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Map and tables showing preliminary results of potassium-argon age studies in the Circle quadrangle, Alaska, with a compilation of previous dating work

by

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As part of the Circle quadrangle Alaska Mineral Resources Assessment Program (AMRAP) a potassium-argon age study of igneous and metamorphic rocks was begun. Presented here are 8 new age determinations on all major intrusive rocks from within the quadrangle and brief petrographic descriptions of the samples dated. Also shown are dates completed by previous workers; these include all potassium-argon and fission-track dates available. In addition, biotite and hornblende age determinations on a sample, from the northern part of the adjacent Big Delta quadrangle are listed in the table but not shown on the map. Further dating work in the Circle quadrangle is planned and will include samples of other plutons and metamorphic rocks. Geologic maps and other publications that this study is related to are being produced under the team leadership of Helen L. Foster of the U.S. Geological Survey.

Our work to date has concentrated on plutonic rocks, which range from two-mica granite to hornblende-biotite granite. All dating samples yield apparent ages of latest Cretaceous (66 m.y.) through Paleocene (56 m.y.) except for one small muscovite-biotite granite pluton outcropping in the southeastern portion of the quadrangle which has been dated at about 73 m.y.(sample 78AWr286). In general, plutons in the southeastern portion of the quadrangle are two-mica granites, or in one extreme case, a muscovite-tourmaline granite (Caribou Creek pluton, not dated yet; sample 79AWs 85, shown on map was collected from this pluton.). However, the Big Windy Creek West pluton is a hornblende-biotite granite. Towards the northwest, the proportion of muscovite in the granitic rocks decreases. Mt. Prindle and nearby plutons are essentially biotite granite. In the extreme northwestern part of the quadrangle, the Victoria Mountain pluton is a hornblende-biotite granite. According to Bjarne Holm (personal communication, 1981), the Mt. Prindle, Quartz Creek, and Lime Peak plutons are all tourmaline- bearing; the Caribou Creek pluton mentioned earlier is the only other pluton in the quadrangle that is known to be tourmaline-bearing. The sample location for CHS72X from Chena Hot Springs is approximate as no location is given in the original thesis (Biggar, 1974). Sample 75AS353B is a biotite-hornblende granite from the Big Delta quadrangle, further information on this sample can be found in Luthy and others(1981).

For samples dated by the authors, potassium was determined by flame photometry using a lithium metaborate fusion technique (Engels and Ingamells, 1970). Potassium analysts were Byron Lai, D. Vivit, and Paul Klock. Argon extraction and measurement was accomplished using standard techniques of isotope dilution mass spectrometry, essentially as described by Dalrymple and Lanphere (1969). The analytical error assigned to each age newly reported here (table 1) is an estimate of the standard deviation of analytical precision using the method of Cox and Dalrymple (1967) together with the authors calculated estimates of uncertainties in the concentration of 38-Ar tracer and potassium measurements. Sample preparation, argon extraction and data reduction was by the authors with assistance from Rita Taylor, Brian Ho, and Leda Beth Gray. M.A. Lanphere and G.D. Eberlein generously contributed data on samples collected and analyzed by themselves in the early 1960's.

Analytical data is listed in table 1, rock sample descriptions in table 2 and sample locations are plotted on the map. Modes in table 2 except MP406 and CHS72X are estimated from thin-sections; minor components compose 1 to 5% and accessory components are less than 1% of the thin-section. Sample descriptions for MP406 and CHS72X are from the original references.

References

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Table 2
Rock descriptions

78AWr 286, Salcha River. Fine to medium-grained muscovite-biotite granite. Mode: 35% microcline, 35% quartz, 10-15% plagioclase, 10% biotite, and 5% muscovite. Biotite has minor chloritic alteration, very minor argillization of feldspars. Hypidiomorphic-granular texture.

78AWr 287, Big Windy Creek East. Fine to medium-grained muscovite-biotite granite. Mode: 35% strained quartz, 30% potassium feldspar, 20% plagioclase, 5-10% biotite, and 5% muscovite. Sparsely scattered areas of myrmekite. Muscovite is fine-grained and possibly late. Hypidiomorphic-granular texture.

