1984

Hydrological/Geochamical Search for Sandstone-Type Uranium Deposits in Forrest, Jones, Perry, and Eastern Lamar Counites, Southeastern Mississippi

C. Winston Russell

Open-File Report 83-11S

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The Mississippi Mineral Resources Institute
University, Mississippi 38677

Report on research Project NHRI # 83-1 IS

HYDROLOGICAL/GEOCHEMICAL SEARCH FOR SANDSTONE-TYPE URANIUM DEPOSITS IN FORREST., JONES, PERRY AND EASTERN LAMAR COUNTIES, SOUTHEASTERN MISSISSIPPI

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January 31$_{5}$ 1904

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ABSTRACT

F arty gr-aLlndwater-eamp1es From the (3atahau1a Sandstane and Hattiesburg/Pascagoula Formations (undifferentiated) of Jones, Lamar ¡i Forrest and Ferry Counties, Mississippi were analyzed for uranium concentration, $^{234}U/^{238}U$ ap^a activity ratio, temperature, Eh and pH«

Uranium concentrations ranged from 0.001 ppb (parts per billion) to 0.722 ppb with an average of 0.055 ppb. $^{234}U/^{238}U$ activity ratios varied from 0.49 to 3.65.

Trends in the uranium data for both the Catahoula Sandstone and Hatt ıi esburg/Pascagoul . a Formations are similar to that observed by Cowart and Osmond (1977 and 1980) for Texas uranium deposits. Uranium data trends are supported by pH trends similar to those predicted for an alteration zone in sandstone.

Areas suggested as redox front sites should not be interpreted as the site of an economic ore deposit. However, it does indicate the location of an environment favorable for the deposition of uranium.

INTRODUCTION

Sandstone-type uranium deposits are currently the most important single type of economic uranium resource in the United States (Nash and others, 1981). These include the reserves in Eocene to Pliocene Coastal Plain sediments in south Texas (Eargl© and Weeks, 1973? Galloway, 1978)« There are geological similarities between the south Texas area and the southeastern Mississippi Coastal Plain. These include the extension of several mapped formations from Texas into Mississippi. One of these, the Catahoula Formation, is the site of much of the Texas uranium. Precise correlation of age and sediment type may be uncertain over such <a wide area but the possibility that Mississippi contains economic uranium deposits should be evaluated.

Groundwater samples from Jones, Forrest, Lamar and Perry Counties in southeastern Mississippi have been analyzed for uranium concentration, uranium isotopic ratios, temperature, Eh and pH. This information can be used to locate zones with a higher probability of uranium deposition.

Measurement of uranium concentrations in groundwater is a common technique for geochemical prospecting for uranium. Concentrations range from less than 0.01 parts per billion to greater than 100 parts per billion (Osmond and Cowart, 1976). A variation of this approach, suggested by Cowart and Osmond (1977), is the analysis of the two naturally occurring isotopes "·:··?^U and ^^'U.

As shown in Figure I, ^-^U is an intermediate daughter in the radioactive decay series of Variations in the ratio ^{238}U.

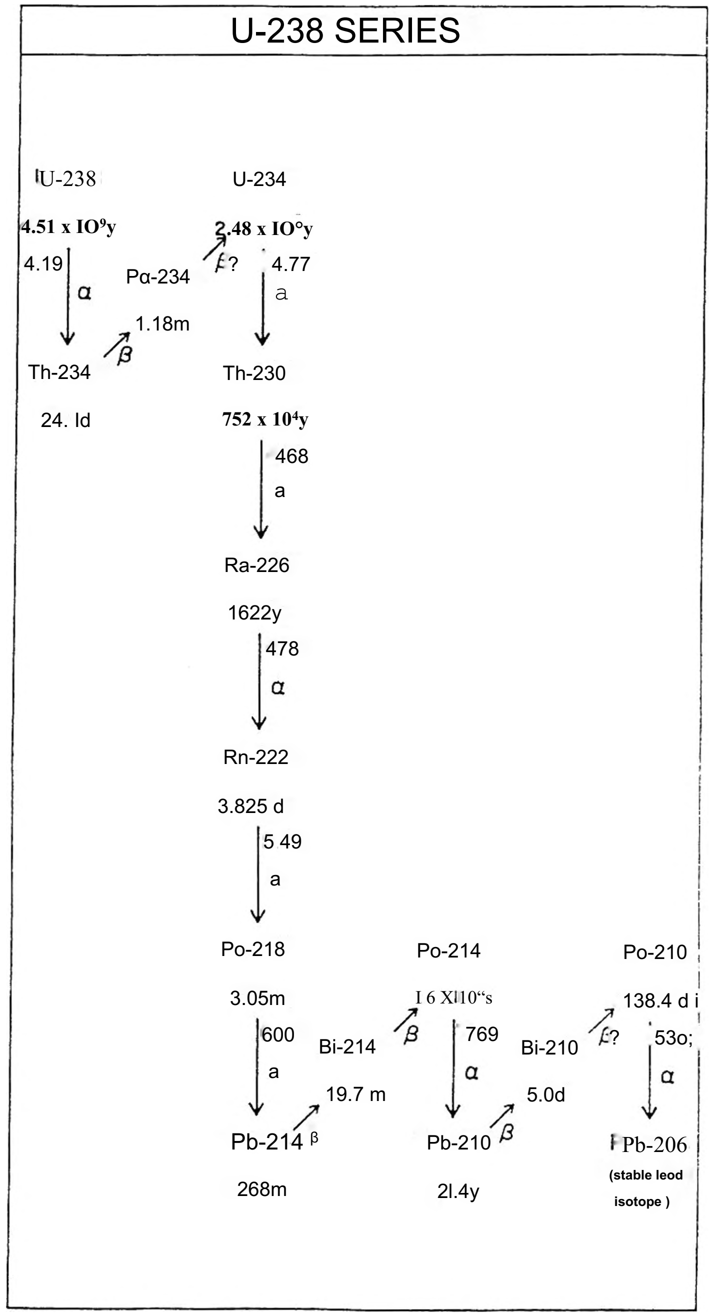


Figure 1 Decay chain of ---^UraniLun.

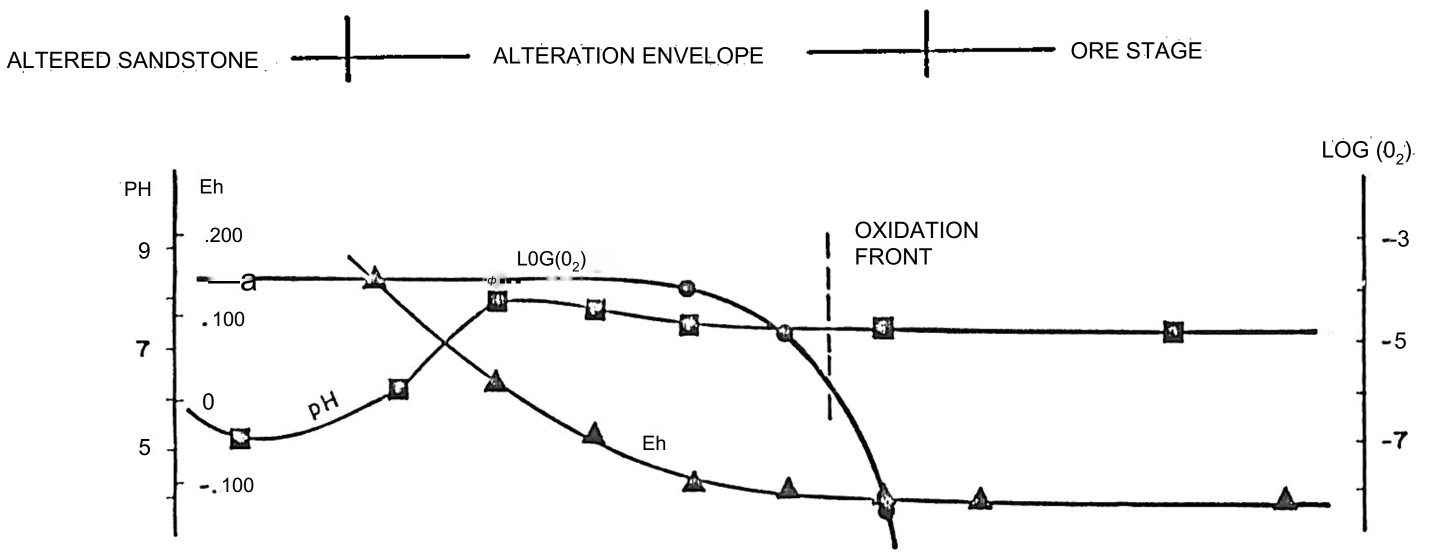
of ^{238}U to ^{235}U have not been found in nature, with the exception of the Oklo "fossil reactor" (Lancelot and others, 1976). In contrast, the $^{234}U/^{238}U$ ratio varies from slightly less than one to greater than fifteen (Osmond and Cowart, 1976).

Isotopic fractionation of the ^{238}U series was first reported by Cherdynstev and others in 1955. The principle mechanism of fractionation is alpha recoil (Fleischer, 1900) which can move ^{234}Th atoms to more leachable sites or expel them directly into the aquifer. ^{234}Th has a half-life of 24.1 days and decays to ^{234}U (Figure 1). The result is a liquid enriched in ^{234}U and a solid phase depleted in ^{234}U. Fractionation mechanisms are discussed in detail in Osmond and Cowart (1976).

