RE:fi

xc: Roger Shaffer - Cheyenne DEQ/LQD

Attachments

# Well Field A, $U_3O_8$ Concent.\* in mg/l

Dates	Wells								
	1A	2A	3A	4A	5A	6A	7A	8A	$\bar{A}$
4/81	4.10	4.19	2.88	0.7	4.19	4.97	6.32	1.56	3.11
7/81	.032	4.07	2.29	1.06	3.93	5.94	6.92	1.65	3.24
10/81	.10	4.44	2.40	.80	4.21	6.20	7.77	2.82	3.59
12/82					5.00	7.75	9.87		
9/83	.012	1.35	2.5	.385	4.2	5.3	6.5	3.73	3.00
3/84	.08	7.4	4.1	.53	5.7	4.45	12.0	5.3	4.95
6/84	.088	6.35	4.45	.725	6.6	5.2	14.0	3.9	5.16
9/84	.077	5.3	3.7	.725	5.7	4.8	12.0	3.3	4.45

\* Data is from MEL. ~~file~~. ~~For well 6A, 3 samples~~  
 Attached to this table is a more complete set of  
 raw data



# Stabilization Period

From Larry Martin's  
4/29/82 memo

U<sub>3</sub>O<sub>8</sub> mg/l

	1B	2B	3B	4B	5B	B
9-1-78	1.50	1.50	.750	.480	.36	0.92*
5-10-79	2.9	6.82	.58	.72	5.62	3.33*
7-11-79	1.45	5.7	.59	.56	3.95	2.45*
7-21-80	3.5	1.2			5.0	3.23
8-29-80	2.3	0.9			3.1	2.10
4-13-81	4.47	1.35	2.42	0.43	2.70	2.27*
4-29-81	5.04					
5-13-81	5.60					
7-9-81		1.65	3.02	0.04	2.23	<del>2.52*</del> 2.52
7-12-81	5.67					
10-22-81	4.88	2.39	3.61	0.74	2.55	2.83*
<u>Baseline</u>						
7-29-76	.045	.028	.044	.037	.047	.040*
9-29-76	.002	.021	.011	.020	.010	.013*
12-7-82	4.32				2.45	
OEQ	3.76				2.45	
9-26-83	3.05	0.90	4.80	0.50	1.90	2.23
OEQ	3.70	1.50	5.40	0.56	2.10	
3-20-84	5.30	1.60	5.75	0.735	2.90	3.26
6-13-84	6.00	2.45	6.10	0.960	3.36	3.76
9-11-85	5.70	3.00	5.3	0.810	2.80	3.52

\* Only dates where a complete set of samples are available are plotted.

Date from unfiltered and/or unpreserved samples are not included in this table

Well Field B,  $U_3O_8$  Concent. in mg/l \*

	Wells					
	1B	2B	3B	4B	5B	$\bar{A}$
4/81	4.47	1.35	2.42	0.43	2.70	2.27
7/81	5.67	1.65	3.02	0.04	2.23	2.52
10/81	4.58	2.39	3.61	0.74	2.55	2.53
Date 9/83	3.05	0.90	4.80	0.50	1.90	2.23
3/84	5.30	1.60	5.75	0.74	2.90	3.26
6/84	6.00	2.45	6.10	0.96	3.30	3.76
9/84	5.70	3.00	5.3	0.81	2.80	3.52

\* Data is from MEL files. Attached to this table is a more complete set of raw data.



# Stabilization Period

From Larry Martin!  
9/29/82 memo

U<sub>3</sub>O<sub>8</sub> mg/l

	1A	2A	3A	4A	5A	6A	7A	8A	A
9-1-78	2.15	5.30	2.20	1.10	2.45	3.80	5.75	0.73	2.94*
4-25-79	2.3	2.4	2.2	4.2	7.25	3.85	4.6	2.0	3.60*
7-10-79	1.6	6.65	2.4	2.7	6.75	1.7	4.5	2.1	3.55*
7-21-80		4.1			5.3	3.9	5.3		4.65
8-29-80		2.9			2.4	2.8	3.6		2.93
4-13-81	<.10	4.19	2.88	0.7	4.19	4.97	6.32	1.56	3.11*
4-29-81						5.34			
5-13-81						5.69			
7-8-81	.032					5.94	6.92	1.65	<del>3.24</del>
7-9-81		4.07	2.29		3.93				3.24
7-12-81				1.06					
10-20-81	0.10	4.44			4.21	6.20	7.77	2.82	3.59*
10-22-81			2.40	0.80					
7-8-76	.014	.095	.033	.041	.085	#6, 7, and 8 were drilled later, no baseline data available			.045*
7-31-76	.020	.030	.008	.016	.006				.013*

