U.S. Geological Survey radiometric ages—compilation "C" Part four: Idaho, Oregon, and Washington

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U.S. GEOLOGICAL SURVEY RADIOMETRIC AGES—COMPILATION "C"
Part four: Idaho, Oregon, and Washington

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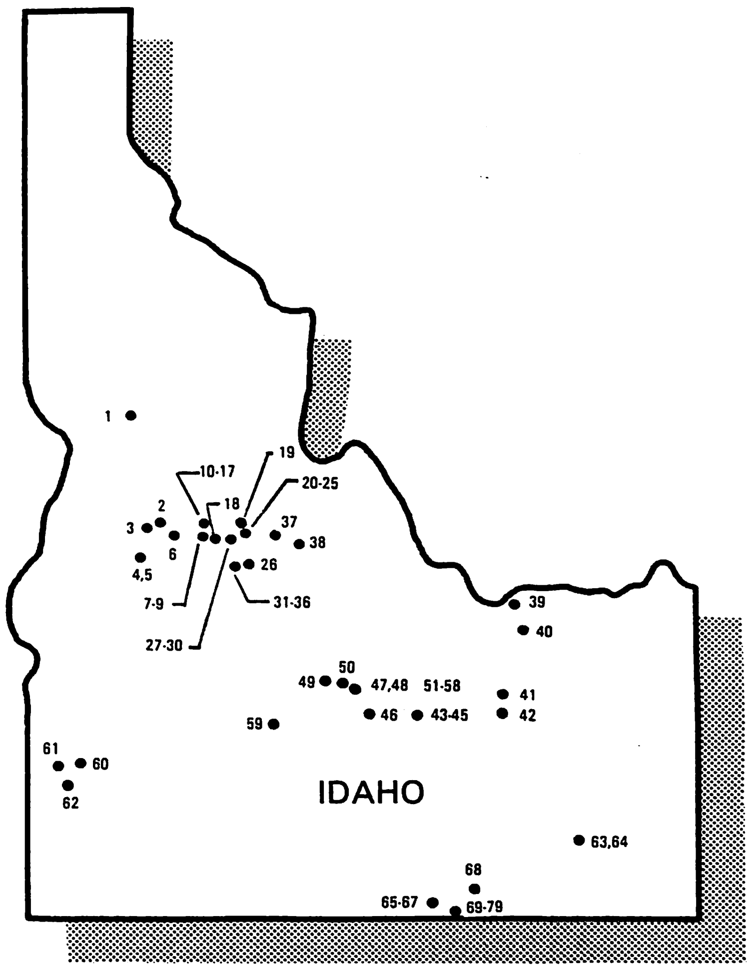
This is part four of the third compilation of a planned series of age determinations by the U.S. Geological Survey appearing in Isochron/West. It contains both unpublished and published dates. However, the latter ages lacked either a specific sample location, petrologic information, or analytical data in their published form. Such specifics are often needed for evaluation and utilization of an isotopic age. That, we believe, is the value of this compilation—it supplies such information for most of the listed samples. Users are warned to use these ages with discretion as they constitute only a part of the total geologic picture in any particular area. For ease of reference, samples are grouped together by state.

Some of the listed ages are spurious due to the presence of xenocrystic material, excess radiogenic argon, mineral alteration, diffusion of radiogenic argon, etc. If the age is recognized as being spurious, this fact is mentioned. In a number of cases, we have insufficient information, geologic or otherwise, to accurately evaluate the listed age. The spurious mineral ages are of value in that they may indicate to future geochronologists and geologists that there are potential problems in dating certain rocks in that sampled locality.

All the ages were determined by U.S. Geological Survey personnel in Denver, Colorado. Analysts are R. F. Marvin, H. H. Mehnert, and E. A. Brandt for K-Ar ages; C. E. Hedge and K. Futa or R. E. Zartman and W. T. Henderson for Rb-Sr ages; R. E. Zartman and M. D. Gallego or L. M. Kwak for U-Th-Pb ages; and C. W. Naeser for fission-track ages. Analytical techniques are not described as these dating methods are fairly common knowledge to most geologists.

The following decay constants, recommended by the IUGS Subcommission on Geochronology were used.

Potassium-40: $\lambda\epsilon = 0.581 \times 10^{-10}$/yr, $\lambda\beta = 4.962 \times 10^{-10}$/yr; atomic abundance is 0.01167 atomic percent
Rubidium-87: $\lambda\beta = 1.42 \times 10^{-11}$/yr
Fission-track: $\lambda = 7.03 \times 10^{-17}$/yr for U^{238}



Geographic index to sample localities in Idaho.

SAMPLE DESCRIPTIONS

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1. *USGS(D)797-26D* Rb-Sr
Muscovite-biotite-garnet trondhjemite (45°53'12"N, 116°02'07"W; SW¼ SW¼ S36,T30N,R3E; 60-m N of bridge over South Fork of Clearwater River at intersection with Idaho State Highway 14, Grangeville East 7.5' quad., Idaho Co., ID). *Analytical data:* Rb = 210.5 ppm, Sr = 43.49 ppm, Rb^{87}/Sr^{86} = 14.04, Sr^{87}/Sr^{86} = 0.72438, assumed initial Sr^{87}/Sr^{86} = 0.7038. *Submitted by:* Robert Fleck.
muscovite 103 ± 3 Ma

2. *USGS(D)LC-72-4* K-Ar
Granodiorite (45°04'N, 115°47'W; along Lick-Creek-Summit road, Enos Lake 7.5' quad., Valley Co., ID). *Analytical data:* (biotite) K_2O = 7.86, 7.87%; $^*Ar^{40} = 7.936 \times 10^{-10}$ mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 85%; (muscovite) K_2O = 10.34, 10.21, 10.19, 10.07%; $^*Ar^{40} = 11.10 \times 10^{-10}$ mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 81%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite-muscovite granodiorite from the Idaho batholith.
biotite 68.8 ± 2.5 Ma
muscovite 74.0 ± 1.7 Ma

3. *USGS(D)LC-72-3* K-Ar
Granodiorite (45 °02'N, 115 °55'30" W; along Lick-Creek-Summit road, Box Lake 7.5' quad., Valley Co., ID). *Analytical data:* (biotite) K_2O = 8.86, 8.80%; $*Ar^{40}$ = 9.937 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 86%; (muscovite) K_2O = 10.22, 10.22%; $*Ar^{40}$ = 10.94 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 85%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite-muscovite granodiorite from the Idaho batholith.
biotite 76.5 ± 2.8 Ma
muscovite 72.9 ± 1.6 Ma

4. *USGS(D)LC-72-1* K-Ar
Granodiorite (44 °48'N, 115 °59'30" W; along Lick-Creek-Summit road, Paddy Flat 7.5' quad., Valley Co., ID). *Analytical data:* (biotite) K_2O = 8.65, 8.62%; $*Ar^{40}$ = 10.03 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 80%; (orthoclase) K_2O = 13.56, 13.56%; $*Ar^{40}$ = 14.48 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 93%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite granodiorite from the Idaho batholith.
biotite 78.9 ± 2.8 Ma
orthoclase 72.2 ± 1.6 Ma

5. *USGS(D)LC-72-2* K-Ar
Granodiorite (44 °48'N, 115 °58'W; along Lick-Creek-Summit road, Paddy Flat 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 7.54, 7.57%; $*Ar^{40}$ = 7.977 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 77%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite granodiorite from the Idaho batholith.
biotite 71.9 ± 2.6 Ma

