Rb-Sr geochronologic studies of Precambrian rocks near Eldora, Colorado

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Rb-Sr GEOCHRONOLOGIC STUDIES OF PRECAMBRIAN ROCKS NEAR ELDORA, COLORADO

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We report Rb-Sr ages for several Precambrian rock units from near Eldora, Colorado. These units are all from the Front Range rocks, loosely grouped under the name "Idaho Springs Formation", but we prefer to refer to them by their generic rock name, e.g., hornblende gneiss. Sample locations and brief sample descriptions are given in table 1.

TABLE 1. Sample locations and brief sample descriptions.

Sample	N latitude	W longitude	Description
EL-5b	39°57'05"	105°35'10"	Felsic. Mineralogy: 60% K-spar and plagioclase, 35% quartz, 5% biotite, 1% opaques
EL-6a	39°57'05"	105°35'10"	Idaho Springs–hornblende gneiss. Mineralogy: 43% plagioclase, 27% pyroxene, 25% amphibole, 5% opaques
EL-6b-1	39°57'05"	105°35'10"	Idaho Springs felsic-pegmatite. Mineralogy: 36% quartz, 60% K-spar, 3% biotite, 1% opaques
EL-7-1	39°57'05"	105°35'10"	Hornblende gneiss cut by felsic stringer. Mineralogy: 50% amphibole, 40% plagioclase, 4% pyroxene, 4% quartz, 2% opaques
EL-7-2	39°57'05"	105°35'10"	Hornblende gneiss cut by felsic stringer. Mineralogy: 50% amphibole, 40% plagioclase, 4% pyroxene, 4% quartz, 2% opaques
EL-7-3	39°57'05"	105°35'10"	Hornblende gneiss cut by felsic stringer. Mineralogy: 50% amphibole, 40% plagioclase, 4% pyroxene, 4% quartz, 2% opaques
EL-8	39°57'05"	105°35'10"	Strongly foliated mafic gneiss. Mineralogy: 60% amphibole, 40% plagioclase
EL-9a	39°57'05"	105°35'10"	Predominantly mafic with epidote. Mineralogy: 5% amphibole, 60% plagioclase, 25% pyroxene, 7% sphene, 2% opaques, 1% epidote
EL-9a'	39°57'05"	105°35'10"	Felsic. Mineralogy: 82% plagioclase, 15% quartz, 3% biotite
EL-9b	39°57'05"	105°35'10"	Mafic—dominantly hornblende. Mineralogy: 47% plagioclase, 42% amphibole, 8% second amphibole, 1% quartz, 1% pyroxene, 1% opaques
EL-10a	39°57'05"	105°35'10"	Predominantly mafic. Mineralogy: 55% plagioclase, 40% quartz, 3% biotite, 2% epidote
EL-11a	39°57'05"	105°35'10"	Mineralogy: 30% quartz, 38% plagioclase, 20% orthoclase, 5% biotite, 2% opaques, 5% amphibole
EL-11c	39°57'05"	105°35'10"	Mineralogy: 35% plagioclase, 35% quartz, 25% orthoclase, 2% biotite, 2% epidote, 1% opaques
EL-11e	39°57'05"	105°35'10"	
EL-13a	39°57'05"	105°35'10"	
EL-13b	39°57'05"	105°35'10"	
EL-13c	39°57'05"	105°35'10"	
EL-13e	39°57'05"	105°35'10"	
EL-18a	39°57'05"	105°35'00"	Idaho Springs–hornblende gneiss. Mineralogy: 48% amphibole, 50% plagioclase, 2% opaques
EL-19 bi	39°57'05"	105°34'40"	
EL-19 bii	39°57'05"	105°34'40"	
EL-20a	39°57'05"	105°34'25"	Idaho Springs–hornblende gneiss. Mineralogy: 45% plagioclase, 35% amphibole, 10% pyroxene, 8% quartz, 2% opaques
EL-20b	39°57'05"	105°34'25"	Felsic coarse pegmatite. Mineralogy: 40% microcline, 27% albite, 33% quartz
EL-21a	39°57'00"	105°33'55"	Mafic. Mineralogy: 45% plagioclase, 20% quartz, 27% amphibole, 4% biotite, 4% opaques
EL-21b	39°57'00"	105°33'55"	Coarse felsic to pegmatitic. Mineralogy: 70% microcline, 20% quartz, 8% plagioclase
EL-22a	39°56'50"	105°33'25"	Mafic-felsic mixed. Mineralogy: 60% quartz, 22% orthoclase, 10% biotite, 7% plagioclase, 1% oqaques
EL-22b	39°56'50"	105°33'25"	
EL-22c	39°56'50"	105°33'25"	

