UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Assessment of Uranium Favorability for the Crystalline Rocks of the Wind River Range, Wyoming

by

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Open-File Report 83-323

1983

INTRODUCTION

The Wind River Range, western Wyoming (fig. 1), is a north-trending uplift of Precambrian crystalline rocks flanked by younger sedimentary rock. The crystalline core is a complex of amphibolite-to granulite-facies metamorphic rocks and at least two major groups of plutonic rocks. The older plutonic rocks are characterized by the Louis Lake batholith (Bayley, 1965a, b) which is composed largely of equigranular quartz diorite and granodiorite with minor amounts of quartz monzonite (K. K. Cheang, D. B. Wenner, and J. S. tuckless, unpub. data). This unit is the dominant crystalline rock at the southern end of the range and has been dated by the U-Pb zircon method as 2642 ± 9 Ma old[1] (Naylor and others, 1970). The younger plutonic rock is more granitic in composition and is typically porphyritic. It has been dated near the northeastern corner of the Popo Agie Primitive Area by the U-Pb zircon method as 2562 ± 75 Ma old[1] (Naylor and others, 1970). These authors refer to the unit as the Bears Ears pluton; however rocks of similar composition and texture have been referred to as the Popo Agie batholith in the Popo Agie Wilderness (Pearson and others, 1971) and the Middle Mountain batholith in the Fitzpatrick Wilderness (Granger and others, 1971).

There are several producing uranium districts in Wyoming (Butler, 1972), but no known igneous or metamorphic deposits of uranium, thorium, or rare-earth elements. However, granitic rocks within Wyoming have been shown to be likely source-rocks for the major sandstone-hosted uranium deposits (Seeland, 1976; Stuckless and Nkomo, 1978). Furthermore, granitic rocks in the Owl Creek Mountains (approximately 180 km northeast of Lander) host large, low-grade secondary uranium deposits (Yellich, 1978) which apparently developed in

[1]Ages recalculated by Ludwig and Stuckless (1978) using decay constants recommended by the IUGS Subcommission on Geochronology (Steiger and Jager, 1977).

response to early Tertiary uplift and erosion (Nkomo and others, 1978). Shannon (1979) has suggested that similar deposits may exist within the crystalline rock of the Wind River Range. However, the special geologic setting described by Yellich (1978) of highly fractured and brecciated crystalline rocks with hydrocarbons migrating upwards is not known to exist within the Wind River Range.

ANALYTICAL PROCEDURES

Thirty four granitic rock samples and 12 metamorphic rock samples were collected in the Bridger Wilderness to evaluate radioelement favorability within the crystalline rocks. An additional 44 granite samples were collected from areas adjacent to the Wilderness. A statistical evaluation of the geochemical data indicates that there is no difference between granitic rocks within and as compared to those outside of the Wilderness and therefore, the combined results are presented for granitic rocks in order to use the larger and more statistically significant data base.

Uranium and thorium concentrations (Table 1) were determined by the delayed neutron method (Millard, 1976) which has an average accuracy of ± 4 percent, and ± 10 percent for these elements, respectively. The concentrations of potassium (eK), thorium (eTh), and RaeU (radium equivalent uranium which is the amount of uranium needed for secular equilibrium with measured radium) were determined by gamma-ray spectrometry (Bunker and Bush, 1966, 1967). Average accuracies for concentrations reported in Table 1 are ± 2 percent. Yttrium, rubidium and strontium concentrations (Table 1) were determined by X-ray fluorescence and are generally accurate within ± 6 percent. Trace-element data for the granitic samples are best represented by a log-normal distribution as judged from skewness and kurtosis of the untransformed as compared to the logarithmetically transformed data. Therefore, means and standard deviations were calculated from the logarithms of the data and are reported as antilogs (Table 2).

Statistical evaluation of the data was accomplished by use of the USGS RASS-STATPAC computer system (VanTrump and Miesch, 1977).

RESULTS AND DISCUSSION

The range in values for concentration and ratios reported in Table 2 are very large for both the granitic plutonic and metamorphic rocks; however, mean values are not markedly different from those reported for average granite (Table 2). Furthermore neither uranium nor thorium contents approach within an order of magnetude of ore grade in any sample (Table 1) which suggests that none of the analyzed samples has been subjected to ore-forming processes. The probability of an economic deposit of these elements in either the igneous or metamorphic rocks is considered to be very low.