6. *USGS(D)LC-72-5* K-Ar
Granodiorite (44 °58'N, 115 °40'W; along Lick-Creek-Summit road, Teapot Mountain 7.5' quad., Valley Co., ID). *Analytical data:* (biotite) K_2O = 8.10, 8.16%; $*Ar^{40}$ = 8.333 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 87%; (muscovite) K_2O = 10.39, 10.37%; $*Ar^{40}$ = 11.30 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 83%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite-muscovite granodiorite from the Idaho batholith.
biotite 69.8 ± 2.5 Ma
muscovite 74.1 ± 1.7 Ma

7. *USGS(D)LC-72-6* K-Ar
Granodiorite (44 °57'N, 115 °33'W; along Lick-Creek-Summit road, Caton Lake 7.5' quad., Valley Co., ID). *Analytical data:* (biotite) K_2O = 7.67, 7.71%; $*Ar^{40}$ = 7.847 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 75%; (muscovite) K_2O = 8.26, 8.28%; $*Ar^{40}$ = 8.585 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 86%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite-muscovite granodiorite from the Idaho batholith.
biotite 69.5 ± 2.5 Ma
muscovite 70.7 ± 2.5 Ma

8. *USGS(D)L-73-3* K-Ar, Fission-track
Biotite monzonite porphyry (granophyre) (44 °58'12"N, 115 °29'54"W; SW¼ SE¼ NE¼ S20,T19N,R8E; talus at foot of spur and 240-m N of hump 5050, Yellow Pine 7.5' quad., Valley Co., ID). *Analytical data:* (K-feldspar) K_2O = 6.09, 6.22%; $*Ar^{40}$ = 3.891 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 76%; (apatite—5 grains) Ps = 0.195 × 10^6 tracks/cm² (32), Pi = 1.35 × 10^6 tracks/cm² (111), O = 4.86 × 10^{15} n/cm², U = 11 ppm. *Collected by:* B. F. Leonard. *Comment:* Feldspar age is a minimum age for the monzonite porphyry.
K-Ar: K-feldspar 43.4 ± 1.5 Ma
Fission-track: apatite 41.8 ± 17 Ma

9. *L-73-1* (Leonard and Marvin, 1982) K-Ar
Welded latite tuff, Challis Volcanics (44°59'40"N, 115°29'35"W, SW¼ SW¼ S9,T19N,R8E; summit of Van Meter Hill at elevation 8,119-ft, Yellow Pine 7.5' quad., Valley Co., ID). *Analytical data:* (plagioclase) K_2O = 0.26, 0.26%; $*Ar^{40}$ = 0.1784 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 44%; (sanidine) K_2O = 8.82, 8.87%; $*Ar^{40}$ = 6.551 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 76%. *Collected by:* B. F. Leonard. *Comments:* Sample is from the lowest part of the welded latite tuff; it rests on granodiorite of the Idaho batholith. Welded latite tuff is probably 50–51 Ma old.
plagioclase 47.1 ± 5.6 Ma
sanidine 50.8 ± 1.7 Ma

10. *L-73-19* (Leonard and Marvin, 1982) K-Ar, Fission-track
Elk Creek quartz-diorite porphyry dike (45°07'12"N, 115°29'12"W; talus, 15-m SW of trail ford near elevation 6,200-ft, South Fork of Elk Creek, Profile Gap 7.5' quad., Valley Co., ID). *Analytical data:* (biotite) K_2O = 6.27, 6.24%; $*Ar^{40}$ = 4.296 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 80%; (zircon—7 grains) Ps = 4.69 × 10^6 tracks/cm² (1024), Pi = 6.98 × 10^6 tracks/cm² (762), O = 1.03 × 10^{15} n/cm², U = 278 ppm. *Collected by:* B. F. Leonard. *Comments:* K-Ar and fission-track ages are in sharp disagreement; the cause of this disagreement is not known at this time. Neither age violates the geologic setting.
K-Ar: biotite 47.1 ± 1.6 Ma
Fission-track: zircon 41.3 ± 4.4 Ma

11. *L-73-5* (Leonard and Marvin, 1982) K-Ar
Welded latite tuff, Challis Volcanics (45°11'N, 115°23'W; 0.8 km N45° W of BM6681, Wolf Fang 7.5' quad., Valley Co., ID). *Analytical data:* (plagioclase) K_2O = 0.74, 0.76%; $*Ar^{40}$ = 0.5493 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 41%; (whole-rock—bromoform lights) K_2O = 3.09, 3.11%; $*Ar^{40}$ = 2.093 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 83%. *Collected by:* B. F. Leonard. *Comments:* From the lowest part of the welded latite tuff which rests on Precambrian syenite and quartzite. The tuff is probably 50–51 Ma old. The large analytical uncertainty for the plagioclase age is the results of the low potassium content for the plagioclase. The age given by the bromoform lights (whole-rock) appears to be too young.
plagioclase 50.3 ± 3.1 Ma
whole-rock (bromoform lights) 46.3 ± 1.5 Ma

12. *L-73-22* (Leonard and Marvin, 1982) K-Ar
Granophyritic rhyolite dike, Profile-Smith Creek dike swarm (45°09'05"N, 115°25'25"W; 240-m NW of Elk Summit, Wolf Fang 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 5.97, 6.03%; $*Ar^{40}$ = 3.998 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 64%. *Collected by:* B. F. Leonard. *Comment:* The age given by the phenocrystic sanidine appears reliable and is probably the age of intrusion.
sanidine 45.7 ± 1.6 Ma

13. *L-71-4* (Leonard and Marvin, 1982) K-Ar
Hornblende latite dike, Profile Creek-Smith Creek dike swarm (45°08′30″N, 115°24′W; 107-m E of creek on Elk Summit Road at elevation 7,825-ft, near head of South Fork of Smith Creek, Wolf Fang Peak 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 0.847, 0.847%; $^*Ar^{40}$ = 0.5830 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 77%. *Collected by:* B. F. Leonard. *Comment:* Hornblende age is apparently a primary age.

hornblende 47.3 ± 1.3 Ma

14. *L-71-2* (Leonard and Marvin, 1982) K-Ar
Miarolitic granite, Logan Creek stock (45°06′N, 115°26′W; W of Logan Creek at 7,500–7,650 ft elevation, Profile Gap 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 4.16, 4.19%; $^*Ar^{40}$ = 2.344 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 75%. *Collected by:* B. F. Leonard. *Comments:* The age given by biotite from the coarsely miarolitic, fluorite-bearing granite stock is consistent with the local geology and indicates that episodic intrusive activity has continued for 10 million or more years in this region.

biotite 38.7 ± 1.3 Ma

15. *L-74-14* (Leonard and Marvin, 1982) K-Ar
Rhyolite, The Hogback dike (45°07′24″N, 115°19′15″W; 500-m SE of Big Creek Lodge at S end of The Hogback, elevation 5900 ft.; Edwardsburg 7.5′ quad., Valley Co., ID). *Analytical data*: (biotite) K_2O = 5.28, 5.31%; $^*Ar^{40}$ = 1.585 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 18%; (sanidine) K_2O = 13.48, 13.45%; $^*Ar^{40}$ = 9.084 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 64%. *Collected by:* B. F. Leonard. *Comments*: The Hogback is a prominent rhyolite dike that is very similar petrologically to rhyolite dikes of the Little Pistol and Profile-Smith Creek dike swarms (Leonard and Marvin, 1982, p. 39).