78AWr 288, Big Windy Creek West. Fine to medium-grained hornblende-biotite granite. Mode: 25% microcline, 25% plagioclase, 15% quartz, 15% perthitic feldspar, 10% biotite, 5-10% hornblende, and minor chlorite after biotite, and calcite. Some areas of myrmekite and very fine myrmekite. Feldspars are generally unaltered though hornblende has intergrown biotite, and some biotite is altered to chlorite. Hypidiomorphic-granular texture.

79AWs 93, Victoria Mountain. Coarse to medium-grained hornblende-biotite granite with coarse phenocrysts of pink potassium feldspar. Mode: 30-60% sericitically altered potassium feldspar, 10-15% quartz, 10% plagioclase (approximately An 20), 10% very slightly chloritized biotite and 5-10% hornblende pleochroic in greens. Accessory zircon. Hypidiomorphic-granular texture.

79AWs 76, Lime Peak. Coarse-grained biotite granite. Euhedral crystals of biotite and tourmaline in a groundmass of quartz and feldspar. Mode: 80-85% perthitic feldspar, 10% quartz, 5% biotite pleochroic in greens, minor muscovite and tourmaline. Tourmaline in clusters. Hypidiomorphic-granular texture.

79AWs 77, Quartz Creek. Medium to fine-grained biotite granite. Mode: 80-85% perthitic feldspar, 5-10% quartz, 5-10% slightly chloritized biotite, trace plagioclase (An 20) and muscovite, and accessory zircon. Minor sericitization of some feldspar grains. Hypidiomorphic-granular texture.

79AWs 85, Caribou Creek. Fine to medium-grained, light-gray, tourmaline granite. Mode: 40% microcline, 25% plagioclase (An 10), 25% quartz, 5% tourmaline, minor garnet and muscovite. Allotriomorphic-granular texture.

79AWs 89, Chena Hot Springs. Medium-grained biotite granite or granodiorite. Mode: 30-35% plagioclase (oligoclase), 25-30% orthoclase, 20-25% quartz, 10% slightly chloritized biotite, minor muscovite, and accessory zircon. Hypidiomorphic-granular texture.

79AWs 94a, Yukon Fork. Medium-grained biotite granite. Mode: 35% strained quartz, 30% microcline and perthitic feldspar, 20% plagioclase (An 40), 10% biotite with minor chlorite, 5% muscovite, accessory garnet and zircon. Zircon in two populations, 1. prismatic with strong birefringence and oval, rounded with low birefringence.

MP406, Mt. Prindle. Medium-grained biotite granite of early phase. Mode: 38% quartz, 30% potassium-feldspar, 18% plagioclase (oligoclase-andesine), trace muscovite, 12% opaque minerals, 1% fluorite. Hypidiomorphic-granular texture (Holm, 1973).

CHS72X, Chena Hot Springs. Fine-grained biotite granite with poikilitic grains of potassium feldspar and quartz to 4mm in size. Mode: 35% plagioclase (An 40-25), 30% potassium feldspar, 15% quartz, 15% biotite, 2% sphene, 2% opaques, 1% chlorite, trace apatite, epidote, and allanite. Along minute parallel fractures, feldspars are extensively kaolinized and sericitized (Biggar, 1974).

