Lead-Alpha Age Determinations of Accessory Minerals of Igneous Rocks (1953-1957)

GEOLOGICAL SURVEY BULLETIN 1097-B

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By HOWARD W. JAFFE, DAVID GOTTFRIED, CLAUDE L. WARING
and HELEN W. WORTHING

STUDIES IN GEOCHRONOLOGY

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UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1959

UNITED STATES DEPARTMENT OF THE INTERIOR

FRED A. SEATON, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington 25, D.C. - Price 30 cents (paper cover)

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By Howard W. Jaffe, David Gottfried, Claude L. Waring, and Helen W. Worthing

ABSTRACT

The U.S. Geological Survey completed lead-alpha age determinations of accessory minerals from about 400 rocks between July 1953 and January 1957. All the ages and the experimental data, equations, and constants from which they were calculated are given in tabular form. A citation of the most probable geologic age of each rock is included for comparison with the measured age. The tabulation is followed by a geographic index of sample localities.

INTRODUCTION

Publication of the original report on the method of determining the age of igneous rocks from the lead-alpha ratios of their accessory minerals (Larsen and others, 1952) aroused considerable interest in the application of the method to the solution of geologic problems. Larsen has received numerous requests for age determination from geologists engaged in field mapping of areas where the age of intrusive rocks could not be established from field evidence because of poor paleontologic and stratigraphic control.

In July of 1953, the U.S. Geological Survey established a project to fill the numerous requests received for lead-alpha age determinations. Since then, determinations have been completed on accessory minerals from about 400 rocks, most of which were submitted by geologists of the U.S. Geological Survey. A few samples were submitted by State and foreign geological surveys. Ages were determined of a variety of predominantly silicic to intermediate type igneous rocks representing most of the major bodies of intrusive rock in the United States. A limited number of determinations were also made on rocks from Mexico, Canada, Norway, Finland, France, Ceylon, Nyasaland, Formosa, Greenland, British Territories in Borneo, and Saudi Arabia.

A few determinations were made of detrital zircon from sedimentary rocks to obtain information of potential use in provenance studies. Although the geologist was advised against submitting metamorphic rocks because of the uncertainty in interpreting the results, some were received from those who believed that the age data might aid in the interpretation of the geologic history of an area.

The samples represented a geologic age span of Precambrian through late Tertiary. From periods after the Precambrian several rocks, whose geologic age has been established from good stratigraphic and paleontologic control, were either solicited from the field geologist or collected by the authors in the company of the field geologist in order to test the geologic consistency of the lead-alpha method. Many of the samples, however, represent intrusive bodies of questionable to totally unknown geologic age. Although the determined ages of many of these rocks cannot be properly evaluated from geologic evidence, their publication at this time may provide useful information to geologists engaged in field mapping of related rocks and to other investigators in the field of geochronology.

ACKNOWLEDGMENTS

The authors are indebted to many of their colleagues in the U.S. Geological Survey who collected large samples of a wide variety of igneous rocks for separation of accessory minerals used for the lead-alpha age determinations. These include P. C. Bateman, A. J. Boucot, G. F. Brown, R. S. Cannon, Jr., R. W. Chapman, R. C. Ellis, Carl Fries, Jr., J. T. Hack, D. F. Hewett, H. L. James, M. R. Klepper, E. S. Larsen, Jr., B. F. Leonard, T. S. Lovering, J. B. Lyons, J. J. Matzko, T. McCullough, H. T. Morris, T. B. Nolan, W. C. Overstreet, J. P. Owens, W. T. Pecora, George Phair, A. W. Postel, A. W. Quinn, J. F. Robertson, C. P. Ross, R. G. Schmidt, D. R. Shaw, R. L. Smith, W. I. Smith, and R. A. Weeks.

Many other geologists also gave generously of their time in the collection of samples for lead-alpha age work. These include A. F. Buddington and H. D. Holland, Princeton University; O. Kuovo, University of Helsinki; R. L. Dott, Oklahoma Geological Survey; C. E. Tilley, Cambridge University; G. M. Schwartz, Minnesota Geological Survey; F. W. Roe, Geological Survey Department of British Territories in Borneo; P. T. Flawn, Bureau of Economic Geology of Texas; L. T. Silver, California Institute of Technology; T. F. W. Barth, University of Oslo; R. M. Hutchinson, Colorado School of Mines; G. A. Russell, Department of Mines and Natural Resources of Manitoba; and R. E. Folinsbee, University of Alberta.

The authors are greatly indebted to W. F. Outerbridge, W. L. Smith, R. P. Marquiss, George Hayfield, John Mangum, Theodore Woodward, and Carl Mayhew for the exacting job of separating and purifying hundreds of accessory mineral samples from igneous rocks.

The authors are grateful to E. S. Larsen, Jr., Earl Ingerson, R. M. Garrels, and Michael Fleischer for their guidance and cooperation in setting up the facilities required for the lead-alpha age program.

This work was done partly on behalf of the Division of Research of the U.S. Atomic Energy Commission.

NATURE OF THE DESCRIPTIVE AND EXPERIMENTAL DATA

This report presents a tabulation of the descriptive and experimental data on all the rocks whose age has been determined by the lead-alpha method. For each rock the data, wherever available, include:

Index number
Petrographic classification
Sample number
Geographic locality
Collector of the sample
Mineral used for age determination
Mesh size of the crystals used for age determination
Alpha activity of the mineral used for age determination
Total lead content of the mineral used for age determination
Lead-alpha age of the mineral
Geologic age [1] of the rock from which the mineral was separated, based on geologic evidence of the authority cited.

The citation of the geologic age was taken from published papers or from written communications, whichever incorporated the results of the most recent and complete field data for a given rock or area. In this way, the reader can readily note the degree of consistency or inconsistency of the measured lead-alpha age with the geologic age assigned from stratigraphic, paleontologic, and field mapping investigations. Where geologists disagree on the geologic age of a rock, both field age assignments are given with the respective references.

A comparison between the lead-alpha ages and ages obtained by isotopic methods is given by Gottfried and others (1959).

METHOD OF CALCULATION OF THE AGE

The lead-alpha ages reported herein were calculated from the age equations and constants given and evaluated by Gottfried and others from the measurements of the alpha activity and total lead content of each accessory mineral.

The age equations, repeated here for convenience of the reader, are as follows:

Range (millions of years)	*Equation*
0—200	$t=\frac{c\times \text{Pb (ppm)}}{\alpha \text{ per mg per hr}}$
200—1,700	$t_o=t-\frac{1}{2}kt^2$
1,700—4,000	$T=(t-\frac{1}{2}kt^2)+3.4\times 10^{-9}(t-\frac{1}{2}kt^2)^3=t_o+3.4\times 10^{-9}t_o^3$

The constants, c and k are functions of the thorium to uranium ratios of the different accessory minerals xenotime, zircon, and monazite. The thorium to uranium ratio given for each mineral is an

[1] The term "geologic age" is used in this report to refer to the divisions of geologic time founded on stratigraphic-paleontologic evidence, as opposed to age expressed in number of years.

average value selected from published analyses (Gottfried and others, 1959). These are as follows:

Mineral	*Selected thorium-uranium ratio*	*c*	*k* (×10⁻⁴)
Xenotime	0. 5	2, 550	1. 71
Zircon	1. 0	2, 485	1. 56
Monazite	25	2, 085	. 65

Where thorium and uranium have been experimentally determined for specific minerals included in the age tabulation, the *c* and *k* constants were obtained directly from the curves of Gottfried and others.

The ages measured on accessory minerals from rocks of well-established geologic age have been evaluated by Gottfried and others (1959); Lyons and others (1957); Quinn and others (1957); and Larsen and others (1958). This report is principally a complete compilation of experimental lead-alpha age data obtained by the U. S. Geological Survey between 1953 and 1957.

The spectrographic lead determinations were made by Claude L. Waring and Helen W. Worthing. The alpha activity was determined by Howard W. Jaffe and David Gottfried.

Where duplicate or replicate lead determinations were made on a given sample of zircon, all the values are entered in the tabulation and the mean value is used in the age calculation. All the lead-alpha age determinations are reported to two significant figures with the third and fourth figures in italics.

REPRODUCIBILITY OF THE AGE DETERMINATION

Replicate age determinations were made of zircon from the same rock in 85 of the 411 rocks reported in the tabulation. Each age was reproducible to ±10 percent of the mean, or 10 million years, whichever is the greater, in all but three of the rocks. In these three rocks each age was reproducible to only 10 to 34 percent of the mean. It is therefore reasonable to assume that, generally, any single age determination if repeated would be reproducible to ±10 percent of the mean or 10 million years. In a limited number of rocks, the age of more than one mineral has been measured. The agreement between the ages of zircon, monazite, and xenotime, separated from the same rock, is of the same order of reproducibility as obtained on different splits of zircon. The few determinations on thorite show a poorer agreement with cogenetic zircon.

ARRANGEMENT OF THE DATA IN THE TABULATION

The lead-alpha age determinations are listed in tabular form in a general order of increasing determined age. An attempt has been made to group data from petrographic and geographic provinces so that the entries do not always follow the strict numerical order of increasing age. An index number preceding each entry is provided for use in a geographic index following the tabulation.

Lead-alpha age determinations of accessory minerals

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
1	Rhyolite, Hinsdale formation Z–40. Spring Creek, San Cristobal quadrangle, San Juan Mountains, Colo. E. S. Larsen, Jr.	Zircon	−100+200	400	2. 5		15	Pliocene(?). Larsen and Cross, 1956.
2	Quartz latite porphyry GL–8. Intrusive, east of Square Top, Summitville quadrangle, San Juan Mountains, Colo. D. Gottfried, G. Phair.	do	−100+200 −200+400	188 232	0. 7, 0. 8 1. 0, 1. 1	0. 75 1. 05	10 11	Miocene. Larsen and Cross, 1956.
3	Quartz latite GL–5. Intrusive, near northern part of Klondike Mountain, Summitville quadrangle, San Juan Mountains, Colo. D. Gottfried, G. Phair.	do	−80+400	285	1. 5, 1. 2	1. 35	12	Do.
4	Quartz latite porphyry GL–7. Intrusive, eastern slope of Jackson Mountain, western border of Summitville quadrangle, San Juan Mountains, Colo. D. Gottfried, G. Phair.	do	−200+400	215	1. 3, 1. 2	1. 25	14	Do.
5	Quartz latite porphyry GL–6. Intrusive along Baughman Creek, Creede quadrangle, San Juan Mountains, Colo. D. Gottfried, G. Phair.	do	−80+200 −200+400	56 58	. 4 . 4, . 6	 . 5	17 21	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
6	Quartz latite GL–3. Intrusive, near Sunnyside, Creede quadrangle, San Juan Mountains, Colo. D. Gottfried, G. Phair.	Zircon	−80+400	95	0. 8, 0. 9	0. 85	22	Miocene. Larsen and Cross, 1956.
7	Piedra rhyolite Z–8. Potosi volcanic series, San Critsobal quadrangle, San Juan Mountains, Colo. E. S. Larsen, Jr.	do	−100+200	730	7. 0		24	Do.
8	Treasure Mountain rhyolite Z–43. San Juan Mounains, Colo. E. S. Larsen, Jr.	do	−100+200	111	1. 0		22	Do.
9	Granite SC–1045. Dike intrusive into Silverton volcanic series, Alpine Gulch, San Cristobal quadrangle, San Juan Mountains, Colo. E. S. Larsen, Jr.	do	−100+200	600	5. 5		23	Do.
10	Dacitic(?), vitric ash PJ–7. Santa Fe group, sec. 17, T.19N., R.9E., Santa Fe County, N. Mex. R. S. Cannon, Jr., R. L. Smith.	do	−80+400	151	1. 0, 1. 2	1. 1	18	Late Miocene. R. L. Smith, R. S. Cannon, Jr.
11	Hornblende diorite DLP–55–10–4a.	do	−200+400	180	1. 8, 1. 5	1. 65	23	Late Miocene (post-Sardine series,

	Eight miles above Detroit dam, Mill City quadrangle, Marion County, Oreg. D. L. Peck.							pre-Pliocene-Pleistocene). D. L. Peck
12	Tilzapotla rhyolite tuff F56–27. Mexico-Taxco highway, km.129.5, halfway between Huajintlan (Morelos) and Teacalco (Guerrero) Mexico. C. Fries, Jr.	do	−80+200	315	3. 5, 3. 2	3. 35	26	Late Oligocene(?). C. Fries, Jr.
13	Granodiorite RLS–2. Bland mining district, Jenks Draw, Valles Mountains, north-central New Mexico. R. L. Smith.	do	−80+400	424	4. 0, 4. 0	4. 0	23	Tertiary. C. S. Ross, R. L. Smith.
			−400	547	3. 0, 4. 0	3. 5	16	
14	Granite LOV–1. East side of Hard to Beat Canyon, Sheep Rock Range, SW¼ sec. 22, T.10S., R.6W., Tooele County, Utah. T. S. Lovering, C. G. Tillman.	do	−100+200	1, 920	15, 16, 15, 16	15. 5	20	No data. T. S. Lovering.
		Monazite	−100+200	7, 657	55, 58	56. 5	15	
15	Rhyolitic welded crystal tuff WJC–24–54. West side of Thomas Range, Colored Pass area, Juab County, Utah. W. J. Carr.	Zircon	−80+200	552	4. 3, 4. 5	4. 4	20	Tertiary(?). W. J. Carr.
16	White tuff HM–3. Post-intrusive volcanics Iron Springs district, Utah. J. H. Mackin.	do	−80+200	127	1. 0, . 9	. 95	19	Middle Tertiary (Oligocene?). J. H. Mackin. Miocene. Gregory, 1945.
17	Three Peaks intrusive HM–1. Iron Springs district, Utah. J. H. Mackin.	do	−80+200	343	3. 0, 3. 1	3. 05	22	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
18	Lower tuff HM-2. Pre-intrusive volcanic rocks, Iron Springs district, Utah. J. H. Mackin.	Zircon	−80+200	262	2. 9, 3. 0	2. 95	28	Middle Tertiary (Oligocene?). J. H. Mackin. Miocene. Gregory, 1945.
19	Syenite porphyry LS-2-55. West shoulder of Mineral Mountain, La Sal Mountains, Utah. D. R. Shawe.	do	−80+200	2, 270 2, 240	22, 23 22, 23	22. 5 22. 5	25 25	Tertiary. Hunt, 1956, p. 42; Waters, 1955.
20	Monzonite porphyry LS-7-55. Southern edge of intrusive, west-central part of North Mountain, La Sal Mountains, Utah. D. R. Shawe.	do	−80+200	3, 180 3, 720	70, 70 75, 79	70 77	55 51	Do.
21	Diorite porphyry LS-6-55. Middle Mountain, La Sal Mountains, Utah. D. R. Shawe.	do	−80+200	312	49, 51	50	*386*	Do.
22	Diorite porphyry, hydrothermally altered. LS-8-55. South side of Miner's Basin, North Mountain, La Sal Mountains, Utah. D. R. Shawe.	do	−80+200	297	62, 60	61	*490*	Do.
23	Diorite porphyry LS-10-54.	do	−80+200	401	70, 70	70	*419*	Do.

