RADIUM CONTENT OF CENTRAL

MISSISSIPPI SALT BASIN BRINES

U.S. GEOLOGICAL SURVEY

Open-File Report 87-694

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By T. F. Kraemer

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Forth convenience of reorders who may prefer to use matrix (International System) units rather then the inch - pound unit used in this report, values may be converted by using the following factors:

Multiply inch -pound unit	by	To obtain matric unit
	Length	
inch (in)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow	
foot per day (ft^2)	0.3048	meter per day (m/d)
foot squared per day (ft^2 /d)	0.0929	meter squared per day (m^2/d)
gallon per minute (gal/min)	0.0630	liter per second (L/s)
	3.785×10^3	cubic meter per minute (m^3/min)

To convert temperature in degree Celsius (°C) to degree Fahrenheit (°F), multiply by 9/5 and add 32.

dpm/L = disintigration per minute per liter.

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By T. F. Kraemer

ABSTRACT

Seventeen wells in the Central Mississippi Salt Basin were sampled for radium analysis. All brines contained ^{226}Ra activities greater than 500 disintigrations per minute per liter (dpm/L) with the highest activity being 2318 dpm/L. ^{228}Ra was more variable with values of less than 50 dpm/L from the Smackover Formation to 2897 dpm/L for the sample from rocks equivalent to the Washita and Fredricksburg Groups. Most of the sample ^{226}Ra values define a salinity and radium-226 trend found for other formation waters from the northern Gulf of Mexico Basin.

INTRODUCTION

One objective of this report is to summarize radium and salinity data collected in 1984 from the Central Mississippi Salt Basin. Waters from formations in this basin are typically very saline and have been extensively studied (Carpenter and others, 1974), but no data to date have been available on radium distribution in these waters.. Samples were collected from 17 wells representing in descending order the Eutaw Formation, Tuscaloosa Group, equivalents of the Washita and Fredericksburg Groups, Paluxy, Rodessa, Sligo and Hosston Formations all of Cretaceous age, and the Smackover and Norphlet Formations of Jurassic age.

Another objective of this report was to see if the radium-salinity relation found by Kraemer and Reid (1984) for the Northern Gulf of Mexico basin was valid for the Central Mississippi Salt Basin. If so, a convenient method for estimating radium content from salinity would be available for these brines.

All wells sampled were oil and/or gas wells producing various quantities of water. The water was thought to represent true formation water unaltered by chemicals used in oil production or condensation from natural gas.

SAMPLING AND LABORATORY PROCEDURES

Brine samples were taken from producing wells at the well head or along the tubing leading to oil-water-gas separators, but as close to the well-head as possible. The wells were sampled only during periods of active water production and transported back to the laboratory for analysis within a matter of days to prevent possible difficulties in analysis such as could occur as reported by Kraemer and Reid (1984). In this way problems of precipitation of barium-radium sulfate in separators or in sample bottles during long storage periods were eliminated.

In the laboratory, 250 ml (milliliter) of sample was added to a bubbler flask and the radium determined by the radon emanation technique (Thatcher, and others 1977). The sample is purged of all radon, sealed for a measured period of time, and the amount of regenerated radon purged and measured. The amount of radium required to generate the measured activity if radon is calculated. After at least two repetitions of the above procedure the sample was removed from the flask and placed in a beaker. $Ba(NO_3)_2$ was added to the sample and mixed. A solution of 17% (per cent) H_2SO_4 was then added to the sample to precipitate radium as a barium-radium sulfate. This precipitate was filtered and, if necessary, washed in distilled water to remove $CaSO_4$. The precipitate was placed on a calibrated high-purity germanium detector for determination of the $^{228}Ra/^{226}Ra$ activity ratio following procedures established by Michel and others (1982). The ^{228}Ra activity was then calculated by multiplying the activity ratio by the ^{226}Ra activity.