Although both biotite and sanidine phenocrysts are present, and both are unaltered and apparently suitable for K-Ar dating, a valid age for the dike has been elusive. The coexisting biotite and sanidine give K-Ar ages that are in decided disagreement with each other, although neither the biotite or sanidine ages violate geologic constraints. The biotite ages being much younger than the sanidine ages. There is apparently no Precambrian xenocrystic feldspar present that would mix with and thereby increase the age given by the sanidine. There are apparently no other nearby Tertiary intrusives that would possibly cause a thermal degassing of the biotite and thereby decrease the age given by the biotite; such a thermal regime would presumably affect the sanidine in the same manner.

Biotite and sanidine concentrates from two rhyolite samples of The Hogback dike have been analyzed; the dated samples were collected within several meters of each other. The first analyses were done about 20 years ago (see Armstrong, 1975, p. 29, entry #22). Comparison of the analytical data from the first set of minerals with the analytical data from the second set shows significant differences in potassium content. The differences highlight the purity of the mineral concentrates, the second set being much purer.

Usually, the radiometric age increases as the mineral purity increases. In the case of the sanidine concentrates, the potassium content changed from 5.96% K_2O for the first concentrate to 13.465% K_2O for the second concentrate; the calculated age rose from 42 Ma (Armstrong, 1975)—recalculated to 43 Ma—to 46.3 Ma for the second sanidine concentrate. The percentage of radiogenic argon rose slightly.

However, the biotite concentrates depict a different picture. The potassium content increased from 4.02% K_2O for the first biotite concentrate to 5.295% K_2O for the second concentrate. The first biotite concentrate gave two ages, 33 and 28 Ma (calculated with IUGS recommended decay constants), and the percentage of radiogenic argon-40 to total argon-40 was 27 and 26%. The calculated age for the second biotite concentrate is 20.7 Ma, a much younger age than previously determined; the percentage of radiogenic argon decreased to 18%. These trends strongly suggest that the biotite has not been a closed system for the radiogenic argon produced by radioactive decay of potassium-40. The actual cause of the presumed loss of radiogenic argon is not known, but distortion of the biotite crystals by extraneous ions or minute inclusions could achieve the observed results.

Therefore, in view of both the analytical data and the geologic setting, the biotite K-Ar ages appear spurious. The sanidine age of 46.3 Ma is probably a reliable indication of the time of intrusion.

biotite 20.7 ± 0.7 Ma
sanidine 46.3 ± 1.1 Ma

16. *L-73-2* (Leonard and Marvin, 1982) K-Ar
Augite-hornblende latite, Challis Volcanics (45°04′32″N, 115°20′35″W; NW¼ S15, T20N,R29E; knoll 150-m NW of road culvert on Big Creek, Edwardsburg 7.5′ quad., Valley Co., ID). *Analytical data:* (hornblende) K_2O = 0.91, 0.90% $^*Ar^{40}$ = 0.6374 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 74%; (whole-rock—bromoform lights) K_2O = 3.07, 3.08%; $^*Ar^{40}$ = 1.941 × 10^{-10} mol/gm, $^*Ar^{40}$ = 76%. *Collected by:* B. F. Leonard. *Comments:* Thin lava flow near the base of the lower latitic unit. The age given by the "bromoform lights" is too young; the hornblende age appears reliable.

hornblende 48.3 ± 2.8 Ma
whole-rock (bromoform lights) 43.3 ± 1.4 Ma

17. *USGS(D)BB-70-MV* K-Ar
Vein gangue (45°03′48″N, 115°24′36″W; a mercury-bearing antimony deposit, Profile Gap 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 10.00, 9.99%; $^*Ar^{40}$ = 16.65 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 93%. *Submitted by:* B. F. Leonard. *Comment:* The validity of this age is questionable as it is in conflict with the geologic setting.

muscovite 113 ± 4 Ma

18. *USGS(D)L-74-1* K-Ar
Gneissic biotite granodiorite pluton (44°54′36″N, 115°24′15″W; SW¼ S7,T18N,R9E; at 7,800-ft elevation on low ridge W of upper reaches of No Name Creek, Yellow Pine 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 9.02, 9.03%; $^*Ar^{40}$ = 10.01 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 94%. *Collected by:* B. F. Leonard.

biotite 75.4 ± 2.7 Ma

19. *L-75-MCD* (Leonard and Marvin, 1982) K-Ar
Rhyolite (feldspathized), Paint Creek stock (45°04′42″N, 115°05′12″W; at 8,100-ft elevation on divide N of Paint Creek and near peak 8123, Monument 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 7.87, 7.91%; $^*Ar^{40}$ = 5.425 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 75%. *Collected by:* B. F.

Leonard. *Comments:* The Paint Creek stock is a composite body of rhyolite porphyry (or granite porphyry) and quartz latite porphyry. The rhyolite porphyry is unusual in that it consists of fresh biotite, hornblende, quartz, plagioclase, and sanidine phenocrysts in a groundmass of chalcedony and adularia. The calculated 47.1 Ma age is accepted as the age of crystallization.

biotite 47.1 ± 1.6 Ma

20. *L-74-5* (Leonard and Marvin, 1982) K-Ar
Youngest latite flow of Lookout Mountain, Challis Volcanics (45°01′54″N, 15°04′18″W; 180-m SSW of Lookout Mountain fire-lookout, Monument 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 2.99, 3.02%; $*Ar^{40}$ = 1.895 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 90%. *Collected by:* B. F. Leonard. *Comments:* Very fresh, young-looking latite flows, interbedded with explosive rubble, originated at a minor volcanic center at Lookout Mountain. The latite flows are black, aphanitic, with a glass or devitrified glass content ranging from 3–63%. This sample has a 3% glass content and gave a whole-rock age of 43.4 Ma, a minimum age. Other latite samples from this volcanic center gave ages ranging from 17 to 40 Ma. The age range seems dependent on the relative size of the glass grains within a dated sample (Leonard and Marvin, 1982, p. 30, 33–34).

whole-rock 43.4 ± 1.4 Ma

21. *L-74-6* (Leonard and Marvin, 1982) K-Ar
Oldest latite flow of Lookout Mountain, Challis Volcanics (45°01′18″N, 115°04′00″W; SSW of Lookout Mountain summit, Monument 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 3.05, 3.04%; $*Ar^{40}$ = 1.819 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 94%. *Collected by:* B. F. Leonard. *Comments:* This sample has a glass content of 3% and gave a whole-rock age of 41.0 Ma. Since the youngest flow has an age of at least 43 Ma, the whole-rock age for this sample is somewhat young. Other latite samples from this volcanic center gave ages ranging from 17 to 43 Ma. The age range seems dependent on the relative size of the glass grains within a dated sample (Leonard and Marvin, 1982, p. 30, 33–34).

whole-rock 41.0 ± 1.4 Ma

22. *L-74-12* (Leonard and Marvin, 1982) K-Ar
Youngest latite flow of Lookout Mountain, Challis Volcanics (44°59′29″N, 115°07′35″W; NE spur of Land Monument Mesa at 7,830-ft elevation, Thunder Mountain district, Rainbow Peak 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 3.38, 3.38%; $*Ar^{40}$ = 0.8305 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 90%. *Collected by:* B. F. Leonard. *Comments:* This sample has a glass content of about 34% and gave an age of 17.0 Ma, a spurious age. Other samples from this flow gave ages ranging from 28 to 43 Ma; the latter is a minimum age of the flow. The age range seems dependent on the relative size of the glass grains within a dated sample (Leonard and Marvin, 1982, p. 30, 33–34).