continued

TABLE 1. Sample locations and brief sample descriptions (continued).

Sample	N latitude	W longitude	Description
EL-23a	39°56'30"	105°33'00"	Biotite-hornblende schist/gneiss. Mineralogy: 52% plagioclase, 20% pyroxene, 20% quartz, 5% amphibole, 1% sphene, 2% opaques
EL-23b	39°56'30"	105°33'00"	
EL-23c	39°56'30"	105°33'00"	
EL-23f	39°56'30"	105°33'00"	
EL-23g	39°56'30"	105°33'00"	
EL-23 di	39°56'30"	105°33'00"	
EL-23 dii	39°56'30"	105°33'00"	
EL-23 diii	39°56'30"	105°33'00"	
EL-23 div	39°56'30"	105°33'00"	
EL-25a	39°55'15"	105°36'48"	
EL-25 bi	39°55'15"	105°36'48"	
EL-25 bii	39°55'15"	105°36'48"	
EL-25c	39°55'15"	105°36'48"	
EL-26a	39°55'15"	105°46'50"	
EL-26b	39°55'15"	105°36'50"	
EL-27	39°55'20"	105°36'30"	
EL-28	39°55'20"	105°36'20"	
EL-29a	39°55'15"	105°36'15"	
EL-29b	39°55'15"	105°36'15"	

ANALYTICAL PROCEDURES

The Rb and Sr contents were determined by isotope dilution, and the data are precise to ± 0.5% (two sigma). The $^{87}Sr/^{86}Sr$ data were calculated from the Sr isotope dilution experiments and are precise to ± 0.00005 (two sigma). Seven runs on Eimer and Amend standard $SrCO_3$ yielded 0.70803 ± 0.00004. All Sr isotopic data were normalized to $^{86}Sr/^{88}Sr = 0.1194$. The decay constant for ^{87}Rb was taken as 1.42×10^{-11}/y. Standard least-squares treatment was used to calculate the isochrons shown in figures 1–6. The Rb, Sr, and Sr isotopic data are shown in table 2.

TABLE 2. Whole-rock data.

Sample	$^{87}Sr/^{86}Sr$	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$
Hornblende gneiss				
EL-13b	0.7082	16.34	222.1	0.213
EL-6a	0.7079	18.70	301.02	0.180
EL-7-1	0.7068	22.54	445.2	0.147
EL-7-2	0.7067	22.56	431.9	0.151
EL-7-3	0.7097	41.73	350.52	0.345
EL-8	0.7111	30.68	271.6	0.327
EL-9a'	0.7059	14.44	305.3	0.137
EL-9b	0.7092	16.32	178.82	0.264
EL-18a	0.7070	16.92	339.4	0.144
EL-20a	0.7086	12.85	164.6	0.226
EL-21a	0.7049	14.94	432.56	0.100
EL-23a	0.7171	40.40	199.13	0.588
EL-23c	0.7142	29.76	203.5	0.424
Leucocratic (microcline) gneiss				
EL-11e	0.7140	99.47	659.3	0.437
EL-13c	0.7277	89.17	261.1	0.990
EL-19 bii	0.7166	46.77	254.6	0.532
Young pegmatites				
EL-13e	0.7311	190.66	419.2	1.320
EL-29b	0.7468	238.65	315.99	2.194
EL-19 bi	0.7843	352.17	250.20	4.104
EL-25a	0.7167	106.06	534.64	0.575
EL-25 bi	0.7167	107.82	523.43	0.597
EL-25 bii	0.7260	243.72	649.68	1.088
EL-25c	0.7287	155.39	362.79	1.243

TABLE 2. Whole-rock data (continued).