RADIUM CONTENT OF BRINES

Results of the analyses are presented in table 1. Salinity and chloride data are from Kharaka and others (in press). Total dissolved solids ranged from 157,000 to 333,100 mg/L (Milligrams per liter). Figure 1 shows that the high salinity brines of the Central Mississippi Salt Basin seem to fall on or near the same trend as the Northern Gulf of Mexico Basin samples of Kraemer and Reid (1984), although the relation does not appear to be precise enough to predict radium content accurately from salinity data alone.

The ^{228}Ra data are more variable than the ^{226}Ra data, with the lowest values of 50 dpm/L occurring in the Smackover samples. This is most probably because the Smackover, an oolitic limestone, contains abundant uranium (the progenator of ^{226}Ra) but relatively little thorium (the progenator of ^{228}Ra). The other formations apparently contain enough detrital material to generate significant activities of ^{228}Ra from the thorium present.

During the analysis program the samples were also run for uranium isotopes. Unfortunately, because of interference from another radioelement, uranium could not be determined accurately in many samples although it was most probably present only in sub-microgram per liter quantities, as found by Kraemer (1981) and Kraemer and Kharaka (1986) for samples from similar environments in the Northern Gulf of Mexico Basin. The interfering radioelement was most likely ^{210}Po, which although not accurately measured, was present in unexpected high activity. This raises the possibility of its parent isotope, ^{210}Pb, a beta emitter, also being present in considerable activity in these waters. Although this isotope was not measured, analytical data does show high Pb values in many of the samples (Kharaka and others, [in press], Carpenter and others, 1974).

SUMMARY

Radium isotopes in various brines from the Central Mississippi Salt Basin have been determined. High salinity correlates with high ^{226}Ra content, although not sufficiently to use salinity to precisely predict radium activity in the brines. Radium -228 is much more variable, being as high or higher than ^{226}Ra in brines from clastic formations to less than 50 dpm/L for the Smackover oolite formation.

Polonium -210 is also abundant in many of the Central Mississippi Salt Basin brines, although the exact activities could not be determined. By inference ^{210}Pb, the parent of ^{210}Po, is also probably present in the brines in high activity.

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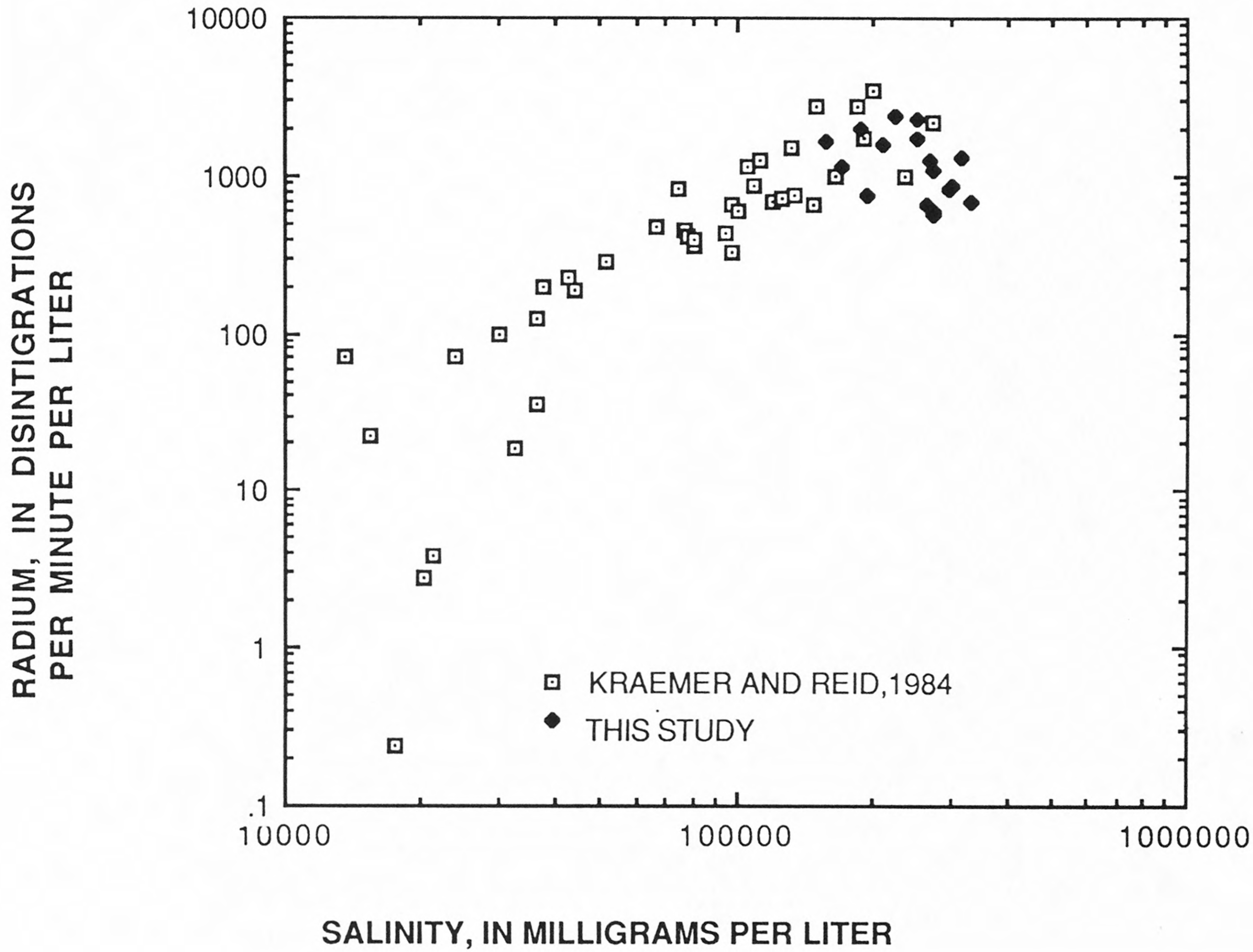
Table 1.-- Radium-228, radium-226, total dissolved solids and chloride content of samples from Central Mississippi Salt Basin.