whole-rock 17.0 ± 0.6 Ma

23. *L-74-13* (Leonard and Marvin, 1982) K-Ar
Youngest latite flow of Lookout Mountain, Challis Volcanics (44°58′43″N, 115°08′30″W; 53-m NE of Land Monument No. 5A on W edge of Land Monument Mesa, Thunder Mountain district, Rainbow Peak 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 3.46, 3.45%; $*Ar^{40}$ = 2.376 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 90%. *Collected by:* B. F. Leonard. *Comments:* This sample has a glass content of about 56% and gave an age of 27.5 Ma, a spurious age. Other samples from this flow gave ages ranging from 17 to 43 Ma; the latter is a minimum age for the flow. The age range seems dependent on the relative size of the glass grains within a dated sample (Leonard and Marvin, 1982, p. 30, 33–34).

whole-rock 27.5 ± 0.9 Ma

24. *L-74-7* K-Ar, Fission-track
(Leonard and Marvin, 1982)
Welded rhyolite tuff, "Sunnyside rhyolite", Challis Volcanics (44°58′54″N, 115°05′00″W; on Lookout Mountain Ridge about 0.5-km SW of junction of Lookout Mountain and Holly Terror Creek Trails, Safety Creek 7.5′ quad., Valley Co., ID). *Analytical data:* (sanidine) K_2O = 10.30, 10.30%, $*Ar^{40}$ = 6.959 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 79%; (biotite) K_2O = 6.29, 6.28%; $*Ar^{40}$ = 4.370 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 76%; (zircon—6 grains) Ps = 4.18 × 10^6 tracks/cm² (832), Pi = 6.34 × 10^6 tracks/cm² (630), 0 = 1.03 × 10^{15} n/cm², U = 253 ppm. *Collected by:* B. F. Leonard. *Comments:* The sample is from the welded interior of an ash-flow unit containing unaltered phenocrysts of biotite, hornblende, quartz, sanidine, and plagioclase. The "Sunnyside rhyolite" is probably 46–47 Ma old. The zircon age is apparently too young.

K-Ar: sanidine 46.3 ± 1.1 Ma
biotite 47.7 ± 1.6 Ma
Fission-track: zircon 40.6 ± 4.6 Ma

25. *L-74-8* (Leonard and Marvin, 1982) K-Ar
Youngest latite flow of Lookout Mountain, Challis Volcanics (44°57′23″N, 115°04′45″W; 150-m E of Black Pole on E side of Marble Creek, Thunder Mountain mining district, Safety Creek 7.5′ quad., Valley Co., ID). *Analytical data:* K_2O = 2.43, 2.54, 2.55, 2.48%; $*Ar^{40}$ = 1.464 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 86%. *Collected by:* B. F. Leonard. *Comments:* This sample has a glass content of about 3% and gave an age of 40.3 Ma. Other samples from this flow gave ages ranging from 17 to 43 Ma; the latter is a minimum age for the flow. The age range seems dependent on the relative size of the glass grains within a dated sample (Leonard and Marvin, 1982, p. 30, 33–34).

whole-rock 40.3 ± 1.8 Ma

26. *TM-71-2* (Leonard and Marvin, 1982) K-Ar
Nonwelded rhyolite tuff, "Sunnyside rhyolite", Challis Volcanics (44°52′N, 115°02′W; about 300-m SE of ruins of Belleco Mill, E side of Marble Creek, Thunder Mountain mining district, Safety Creek 7.5′ quad., Valley Co, ID). *Analytical data:* K_2O = 13.56, 13.50, 13.53%; $*Ar^{40}$ = 9.125 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 94%. *Collected by:* B. F. Leonard. *Comments:* The sample is from near the top of the ash-flow unit. The "Sunnyside rhyolite" is probably 46–47 Ma old.

sanidine 46.3 ± 1.0 Ma

27. *L-74-11* (Leonard and Marvin, 1982) K-Ar
Rhyolite, Century Creek stock (44°55′59″N, 115°12′01″W; spur at elevation 6,660-ft near Thunder Mountain, Rainbow Peak 7.5′ quad., Valley

Co., ID). *Analytical data:* K_2O = 8.34, 8.37%; $*Ar^{40}$ = 5.436 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 91%. *Collected by:* B. F. Leonard. *Comments:* The dated rock is a dark green, fresh, ferrohedenbergite rhyolite porphyry. The age given by the sanidine is consistent with the geologic setting.

sanidine 44.6 ± 1.5 Ma

28. *USGS(D)L-74-15* K-Ar
Granodiorite (44°52'42"N, 115°15'37"W; Stibnite 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 5.58, 5.53%; $*Ar^{40}$ = 5.832 × 10^{10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 89%. *Collected by:* B. F. Leonard. *Comment:* A porphyritic biotite granodiorite from the Idaho batholith.

biotite 71.5 ± 2.6 Ma

29. *L-73-8* (Leonard and Marvin, 1982) K-Ar
Miarolitic rhyolite (44°50'36"N, 115°15'18"W; E side of mouth of Little Indian Creek, Big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 4.96, 4.95%; $*Ar^{40}$ = 2.912 and 2.824 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 86, 85%. *Collected by:* B. F. Leonard. *Comments:* The slightly miarolitic rhyolite contains sparse phenocrysts of biotite, quartz, sanidine, and plagioclase; the biotite and sanidine could not be adequately prepared for K-Ar analysis so the groundmass, mainly very fine-grained alkali feldspar and quartz, was dated. The calculated age is a minimum age. The rhyolite forms a stock, one of several stocks present in the middle Indian Creek area; this stock intrudes the upper rhyolitic tuff unit of the Challis Volcanics.

whole-rock groundmass 39.8 ± 0.9 Ma

30. *L-73-9* (Leonard and Marvin, 1982) K-Ar
Rhyolite (44°50'18"N, 115°14'30"W; below trail in Indian Creek, Big Baldy 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 15.42, 15.43%; $*Ar^{40}$ = 9.235 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 73%. *Collected by:* B. F. Leonard. *Comments:* The rhyolite is composed of phenocrysts of biotite, quartz, K-feldspar, and plagioclase in a very fine-grained groundmass; the K-feldspar is slightly turbid and faintly mottled. The calculated age probably represents the time of crystallization. The rhyolite forms one of the stocks outcropping in the middle Indian Creek area.

(K-feldspar) 41.1 ± 0.9 Ma

31. *L-73-12* (Leonard and Marvin, 1982) K-Ar
Miarolitic granite porphyry (44°48'30"N, 115°19'30"W; S14,T17N,R9E; on Indian Creek at 6,750-ft elevation, big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 9.40, 9.42%; $*Ar^{40}$ = 6.443 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 82%. *Collected by:* B. F. Leonard. *Comments:* The granite porphyry consists of small miarolites, sparse phenocrysts of quartz and feldspar, and patches of micropegmatite in a nearly equigranular matrix composed of quartz and feldspar. The granite forms a stock, one of several stocks on upper Indian Creek. Calculated ages of samples from these stocks range from 44.4 to 46.9 Ma.

sanidine 46.9 ± 1.6 Ma

32. *L-73-11* (Leonard and Marvin, 1982) K-Ar
Quartz diorite (44°48'24"N, 115°19'30"W; S14,T17N,R9E; talus on N side of Indian Creek at 6,700-ft elevation, Big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 0.93, 0.94%; $*Ar^{40}$ = 0.6036 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 65%. *Collected by:* B. F. Leonard. *Comments:* Hornblende-pyroxene quartz-diorite porphyry or granodiorite porphyry from a stock, one of several on upper Indian Creek. Calculated ages of samples from these stocks range from 44.4 to 46.9 Ma.

