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Uranium and Thorium Content of Some Sedimentary and Igneous Rocks from the Rolla 1° X 2° Quadrangle, Missouri

By

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INTRODUCTION

Uranium and thorium contents of 175 samples of Precambrian and overlying sedimentary rocks from 28 drill holes in the Rolla 1° X 2° quadrangle, Missouri, were determined in 1978 as part of the NURE (National Uranium Resource Evaluation) effort of the U.S. Department of Energy to assess uranium potential in the United States. The limited number of drill-hole samples analyzed and the great distance between drill holes does not provide sufficient analytical data for an evaluation of the uranium potential in the quadrangle. However, because NURE studies in the quadrangle have been recessed, the data at hand are being made available in this report.

In a study of outcropping Precambrian rocks of the St. Francois Mountains in the Rolla quadrangle, Nash (1977) reported the granites contained 1.78 to 34 ppm (parts per million) uranium and were potential source rocks for uranium deposits in intragranitic veins and onlapping Cambrian sedimentary rocks. He further reported that "...The most radioactive is the Graniteville Granite which contains an average of 16.9 ppm U and 42.6 ppm Th. The Butler Hill and Breadtray Granites also contain anomalous amounts, averaging 6.2 and 5.6 ppm U and 23.5 and 20.5 ppm Th respectively. Other Precambrian granitic rocks have normal concentrations of U and Th.".

The location and drill-hole numbers of the 28 drill holes included in this study are shown on figure 1. Missouri log numbers, county names, sections, townships, and ranges, formations, depths, lithologies, and analytical results are shown in table 1.

PURPOSE

The 175 rock samples for uranium and thorium analyses were selected to 1) determine the uranium and thorium content of lower Paleozoic stratigraphic units in the quadrangle, and 2) test the conceptual model of uranium accumulation in basal sandstones, conglomerates and arkoses that onlap the Precambrian igneous rocks. Nash's speculative model (1977) of uranium association with the lead, zinc, copper, cobalt, and nickel deposits of the southeast Missouri lead district was not tested because none of the drill holes are within the main zones of mineralization. The conceptual model of uranium in intragranitic veins was not tested, because not all drill holes penetrate Precambrian rocks and none penetrate them more than a few meters.

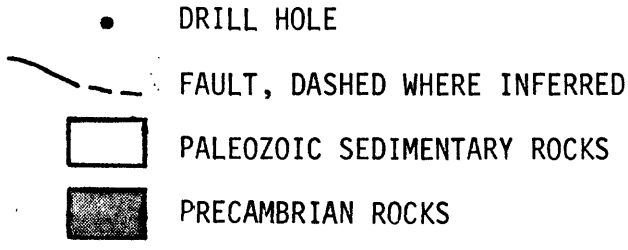
ANALYTICAL METHODS

Uranium and thorium contents were determined by the delayed-neutron technique. Details of the procedure are given by Millard (1976). The samples were pulverized to minus 140 mesh (0.105 mm) in a vertical grinder with ceramic plates. An average sample weight of 8 g was used for each analysis, with weights ranging from 1.2 g to 10.4 g depending on the sample. Precision for U and Th is computed from counting statistics and varies with the weight of sample available, the concentration of these two elements in the sample, and the Th/U ratio. Results are generally precise and accurate within 8 percent (2σ) for uranium and 22 percent (2σ) for thorium. In those cases where counting statistics indicate a precision worse than 60 percent (2σ) concentrations are reported as less than the upper detection limit.