[mg/L = milligrams per liter, dpm/L = disintigrations per minute per liter]

Well	Field	Formation	Total Dissolved Solids* mg/L	Chloride* mg/L	^{226}Ra dpm/L	^{228}Ra dpm/L
28-7-2	Soso	Paluxy	225,000	140,000	2318	2341
21-15-2	Soso	Tuscaloosa	194,000	120,000	739	907
McCullough et al	Soso	Eutaw	157,000	95,000	1661	1498
Central Oil 5-6	Raleigh	Hosston	268,000	166,000	1265	1225
T.H. Lucky 1	Raleigh	Hosston	274,000	169,000	1108	798
H. Currie 6	Raleigh	Sligo	212,000	127,000	1576	1595
Geiger Cupp 9-13-1	Reedy Creek	Washita-Fredericksburg equivalent	253,000	158,000	1696	2897
Sara Bemis 10	Reedy Creek	Paluxy	250,000	159,000	2258	1831
Walker 2-1-1	Reedy Creek	Tuscaloosa	188,000	116,000	1998	2174
Geiger 2-1	Reedy Creek	Rodessa	316,000	198,000	1327	682
Walker 2-2	Reedy Creek	Lower Eutaw	170,000	105,000	1114	749
Tony 1	Sumral	Smackover	295,000	184,000	825	<50
Tony 2	Sumral	Smackover	301,000	190,000	848	---
Jessie Allen, 1-N	E. Nancy	Norphlet	333,000	201,000	698	814
Allen estate, 2-7	E. Nancy	Smackover	266,000	165,000	664	<50
West 6-11-1	W. Nancy	Smackover	273,000	170,000	573	---
West 6-6-1	W. Nancy	Smackover	273,000	171,000	590	<50

*Total dissolved solids and chloride data from Kharaka and others (in press).


10000
1000
100
10
1
.1
10000
100000
1000000
RADIUM, IN DISINTIGRATIONS
PER MINUTE PER LITER
SALINITY, IN MILLIGRAMS PER LITER
KRAEMER AND REID,1984
THIS STUDY