hornblende 44.4 ± 1.8 Ma

33. *L-72-2* (Leonard and Marvin, 1982) K-Ar
Slightly amygdaloidal latite, Challis Volcanics (44°48'N, 115°20'W; N½ S23,T17N,R9E; Big Baldy Ridge, Big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* (hornblende) K_2O = 0.15, 0.13%; $*Ar^{40}$ = 0.1485 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 34%; (plagioclase) K_2O = 0.43, 0.43%; $*Ar^{40}$ = 0.2718 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 47%. *Collected by:* B. F. Leonard. *Comments:* Latite flow is near the base of the unit. Green hornblende is a pseudomorph after orthopyroxene and the age it gave is spurious. The age given by the plagioclase is a minimum age for the latite flow, but, in relation to other ages of this unit, this age appears to be too young. The latite may be 50–51 Ma old (Leonard and Marvin, 1982).

hornblende 72.4 ± 12.8 Ma
plagioclase 43.5 ± 3.0 Ma

34. *L-72-1* (Leonard and Marvin, 1982) K-Ar
Rhyolite dike in the Little Pistol dike swarm (44°48'N, 115°18'W; Big Baldy Ridge, Big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 9.50, 9.47%; $*Ar^{40}$ = 6.236 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 80%. *Collected by:* B. F. Leonard. *Comments:* The dike swarm consists of rhyolite and latite dikes. Samples from three different dikes gave ages ranging from 36.7 to 45.2 Ma, suggesting an intrusive igneous interval of 7-8 million years.

sanidine 45.2 ± 1.5 Ma

35. *L-73-15* (Leonard and Marvin, 1982) K-Ar
Rhyolite dike in the Little Pistol dike swarm (44°46'24"N, 115°17'42"W; 75-m E of crest of Stevens Creek-Savage Creek divide at 7,500-ft elevation, Big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 6.56, 6.56%; $*Ar^{40}$ ⁵4.047 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 71%. *Collected by:* B. F. Leonard. *Comments:* The dike swarm consists of rhyolite and latite dikes. Samples from three different dikes gave ages ranging from 36.7 to 45.2 Ma, suggesting an intrusive igneous interval of 7–8 millions years.

sanidine 42.4 ± 1.5 Ma

36. *L-73-18* (Leonard and Marvin, 1982) K-Ar
Hornblende latite dike in the Little Pistol dike swarm (44°45'36"N, 115°18'30"W; SE¼ S36,T17N,R9E; 0.8 km SE of mouth of Winchester Creek at 6,500-ft elevation, Big Chief Creek 7.5' quad., Valley Co., ID). *Analytical data:* K_2O = 0.79, 0.78%; $*Ar^{40}$ = 0.4287 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 55%. *Collected by:* B. F. Leonard. *Comments:* The dike swarm consists of rhyolite and latite dikes. Samples from three different dikes gave ages ranging from 36.7 to 45.2 Ma, suggesting an intrusive igneous interval of 7–8 million years.

hornblende 36.7 ± 2.5 Ma

37. *FWC-6-67* (Leonard and Marvin, 1982) K-Ar
Granite core, Casto pluton (44°55′15″N, 114°43′42″W; outcrop on Middle Fork of Salmon River, S of Aparejo Creek, Aparejo Point 7.5′ quad., Lemhi Co., ID). *Analytical data:* K_2O = 6.12, 6.12, 6.00, 6.07, 5.91%; $*Ar^{40}$ = 4.208 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 78%. *Collected by:* E. W. Cater. *Comments:* Calculated age probably represents the time of crystallization, but there are a number of complications as explained by Leonard and Marvin (1982). A younger K-Ar age of 43.8 Ma was obtained by Armstrong (1974, p. 13) for this same granite sample.

biotite 47.8 ± 1.9 Ma

38. *L-7-1* (Leonard and Marvin, 1982) K-Ar
Microlitic granite, roof facies of Casto pluton (44°52′30″N, 114°33′45″W; talus on N side of Camas Creek at 430-m upstream from Anvil Creek, Yellowjack 7.5′ quad., Lemhi Co., ID). *Analytical data:* K_2O = 1.74, 1.88, 1.93, 1.95%; $*Ar^{40}$ = 1.133 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 71%. *Collected by:* B. F. Leonard. *Comments:* The material analyzed consisted of septechlorite, biotite, and chlorite, in roughly the proportions 75:20:5. This mixed composition was not recognized until after the analysis. As a result, the validity of this age is under question. It appears that the age is too young when compared to the other ages obtained for the Casto pluton, but a firm age for the Casto pluton has not been established (Leonard and Marvin, 1982).

septechlorite + biotite 41.6 ± 1.8 Ma

39. *38S83* (Skipp, 1984) K-Ar
Rhyodacite tuff (44°28′N, 112°47′W; S10(?),T13N,R31E; Italian Peak Wilderness area, Beaverhead Mountains, Scott Peak 15′ quad., Clark Co., ID). *Analytical data:* K_2O = 6.637% (isotope dilution, K. Futa, analyst, USGS), $*Ar^{40}$ = 4.550 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 65%. *Collected by:* Betty Skipp. *Comments:* This rhyodacite tuff is one of the units of the Challis Volcanics in SE Idaho. Scholten and others (1955) had originally named these volcanics, the Medicine Lodge Volcanics.

biotite 47.0 ± 1.3 Ma

40. *25S74* (Skipp, 1984) K-Ar
Meladiorite pluton (44°15′45″N, 112°38′30″W; SW¼SE¼ S24,T11N,R32E; E side of a road cut in Beaverhead Mountains, Edie Ranch 15′ quad., Clark Co., ID). *Analytical data:* (biotite) K_2O = 5.14, 5.17%; $*Ar^{40}$ = 40.96 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 97%; (hornblende) K_2O = 1.35, 1.36%; $*Ar^{40}$ = 10.41 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 96%. *Collected by:* Betty Skipp. *Comments:* This pluton of coarse-grained plagioclase-hornblende meladiorite formed at the same time as the Beaverhead Mountains pluton (Middle Ordovician), formerly the Beaverhead pluton of Scholten and Ramspott (1968).

biotite 482 ± 16 Ma
hornblende 467 ± 16 Ma

41. *USGS(D)SRP-84-194(5,6)* K-Ar
Ignimbrite (43°50′N, 112°51′W; S34,T6N,R30E; Big Lost River Sinks 7.5′ quad., Butte Co., ID). *Analytical data:* K_2O = 5.06, 5.04%; $*Ar^{40}$ = 0.4359 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 48%. *Collected by:* Lisa Morgan. *Comments:* A densely-welded, crystal-poor, vapor-phase, platy ignimbrite (high-silica rhyolite)—the tuff of Blue Creek.

whole-rock 6.0 ± 0.2 Ma

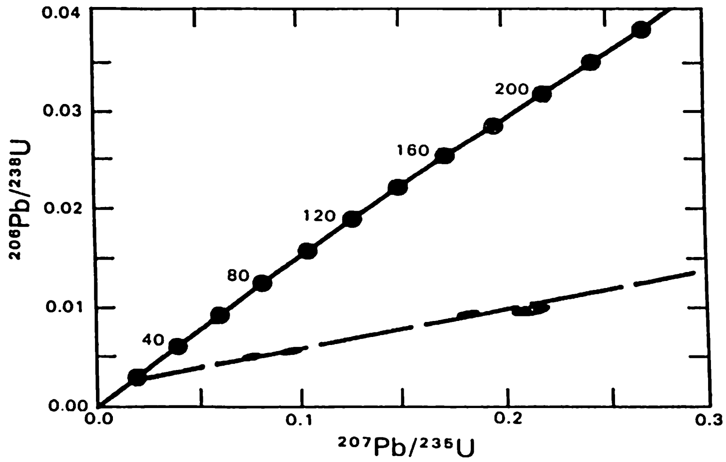

FIGURE 1. Concordia intercept plot obtained for zircons separated from sample 42. Lower concordia intercept is 19 Ma; upper concordia intercept of 2710 Ma is not shown.