RESULTS

No attempt is made to interpret the analytical results in terms of assessment of uranium resource potential in the quadrangle because of the limited scope of the investigation. However, the results do give some indication of the uranium and thorium content of various rock units in the quadrangle. The analytical results (table 1 and 2) show that the sedimentary rocks contain only small amounts of uranium and thorium ranging from 0.20 to 11.1 ppm uranium and from 1.4 to 27.5 ppm thorium. As expected, the basal arkose and conglomerate of the Lamotte Sandstone contain the highest amounts of both uranium and thorium and the carbonate rocks contain the lowest amounts (table 2). Most of the uranium and thorium probably are contained in detrital Precambrian granite grains and fragments incorporated in the onlap sediments. The Precambrian rocks analyzed in this study (23 samples) contain as much as 8.69 ppm uranium and 27.6 ppm thorium and average 3.31 ppm and 11.6 ppm, respectively (table 2). The highest uranium content in Precambrian rocks reported in these analyses occurs in drill hole 33 in the Belleview basin. The basin is underlain by Graniteville Granite which is exposed in the eastern edge of the basin. Kisvarsanyi and others (1978) describe this granite as "a distinctive tin granite containing up to 30 ppm Sn, 80 ppm Nb, 150 ppm Y, 43 ppm Th, 17 ppm U, 10 ppm Be and 0.6 percent F occurring in a broad belt west and south of the St. Francois Mountains."

Although higher concentrations of uranium in basal onlap sediments may be found elsewhere in the area, especially in areas adjacent to or underlain by Graniteville Granite or similar granites, the analytical results from this suite of samples give little indication that appreciable amounts of uranium have been mobilized from the Precambrian granitic rocks of the St. Francois Mountains and concentrated in the onlapping clastic sediments of Cambrian age.



Structure after Heyl and others (1965) and Pratt (1978)

Stratigraphic column after Thacker and Anderson (1977) and Kisvarsanyi (1976).

FIGURE 1.--Location of drill holes studied in the Rolla 1° X 2° quadrangle, Mo., and generalized stratigraphic column of units sampled.

