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K/AR AGES OF IGNEOUS ROCKS IN THE MCGRATH QUADRANGLE, ALASKA

by

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This Public Data File is a compilation of all currently available K/Ar and 40Ar/39Ar ages in the McGrath Quadrangle of the Alaska Range. It includes published data from all sources, and unpublished data collected by the Alaska Division of Geological and Geophysical Surveys (ADGGS). The data are presented in Table 1; the location of each sample listed in the table is shown on Plate 1. The map outlines shown on Plate 1 are taken from ADGGS mapping, both published and unpublished, and depict volcanic, hypabyssal and plutonic rock exposures. These outlines have been generalized for the purpose of this brief report, and not all areas of extensive dike swarms are outlined. Compilation of the geology of the entire McGrath Quadrangle is in progress, as is a compilation of all major oxide geochemistry of igneous rocks from the quadrangle.

The age of dated samples from the McGrath Quadrangle ranges from Late Cretaceous (oldest dated sample 79 Ma) to Miocene (youngest dated sample 20.9 Ma). The plutons are predominantly older than 55 Ma, with a large grouping between 55 Ma and 65 Ma (Figure 1). Among the Tertiary plutons, there is no apparent trend in spatial distribution over time. The middle Tertiary plutons are fewer in number than those of early Tertiary age in the McGrath Quadrangle.

Wallace and Engebretson (1984), Bergman and others (1986, 1987) and Moll-Stalcup (in press) have suggested that the Alaska Range and Kuskokwim Mountains magmatic belts are manifestations of northerly movement of the Kula plate from about Late Cretaceous to early Tertiary. Plutonic examples of this magmatic event are found throughout the McGrath Quadrangle. The oldest dated plutons are located in the northwest portion of the quadrangle, and include the Selatna, Takotna, Candle and Vinasale plutons. These range from a minimum measured age of 61.1 Ma to 71.2 Ma (Bundtzen and Laird, 1983; Bundtzen, 1986; Table 1, this report).

The Post River, Sheep Creek, and Mount Estelle plutons (Bundtzen and others, 1987; Bundtzen and others, 1982; Reed and Lanphere, 1972) and Middle Fork plutonic complex (Gilbert and others, 1988; Solie, 1988; Table 1, this report) range from 55 Ma to 67 Ma, with a strong population peak at 57 - 58 Ma. This grouping corresponds with the early Tertiary plutonic episode described by Reed and Lanphere (1970, 1973). The comparative lull in magmatism at 63 ± 3 Ma is reported by Bergman and others (1987) throughout southern and interior Alaska, and is interpreted by them to result from post-subduction melting processes.

The younger plutonic rocks in the McGrath Quadrangle fall within the middle Tertiary groupings of Reed and Lanphere (1970, 1973) of 34 Ma - 41 Ma and 25 Ma - 30 Ma. The former includes granite (88BT161) in the A-1 Quadrangle from an area adjacent to the Hartman pluton. In the Lime Hills Quadrangle, the Hartman pluton has been dated at 62.0 ± 1.9 Ma (Reed and Lanphere, 1972). Therefore, the dated intrusive in McGrath A-1 Quadrangle is probably a distinct younger intrusive body.

Wallace and Engebretson (1984) suggest that a major plate reorganization took place from 43 Ma to 56 Ma, which might be reflected in the plutonic/volcanic ages and changing chemical compositions observed in the McGrath Quadrangle, as well as throughout western Alaska. In the

McGrath Quadrangle, there is a general trend toward granite over time among quartz-rich plutonic rocks. The Late Cretaceous plutons include monzonite, monzodiorite, quartz monzonite, and granodiorite, but no granite. The early Tertiary plutons include quartz-rich rock types from monzodiorite to granite; the quartz-rich middle Tertiary plutons are all granites.

The six dated volcanic rocks in the McGrath Quadrangle are all younger than 50 Ma, and formed during the observed hiatus in plutonic activity between 41 Ma and 50 Ma. The exceptions, dated younger than 41 Ma, are the 37.2 ± 2.9 sample from the Windy Fork volcanic center, which is difficult to interpret due to its large analytical error, and one Post Lake volcanic rock sample (31.35 ± .94 Ma), which represents a minimum age and is probably coeval with the other Post Lake volcanic sample of 41.1 ± 1.23 Ma. Volcanic rocks of similar age and composition have been described by Decker and Gilbert (1978) in the Mount Galen area of Denali National Park about 150 km northeast of the McGrath Quadrangle.