12-7-82  
OEQ

(1) 5.00 (11) 7.75 (21) 9.87  
4.47 6.94 9.41

\* Only dates where a complete set of samples are available are plotted.

Date from unfiltered and/or unpreserved samples are not included in this table.

✓ 9-26-83	0.012	1.35	(1) 2.5	(11) 0.385	(10) 4.2	(11) 5.3	(11) 6.5	(11) 8.725	3.00
OEQ	0.12	4.3	2.6	0.61	4.3	6.1	8.9	4.2	
✓ 3-20-84	0.08	7.4	(1) 4.1	(11) 0.53	(11) 5.7	(11) 4.5	(11) 12.0	(11) 5.3	4.95
6-13-84	.088	6.35	(11) 4.45	(11) 0.725	(11) 6.6	(11) 5.2	(11) 14.0	(11) 3.7	5.16
9-11-84	.077	5.3	(11) 3.7	(11) 0.725	(11) 5.7	(11) 4.8	(11) 12.0	(11) 3.3	4.45

# Well Field A, Ra-226 Content, in pCi/l \*

## Wells

	1A	2A	3A	4A	5A	6A	7A	8A	$\bar{A}$
4/81	$1.7 \pm 0.7$	$30 \pm 3$	$34 \pm 3$	$1.6 \pm 0.6$	$54 \pm 4$	$28 \pm 3$	$28 \pm 3$	$7.9 \pm 1.4$	23.2
10/81	$2.2 \pm 0.8$	$28 \pm 3$	$32 \pm 3$	$2.3 \pm 0.8$	$34 \pm 3$	$24 \pm 3$	$39 \pm 2$	$6.0 \pm 1.3$	20.9
9/83	$1.3 \pm 0.1$	$4.9 \pm 1$	$16 \pm 1$	$8.7 \pm 1$	$44 \pm 1$	$14 \pm 1$	$36 \pm 1$	$12 \pm 1$	17.1
3/84	$0.7 \pm 0.2$	$41 \pm 1$	$2.9 \pm 0.3$	$1.2 \pm 0.3$	$8.3 \pm 0.5$	7.8	$4.6 \pm 0.4$	$7.7 \pm 0.9$	9.3
6/84	1.4	20.0	24.0	0.7	32.0	17.0	5.6	9.0	13.7
9/84	0.5	31.0	41.0	0.9	17.0	7.1	13.0	7.2	14.7