Cowart and Osmond (1977) found $^{234}U/^{238}U$ high activity ratios and low concentrations of uranium down dip from previously unsuspected, but later confirmed, uranium deposits in Texas. The model they proposed involved leaching and mobilization of uranium in near-surface oxidizing environments (which produce high concentration and low activity ratios) and precipitation in a reduced ore zone? (downflow from which the concentration of uranium is much lower but activity ratios higher). The ore body can be defined by isotopic analysis of well water in the area. A later investigation of uranium isotopic variations around several known uranium ore bodies in the western United States (Cowart and Osmond, 1980) confirmed the observed relationships between activity ratios and ore deposits.

Uranium isotopic variations may also be used to characterize groundwater aquifer systems. Fractionation of uranium isotopes occurs primarily in weathering zones and soils (Osmond and Cowart, 1976). Thus groundwater will exhibit isotopic variations dependent on conditions in the recharge area. Distinctive isotopic ratios can be used to trace the movement of groundwater. Applications of this technique are reviewed in Osmond and Cowart (1976).

The formation of a redox interface within an aquifer has considerable influence on the chemical properties of the groundwater. Öoulegue and Michard (1979) calculated the evolution of water composition and the ratio of secondary minerals (precipitated directly from the groundwater) across a weathering profile in sandstone. Trends of pH, Eh and dissolved oxygen across the redox front, as computed by Boulegue and Michard (1979), are reproduced in Figure 2. Uranium released by chemical alteration in the oxidizing zone is precipitated downflow in the reduced zone. (Figure 2) . Thus based on this simplified model of a sandstone-type deposit, the location of a redox interface is an indicator of areas of uranium deposition.



Fi gure 2. The predicted variations in pH, Eh aand dissolved oxygen content across ¿a sandstone alteration sone modified -from Chatham and others, 1901).

LOCATION AND GEOLOGIC SETTING

The project area is within Jones, Forrest, Lamar and Perry Counties, Mississippi (Figure 3). The area is within the Pascagoula River basin in the East Gulf Coastal Plain« Rocks exposed are sedimentary, ranging in age from Oligocene to Recent, with Miocene representing the majority.

Structurally the area lies south of the Pickens-Gilbertown Fault system and north of the Wiggins Anticline in the eastern portion of the Mississippi Salt Dome Basin (Figure 4). Shallow piercement salt domes and several faults are known to exist in the area. One east-west trending subsurface fault in southern Forrest County offsets beds at the base of the Catahoula Sandstone (Shows and others, 1966). Other known faults are shown in Figure 4.

The regional dip is to the southwest varying from 40-45 feet per mile in Jones County to 20-25 feet per mile in Forrest County due to the structural uplift of the Wiggins Anticline to the south (Shows and others, 1966).

The principle aquifer of the study area is the Catahoula Sandstone, which is used extensively as a public water supply throughout the study area. The overlying Hattiesburg/ Pascagoula Formations (undifferentiated) is utilizied in much of Lamar, Forrest and Perry Counties.

Aquifers of the study area are recharged by rainfall directly on the outcrop, by infiltration through overlying deposits (Citronelle) and by leakage between clay and silt beds separating the sand units. Because of its thickness,

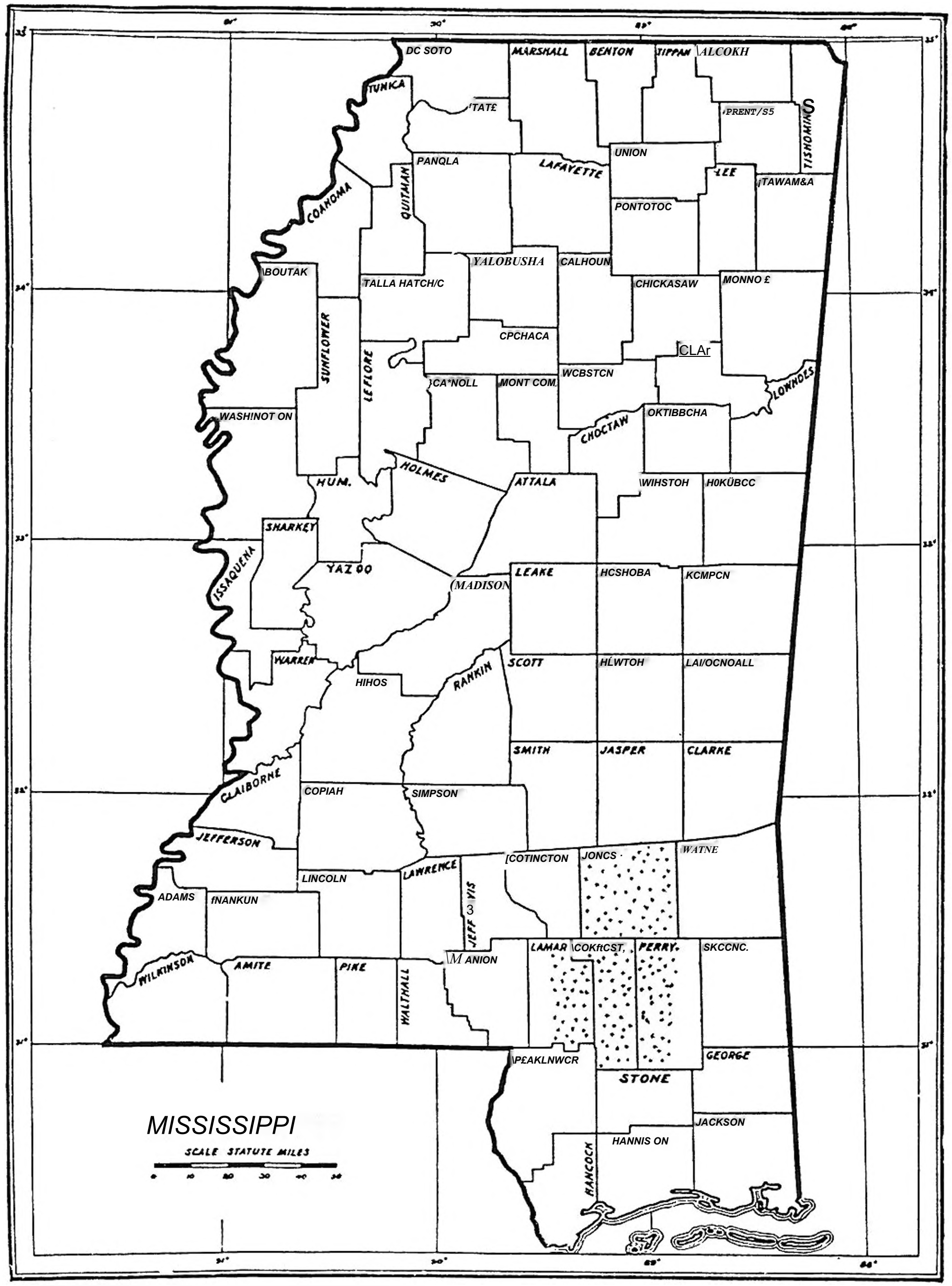


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Figure 3. Study area in Jones, Lam ¿ar, Forrest and Perry Counties (stippled)«

