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Geochronology and Generalized Geology of the Central Alaska Range, Clearwater Mountains and Northern Talkeetna Mountains

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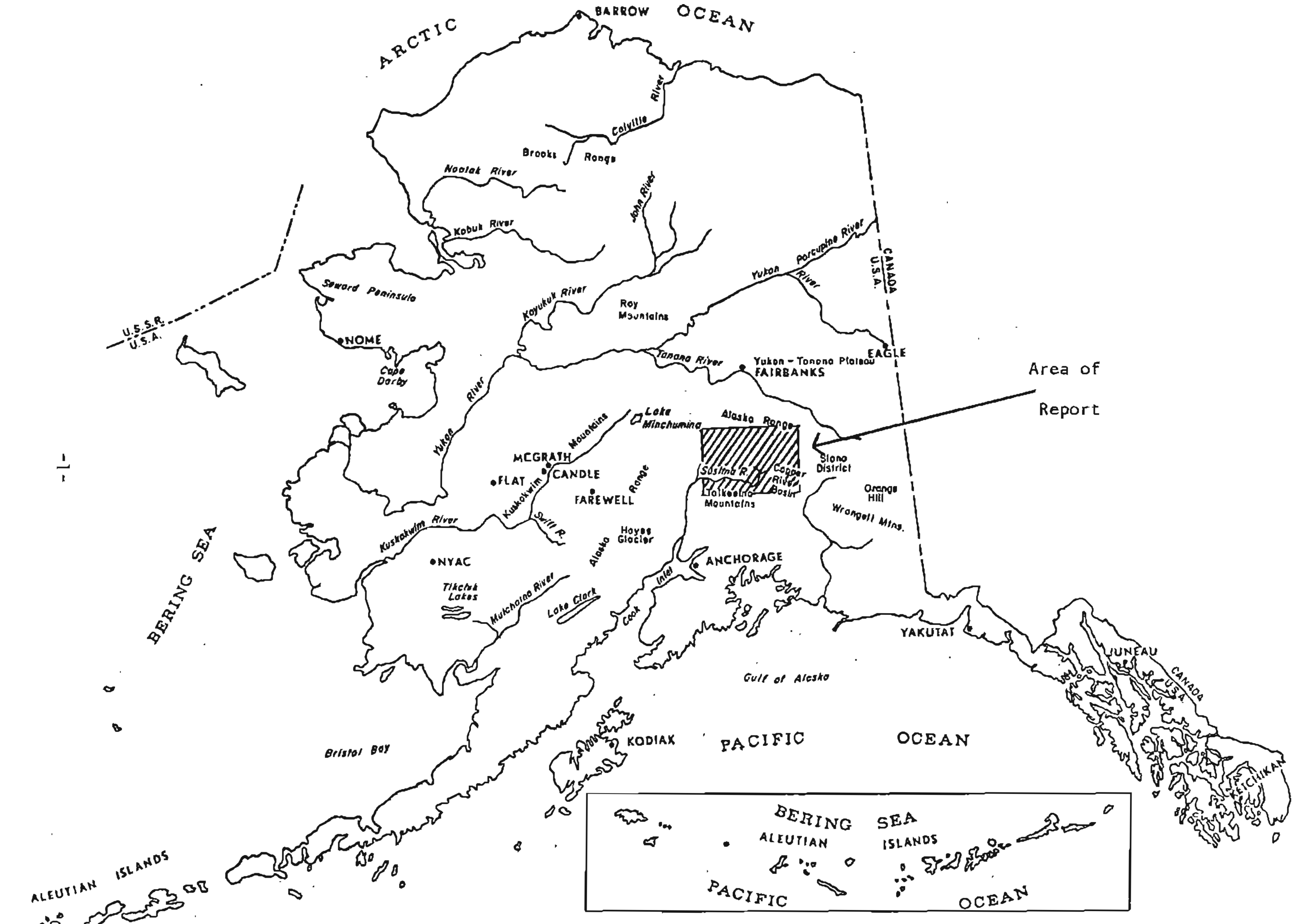
ILLUSTRATION



Location Map

INTRODUCTION

Age assignments of metamorphic and plutonic rocks are based on potassium-argon measurements of 41 biotite, 32 amphibole, and 10 muscovite separates from 58 rock samples. Sample localities are shown on the accompanying map. Radiometric ages, analytical data and rock types are given in Table 1.