\* Data is from MEC, Attached to this table is a more complete table of raw data

# Stabilization Period

Ra-226 pCi/l

From Larry  
Martin's 9/27/82  
memo

	1A	2A	3A	4A	5A	6A	7A	8A	9A
1-78	2.9 $\pm$ 0.3	21.5 $\pm$ 0.3	11.7 $\pm$ 0.3	2.1 $\pm$ 0.4	13.4 $\pm$ 0.3	18.2 $\pm$ 0.3	2.1 $\pm$ 0.3	4.5 $\pm$ 0.3	9.
25-79 & 10-79	1.4.	1.1	27.3	2.1	12.0	38.8	22	12	14.
10-79	3.5	20.5	7.9	2.3	6.1	26.3	22	5.26	11.
21-80		20.4			38.1	38.1	13.9		27.
29-80 DEQ		23 $\pm$ 3			23 $\pm$ 3	32 $\pm$ 3	20 $\pm$ 3		24.
13-81	1.7 $\pm$ 0.7	30 $\pm$ 3	34 $\pm$ 3	1.6 $\pm$ 0.6	54 $\pm$ 4	28 $\pm$ 3	28 $\pm$ 3	7.9 $\pm$ 1.4	23.
29-81 April						27.3 $\pm$ 3			
13-81						28 $\pm$ 3			
8-81	1.0 $\pm$ 0.5								
9-81		24 $\pm$ 3	25 $\pm$ 3	1.4 $\pm$ 0.6				36 $\pm$ 3	17.
12-81				0.7 $\pm$ 0.4					
-20-81 \	2.2 $\pm$ 0.8	28 $\pm$ 3			34 $\pm$ 3	24 $\pm$ 3	39 $\pm$ 2	6.0 $\pm$ 1.3	20.
02- -22-81			32 $\pm$ 3	2.3 $\pm$ 0.8					
12-7-82 OLR					39 $\pm$ 4	21 $\pm$ 3	38 $\pm$ 4		
					58 $\pm$ 1	21 $\pm$ 1	36 $\pm$ 1		
9-26-83 DEQ	1.3 $\pm$ 0.	49 $\pm$ 1	16 $\pm$ 1	8.7 $\pm$ 1	44 $\pm$ 1	14 $\pm$ 1	36 $\pm$ 1	12 $\pm$ 1	17.
	15.4 $\pm$ 1.2	84 $\pm$ 5.9	188 $\pm$ 3.6	40 $\pm$ 6.2	10.8 $\pm$ 0.9	59 $\pm$ 7.7	142 $\pm$ 10.8	71 $\pm$ 5.6	
3-20-84	0.7 $\pm$ 0.2	41 $\pm$ 1	2.9 $\pm$ 0.2	1.2 $\pm$ 0.3	8.3 $\pm$ 0.5	7.8	4.6 $\pm$ 0.4	7.7 $\pm$ 0.9	9.3
6-13-84	1.4	20.0	24.0	0.7	32.0	17.0	5.6	9.0	13.
9-11-84	0.5	31.0	41.0	0.9	17.0	7.1	13.0	7.2	14.7
* Only dates where a complete set of samples are available are plotted.									

Date from unfiltered and/or unpreserved samples are not included in this table.

Well Field B, Ra-226 concentration in pCi/l \*

	1B	2B	3B	4B	5B	$\bar{B}$
4/81	28 ± 3	10.9 ± 1.7	17.9 ± 2.1	9.1 ± 1.5	30 ± 3	19.2
7/81	27 ± 3.0	4.8 ± 1.1	7.8 ± 1.4	3.7 ± 1.0	15.8 ± 2.0	11.8
10/81	29 ± 3	7.4 ± 1.6	9.8 ± 1.8	8.6 ± 1.6	33 ± 3	17.6
9/83	24 ± 1	14 ± 1	14 ± 1	9.4 ± 0	30 ± 1	18.3
3/84	2.6 ± 0.9	12 ± 1	3.8 ± 0.5	15 ± 0.6	49 ± 1	16.5
6/84	21.0	8.9	8.6	15.0	19.0	14.5
9/84	31.0	3.2	4.6	1.2	8.7	9.7

\* Data is from MEL. Attached to this table is a more complete set of raw data.