Sample	$^{87}Sr/^{86}Sr$	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$
Pegmatites[1] and pegmatite-influenced samples				
EL-5b	0.7219	149.21	542.1	0.798
EL-6b-1[1]	0.7421	238.08	334.12	2.070
EL-9a	0.7072	36.21	760.86	0.138
EL-10a	0.7135	68.63	390.0	0.510
EL-11a	0.7083	206.58	552.53	1.082
EL-11c	0.7145	120.17	485.5	0.717
EL-13a[1]	0.7279	165.60	373.2	1.287
EL-13c[1]	0.7277	89.17	261.1	0.990
EL-13e[1]	0.7311	190.66	419.2	1.320
EL-19 bi	0.7843	352.17	250.2	4.104
EL-19 bii[1]	0.7166	46.77	254.6	0.532
EL-20b	0.7216	93.46	351.3	0.771
EL-21b[1]	0.7469	232.02	346.9	1.943
EL-22a	0.7874	232.68	169.6	4.001
EL-22b[1]	0.7498	175.67	229.1	2.229
EL-22c	0.7083	68.96	1035.2	0.193
EL-23b[1]	0.7476	177.14	255.6	2.013
EL-23f	0.7430	105.48	167.55	1.829
EL-23g	0.7420	202.03	337.6	1.738
EL-23 di	0.7985	305.16	193.0	4.618
EL-23 dii	0.7384	117.97	201.3	1.701
EL-23 diii[1]	0.7475	155.29	223.5	2.019
EL-23 div	0.7298	91.62	237.55	1.120
EL-29b[1]	0.7468	238.65	315.99	2.194

continued

TABLE 2. Whole-rock data (continued).

Sample	$^{87}Sr/^{86}Sr$	Rb (ppm)	Sr (ppm)	$^{87}Rb/^{86}Sr$
Biotite gneiss				
EL-26a	0.8179	210.65	141.31	4.361
EL-26b	0.8047	218.96	172.09	3.718
EL-27	0.7533	203.52	353.57	1.674
EL-28	0.7612	170.09	242.28	2.043
EL-29a	0.8109	186.41	141.41	3.854

[1]First-generation pegmatites; not plotted on fig. 5.

RESULTS

The Rb-Sr whole-rock isochron for the hornblende gneiss yields an age of 1.775 ± 0.130 b.y.b.p. (fig. 1), while the leucocratic (microcline) gneiss yields 1.744 ± 0.047 b.y.b.p. (fig. 2). When the hornblende and microcline gneiss samples are treated as one unit, the resultant age is 1.792 ± 0.0088 b.y.b.p. (fig. 3). Two pegmatite events are noted in the field. A young, massive pegmatite, coeval with some granitic dikes, is dated at 1.338 ± 0.0019 b.y.b.p. (fig. 4), while older, folded pegmatites (including gneiss samples heavily infiltrated by pegmatite; i.e., pegmatite influenced) yield 1.488 ± 0.0027 b.y.b.p. (fig. 5). This date is recognized as a metamorphic event throughout much of the Front Range. The biotite gneiss yields an age of 1.778 ± 0.0057 b.y.b.p., with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7106, significantly higher than values for the other gneiss units (fig. 6).

The study of these rocks is ongoing, and the data presented in this article are considered preliminary.