Analytical work was done at the Geochronology Laboratory of the Geophysical Institute, University of Alaska, Fairbanks. Our analytical techniques have been described previously (Turner and others, 1973). The plus-or-minus value assigned to each age measurement (Table 1) is an estimate of the standard deviation of analytical precision based on the method of Cox and Dalrymple (1967).

Some of the samples for this study were generously provided by J. H. Stout of the University of Minnesota, Florence R. Weber of the U.S. Geological Survey and R. B. Forbes of the University of Alaska. The U.S. Geological Survey also provided a portion of our helicopter support.

We wish to thank Robert Forbes, Florence Weber, Clyde Wahrhaftig, and J. H. Stout for sharing freely their knowledge of the geology of parts of the areas studied and for many helpful discussions in and out of the field.

In some cases, measured ages reported here are from rocks that have had complex metamorphic thermal histories. Some ages have been partially or totally reset by later plutonism. Preliminary geologic conclusions based in part on geologic and geochronologic data presented here may be found in Smith and Lanphere (1971), Smith (1974), Smith and Turner (1973, 1974), Forbes and others (1973), Turner and others (1974), and Forbes and others (1974 a, b). These data will be treated more extensively in future publications. The purpose of this report is to make the basic data of this study generally available in advance of formal publication.

REFERENCES

Cox, Allan; and Dalrymple, G. B., 1967, Statistical analysis of geomagnetic reversal data and the precision of potassium argon dating: Jour. Geophys. Research, V. 72, p. 2603-2614

Forbes, R. B.; Smith, T. E.; and Turner, D. L., 1974, A solution to the Denali Fault offset problem: Alaska Div. Geol. and Geophys. Surveys, Annual Report 1973, p. 25-27

________________, 1974, Comparative petrology and structure of the Maclaren, Ruby Range and Coast Range belts: implications for offset along the Denali fault system (abs.): Geol. Soc. Amer. 70th Ann. Cordilleran Section Mtg. Abs. with Prog., Las Vegas, Nev., V. 6, No. 3, p. 177

Forbes, R. B.; Turner, D. L.; Stout, J. H.; and Smith, T. E., 1973, Cenozoic offset along the Denali fault, Alaska (abs.): EOS, V. 54, No. 4, p. 495

Smith, T. E., 1974, Regional geology of the Susitna-Maclaren River area: Alaska Div. Geol. and Geophys. Surveys, Annual Report 1973, p. 3-6

Smith, T. E.; and Lanphere, M. A., 1971, Age of sedimentation, plutonism and regional metamorphism in the Clearwater Mountains region, central Alaska: Isochron West, No. 2, p. 17-20

Smith, T. E.; and Turner, D. L., 1973, Geochronology of the Maclaren metamorphic belt, south-central Alaska - A progress report: Isochron West, No. 7, p. 21-25

________________, 1974, Maclaren metamorphic belt of central Alaska (abs.): Geol. Soc. Amer. 70th Ann. Cordilleran Section Mtg. Abs. with Prog., Las Vegas, New., V. 6, No. 3, p. 257

Turner, D. L.; Forbes, R. B.; and Naeser, C. W., 1973, Radiometric ages of Kodiak Seamount and Giacomini Guyot, Gulf of Alaska: Implications for Circum-Pacific Tectonics, Science, V. 182, p. 579-581