42. *USGS(D)INEL-1 (3,140 m)* U-Th-Pb
Latite tuff (43°37′N, 112°53′W; Idaho National Engineering Laboratory exploratory geothermal test well, INEL-1, at 3,140 m depth, Butte Co., ID). An intracauldra, latite tuff that is tentatively correlated with the tuff of the Lost Sinks. *Analytical data:* Zircon (−100+150 mesh): U = 217.0 ppm, Th = 139.7 ppm, Pb = 2.542 ppm; isotopic composition of lead (atomic percent); ^{204}Pb = 0.1646, ^{206}Pb = 72.49, ^{207}Pb = 12.27, ^{208}Pb = 15.08. Zircon (−50+200 mesh): U = 202.9 ppm, Th = 155.6 ppm, Pb = 1.278 ppm; isotopic composition of lead (atomic percent): ^{204}Pb = 0.1290, ^{206}Pb = 74.58, ^{207}Pb = 9.606, ^{208}Pb = 15.68. Zircon (−200+400 mesh): U = 220.7 ppm, Th = 176.0 ppm, Pb = 1.513 ppm; isotopic composition of lead (atomic percent): ^{240}Pb = 0.0902, ^{206}Pb = 75.71, ^{207}Pb = 10.16, ^{208}Pb = 14.04. Zircon (−400 mesh): U = 266.7 ppm, Th = 224.8 ppm, Pb = 3.686; isotopic composition of lead (atomic percent): ^{204}Pb = 0.1012, ^{206}Pb = 74.48, ^{207}Pb = 13.06, ^{208}Pb = 12.36. Isotopic composition of common lead assumed to be ^{204}Pb:^{206}Pb:^{207}Pb:^{208}Pb = 1:18.69:15.63:38.61. *Collected by:* L. A. McBroome. *Comment:* Major phenocrystic components are feldspar and mafic minerals (all totally altered) with subordinate quartz; unit exhibits extensive propylitic alteration. Lower concordia intercept age of 19 ± 6 Ma (fig. 1) records approximate time of extrusion of latite tuff; upper concordia intercept age of 2710 ± 280 Ma interpreted to reflect a component of inherited Archean zircon derived from the underlying basement rocks. When geological uncertainties are considered in addition to the isotopic complexities of this sample, its implied early to middle Miocene age remain in some question.

zircon (−100+150 mesh) $^{206}Pb/^{238}U$ = 60.6 ± 0.6 Ma
$^{207}Pb/^{235}U$ = 170 ± 2 Ma
$^{207}Pb/^{206}Pb$ = 2224 ± 24 Ma
$^{208}Pb/^{232}Th$ = 36.1 ± 0.3 Ma
zircon (−150+200 mesh) $^{206}Pb/^{238}U$ = 34.0 ± 0.3 Ma
$^{207}Pb/^{235}U$ = 74.9 ± 0.7 Ma
$^{207}Pb/^{206}Pb$ = 1717 ± 18 Ma

$^{208}Pb/^{232}Th = 20.0 \pm 0.2$ Ma
zircon ($-200+400$ mesh) $^{206}Pb/^{238}U = 37.9 \pm 0.3$ Ma
$^{207}Pb/^{235}U = 93.2 \pm 0.9$ Ma
$^{207}Pb/^{206}Pb = 1929 \pm 20$ Ma
$^{208}/Pb/^{232}Th = 20.6 \pm 0.2$ Ma
zircon ($-$ 400 mesh) $^{206}Pb/^{238}U = 74.7 \pm 0.7$ Ma
$^{207}Pb/^{235}U = 230 \pm 3$ Ma
$^{207}Pb/^{206}Pb = 2436 \pm 26$ Ma
$^{208}Pb/^{232}Th = 31.5 \pm 0.3$ Ma

43. *USGS(D)220S79* K-Ar
Andesite (43°39′N, 113°33′W; NE¼NW¼ S25,T4N,R24E; Grouse 15′ quad., Butte Co., ID). *Analytical data:* K_2O = 0.86, 0.86%; $^*Ar^{40}$ = 0.5548 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 66%. *Collected by:* Betty Skipp.

hornblende 44.3 ± 2.7 Ma

44. *USGS(D)5S82* K-Ar
Vitrophyre (43°36′30″N, 113°33′45″W; NE¼NE¼ S11,T3N,R24E; Grouse 15′ quad., Butte Co., ID). *Analytical data:* K_2O = 5.60, 5.31%; $^*Ar^{40}$ = 3.792 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 81%. *Collected by:* Betty Skipp. *Comments:* Porphyritic pumiceous vitrophyre (dacite) of the Challis Volcanics consists of phenocrysts (20%) in a densely welded matrix.

biotite 47.6 ± 2.1 Ma

45. *USGS(D)17S-71* K-Ar
Basal breccia unit, Challis Volcanics (43°40′50″N, 113°41′50″W; NE¼ S15,T4N,R23E; Bear Creek Valley, Grouse 15′ quad., Custer Co., ID). *Analytical data:* K_2O = 0.794%, $^*Ar^{40}$ = 0.5706 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 88%. *Collected by:* Betty Skipp.

hornblende 49.3 ± 0.7 Ma

46. *USGS(D)O724* (Dover, 1981) K-Ar
Pyroxene-biotite quartz monzonite, Muldoon Creek stock (43°37′08″N, 113°53′13″W; W of Muldoon Creek in central Pioneer Mountains, Muldoon Canyon 15′ quad., Blaine Co., ID). *Analytical data:* K_2O = 8.84, 8.86%; $^*Ar^{40}$ = 6.223 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 81%. *Collected by:* J. H. Dover. *Comments:* The published age of 47.0 Ma for the Muldoon Creek stock has been recalculated with revised potassium-40 decay constants (Steiger and Jager, 1977).

biotite 48.2 ± 1.2 Ma

47. *USGS(D)4356* (Dover, 1981) K-Ar
Leucocratic hornblende-biotite quartz monzonite, Pioneer Mountain pluton (43°47′35″N, 114°03′40″W; Pioneer Mountains, Standhope Peak 7.5′ quad., Custer Co., ID). *Analytical data:* (biotite) K_2O = 9.08, 9.05%; $^*Ar^{40}$ = 5.434 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 82%; (hornblende) K_2O = 1.16, 1.15%; $^*Ar^{40}$ = 0.9087 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 83%. *Collected by:* J. H. Dover. *Comments:* The published biotite and hornblende ages of 40.2 and 52.6 Ma, respectively, have been recalculated with revised potassium-40 decay constants (Steiger and Jager, 1977). However, the actual intrusive age of this pluton is thought to be 48–49 Ma (entry 53).

biotite 41.2 ± 1.0 Ma
hornblende 53.8 ± 1.3 Ma

48. *USGS(D)4309* (Dover, 1981, 1983) K-Ar
Strongly-foliated, coarse- to even-grained, pyroxene-hornblende-biotite granodiorite, border phase of the Pioneer Mountain pluton (43°45′35″N, 114°07′35″W; cirque at head of Wildhorse Creek, central Pioneer Mountains, Phi Kappa Mountain 7.5′ quad., Custer Co., ID). *Analytical data:* K_2O = 1.09, 1.10, 1.09, 1.12%; $^*Ar^{40}$ = 1.085 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 88%. *Collected by:* J. H. Dover. *Comments:* Dover (1981) listed the hornblende age as 65.6 Ma; this age was revised to 67.6 Ma (Dover, 1983). The correct age—recalculated with revised potassium-40 decay constants (Steiger and Jager, 1977)—is listed below. The intrusive age of the main phase of Pioneer Mountain pluton is 48–49 Ma (entry 53).