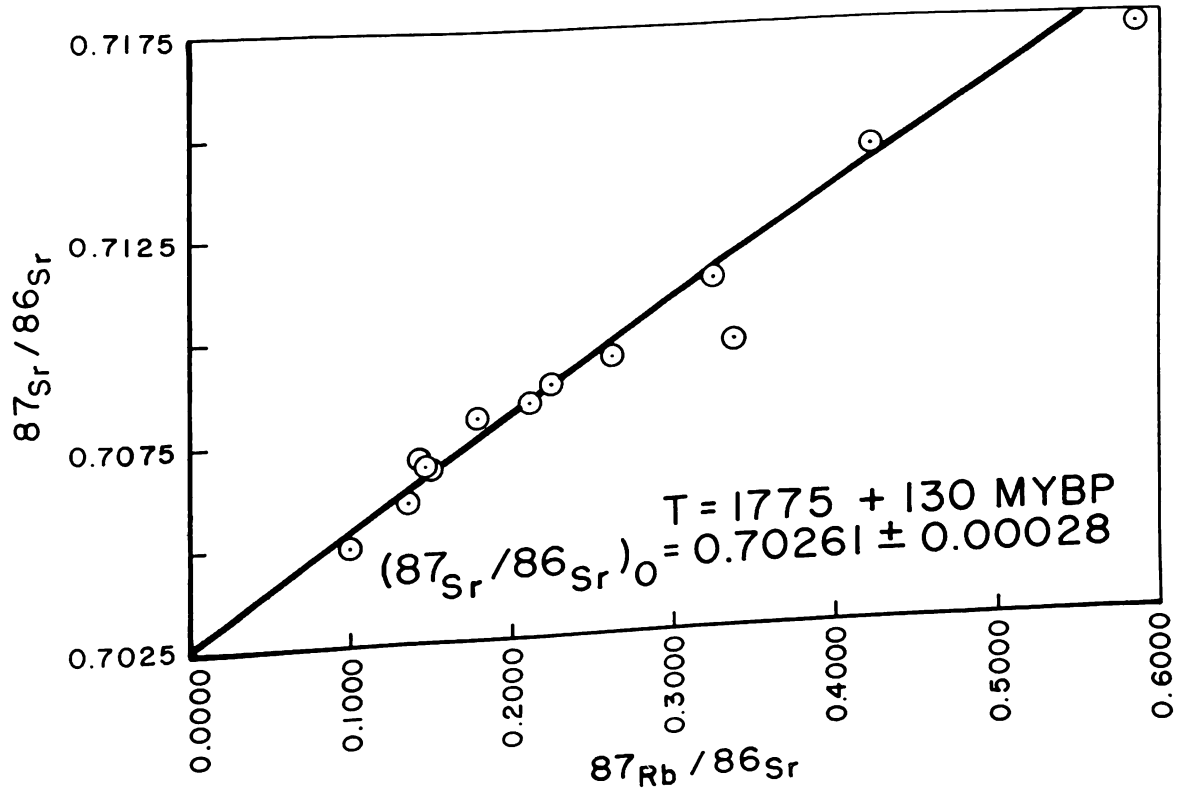

FIGURE 1. Rb-Sr whole-rock isochron for hornblende gneiss samples.