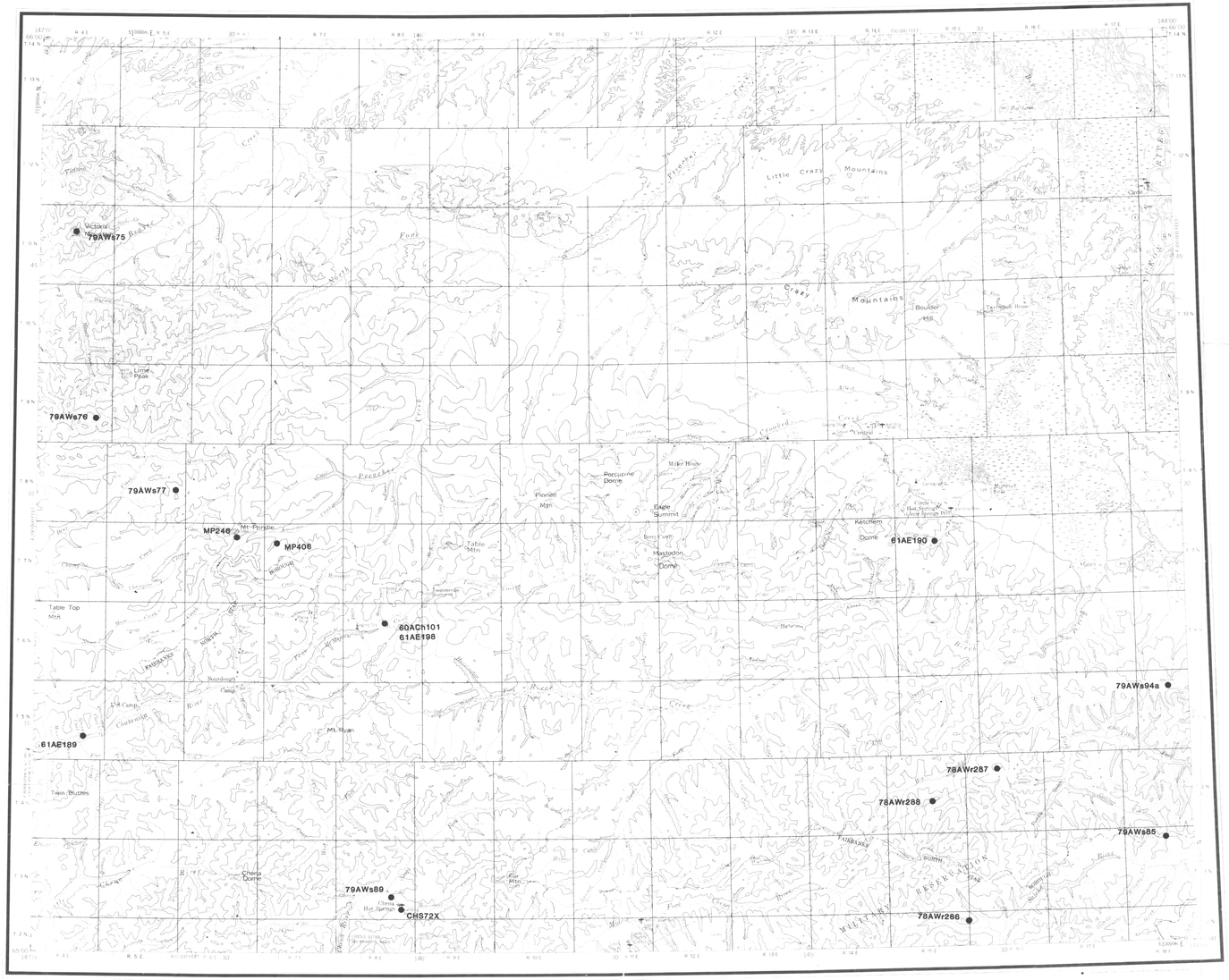

Table 1. Potassium-argon age determinations and fission-track date from the Circle quadrangle.

