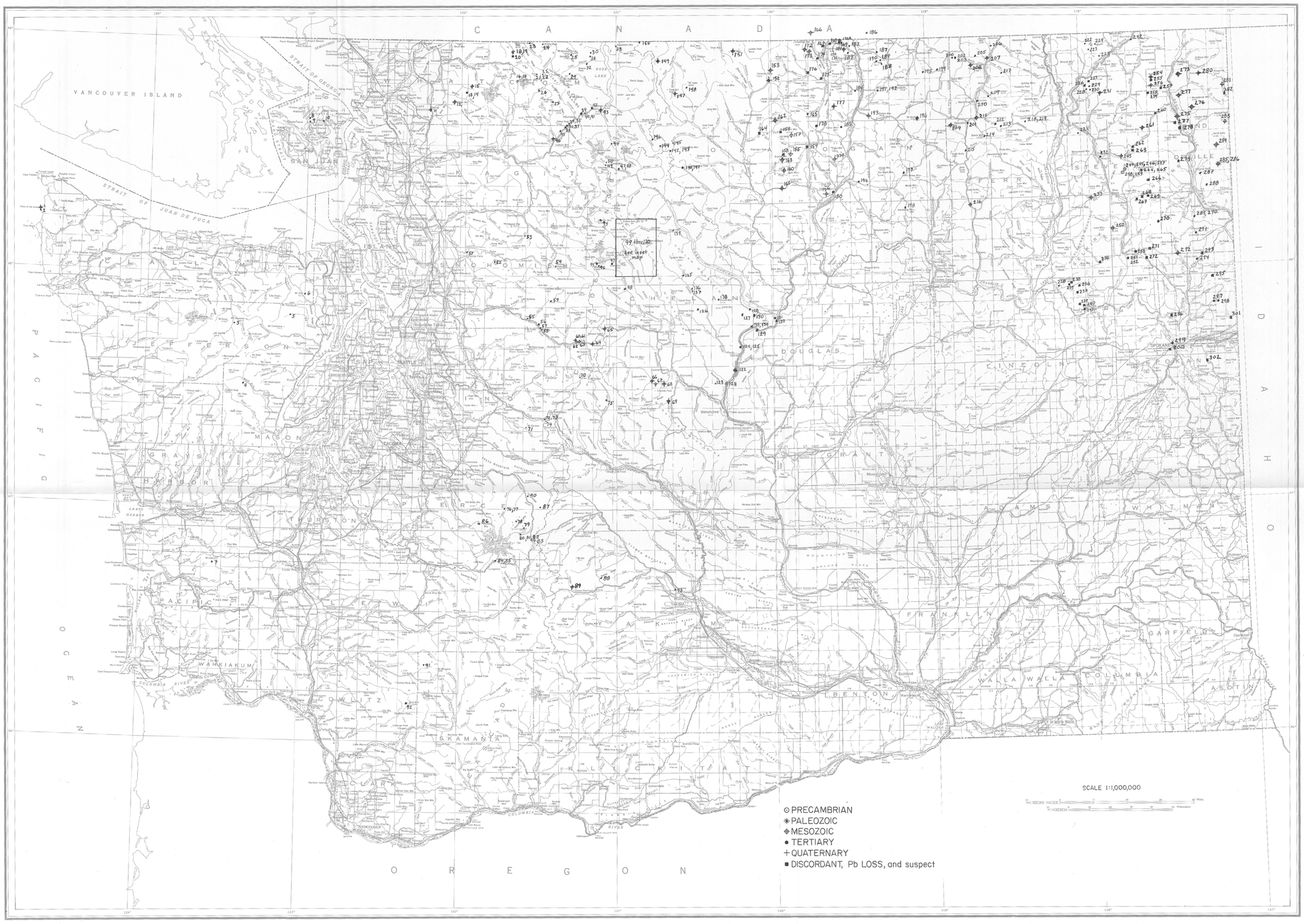
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF – 710
ENGELS AND OTHERS – ISOTOPIC AND FISSION-TRACK AGES, WASHINGTON

SHEET 1 OF 2



The accompanying map and tables include all measured ages in the State of Washington, published and unpublished, known and available to us prior to January 1975. Included in table 1 are rock type, analytical data, locality, names of analysts and collaborating geologists, and references to published sources.

Analytical data for Pbα, KbSr, and fission-track ages are reported separately in tables 2, 3, and 4, respectively. Pbα ages reported as being suspect were among the earliest obtained by the Pbα (Larsen) method. Stern and Rose (1961, p. 608) later discovered through improved analytical techniques that Pb values reported in these early determinations were generally low. They reanalyzed some samples from the earlier group (some from Washington) and reported that, "No systematic variation has been found between the old and new determinations, hence no single empirical factor can be applied to the earlier analyses."

The body of anlytical data from UPb ages is not reproduced here because of its large volume and has all been published in the cited references.