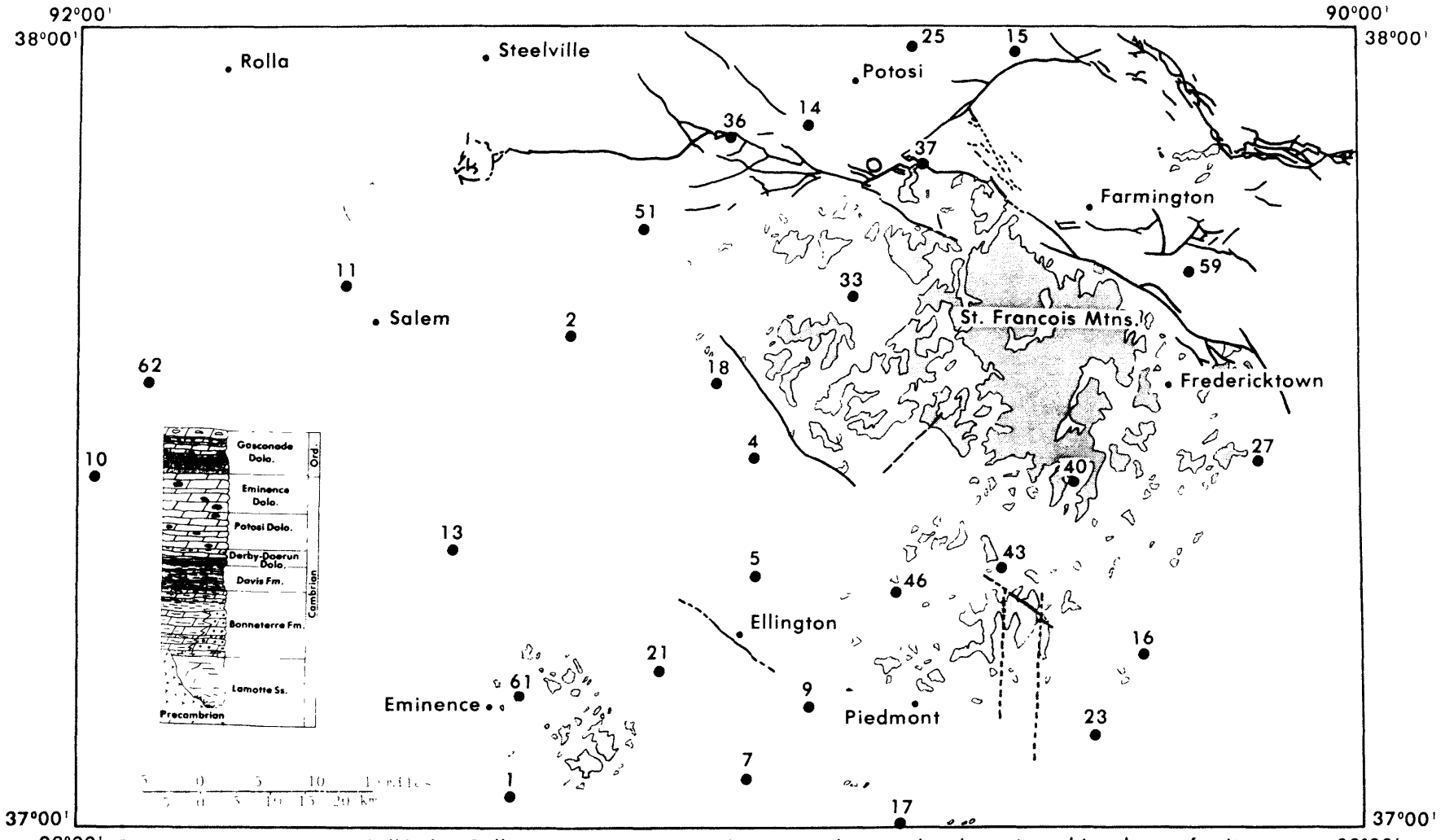


Fig. 1. Location of study drill holes, Rolla, Missouri 1° X 2° quadrangle and generalized stratigraphic column of units sampled

EXPLANATION OF DATA IN TABLE 1

Missouri log number, county name, and location allow correlation with the stratigraphic logs on file at the Missouri Division of Geology and Land Survey in Rolla, Mo. Bendix tag numbers are assigned to all NURE samples.

Drill Hole Number--Corresponds to numbers assigned drill holes in Erickson and others, 1978. Only 28 of the 62 drill holes were selected for use in this study. Locations are shown in figure 1.

Depth of Sample--Each sample represents a 10-foot interval whose lower limit is the depth stated.

*--These samples represent a drill core transition from very weathered granite porphyry rubble and arkose to fresh, unaltered granite porphyry. The samples are not 10-foot intervals, but represent the interval from the listed depth to the depth of the preceding sample.

Formation--A generalized stratigraphic column for southeast Missouri is shown in figure 1.

Th/U--Only given when neither U or Th is qualified by a less than (<) value.

Formation and lithology determined from strip logs prepared by the Missouri Division of Geology and Land Survey.

Table 1.--*Uranium and thorium content of some sedimentary and igneous rocks from drill holes in the Rolla 1° x 2° quadrangle, Missouri*