Dike samples represent the oldest and youngest dated igneous activity in the McGrath Quadrangle, and intruded sporadically throughout the duration of igneous activity. Most of the dated dike samples are from the Veleska Lake area, and are middle Tertiary.

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Table 1: McGrath Quadrangle Age Data, listed sequentially from oldest to youngest

Sample No.	Quad	Locality	Rock	Min.	Age(ma) Reported (a)	Age(ma) Recalc. (b)	Ref. (c)	Lab (d)	Comments	K2O (wt%)	sample wt (grams)	40ArRAD x10-11 (mol/g)	40ArRAD/ 40Kx10-3	40ArRAD/ 40ArTOTAL
K/Ar Data:														
84BT112	B-1	dike swarm	gd	hb	78.97 +/-2.37	79.0	0	a	hb bt gd in dike swarm	0.853	1.2867	9.9161	4.6902	0.799
78BT461	D-6	Takotna Mountain	md	bt	71.2 +/-2.1	71.2	4	a	impure biotite	8.875	0.1117	92.8020	4.2200	0.907
77BT257	C-6	Vinasale Mountain	qm	bt	69.4 +/-2.1	71.2	0	a	bt qm, sample rerun	7.210	0.1183	75.3300	4.2170	0.534
77BT257	C-6	Vinasale Mountain	qm	bt	68.6 +/-2.1	70.4	0	a	bt qm, sample rerun	7.210	0.0922	74.4830	4.1690	0.720
78BT379	D-6	Candle Hills	mon	bt	(69.7 +/-2.1)	69.7	4	a	impure bt, minimum age	8.197	0.1008	83.8300	4.1280	0.873
84BT147	B-1	intrusive, B-1		bt	66.76 +/-2.00	66.8	0	a		8.435	0.2237	82.5750	3.9512	0.945
2	A-2	Post River pluton	qm	bt	61.8 +/-1.9	61.8	1	a		5.412	0.1277	49.0000	3.6500	0.477
78BT321	B-6	Selatna pluton	qm	bt	(61.1 +/-1.8)	61.1	0	a	impure bt, minimum age	6.566	0.1382	58.7600	3.6120	0.795
1	A-2	Bowser Creek area	qp	bt	60.4 +/-1.8	60.4	1	c	quartz porphyry	5.287	0.1600	46.7600	3.5700	0.534
67AR450	C-4	Lone Mountain granite	gr	bt	58.3 +/-1.6	59.8	9	b		8.510		74.4300	3.5299	0.890
67AMa226	B-2	Sheep Creek pluton	qm	hb	57.6 +/-2	59.1	1	b	same locality	1.058		9.1510	3.4900	0.730
88BT167	A-1	South Fork granite	gr	bt	58.94 +/-1.77	58.9	0	a		9.534	0.1259	82.2223	3.4810	0.763
67AMa226	B-2	Sheep Creek pluton	qm	bt	56.6 +/-2	58.1	1	b	same locality	7.220		61.3800	3.4300	0.860
84BT113a	B-2	Sheep Creek pluton	qp	bt	58.10 +/-1.7	58.1	0	a	same as 84BT113b	7.404	0.1162	62.9500	3.4300	0.730
70AMa226	B-2	Sheep Creek pluton	qm	hb	56.5 +/-2	57.9	1	b	same locality	1.062		9.0030	3.4200	0.520
82DNS193	A-3	Middle Fork Complex	afgr	am	57.7 +/-1.7	57.8	6	a	alk-feldspar granite	1.260	1.6443	10.6000	3.4100	0.613
70AMa226	B-2	Sheep Creek pluton	qm	bt	56.4 +/-2	57.8	1	b	same locality	7.370		62.3200	3.4100	0.790
84BT111	B-1	dike	gb	bt	57.72 +/-1.73	57.7	0	a	cpx-rich dike xcuts swarm	7.562	0.4113	63.8436	3.4076	0.857
67AEr116	A-3	plug on Middle Fork	qm	bt	56.0 +/-1.6	57.4	9	b		8.250		69.3000	3.3900	0.840
82DNS197a	A-3	Middle Fork Complex	hbtgr	hb	57.2 +/-1.7	57.3	6	a	same as 82DNS197b	0.938	5.1950	7.8500	3.3800	0.729
82DNS197b	A-3	Middle Fork Complex	hbtgr	bt	56.6 +/-1.7	56.6	6	a	same as 82DNS197a	8.554	1.0569	70.7000	3.3400	0.869
82DNS209	A-3	Middle Fork Complex	dior	bt	56.6 +/-1.7	56.6	6	a		8.776	0.4416	72.6000	3.3400	0.761
82DNS211	A-3	plug on Middle Fork	qm	bt	56.6 +/-1.7	56.6	6	a		8.305	0.3924	68.8000	3.3400	0.553
83DNS196a	A-3	Middle Fork Complex	gab	bt	56.1 +/-1.7	56.1	6	a	same as 83DNS196b	7.843	0.6133	64.3000	3.3100	0.663
83DNS196b	A-3	Middle Fork Complex	gab	bt	56.1 +/-1.7	56.1	6	a	same as 83DNS196a	7.843	0.6133	64.4000	3.3100	0.667
83DNS195c	A-3	Middle Fork Complex	afgr	am	55.6 +/-1.7	55.6	6	a		1.018	5.0868	8.2800	3.2800	0.709
83DNS312	A-3	dike swarm	bas	wr	55.0 +/-1.6	54.9	0	a	mafic dike	5.248	5.6397	42.1800	3.2400	0.929
83DNS311	A-3	dike swarm	bas	wr	54.1 +/-1.6	54.1	0	a	mafic dike	2.973	5.8671	23.5000	3.1900	0.810
84BT113b	B-2	Sheep Creek pluton	qp	hb	51.20 +/-1.5	51.2	0	a	same as 84BT113a	1.235	0.6594	9.2300	3.0200	0.530
83DS-TC49	B-2	Veleska Lake dikes	fel	wr	(50.3 +/-1.5)	50.2	10	a	min.age,qtz felsite dike	2.472	2.3088	18.1000	2.9600	0.859