This conclusion is supported by trace element and other available data. Intra-granitic uranium and thorium deposits are generally associated with highly evolved granites (for example, LeRoy, 1978). Granites associated with uranium or thorium deposits are typified by high Rb/Sr ratios (generally greater than 5), low K/Rb ratios (generally less than 125), and abnormally high rare-earth element and yttrium contents. None of these features is present within the granites of the Bridger Wilderness (Table 2). In fact the average yttrium content of the granitic samples is only 1/3 that of an average granite. In addition, oxygen isotope data for the Louis Lake batholith (K. K. Cheang, D. B. Wenner, and J. S. Stuckless, unpub. data) show that at least this granite was derived from an unevolved source material.

Potassium-rubidium-strontium data also show subtle but significant differences between the plutonic rocks of the Wind River Range and plutonic rocks of the Granite Mountains and Owl Creek Mountains (fig. 2). The average K/Rb ratios for granitic rocks of the Granite Mountains and Owl Creek Mountains are 276 and 188, respectively, distinctly lower than the 324 calculated for granitic rocks of the Wind River Range (Table 2). Similarly, average Rb/Sr ratios are 2.84 and 1.88 for plutonic rocks of the Granite Mountains and Owl Creek Mountains which is 3.5 to 5 times greater than the 0.55 calculated for the plutonic rocks of the Wind River Range. Thus the granitic rocks of the Wind River Range are not as evolved as granites elsewhere in Wyoming that are associated with uranium depoits. In fact the plutonic rocks of the Wind River Range follow a trend similar to that defined by rocks of the Sierra Nevada batholith (fig. 2) for which the average Rb/Sr and K/Rb ratios are 0.50 and 358 respectively, and Sierra Nevada rocks are not known to be associated with uranium deposits.

Average values of Th/U and K/U are anomalously large relative to average granite. The average value of Th/K is only slightly high. These feature suggest some uranium loss either from the protolith prior to magma generation or from the plutons during the magmatic history or in response to exposure to surficial conditions. A magmatic loss of uranium might give rise to pegmatitic uranium deposits whereas a more geologically recent loss could provide a source for sediment-hosted deposits such as those around the Granite Mountains to the east (Stuckless and Nkomo, 1978).

The low RaeU/U ratio for the granitic rocks indicate at least some geologically recent uranium loss (Stuckless and Ferreira, 1976). However, preliminary isotopic studies (Stuckless, unpublished data) show only slight excesses of radiogenic ^{206}Pb relative to ^{238}U. Thus only minor uranium occurrences might reasonably be expected such as the one about 60 km southeast of Pinedale (Butler, 1972). It is not therefore surprising that sediments in the western Wind River Basin, which were derived from the Wind River Range (Seeland, 1978) contain no known uranium deposits.

If recent uranium losses from the plutonic rocks are small, the large Th/U and K/U averages suggest uranium loss during the magmatic or protolith history of the plutons. No radioactive pegmatites have been noted during field studies of the region. Thus if uranium was lost and reconcentrated during the magmatic stage, it probably migrated to higher level rocks which have since been removed by erosion. A loss of uranium from the protolith can not be evaluated directly; however, it is likely that any uranium lost from this source also migrated to levels above the current level of exposure.

Data for the metamorphic rocks also suggest a uranium depletion, but the average RaeU/U ratio is close to unity which indicates that the loss of uranium is not recent. Uranium depletion in response to granulite facies metamorphism has been documented isotopically (Gray and Oversby, 1972; Doe and Delevaux, 1980). Loss of uranium in response to regional heating has also been reported (Killen and Heier, 1975). Inasmuch as the metamorphic rocks have been subjected to both possible causes for uranium loss, it is likely that the loss occurred prior to or during intrusion of the granite. Because pegmatites of the area are not known to be radioactive, it is likely that uranium migrated into higher crustal rocks which have since been removed by erosion.

In summary, the radioelement and trace-element data suggest a low probability for uranium and thorium mineralization within the Bridger Wilderness. There is, however, some potential that the granitic rocks could have provided a source for small sediment-hosted uranium deposits to the south and west.

Table 1.--Location, concentration data, and chemical ratios for crystalline rocks from the Wind River Range, Wyoming.
[Prefix "e" used to denote measurements by gamma-ray spectromet eTh/K multiplied by 10,000. eK/U divided 10,000.]