	Northwest end of North Mountain, La Sal Mountains, Utah. D. R. Shawe.							
24	Biotite granite DLP-55. One and four tenths miles below Nimrod, on U.S. Highway 28, McKenzie Bridge quadrangle, Lane County, Oreg. D. L. Peck.	do	−80+400	540	7.8, 8.2	8.0	37	Oligocene or early Miocene (post-Mehama formation, pre-Sardine series). D. L. Peck.
25	Monzonite RLS-1. Stock near the Cache Entry mine, Cerrillos Hills, north-central New Mexico. R. L. Smith.	do	−80+200 −200+400 −80+400 −400	770 780 760 840	9.0, 11 10, 12 13, 14, 15 14, 15, 17	10 11 14 15.5	32 35 46 46	Oligocene (post-Espinaso formation, pre-Abiquiu tuffs). Stearns, 1953.
26	Rhyolite TN-4. South end of Target Hill, Eureka mining district, Nevada. T. B. Nolan.	do	−80+400	503	8.0		39	Tertiary. T. B. Nolan.
27	Hornblende andesite TN-1. Windfall Canyon, Eureka mining district, Nevada. T. B. Nolan.	do	−80+400	158	3.3		52	Do.
28	Quartz monzonite TN-3. Richmond tunnel and dump, Eureka mining district, Nevada. T. B. Nolan.	do	−80+400	193	5.0		64	Cretaceous(?) (post-Newark Canyon formation). T. B. Nolan.
29	Quartz monzonite RJR-1-56. Austin, Nev. R. J. Roberts.	do	−80+400	382	6.4, 7.1	6.75	44	No data. R. J. Roberts.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
30	Granodiorite RJR-2-56. Trenton Canyon, Nev. R. J. Roberts.	Zircon	−80+400	199	3. 5, 4. 0	3. 75	47	No data. R. J. Roberts.
31	Quartz monzonite RJR-3-56. Copper Canyon, Nev. R. J. Roberts.	do	−80+400	387	7. 2, 8. 0	7. 6	49	Do.
32	Quartz monzonite (mineralized). RJR-1-54. Copper Canyon, Nev. R. J. Roberts.	do	−80+400	520	8. 0		38	Do.
33	Granite P-3-cc. S½ sec. 24, N½ sec. 25, T.26S., R.64E., head of Aztec wash, 4 miles southeast of Nelson, Clark County, Nev. E. H. Pampeyan.	do	−80+400	394	5. 2, 6. 3	5. 75	38	Late Cretaceous to early Tertiary. E. H. Pampeyan.
34	Monzonite P-2-cc. NE¼ sec. 4, T.23S., R.64E., about 1.5 miles northeast of center of Boulder City, Clark County, Nev. E. H. Pampeyan.	do	−80+400	129	2. 1, 3. 4	2. 7	53	Do.
35	Granodiorite 55-W-100. East side of Santa Rosa Peak, extreme southwest corner sec. 32, T.43N., R.39E., Humboldt County, Nev. R. Willden.	do	−80+400	365	5. 3, 5. 5	5. 4	37	Post-Late Cretaceous (pre-Miocene). R. Willden.

36	Granodiorite 55–W–35. West side of Slumbering Hills, north center sec. 26, T.39N., R.35E., Humboldt County, Nev. R. Willden.	do	−80+400	468	9. 0, 10	9. 5	50	Do.
37	Granodiorite 55–W–70. East side of Bloody Run Peak, northwest corner sec. 17, T.38N., R.37E., Humboldt, County, Nev. R. Willden.	do	−80+400	230	4. 7, 5. 2	4. 95	53	Do.
38	Porphyritic quartz monzonite Z–23. Little Cottonwood stock, Temple granite quarry, Wasatch Mountains, Utah. M. Crittenden.	do	−60+200	490	9. 0		46	No data. M. Crittenden.
39	Diorite Z–24. Clayton Peak stock, head of Big Cottonwood Canyon, Brighton, Wasatch Mountains, Utah. M. Crittenden.	Thorite Zircon	−60+200 −60+200	5, 795 3, 330	115 65		40 48	Do.
40	Granodiorite Z–25. Alta stock, west of Brighton, head of Big Cottonwood Canyon, Wasatch Mountains, Utah. M. Crittenden.	do	−60+200	502	11		54	Do.
41	Quartz diorite 851. Intrusive body in Mount Lewis and Crescent Valley quadrangles, Nevada. J. Gilluly, Olcott Gates.	do	−80+400	331	6. 1, 7. 3	6. 7	50	Tertiary or Mesozoic. J. Gilluly.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
42	Quartz monzonite HTM-2. North Lily stock, 1,250 feet N.34°W. of North Lily mine shaft, East Tintic district, Utah. H. T. Morris.	Zircon	−100+200 −200+400	233 228	4. 0 3. 6	---------- ----------	43 39	Middle Eocene (Green River). H. T. Morris, T. S. Lovering.
43	Quartz monzonite HTM-1. Silver City stock, from railroad cut near the Iron Duke mine, Tintic district, Utah. H. T. Morris.	do	−100+200 −200+400	187 223	3. 7 4. 5	---------- ----------	49 50	Do.
44	Porphyritic potassic syenite P-50-49. Big Sandy Creek, Bearpaw Mountains, Mont. W. T. Pecora.	do	−80+100 −100+200	290 275	5. 2, 5. 6 5. 0, 5. 1	5. 4 5. 05	46 46	Middle Eocene (Green River). Brown and Pecora, 1949.
45	Nepheline syenite pegmatite WTP-3. Rocky Boy stock, Pegmatite Peak, Bearpaw Mountains, Mont. W. T. Pecora.	do	+20	218 227	5. 6 4. 0	---------- ----------	64 44	Do.
46	Dacite S. 3673. Bau, 1st Division, West Sarawak, British Territories in Borneo. F. W. Roe.	do	−80+200	225	3. 0, 4. 0 5. 0, 6. 0	4. 5	50	Tertiary. F. W. Roe.
47	Granite South 3686.	do	−80+200	156	3. 0, 2. 9	2. 95	47	Tertiary(?). F. W. Roe.

	Tanjong Datu, 1st Division West Sarawak, British Territories in Borneo. F. W. Roe.							
48	Olivine nodules included in alkaline basalt. TPY-1. Northern Formosa. T. P. Yen.	do	¼ inch crystals.	21	.4, .4	.4	47	Pre-Miocene. T. P. Yen.
49	Seriate porphyritic granite 483245. Hachita quadrangle, SE¼NE¼ sec. 22, T.29S., R.16W., southwest New Mexico. C. Dane.	do	−80+200 −200+400	250 275	4.0, 5.0 5.0, 6.0	4.5 5.5	45 50	Late Cretaceous or Tertiary. Lasky, 1947, p. 32–33.
50	Monzonite 1895. Flat area, Flat Creek near Strandberg cabin, 1.5 miles northwest of Chicken Creek, Iditarod quadrangle, central Alaska. P. Killeen, M. White.	do	−60+100	334	6.2, 7.0	6.6	49	Late or post-Eocene. Mertie and Harrington, 1924.
51	Monzonite 1810. Flat area, opposite placer cut on Chicken Creek, Iditarod quadrangle, central Alaska. P. Killeen, M. White.	do	−60+100	315	7.8, 7.4	7.6	60	Do.
52	Granite 3469. Birch Creek, tributary to Flint Creek of the Sulatna River, Ruby-Poorman district, Ruby quadrangle, central Alaska. M. White, J. Stevens.	do	−80+200	1,366 1,322 1,342	26, 27 29 30	26.5 ---- ----	48 55 56	Mesozoic(?) (post-Mississippian). Mertie and Harrington, 1924.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
53	Monzonite 5044. Nixon Fork mining district, Crystal Shaft mine, Medfra quadrangle, central Alaska. J. J. Matzko, G. D. Eberlein.	Zircon	−60+100	252	5. 8, 6. 0	5. 9	58	Eocene or early Oligocene. Brown, 1926.
54	Kneehills tuff 2415. Vitric-crystal tuff, stream bed of Threehills Creek, 6 miles north of Carbon, Alberta, Canada. R. A. Folinsbee.	do	−100+400	268	5. 5, 6. 0	5. 75	53	Very Late Cretaceous (upper part of Edmonton formation). Folinsbee and others, 1957.
55	Biotite granite porphyry CPR–120. Dike from dike zone along South Fork, Payette River, west of Lowman, Idaho. B. F. Leonard, C. P. Ross.	do	−200+400 −80+200 −400	624 440 624	10, 11 4. 2, 4. 0 9. 0, 11	10. 5 4. 1 10	42 23 40	Middle Tertiary. C. P. Ross.
56	Coarse pink biotite granite CPR–121. Camas Creek below Myers Cove, Casto quadrangle, Idaho. B. F. Leonard, C. P. Ross.	do	−80+200 −200+400	403 625	9. 5, 10 15, 16	9. 7 15. 5	60 62	Tertiary (Miocene). Ross, 1934. Middle Tertiary. Anderson, 1951.
57	Porphyritic biotite-muscovite granodiorite, somewhat gneissic. CPR–122. Near Idaho-Montana line, Lost Horse Creek, near Hamilton, Mont. B. F. Leonard, C. P. Ross.	do Monazite	−80+200 −80+200	257 3, 385	6. 0, 7. 0 90, 90	6. 5 90	63 55	Cretaceous. Ross, 1952. Late Cretaceous or early Tertiary. Larsen and Schmidt, 1958.

58	Gneissic granodiorite CPR-123. Same locality as No. 57. B. F. Leonard, C. P. Ross.	Zircon Monazite	−80+200 −80+200	262 2, 925	5. 0, 6. 0 80, 80	5. 5 80	53 57	Cretaceous. Ross, 1952. Late Cretaceous or early Tertiary. Larsen and Schmidt, 1958.
59	Gneissic granodiorite 53-C-210. Same locality as No. 57. R. W. Chapman.	Zircon Monazite	−80+200 −80+200	275 3, 213	6. 2 79	---------- ----------	56 51	Do.
60	Gneissic granodiorite L-166. Same locality as No. 57. E. S. Larsen, Jr.	do	−80+200	2, 974	96	----------	67	Do.
61	Granodiorite JPO-1. Batholith, near Limones, Puerto Rico. J. P. Owens.	Zircon	−80+200 −200+400	141 212	3. 0, 3. 0 4. 0, 5. 0	3. 0 4. 5	53 53	Late Eocene. Kaye, 1957.
62	Granodiorite JPO-3. South edge of batholith, near Humacao, Puerto Rico. J. P. Owens.	do	−80+400	151	3. 0, 4. 0	3. 5	58	Do.
63	Quartz monzonite 53-C-198. Philipsburg batholith, 1 mile east of Philipsburg, Mont. R. W. Chapman.	do	−80+200	858	18	----------	52	Early Tertiary or Late Cretaceous. Chapman and others, 1955.
64	Porphyritic granite 55-K-304. Inclusion in basalt flow, southeast of Garrison, Mont. M. R. Klepper.	do	−80+400	575	13	----------	56	Early Tertiary or Late Cretaceous (post-Judith River, pre-early Oligocene). M. R. Klepper.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
65	Granite 55–RR–1. Tobacco Root batholith, near Hollowtown Lake, southeast flank of Mount Jefferson, 5 miles southwest of Pony, Mont. R. R. Reid.	Zircon	−80+400	493	13. 5		68	Early Tertiary or Late Cretaceous. Tansley and others, 1933.
66	Zircon-rich "micro-placers" in dacite tuff. 55K–307a. Of Tertiary volcanic rocks resting on eroded surface of Boulder batholith, Obelisk mine, Jefferson County, Mont. M. R. Klepper.	do	−200+400	192	4. 2, 4. 5	4. 35	56	Tertiary. M. R. Klepper.
67	Quartz monzonite Z–2. Satellitic stock of the Boulder batholith, Montana. R. A. Weeks.	do	−80+400	336	9. 0, 10	9. 5	70	Very Late Cretaceous or very early Tertiary (post-Judith River, pre-early Oligocene). Knopf, 1957.
68	Quartz monzonite 52–C–10a. Boulder batholith, from the border of the batholith, 7 miles southeast of Helena, Mont. R. W. Chapman.	do	−80+400	160	4. 6		71	Do.