From Larry Martin's  
9/29/82 memo

# Stabilization Period

Ra-226 pCi/l

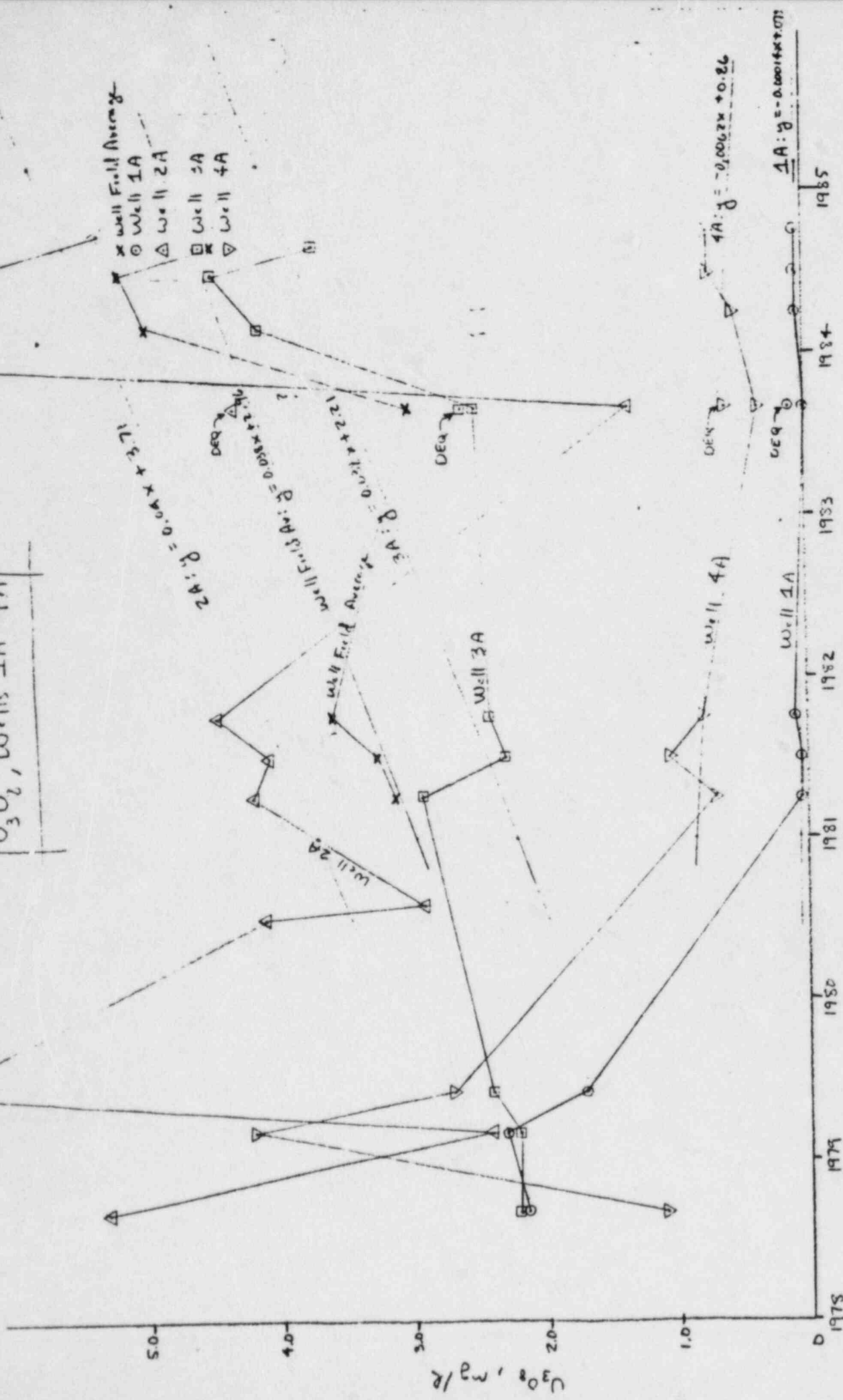
	1B	2B	3B	4B	5B	$\bar{B}$
9-1-78	8.9 $\pm$ 0.3	3.8 $\pm$ 0.3	8.3 $\pm$ 0.3	8.1 $\pm$ 0.4	7.5 $\pm$ 0.3	7.33*
5-10-79	8.9	24.2	6.7	2.2	23	13.0 *
7-11-79	24.5	5.0	3.3	4.4	5.3	8.50*
7-21-80	26.9	6.8			17.3	17.0
8-29-80	29 $\pm$ 3	5.6 $\pm$ 1.4			24 $\pm$ 3	19.63
4-13-81	28 $\pm$ 3	10.9 $\pm$ 1.7	17.9 $\pm$ 2.1	9.1 $\pm$ 1.5	30 $\pm$ 3	19.18*
4-29-81	27 $\pm$ 2.9					
5-13-81	21 $\pm$ 2.5					
7-9-81		4.8 $\pm$ 1.1	7.8 $\pm$ 1.4	3.7 $\pm$ 1.0	15.8 $\pm$ 2.0	<del>11.82*</del>
7-12-81	27 $\pm$ 3.0					11.82
10-22-81	29 $\pm$ 3	7.4 $\pm$ 1.6	9.8 $\pm$ 1.8	8.6 $\pm$ 1.6	33 $\pm$ 33	17.62*
12-7-82	31 $\pm$ 3				19.1 $\pm$ 3	
DEQ	24 $\pm$ 1				54 $\pm$ 1	
9-26-83	24 $\pm$ 1	14 $\pm$ 1	14 $\pm$ 1	9.4 $\pm$ 0	30 $\pm$ 1	18.3
3-20-84	2.6 $\pm$ 0.9	12 $\pm$ 1	3.8 $\pm$ 0.5	15 $\pm$ 0.6	49 $\pm$ 1	16.5
6-13-84	210	8.9	8.6	15.0	19.0	14.5
9-11-84	31.0	5.2	4.6	1.2	8.7	9.7

\*Only dates where a complete set of samples are available are plotted.