Sample	Latitude	Longitude	U (ppm)	RaeU (ppm)	Th (ppm)	eTh (ppm)	eK (wt %)
BEP-1	42 50 19	109 3 14	4.1	3.8	30.9	36.6	3.08
BEP-2	42 54 8	109 5 38	1.0	.9	6.1	6.9	4.06
BEP-3	42 54 8	109 5 38	1.6	1.4	14.2	16.2	2.53
BEP-4	42 50 0	109 2 49	5.9	5.0	89.9	98.2	2.97
BW-01	43 0 11	109 34 21	1.1	.7	15.5	18.3	2.97
BW-02	43 0 23	109 34 9	1.7	1.0	12.2	13.3	3.50
BW-03	43 0 21	109 33 58	3.0	1.9	33.2	36.2	3.67
BW-04	43 0 21	109 33 58	2.0	1.2	18.1	18.6	3.34
BW-05	43 0 23	109 33 34	1.5	.7	55.8	50.8	2.89
BW-06	43 0 25	109 33 43	1.1	.8	15.9	17.3	3.55
BW-07	43 0 38	109 34 37	2.5	2.0	9.8	9.0	4.85
BW-08	43 11 2	109 46 17	2.9	2.4	71.4	68.4	4.29
BW-09	43 11 3	109 46 17	2.8	3.6	50.8	49.5	4.44
BW-10	43 11 1	109 46 17	2.3	3.1	17.0	17.5	4.30
BW-11	43 11 0	109 46 17	2.8	3.1	23.9	23.0	2.88
BW-12	43 10 2	109 46 16	2.4	2.3	58.1	51.8	4.55
BW-13	43 10 2	109 46 16	1.4	1.1	47.7	46.5	4.35
BW-14	43 9 14	109 51 33	.9	.8	34.7	32.7	3.23
BW-15	43 9 10	109 51 27	3.1	2.8	49.7	53.2	3.98
BW-16	43 7 36	109 51 55	3.2	3.0	75.8	71.5	3.59
BW-17	42 43 7	109 11 52	1.4	1.2	20.6	23.9	4.62
BW-18	42 43 7	109 11 52	2.1	1.6	46.7	43.1	3.57
BW-19	42 43 7	109 11 52	1.8	1.4	9.0	7.4	1.59
BW-20	42 43 8	109 11 51	2.4	2.1	13.9	12.7	5.94
BW-21	42 43 8	109 11 51	1.5	1.4	2.0	2.1	4.60
BW-22	42 43 20	109 12 34	1.6	1.3	40.3	33.3	3.29
BW-23	42 43 20	109 12 30	.8	.8	10.0	12.9	3.95
BW-24	42 51 49	109 22 20	.6	.4	17.3	13.2	1.46
BW-25	42 49 8	109 31 52	.8	.9	12.2	14.0	2.78
BW-26	43 19 19	109 40 52	2.7	1.9	56.7	54.9	4.97
BW-30	42 2 42	109 45 24	1.3	1.0	33.1	26.9	3.00
BW-31	43 2 42	109 45 24	1.2	1.4	26.4	31.9	3.29
BW-32	43 2 42	109 48 37	1.3	.8	66.1	56.5	4.49
BW-33	42 57 13	109 37 30	.5	.9	4.9	6.7	1.58
BW-34	42 56 22	109 32 9	1.3	1.2	16.0	17.4	2.20
BW-35	42 51 55	109 34 29	1.8	1.8	21.8	21.2	2.99
BW-36	42 46 21	109 25 59	.6	.7	10.2	6.7	3.34
BW-37	42 50 0	109 18 21	.6	.6	6.7	6.7	3.18
BW-38	42 50 0	109 18 21	.4	.5	4.6	4.3	1.83
BW-39	42 49 43	109 18 5	.9	1.0	19.0	13.6	1.69

Table 1.--Location, concentration data, and chemical ratios for crystalline rocks from the Wind River Range, Wyoming--continued.