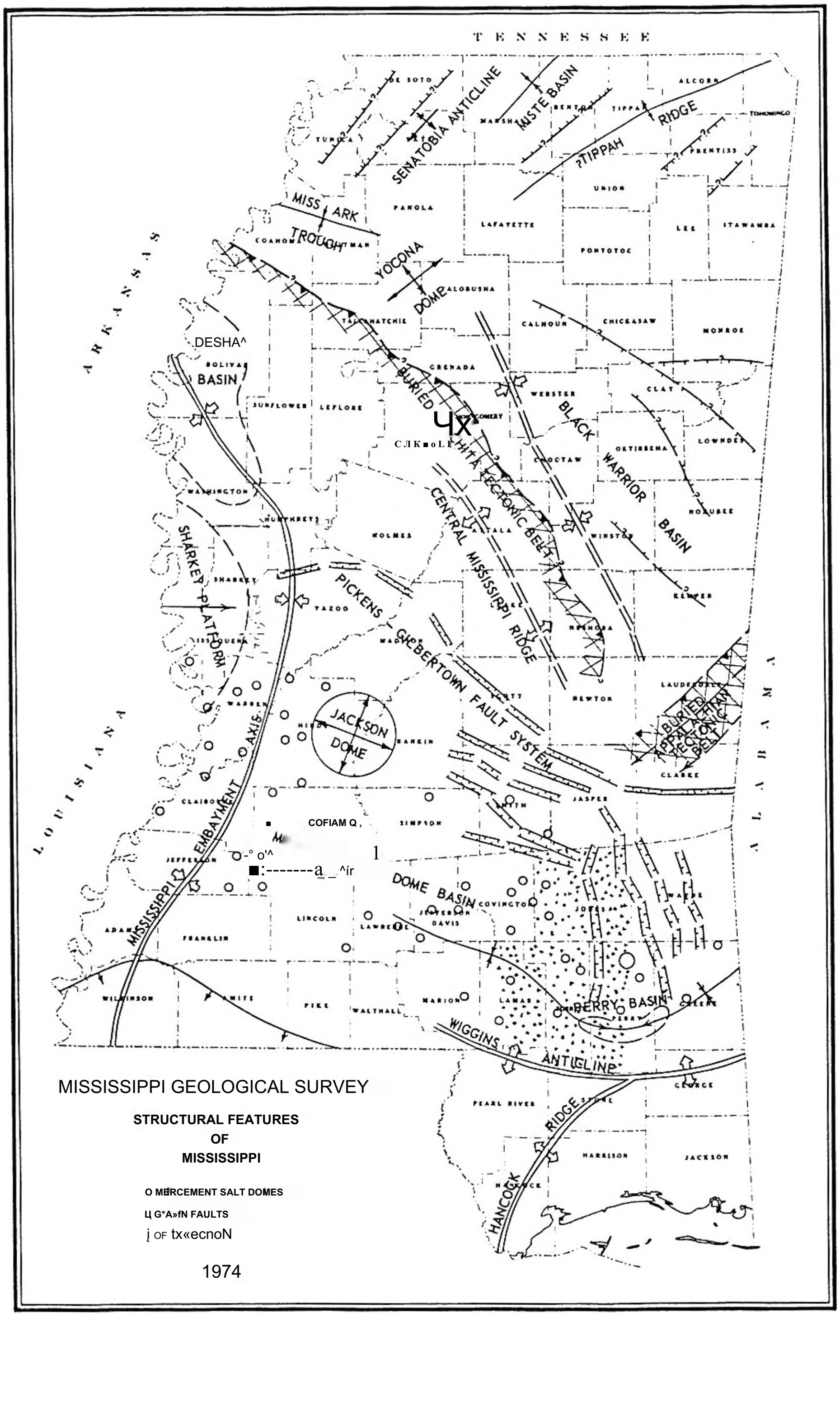


Figure 4. Structural features of the study area (stippled).

areal extent and permeability, the Miocene aquifer system is the largest potential source of groundwater in Mississippi (Spiers and Gandi, 1980)»

PREVIOUS WORK

Aerial gamma ray data for the Hattiesburg two degree quadrangle are reported by E. G. & G. geoMetrics, Inc. (1980). They reported high thorium levels which corresponded well with the Jackson Group outcrop area. The highest peak uranium concentration was found in the Catahoula Formation. Due to a strong correlation of anomalies with cultural features and the uniformly low uranium concentration levels, the authors suggest that the depicted anomalies do not reflect significant u r a n i u m con c en t rations.

An abbreviated report by Bennett (1981) provides uranium concentration data as well as other chemical data for groundwater and stream sediments to the northeast of the report area in southern Choctaw and northern Washington Counties, Alabama. Samples were taken north and south of the Gilbertown fault zone. The Gilbertown fault zone in Choctaw County is about four miles wide and at the surface deforms beds of Claiborne, Jackson, Vicksburg and Miocene-Guaternary age (Copeland and others, 1976).

Bennett (1981) does not indicate which geologic formations were sampled or provide an interpretati on for the data. However, well depths range from 0 feet to 800 feet and thus provide uranium and chemical data on several Tertiary rock units. The mean uranium concentration for groundwater analyses was 0.053 ppb (parts per billion). The minimum uranium concentrati on was 0.007 ppb and the maximum 0.539 ppb. Well depth for the maximum uranium concentrati on is unknown but the next highest (Ø.S22 ppb)came from a well depth et thirty feet and suggests samples from the oxidized zone where uranium is mobile.

Russell (19S2) suggested the presence of a redox front in the Catahoula. Sandstone of southwestern Jones County at ¿4 depth of about 400 feet below mean sea level based on analysis of twenty groundwater samples. Uranium concentrations ranged from 0.004 ppb to 0.072 ppb. $^{234}U/^{238}U$ activity ratios varied from 0.ÓS to 4.4C.

Although several uranium surveys have been conducted by exploration companies, other published data have not been found.

METHODS

Groundwater samples were collected from existing wells in the four county area. Sample size was generally 24.5 liters. The samples were collected and stored prior to analysis in one gallon polyethylene containers.

In the laboratory, samples were decanted or filtered if needed, to remove visible particulate matter. Sample size for each container was adjusted to 3.5 liters. Concentrated nitric acid was added to obtain pH~l, followed by a ferric nitrate carrier and a known activity ^{232}U. Samples were allowed to sit at least 24 hours to promote spike equilibration, before continuing. Following spike equilibration, samples were heated to near boiling in a water bath to remove carbon dioxide. Then coprecipitation of the uranium with the ferric carrier was accomplished by addition of ammonium hydroxide until pH~ll.

Final extraction of the uranium was accomplished using the following procedure. The ferric hydroxide floc was separated and cleaned by decanting, centrifuging and washing. Ether extraction was used to remove the iron. Anion exchange was used to separate uranium from other elements present and the uranium was electroplated onto a stainless steel planchet.

Planchets were analyzed with alpha spectrometers at Florida State University. Additional counting on some of the low concentration samples was provided by Dr. Thomas Kraemer of the U.S. Geological Survey, Naval Systems Testing Laboratory, NSTL Station, Mississippi.

Tempera t ur e, rodox potential (Eh) and hydrogen ion concentration (pH) were measured for most samples« Measurements were made on site, during sample collection«

Temperature measurements were obtained using a Model 4200 Weston thermometer. The scale is Fahrenheit with one degree divisions« Accuracy was checked using a mercury thermometer with 0.01 degree Centigrade divisions.

Redox potential was measured with an Orion Model 401 specific ion meter using a thimble-type platinum electrode and a calomel reference electrode. Electrodes were contained in an Eh measuring cell which allows measurement of well water prior to reaction with the atmosphere. The measuring system was tested for accuracy using a Zobel 1 solution (Zobel 1, 1946) « Measure of Eh on groundwater is considered qualitative data by many hydrachemists because of the ease with which samples may be contaminated. Although precautions were taken, poisoning of the electrode or contami nati on with the atmosphere is always a possibility.

Sample pH was also determined with the Orion 401 specific ion meter. Three buffered solutions were used for cal i brati on.

TREATMENT OF DATA

For each sample, the alpha spectrum peak (Figure 5) corresponding to each of the three uranium isotopes ('^^U, ^{234}U, æ^U) was corrected for background to determine individual isotope activities. The uranium concentration is determined by isotope dilution using the U-232/U-23U activity ratios.

Uranium concentrati on, $^{234}U/^{238}U$ activity ratio and estimated uncertainty was calculated using a Fortran program UWAT written as part of this project. The calculated error •for each sample (Table 1) is based on equations of Jarrett (1946) and is that propagated through multiplication and division in the activity ratio and concentrati on calculations. The errors reported are two standard deviations, representing the 95 per cent confidence level.

The errors reported are based on counting statistics only. Spike calibrations and run blanks during this study indicate that errors due to spike calibrations and reagent blanks are negligible.

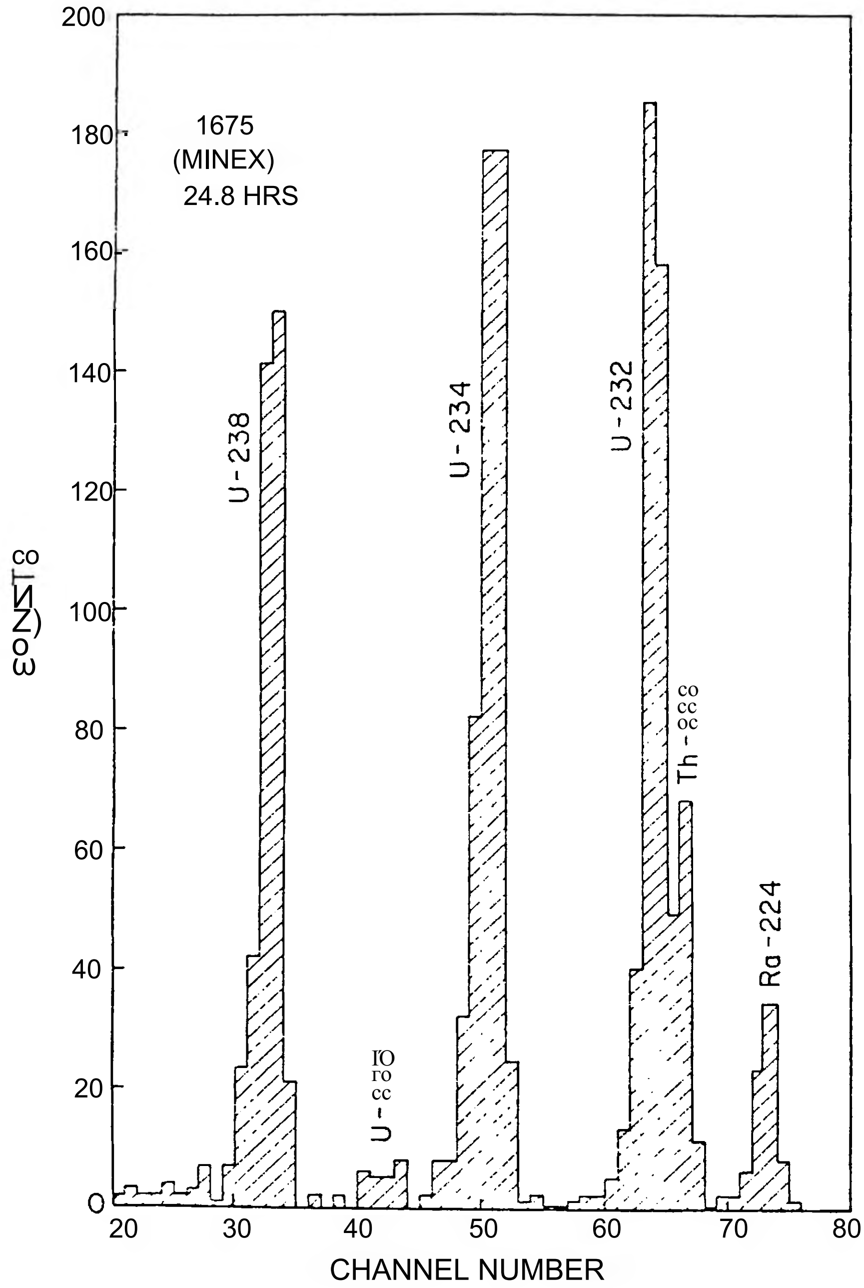


Figure 5. Alpha pulse height analysis spectrum ef uranium in groundwater near an ere body (Cowart and Osmond;, 1900) .