Bendix Tag No.	Formation		Depth (in feet)	U (ppm)	Th (ppm)	Th/U	Lithology
Drill hole 1, Shannon County, sec. 1, T. 27 N., R. 4 W., Missouri log number 21915							
MEA 107	Gasconade		320	1.02	<1.7		Dolomite
108	Eminence		740	3.61	<2.8		Do.
109	Potosi		1020	1.11	<1.7		Dolomite, with sparse Fe oxide
110	Derby-Doerun		1365	.77	<1.6		Dolomite
111	Davis		1450	1.37	<2.2		Do.
112	do		1460	1.60	4.7	2.92	Do.
113	Bonneterre		1575	.79	<1.6		Do.
114	do		1635	1.96	10.4	5.30	Siltstone
115	do		1740	.89	<2.0		Dolomite
101	do		1955	1.30	6.54	5.02	Sandstone, dolomitic, with igneous fragments
102	Lamotte		1960	2.04	7.73	3.79	Sandstone, with igneous fragments
103	do		2025	3.41	9.36	2.75	Arkose
104	do		2030	3.01	7.4	2.47	Do.
105	do		2035	3.20	10.9	3.39	Do.
106	do		2040	3.93	11.4	2.89	Do.
116	do	*	2042.5	3.50	10.7	3.05	Do.
117	do	*	2045.6	3.66	14.2	3.87	Conglomerate
118	do	*	2047	4.60	10.0	2.19	Arkose
119	do	*	2050	4.94	14.1	2.84	Conglomerate
120	do	*	2050	4.99	16.2	3.25	Arkose
121	do	*	2052	5.00	13.3	2.66	Weathered granite porphyry rubble
122	do	*	2052	5.03	14.4	2.85	Do.
123	do	*	2056	5.02	15.2	3.02	Do.
124	do	*	2058	4.22	18.5	4.39	Do.
125	do	*	2060	11.1	12.2	1.09	Do.
126	Precambrian	*	2069	5.53	14.6	2.63	Granite porphyry
127	do	*	2074	6.07	15.7	2.59	Do.
128	do	*	2078	4.80	16.7	3.49	Do.
129	do	*	2086	4.76	14.6	3.07	Granite porphyry, fresh
Drill hole 2, Dent County, sec. 26, T. 34 N., R. 3 W., Missouri log nos. 20975 and 23193							
130	Potosi		505	0.85	<1.7		Dolomite
131	Derby-Doerun		665	.78	4.0	5.16	Dolomite, glauconitic, silty
132	Davis		770	1.27	5.38	4.22	Siltstone, limey
133	Bonneterre		935	2.68	<2.5		Limestone
Drill hole 4, Reynolds County, sec. 20, T. 32 N., R. 1 E., Missouri log no. 5983							
134	Potosi		200	0.68	<1.7		Dolomite, cherty
135	Davis		400	.45	2.7	6.03	Dolomite, limey
136	Bonneterre		630	.13	<1.4		Dolomite
Drill hole 5, Reynolds County, sec. 4, T. 30 N., R. 1 E., Missouri log no. 21245							
137	Eminence		40	1.54	<2.1		Dolomite, cherty
138	Potosi		200	.57	<1.8		Dolomite
139	Derby-Doerun		580	2.35	<2.6		Dolomite, shaly
141	Davis		730	1.00	<2.3		Dolomite, sandy, shaly
142	Bonneterre		890	2.94	<2.7		Dolomite
143	Lamotte		1260	3.00	7.2	2.40	Sandstone
144	do		1410	6.49	13.2	2.04	Arkose
145	Precambrian		1465	3.41	16.8	4.94	Porphyry

Table 1.--*Uranium and thorium content of some sedimentary and igneous rocks from drill holes in the Rolla 1° x 2° quadrangle, Missouri*--Continued

Bendix Tag No.	Formation	Depth (in feet)	U (ppm)	Th (ppm)	Th/U	Lithology
	Drill hole 7, Reynolds County, sec. 33, T. 28 N., R. 1 E., Missouri log no. 20185					
MEA 146	Eminence	110	1.21	<2.1		Dolomite, cherty
147	Potosi	595	.52	<2.1		Dolomite
148	Derby-Doerun	700	2.03	<2.5		Do.
149	do	780	.46	<1.8		Do.
150	Bonneterre	1060	.56	3.3	5.93	Dolomite, shaly
151	do	1110	<.16	<1.8		Dolomite
152	Lamotte	1170	2.08	10.3	4.93	Arkose
153	Precambrian	1185	2.33	9.59	4.12	Granite, fresh
	Drill hole 9, Reynolds County, sec. 29, T. 29 N., R. 2 E., Missouri log no. 21325					
269	Lamotte	1060	3.55	9.8	2.77	Arkose
	Drill hole 10, Texas County, sec. 25, T. 32 N., R. 10 W., Missouri log no. 25825					
163	Gasconade	180	1.59	<2.5		Dolomite
164	Eminence	330	.65	<2.1		Do.
165	Potosi	750	.20	<1.9		Do.
166	Derby-Doerun	890	1.24	4.6	3.70	Do.
167	Davis	1050	1.68	9.93	5.90	Shale, silty, limey
168	Bonneterre	1140	2.26	10.6	4.69	Siltstone, limey
169	do	1340	2.32	11.2	4.82	Dolomite
170	Lamotte	1540	.64	3.1	4.84	Conglomerate
171	Precambrian	1580	3.90	7.4	1.90	Granite
	Drill hole 11, Dent County, sec. 3, T. 34 N., R. 6 W., Missouri log no. 2246					
172	Gasconade	205	0.37	<1.9		Dolomite, cherty
173	do	365	2.12	11.4	5.36	Do.
174	Eminence	495	.41	<1.8		Do.
175	Potosi	705	1.00	<2.0		Dolomite
176	Derby-Doerun	905	.41	<1.8		Do.
177	Davis	1100	1.06	5.5	5.19	Dolomite, sandy
178	Bonneterre	1310	1.72	6.50	3.78	Limestone
179	Lamotte	1460	.79	<2.6		Sandstone
181	Precambrian	1760	2.07	<8.5		Conglomerate, basal
182	do	2255	<1.5	<16		Biotite granite
183	do	2315	<.74	<8.1		Diorite(?)
184	do	2625	1.61	<3.7		Do.
	Drill hole 13, Shannon County, sec. 30, T. 31 N., R. 4 W., Missouri log nos. 24240, 21956, & 23814					
185	Gasconade	200	0.81	<1.9		Dolomite
186	Eminence	460	1.90	<2.9		Do.
187	Potosi	620	1.13	<2.2		Do.
188	do	780	.48	<1.7		Do.
189	Derby-Doerun	880	.88	<3.2		Dolomite, silty
190	Davis	1050	1.15	7.70	6.69	Dolomite, limey
191	Bonneterre	1230	1.52	<2.6		Dolomite
192	Lamotte	1490	.35	<1.9		Sandstone
	Drill hole 14, Washington County, sec. 32, T. 37 N., R. 2 E., Missouri log nos. 27179 & 21181					
193	Potosi	580	0.62	<1.9		Dolomite, cherty
194	Derby-Doerun	660	.76	<1.9		Dolomite
195	Davis	750	1.20	6.25	5.22	Siltstone, dolomitic
196	Bonneterre	870	1.48	<2.4		Dolomite
197	Lamotte	1240	.60	<1.9		Sandstone
198	Precambrian	1285	2.75	7.61	2.77	Weathered trachyte(?) porphyry
199	do	1300	3.45	10.3	2.99	Fresh trachyte(?) porphyry