Sample	Rb (ppm)	Sr (ppm)	Y (ppm)	eTh/U	eTh/eK	eK/U	RaeU/U	Rb/Sr	K/Rb
BEP-1	86	456	27	8.93	11.88	.75	.93	.43	358
BEP-2	107	207	4	6.90	1.69	4.06	.90	.26	379
BEP-3	97	222	13	10.13	6.40	1.58	.88	.66	261
BEP-4	164	224	6	16.64	33.06	.50	.85	.20	181
BW-01	70	346	4	16.64	6.16	2.70	.64	.64	424
BW-02	66	438	37	7.82	3.80	2.06	.59	1.14	530
BW-03	117	485	37	12.07	9.86	1.22	.63	.74	314
BW-04	78	650	16	9.30	5.56	1.67	.60	.71	428
BW-05	77	539	10	33.87	17.57	1.93	.47	.68	375
BW-06	78	691	13	15.73	4.87	3.23	.73	.67	455
BW-07	88	1,510	25	3.60	1.85	1.94	.80	.88	551
BW-08	178	150	19	23.59	15.94	1.48	.83	.25	241
BW-09	204	142	13	17.68	11.14	1.59	1.29	.26	218
BW-10	94	97	6	7.61	4.06	1.87	1.35	.31	457
BW-11	84	480	47	8.21	7.98	1.03	1.11	.95	343
BW-12	186	127	10	21.58	11.38	1.90	.96	.25	245
BW-13	168	196	6	33.21	10.68	3.11	.79	.20	259
BW-14	58	461	23	36.33	10.12	3.59	.89	.62	557
BW-15	116	347	29	17.16	13.36	1.28	.90	.41	343
BW-16	84	287	28	22.34	19.91	1.12	.94	.56	427
BW-17	98	250	4	17.07	5.17	3.30	.86	.29	471
BW-18	93	312	12	20.52	12.07	1.70	.76	.31	384
BW-19	46	299	6	4.11	4.65	.88	.78	1.61	346
BW-20	128	318	5	5.29	2.13	2.48	.87	.39	464
BW-21	94	282	4	1.40	.45	3.07	.93	.39	489
BW-22	77	471	23	20.81	10.12	2.06	.81	.88	427
BW-23	87	478	4	16.13	3.26	4.94	1.00	.37	454
BW-24	51	876	32	22.00	9.04	2.43	.67	1.90	286
BW-25	79	368	8	17.50	5.03	3.48	1.13	.87	352
BW-26	160	187	9	20.33	11.04	1.84	.70	.19	311
BW-30	67	636	37	20.69	8.96	2.31	.77	1.48	448
BW-31	72	641	31	26.58	9.69	2.74	1.17	1.57	457
BW-32	92	346	12	43.46	12.58	3.45	.62	.61	488
BW-33	55	301	30	13.40	4.24	3.16	1.80	1.73	287
BW-34	68	311	12	13.38	7.90	1.69	.92	1.57	324
BW-35	87	553	31	11.78	7.09	1.66	1.00	1.10	344
BW-36	69	692	6	11.17	2.00	5.57	1.17	.86	484
BW-37	75	548	7	11.17	2.10	5.30	1.00	.96	424
BW-38	76	655	25	10.75	2.34	4.58	1.25	1.68	241
BW-39	61	656	27	15.11	8.04	1.88	1.11	2.56	277

Table 1.--Location, concentration data, and chemical ratios for crystalline rocks from the Wind River Range, Wyoming--continued.

Sample	Latitude	Longitude	U (ppm)	RaeU (ppm)	Th (ppm)	eTh (ppm)	eK (wt %)
BW-40	43 14 36	109 40 7	3.3	2.7	86.6	77.4	4.18
BW-41	43 18 11	109 42 26	2.1	1.9	21.1	16.1	1.57
BW-42	43 18 11	109 41 38	2.0	1.8	45.7	38.3	3.75
BW-43	43 18 11	109 41 38	5.6	5.2	22.2	23.4	1.63
BW-44	43 18 5	109 41 46	3.6	4.7	65.9	70.0	4.37
BW-46	43 10 23	109 39 48	1.2	1.2	4.1	7.2	4.80
BW-47	43 10 23	109 39 48	1.1	.8	18.3	16.4	4.01
BW-48	43 10 23	109 39 48	7.4	8.6	42.8	49.0	2.13
BW-49	43 10 23	109 39 48	2.1	1.8	51.2	47.6	3.86
BW-50	43 10 23	109 39 48	.3	.4	65.6	6.5	.71
BW-51	42 59 24	109 46 23	.2	.4	1.6	1.2	1.66
GPA-01	43 22 8	109 36 11	3.5	--	29.3	28.1	3.36
GPA-02	43 24 17	109 37 28	6.3	--	36.6	33.4	4.33
GPA-03	43 20 31	109 36 38	2.6	--	37.6	41.3	3.85
GPA-04	43 21 26	109 40 10	5.8	--	69.1	74.0	4.50
GPA-05	43 18 54	109 38 29	1.7	--	7.8	10.5	6.27
GPA-06	43 19 23	109 35 22	3.3	--	16.5	19.0	2.57
GPA-07	43 18 25	109 34 27	6.5	--	47.3	78.1	2.36
GPA-08	43 20 48	109 38 38	2.4	--	22.8	27.3	2.46
GPA-09	43 22 35	109 40 55	2.7	--	79.1	78.7	4.60
GPA-10	43 24 1	109 38 4	8.5	--	52.8	53.6	4.20
GPA-11	43 24 26	109 36 37	4.2	--	45.8	47.1	4.42
GPA-12	43 24 52	109 42 13	2.4	--	69.9	73.2	4.77
GPA-13	43 1 38	109 31 9	1.2	--	19.2	19.6	1.67
LLB-01	42 32 52	108 45 45	4.9	3.1	11.4	11.7	3.91
LLB-02	42 32 31	108 47 52	3.5	2.8	13.7	15.6	2.27
LLB-03	42 34 21	108 50 27	2.6	2.7	7.7	8.8	1.83
LLB-04	42 36 19	108 50 49	2.8	2.9	16.6	14.7	1.86
LLB-05	42 43 42	108 50 59	5.2	5.7	13.4	12.6	1.64
LLB-06	42 43 42	108 50 59	7.9	6.5	24.7	23.5	4.43
LLB-07	42 43 42	108 50 59	3.5	3.5	20.2	21.3	1.76
LLB-08	42 41 59	108 55 57	7.2	8.3	60.2	63.7	3.73
LLB-09	42 41 59	108 55 57	4.3	3.7	44.9	44.9	4.09
LLB-10	42 41 34	108 53 14	6.4	4.5	48.7	45.7	3.95
LLB-11	42 39 20	108 52 4	6.0	5.5	13.9	14.1	1.89
LLB-12	42 32 52	108 45 45	2.2	1.9	17.0	15.2	3.11
LLB-13	42 33 1	108 46 20	12.7	8.2	22.0	22.0	3.51
LLB-14	42 33 45	108 46 57	2.1	1.7	12.3	11.4	3.06
LLB-15	42 33 45	108 52 33	3.2	3.0	11.2	9.7	1.67
PRM-01	42 33 19	109 16 55	4.3	3.7	53.5	64.7	4.16