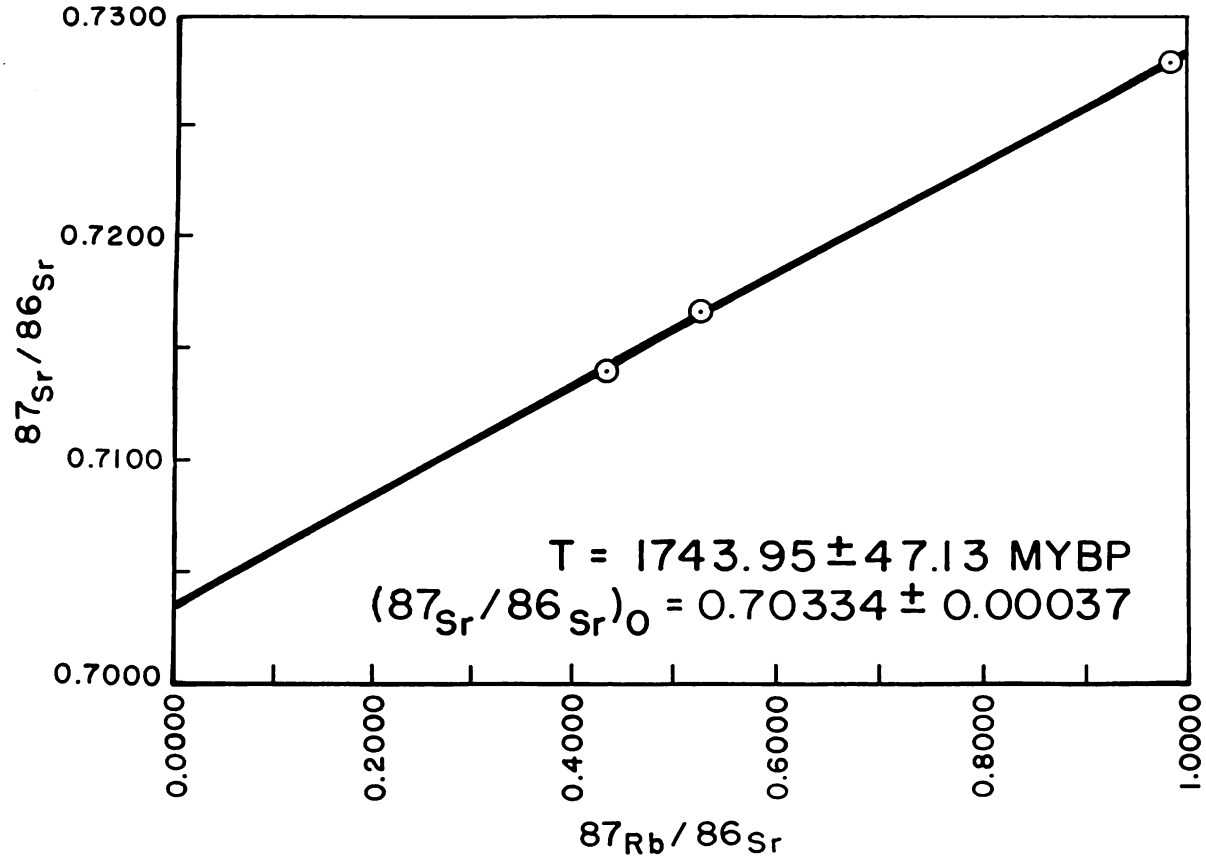

FIGURE 2. Rb-Sr whole-rock isochron for leucocratic (microcline) gneiss samples.