(a)Parentheses denote minimum age; (b)Constants used listed in Table 2; (c)References listed in Table 3; (d)Labs listed in Table 4.

Table 1: McGrath Quadrangle Age Data, listed sequentially from oldest to youngest

Sample No.	Quad	Locality	Rock	Min.	Age(ma) Reported (a)	Age(ma) Recalc. (b)	Ref. (c)	Lab (d)	Comments	K2O (wt%)	sample wt (grams)	40ArRAD x10-11 (mol/g)	40ArRAD/ 40Kx10-3	40ArRAD/ 40ArTOTAL
81BT361	B-2	Sheep Creek volcanics	bas	wr	49.0 +/-3.4	48.9	0	c	mafic volcanic	0.795	0.6218	5.6830	2.8800	0.250
81DB337	B-3	dike(?) in Tert.seds	bas	wr	45.5 +/-1.4	45.5	0	c		1.988	0.5899	13.1780	2.6800	0.420
81BT490	B-2	Sheep Creek volcanics	and	bt	43.6 +/-7.8	43.5	0	c	intermediate volcanic	4.796	0.1544	30.4580	2.5600	0.100
81JD700A	B-2	Sheep Creek volcanics	bas	wr	(41.7 +/-1.3)	41.7	0	a	columnar basalt, min age	1.520	5.4967	9.2400	2.4500	4.070
83BT139	C-1	diorite, C-1	di	hb	41.3 +/-1.2	41.3	8	a		0.588	1.0801	3.5400	2.4300	0.535
88DNS92a	A-1	Post Lake volcanics	dac	hb	41.11 +/-1.23	41.1	0	a	hb dacite	0.520	0.6511	3.1128	2.4161	0.598
78WG151b	A-5	Cheeneetnuk	gr	bt	39.8 +/-1.2	39.8	5	a	biotite granite	7.835	0.1558	45.3380	2.3360	0.869
83BT114	B-2	Veleska Lake intrusive	qp	wr	(39.4 +/-1.2)	39.3	0	a	qtz porph.,min. age	3.140	1.2387	18.0000	2.3100	0.852
88AR233	B-2	Veleska Lake dikes	gd	hb	38.3 +/-1.9	39.3	9	b	just N of volcanics	0.428		2.4490	2.3090	0.330
88BT161	A-1	Hartman(?) pluton	gr	bt	37.87 +/-1.14	37.9	0	a		8.530	0.2012	46.9933	2.2236	0.775
81WG162	B-3	Windy Fork volcanics	and	wr	37.2 +/-2.9	37.1	0	c	hornblende andesite	2.711	0.8238	0.1466	2.1800	0.200
83DS-TC74	B-2	Veleska Lake dikes	gd	hb	34.1 +/-1.0	34.1	10	a	granodiorite porph. dike	0.440	0.9082	2.1800	2.0000	0.169
83DS-TC98	B-2	Veleska Lake dikes	gd	hb	33.0 +/-1.0	32.9	10	a	granodiorite porph. dike	0.384	0.2351	1.8400	1.9300	0.164
88DNS103	A-1	Post Lake volcanics	dac	pl	(31.35 +/-.94)	31.3	0	a	min.age,hb dacite	0.462	1.3183	2.1007	1.8372	0.532