Table 1.--Location, concentration data, and chemical ratios for crystalline rocks from the Wind River Range, Wyoming--continued.

Sample	Rb (ppm)	Sr (ppm)	Y (ppm)	eTh/U	eTh/eK	eK/U	RaeU/U	Rb/Sr	K/Rb
BW-40	178	246	26	23.45	18.51	1.27	.82	.30	235
BW-41	88	626	18	7.67	10.25	.75	.90	.78	178
BW-42	97	209	13	19.15	10.21	1.88	.90	.56	387
BW-43	126	143	56	4.18	14.35	.29	.93	.92	129
BW-44	191	102	16	19.44	16.01	1.21	1.31	.18	229
BW-46	123	289	4	6.00	1.50	4.00	1.00	.24	390
BW-47	85	137	4	14.91	4.08	3.65	.73	.39	472
BW-48	91	790	24	6.62	23.00	.29	1.16	.96	234
BW-49	112	361	13	22.67	12.33	1.84	.86	.56	345
BW-50	23	24	23	21.67	9.15	2.37	1.33	5.78	309
BW-51	20	791	6	6.00	.72	8.30	2.00	3.10	830
GPA-01	108	84	5	8.03	8.36	.96	--	.40	311
GPA-02	156	192	7	5.30	7.71	.69	--	.22	278
GPA-03	144	179	12	15.88	10.72	1.48	--	.31	267
GPA-04	147	148	16	12.76	16.44	.78	--	.21	306
GPA-05	227	100	3	6.18	1.67	3.69	--	.14	276
GPA-06	110	490	10	5.76	7.39	.78	--	.58	234
GPA-07	110	277	102	12.02	33.09	.36	--	.61	215
GPA-08	154	129	8	11.38	11.09	1.03	--	.21	160
GPA-09	157	95	17	29.15	17.10	1.70	--	.24	293
GPA-10	156	131	9	6.31	12.76	.49	--	.29	269
GPA-11	171	61	9	11.21	10.65	1.05	--	.19	258
GPA-12	165	93	11	30.50	15.34	1.99	--	.18	289
GPA-13	67	280	9	16.33	11.73	1.39	--	.79	249
LLB-01	168	40	20	2.39	2.99	.80	.63	.39	233
LLB-02	65	782	18	4.46	6.87	.65	.80	1.05	349
LLB-03	59	835	22	3.38	4.80	.70	1.04	1.39	310
LLB-04	57	850	14	5.25	7.90	.66	1.04	.60	326
LLB-05	103	762	26	2.42	7.68	.32	1.10	.87	159
LLB-06	199	98	14	2.97	5.30	.56	.82	.40	223
LLB-07	113	583	23	6.09	12.10	.50	1.00	.48	156
LLB-08	163	291	50	8.85	17.07	.52	1.15	.20	229
LLB-09	136	271	15	10.44	10.97	.95	.86	.32	301
LLB-10	212	193	14	7.14	11.56	.62	.70	.48	186
LLB-11	65	808	25	2.35	7.46	.32	.92	1.32	291
LLB-12	119	538	12	6.91	4.88	1.41	.86	.40	261
LLB-13	128	104	7	1.73	6.26	.28	.65	.34	274
LLB-14	80	187	4	5.43	3.72	1.46	.81	.35	383
LLB-15	51	869	16	3.03	5.80	.52	.94	2.08	327
PRM-01	120	566	21	15.05	15.55	.97	.86	.35	347

Table 1.--Location, concentration data, and chemical ratios for crystalline rocks from the Wind River Range, Wyoming--continued.