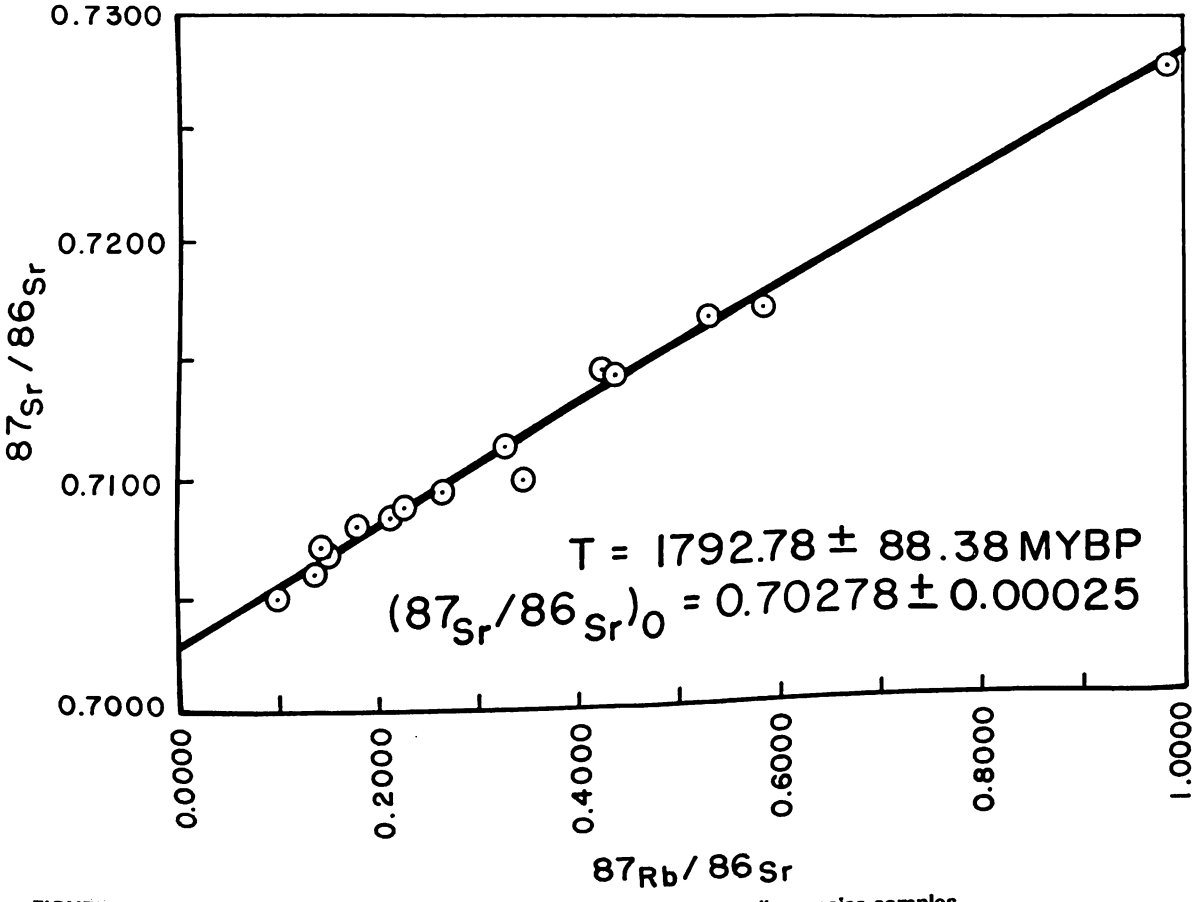

FIGURE 3. Rb-Sr whole-rock isochron for hornblende gneiss and microcline gneiss samples.