RESULTS

The locations of torty wells sampled during the study are shown in figure 6 and listed in the appendix« Locations were selected to cover the area containing the initial traverse in MHRI #82- 188 (Russel, 1982) « Also, wells near the redox front indicated in the first study were resampled» Ur¿Anium extraction was attempted on all samples to provide? uranium concentration and ^u/^U activity ratio« Temperature, Eh and pH were recorded for most samples«

Uranium concentrati ons and activity ratios, along with estimated analytical errors, are shown in Table 1« Uranium concentrations range fram 0 « 001 ppb (parts per billion) to 0«722 ppb« The average? uranium concentrâtion is 0X0ÜU ppb. activity ratios range from 0.49 to 3.65«

Samp1es with 1ow uranium concentrations (0 « 0 01 -· 0 « 003 ppb) did not always yield meaningful activity ratios. However, even in the samples with low concentrations, where the ana1ytica1 errl"or was approximate1y equa1 to the measured values, concentrati on values are significant since uranium in gl'·oundwater varies by sever a 1 orders of magnitude«

Temperature, pH and Eh data are also listed in Table 1« Temperature for the groundwater ranged from 68 degrees Fahrenheit to 78 degrees Fahrenheit, pH ranged from 5»S to 8.8, and Eh varied from +360 millivolts to --220 millivolts.

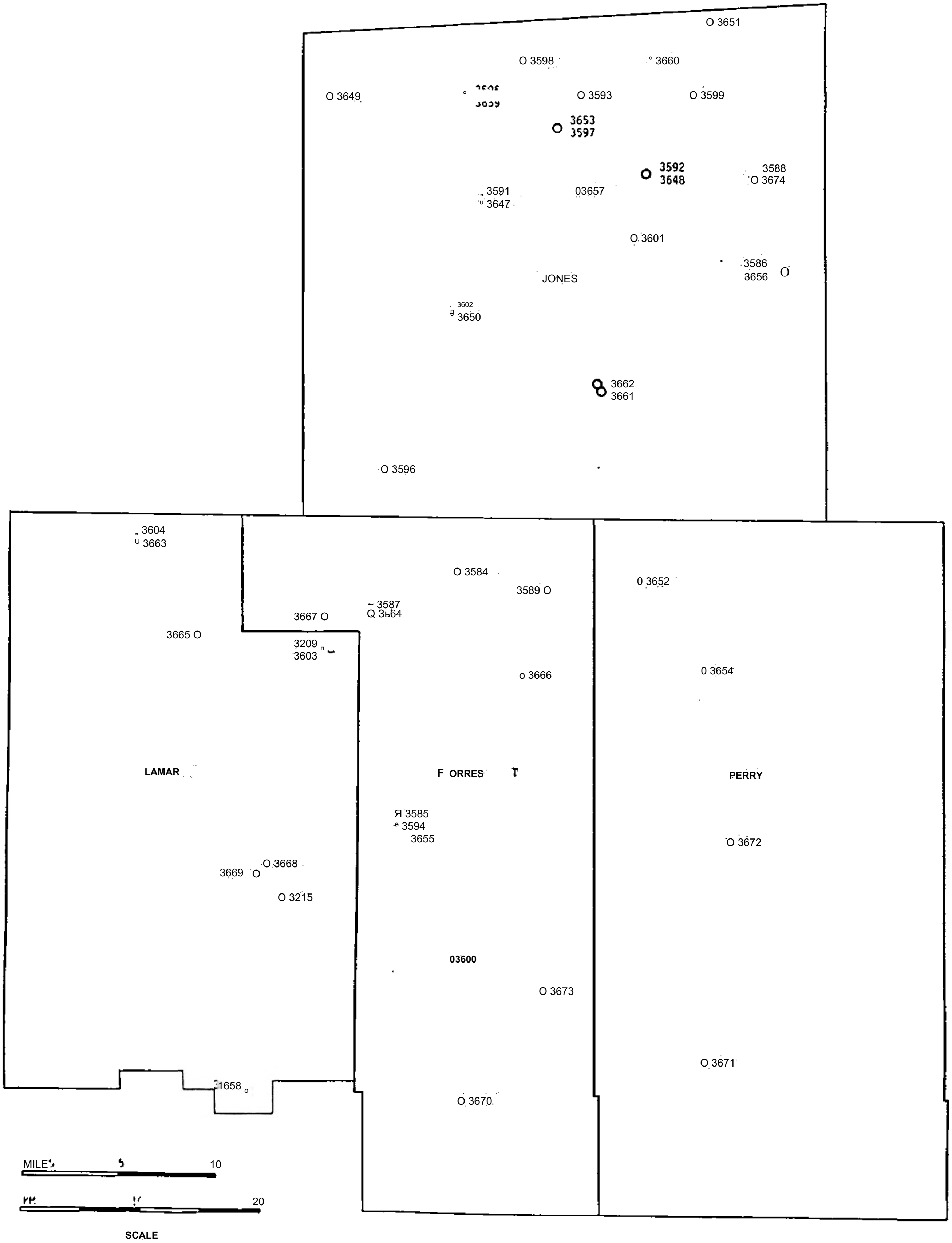


Figure 6. Sample location For MSW samples.

Table 1» Temper ature, p H л Eh and uran i um d ata.

SAMPLE	T (°F)	pH	Eh (mV)	$^{234}U/^{238}U$ ACTIVITY RATIO	URANIUM CONCENTRATION (P ARTS PER DILLION)
MSW-3209	*ND	8. 1	-220	1.71 +/- 1.21	0.003 +/- 0.002
MSW-3215	76	6. 1	— 40	ND	0.002 +/- 0-002
MSW-3584	74	8, 2	- 20	1.38 +/- 0.50	0.012 +/- 0-003
MSW-3585	68	Ó и 1	+280	ND	MD
MSW-3586	71	7. 7	-110	ND	ND
MSW-3587	ND	MD	-130	ND	ND
MSW-3588	69	7-9	- 80	0.74 +/— 0,05	0.208 +/- 0.011
MSW-3589	75	8-4	+ 70	0. 49 +/- 0.19	0.012 +/- 0.003
MSW-3591	68	6 - 1	+210	ND	ND
MSW-3592	70	7. 1	+ 10	ND	ND
MSW-3593	71	8. 1	— 40	0.85 +/- 0.29	0.046 + /- 0.010
MSW-3596	75	7. 7	- 50	3,00 + /- 2.80	0.002 +/- 0.001
MSW-3597	69	6- 7	+ 130	ND	ND
MSW-3598	69	Ь. 7	+ 35	ND	0.001 +/- 0.002
MSW-3599	70	6-8	+ 60	ND	0.001 + /- 0.002
MSW-3600	68	7. 6	+200	ND	0.001 +/- 0,002
MSW-3601	72	7.5	— 20	0.59 + /- 0.59	0.004 + /- 0.002
MSW-3602	73	8-3	— ¿30	ND	ND
MSW-3603	75	7.7	-200	ND	ND
MSW-3604	69	6. 7	+ 180	ND	ND
MSW-3647	68	5-8	+210	0- 64 +/- 0.21	0-048 +/- 0.010
MSW-3648	69	7.5	-160	0. 59 +/- 0.18	0.053 +/- 0.009
MSW-3649	68	7.[illegible]	-110	1 - 03 +/- 0.39	0.008 + /- 0.002
MSW-3650	71	8.8	- 70	2.00 +/— 0.33	0.022 + /- 0.003