69	Quartz monzonite. 52–C–45. Boulder batholith, quarry 1½ miles west of Boulder, Mont. R. W. Chapman.	do	−80+400	277	8. 0		72	Do.
70	Quartz monzonite. 52–C–60. Boulder batholith, roadcut 3 miles northeast of Elk Park, Mont. R. W. Chapman.	do	−80+400	203	6. 0		73	Do.
71	Alaskite. 52–C–8. Boulder batholith, half a mile southwest of summit of Elkhorn Peak, Mont. R. W. Chapman.	Zircon (metamict).	−80+400	4, 990	127		63	Do.
		Monazite	−80+400	6, 733	231		72	
72	Wilson Park stock. 5W–824. Near Boulder batholith, central portion, Quinn Canyon, Jefferson County, Mont. R. A. Weeks.	Zircon	−80+400	303	8. 5, 9. 0	8. 75	72	Do.
73	Lone Mountain stock. 5W–825. Near Boulder batholith, SW¼ NW¼ T.4N., R.1E., Broadwater County, Mont. R. A. Weeks.	do	−80+400	260	8. 0		76	Do.
74	Fine-grained igneous rock inclusion. 5–W–1. Near margin of the Boulder batholith, Boulder Hot Springs, Jefferson County, Mont. R. A. Weeks.	do	−80+400	750	15, 16, 16, 16	16	53	No data. M. R. Klepper, R. A. Weeks.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
75	Granitic rock 53C–160b. Granitic rock inclusion in quartz monzonite of the Boulder batholith, Montana. R. W. Chapman.	Zircon	−80+400	340	15		110	No data. R. W. Chapman.
76	Granodiorite G–155. Snoqualmie batholith, along north slope of Goat Island Mountain, Mount Rainier National Park, Wash. D. Gottfried, W. L. Smith.	do	−80+200	144	3. 6		62	Tertiary (post-Guye formation). Waters, 1955.
77	Granodiorite 54–W–48. North side of Julian Creek, north center sec. 17, T.38N., R.42E., Osgood Mountains quadrangle, Osgood Mountains, Nev. P. E. Hotz.	do	−80+400	378	10, 11	10. 5	69	Pre-Miocene, post-Late Pennsylvanian. P. E. Hotz.
78	Granite G–203. Paymaster mine, Craters of the Moon Monument, Idaho. D. Gottfried, W. L. Smith.	do	−80+400	305	9. 0		73	Tertiary. Ross and Forrester, 1947.
79	La Grulla granodiorite BC–1–2. Sierra San Pedro de Martir Mountains, Baja California. L. T. Silver.	Monazite	−100+200	3, 529	165, 170	168	99	Early Late Cretaceous (post-Albian, pre-Maestrichtian). Silver and others, 1956.

80	La Encina quartz diorite. BC-1-4. West slope of Sierra San Pedro de Martir Mountains, Baja California. L. T. Silver.	Zircon	−100+400	156	6.3, 6.0	6.15	98	Do.
81	San Jose quartz diorite. BC-1-5. Border phase, 100 feet from intrusive contact with Albian sediments, northwest corner San Jose pluton, Baja California. L. T. Silver.	do	−200+400	42	1.8, 2.0	1.9	112	Do.
82	Quartz diorite. SV-1. Roadcut, north edge of town of San Vincente, Baja California. D. Gottfried, L. R. Stieff, and T. W. Stern.	do	−100+200	123	5.1, 5.0	5.05	102	Do.
83	Granite. F-56-19. El Ocotito (Guerrero) Mexico. C. Fries, Jr., Z. de Cserna.	do	−80+200	273	10, 11	10.5	96	Cretaceous(?) (post-Albian). C. Fries, Jr.
84	Granite. F-56-20. Xaltianguis (Guerrero) Mexico. C. Fries, Jr., Z. de Cserna.	do	−80+200	650	25, 26	25.5	97	Post-probable Paleozoic. C. Fries, Jr.
85	Granite. F-56-21. Near Acapulco (Guerrero) Mexico. C. Fries, Jr., Z. de Cserna.	do	−80+200	572	22, 23	22.5	98	Do.
86	Granite. F-55-52. Near Placeres (Guerrero) Mexico. C. Fries, Jr., Z. de Cserna.	do	−200+400	47	1.8, 2.0	1.9	100	Mesozoic(?) (Equivalent to Baja California granites). Hall, 1903.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
87	Granite CF-1. Isthmus of Tehuantepec area, near Huilotepec (Oaxaca) Mexico. C. Fries, Jr., B. Webber.	Zircon	−80+200	310	12		96	Post-probable Paleozoic. B. Webber, C. Fries, Jr.
88	Granite JAL-1. Four miles southeast of Jalapa (Oaxaca) Mexico. C. Fries, Jr., B. Webber.	do	−80+200	104	4. 0, 5. 0	4. 5	108	Do.
89	Tonalite G-10. Southern California batholith, Aguanga, Calif. E. S. Larsen, Jr.	do	−100+200	280	11		98	Early Late Cretaceous (post-Late Triassic, pre-Late Cretaceous). Larsen, 1948.
90	Green Valley tonalite G-11. Southern California batholith, Green Valley, Calif. E. S. Larsen, Jr., D. Gottfried.	do	−100+200	149	6. 0		100	Do.
91	Green Valley tonalite SLR-138. Southern California batholith, Green Valley, Calif. E. S. Larsen, Jr.	do	−100+200	340	15		110	Do.
92	Tonalite G-30. Southern California batholith, southwest of Palm Springs, Calif. E. S. Larsen, Jr., D. Gottfried.	do	−100+200	317	14		110	Do.

93	Tonalite G-3. Southern California batholith, Mountain Center, Calif. E. S. Larsen, Jr., D. Gottfried.	do	−100+200	194	9.0		115	Do.
94	Lakeview Mountain tonalite Z-7. Southern California batholith, Lakeview, Calif. E. S. Larsen, Jr.	do	−100+200	646	30		115	Do.
95	Tonalite EL-134. Southern California batholith, 3½ miles northwest of Perris, Calif. E. S. Larsen, Jr.	do	−100+200	752	35		116	Do.
96	Tonalite Z-19. Southern California batholith, Valverdi, Calif. E. S. Larsen, Jr.	do	−100+200	170	8.0		117	Do.
97	G-13. Tonalite Southern California batholith, La Posta, Calif. E. S. Larsen, Jr., D. Gottfried.	do	−100+200	594	28		117	Do.
98	Tonalite G-33. Southern California batholith, Mount Wilson, Calif. E. S. Larsen, Jr., D. Gottfried.	do	−100+200	143	7.0		122	Do.
99	Lakeview Mountain tonalite S-1. Southern California batholith, 2 miles east of Nuevo, Calif. E. S. Larsen, Jr.	do	−100+200	183	10		136	Do.
100	Woodson Mountain granodiorite Z-20. Southern California batholith, Descanso Junction, Calif. E. S. Larsen, Jr.	do	−100+200	786	29		92	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
101	Mount Hole granodiorite Z–17. Southern California batholith, Mount Hole, Calif. E. S. Larsen, Jr.	Zircon	−100+200	1, 204	46		95	Early Late Cretaceous (post-Late Triassic, pre-Late Cretaceous). Larsen, 1948.
102	Stonewall granodiorite G–48. Southern California batholith, Stonewall Mountain, Calif. E. S. Larsen, Jr.	do	−100+200	545	21		96	Do.
103	Woodson Mountain granodiorite S–6. Southern California batholith, northeast of Descanso Junction, Calif. E. S. Larsen, Jr.	do	−100+200	1, 180	46		97	Do.
		Monazite	−100+200	6, 430	360		117	
104	Woodson Mountain granodiorite. Z–16. Southern California batholith, Descanso Junction, Calif. E. S. Larsen, Jr.	Zircon	−100+200	1, 235	50		101	Do.
		Xenotime	−100+200	6, 400	260		104	Do.
105	Woodson Mountain granodiorite. G–32A. Southern California batholith, west of Elsinore, Calif. E. S. Larsen, Jr.	Zircon	−100+200	457	22		120	Do.
106	Woodson Mountain granodiorite. S–2.	do	−100+200	433	20, 22	21	121	Do.

	Southern California batholith, 1 mile south of Temecula, Calif. E. S. Larson, Jr.							
107	Granite. Z–15. Southern California batholith, Rubidoux Mountain, Calif. E. S. Larsen, Jr.	Zircon (metamict).	−100+200	2, 700	106		98	Do.
108	Granite. EL–167. Southern California batholith, Rubidoux Mountain, Calif. E. S. Larsen, Jr.	Zircon	−100+200	725	29		99	Do.
109	Rattlesnake granite. X–101. Southern California batholith, Cuyumaca quadrangle, California. E. S. Larsen, Jr.	Xenotime	−100+200	1, 743	80		117	Early Late Cretaceous (post-Late Triassic, pre-Late Cretaceous). Everhart, 1951.
110	Granodiorite. RCE–54–7–28A. Pomona Tile quarry, Mojave Desert area, California. R. C. Ellis.	Zircon	−80+200	237	8. 0, 9. 0	8. 5	89	Mesozoic. Miller, 1946.
111	Granite. RCE–54–7–14B. Neenach quadrangle, Mojave Desert area, California. R. C. Ellis.	do	−80+200	866	30, 32	31	89	Do.
112	Quartz monzonite. G–21. Southern California batholith, Providence Mountain, Calif. E. S. Larsen, Jr.	do	−100+200	610	23		94	Do.
113	Quartz monzonite. G–24M. Southern California batholith, Soda Lake, Calif. E. S. Larsen, Jr.	Zircon (metamict).	−100+200	4, 660	180		96	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
114	Quartz monzonite RCE-54-7-14C. Rosamond quadrangle, Mojave Desert area, California. R. C. Ellis.	Zircon	−80+200	203	8. 0, 8. 0	8. 0	98	Mesozoic. Miller, 1946.
115	Granite RCE-54-7-18A. Ivanpah quadrangle, Mojave Desert area, California. R. C. Ellis.	do	−80+200	171	8. 0, 7. 0	7. 5	*109*	Do.
116	Granite RCE-54-7-27C. White tanks, south of Twenty Nine Palms, Mojave Desert area, California. R. C. Ellis.	do	−80+200	267	12, 13	12. 5	*116*	Do.
117	Granite RCE-54-7-28B. Granite Mountains, southeast of Apple Valley, Mojave Desert area, California. R. C. Ellis.	do	−80+200	590	27, 28	27. 5	*116*	Do.
118	Quartz monzonite G-28. Southern California batholith, Berdoo Canyon, Calif. E. S. Larsen, Jr.	do	−100+200	385	20		*129*	Do.
119	Quartz monzonite G-15. Southern California batholith, Cottonwood Springs, Calif. E. S. Larsen, Jr.	do	−100+200	190	10		*131*	Do.

120	Granitic rock I. Shadow Mountains, San Bernardino County, Mojave Desert area, California. R. J. Roberts.	do	−80+200	213	8. 0, 8. 5	8. 25	96	No data. R. J. Roberts.
121	Granodiorite PB–3.	do	−100+200	400	15		93	Late Jurassic. Hinds, 1934.
	Mount Goddard quadrangle, NW¼ sec. 14, T.9S., R.31E., northeast side of South Lake, near Bishop, Calif. P. C. Bateman.	Thorite	−100+200	4, 670	205		88	
122	Granodiorite PB–6. Mount Tom quadrangle, one-fourth mile northeast of Rock Creek Lake, near Bishop, Calif. P. C. Bateman.	Zircon	−100+200	396	12, 13, 14, 16	14	88	Do.
123	Quartz monzonite PB–10. Big Pine quadrangle, NE¼ sec. 9, T.10S., R.33E., near Bishop, Calif. P. C. Bateman.	Monazite	−100+200	4, 897	234, 238	236	100	Do.
124	Quartz monzonite PB–1. Big Pine quadrangle, SW¼ sec. 26, T.9S., R.32E., at end of Big Pine Creek road, near Bishop, Calif. P. C. Bateman.	Zircon	−100+200	618	26		105	Do.
125	Quartz monzonite PB–4. Mount Goddard quadrangle, NE¼ sec. 20, T.8S., R.31E., along Bishop Creek road, near Bishop, Calif. P. C. Bateman.	do	−100+200	792	35		110	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
126	Granodiorite PB-7. Big Pine quadrangle, southeast corner sec. 33, T.9S., R.33E., one-fourth mile south of Third Lake, near Bishop, Calif. P. C. Bateman.	Zircon	−100+200	221	10		112	Late Jurassic. Hinds, 1934.
127	Granodiorite PB-5. Big Pine quadrangle, NW¼ sec. 14, T.10S., R.33E., near Bishop, Calif. P. C. Bateman.	do	−100+200	331	15, 16	15.5	116	Do.
128	Quartz monzonite PB-2. Mount Tom quadrangle, west of surface workings Pine Creek mine, near Bishop, Calif. P. C. Bateman.	do	−100+200	796	37		116	Do.
129	Quartz monzonite 54-EM-1. Hunter Mountain batholith, southwest corner Ubehebe quadrangle, Inyo County, Calif. E. M. MacKevett.	do	−80+200	145	6.0		103	Do.
130	Isabella granodiorite EMM-1. Kern River uranium area, California. E. M. MacKevett.	do	−80+200 −200+400 −400	283 320 351	9.0, 10 11, 12 13, 14	9.5 11.5 13.5	83 89 96	Do.