Date from unfiltered and/or unpreserved samples are not included in this table.



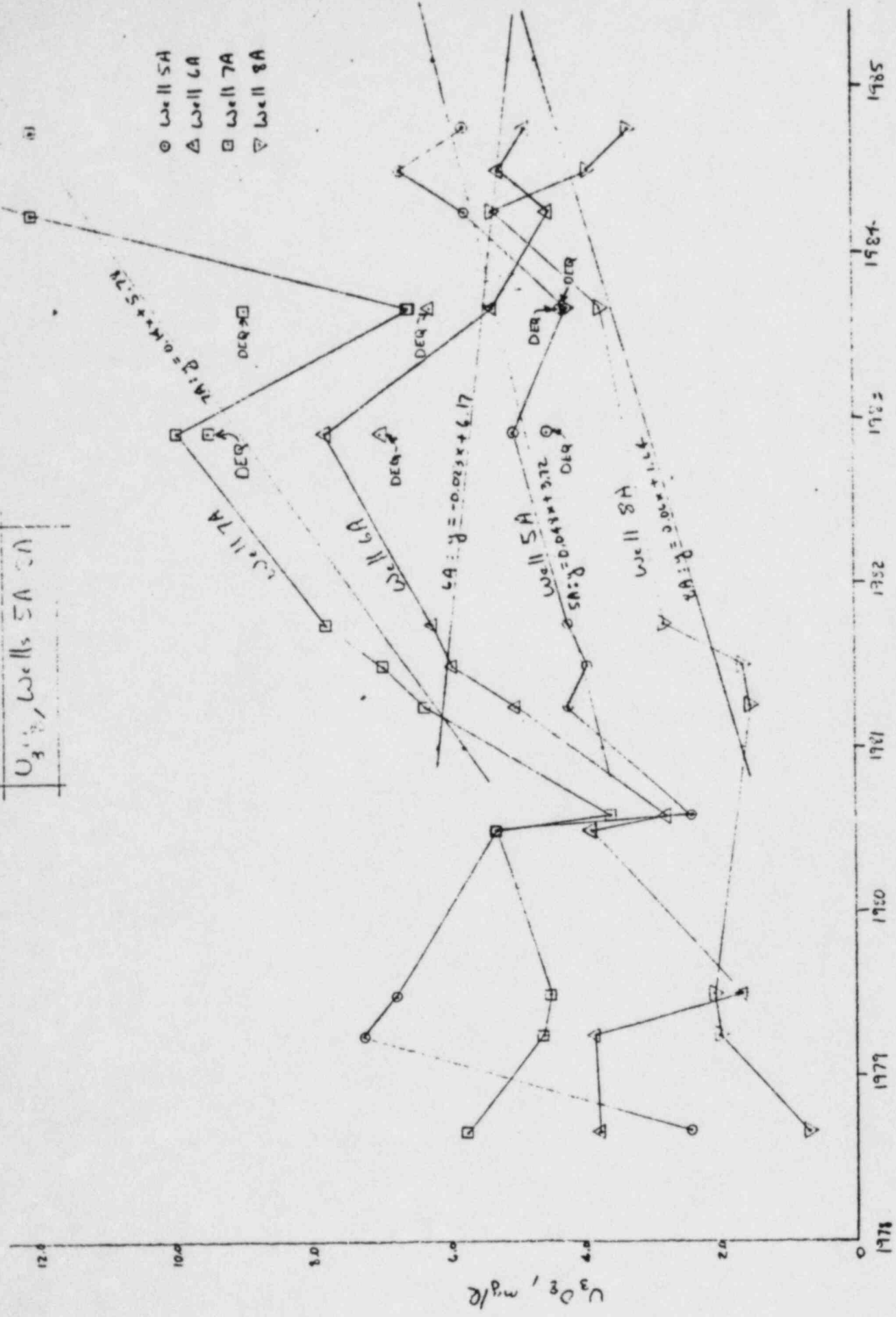
$U_3O_8$ , Wells 1A-4A