Sample Number and Locality Name	Location	Rock Type	Mineral dated	K_2O	$^{40}Ar_{rad}$ $\times 10^{-10}$ moles/gm	$^{40}Ar_{rad}$	Apparent age (m.y.) $\pm$ 1 σ	References
75AS353B	64°52.6'N 144°04.5'W Big Delta D-1	Granodiorite	Bio	8.85 8.90	11.79	96.5	90.0 $\pm$ 2.0	This report
			Hbl	.858 .862 .862 .863	1.182	67.5	92.9 $\pm$ 2.0	This report
78AWr286 Salcha River	65°01.8'N 144°33.0'W Circle A-2	Granite	Bio	8.51 8.63 8.51 8.63	9.265	79.7	73.5 $\pm$ 2.5	This report
			Mus	10.90 10.91 10.89 10.94	12.45	81.6	77.6 $\pm$ 2.0	This report
78AWr287 Big Windy Creek East	65°11.7'N 144°30.2'W Circle A-2	Granite	Bio	9.10 9.09 9.21 9.21	8.123	71.1	60.6 $\pm$ 0.6	This report
			Mus	10.9 10.89 10.91	9.654	61.8	60.5 $\pm$ 0.6	This report
78AWr288 Big Windy Creek West	65°09.6'N 144°30.0'W Circle A-2	Granite	Bio	9.28 9.30	8.796 8.744	79.3 80.3	64.4 $\pm$ 0.48	This report
79AWs75 Victoria Mtn.	65°47.3'N 146°44.4'W Circle D-6	Granite	Bio	9.37 9.37 9.37 9.36	8.965	58.0	65.3 $\pm$ 0.65	This report
			Hbl	1.073 1.069 1.066 1.078	1.038 1.018	70.0 72.2	65.5 $\pm$ 1.03	This report
79AWs76 Lime Peak	65°35.1'N 146°51.0'W Circle C-5	Granite	Bio	7.76 7.64 7.85 7.77	6.432 6.416	65.9 76.4	56.7 $\pm$ 0.95	This report
79AWs77 Quartz Creek	65°30.4'N 146°39.3'W Circle C-6	Granite	Bio	8.96 9.00 8.98 8.98	8.552 8.804	76.0 75.3	65.9 $\pm$ 1.38	This report
78AWs89 Chena Hot Springs	65°03.6'N 146°04.2'W Circle A-5	Granite	Bio	9.10 9.07 9.07 9.06	7.754 7.730 7.911	73.0 73.4 72.7	58.7 $\pm$ 0.85	This report
79AWs94a Yukon Fork	65°16.7'N 144°03.1'W Circle B-1	Granite	Bio	7.74 7.63 7.66 7.58	6.911 7.079	61.4 61.1	62.4 $\pm$ 1.34	This report
CHS72X Chena Hot Springs	65°02.9'N 146°02.8'W Circle A-5	Granite	Bio	8.641 8.628	7.538	82.9	59.7 $\pm$ 1.8** Biggar, 1974	
			Sphene	Fission-track Spontaneous tracks = 8.424 x 10^5/cm^2 (936 tracks) Induced tracks = 17.237 x 10^5/cm^2 (958 tracks)			58.9 $\pm$ 2.7 Holm, 1973 Biggar, 1974	
MP246 Mt. Prindle	65°22.1'N 146°27.8'W Circle B-5	Pegmatite	Mus	10.106 10.112	8.570	76.4	58.0 $\pm$ 1.8** Holm, 1973	
MP406 Mt. Prindle	65°20.7'N 146°21.2'W Circle B-5	Granite	Bio	8.975 8.970	7.806	72.5	59.5 $\pm$ 1.8** Holm, 1973	
61AE189a Grouse Creek	65°14.1'N 144°51.8'W Circle B-6	Fine-grained mica schist	Mus	8.93(2)	24.12	88	178 $\pm$ 5.3* M. A. Lanphere & G. D. Eberlein, written commun., 1981	
61AE189b		Coarse-grained mica schist	Mus	9.28(2)	23.32 23.16	86 92	166 $\pm$ 3.5* M. A. Lanphere & G. D. Eberlein, written commun., 1981	
61AE190 Circle Hot Springs	65°26.6'N 144°39.1'W Circle B-2	Granite	Bio	7.90(2)	7.003	82	60.5 $\pm$ 1.8* Wasserburg and others, 1963	
60ACh101 Montana Creek	65°21.6'N 146°05.4'W Circle B-5	Mica schist	Musc	9.14(2)	14.92	90	110 $\pm$ 3.3* Wasserburg and others, 1963	
61AE198 Montana Creek	65°21.6'N 146°05.4'W Circle B-5	Mica schist	Musc	1.12(2)	1.930	54	116 $\pm$ 3.5* Wasserburg and others, 1963; Forbes and Weber, 1975	

*Location, analytical date, and locations furnished by M. A. Lanphere and G. D. Eberlein, 1981.
**Recalculated with constants given below.
λ_β = 4.963 x 10^{-10} year^{-1}, λ_ε = 5.72 x 10^{-11} year^{-1}, λ_e = 8.78 x 10^{-13} year^{-1}, $^{40}K/K$ = 1.167 x 10^{-4} atom percent,
λ = 6.85 x 10^{-17} year^{-1}, thermal neutron dose = 1.97 x 10^5 neutrons/cm^2.

CIRCLE, ALASKA

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards.

1981