131	Half Dome quartz monzonite. 53-PB-10. Mount Lyell quadrangle, NW¼ sec. 28, T.1S., R.23E., 1 mile southwest of Tenaya Lake, Yosemite National Park, Calif. P. C. Bateman.	Thorite	−100+200	10, 370	454		88	Do.
		Zircon	−100+200	330	15, 16	15. 5	117	
132	El Capitan granite. 53-PB-9. Yosemite quadrangle at junction of Tamarack and Cascade Creeks, sec. 25, T.2S., R.20E., Yosemite National Park, Calif. P. C. Bateman.	do	−100+200	395	15		94	Do.
133	Granodiorite. 53-PB-8. Yosemite quadrangle, at junction of Avalanche Creek with Merced River, NW¼ sec. 14, T.3S., R.20E., Yosemite National Park, Calif. P. C. Bateman.	do	−100+200	385	16		103	Do.
134	Quartz diorite. MD-180-3. West-central part of French Gulch quadrangle, 1.3 miles east from Buckhorn Summit, U.S. Highway 299, Shasta Bally batholith, Klamath Mountains, Shasta County, Calif. J. F. Robertson.	do	−100+200	276	9. 0		81	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
135	Biotite-hornblende quartz diorite. MD-180-4. Southeast part of French Gulch quadrangle, where Silver Falls mine road crosses Andrews Creek, Shasta Bally batholith, Klamath Mountains, Shasta County, Calif. J. F. Robertson.	Zircon	−100+200	197 223	8 11	---------- ----------	101 123	Late Juraissic. Hinds, 1934.
136	Quartz diorite Ta-1. Facies of the Bald Mountain batholith, Sumpter quadrangle, Baker County, Oreg. W. Taubeneck.	do	−80+200	153	5.5, 7.0	6.3	102	Late Jurassic or Early Cretaceous. Taubeneck, 1955.
137	Granodiorite FGW-12-53. Grouse Creek, Medford quadrangle, Jackson County, Oreg. F. G. Wells.	do	−80+400	230	9.0, 10	9.5	103	Jurassic or Cretaceous. Wells, 1956.
138	Granodiorite FGW-3-54. Medford quadrangle, Jackson County, Oreg. F. G. Wells.	Zircon (and included apatite).	−80+400	322	59, 59	59	425	Do.
		Zircon	---------	291	12, 13	12.5	107	
139	Biotite-hornblende-pyroxene diorite. CPR-119. Diana school, Quartzburg district, Idaho. B. F. Leonard, C. P. Ross.	do	−80+200 −200+400	100 116	3.0, 4.0, 4.0 4.0, 5.0	3.7 4.5	92 96	Tertiary. Ross and Forrester, 1947. Laramide. Anderson, 1952.

140	Quartz diorite L-113. Idaho batholith, Salmon River below Stanley, Idaho. E. S. Larsen, Jr.	do Thorite	−100+200 −100+200	825 1, 375	30 70		90 102	Cretaceous. Ross and Forrester, 1947.
141	Quartz diorite L-217. Idaho batholith, near Bungalow, Idaho. E. S. Larsen, Jr.	Zircon	−100+200	225	9. 0, 10	9. 5	105	Do.
142	Quartz diorite L-81. Idaho batholith, South Fork Payette River, Idaho. E. S. Larsen, Jr.	do	−100+200	370	16		107	Do.
143	Granodiorite L-70. Idaho batholith, near Cascade, Idaho. E. S. Larsen, Jr.	do	−100+200	210	9. 0		107	Do.
144	Porphyritic biotite granodiorite. L-53-573a.	do	−80+200	340	13, 15	14	102	Do.
	Idaho batholith, 2,000 feet north-northwest of Peak 8520 near Pilot Peak trail, Big Creek quadrangle, Idaho. B. F. Leonard.	Monazite	−80+200	2, 726	144, 148	146	112	
145	Porphyritic biotite-muscovite granodiorite. L-53-88. Near Big Creek Ranger Station, Idaho batholith, Big Creek quadrangle, Idaho. B. F. Leonard.	Monazite	−80+200	2, 678	145		113	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
146	Hornblende-biotite diorite L-53-377 Half a mile southwest of Mahan cabin, northwest rectangle Big Creek quadrangle, Idaho. B. F. Leonard.	Zircon	−80+200	158	28, 32, 33	31	47*9*	Cretaceous. Ross and Forrester, 1947.
147	Biotite-hornblende diorite CPR-118. Border facies of Idaho batholith, Horseshoe Bend, Idaho. C. P. Ross, B. F. Leonard.	do	−80+200	120	5.0, 6.0	5.5	11*4*	Cretaceous. C. P. Ross. Laramide. Anderson, 1952.
148	Biotite-augite-hypersthene diorite. CPR-117. Border facies, Idaho batholith, Hailey, Idaho. C. P. Ross, B. F. Leonard.	do	−80+200	173	8.0, 8.0	8.0	11*5*	Cretaceous. Umpleby, Westgate, and Ross, 1930. Laramide. Anderson, 1952.
149	Quartz diorite G-200. Idaho batholith, near Stanley, Idaho. D. Gottfried.	do	−100+200	190	10	----------	13*1*	Cretaceous. Ross and Forrester, 1947.
150	Granodiorite L-110. Idaho batholith, below Stanley, Idaho. E. S. Larsen, Jr.	do	−100+200	1,000	38	----------	94	Do.
151	Granodiorite L-288. Idaho batholith, near Atlanta, Idaho. E. S. Larsen, Jr.	do	−100+200	700	38	----------	13*5*	Do.

152	Quartz monzonite L-207. Idaho batholith, Indian Grave near Powell, Idaho. E. S. Larsen, Jr.	do	−100+200	922	37		100	Do.
153	Granite G-199.	do	−100+200	1, 970	90		114	Do.
	Idaho batholith, 15 miles northeast of Garden Valley, Idaho. D. Gottfried.	Monazite Xenotime	−100+200 −100+200	5, 617 6, 025	250, 256 220	253 	93 93	
154	Muscovite placer M-60. Idaho batholith, near Placerville, Idaho. E. S. Larsen, Jr.	Monazite	−100+200	2, 983	150		105	Do.
155	Muscovite placer L-264. Idaho batholith area near Idaho City, Idaho. E. S. Larsen, Jr.	do	−100+200	2, 994	150		104	Do.
156	Muscovite placer L-269. Idaho batholith area, near Idaho City, Idaho. E. S. Larsen, Jr.	do	−100+200	2, 888	155		112	Do.
157	Muscovite placer L-267. Idaho batholith area near Idaho City, Idaho. E. S. Larsen, Jr.	do	−100+200	2, 634	160		127	Do.
158	Muscovite placer 0-7. Idaho batholith, near Idaho City, Idaho. E. S. Larsen, Jr.	do	−100+200	3, 241	155		100	Do.
159	Granodiorite HCD-63. Gem stocks, Coeur d'Alene district, Idaho. A. B. Griggs.	Zircon	−100+200	292	11		94	Cretaceous or early Tertiary. A. B. Griggs.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
160	Granodiorite HCD-62. Gem stocks, Coeur d'Alene district, Idaho. A. B. Griggs.	Zircon and thorite.	−100+200	1, 739	100	----------	116	Cretaceous or early Tertiary. A. B. Griggs.
161	Rare-metal deposits of monazite, niobium-bearing ilmenite segregated in limestone layers in Precambrian metasedimentary terrane near border zone of Idaho batholith. ID-9-30. Indian Creek area, Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	Monazite	+60	578	25, 30	27. 5	99	Cretaceous. E. P. Kaiser.
162	Rare-metal deposits of monazite, niobium-bearing ilmenite segregated in limestone layers in Precambrian metasedimentary terrane near border zone of Idaho batholith. ID-9-35. Indian Creek area, Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	do	+60	1, 024	45, 48	46. 5	95	Do.

163	Rare-metal deposits of monazite, niobium-bearing ilmenite segregated in limestone layers in Precambrian metasedimentary terrane near border zone of Idaho batholith. ID-51A. Indian Creek area, Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	do	+60	617	25, 28	26. 5	90	Do.
164	Porphyritic gneissic granodiorite. G-125. Border facies of Colville batholith near Mt. Annie, Anglin, Wash. D. Gottfried, W. L. Smith.	Zircon	−80+200	296	10, 12	11	92	Late Jurassic or pre-Paleocene, Early Cretaceous. Waters and Krauskopf, 1941.
165	Gneissic granodiorite G-124. Colville batholith, deformed border phase, migmatitic?, State Highway 4, near Tonasket, Wash. D. Gottfried, W. L. Smith.	do	−80+200	275	10, 11	10. 5	95	Do.
166	Granodiorite G-115. Near Arden, Wash. D. Gottfried, W. L. Smith.	do	−80+200	876	34, 36	35	99	Do.
167	Tonalite G-146. Near Halford, Sultan quadrangle, Washington. D. Gottfried, W. L. Smith.	do	−80+200	62	2. 1, 2. 5	2. 3	92	Do.
168	Tonalite G-142. Chelan batholith, 3 miles from Entiat, Chelan quadrangle, Washington. D. Gottfried, W. L. Smith.	do	−80+200	63	2. 0, 2. 4	2. 2	87	Pre-Paleocene, post-early Mesozoic. Waters, 1938.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
169	Tonalite HC-2. Chelan batholith, Lower Knapp Coulee (east side), Chelan quadrangle, Washington. C. A. Hopson.	Zircon	−80+200	98	4. 0, 4. 2	4. 1	*104*	Pre-Paleocene, post-early Mesozoic. Waters, 1938.
170	Gneissic hornblende-quartz diorite. FW-60-55. Chelan batholith, Holden quadrangle, north side Entiat River, 3 miles south of Holden, Wash. F. W. Cater.	do	−80+200	78	3. 2, 3. 5	3. 35	*107*	Do.
171	Granodiorite DFC-106-55. Holden quadrangle, Washington. D. F. Crowder.	do	−80+200	110	5. 4, 4. 4	4. 9	*111*	Do.
172	Tonalite HC-1. Chelan batholith, Upper Knapp Coulee (west side), Chelan quadrangle, Washington. C. A. Hopson.	do	−80+200	83	4. 0, 4. 1	4. 05	*121*	Do.
173	Tonalite DFC-107-55. Holden quadrangle, Washington. D. F. Crowder.	do	−80+200	56	2. 5, 3. 2	2. 85	*126*	Do.

174	Quartz diorite FC–1. Holden quadrangle, Washington. F. W. Cater.	do	−100+200	74	4.0		134	Do.
175	Granodiorite G–122. Similkameen batholith, 2 miles from Richter Ranch, near Washington-British Columbia border, British Columbia, Canada. D. Gottfried, W. L. Smith.	do	−80+200	160	7.2, 7.5	7.35	114	Do.
176	Granodiorite REF–1. Nelson batholith, Lower Arrow Lake district, British Columbia, Canada. R. A. Folinsbee.	do	−100+200	310	13, 14	13.5	108	Late Cretaceous or younger. Smith and Stevenson, 1955.
177	Leucosyenite 3881. Near Mount Fairplay, milepost 29, Fortymile district, east-central Alaska. A. Nelson, J. J. Matzko.	do	−60+200	1,270	48, 52	50	98	Mesozoic. Mertie, 1937.
				1,134	45		99	
				1,476	63		106	
				1,550	60, 63	61.5	99	
				1,620	68		104	
		Zircon (metamict).		1,930	72		93	
				1,594	72		112	
				2,600	115		110	
178	Granodiorite 54–APr–106. Taku Inlet, near outlet of Turner Lake, west of Juneau, southeastern Alaska. G. Plafker.	Zircon	−200+400	152	5.8, 5.6	5.7	93	Late Early Cretaceous or Late Jurassic(?). Buddington and Chapin, 1929.
179	Diorite 55–ASn–242. Tolstoi Point, Prince of Wales Island, northeast-central part of Craig quadrangle, southeastern Alaska. C. S. Sainsbury.	do	−100	142	5.8, 6.0	5.9	103	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
180	Granodiorite 13–A. Porcupine Creek, Kuskulana River area, Chitina Valley, east-central Alaska. J. F. Seitz.	Zircon	−80+400	283	11, 13	12	*105*	Late Early Cretaceous or Late Jurassic(?). Buddington and Chapin, 1929.
181	Granite porphyry SCC–1. Near San Manuel, Ariz. S. C. Creasey.	do	−80+400	73	3.0, 3.5, 4.0	3.5	*119*	Late Cretaceous or early Tertiary. S. C. Creasey.
182	Pegmatitic facies of nepheline syenite. 56–2. Larvikofjorden, Norway. T. F. W. Barth.	do	+20	177	9.0, 11	10	*140*	Early Permian. Hoegh, 1936.
183	Pegmatitic nepheline syenite 56–3. Tveitdalen, Norway. T. F. W. Barth.	do	+20	76	4.9, 4.9	4.9	*160*	Do.
184	Nepheline syenite TB–7. Barkevik, Langesundsfjord, southern Norway. T. F. W. Barth.	do	+20	75	5.0, 5.0, 5.0, 5.0	5.0	*166*	Do.
185	Nepheline syenite 56–8. Laven Langesundsfjord, southern Norway. T. F. W. Barth.	do	+20	324	20, 25	22.5	*173*	Do.
186	Cataclastic metanorite N–1. Djupdalen, Losby, Lorenskog Herad, Akershus, southern Norway. H. Faul, O. Holtedahl.	do	−100+200	108	7.0, 8.0, 9.0	8.0	*184*	No data. H. Faul.