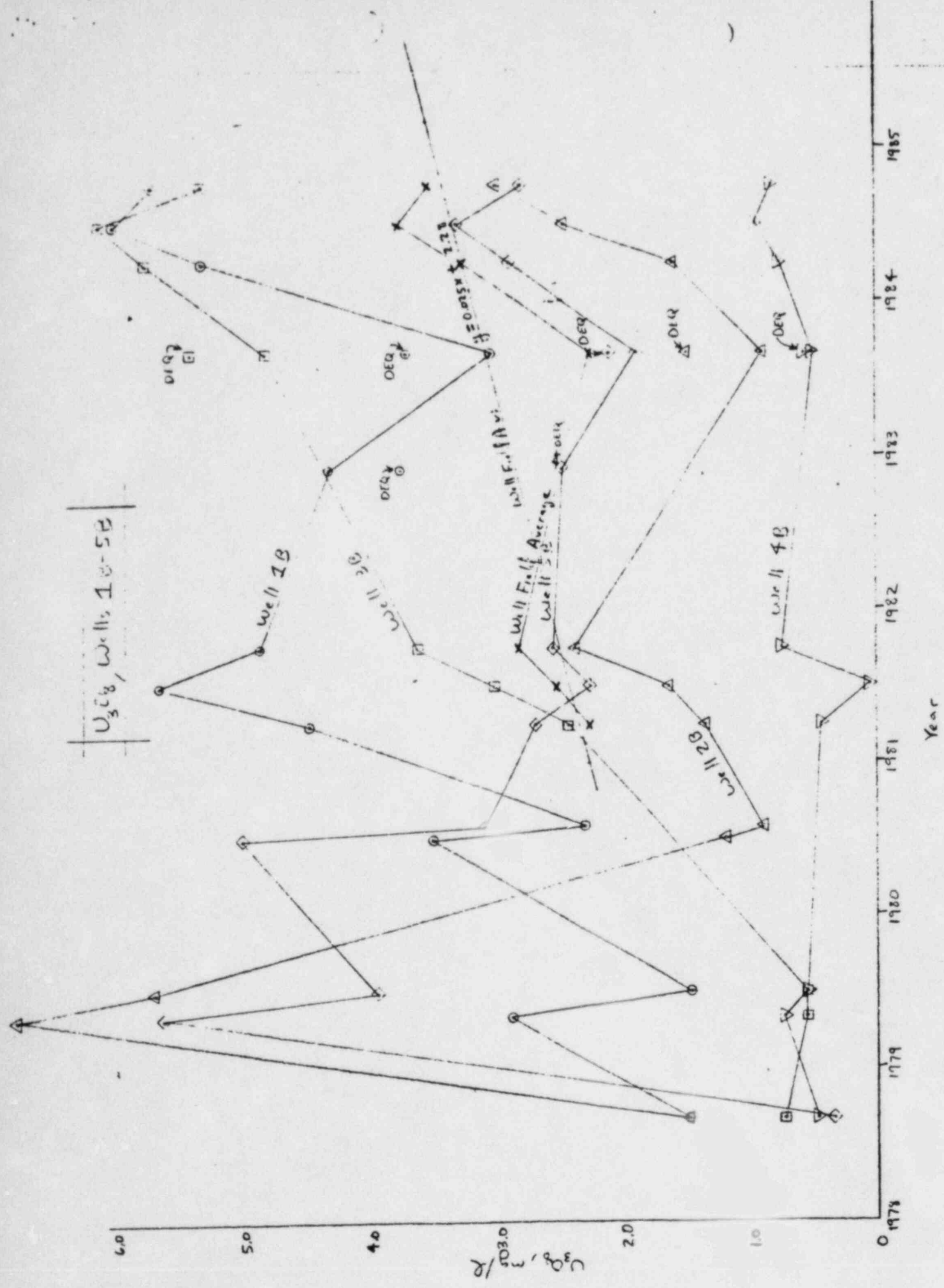
Year



Well 5A SA



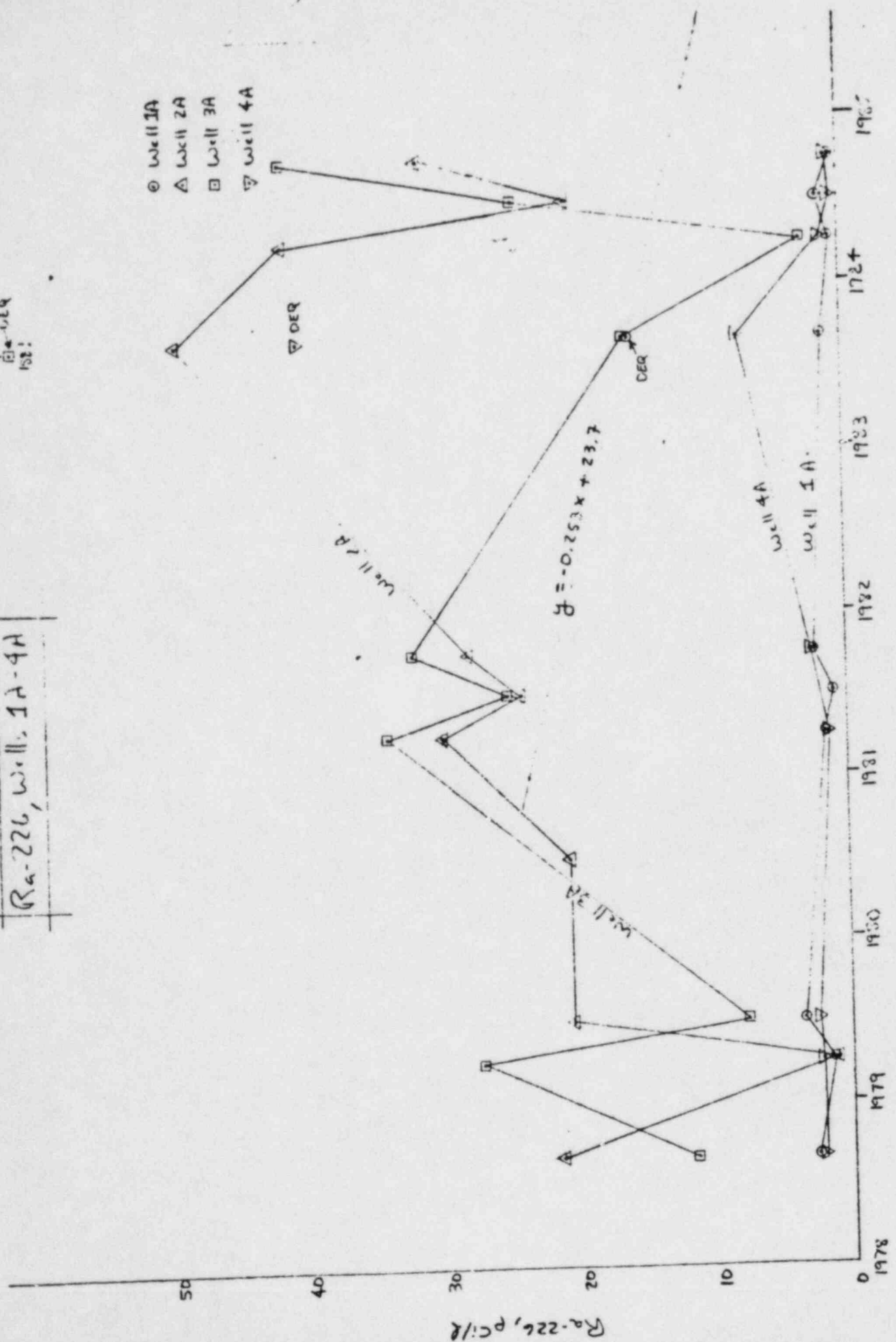
Year



↑ 84 DER  
 ↑ 131 DER

Ra-226, Well 1A-4A