Turner, D. L.; Smith, T. E.; and Forbes, R. B., 1974, Geochronology of offset along the Denali fault system in Alaska (abs.): Geol. Soc. Amer. 70th Ann. Cordilleran Section Mtg. Abs. with Prog., Las Vegas, Nev., V. 6, No. 3, p. 268-269

TABLE 1

ANALYTICAL DATA FOR K-Ar AGE DETERMINATIONS

Map No.	Sample No. (Lab. No.)	Rock Type	Mineral Dated	K_2O (weight percent)	Sample Weight (grams)	$^{40}Ar_{rad}$ (moles/gm) X 10^{-11}	$\frac{^{40}Ar_{rad}}{^{40}K}$ X 10^{-3}	$\frac{^{40}Ar_{rad}}{^{40}Ar_{total}}$	Age ± 1σ (m.y.)
1	72AST-332 (73047)	QMON	B	8.457 8.463 $\bar{x}$=8.460	0.5364	46.65	2.183	0.693	36.9±1.1
2	TT-6-72 (73068)	QDI	B	7.922 7.936 $\bar{x}$=7.929	0.4025	67.88	3.389	0.796	57.1±1.7
3	TT-4-72 (73069)	QDI	B	8.100 8.132 $\bar{x}$=8.116	0.4426	68.99	3.365	0.695	56.7±1.7
4	TT-1-72 (73064)	GDI	B	7.777 7.780 $\bar{x}$=7.778	0.5591	66.80	3.400	0.888	57.2±1.7
5	72AST-178 (73026)	GDI	B	8.928 8.904 $\bar{x}$=8.916	0.3673	65.15	2.893	0.779	48.8±1.5
5	72AST-178 (73014)	GDI	H	0.520 0.520 0.520 0.520	3.2927	3.487	2.655	0.571	44.8±1.3
6	72AST-351 (73063)	GR	B	7.040 6.952 $\bar{x}$=6.996	0.9830	58.58	3.315	0.875	55.8±1.7
7	72AST-165A (73008)	GDI	H	0.979 0.970 0.972 0.979 0.980 0.975 0.977 0.977 0.974 0.969 $\bar{x}$=0.975	3.6846	9.432	3.829	0.866	64.3±1.9

7	72AST-165A (73012) Replicate	GDI	H	0.983 0.990 0.990 0.990 0.990 0.990 0.990 0.990 0.990 0.985 $\bar{x}$=0.989	5.5034	9.438	3.779	0.791	63.5±1.9 $\bar{x}$=63.9±1.9
8	72AST-1658 (73025)	SCH	B	8.373 8.438 $\bar{x}$=8.405	0.6955	66.84	3.148	0.888	53.0±1.6
9	DT72-45A (72198)	GDI	B	8.833 8.848 $\bar{x}$=8.840	0.4693	48.78	2.184	0.775	37.0±1.1
9	DT72-45A (72201)	GDI	H	0.680 0.679 $\bar{x}$=0.679	3.4280	3.910	2.278	0.729	38.5±1.1
10	72AST-331 (73020)	QMON	B	8.850 8.876 $\bar{x}$=8.863	0.7202	48.41	2.162	0.835	36.6±1.1
11	72AST-1657 (73091)	GDI	H	1.149 1.150 $\bar{x}$=1.149	4.2615	9.646	3.322	0.857	55.9±1.7
12	72AST-329 (73016)	AMPH GNS	A	0.210 0.210 0.210 0.210	4.1263	2.223	4.191	0.272	70.3±2.1
13	68ASB-638 (72017)	AMPH SCH	H	0.310 0.304 $\bar{x}$=0.307	2.4533	2.958	3.815	0.374	64.1±1.9
14	DT72-43A (72178)	QMON	B	7.862 7.865 $\bar{x}$=7.863	0.7861	111.8	5.627	0.855	93.8±2.8
14	DT72-43B (72180)	QMON	B	7.528 7.545 $\bar{x}$=7.536	0.7111	106.6	5.600	0.883	93.4±2.8 $\bar{x}$=93.6±2.8
14	DT72-43A (72172)	QMON	H	1.022 1.022	4.3612	14.76	5.718	0.838	95.3±2.8
14	DT72-43B (72170)	QMON	H	0.969 0.980 $\bar{x}$=0.974	4.6925	14.01	5.690	0.857	94.8±2.8 $\bar{x}$=95.0±2.8