187	Nepheline syenite. 56–9. Barkevik, Langesundsfjord, Norway. T. F. W. Barth.	do	+20	44	4.2, 4.5	4.35	*241*	Early Permian. Hoegh, 1936.
188	Nepheline syenite. 56–4. Meyerfjord, Langesundsfjord, Norway. T. F. W. Barth.	do	+20	75	7.6, 8.0	7.8	*253*	Do.
189	Granite. S. 1822. Tenting, Bedil, 2nd Division, West Sarawak, British Territories in Borneo. F. W. Roe.	do	−80+200	305	20, 25	22.5	*183*	Pre-Tertiary. F. W. Roe.
190	Granodiorite. S. 547. Sebuyau, 2nd Division, West Sarawak, British Territories in Borneo. F. W. Roe.	do	−80+200	525	40, 45	42.5	*198*	Do.
191	Granite. CL–1. Calzada Larga (Chiapas) Mexico. C. Fries, Jr., B. F. Webber.	do	−80+200	120	10.3, 9.7	10	*205*	Carboniferous(?) (pre-Santa Rosa formation). C. Fries, Jr.
192	Porphyritic granite. 1–F. Andlau, Carriere Sud, 53 G, 77.2, SG.62.8E, Vosges Mountains, France. H. Faul.	do	----------	396	25, 26, 27	26	*163*	Early Carboniferous. Jung, 1928.
193	Reddish biotite granite. SA–1. Jebal Rafa, Saudi Arabia. G. F. Brown.	Zircon (metamict).	−60+200	3,840	390	----------	*247*	Pre-Permian. Bramkamp and others, 1956.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
194	Coarse gray porphyritic granite. SA-2. Eastern side of eastern batholith, Saudia Arabia. G. F. Brown.	Zircon	−60+200	460 360 483	65, 68, 47, 49, 61	66. 5 48	349 323 306	Pre-Permian. Bramkamp and others, 1956.
195	Granite rock SA-3. Jebal Z'aba, Saudi Arabia. G. F. Brown.	do	−60+200	2, 083 1, 970	302, 305, 307, 308	303 307	351 377	Do.
196	Fine-grained gray granodiorite. SA-4. Taif, Saudi Arabia. G. F. Brown.	do	−60+400	380	48, 50, 50	49	314	Do.
197	Pink granitic rock Sa-6. Dhalm, Saudi Arabia. G. F. Brown.	do	−60+400	410 462	62, 65 62, 65	63. 5 63. 5	373 333	Do.
198	Narragansett Pier granite S-46. Ashaway quadrangle, Rhode Island. W. L. Smith.	do	−80+200	304	27, 29	28	225	Late or post-Pennsylvanian. Quinn and others, 1957.
199	Narragansett Pier granite Q-55-3. Ashaway quadrangle, Rhode Island. A. W. Quinn.	do	−80+200	300	25, 26	25. 5	208	Do.
200	Westerly granite Q-55-4. Ashaway quadrangle, Rhode Island. A. W. Quinn.	Monazite	−80+200	5, 494	580, 590	585	220	Do.

201	Westerly granite S-47. Carolian quadrangle, Sullivan quarry, 1.2 miles southeast of Bradford, R. I. W. L. Smith, A. W. Quinn.	Zircon	−200+400	190	19	----------	243	Do.
202	Narragansett Pier granite Q-55-1. Narragansett Pier quadrangle at south end of Tower Hill, R. I. A. W. Quinn.	do	−80+200	509	48, 50	49	235	Do.
203	Narragansett Pier granite 53-S-49. Quonochontaug Beach, Quonochontaug quadrangle, Rhode Island. W. L. Smith.	do	−80+200	515	58	----------	274	Do.
204	Cowesett granite Q-48-3. East Greenwich quadrangle, Cowesett Road, 3,100 feet east of Quaker Lane, R. I. A. W. Quinn.	do	−80+200 −200+400 −400	134 217 322	14, 16 24, 25 33, 35	15 24 34	272 272 257	Mississippian. Quinn and others, 1957.
205	Quincy granite QG-1. Peabody, Mass. W. L. Smith.	do	−80+400	124 165	14, 14, 15 18, 18, 18, 20	14 18. 5	275 273	Do.
206	Augen gneiss Q-53-38. Hope Valley quadrangle, Ten Rod road, 2,800 feet east of West Exeter, R.I. A. W. Quinn.	do	−80+200	151	18	----------	289	Devonian. Quinn and others, 1957.
207	Scituate granite gneiss Q-50-17. North Scituate quadrangle, west abutment of Ganier Memorial Dam, Rhode Island. A. W. Quinn.	do	−80+200	146	18	----------	299	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
208	Alaskite gneiss Q-53-39. Tower Hill Road, 2,500 feet south of Mooresfield road, Narragansett Pier quadrangle, Rhode Island. A. W. Quinn.	Zircon	−80+200	800	100		*303*	Devonian. Quinn and others, 1957.
209	Scituate granite gneiss Q-53-37. Georgiaville quadrangle, Fornum Pike, 1,200 feet southeast of west end of Capron road, Rhode Island. A. W. Quinn.	do	−80+200	352 251	44 35		*303* *337*	Do.
210	Oneco granite 53-S-48. Moosup, Conn. W. L. Smith.	do	−80+200	544	63, 65	64	*286*	No data.
211	Syenite Vt-Sy-56J-12. White Mountain plutonic-volcanic series, near summit of Mount Ascutney, Vt. H. W. Jaffe, J. B. Lyons.	do	−80+200 −200+400	166 214	11, 12 17, 20	11.5 18.5	*172* *211*	Mississippian(?). Billings, 1956. Late Permian(?). Lyons and others, 1957.
212	Granite Vt-Gr-56J-13. White Mountain plutonic-volcanic series, below summit of Mount Ascutney, Vt. H. W. Jaffe, J. B. Lyons.	do	−80+200 −200+400	247 373	19, 22 25, 27	20.5 26	*212* *179*	Do.
213	Monzodiorite NH-M-56J-17.	do	−80+200	240 260	16, 17 18, 20	16.5 19	*171* *182*	Do.

	White Mountain plutonic-volcanic series, south of Belknap Point, west shore of Lake Winnepesaukee, Lake Winnepesaukee quadrangle, New Hampshire. H. W Jaffe, J. B. Lyons.		−200+400	650 352 373	46, 48 24, 26 26, 27	47 25 26. 5	180 176 177	
214	Conway granite. 2-B-NH-40. White Mountain plutonic-volcanic series, North Conway quadrangle, east end of Green quarry, Redstone, N.H. A. Butler.	do	−80+200	298	22, 23	22. 5	188	Do.
215	Mount Osceola granite. 99-BNH-67A. White Mountain plutonic-volcanic series, north side of Forest road opposite Franconia Paper Company dam, Franconia quadrangle, New Hampshire. A. Butler.	do	−80+200 −200+400	446 508	33, 37 38, 39	35 38. 5	195 188	Do.
216	Conway granite. BNH-69. White Mountain plutonic-volcanic series, North Conway quadrangle, New Hampshire. A. Butler.	do	−60+100	855	62, 65	63. 5	185	Do.
217	Conway granite. 16-BNH-8. White Mountain plutonic-volcanic series, North Conway quadrangle, New Hampshire. A. Butler.	do Zircon (metamict).	−60+200	1, 010 836 1, 050 1, 417	85 86 105 150	---------- ---------- ---------- ----------	206 250 245 260	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
218	Mount Osceola granite 33–BNH–17. White Mountain plutonic-volcanic series, Mount Chocura quadrangle, New Hampshire. A. Butler.	Zircon	−60+200	470 723 843	50 68 80		259 230 232	Mississippian(?). Billings, 1956. Late Permian(?). Lyons and others, 1957.
219	Fayalite quartz syenite BNH–20. Devils Slide ring dike, White Mountain plutonic-volcanic series, Percy quadrangle, New Hampshire. A. Butler.	Zircon Th:U=2.1 c=2,385. Chevkinite Th:U=54 c=2,050 $k=0.50\times10^{-4}$	−60+200 −100+200	465 443 995	44 42 98		222 224 201	Do.
220	Essexite MR–1. Stock, Monteregian Hills, Mount Royal, Montreal, Quebec, Canada. J. B. Lyons.	Zircon (metamict).	−80+200	2, 323	210, 215	213	224	Late Paleozoic. Lyons and others 1957.
221	Winnepesaukee quartz diorite NH–WQd–56J–16. New Hampshire plutonic series, south of Belknap Point, Lake Winnepesaukee quadrangle, New Hampshire. H. W. Jaffe, J. B. Lyons.	Zircon	−80+200 −200+400	353 391	38, 40 45, 47	39 46	269 285	Late Devonian(?) (post-Early Devonian). Billings, 1956. Lyons and others, 1957.
222	Kinsman quartz monzonite NH–LM–1–52.	Zircon Th:U=0.4	−100+200	248	26, 30	28	282	Do.

	New Hampshire plutonic series, Lovewell Mountain quadrangle, New Hampshire. J. B. Lyons.	$c=2,560$ $k=1.74\times10^{-4}$						
		Monazite Th:U=33 $c=2,065$ $k=0.61\times10^{-4}$	−100+200	4,351	640, 800	720	337	
223	Kinsman quarts monzonite NH-C 2-52. New Hampshire plutonic series, Cardigan quadrangle, New Hampshire. J. B. Lyons.	Zircon	−100+200	333	36, 38	37	270	Do.
224	Bethlehem gneiss NH-R-8-52-1. New Hampshire plutonic series, Rumney quadrangle, New Hampshire. J. B. Lyons.	do	−100+200	246	28		277	Do.
225	Bethlehem gneiss NH-S-4-52-1. New Hampshire plutonic series, Sunapee quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=1.4 $c=2,455$ $k=1.47\times10^{-4}$	−100+200	242	30		297	Do.
		Monazite Th:U=8.5 $c=2,180$ $k=0.87\times10^{-4}$	−100+200	2, 922	470		342	
		Xenotime Th:U=54 $c=2,048$ $k=0.56\times10^{-4}$.	−100+200	4, 053	530		266	
226	Concord granite NH-Big-56-J-20. Binary granite, New Hampshire plutonic series, Swenson quarry, Concord, N.H. H. W. Jaffe, J. B. Lyons.	Monazite	−80+200	5, 352	825, 835	830	320	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
227	Concord granite NH-C-4-52-1. Binary granite, New Hampshire plutonic series, Cardigan quadrangle, New Hampshire. J. B. Lyons.	Monazite Th:U=46 c=2,052 $k=0.58\times10^{-4}$.	−100+200	2, 784	450	----------	329	Late Devonian(?) (post-Early Devonian). Billings, 1956. Lyons and others, 1957.
228	Pegmatite in Concord granite NH-C-5-52-E. New Hampshire plutonic series, Cardigan quadrangle, New Hampshire. J. B. Lyons.	Monazite	−100+200	5, 285	700	----------	274	Do.
229	Binary granite NH-Gr-56-J-19. In Fitchburg pluton on U.S. Highway 3, 4.2 miles south of Suncook River, Martin, Suncook quadrangle, New Hampshire. H. W. Jaffe, J. B. Lyons.	Zircon	−80+200	394	45, 48	46. 5	286	Do.
230	Exeter diorite NH-di-56-J-18. Exeter pluton, between Exeter and Epping, N.H. H. W. Jaffe, J. B. Lyons.	do	−80+200	75	9. 0, 10	9. 5	307	Do.
231	Metarhyolite NH-L-1-56. Littleton formation, Littleton, N.H. J. B. Lyons.	do	−80+200	53	6. 0, 7. 0	6. 5	298	Early to Middle Devonian (Oriskany-Onondaga age). J. B. Lyons.

232	Felsic volcanics NH-Mo-3-56. High grade zone of Littleton formation, east of Lisbon, N.H. J. B. Lyons.	do	−80+400	165	21, 22	21.5	316	Do.
233	Granite NH-MW-4-52-1. Oliverian plutonic series, Mount Washington quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=2.3 c=2,390 $k=1.31\times10^{-4}$	−100+200	498	61	----------	287	Middle to Late Devonian(?). Billings, 1956, Lyons and others, 1957.
234	Lebanon granite, border gneiss NH-H-6-52-1. Oliverian plutonic series, Mount Washington quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=1.1 c=2,475 $k=1.55\times10^{-4}$	−100+200	217	27	----------	301	Do.
235	Lebanon granite NH-H-1-52. Hanover quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=0.56 c=2,540 $k=1.69\times10^{-4}$	−100+200	574	79	----------	340	Do.
236	Aplite in Lebanon granite NH-H-2-52-1. Oliverian plutonic series, Hanover quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=0 c=2,632 $k=1.90\times10^{-4}$	−100+200	980	130	----------	337	Do.
237	Granite of Mascoma group NH-H-50-52. Oliverian plutonic series, Mascoma quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=1.3 c=2,460 $k=1.50\times10^{-4}$	−100+200	514	60, 63	61.5	288	Do.
238	Pink granite Me-Gr-56J-21. Biddeford granite, Kennebunk quadrangle, Wells, Maine. J. B. Lyons, H. W. Jaffe.	Zircon	−80+200 −200+400	348 410	42, 45 47, 48	43.5 47.5	308	Middle to Late Devonian. Lyons and others, 1957.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
239	Granite AB–1. Near Parlin Pond, Jackman, Maine. A. J. Boucot.	Zircon	−80+200	315	43		330	Middle Devonian. A. J. Boucot.
240	Granite JBL–Me. Near Parlin Pond, 5 miles south of Jackman, Maine. J. B. Lyons.	do	−80+200	248 237	33, 33 30, 29	33 29. 5	322 302	Do.
241	Katahdin granite AB–2. Katahdin batholith, near Ripogenus dam, Maine. A. J. Boucot.	do	−80+200 −200+400	212 230	28 30		320 316	Post-Early Devonian. Boucot, 1954.
242	Kineo rhyolite, intrusive phase AB–3. Northeast part of Brassua quadrangle, Somerset County, Maine. A. J. Boucot.	do	−200+400	95	11		281	Late Early Devonian. A. J. Boucot.
243	Granite AB–5. Big Dump quarry, St. George, New Brunswick, Canada. A. J. Boucot.	do	−80+400	363	45, 45	45	301	Middle Devonian (post-Eastport, pre-Perry formation). A. J. Boucot.
244	Gray granite AB–6. Southeast tip of Pocologan Harbor, Charlotte County, New Brunswick, Canada. A. J. Boucot.	do	−80+200 −200+400 −400	164 229 232	24, 26 34, 33 34, 36	25 33. 5 35	368 354 364	Pre-Middle Silurian(?). A. J. Boucot.