67AR186	A-3	Windy Fork pluton	gr	bt	30.1 +/-0.9	30.9	9	b	diff. locality 67AR318	8.260		37.0300	1.8090	0.790
67AR318	A-3	Windy Fork pluton	gr	hb	29.0 +/-0.9	29.7	9	b	diff. locality 67AR186	0.972		4.1920	1.7410	0.570
83DS-TC55	B-2	Veleska Lake dikes	dac	hb	28.9 +/-0.9	28.9	10	a	hb-rich dacite dike	0.390	0.3917	1.6400	1.6900	0.195
83BTWF	A-3	Windy Fork pluton	gr	px	23.5 +/-0.7	23.4	6	a	late dike adj. to pluton	0.070	1.7910	0.2370	1.3700	0.209
81BT486	B-2	Veleska Lake dikes	gd	hb	20.9 +/-1.2	20.9	10	c	fine-grained dike	0.880	0.2980	2.6685	1.2200	0.300
40Ar/39Ar Data:														
89Ha19	A-1	Mt. Estelle pluton	gd	bt	67.38 +/-0.40 (1 sigma)	-	0	d	40Ar/39Ar plateau Fractions 4-10	9.600	0.0825	Initial 40Ar/36Ar=305.6 +/-2.3		

(a)Parentheses denote minimum age; (b)Constants used listed in Table 2; (c)References listed in Table 3; (d)Labs listed in Table 4.

Table 2: Constants Used to Recalculate K/Ar Ages

$$\text{Lambda}_e + \text{Lambda}_{e'} = 0.581 \times 10^{-10}\ \text{yr}^{-1}$$

$$\text{Lambda}_\beta = 4.962 \times 10^{-10}\ \text{yr}^{-1}$$

Table 3: References Cited in Table 1

0 = unpublished ADGGS data.
1 = Berry, A.L., Dalrymple, G.B., Lanphere, M.A., and Von Essen, J.C. (1976).
2 = Bundtzen, T.K. (1986).
3 = Bundtzen, T.K., Kline, J.T., Smith, T.E., and Albanese, M.A. (1987).
4 = Bundtzen, T.K. and Laird, G.M. (1983).
5 = Gilbert, W.G. (1981).
6 = Gilbert, W.G., Solie, D.N., and Kline, J.T. (1988).
7 = Gilbert, W.G., Solie, D.N., Kline, J.T., and Dickey, D.B. (1990).
8 = Kline, J.T., Gilbert, W.G., and Bundtzen, T.K. (1986).
9 = Reed, B.L. and Lanphere, M.A. (1972).
10 = Szumigala, D.J. (1986).

Table 4: Laboratories listed in Table 1

a = ADGGS and UAF Cooperative K/Ar Geochronology Lab, Fairbanks, Alaska.
b = U.S. Geological Survey Geochronology Labs.
c = D. Krummenacher, Department of Geological Sciences, San Diego State University, San Diego, California.
d = ADGGS and UAF Cooperative 40Ar/39Ar Geochronology Lab, Fairbanks, Alaska.

Figure 1: McGrath Age Date Distribution