Sample	Latitude	Longitude	U (ppm)	RaeU (ppm)	Th (ppm)	eTh (ppm)	eK (wt %)
PRM-02	42 34 55	109 15 16	1.2	.9	21.1	25.6	3.63
PRM-03	42 26 33	109 6 38	6.4	6.0	53.0	48.8	4.23
PRM-04	42 29 52	109 9 32	1.5	1.3	29.5	30.7	3.26
PRM-05	42 29 50	109 13 10	1.8	1.8	20.6	18.5	3.98
PRM-06	42 29 50	109 13 10	5.3	4.5	50.3	52.4	4.09
PRM-07	42 27 34	108 51 3	2.2	1.9	13.1	15.1	5.63
PRM-08	42 26 6	108 55 37	1.8	1.1	3.6	4.6	2.65
PRM-09	42 30 8	108 53 17	1.2	1.0	7.5	7.8	3.44
PRM-10	42 30 0	108 53 10	2.0	1.9	15.6	19.4	1.76
PRM-11	42 29 39	108 59 19	2.6	2.6	18.7	15.1	2.19
PRM-12	42 31 0	108 58 39	2.4	2.2	4.0	4.2	2.19
PRM-13	42 31 13	109 1 36	2.0	2.2	7.2	7.9	1.86
PRM-14	42 33 45	109 3 46	1.0	1.8	10.7	12.3	1.28

Table 1.--Location, concentration data, and chemical ratios for crystalline rocks from the Wind River Range, Wyoming--continued.

Sample	Rb (ppm)	Sr (ppm)	Y (ppm)	eTh/U	eTh/eK	eK/U	RaeU/U	Rb/Sr	K/Rb
PRM-02	85	618	5	21.33	7.05	3.02	.75	.80	427
PRM-03	135	444	10	7.63	11.53	.66	.94	.23	313
PRM-04	111	486	20	20.47	9.41	2.17	.87	.77	294
PRM-05	92	760	6	10.28	4.64	2.21	1.00	.45	433
PRM-06	118	871	35	9.39	12.81	.77	.85	.72	347
PRM-07	194	70	18	6.86	2.68	2.56	.86	.19	290
PRM-08	243	9	4	2.56	1.73	1.47	.61	.48	109
PRM-09	82	332	6	6.50	2.26	2.97	.83	.51	420
PRM-10	84	558	6	9.70	11.02	.88	.95	.85	210
PRM-11	63	806	24	5.31	6.39	.84	1.00	1.30	348
PRM-12	41	558	35	1.75	1.91	.91	.92	4.32	534
PRM-13	49	912	24	3.95	4.24	.93	1.10	1.63	380
PRM-14	--	--	--	12.30	9.60	1.28	1.80	--	--

Table 2.--Summary of Radioelement and selected Trace-element concentrations and ratios for granitic and metamorphic rocks from the Wind River Range, Wyoming. [N is the number of samples. Average granitic values for radioelements and ratios are from Stuckless and VanTrump (1982). Average Y, average Rb to average Sr, and average K to average Rb are from Krauskoff (1967). Leaders (---) indicate no reported value.]