Table 1.--*Uranium and thorium content of some sedimentary and igneous rocks from drill holes in the Rolla 1° x 2° quadrangle, Missouri*--Continued

Bendix Tag No.	Formation	Depth (in feet)	U (ppm)	Th (ppm)	Th/U	Lithology
	Drill hole 15, St. Francois County, sec. 25, T. 38 N., R. 4 E., Missouri log no. 26598					
MEA 252	Bonneterre	40	1.23	<2.0		Dolomite
253	do	220	1.19	3.8	3.20	Do.
254	do	400	1.49	<2.2		Dolomite, sandy
255	Lamotte	700	1.40	12.2	8.69	Arkose
256	Precambrian	785	4.18	21.0	5.04	Rhyolite porphyry
	Drill hole 16, Wayne County, sec. 1, T. 29 N., R. 6 E., Missouri log nos. 21231 & 23857					
274	Bonneterre	1310	0.49	<1.9		Dolomite
275	Lamotte	1630	3.38	7.7	2.27	Arkose
276	Precambrian	1645	1.29	6.80	5.27	Granite
	Drill hole 17, Wayne County, sec. 10, T. 27 N., R. 3 E., Missouri log no. 22812					
200	Gasconade	280	1.03	<2.0		Dolomite, cherty, sandy
201	Eminence	470	2.12	<2.3		Dolomite, cherty
202	Potosi	760	.98	<2.0		Dolomite
203	do	1180	1.25	<2.4		Dolomite, cherty
204	Davis	1590	.57	<2.2		Dolomite
205	Bonneterre	1880	3.50	<2.7		Do.
206	do	2230	4.77	15.7	3.28	Shale, sandy
207	Lamotte	2327	9.76	27.5	2.81	Conglomerate
	Drill hole 18, Reynolds County, sec. 13, T. 33 N., R. 1 W., Missouri log nos. 24244 & 20974					
270	Lamotte	550	3.12	18.9	6.06	Conglomerate
271	Precambrian	565	3.80	18.8	4.95	Rhyolite porphyry
	Drill hole 21, Shannon County, sec. 7, T. 29 N., R. 1 W., Missouri log no. 21595					
154	Potosi	760	0.50	<1.9		Dolomite
155	Derby-Doerun	890	.64	<1.9		Siltstone, shaly
156	Davis	1000	1.08	9.30	8.58	Shale, silty
157	Bonneterre	1280	4.30	8.60	2.00	Dolomite
158	do	1400	3.46	<3.1		Dolomite, sandy
159	Lamotte	1510	1.13	<2.5		Sandstone
160	do	1610	3.21	8.48	2.64	Conglomerate
161	do	1650	5.45	8.3	1.53	Do.
162	Precambrian	1670	3.43	11.8	3.43	Weathered rhyolite porphyry
	Drill hole 23, Wayne County, sec. 8, T. 28 N., R. 6 E., Missouri log nos. 21239 & 23878					
208	Potosi	680	0.49	<1.9		Dolomite
209	Davis equivalent	1110	.39	<1.8		Do.
210	Bonneterre	1200	2.14	3.6	1.68	Do.
211	do	1290	.64	<1.9		Do.
212	do	1450	1.84	6.38	3.47	Dolomite, conglomeratic
213	do	1540	1.65	8.01	4.86	Do.
214	Precambrian	1565	4.21	13.7	3.25	Rhyolite porphyry
	Drill hole 25, Washington County, sec. 27, T. 38 N., R. 3 E., Missouri log no. 22394					
215	Potosi	160	0.89	<1.9		Dolomite
216	Derby-Doerun	330	.93	<2.2		Do.
217	Davis	420	1.15	6.54	5.68	Siltstone, dolomitic