245	Granodiorite NH-L-1-52-1. Highlandcroft plutonic series, Littleton quadrangle, New Hampshire. J. B. Lyons.	Zircon Th:U=1.4 c=2,455 $k=1.47\times10^{-4}$	−100+200	166	25, 27	26	374	Late Ordovician. Billings, 1956; Lyons and others, 1957.
246	Fairlee quartz monzonite NH-MC-1-53-3. Highlandcroft plutonic series, Mount Cube quadrangle, New Hampshire. J. B. Lyons.	Zircon	−100+200	164	25		368	Do.
247	Sodaclase tonalite NH-H-5-52-1. Highlandcroft plutonic series, Hanover quadrangle, New Hampshire. J. B. Lyons.	do	−100+200	882	156		425	Do.
248	Quartz diorite of Lost Nation group. NH-LN-56-J-9. Highlandcroft plutonic series, 3.5 miles south of Lancaster, N. H. H. W. Jaffe, J. B. Lyons.	do	−80+200	200	32, 30	31	373	Do.
249	Nepheline syenite S-44. Near Beemerville, N. J. C. Milton.	do	−80+200	153	21		332	Late Ordovician to Early Silurian. M. Johnson.
250	"Mixed rock" S-45. Near Beemerville, N.J. C. Milton.	do	−80+200	267	42		379	Do.
251	Bostonite porphyry S-45. Near Beemerville, N.J. C. Milton.	do	−80+200	172	29		406	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
252	Swarthmore granodiorite AWP-1. Near Springfield, Philadelphia area, Pennsylvania. A. W. Postel.	Zircon	−80+400	297	25. 28	26. 5	*218*	Post-Precambrian. Postel and Jaffe, 1957.
253	Swarthmore granodiorite AWP-8. Near Falls Bridge, Fairmount Park, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	288	25, 26	25. 5	*216*	Do.
254	Swarthmore granodiorite S-23. Near Springfield, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	240	28, 30	29	*293*	Do.
255	Aplitic phase, Swarthmore granodiorite. S-16. Near Springfield, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	247	24, 25	24. 5	*241*	Do.
256	Swarthmore granodiorite AWP-5. Intermediate replacement type, East Lake Park, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	220	20, 23	21. 5	*238*	Do.
257	Swarthmore granodiorite AWP-6. Intermediate replacement type, Clifton Heights, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	250	22, 25	23. 5	*230*	Do.

258	Biotitic Wissahickon schist. AWP-7. Near Falls Bridge, Fairmount Park, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	135	22, 25	23.5	418	Precambrian or Early Paleozoic. Postel and Jaffe, 1957.
259	Biotitic Wissahickon schist. AWP-10. Gulley Run, south of West Manayunk, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	125	21, 23	22	422	Do.
260	Muscovitic Wissahickon schist. AWP-4A. Intersection of Crum Creek, and Chester road, south of Swarthmore, Philadelphia area, Pennsylvania. A. W. Postel.	Monazite	−80+400	3, 920	1,020, 1,040	1, 030	529	Do.
261	Muscovitic Wissahickon schist. AWP-9. Gulley Run, south of West Manayunk, Philadelphia area, Pennsylvania. A. W. Postel.	do	−80+400	3, 024	790, 800	795	529	Do.
262	Wissahickon schist. WFQ. Darby Creek, Clifton Heights, Philadelphia area, Pennsylvania. C. Dryden.	do	−60+200	4, 137	1, 600		785	Do.
263	Wissahickon schist. Wis-1. Somerton, Bucks County, Pa. C. Dryden.	Zircon	−60+200	276	110		914	Do.
264	"Eastonite". Mont-1. Near Easton, Pa. A. Montgomery.	do	½-inch crystals.	620	240		890	Precambrian. A. Montgomery.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
265	Granite felsophyre. CM–2. Dike, Crab Bottom road, 2½ miles northeast of Hightown, Highland County, Va. C. Milton.	Zircon	−80+200	23	3. 0, 3. 0	3. 0	*316*	Post-Silurian. Butts, 1933.
266	Bentonite. JTH–2. Volcanic tuff, 7 feet above the base of the Martinsburg shale near Strasburg, Va. J. T. Hack.	do	−200+400	106	15, 16	15. 5	35*3*	Middle to Late Ordovician. Butts, 1933.
267	Metarhyolite of Catoctin formation. Pa-Sm-fr. South Mountain, Franklin County, Pa. R. S. Cannon.	do	−100+400	37	7. 0, 8. 0	7. 5	48*4*	Early Cambrian or Precambrian. Reed, 1955.
268	White granodiorite gneiss. 54J–1. U.S. Highway 211, 1.6 miles west of Sperryville, Va. H. W. Jaffe.	do	−100+200	686	135	----------	47*0*	Precambrian. J. C. Reed, Jr.
				854	160	----------	44*9*	
		Monazite	−100+200	8, 786	2, 000	----------	46*8*	
269	Gray granodiorite gneiss. VR–1. One and seven-tenths miles west of Sperryville, Va. R. S. Cannon, H. W. Jaffe, K. J. Murata, G. Neuerberg, and G. H. Espenshade.	Zircon	−100+200	533	116	----------	50*8*	Do.
				530	113	----------	51*0*	
270	Old Rag Granite. OR–1.	do	−80+200	725	125, 128	126	41*7*	Do.
				1, 133	200, 205	202	42*8*	

271	White Oak Canyon, Shenandoah National Park, Va. J. C. Reed, Jr. Hypersthene granodiorite gneiss. 54J–20	do	−100+200	192	46	51	567	Do.
	Milepost 21, Skyline Drive, Shenandoah National Park, Va. H. W. Jaffe.			206	----------	----------	586	
272	Granite. B.I. 1. Bear Island, Potomac gorge below Great Falls, Potomac River, Md. J. C. Reed, Jr.	do	−80+200	150	35, 37	36	568	Post-Precambrian(?). Cloos and Anderson, 1950.
273	Yorkville quartz-monzonite. 540T–225. One and seven-tenths miles south-southeast of Henry Knob, York County, N.C. W. R. Griffitts.	do	−80+200	533	58	----------	262	Paleozoic. Griffitts and Overstreet, 1952.
274	Cherryville quartz monzonite. 53–Be–3. Near bridge over Muddy Creek, Cleveland County, N.C. W. C. Overstreet, P. E. Benson.	Monazite Th:U=2.5 c=2,375.	−80+200	11, 197	1, 250	----------	260	Do.
275	Henderson granite. 54–Ot–207. Rutherford County, N.C. W. C. Overstreet.	Zircon	−80+200	166	24, 25	24.5	357	Do.
276	Biotitic Whiteside granite. 55Nc–7.	do	−80+200	924	270, 275	272	689	Do.
	Three and three-fourths miles west of Cashiers, N.C. W. R. Griffitts.	Monazite	−80+200	4, 794	830, 830	830	358	

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
277	Biotitic Whiteside granite 55–NC–5. On U.S. Highway 64, north edge of Highlands, N.C. W. R. Griffitts.	Monazite	−80+200	4, 321	770, 765	768	368	Paleozoic. Griffitts and Overstreet, 1952.
278	Biotitic Whiteside granite 55–NC–4. Five miles west of Highlands, N.C. W. R. Griffitts.	do	−80+200	3, 909	780, 790	785	413	Do.
279	Muscovite Whiteside granite 55–NC–3. Five miles west of Highlands, N.C. W. R. Griffitts.	do	−80+200	3, 600	770, 760	765	437	Do.
		Zircon	−80+200	241	71, 75	73	708	
280	Bessemer granite 50L–174. Two and six-tenths miles northeast of Bessemer City, N.C. W. C. Overstreet.	do	−100+200	620	130, 125	127	491	Do.
281	Pegmatite intrusive into Toluca quartz monzonite. 49–Ot–16. Acre rock quarry, Cleveland County, N.C. W. C. Overstreet.	do	−100+200	456 452	81 82		427 435	Do.
		Monazite	−100+200	5, 685	1, 050		380	
282	Tuloca quartz monzonite 49–Ot–14. Acre rock quarry, Cleveland County, N.C. W. C. Overstreet.	Zircon	−100+200	450	83		442	Do.

283	Pegmatite, intrusive into Toluca quartz monzonite. 53–Ot–14.	Monazite	−100+200	5, 464	1, 000	----------	377	Do.
	Acre rock quarry, Cleveland County, N.C. W. C. Overstreet.	Zircon	−100+200	652	124	----------	456	
284	Toluca quartz monzonite, late phase dike. 49–Ot–22. Quarry at Hollis, Rutherford County, N.C. W. C. Overstreet.	Monazite	−100+200	7, 068	1, 290	----------	377	Do.
285	Saprolite of gneissic granite of the type found near Toluca. 47–Mt–73. Eight-tenths mile N.11°W. of Toluca, Cleveland County, N.C. J. B. Mertie.	do	−100+200	6, 666	1, 020	----------	319	Do.
286	Carolina gneiss	Zircon	−100+200	231	34	----------	356	Precambrian(?). Griffitts and Overstreet, 1952.
	SOY–328. Shelby area, North Carolina. R. G. Yates.	Monazite	−100+200	4, 583	890	----------	400	
287	Schist of Carolina gneiss	Zircon	−100+200	257	45	----------	420	Do.
	A48–Ot–81. Shelby area, North Carolina. W. C. Overstreet.	Monazite	−100+200	5, 298	1, 000	----------	389	
288	Schist of Carolina gneiss 48–Ot–81. Shelby area, North Carolina. W. C. Overstreet.	Zircon	−100+200	233	38	----------	393	Do.
289	Schist of Carolina gneiss 50–Y–538. Shelby area, North Carolina. R. G. Yates.	Monazite	−100+200	4, 660	910	----------	395	Do.
290	Schist of Carolina gneiss 50–Ot–441. Shelby area, North Carolina. W. C. Overstreet.	do	−100+200	4, 573	920	----------	413	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
291	Homogeneous foliated Cranberry gneiss, saprolite. C-1. Spruce Pine district, North Carolina. W. R. Griffitts.	Zircon	−80+200	90	18, 20	19	503	Precambrian(?). Griffitts and Overstreet, 1952.
292	Homogeneous foliated Cranberry gneiss, saprolite. C-2. Spruce Pine district, North Carolina. W. R. Griffitts.	do	−80+200	38	7.0, 8.0	7.5	471	Do.
293	Granitoid band in augen gneiss RG-2. Dellwood quadrangle, Haywood County, N.C. R. Goldsmith.	do	−80+200 −200+400	457 472	102 105		531 529	Precambrian. R. Goldsmith.
294	Mica schist of Carolina gneiss 55NC-2. On U.S. Highway 64, 6.3 miles east of Franklin, N.C. W. R. Griffitts.	do	−60+200	129 218	33, 35 53, 55	34 54	622 587	Precambrian. W. R. Griffitts.
295	Max Patch granite MP-1. Lemon Gap quadrangle, Max Patch Mountain, Tenn. R. Goldsmith, D. Carroll, R. B. Neuman.	do	−80+200	78	31		912	Precambrian. R. Goldsmith.
296	Arenite RN-2. Ocoee series, Great Smoky Mountains, Gatlinburg quadrangle, Tennessee. R. B. Neuman.	Detrital zircon (fresh). (metamict)	−80+200 −80+200	124 287	58, 59 104, 110	58.5 107	1,070 859	Late Precambrian(?). King, 1949; Carroll, Neuman, and Jaffe, 1957.

297	Arenite RN-9. Ocoee series, Great Smoky Mountains, Calderwood quadrangle, Tennessee-North Carolina. R. B. Neuman, D. Carroll.	Detrital zircon (fresh).	−80+200	112	58, 59	58. 5	1, 170	Do.
		(metamict)	−80+200	273	105, 109	107	900	
298	Arenite RN-12. Ocoee series, Great Smoky Mountains, Thunderhead quadrangle, Tennessee-North Carolina. R. B. Neuman, D. Carroll.	Detrital zircon (fresh).	−80+200	129	32, 35	33. 5	613	Do.
		(metamict)	−80+200	300	98, 100	99	767	
299	Arenite RN-13. Ocoee series, Great Smoky Mountains, Thunderhead quadrangle, Tennessee-North Carolina. R. B. Neuman, D. Carroll.	Detrital zircon (fresh).	−80+200	136	36, 38	37	640	Do.
300	Arenite RN-8. Ocoee series, Great Smoky Mountains, Calderwood quadrangle, Tennessee-North Carolina. R. B. Neuman, D. Carroll.	do	−80+200	110	58, 58	58	1, 180	Do.
301	Arenite RN-3b. Ocoee series, Great Smoky Mountains, Gatlinburg quadrangle, Tennessee. R. B. Neuman, D. Carroll.	do	−80+200	153	61	----------	914	Do.
302	Pegmatite TB56-10. Pegmatitic nest, border of ilmenite norite and anorthosite, coordinates Y 21634 and X 37057, Tellenes, Hange i Dalane, southern Norway. T. F. W. Barth.	Zircon	+60	48	7. 0, 8. 0	7. 5	376	Ordovician-Silurian. Holtedahl, 1953.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
303	Pegmatite TB56–11. Pegmatitic nest, border of ilmenite norite and anorthosite, coordinates Y 21536 and X 37057, Tellenes, Hange i Dalane, southern Norway. T. F. W. Barth.	Zircon	+60	86	14, 15	14. 5	*405*	Ordovician-Silurian Holtedahl, 1953.
304	Pegmatite TB–1. Melkodoela, Bygdin, southern Norway. T. F. W. Barth.	do	+60	211	51		*573*	Do.
305	Pegmatite 56–1. Stjerno, Finmark, southern Norway. T. F. W. Barth.	do	+60	27	6.0 6.3	6. 15	*541*	Do.
306	Pegmatite TB–3. Dike in basic igneous rock, Skarvaan, Seiland, northern Norway. T. F. W. Barth.	do	+60	88	36		*936*	Do.
307	Pegmatite TB–6. Dike in igneous basic rock, Skarvbergnes, Seiland, northern Norway. T. F. W. Barth.	do	+60	31	13		*957*	Do.