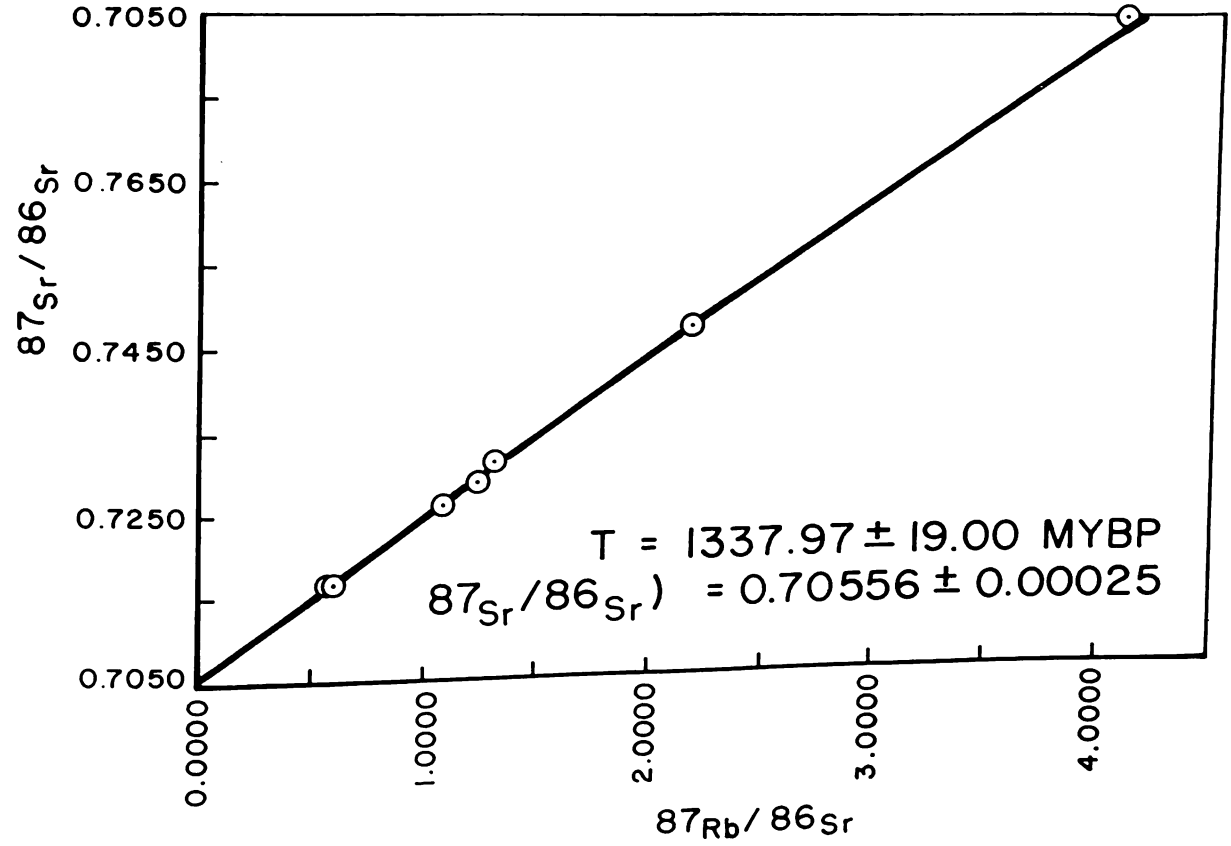

FIGURE 4. Rb-Sr whole-rock isochron for younger dike–pegmatite event samples.