hornblende 67.2 ± 2.4 Ma

49. *USGS(D)5212* (Dover, 1981, 1983) K-Ar
Hornblende-quartz porphyry dike complex of North Fork Lake (43°53′35″N, 114°22′30″W; Boulder Mountains, Meridian Peak 7.5′ quad., Custer Co., ID). *Analytical data:* K_2O = 0.80, 0.79%; $^*Ar^{40}$ = 0.5664 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 72%. *Collected by:* J. H. Dover. *Comment:* Published age of 47.2 Ma has been recalculated with revised potassium-40 decay constants (Steiger and Jager, 1977).

hornblende 48.8 ± 1.8 Ma

50. *USGS(D)RDS-13* K-Ar, Rb-Sr
Quartz monzonite, Summit Creek stock (43°51′08″N, 114°13′48″W; 3 miles NE of Trail Creek Summit on N side of Summit Creek, Phi Kappa Mountain 7.5′ quad., Custer Co., ID). *Analytical data:* (hornblende) K_2O = 0.636, 0.622% (isotope dilution); $^*Ar^{40}$ = 0.4448 × 10^{-10} mol/gm; $^*Ar^{40}/\Sigma Ar^{40}$ = 51%; (whole-rock) Rb = 170.6 ppm, Sr = 328.7 ppm, $^{87}/Rb/^{86}Sr$ = 1.50, $^{87}Sr/^{86}Sr$ = 0.7123; (plagioclase) Rb = 22.4 ppm, Sr = 516.1 ppm, $^{87}Sr/^{86}Sr$ = 0.126, $^{87}Sr/^{86}Sr$ = 0.7123; (microcline) Rb = 340.7 ppm, Sr = 316.1 ppm, $^{87}Rb/^{86}Sr$ = 3.12, $^{87}Sr/^{86}Sr$ = 0.7141; (biotite) Rb = 656.9 ppm, Sr = 20.9 ppm, $^{87}Rb/^{86}Sr$ = 91.6, $^{87}Sr/^{86}Sr$ = 0.7754. Calculated initial $^{87}Sr/^{86}Sr$ = 0.7122 ± 0.0002 based on four-point isochron. *Collected by:* J. H. Dover. *Comment:* Medium-grained, unfoliated quartz monzonite of post-orogenic Summit Creek stock. Dover (1981) lists the K-Ar hornblende age as 47.3 Ma; this age has been recalculated with revised potassium-40 decay constants (Steiger and Jager, 1977). The Rb-Sr whole rock-plagioclase-microcline-biotite isochron age of 48.5 ± 3.8 Ma (fig. 2) records time of intrusion of Summit Creek stock. Within limits of analytical uncertainty, it is not possible to distinguish between the age of the post-orogenic Summit Creek stock and the synorogenic Pioneer Mountain pluton represented by sample RDS-9 (entry 53).

K-Ar: hornblende 48.5 ± 2.0 Ma
Rb-Sr: whole-rock-plagioclase-microcline-biotite isochron 48.5 ± 3.8 Ma

51. *USGS(D)5088* Rb-Sr
Paragneiss (43°44′55″N, 114°05′45″W; upper reaches of Wildhorse Creek, Grays Peak 7.5′ quad., Custer Co., ID). *Analytical data:* (whole-rock) Rb = 86.9 ppm, Sr = 49.7 ppm, $^{87}Rb/^{86}Sr$ = 5.106,

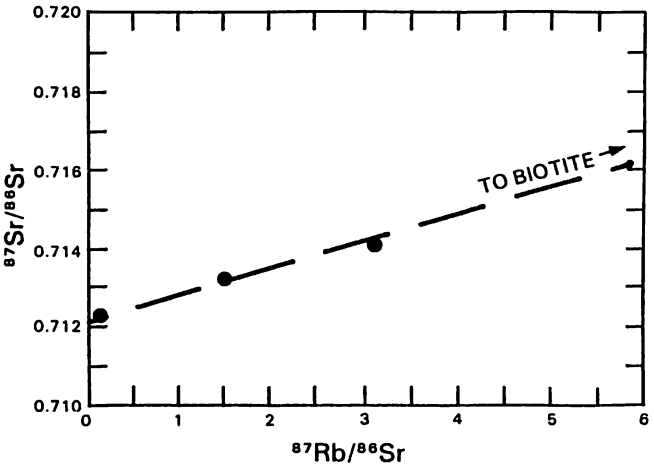

FIGURE 2. A four point Rb-Sr isochron plot for the minerals and whole-rock of sample 50.

^{87}Sr/^{86}Sr = 0.8089. Initial ^{87}Sr/^{86}Sr assumed to be 0.703. *Collected by:* J. H. Dover. *Comment:* Paragneiss unit from the Wildhorse Canyon migmatitic gneiss dome. Significance of Rb-Sr whole-rock model age uncertain, but it clearly identifies paragneiss as Precambrian.

whole-rock 1480 ± 30 Ma

52\. *USGS(D)5080* Rb-Sr

Orthogneiss (43 °47′05″N, 114 °08′20″W; upper reaches of Kane Creek, Phi Kappa Mountain 7.5′ quad., Custer Co., ID). *Analytical data:* (whole-rock) Rb = 124.4 ppm, Sr = 395.9 ppm, ^{87}Rb/^{86}Sr = 0.9102, ^{87}Sr/^{86}Sr = 0.7195. Initial ^{87}Sr/^{87}Sr assumed to be 0.703. *Collected by:* J. H. Dover. *Comments:* Orthogneiss(?) unit from the Wildhorse Canyon migmatitic gneiss dome. Significance of Rb-Sr Whole-rock model age uncertain, but it clearly identifies orthogneiss as Precambrian.

whole-rock 1290 ± 90 Ma

53\. *USGS(D)RDS-9* U-Th-Pb

Quartz monzonite, Pioneer Mountain pluton (43 °49′05″N, 114 °05′40″W; Wildhorse Canyon, Standhope Peak 7.5′ quad., Custer Co., ID). *Analytical data:* Zircon (−100+150 mesh); U = 1212 ppm, Th = 650 ppm, Pb = 10.17 ppm; isotopic composition of lead (atomic percent): ^{204}Pb = 0.0479, ^{206}Pb = 79.21, ^{207}Pb = 5.017, ^{208}Pb = 15.73. Zircon (−150+200 mesh); U = 1238 ppm, Th = 728 ppm, Pb = 10.33 ppm; isotopic composition of lead (atomic percent): ^{204}Pb = 0.0341, ^{206}Pb = 78.96, ^{207}Pb = 4.441, ^{208}Pb = 16.57. Zircon (−200+270 mesh): U = 1408 ppm, Th = 906 ppm, Pb = 11.71 ppm; isotopic composition of lead (atomic percent): ^{204}Pb = 0.0234, ^{206}Pb = 78.32, ^{207}Pb = 4.143, ^{208}Pb = 17.52. Zircon (−325+400 mesh): U = 1504 ppm, Th = 1018 ppm, Pb = 12.50 ppm; isotopic composition of lead (atomic percent): ^{204}Pb = 0.0183, ^{206}Pb = 77.98, ^{207}Pb = 3.998, ^{208}Pb = 18.00. Isotopic composition of common lead assumed to be ^{204}Pb:^{206}Pb:^{207}Pb:^{208}Pb = 1:18.8:15.7:38.7. *Collected by:* J. H. Dover. *Comments:* Coarse-grained, moderately-foliated quartz monzonite with megacrysts of perthitic microcline; main phase of synorogenic Pioneer Mountain pluton near contact with Wildhorse Canyon migmatitic gneiss dome. Lower concordia intercept age of 48.3 ± 0.6 Ma (fig. 3) records time of intrusion of Pioneer Mountain pluton; upper concordia intercept age is poorly defined, but is interpreted to reflect a component of inherited Archean zircon derived from the underlying basement rock.