Table i- (continued)«

SAMPLE	T (°F)	pH	Eh GnY)	^U/^'U ACTIVITY RATIO		URANIUM CONCENTRATION (PARTS PER BILLION)	
MSW-3651	68	6» 7	- 90	0.92 + /-	0. 23	0.005 + /-	0.001
MSW-3652	72	7.6	-140	0.60 + /-	0.04	0.489 +/-	0. 026
MSW-3653	68	6. 1	·— 7 0	ND		0.003 + / —	0.002
MSW-3654	72	7.3	— 90	3. 40 + / — ·	0.94	0.002 +/-	0.001
MSW-3655	68	œ IK* sU ω	"1-360	1.51 +/—	0.56	0.018 +/-	0.005
MSW-3656	71	8.0	- 80	0 ■ 8 0 + / —	0 „ 30	0.012 + /-	0.003
MSW-3657	68	7.0	ND	0.71 + /-	0.22	0. 006 "1"/ —	0.001
MSW-3658	74	7.9	ND	1.44 + / —	0.55	0.014 + /-	0.004
MSW-3659	69	6.6	.. 6 0	0.76 + /-	0.58	0.005 + /-	0.002
MSW—3660	68	7. 1	-110	1.74 + /-	0.80	0.002 +/-	0.001
MSW -366 1	75	7.8	-200	0.83 +/-	0.27	0. 0 10 + / —	0.002
MSW-3662	75	7.9	-150	0.51 + /-	0. 18	0. 0 19 -f·· / —	0.004
MSW-3663	ND	ND	ND	0.85 + /-	0. 08	0.722 +/-	0.005
MSW—3664	73	7. 1	- 30	1.35 + /-	0. 63	0.003 + / —	0.001
MSW—3665	70	6.3	+160	2.38 + /-	1.03	0.003 + /-	0.001
MSW—3666	75	8. 6	-140	3.65 + /-	1.68	0.004 + /-	0.002
MSW-3667	75	7. 6	ND	1.38 + /—	0. 43	0.002 +/-	0.001
MSW-3668	69	6.2	+250	1.44 + /-	0. 23	0 R 066 + / —	0.008
MSW-3669	ND	ND	ND	1.80 + / —	0.37	0.014 +/-	0.002
MSW-3670	77	8. 0	-130	0.65 +/ —	0. 37	0.007 + / —	0.003
MSW-3671	75	8. 6	- 50	0.51 + /-	0. 2 6	0.010 +/-	0.003
MSW-3672	78	8. 0	-150	0.96 + /-	0.27	0.012 +7-·	0.002
MSW-3673	78	8. 1	— 80	ND		ND	
MSW-3674	69	8.0	- 80	0.71 + /-	0.05	0.280 + /-	0. 017

*NDS No data«

Dup 1 i c at e Ana1 yses

Results of -four duplicate analyses from this study are shown in Table 2. Three of these were repeat analyses of wells reported in MMRI ił 82-188 (Russell, 1982) and one is a duplicate of the sample with the highest concentrâtion found during the initial stages of this study.

The low temperature and high Eh reported for sample MSW-3218 in the earlier study (Russell, 1982) raised a question about the validity of the analysis. The duplicate resulted in a higher temperature and a lower Eh, similar to the other wells in the area, but did not significantly change the uranium data. Apparently the well was not given sufficient time to purge prior to sample collection, however, this had little effect on the uranium data.

Table 2. Duplicate analyses.

SAMPLE	T (°F)	pH	Eh (mV)	^^U/^^'U ACTIVITY RATIO	URAN ï UM CONCENTRATION (PARTS PER DILLION)
MSW-3218*	89	8. 7	+500	3.77 +/- 2.48	0.008 +/- 0.004
MSW-3596	75	7.7	- 50	3. 00 + / — 2. 80	0.002 + /- 0.001
MSW-3225*	73	8.3	—3 4 0	4. 48 'l" /┄ 2. 19	0.008 + /— 0. 004
MSW-3862	75	7.9	-150	.51 "b / ~·· 0. 18	0.019 +/- 0.004
MSW-3228*	74	8.0	-240	0. 88 + /- 0. 40	0.058 + /- 0.021
MSW-3661	75	7.8	-200	0.83 + / ·" 0. 27	0.010 + /- 0. 002
MSW-3588	89	7.9	- 80	0. 74 + / ™ 0.05	0.208 + /- 0.011
MSW—3674	89	8.0	— 80	0.71 + / ┄ 0 » 05	0.280 + /- 0.017

* Data from MMRI 41= 82-188 (Russell, 1982).

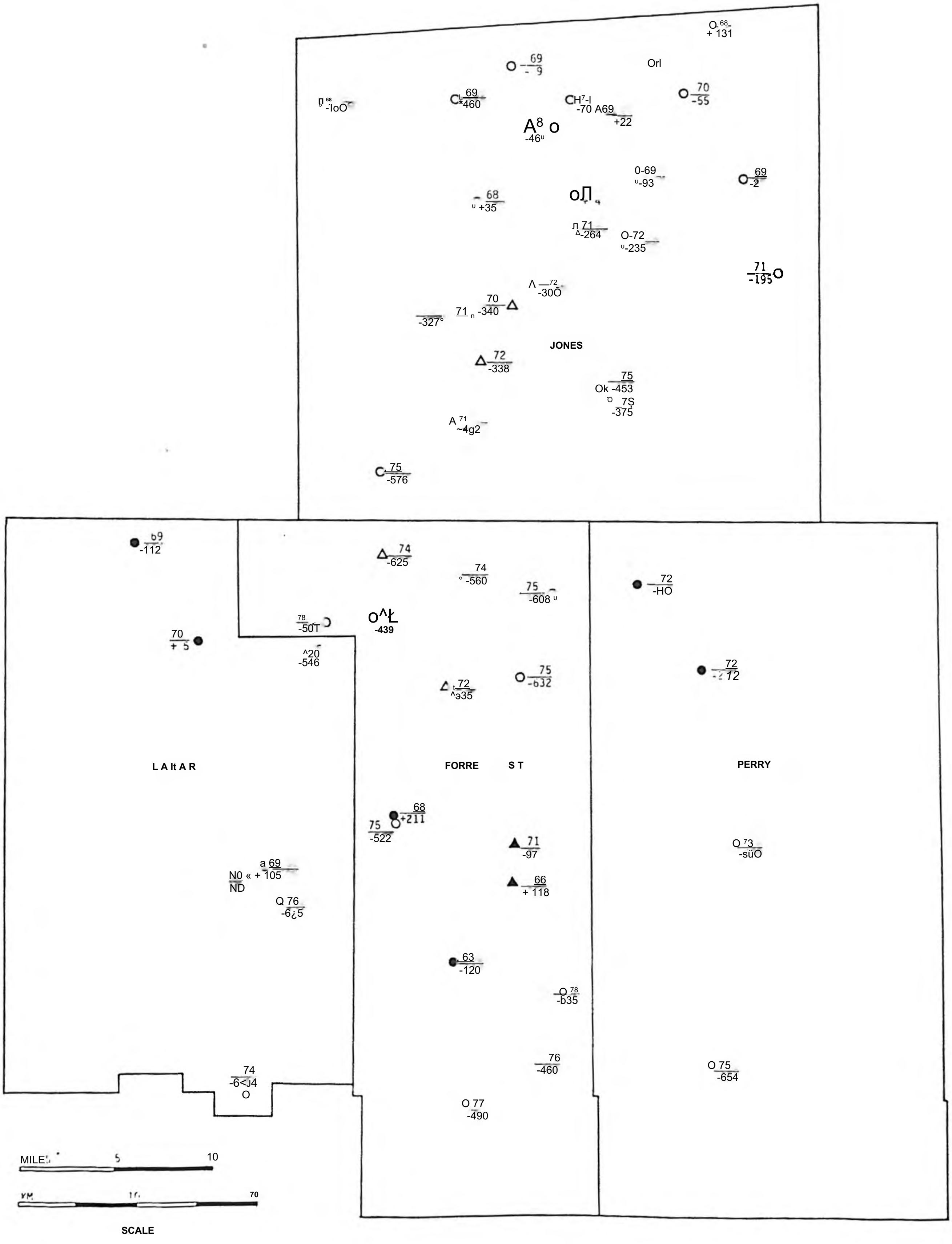
The temperature, pH and Eh values for the other sets of samples agree« Uranium concentrati ens» for the pairs of samples, collected about 8 months apart, show small but significant differences at the 95% confidence level. These differencss are not great enough to inf1uenee the interpretation of the data» The uranium activity ratios agree, within the ana1ytica1 uncertainty, for three of the four sets of duplicates. The significance of the large diiferenee in the activity ratio of samp1e MSW-3225 and MSW-3662 is uncertain but emphasizes the importance of our standard 1aboratory procedure of ana1yzing random duplicates and rechecking values that deviate from the regional trend.

Temperature and we11 depth

Groundwater temperature and well depth relative to mean sea level are shown in figure 7. A general increase in temperature with depth was observed, with shallow wells in the north having lower temperatures and wells to the south having higher temperature and greater depth.

in the north-central portion of Lamar, Forrest and Perry Counties, sampies from both the Ha11iesburg-PaseagoLI1a Formations and Catahoula Sandstone were analyzed. The? top) of the Catahoula was based on cross-sections by Shows and others (1966) and Bentley (1993). Groundwater samples from the Ha11iesburcj-Pascagou1a Formations are shown as solid symbo1s and have consisten11y 1ower temperatures re1ative to neighbol"ingwe11s in the Catahouia Sandstone (Figure 7).