308	Sovite	do	−60+200	102	19, 20, 19, 21	20	468	No data. T. F. W. Barth.
	TB–8.							
	Fen area, southern Norway.							
	T. F. W. Barth.							
309	Pegmatite	do	−60+200	57	18	----------	736	Late Precambrian. T. F. W. Barth.
	TB–2.							
	Dike in migmatitic gneiss, Fen area, southern Norway.							
	T. F. W. Barth.							
310	Granite	do	−60+200	303	100	----------	767	Precambrian. A. Kahma.
	EI–1.			374	118	----------	735	
	Rovaniemi, Finland.							
	E. Ingerson.							
311	Granite	do	−60+200	160	52	----------	757	Do.
	EI–2.							
	Salonenkala, Finland.							
	E. Ingerson.							
312	Potassium granite	Zircon (metamict)	−80+400	150	101	----------	1,480	Do.
	EI–3.	Th:U=0.3		146	101	----------	1,510	
	Bodom, Finland.	c=2,575		157	103	----------	1,450	
	E. Ingerson.	$k=1.77\times10^{-4}$		184	120	----------	1,440	
313	Pegmatite		30 mm crystals.					
	Z–61.	Zircon (fresh)		168	43	----------	579	Late Precambrian. Taylor, 1915.
	Z–Sa.	Th:U=3		170	45	----------	599	
	Z–1.	c=2,350		326	88	----------	610	
	Z–3.	$k=1.22\times10^{-4}$.		151	41	----------	613	
	Z–2.	Zircon (metamict)		1,103	290	----------	585	
	Z–2L.			1,292	350	----------	601	
	Z–4.	Th:U=4		1,220	335	----------	610	
	Z–4a.	c=2,300		1,270	380	----------	662	
	Z–Sb.	$k=1.12\times10^{-4}$		1,180	340	----------	638	
	Z–Sc.			1,230	360	----------	648	
	Z–63.			1,190	343	----------	637	
	Z–63L.			1,168	339	----------	[1] 642	
	Intrusive into Quanah granite, Quanah Mountain, Wichita Mountains, Okla.							
	F. L. Hess, R. L. Dott.							

[1] Mean lead-alpha age (Oklahoma zircon) of No. 313 is 619 millions of years.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
314	Tishomingo granite, porphyritic granite.	Zircon	−60+400	72	28, 30	29	922	Precambrian.
	Ten Acre Rock, 8 miles northwest of Tishomingo, Arbuckle Mountains, Okla.			80	29, 31	30	845	Hamilton, 1956.
	W. B. Hamilton.							
315	Gem-bearing gravels presumably derived from pegmatite–Ceylon.	Zircon Th:U=<0.1 c=2,632 k=1.9×10⁻⁴.	Large crystals.					Precambrian. Wadia and Fernando, 1944.
	Z–1.			103	22		532	
	Z–2.			273	65		590	
	Z–4–33.			150	37		609	
	Z–3–16.			352	80		565	
	Z–5–1.			380	88		575	
	Z–4–36.			430	91		527	
	Z–3–11.			533	115		536	
	Z–3.			643	150		578	
	Z–3–42.			649	143		548	
	Z–2–37.			652	148		563	
	Z–2–13.			850	196		573	
	Z–4.			882	205		576	
	Z–2–18.			913	200		545	
	Z–2–23.			985	227		572	
	Z–6.			1, 185	275		576	
	Z–2–17.			1, 245	270		538	
	Z–7.			1, 583	392		613	
	Z–9.			1, 815	450		613	
	Z–1–2.			2, 040	440		536	
	Z–10.			2, 197	529		594	
	Z–1–26.			2, 210	498		560	Late Precambrian.
316	Nepheline syenite	Zircon	−60+200	344	75		519	
	G–2117.			358	85		562	C. E. Tilley.

317	Tambane, Nyasaland, Africa. C. E. Tilley. Pegmatite T-1.	do	+60	380 489 185 375	86 105 47 85	---------- ---------- ---------- ----------	537 512 600 538	Do.
318	Tambane, Nyasaland, Africa. C. E. Tilley. Pegmatite 62081.	Monazite	+60	1, 634	430	----------	539	Do.
319	Tambane, Nyasaland, Africa. C. E. Tilley. Fayalite ferrohedenbergite granite. H-3. Cranberry Lake quadrangle, Adirondack Mountains, N. Y. A. W. Postel.	Zircon	----------	73	17	----------	553	Precambrian. Buddington, 1939.
320	Hawkeye granite gneiss P-3. Mud Lake Mountain quarry, Loon Lake quadrangle, Adirondack Mountains, N.Y. A. W. Postel.	do	−60+200	185 187	51 48, 51 48, 48	---------- 48	649 607	Do.
321	Lyon Mountain granite P-1. Adirondack Mountains, Dannemora, N.Y. A. W. Postel.	do	−60+200	215 213	60 60	---------- ----------	656 660	Do.
322	Hornblende microcline plagioclase granite gneiss. 188. One hundred seventy-five yards southwest of Stone school, Russell quadrangle, Adirondack Mountains, N. Y. A. F. Buddington.	do	----------	285	75	----------	621	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
323	Coarse rapikivi alaskite 191. Stark complex, 1.5 miles west-northwest of Coldbrook school, Stark quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	Zircon		188	50		627	Precambrian. Buddington, 1939.
324	Pyroxene hornblende granite gneiss. 124. Garnetiferous granulite facies, Tupper Lake quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	101	30, 29	29.5	696	Do.
325	Paragneiss 229. Seven-tenths of a mile northeast of road to Golden Beach on Raquette Lake quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	130	34, 36	35	634	Do.
326	Eulite quartz syenite gneiss 248. Raquette Pond, southwest end of Tupper Lake, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	134	35, 37	36	633	Do.

327	Hornblende granite 38. Oswegatchie quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	Zircon (metamict).	−60+200	297 544	102 160	------ ------	796 689	Do.
328	Hornblende granite 42. Oswegatchie quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	Zircon	−60+200	189	61, 63	62	763	Do.
329	Pyroxene syenite gneiss 58SA. Tupper Lake quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	250	72, 75	73. 5	689	Do.
330	Hornblende granite 251. Road cut north of Cat Pond, Tupper Lake quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	228	63, 65	64	660	Do.
331	Metamorphosed limestone at contact with intrusive quartz syenite. 6–37. Ashmore Farm, 1 mile east-northeast at Natural Bridge, Lake Bonaparte quadrangle, Adirondack Mountains, N.Y. A. F. Buddington, H. D. Holland.	do	+60	217	65, 67	66	711	Do.
332	Quartz syenite P–4. Goodnow Mountain quarry, Santa Clara quadrangle, Adirondack Mountains, N.Y. A. W. Postel.	do	−60+200	148	45, 46, 49	47	740	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
333	Hornblende microperthite granite. B-36. Cranberry Lake quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	Zircon (metamict).	−60+200	293 325 435 460	95 105 125 130	---------- ---------- ---------- ----------	755 735 674 664	Precambrian. Buddington, 1939.
334	Olivine quartz syenite P-2. Ausable Forks quarry, Ausable Forks, Adirondack Mountains, N.Y. A. W. Postel.	Zircon	−60+200	165 157	52, 53, 55, 56 ----------	54 52	761 770	Do.
335	Ilmenitic magnetitic pyroxenic shonkinite. 4973. Diana complex, 1.6 miles south of Harrisville bridge, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	42	14	----------	775	Do.
336	Hornblende granite gneiss 244. One and one-tenth mile east-northeast of road junction to Rainbow Falls, Stark quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	185	65	----------	814	Do.
337	Hornblende microperthite granite. 79. Big Moose quadrangle, Adirondack Mountains, N.Y. A. F. Buddington.	Zircon (metamict).	−60+200	310 615	118, 120 196, 200	119 198	883 750	Do.

338	Anorthosite (Whiteface type). MO–2. Tupper Lake quadrangle, Adirondack Mountains, N.Y. A. W. Postel.	do	−60+200	71	26, 27	26. 5	860	Do.
339	Hornblende microcline granite gneiss. 45. One and one-half miles east of Sevey's road junction, on road to Tupper Lake, Adirondack Mountains, N.Y. A. F. Buddington.	do	−60+200	309	119, 120	119	892	Do.
340	Hedenbergite quartz syenite, partly albitized. 1923. New Jersey Highlands, N.J. A. F. Buddington.	Zircon	−60+200	93	26		657	Precambrian. Spencer and others, 1908.
341	Hedenbergite microantiperthite quartz syenite. 1924. New Jersey Highlands, N.J. A. F. Buddington.	do	−60+200	129	35		639	Do.
342	Vein. SO–1. Scrub Oak mine, North Dover, N.J. A. J. Boucot.	do	+60	433	112, 115	113	616	Do.
343	Syenite. 51–L–6. Iron Hill, Colo. E. S. Larsen, Jr.	do	−60+200	136	30		525	Late Precambrian. Larsen, 1942.
				260	64		583	
344	Albite syenite. AND–3. Stock, Wet Mountains, Custer County, Colo. Q. D. Singewald.	Zircon (fresh) (metamict).	−60+200	319	78		580	Precambrian. Q. D. Singewald.
				452	115		601	
				770	192		590	
				1, 060	290		644	
				1, 680	430		605	
				3, 520	980		655	

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
345	Granite 4B-48. Wet Mountains, Colo. Q. D. Singewald, M. Brock.	Zircon	−80+200	74	23, 25	24	755	Precambrian. Q. D. Singewald.
346	Granite gneiss 4B-50. Paragneiss, orthogneiss, or granitized rock, origin uncertain, Wet Mountains, Colo. Q. D. Singewald, M. Brock.	Zircon (metamict).	−80+200	176 213 232	95, 98 105, 109 110, 112	96. 5 107 111	1, 220 1, 130 1, 080	Do.
347	Granite porphyry Co-R-S1. Park Range, Slavonia, Routt County, Colo. R. S. Cannon.	Zircon	−60+200	164	55, 50, 52	52	739	Precambrian. R. S. Cannon.
348	Pegmatite Co-R-Goo. Park Range, Routt County, Colo. R. S. Cannon.	Monazite Xenotime	−80+400 −80+400	1, 749 2, 390	1, 250, 1, 270 1, 550, 1, 560	1, 260 1, 555	1, 430 1, 420	Do.
349	Granite Wy-F-GM-g. Grannier Meadow, Fremont County, Wyo. R. S. Cannon.	Zircon (metamict).	−80+400	174	116	----------	1, 450	Do.
350	Graywacke Wy-F-MD-GW. Miner's Delight, Fremont County, Wyo. R. S. Cannon.	do	−80+400	140	130, 135	133	1, 950	Do.

351	Quartz monzonite EDJ-1. Intrusive into Stillwater complex, Mouat mine area, facies of the Cooke granite, Stillwater County, Mont. E. D. Jackson.	do	−80+200 −200+400	167 179	122, 125 135, 138	123 136	1, 580 1, 620	Precambrian. Lovering, 1929.
352	Titaniferous black sandstone of the Late Cretaceous Mesaverde formation. GC-W. Grass Creek area, Wyoming. J. F. Murphy, R. S. Houston.	Detrital zircon (white and purple grains).	−100+400	178	10, 11	10	135	Late Cretaceous. Murphy and Houston, 1955.
353	Titaniferous black sandstone of the Late Cretaceous Frontier formation. B-1. Cumberland Gap area, Wyoming. J. F. Murphy, R. S. Houston.	Detrital zircon (white variety, only).	−100+400	218	8. 0, 9. 0	8. 5	94	Do.
354	Titaniferous black sandstone of the Late Cretaceous Ericson sandstone. RS-1. Rock Springs area, Wyoming. J. F. Murphy, R. S. Houston.	Detrital zircon (purple alone).	−100+400	115	38, 39	38	750	Do.
355	Granitic gneiss 55ID-60. Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	Zircon	−60+200	220	69, 70	69. 5	737	Precambrian E. P. Kaiser.
356	Granitic gneiss 55ID-52. Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	do	−60+200	247	70, 72	71	674	Do.
357	Granulite 55ID-55. Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	do	−60+200	72	28, 29	28. 5	908	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
358	Granitic gneiss 55ID-51. Mineral Hill district, Lemhi County, Idaho. E. P. Kaiser.	Zircon	−60+200	202	66, 67	66.5	766	Precambrian. E. P. Kaiser.
359	Granodiorite AND-2. Prescott quadrangle, south of Prescott, Ariz. C. A. Anderson.	do	−60+200	135	55		932	Precambrian. M. H. Krieger.
360	Quartz diorite AND-1. Five hundred to one thousand feet east of bridge on Ash Creek, Cherry Creek road, Mingus Mountain quadrangle, Arizona. C. A. Anderson.	Zircon (metamict).	−60+200	238	110		1,050	Precambrian. C. A. Anderson.
361	Granite II. Crescent Peak, McCullough Mountains, T.28S., R.61E., Clark County, Nev. R. J. Roberts.	do	−60+200	593	240		927	
362	Sandstone HF-1. Harmony formation, sec. 15, T.31N., R.43E., Antler Peak quadrangle, Nevada. R. J. Roberts.	Detrital zircon	−60+200	130	54, 55	54.5	958	Late Cambrian. R. J. Roberts.
363	Gray porphyritic hornblende granite.	Zircon	−80+200 −200+400	102 115	26, 28 32, 33	27 32.5	624 664	Late Cretaceous or Tertiary(?).