We are indebted to many co-workers who have helped with this compilation. In particular, Kenneth Fox, Richard Marvin, and C. Dean Rinehart spent considerable effort compiling and contributing in many ways. Jim Smith and Richard Marvin reviewed the manuscript. We especially thank Richard Marvin for supplying a considerable part of the data for tables 2, 3, and 4.

Special thanks are due to Lois Schlocker, who analyzed the potassium analyses for KAr dates determined by the following people: Engels, Tabor, Miller, Berry, Kover, Myers, and Von Essen.

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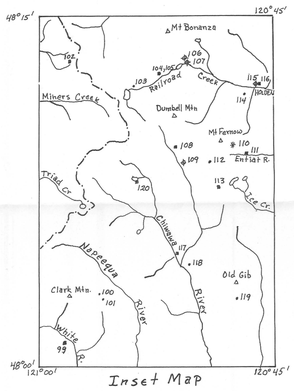

Inset Map
Numbers 99 thru 120

TABLE 2. Additional analytical data on Pbα ages.

Map Loc. No.	Field No.	d/mg/hr	Pb(ppm)	Age
56[1]	G-146	62	2.1, 2.5	92 ± 3[2]
*	7(ZIRC)	794	9, 17, 16, 21, 23	63
*	7(APAT)	22	.2, 2, 8, 7, 6	700
80[1]	G-155	144	3.6	62 ± 10
102	DFC 179-60	261	35	320 ± 40
103	DFC 1e-60	192	1.9	20 ± 20
	DFC 1e-60	367	3.8	30 ± 20
104	DFC 180-61	111	1.4	30 ± 20
105[1]	DFC 106-55	110	5.4, 4.4	111 ± 11
*	FC-1	74	4.0	134 ± 13
111[1]	FV 60-55	78	3.2, 3.5	107 ± 11
110[1]	DFC 107-55	56	2.5, 3.2	126 ± 13
120	DFC 1f-60	176	21.3	300 ± 40
121[1]	G-142	63	2.0, 2.4	87 ± 9
130[1]	HC-1	83	4.0, 4.1	121 ± 12
133[1]	HC-2	98	4.0, 4.2	104 ± 10
135	TLW 252	520	8.8	40 ± 10
155	OK-1	505	17.8	90 ± 20
160	OK-3	113	4.3	90 ± 10
180	OK-2	107	7.3	170 ± 20
193[1]	G-124	275	10.5	95 ± 10
196[1]	G-125	296	11	92 ± 10
204	SBR-360Z	270	82	75 ± 10
204	SBR-360M	2860	80	60 ± 10[3]
207	BAP119	465	11.9	65 ± 10
208	G17C117	56	2.9	130 ± 15
209	01M364	183	4.4	60 ± 10
210	09M363	208	4.9	60 ± 15
211	03ZM362	89	2.8	80 ± 15
212	Q16MZ59	134	3.0	55 ± 15
*	133MZ02	158	4.3	70 ± 10
216	MBB-1-60	133	4.2	80 ± 10
232[1]	G-115	876	34, 36	99 ± 10
235	BW5	1365	16, 16.5	95 ± 10
236	6W501	1097	30, 32, 35	75 ± 10
237	BW3	1089	46	105 ± 10
239	.W2	392	19, 14	105 ± 10
240	BW1	389	17, 13	95 ± 10
241	6B499	453	18.5, 17.0	100 ± 10
255	59-Y-300Z	597	34	145 ± 20[5]
255	59-Y-300M	5363	309	120 ± 15[6]
295	DA-20	4077	150	75 ± 10[5]
301	1W7	227	117	1150 ± 130
302	1W8	251	125	1120 ± 130

[1] Age suspect; see introduction
[2] assumed Th/U = 1.0
[3] assumed Th/U = 25.0
[4] measured Th/U = 0.33
[5] measured Th/U = 50.0
[6] assumed Th/U = 25.0

TABLE 3. Analytical data for Rb-Sr ages.

Map loc. No.	Field No.	Material analyzed	Rb (ppm)	Sr (ppm)	Sr^{87} (ppm)	Rb^{87}/Sr^{86}	Sr^{87}/Sr^{86}	Age (m.y.)
55	3	Biotite	386	13.10	0.053	–	–	35 ± 5
57	4	Biotite	453.4	6.70	.071	–	–	40 ± 2
60	1	Biotite	188.7	19.89	.070	–	–	94.2 ± 16
62	2	Biotite	197	19.06	.067	–	–	86 ± 14
156	OK-1	Apatite	.64	338.45	–	.0054	.7054	–
			.65	337.79	–	.0056	.7057	–
		Biotite	565.02	31.09	–	52.279	.7641	–
			563.77	30.83	–	52.599	.7639	–
	OK-4	Biotite	528.18	23.73	–	64.012	–	–
			532.00	24.04	–	63.643	.7783	–
		Muscovite	444.88	66.65	–	19.203	.7273	–
			444.78	66.07	–	19.364	.7269	–
		Whole rock	110.48	274.66	–	1.157	.7081	–
			110.62	275.82	–	1.154	.7072	–

Isochron constructed with OK-1 and OK-4 data yielded age of 81.8 ± 0.8 m.y.; Sr^{87}/Sr^{86} intercept is 0.7058 ± 0.0005; Rb^{87} half-life assumed to be 5×10^{10} years.