	Minimum Value	Maximum Value	Mean Value	Standard Deviation $+\sigma$	$-\sigma$
			Granitic Plutonic Rocks (N=77)		
U(ppm)	0.4	12.7	2.28	+ 2.32	- 1.15
RaeU(ppm)	0.4	8.3	1.87	+ 1.94	- 0.95
Th(ppm)	2.1	98.2	22.8	+ 28.3	-12.6
K(wt%)	1.28	6.27	3.35	+ 1.10	- 1.10
Th/U	1.40	43.5	9.98	+ 11.45	- 5.33
(Th/K)x10^4	0.45	33.1	7.23	+ 7.93	- 3.78
(K/U)x10^{-4}	0.28	5.57	1.38	+ 1.47	- 0.71
Y(ppm)	3.0	102	13.2	+ 14.9	- 7.0
Rb/Sr	0.14	4.32	0.55	+ 0.60	- 0.29
K/Rb	156	557	324	+116	-85
RaeU/U	0.47	1.8	0.89	+ 0.22	- 0.18
			Metamorphic Rocks (N=12)		
U(ppm)	0.3	7.4	1.79	+ 2.76	- 1.09
RaeU(ppm)	0.4	8.6	1.83	+ 2.56	- 1.07
Th(ppm)	6.5	77.4	22.4	+ 32.6	-13.3
K(wt%)	0.71	4.80	2.90	+ 1.39	- 1.39
Th/U	4.18	23.5	12.5	+ 10.1	- 5.6
Th/Kx10^4	1.5	23.0	8.87	+ 10.3	- 4.8
K/Ux10^{-4}	0.29	4.00	1.41	+ 1.99	- 0.83
Y(ppm)	4.0	56.0	15.7	+ 18.2	8.4
Rb/Sr	0.18	5.78	0.71	+ 1.16	- 0.44
K/Rb	129	472	277	+122	-85
RaeU/U	0.73	1.80	1.02	+ 0.30	- 0.23
			Average Granite Values		
U(ppm)	---	---	3.54	4.58	- 2.00
Th(ppm)	---	---	17.76	22.47	- 9.60
K(wt%)	---	---	3.52	1.02	- 1.02
Th/U	---	---	4.73	5.97	- 2.64
(Th/K)x10^4	---	---	5.00	5.98	- 2.72
(K/U)x10^{-4}	---	---	0.95	1.18	- 0.53
Y(ppm)	---	---	40	---	---
Rb/Sr	---	---	0.53	---	---
K/Rb	---	---	220	---	---

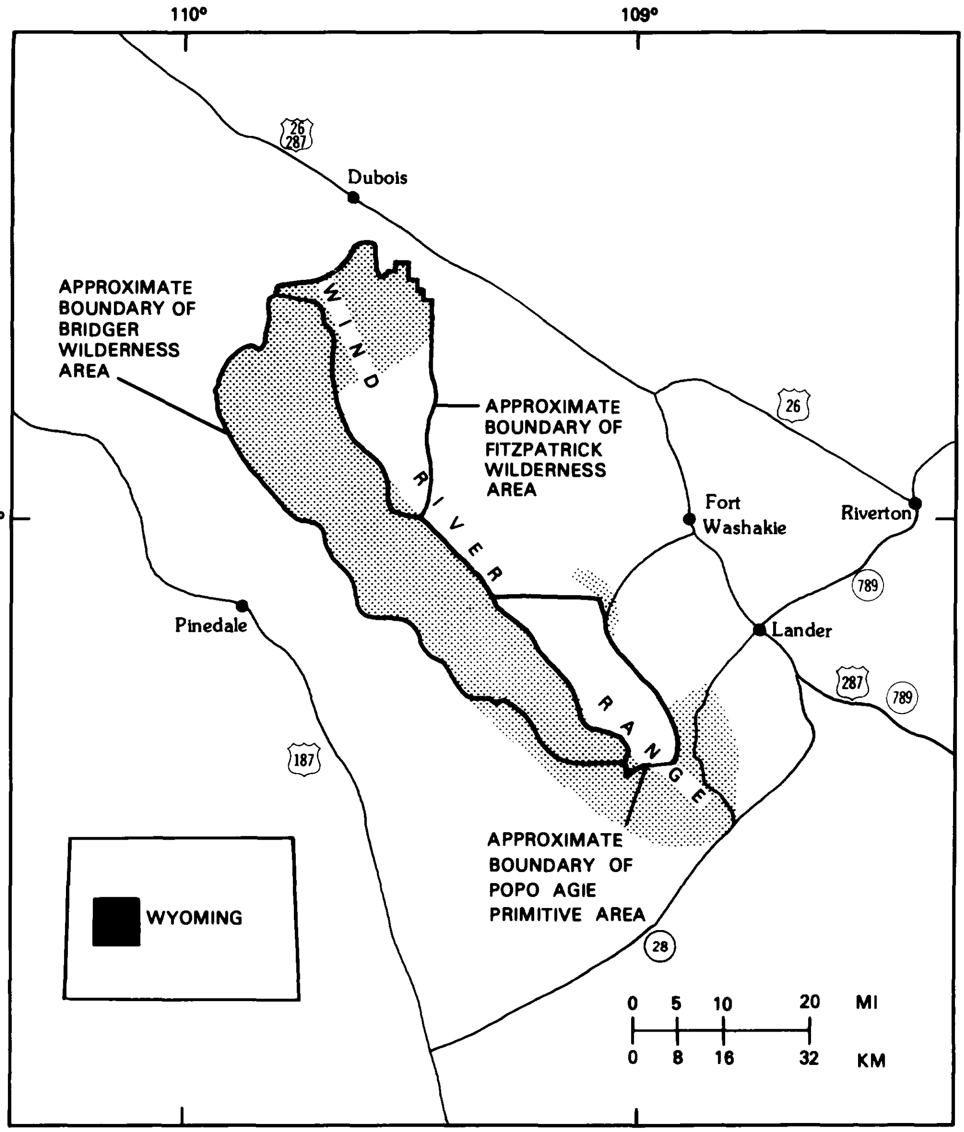

Figure 1.--Map with the location of the Wind River Range and wilderness areas. The approximate area sampled for this study is shown by shading.