15	72AST-326 (73061)	QDI	B	8.840 8.832 $\bar{x}$=8.836	0.4447	70.62	3.164	0.862	53.3±1.6
15	72AST-326 (73013)	QDI	H	0.597 0.600 0.595 0.598 $\bar{x}$=0.597	4.2110	7.900	5.234	0.637	87.4±2.6
16	69AST-199 (72011)	AMPH GNS	H	0.182 0.194 $\bar{x}$=0.188	3.3149	1.872	3.942	0.427	66.2±2.0
17	72AST-290 (73087)	DI	H	0.380 0.380	2.6603	10.14	10.57	0.757	172.5±5.1
18	DT72-44A (72179)	QMON	B	7.788 7.783 $\bar{x}$=7.785	0.6821	109.2	5.554	0.903	92.6±2.8
18	DT72-44A (73070)	QMON	H	1.068 1.067 $\bar{x}$=1.067	1.9927	15.07	5.589	0.823	93.2±2.8
19	72AST-323 (73015)	AMPH GNS	H	0.600 0.599 0.602 0.608 $\bar{x}$=0.602	4.1655	7.026	4.618	0.743	77.3±2.3
20	DT73-208 (74007)	DI GNS	B	8.466 8.500 $\bar{x}$=8.483	0.5514	63.83	2.979	0.906	50.2±1.5
20	DT73-208 (74019)	DI GNS	H	0.687 0.683 $\bar{x}$=0.685	2.5216	6.063	3.504	0.658	59.0±1.8
21	DT73-207 (74010)	MIG	B	9.034 8.952 $\bar{x}$=8.993	0.4932	67.46	2.970	0.871	50.1±1.5
21	DT73-207 (74017)	MIG	H	0.763 0.753 $\bar{x}$=0.758	2.3703	5.493	2.869	0.294	48.4±1.4
22	DT73-205 (74024)	AMPH	H	0.360 0.360	2.3410	3.110	3.420	0.681	57.6±1.7
23	72AST-311 (73022)	GDI	B	9.145 9.212 $\bar{x}$=9.178	0.4162	48.23	2.080	0.723	35.2±1.1
23	72AST-311 (73071)	GDI	H	0.618 0.618	1.1812	3.201	2.050	0.635	34.7±1.0

24	72AST-214 (73092)	AMPH GNS	H	1.898 1.895 1.895 $\bar{x}$=1.896	3.7769	16.59	3.464	0.875	58.3±1.7
25	71AWR-472 (71074)	GDI	B	9.142 9.151 $\bar{x}$=9.146	0.6588	47.20	2.043	0.472	34.6±1.0
26	DT73-204 (74005)	GDI GNS	B	8.495 8.471 $\bar{x}$=8.483	0.3996	66.09	3.084	0.904	52.0±1.5
26	DT73-204 (74015)	GDI GNS	H	0.600 0.607 $\bar{x}$=0.603	2.3701	5.280	3.463	0.754	58.3±1.7
27	DT73-202 (74013)	PEL GNS	H	1.274 1.274	2.2057	11.52	3.581	0.843	60.2±1.8
28	DT73-203 (74004)	PEG	B	8.458 8.708 $\bar{x}$=8.583	0.5594	70.17	3.237	0.913	54.5±1.6
28	DT73-203 (74016)	PEG	H	0.868 0.863 $\bar{x}$=0.865	2.0819	7.406	3.387	0.773	57.0±1.7
29	DT73-201 (74001)	PEL GNS	B	8.111 8.237 $\bar{x}$=8.174	0.3517	68.09	3.298	0.916	55.5±1.7
29	DT73-201 (74014)	PEL GNS	H	0.982 0.960 $\bar{x}$=0.971	2.6567	9.390	3.829	0.802	64.3±1.9
30	72AST-228 (73062)	SCH	B	8.542 8.566 $\bar{x}$=8.554	0.3807	59.92	2.773	0.900	46.8±1.4
30	72AST-228 (73072)	SCH	H	0.430 0.430	1.7954	4.391	4.043	0.688	67.9±2.0
31	71H-224 (72090)	QDI	H	0.716 0.718 $\bar{x}$=0.717	0.474	13.79	7.613	0.852	125.8±3.8
32	71AST-42 (73019)	GDI	A	0.183 0.183 0.188 0.188 $\bar{x}$=0.185	2.5293	4.068	8.681	0.426	142.8±4.3
33	DT72-39A (72205)	GNS	B	8.365 8.452 $\bar{x}$=8.408	0.5587	4.113	1.937	0.714	32.8±1.0