Figure 7. Temperature in degrees Fahrenheit (above line) and well depth relative to mean sea level (be-low line).. Triangles are data from Russell (1902). Open symbols are Catahoula Sandstone wells. Dark symbols are Hatt i esburg/Pascagoul . a Formations wells. MD is no data.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Catahou 1 a Sandstone

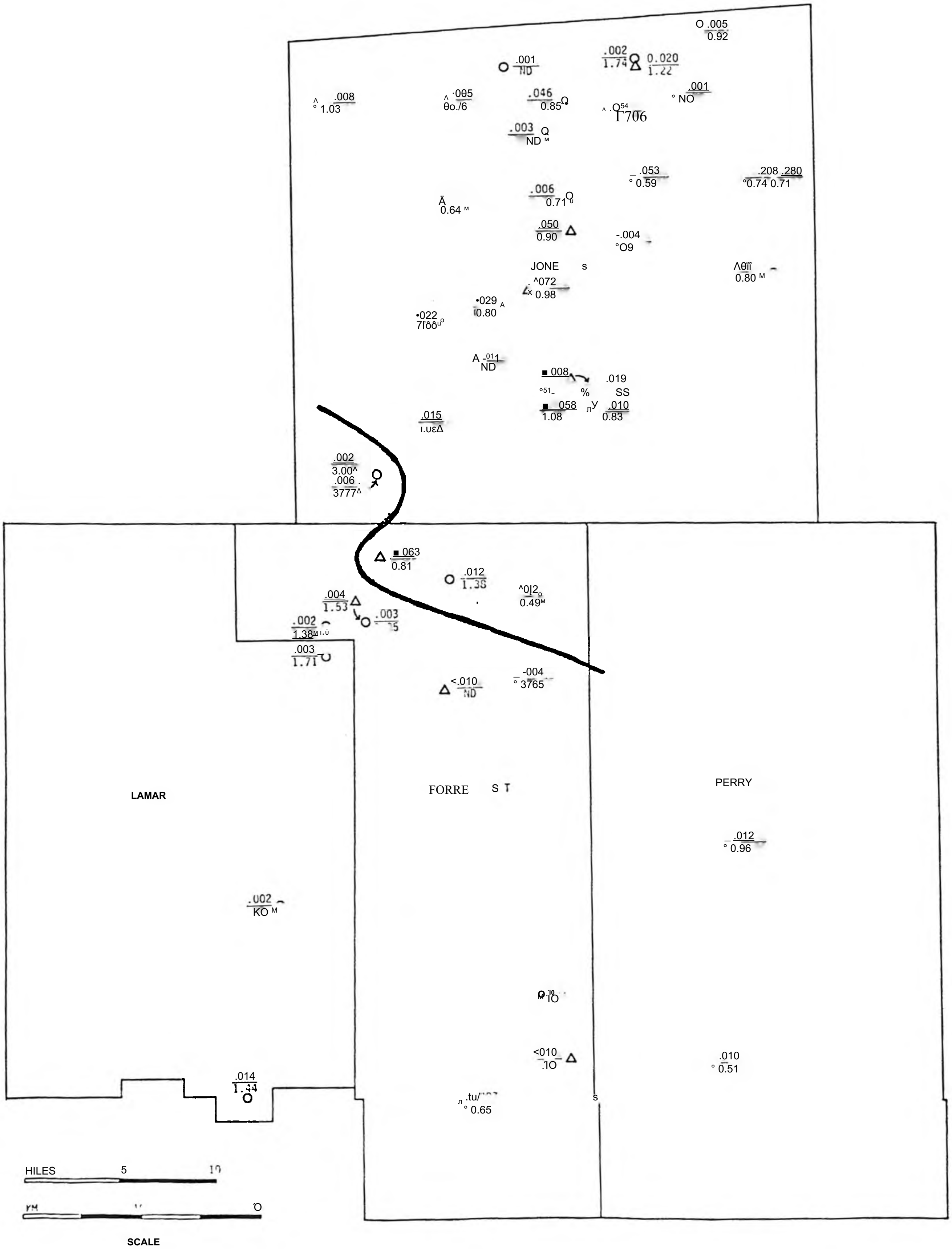
Figure 0 shows 43 uranium analyse® of groundwater from the Cat¿Ahou1a Sandstone« Regional groundwater flow in this area is generally downdip or to the southwest except in high production areas where flowlines are distorted (Shows and othersл 1966)u

(3 l"oundwater uranium concent.r·ation in southern ¿lones anii northernmost Forrest Counties are consistently greater than 0-0165 ppb и [illegible] activity ratios for these samples are generally less than one« The? average uranium concentrati on of groundwater in Jones County was 0 «033 ppb excluding M $3 W -· 3 S 9 6 in the southwest corner»

A sharp decrease in groundwater uranium was observed in northern Forrest County where concentrâtion was reduced from 65 » 012 - 0 « 063 ppb to 0 » 65 02 - 65 «004 ppb« The [illegible] U / ° IJ activity ratios in southwestern Jones and northern Forrest Counties are generally less than or only slightly greater than one to the north of the decrease in concentrâtion » To the southwest, a consistant increase in the [illegible] activity ratio to values greater than one was observed« This is the signature of a reduction копе which would favor deposition of uranium from groundwater according to the model of Cowart and Osmond (1977)»

The shape of a redox front in an aquifer is controlled by water velocity» Large withdrawals from the Catahoula Sandstone in the Hattiesburg area may be controlling the shape of the redox front. (Figure 8, heavy line) in northern Forrest County«

Figure? 8« Uranium concentration (above line in ppb) and $^{234}U/^{238}U$ (below line) from Catahoula Sandstone wells. Triangles are datai from Russel i (1982). ND is no data.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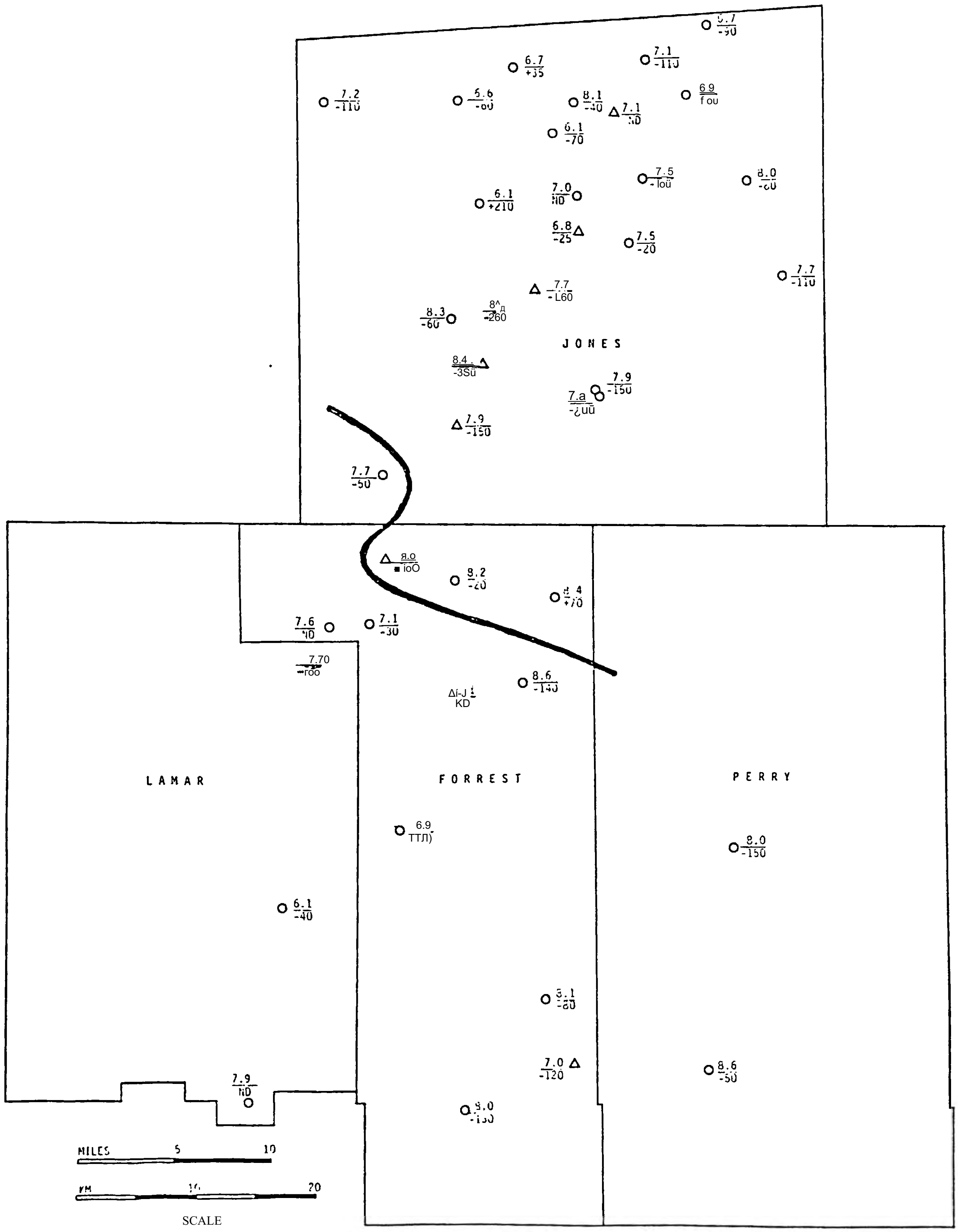
SCALE

Another redox rone *may* be present in the northwest corner of Jones County where concentrati .ons range from 0.001 to 0.008 ppb. Some wells of this area have a strong hydrogen sulfide sme 11, suggesting reducing conditions. The soul"' ce of the hydrogen sulfide is unknown however its presence may be related to local petroleum resero!rs. Uranium depositi» of Texas are commonly 1ocated near petro1eum produotional"' eas.