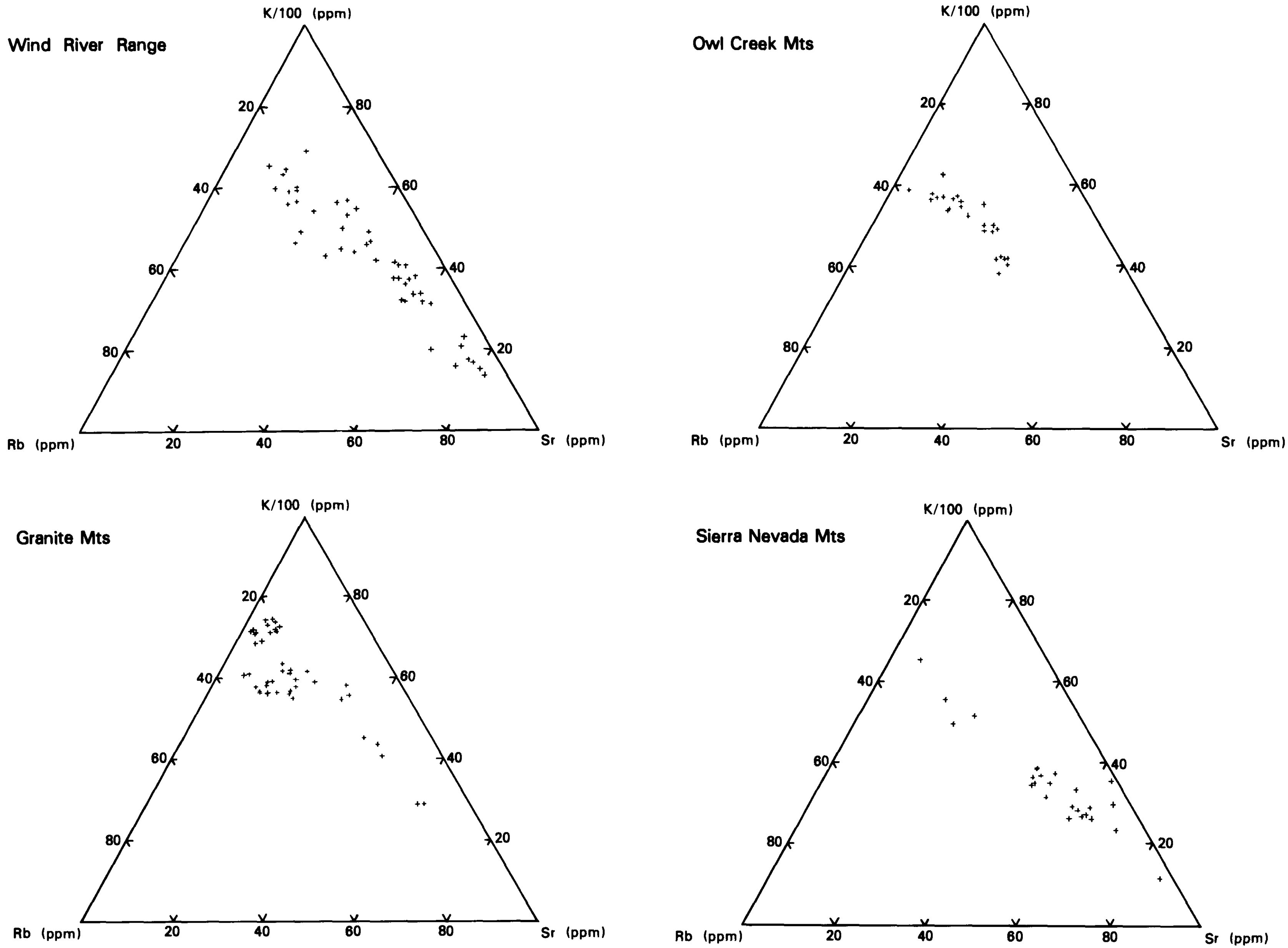

Figure 2.--Ternary diagrams for the relative proportions of potassium, rubidium and strontium in granitic rocks from the Wind River Range (this report), the Owl Creek Mountains (Stuckless and others, unpub. data) the Granite Mountains (Stuckless and Miesch, 1981), and the Sierra Nevada Mountains (Dodge and others, 1982).

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