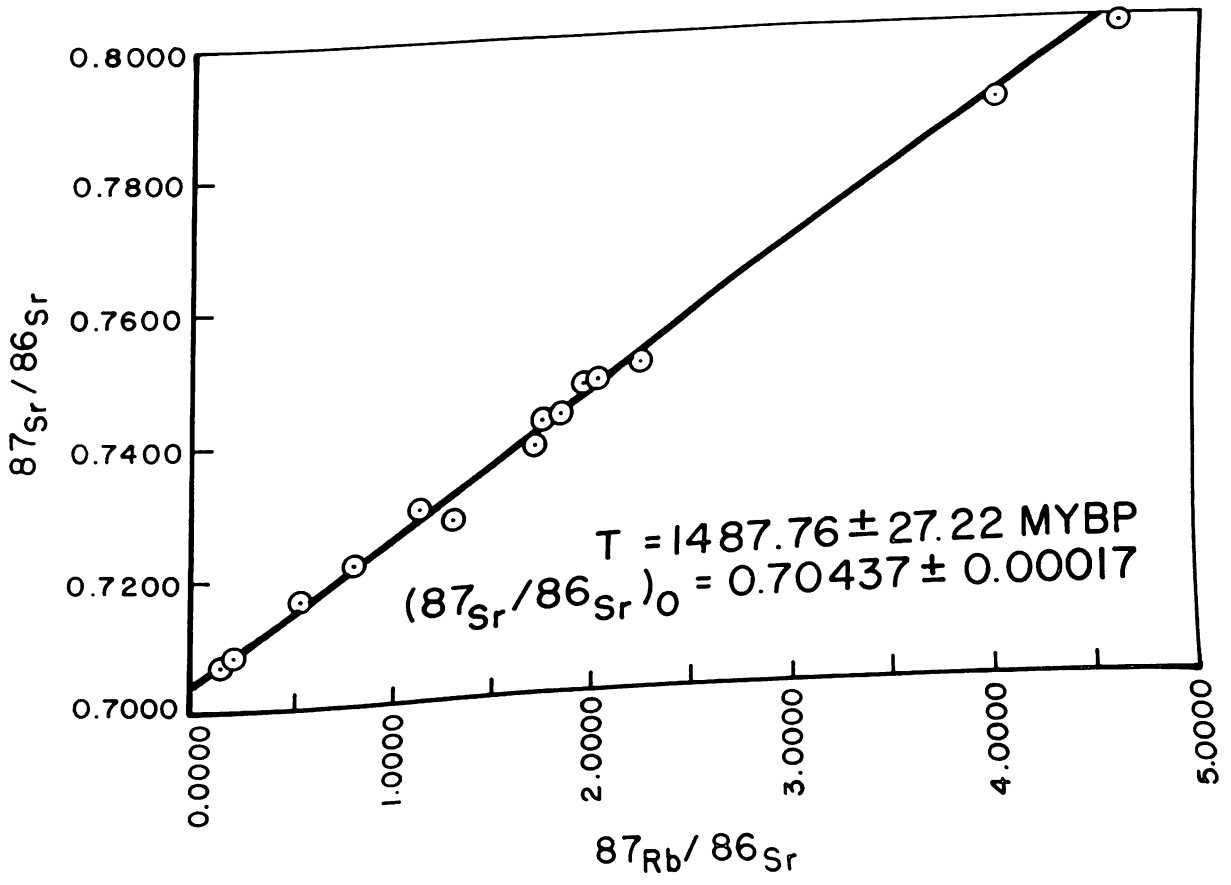

FIGURE 5. Rb-Sr whole-rock isochron for pegmatite-influenced samples.

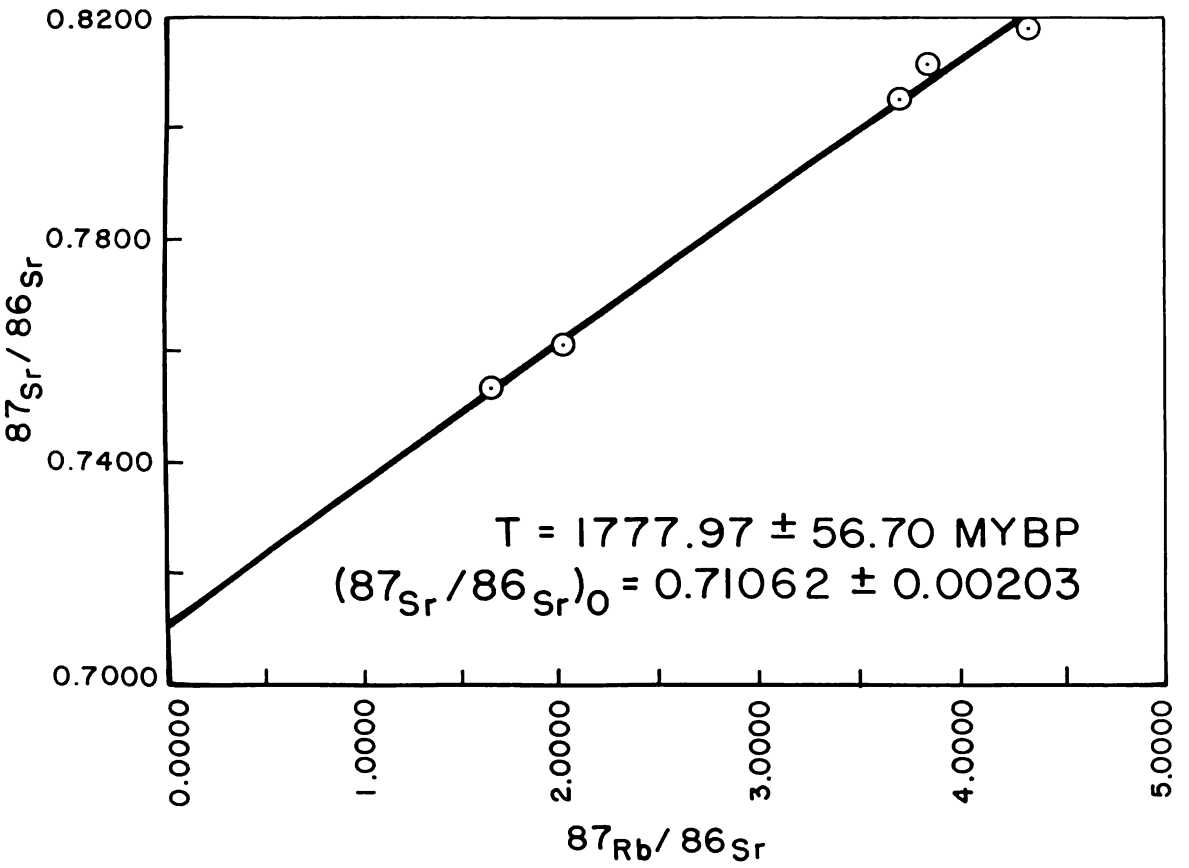

FIGURE 6. Rb-Sr whole-rock isochron for biotite gneiss samples.