● Well 1A  
 ▲ Well 2A  
 □ Well 3A  
 ▽ Well 4A



Year

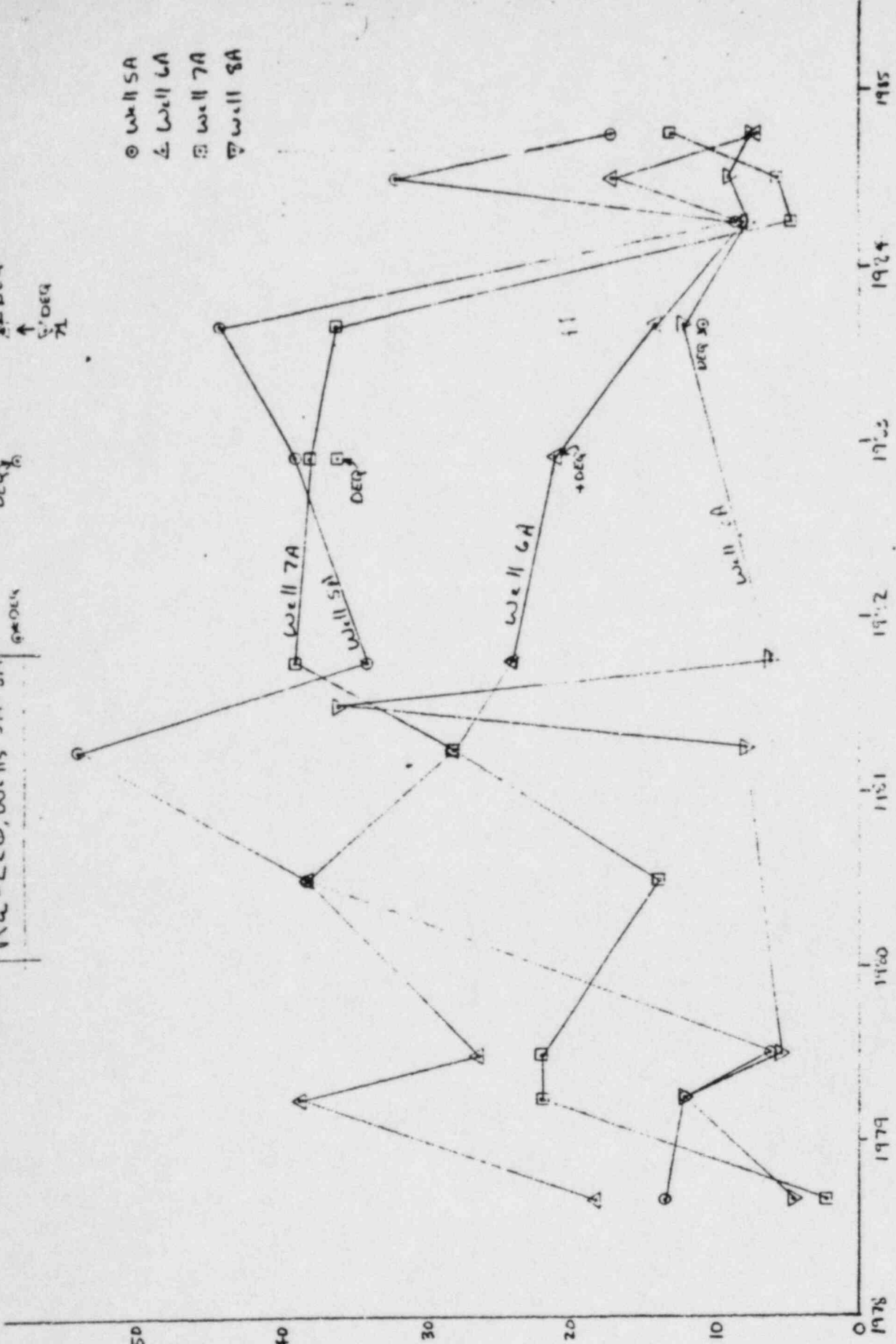
Ra-226, Wells SA-SA

Ra-226, pCi/l

- Well SA
- △ Well 6A
- Well 7A
- ◇ Well 8A

↑ 142 DEQ  
↑ 142 DEQ  
↑ 142 DEQ

DEQ



Year

Ra-226, Wells 19-55

0157

- Well 1B
- △ Well 2B
- Well 3B
- ▽ Well 4B
- Well 5B