Table 1.--*Uranium and thorium content of some sedimentary and igneous rocks from drill holes in the Rolla 1° x 2° quadrangle, Missouri*--Continued

Bendix Tag No.	Formation	Depth (in feet)	U (ppm)	Th (ppm)	Th/U	Lithology
	Drill hole 25, Washington County, sec. 27, T. 38 N., R. 3 E., Missouri log no. 22394--Continued					
MEA 218	Bonneterre	640	1.41	<2.5		Limestone, oolitic
219	Lamotte	1010	1.39	3.8	2.71	Sandstone
221	do	1070	.43	<1.7		Do.
222	do	1250	.70	3.1	4.37	Arkose
223	Precambrian	1259	2.19	3.8	1.72	Granite
	Drill hole 27, Madison County, sec. 15, T. 32 N., R. 8 E., Missouri log no. 25310					
224	Potosi	250	0.97	<1.8		Dolomite, sandy
225	Derby-Doerun	470	.33	<1.6		Dolomite
226	Precambrian	530	2.42	5.4	2.23	Granite porphyry
	Drill hole 33, Iron County, sec. 11, T. 34 N., R. 2 E., Missouri log no. 24247					
246	Davis	60	1.03	4.5	4.33	Limestone, shaly
247	Bonneterre	320	.34	<1.5		Dolomite
248	do	490	1.16	<2.2		Sandstone, dolomitic
249	do	510	5.51	5.7	1.04	Dolomite, sandy
250	Lamotte	640	6.53	12.5	1.92	Arkose
251	Precambrian	690	8.69	27.6	3.18	Granite
	Drill hole 36, Washington County, sec. 1, T. 36 W., R. 1 W., Missouri log no. 9375					
227	Derby-Doerun	450	0.43	<1.6		Dolomite
228	Davis	550	1.44	6.64	4.61	Sandstone, dolomitic, silty
229	Bonneterre	780	.95	<1.8		Dolomite
230	do	850	4.05	12.3	3.04	Dolomite, conglomeratic, base of Bonneterre
	Drill hole 37, Washington County, sec. 14, T. 36 N., R. 3 E., Missouri log no. 2309					
231	Bonneterre	480	1.06	<1.8		Dolomite
232	do	580	1.29	<2.0		Do.
233	do	750	2.76	<2.5		Arkose
234	do	870	1.30	3.6	2.80	Do.
235	Precambrian	874	2.01	6.30	3.14	Rhyolite(?) porphyry
	Drill hole 40, Madison County, sec. 25, T. 32 N., R. 5 E., Missouri log no. 9047					
264	Bonneterre	220	<0.10	<1.7		Dolomite
265	do	400	2.42	<2.6		Do.
266	do	460	2.86	<2.9		Conglomerate
267	do	510	2.27	4.3	1.90	Conglomerate, basal
268	do	540	3.00	9.83	3.28	Rhyolite porphyry, Boulder conglomerate
	Drill hole 43, Iron County, sec. 36, T. 31 N., R. 4 E., Missouri log no. 2164					
257	Potosi	70	0.33	<1.7		Dolomite
258	Derby-Doerun	150	.44	<1.6		Do.
259	Davis	220	.52	<1.8		Do.
261	Bonneterre	390	1.20	3.0	2.49	Do.
262	do	490	3.81	9.86	2.59	Conglomerate, basal
263	do	535	3.20	10.2	3.17	Do.