34	DT72-38A (72175)	QDI	B	9.357 9.372 $\bar{x}$=9.364	0.8760	42.71	1.806	0.745	30.6±0.9
34	DT72-38B (73039)	QDI	B	9.252 9.268 $\bar{x}$=9.260	0.4927	41.92	1.792	0.764	30.4±0.9 $\bar{x}$=30.5±0.9
34	DT72-38B (73003)	QDI	H	0.708 0.710 $\bar{x}$=0.709	3.6815	3.777	2.109	0.768	35.7±1.1
35	DT72-37A (72199)	GDI	M	10.403	0.1792	48.60	1.850	0.520	31.3±1.0
35	DT72-37B (72206)	GDI	B	9.295 9.262 $\bar{x}$=9.278	0.4770	40.84	1.743	0.598	29.5±0.8
35	DT72-37B (72208)	GDI	M	10.323 10.277 $\bar{x}$=10.300	0.2696	46.76	1.797	0.572	30.5±0.9
36	DT72-40A (72181)	GDI	B	9.115 9.277 $\bar{x}$=9.196	0.5235	42.56	1.832	0.601	31.1±0.9
36	DT72-40B (73027)	GDI	B	9.402 9.383 $\bar{x}$=9.393	0.5253	41.91	1.767	0.574	30.0±0.9 $\bar{x}$=30.5±0.9
36	DT72-40A (72197)	GDI	M	10.392 10.442 $\bar{x}$=10.417	0.5206	48.54	1.845	0.508	31.3±0.9
36	DT72-40B (73036)	GDI	M	10.417 10.368 $\bar{x}$=10.392	0.3202	47.69	1.817	0.391	30.8±0.9 $\bar{x}$=31.0±0.9
37	71AWR-480 (71033)	GDI	B	9.340 9.371 $\bar{x}$=9.355	0.6089	41.07	1.783	0.710	29.5±0.9
37	71AWR-480 (72120)	GDI	M	10.493 10.497 $\bar{x}$=10.495	0.5007	45.62	1.721	0.708	29.2±0.9
38	DT72-31B (72210)	GNS	B	9.155	0.5175	38.88	1.681	0.828	28.5±0.8
39	A59B-71 (72109)	PEL GNS	B	8.644 8.632 $\bar{x}$=8.638	0.5166	39.20	1.797	0.551	30.5±0.9