Figure 9 shows pH and Eh (millivolts) data for sample 1oca1ites in the Catahou1a Sandston e. The pH of groundw¿íter in northern Jones County is greater than 6 but less than eight, increasing to 8.0 and above in southern Jones and northern Forrest, and then decreasing again to the south in the wells with the low uranium concentrations. This trend is similar to that predicted by Boulogne and Mi chard (1979) and illustrated in Figure 2 for a sandstone alteration cone.

Eh values for the Catahoula indicate *a* reducing environment for most of the wells. The few values which suggest oxi die ing conditions should be regarded as suspicious due to the possibility of atmospheric contamination.

Figure 9. pH data (above line) and Eh data (below lins in millivolts) from Catahoula Sandstone wells. Triangles are data from Russell (1982). MD is no data.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1-1 a t; t' i e få b u r g / P a s c: a g o Lı 1 a F o r m a t i o n få

F i g u r[1] e 10 в h o w få u l"' a ri i um g r o u n d w a t. e r d a ta for t h e 14 a t1, i e s -- b u r g / P a få c a g o u la F o r m a t, ions (u n d i f -f e r e n 't: ita t ed). R e g i o n a 1 g r o u n d w a 'h e r f 1 o w f o r- t. h e H a 1.1 i e få b u r g / P a в c a g o u J. a F o r m a t i o n s i s generally downdip or to the fåouthwest (Shows and others, 1966)-

The hi g he st urani u m co n cen t r a t i o n f ou nd i n t his s tu d y, 0-722 ppb, was in northern Lamar County (MSW-3663). The second highest was in northern Perry County, 0.489 ppb (MSW-3652) « T h e s e conc: e n t r a t i o n s f r o m the H a 11 i e s b u r g / P a в c a g o u 1 a Formations are an order of magnitude larger than those from the Catahoula Formation- The high concentrations are associated with activity ratios less than one.

This high uranium concentration is reduced by two orders of magnitude to the south where concentrations are 0-002 to 0.003 ppb. The low concentrations have activity ratios greater than one. Although there were few wells s a m p 1 e d i n t h i s a l"' e a, d u e t o g l"' e a t er utilis a t i o n o -f t li e deeper Catahoula, the data suggest the presence of a reducing barri er -

Figure 11 shows pH and Eh data for the Hattiesburg/Pascagoula Formation samples. Values for pH tend to be lower than in the underlying Catahoula Sandstone, but a decrease similar to that predicted by ßoulegue and Mi chard (1979) was observed a c r o s s t h e p r o p o s e d r e d u c i n g 2 o n e »

Fi gure 10. Uranium concentration (above line in ppb) and $^{234}U/^{238}U$ activity ratio (below line) from Hatt i esburg-Pascagoul a Formations wells. Tri ¿angl es are data from Russel 1 (19(32). ND is no data.

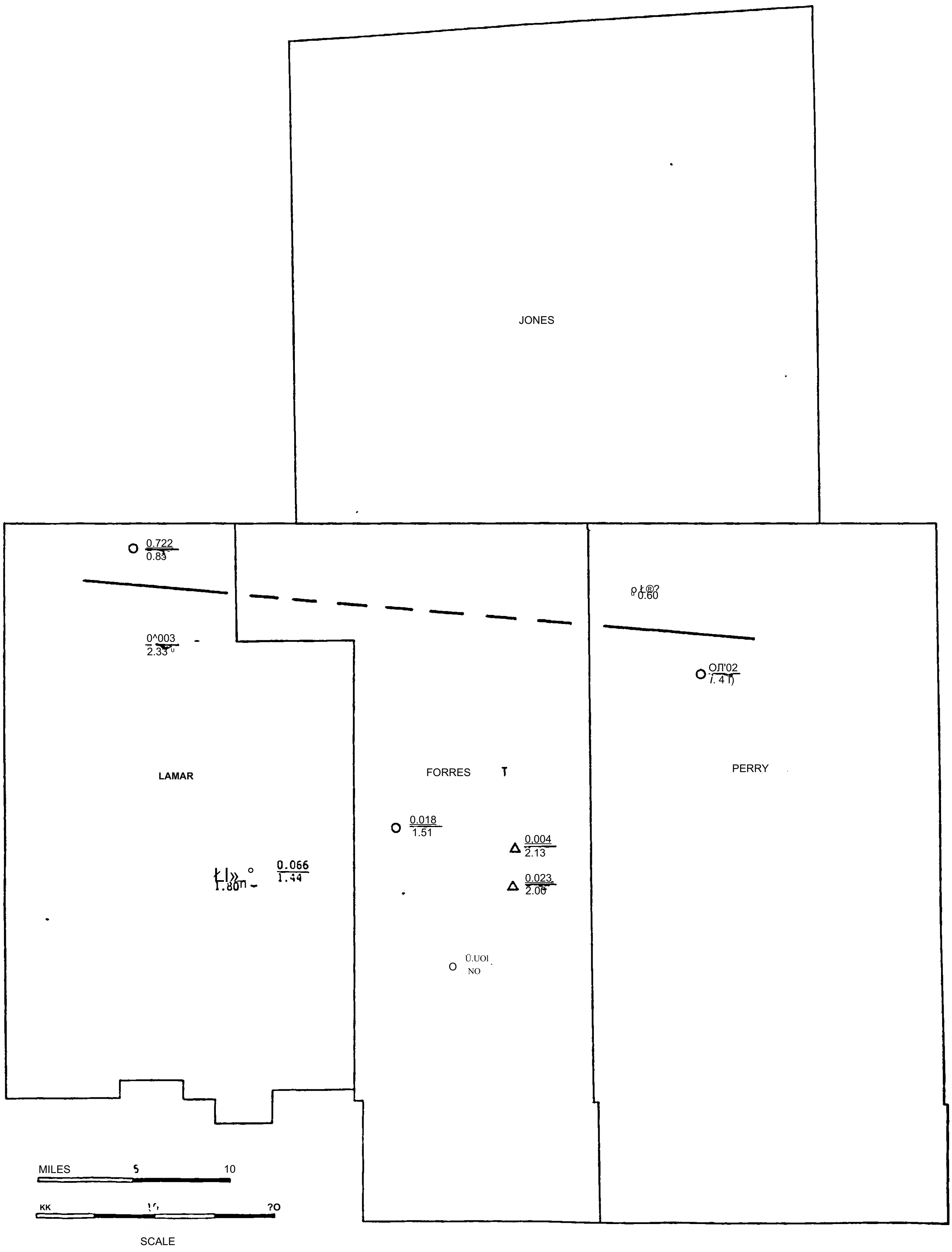
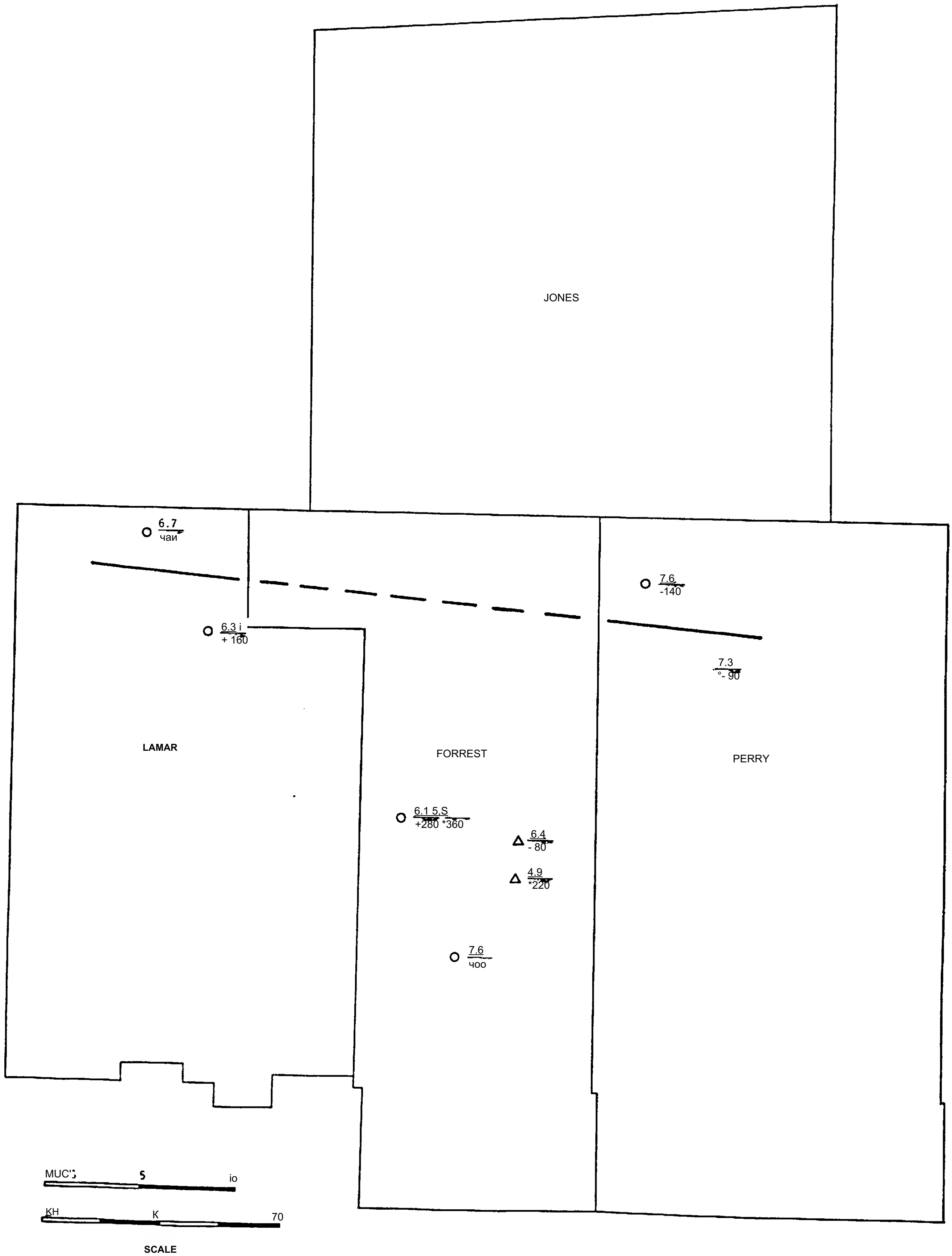