Table 1.--*Uranium and thorium content of some sedimentary and igneous rocks from drill holes in the Rolla 1° x 2° quadrangle, Missouri*--Continued

Bendix Tag No.	Formation	Depth (in feet)	U (ppm)	Th (ppm)	Th/U	Lithology
	Drill hole 46, Iron County, sec. 9, T. 30 N., R. 3 E., Missouri log nos. 21957 & 24241					
MEA 272	Bonneterre	800	1.64	10.9	6.65	Arkose, base of Bonneterre
273	Precambrian	810	2.13	10.0	4.73	Rhyolite porphyry
	Drill hole 51, Crawford County, sec. 14, T. 35 N., R. 2 W., Missouri log no. 26096					
236	Potosi	270	0.47	<1.6		Dolomite
237	Derby-Doerun	350	.97	2.2	2.24	Do.
238	Davis	450	1.40	7.33	5.23	Siltstone, sandy dolomitic
239	Bonneterre	590	1.07	<1.8		Dolomite
240	do	805	2.15	5.2	2.42	Dolomite, base of Bonneterre
241	Precambrian	890	4.56	11.3	2.47	Granite
	Drill hole 59, St. Francois County, sec. 33, T. 35 N., R. 7 E., Missouri log no. 22256					
277	Lamotte	400	0.97	<2.3		Sandstone
	Drill hole 61, Shannon County, sec. 30, T. 29 N., R. 3 W., Missouri log nos. 21235 & 23904					
278	Bonneterre	1280	4.00	8.1	2.04	Arkose
279	Precambrian	1315	2.54	11.9	4.68	Rhyolite porphyry
	Drill hole 62, Texas County, sec. 14, T. 33 N., R. 9 W., Missouri log no. 2879					
242	Derby-Doerun	1070	0.85	<1.8		Dolomite, cherty
243	Davis	1200	.99	6.40	6.43	Dolomite, sandy
244	Bonneterre	1550	1.81	7.34	4.05	Do.
245	Lamotte	1657	.37	<1.8		Sandstone

Table 2.--*Summary of average uranium and thorium content of some sedimentary and igneous rocks in the Rolla 1° x 2° quadrangle, Missouri*

Formation	No. of samples	Average U (ppm)	Range	Average Th (ppm)	Range
Gasconade	6	1.15	0.37- 2.12	3.4	1.7-11.4
Eminence	7	1.63	.41- 3.61	2.3	1.8- 2.9
Potosi	18	.72	.20- 1.25	1.9	1.6- 2.4
Derby-Doerun	16	.89	.33- 2.35	2.3	1.6- 4.6
Davis	17	1.11	.52- 1.68	5.4	1.8- 9.93
Bonneterre					
Dolomite	24	1.34	.10- 4.30	2.8	1.4-11.2
Sandy dolomite	5	2.68	1.16- 5.51	4.1	2.2- 7.34
Limestone	3	1.94	1.41- 2.68	3.8	2.5- 6.5
Siltstone or silty dolomite	4	2.39	.56- 4.77	10.0	3.3-15.7
Arkose and conglomerate	12	2.4	1.3 - 4.05	6.7	2.5-12.3
Lamotte					
Sandstone	11	1.06	.35- 3.00	3.3	1.7- 7.73
Arkose and conglomerate	29	4.36	.70-11.1	12.1	3.1-27.5
Precambrian	23	3.31	.74- 8.69	11.6	3.7-27.6
Total--	175				

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