40	553B-71 (72114)	GNS	B	8.753 8.744 $\bar{x}$=8.748	0.4117	39.89	1.805	0.720	30.6±0.9
41	A34-71 (72111)	PEL GNS	B	7.862 7.889 7.845 $\bar{x}$=7.865	0.5026	34.88	1.756	0.699	29.8±0.9
42	71AWR-452 (71072)	MYLT	M	10.370 10.370	0.1356	50.38	1.925	0.484	32.6±1.0
43	DENALI FLT (72207)	FAULT GOUGE	S	7.952 7.966 $\bar{x}$=7.959	0.7083	8.629	0.429	0.351	7.3±0.2
44	71AWR-479 (72006)	GDI	B	7.582 7.515 7.594 7.604 $\bar{x}$=7.574	0.3987	106.0	5.542	0.911	92.4±2.8
44	71AWR-479 (71030)	GDI	H	0.937 0.952 $\bar{x}$=0.944	4.9714	12.48	5.231	0.855	87.4±2.6
45	71AWR-474B (71031)	DI	H	0.640 0.640	4.6225	4.394	2.718	0.648	45.9±1.4
45	71AWR-474C (71032)	DI	H	0.848 0.842 $\bar{x}$=0.845	4.6354	5.530	2.591	0.547	43.8±1.3 $\bar{x}$=44.8±1.4
46	A 146 (72113)	DI GNS	B	9.038 9.048 $\bar{x}$=9.043	0.3539	45.32	1.984	0.699	33.6±1.0
46	A 146 (72119)	DI GNS	H	0.961 0.964 $\bar{x}$=0.962	3.3818	7.025	2.889	0.808	48.7±1.5
47	DT72-42A (73103)	GDI	B	8.777 8.607 $\bar{x}$=8.692	0.1113	110.1	5.016	0.819	83.8±2.5
48	71AWR-476 (71035)	QMON	B	9.067 9.104 9.131 9.140 $\bar{x}$=9.110	0.4594	42.18	1.833	0.687	31.1±0.9
48	71AWR-476 (72118)	QMON	M	10.401 10.405 $\bar{x}$=10.403	0.4579	55.16	2.099	0.697	35.5±1.1

49	DT72-36A (72194)	GNS	B	8.272 8.300 $\bar{x}$=8.286	0.7697	39.03	1.865	0.671	31.6±0.9
49	DT72-36B (72192)	GNS	B	8.913 8.873 $\bar{x}$=8.893	0.9047	40.82	1.817	0.737	30.8±0.9 $\bar{x}$=31.2±0.9
49	DT72-36B (72203)	GNS	H	1.010 1.010	2.7313	7.204	2.824	0.660	47.6±1.4
50	71AWR-482 (72117)	SCH	M	9.710 9.692 $\bar{x}$=9.701	0.2043	169.8	6.929	0.935	114.9±3.4
51	71AWR-483 (72115)	SCH	M	10.243 10.358 $\bar{x}$=10.300	0.2762	176.3	6.776	0.945	112.4±3.4
52	73AST-256 (74051)	GR	B	8.844 8.842 $\bar{x}$=8.843	0.3830	194.3	8.701	0.951	143.1±4.3
53	73AST-275 (74052)	QMON	B	9.400 9.400	0.3590	209.4	8.819	0.949	145.0±4.3

ABBREVIATIONS USED FOR ROCK TYPES

AMPH	- amphibolite
AMPH SCH	- amphibolite schist
AMPH GNS	- amphibolite gneiss
DI	- diorite
DI GNS	- diorite gneiss
GDI	- granodiorite
GNS	- gneiss
GR	- granite
MIG	- migmatite
MYLT	- mylonite
PEG	- pegmatite
PEL GNS	- pelitic gneiss
QDI	- quartz diorite
QMON	- quartz monzonite
SCH	- schist

ABBREVIATIONS USED FOR MINERALS

A - amphibole
B - biotite
H - hornblende
M - muscovite
S - sericite

CONSTANTS USED IN AGE CALCULATIONS

$$\lambda_{\varepsilon} = 0.585 \times 10^{-10}/yr$$

$$\lambda_{\beta} = 4.72 \times 10^{-10}/yr$$

$$K^{40}/K_{total} = 1.19 \times 10^{-4} \text{ mole/mole}$$

Potassium analyses by G. Edsall, Kristina Ahlnas, and Diane Duvall.

Age calculations and Argon analyses by Donald Turner, Wilfred Davis and Diane Duvall.