	493–930. SE ¼ sec. 36, T.29S., R.16W., Big Hatchet Peak quadrangle, New Mexico. C. Dane.							Lasky, 1947, p. 31–33.
364	Aplitic granite NM–SF–Ahrg. One to five foot dikes, Sangre de Cristo range, 5 miles S.30°E. of Santa Fe County, Santa Fe, N. Mex. R. S. Cannon.	Zircon (metamict).	−60+200	847	260	----------	718	Precambrian. R. S. Cannon.
365	Rhyolite of Servilleta formation. NM–SC–SR. Los Pinos Mountains, half a mile south of State Highway 60, Socorro County, N. Mex. R. S. Cannon.	Zircon	−60+200	52	19, 19	19	844	Do.
366	Granite III. T.18S., R.22W., Mineral Park, Mohave County, Ariz. R. J. Roberts.	Zircon (metamict).	−60+200	708	340	----------	1080	
367	Silicified granite IV. T.18S., R.22W., Mineral Park, Mohave County, Ariz. R. J. Roberts.	Zircon	−80+200	77	2. 4, 3. 2	2. 8	90	
368	Town Mountain granite TM–1. Enchanted Rock pluton, Llano County, central Texas. R. M. Hutchinson.	Zircon (metamict).	−60+200	340 494	116 180	---------- ----------	791 842	Precambrian. Stenzel, 1932, 1935.
369	Porphyritic quartz monzonite to alkalic granodiorite. TM–2. Enchanted Rock pluton, Llano County, central Texas. R. M. Hutchinson.	do	−60+200	404	150	----------	857	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
370	Oatman Creek granite OT.	Zircon (metamict).	−60+200	552	205	----------	857	Precambrian. Stenzel, 1932, 1935.
	Sharp Mountain mass, Llano County, central Texas. R. M. Hutchinson.			535	210	----------	901	
371	Sixmile granite SM. Llano County, central Texas. R. M. Hutchinson.	do	−60+200	629	230	----------	844	Do.
372	Town Mountain granite TM–3.	Zircon	−60+200	220	90	----------	936	Do.
	Legion Creek mass, Llano County, central Texas. R. M. Hutchinson.			244	95	----------	894	
373	Phacolith granite of Wolf Mountain intrusive body. TM–4. Llano County, central Texas. R. M. Hutchinson.	do	−60+200	163	67	----------	940	Do.
374	Llanite LL–1. Intersection of Llanite dike and Llano-San Saba road, 9 miles north of Llano, Llano County, Tex. P. T. Flawn.	do	−80+200	25	9. 3, 9. 5	9. 4	866	Precambrian. Flawn, 1956.
375	Big Branch gneiss, migmatitic, contains inclusions of Packsaddle(?) schist. BB–1. Blowout quadrangle, Texas. P. T. Flawn.	do	−80+200	101	40, 41	40. 5	919	Do.

376	Big Branch gneiss, uncontaminated. BB-2. Blowout quadrangle, Texas. P. T. Flawn.	do	−80+200	87	37, 38	37.5	982	Do.
377	Granite. Pu-1c. Drill core (14,900 to 14,930 feet) Phillips No. 1-C Puckett well, SE¼SE¼ sec. 42, block 101, Pecos County, Tex. P. T. Flawn.	do	−80+200	49	18, 21	19.5	913	Do.
378	Granite. AR-1. Drill core (7,735 to 7,751 feet) Atlantic Refining Company No. 1 Roberts Gas unit well, 1,980 feet from the north and east lines of sec. 175, block A, Schleicher County, Tex. P. T. Flawn.	Zircon (metamict).	−80+200	248	110, 115	112	1,020	Do.
379	Barite carbonate rock. SQ-42. Dolomite-rich phase, northeast edge of Sulphide Queen carbonate body near its contact with gneiss. Mountain Pass, San Bernardino County, Calif. W. T. Pecora, J. C. Olson.	Monazite Th:U=1,300 c=2,013 $k=0.6\times10^{-4}$.	+60	2,190	1,140, 1,150	1,145	1,020	Pre-early Tertiary. Olson and others, 1954 p. 26; Jaffe, 1955.
380	Barite carbonate rock. SP-40. Northeast edge of Sulphide Queen carbonate body near its contact with gneiss, Mountain Pass, San Bernardino County, Calif. W. N. Sharp.	Monazite	+60	1,224	550	----------	911	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
381	Coarse shonkinite NM-1. Birthday area north of Sulphide Queen carbonate body, Mountain Pass, San Bernardino County, Calif. T. B. Nolan, W. T. Pecora.	Zircon (metamict).	−60+200	270 300 600 1, 220	110 110 210 465	---------- ---------- ---------- ----------	932 846 811 877	Pre-early Tertiary. Olson and others, 1954, p. 26; Jaffe, 1955.
382	Barite carbonate rock SQ-81. West edge of Sulphide Queen carbonate body near its contact with gneiss, Mountain Pass, San Bernardino County, Calif. D. F. Hewett, D. R. Shawe.	Monazite Th:U=1,300 c=2,013 $k=0.6\times10^{-4}$.	+60	2, 200	1, 130	----------	1, 000	Do.
383	Biotite-rich inclusions in the Mesozoic intrusive rocks of the Mojave Desert. ZC. Conkey Claims, Yucca Valley, San Bernardino County, Calif. D. F. Hewett.	Zircon (metamict).	−60+200 −60+200 −60+200	569 3, 818 2, 369	120 870 535	---------- ---------- ----------	503 542 496	Pre-Mesozoic. D. F. Hewett.
384	Ashokan flagstone NY-Da-56-J-24. Ashokan formation of the Hamilton group, new road cut on New York route 32, west of Quarryville, Catskill-Kaaterskill quadrangles, New York. H. W. Jaffe.	Detrital zircon (composite of white and purple crystals).	−60+200	85	42, 44	43	1, 130	Middle Devonian. Chadwick, 1944.
		(White crystals alone).	−60+200	90	43, 43	43	1, 080	

385	Katsberg red beds. NY-DcK-56-J-25. Stony Clove sandstone member of Katsberg red beds, on New York route 214, near Stony Clove, Catskill-Kaaterskill quadrangles, New York. H. W. Jaffe.	Detrital zircon (composite of white and purple crystals).	−60+200	87	42, 43	42.5	1,100	Late Devonian. Chadwick, 1944.
		(White crystals alone).	−60+200	81	44, 45	44.5	1,220	
386	Pegmatite. Z-6-6. Renfrew County, Ontario, Canada. E. S. Larsen, Jr.	Zircon	Large crystals.	30	12		918	Precambrian. D. F. Hewett.
387	Pegmatite. Z-6A. Renfrew County, Ontario, Canada. E. S. Larsen, Jr.	do	Large crystals.	30	15		1,120	Do.
388	Pegmatite. Z-6-9. Burgess County, Ontario, Canada. E. S. Larsen, Jr.	do	Large crystals.	36	15		951	Do.
389	Granite. Z-22. Tory Hill near Essonville, Ontario, Canada. E. S. Larsen, Jr.	do	−60+200	1,084 1,100 1,011 976	430 440 428 415		915 1,000 967 971	Do.
390	Granitic gneiss. 53FA-230. Greenland Shield, 25 miles ENE of Thule, Greenland. A. T. Fernald, A. S. Horowitz.	Zircon (metamict).	−100+400	955	460		1,090	Precambrian. (pre-late Precambrian Thule sediments). A. T. Fernald.
391	Granite. GR-1. Younger of two granites in the Snow Lake-Herb Lake area, Manitoba, Canada. G. A. Russell.	do	−80+400	214	155, 160	158	1,590	Precambrian. G. A. Russell.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm) Determinations	Lead (ppm) Mean	Lead-alpha age in millions of years	Cited geologic age of the rock
392	Rhyolite 3094. Copper Cliff rhyolite, Frood mine, McKim Township, Ontario, Canada. P. M. Hurley, H. Fairbairn.	Zircon (metamict).	−80+400	56	57, 58	57. 5	2, 010	Precambrian. Phemister, 1956.
393	Placer monazite GS-2-36-55. From Archean injection gneiss or migmatite, Yamba Lake, Northwest Territories, Canada. R. E. Folinsbee.	Monazite Th:U=21 c=2,100 $k=0.68\times10^{-4}$	−80+400	4, 339	6, 810	----------	3, 010	Precambrian (Archean). Folinsbee, 1955.
394	Granophyre, red granite HJ-47-54. From gabbro-red rock complex of Keweenawan age, Mellen, Wis. H. L. James.	Zircon	−80+200	103 101 100	25 26 29, 30	---------- ---------- 29. 5	575 608 691	Very late Precambrian (post-middle Keweenawan). Leighton, 1954.
395	Quartz-zircon pegmatite, float WM-124-53. Sec. 23, T.29N., R.6E., Marathon County, Wis. R. C. Vickers.	Zircon (metamict).	Large crystals.	952	233	----------	580	Precambrian (post-lower Huronian). R. C. Vickers.
396	Granite gneiss HJ-43-54. NE¼ sec. 7, T.42N., R.28W., central Dickinson County, Mich. H. L. James.	do	−80+200	680	225	----------	769	Precambrian (Laurentian). H. L. James.
397	Granite KW-120-54.	do	−80+200	610	220, 225	222	840	Precambrian (post-Huronian).

	NE¼ sec. 21, T.42N., R.32W., Iron County, Mich. K. Wier.							H. L. James.
398	Gneissic granite HJ-44-54. NE¼SW¼ sec. 22, T.41N., R.30W., central Dickinson County, Mich. H. L. James.	do	−80+400	808	470		1, 280	Precambrian (pre-Huronian, Algoman). H. L. James.
399	Porphyritic granite KW-126-54. Roadcut, 1.2 miles north of Randville, SW¼NE¼ sec. 28, T. 42 N., R. 30 W., Dickinson County, Mich. K. Wier.	Zircon	−80+400	99	59, 60	59. 5	1, 320	Do.
400	Quartz monzonite 1101-A. Active quarry, 5 miles south of Isle, Minn. R. G. Schmidt.	Zircon (metamict).	−80+400	610	245		922	Precambrain (Algoman?). R. G. Schmidt.
401	Granite at Bellingham FS-2. Upper Minnesota River valley, Minn. G. M. Schwartz.	do	−80+400	253	125		1, 110	Precambrian (Algoman?). G. M. Schwartz.
402	Porphyritic granite SG-5. Cold Springs granite quarry, Rockville, Minn. G. M. Schwartz.	do	−80+200 −200+400	230 250	120, 125 118, 122	122 120	1, 180 1, 080	Do.
403	St. Cloud gray "granite", (granodiorite). FS-1. St. Cloud, Minn. G. M. Schwartz.	do	−80+200	866	465		1, 190	Do.
404	Granite SG-4. Giant's Range, Embarass batholith, Babbitt, Minn. G. M. Schwartz.	Zircon	−80+200 −200+400	165 177	80, 85 83, 85	82. 5 84	1, 120 1, 070	Do.

Lead-alpha age determinations of accessory minerals—Continued

No.	Rock type Field No. Locality Collector	Mineral	Mesh size	α per mg per hr	Lead (ppm)		Lead-alpha age in millions of years	Cited geologic age of the rock
					Determinations	Mean		
405	Granite SG–1. Giant's Range batholith, quarry north of Mount Iron, Minn. G. M. Schwartz.	Zircon (metamict).	−80+200 −200+400	393 420	233, 236 229, 233	235 231	1, *310* 1, *220*	Precambrian (Algoman?). G. M. Schwartz.
406	Hillman tonalite 1204. Sec. 10, T. 40 N., R. 30 W., near Pierz, Minn. R. G. Schmidt.	do	−80+200	360	206, 210	208	1, *280*	Precambrian (Algoman?). R. G. Schmidt.
407	Quartz monzonite 1100. Myer's quarry, sec. 13, T. 40 N., R. 31 W., Pierz, Minn. R. G. Schmidt.	Monazite	−80+200	3, 858	3, 000	----------	1, *550*	Do.
408	McGrath gneiss 1203. Sec. 12, T. 43 N., R. 24 W., McGrath, Minn. R. G. Schmidt.	Zircon (metamict).	−80+200	318 353	228, 232 255, 260	230 257	1, *560* 1, *570*	Precambrian. Wyoski, 1949.
409	Granite SG–2. Border phase of Saganaga batholith, sec. 22, T. 65 N., R. 4 W., Gunflint Trail, Minn. G. M. Schwartz.	Zircon	−80+200 −200+400	104 95	50, 50 48, 50	50 49	1, *080* 1, *150*	Precambrian (Laurentian, pre-Knife Lake). G. M. Schwartz.
410	Granite M–3655. Interior mass of Saganaga batholith, Sea Gull Lake, east side of Cucumber Island, NW¼ sec. 12, T. 65 N., R. 5 W., Cook County, Minn. G. M. Schwartz.	do	−80+200 −200+400	63 62	57, 57, 59 53, 54	58 53. 5	1, *900* 1, *800*	Do.

411	Granite M-3656. Interior mass of Saganaga batholith, on highway on north side of Sea Gull Lake, 1,500 feet west and 3,000 feet south of intersection of 48°10′ north latitude, and 90°52′ west longitude, NW¼ sec. 32, T. 65 N., Cook County, Minn. G. M. Schwartz.	do	−80+200 −200+400	50 54	38, 40, 41 46, 47	40 46. 5	1, *700* 1, 8*00*	Do.

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