JONES
0.722
0.83
0.60
0.003
2.33
LAMAR
FORRES
PERRY
0.018
1.51
0.004
2.13
0.066
1.44
1.80
0.023
2.06
MILES 5 10
SCALE

Figure il. pH data (above line) and Eh data (below line in millivolts) trom Hattiesburg/Pascagoula Formations wells» Triangles are datât from Russell (1982)» MD is no data»


JONES
6.7
7.6
-140
6.3
+ 160
7.3
LAMAR
FORREST
PERRY
6.1
+280
6.4
- 80
4.9
7.6
70
SCALE

CONCLUSIONS

This report conci udes a reconnaissance study of Jones and Forrest Counties beginning May 1, 1902 (MMRI 82-188) « The objective has been to search for areas with chemical environments favorable for the deposition of uranium using hydrogeochemical and isotopic techniques.

Trends in groundwater uranium data for the Catahoula Sandstone and the Hattiesburg/Pascagoula Formations are similar to that observed by Cowart and Osmond (1977 and 1980) for Texas deposits. For the Catahoula Sandstone there is a decrease in uranium concentrâtion and an increase in ^7.'^HJU/activity ratios in northern Forrest and south-western Jones Counties at a depth of approximately 500-600 feet below mean sea level, suggesting a redox front in this area. This is slightly southwest of the area proposed in MMRI 82-18S (Russel 1, 1902).

A similar trend was observed in the Hattiesburg/Pascagoula Formations, suggesting a redox front in northern Lamar, Forrest and Perry Counties at a shallower depth (less than 300 feet below mean sea level).

pH trends are similar to those predicted by Boulogne and Michard (1978) for an alteration roпe in sandstone and support the uranium data in suggesting redox fronts.

Greater concentrâtions of uranium were found in the Hatt ei esburg/Pascagoul . a Formations. The data are limited but suggest greater uranium mobility due to the slightly lower pH and probable greater oxygen content than the underlying Catahou1a Sandstone»

A11hough the aver¿age uranium r.:oncentration is simi1ar to that found by Benne11 (1981) for A1abama groundwatel"₉ the largest single concentration, 0.722 ppb, is greater than Bennett*s (1981) maximum of 0.539 ppb.

Areas suggested above should not be interpreted as the site of an economic ore deposit. However, the study does indicate the location of environments favorable for the deposition of uranium from groundwater„ These areas would be candidates for detai1ed geochemica1 and hydro1ogic studies.

ACKNOWLEDGMENTS

Contributions by the following during this study were greatly appreciated. The University of Southern Mississippi provided laboratory space. Dr. James B. Cowart of Florida State University provided access to alpha spectrometer facilities. Dr. Thomas Kraemer of the U.S. Geological Survey, Naval Systems Testing Laboratory provided additional alpha spectrometry. Lynda O'Brian assisted in the laboratory. Dr. Gail S. Russell assisted in editing the manuscript.

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/-WEND IX

SAMPLE	OWNER	COUNTY	SEC-TION	TOWN-SHIP	RANCE	WELL DEPTH (FT)	*DEPTH CMSL3 (FT)
MSW-3209	Arnold Line	Lamar	02	04N	14W	786	-546
MSW-3215	Purvis Otii«	Lamar	16	02N	14W	975	-625
MSW-3584	Eastabuchi e Water Assoc.	Forrest	13	05M	13W	810	-560
MSW-3585	Dixie Water Assoc «	Forrest	20	03N	13W	164	+211
MSW-3586	Myrick Mill Water Assoc-	Jones	34	08N	10W	540	-195
MSW-3587	Hatt i osburg Well # 5	Forrest	32	05N	13W	621	-461
MSW-3588	Myrick Mill Water Assoc »	Jones	35	09 N	10W	[illegible]	- 42
MSW-3589	Barrontown Utility	Forrest	23	05 N	12W	900	-608
MSW-3591	Pl easant Ri dge Water Assoc «	J ones	07	ØSN	12W	385	+ 35
MSW-3592	Powers Water Assoc.	Jones	33	09N	UW	385	- 93
MSW«3593	Shady Srove Water Assoc-	J ones	13	09N	12W	360	- 70
MSW—3594	Dixie Water Assoc-	Forrest	20	03N	13W	897	-522
MSW—3595	Saso Water Assoc.	Jones	13	09 N	13W	470	— 160
MSW—3596	Pine Belt Ai rport	Jones	20	06N	13W	886	-576
MSW—3597	Calhoun Water Assoc —	Jones	22	09N	12W	400	- 46
MSW-3598	Matthews Moss Water Assoc-	Jones	05	09N	12W	314	···· 9

SAMPLE	OWNER	COUNTY	SEC-TION	TOWN™ SH IP	RANGE	WELL DEPTH (FT)	•«•DEPTH ĽMSL3 (FT)
MOW-3599	Errata Water Assoc.	Jones	12	09 N	11W	255	4- 55
MSW-3600	J « EL Sachs Resi d en c e	Forrest	35	02N	13W	200	-120
MSW-3601	01 ado Water Assoc -	Jones	21	ØGN	11W	475	-23[illegible]
MSW ·и"30 02	Water Assoc, of Pine	Jones	11	07N	13W	677	-327
MSW-3603	Arnold Line	Lamar	02	04N	14W	786	-546
MSW-3604	Sumrall Util-	Lamar	07	05 IM	15W	382	-112
MSW-3647	P leas a n t R idge Water Assoc «	Jones	07	ØGN	12W	385	"Ϯ" 35
MSW-3648	Powers Water Assoc «	Jones	35	09N	11W	385	- 93
MSW-3649	Hatten Water Assoc -	J on es	14	09M	14W	480	-160
MSW-3650	Water Assoc, of Pine	Jones	И	07M	13W	677	-327
MSW-3651	Sandersvi lie Water Assoc-	Jones	30	1ØN	10W	184	+131
MSW-3652	Runnel stown Utility	Perry	21	05N	11W	380	-130
MSW-3653	Calhoun Water Assoc.	Jones	22	09N	12W	400	- 46
MSW-3654	Runnel stown Utility	Perry	12	04N	11W	512	-27^·2
MSW-3655	Dixie Water Assoc «	Forrest	20	03N	13W	164	4-211
MSW—3656	Myrick Mill Water Assoc.	J ones	34	ØGN	10W	540	-195
MSW-3657	Dixie Golf Course	Jones	11	ØGN	12W	206	•i·* 4

SAMPLE	OWNER	COUNTY	SEC-TION	TOWN-SHIP	RAMCE	WELL DEPTH (FT)	*DEPTH E MOL (FT)
MSW-3650	Lumberton Utili ty	Lamar	31	01N	14W	074	—6 0 4·
MSW-3659	Sosa Water Assoc «	J ones	13	09N	13W	470	-160
MSW-3660	Sharon Water Assoc.	Jones	34	IØM	uw	259	… φ
MSW-3661	J & P Water Assoc «	Jones	31	07N	uw	760	-375
MSW-3662	J & P Water Assoc «	Jones	31	07N	1 IW	013	-453
MSW—3663	Sumrall Util«	Lamar	07	05N	15W	302	-112
MSW-3664	Hatti esburg Well # 2	Forrest	IS	04M	13W	600	-439
MOW—3665	West Lamar Water Assoc«	Lamar	03	04N	15W	425	4- 5
MSW-3666	Sunri se Utility	Forrest	09	04N	12W	094	—632
MSW-3667	Hatti esburg Country Club	Forrest	3S	05N	14W	757	—503
MSW-3668	Progress Water Assoc.	Lamar	05	02N	14W	265	4-105
MSW-3669	Coal town Bapt. Church	Lamar	06	02N	14W	ND	ND
MSW-3670	Carnes Utility Assoc.	Forrest	02	øl S	13W	820	-460
MSW—3671	Janice Water Assoc «	Perry	25	øl N	uw	952	-654
MSW—3672	New Augusta Uti lity	Perry	30	03 N	10W	1090	—900

SAMPLE	OWNER	COUNTY	SECTION	TOWNSHIP	RANGE	DEPTH (FT)	WELL DEPTH CMSLJ (FT)
MSW-3Ó73	Brooklyn Water Assoc «	■ Forrest	10	01N	12W	850	-835
MSW-3674	Myrick Mill Water Assoc«	Jones	[illegible]	09N	10W	35.2	- 42

* Well depth relative to mean seat level,
ND: No data«