158	OK-5	Biotite	352.46	13.35	–	75.932	0.8420	–
			356.22	13.82	–	74.201	.8426	–
		Whole rock	101.24	389.34	–	.748	.7094	–
			100.94	390.66	–	.743	.7093	–

Isochron constructed with OK-5 data yielded age of 129.0 ± 1.8 m.y.; Sr^{87}/Sr^{86} intercept is 0.7081 ± 0.0001; Rb^{87} half-life assumed to be 5×10^{10} years.

160	OK-3	Biotite	254.43	65.04	–	16.250	0.7272	–
			254.43	45.02	–	16.259	–	–
		Whole rock	14.45	1116.62	–	.0372	.7040	–
			14.35	1121.93	–	.0368	.7046	–
161	OK-6	Biotite	389.91	22.46	–	49.936	.7767	–
			389.73	22.11	–	50.715	.7767	–
		Whole rock	25.75	1074.91	–	.0689	.7051	–
			25.63	1078.34	–	.0684	.7046	–

Isochron constructed with OK-3 and OK-6 data yielded age of 104.2 ± 0.5 m.y.; Sr^{87}/Sr^{86} intercept is 0.7039 ± 0.0002; Rb^{87} half-life assumed to be 5×10^{10} years.

180	OK-2	Biotite	365.386	13.60	–	77.279	.7949	–
			362.649	13.55	–	76.966	.7949	–
		Whole rock	75.880	762.39	–	.286	.7066	–
			76.117	761.23	–	.288	.7071	–

Isochron constructed with OK-2 data yielded age of 82.6 ± 0.3 m.y.; Sr^{87}/Sr^{86} intercept is 0.7066 ± 0.0006; Rb^{87} half-life assumed to be 5×10^{10} years.

TABLE 4. Analytical data for fission-track ages.

Map loc. No.	Field No.	Mineral analyzed	Pu tracks/cm² x10⁴	Number of tracks counted	¼Pi tracks/cm² x10⁶	Number of tracks counted	neutrons/cm² x10¹⁴	
61	RWI18-68	Allanite	3.42	141	1.89	78	15.3	84 ± 7
			3.34	153	1.59	73	15.3	98
		Epidote	1.16	48	6.55	27	15.3	83 ± 20
		Apatite	*	133	*	136	16.16	42 ± 5
64	JE13-67	Apatite	*	185	*	570	13.97	28 ± 3
65	JE14-67	Apatite	*	1123	*	766	13.97	62 ± 4
66	JE20-67	Apatite	*	688	*	831	13.97	71 ± 5
67	JE21-67	Apatite	*	812	*	900	11.9	65 ± 4
68	JE22-67	Apatite	*	503	*	1141	13.97	57 ± 4
		Allanite	32.7	486	14.3	213	13.5	94 ± 7
145	JE29A-67	Allanite	1.00	427	.839	422	12.8	47
			1.16	423	1.16	571	12.8	39
			.987	470	.930	486	12.8	41
			1.34	450	1.23	660	12.8	42
			.819	240	.751	310	12.8	43
			.895	308	.852	320	12.8	41
187	O-131	Epidote	1.76	242	.967	155	12.8	71
			1.13	323	.652	211	12.8	67
			1.06	213	.693	138	12.8	59
			.952	169	.692	115	12.8	54
			1.15	451	.871	390	12.8	52
			.667	191	.413	125	12.8	63
			1.75	84	1.12	54	12.8	61
			1.15	139	.577	70	12.8	77
		Sphene	*	*	*	*	*	66 ± 7
188	O-36	Allanite	2.58	71	1.09	30	9.8	71
			2.58	130	1.09	71	9.8	50
			6.93	127	3.71	68	9.8	56
		Apatite	*	*	*	*	*	51 ± 5
190	O-38	Allanite	1.13	301	0.568	177	9.8	60
			1.91	131	1.08	74	9.8	53
			1.25	132	.607	75	9.8	64
			1.65	68	.946	39	9.8	52
			1.75	48	.849	35	9.8	62
			8.19	300	.404	148	9.8	61
		Apatite	*	*	*	*	*	53 ± 5

SUMMARY OF K-Ar, Rb-Sr, U-Pb, Pbα, AND FISSION-TRACK AGES OF ROCKS FROM WASHINGTON STATE PRIOR TO 1975 (EXCLUSIVE OF COLUMBIA PLATEAU BASALTS)

By

Joan C. Engels, Rowland W. Tabor, Fred K. Miller, and John D. Obradovich

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