zircon (−100+150 mesh) ^{206}Pb/^{238}U = 49.0 ± 0.4 Ma
^{207}Pb/^{235}U = 56.6 ± 0.5 Ma
^{207}Pb/^{206}Pb = 390 ± 4 Ma
^{208}Pb/^{232}Th = 49.3 ± 0.4 Ma
zircon (−150+200 mesh) ^{206}Pb/^{238}U = 48.8 ± 0.4 Ma
^{207}Pb/^{235}U = 51.7 ± 0.5 Ma
^{207}Pb/^{206}Pb = 189 ± 2 Ma
^{208}Pb/^{232}Th = 49.1 ± 0.4 Ma
zircon (−200+270 mesh) ^{206}Pb/^{238}U = 48.3 ± 0.4 Ma
^{207}Pb/^{235}U = 49.8 ± 0.5 Ma
^{207}Pb/^{206}Pb = 123 ± 2 Ma
^{208}Pb/^{232}Pb = 48.8 ± 0.4 Ma
zircon (−325+400 mesh) ^{206}Pb/^{238}U = 48.1 ± 0.4 Ma
^{207}Pb/^{235}U = 49.0 ± 0.5 Ma
^{207}Pb/^{206}Pb = 89 ± 1 Ma
^{208}Pb/^{232}Th = 48.2 ± 0.4 Ma

53–58 *USGS(D)RDS-9,-11,-15,-18A,-18B,-19* Rb-Sr

Quartz monzonite, Pioneer Mountain pluton (RSD-9, 43 °49′05″N, 114 °05′40″W; Wildhorse Canyon, Standhope Peak 7.5′ quad., Custer Co.); granodiorite (RSD-11, 43 °46′10″N, 113 °59′55″W; Broad Canyon, Copper Basin 15′ quad., Custer Co.); granodiorite (RSD-15, 43 °43′35″N, 114 °04′40″W; head of East Fork, Big Wood River, Grays Peak 7.5′ quad., Blaine Co.); aplite (RSD-18A, RSD-18B, 43 °47′00″N, 114 °08′55″W; Kane Creek cirque, Phi Kappa Mountain 7.5′ quad., Custer Co.); and aplite (RSD-19, 43 °46′50″N, 114 °08′45″W; Kane Creek cirque, Phi Kappa Mountain 7.5′ quad., Custer Co.). *Analytical data:*

Sample	Rb,ppm	Sr,ppm	^{87}Rb/^{86}Sr	^{87}Sr/^{86}Sr	(^{87}Sr/^{86}Sr)$_i$
RDS-9	117.2	504.7	0.672	0.7110	0.7106
RDS-11	98.8	870.6	.329	.7093	.7091
RDS-15	166.0	458.7	1.05	.7102	.7096
RDS-18A	137.1	164.1	2.42	.7135	.7120
RDS-18B	250.6	151.8	4.78	.7157	.7129
RDS-19	190.8	176.5	3.13	.7145	.7126

Initial (^{87}Sr/^{86}Sr)$_i$ calculated for an age of 48 Ma.

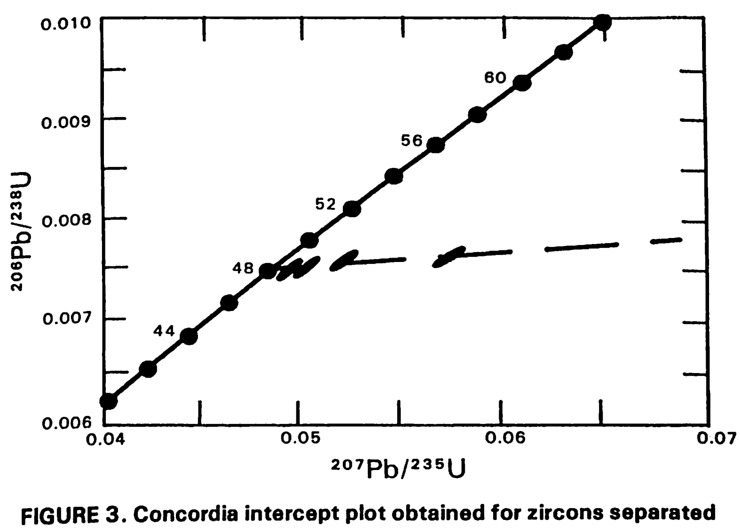

FIGURE 3. Concordia intercept plot obtained for zircons separated from sample 53.

Collected by: J. H. Dover. *Comments:* Fine- to coarse-grained samples from well-foliated to massive outcrops of the synorogenic Pioneer Mountain pluton. Samples originally collected in hopes of obtaining a Rb-Sr whole-rock isochron age for the Pioneer Mountain pluton. However, that object was thwarted by the highly variable $(^{87}Sr/^{86}Sr)_i$ ratios found throughout the intrusion.

59. *USGS(D)T80D-1* K-Ar
Altered granite (43°34′55″N, 114°40′39″W; S21,T3N,R15E; big bulldozer cut at Strout prospect, Dollarhide Mountain 7.5′ quad., Camas Co., ID). *Analytical data:* K_2O = 9.93, 9.86%; $^*Ar^{40}$ = 11.27 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 92%. *Collected by:* C. M. Tschanz. *Comment:* Altered granite in the intrusive complex of Shaw Mountain.
muscovite 77.4 ± 2.6 Ma

60. *USGS(D)OM-26* K-Ar
Basalt (43°17′N, 116°37′W; NE¼ S6,T2S,R2W; Walters Butte 7.5′ quad., Owyhee Co., ID). *Analytical data:* K_2O = 0.07, 0.08, 0.12, 0.14%; $^*Ar^{40}$ = 0.0779 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 28%. *Comments:* Basalt in a pillow breccia. Age is spurious (too old), probably due to excess radiogenic argon.
plagioclase 53.3 ± 10.7 Ma

61. *USGS(D)OM-57* (Ekren and others, 1981) K-Ar
Andesite (43°17′05″N, 116°49′43″W; NE¼ S5,T2S,R4W; on Salmon Creek, Sands Basin 15′ quad., Owyhee Co., ID). *Analytical data:* K_2O = 1.72, 1.70%; $^*Ar^{40}$ = 0.7591 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 85%. *Comments:* Trachytic andesite with microphenocrysts of clinopyroxene and olivine pseudomorphs in a fine-grained holocrystalline matrix of plagioclase, clinopyroxene, and opaques. Andesite is part of the Salmon Creek Volcanics of McIntyre (1972). Age is probably a minimum age for the andesite.
whole-rock 30.6 ± 1.0 Ma

62. *USGS(D)OM-60* K-Ar
Basalt (43°04′04″N, 116°45′03″W; NE¼ S24,T4S,R4W; blasted exposure, Rooster Comb Peak 15′ quad., Owyhee Co., ID). *Analytical data:* K_2O = 1.37, 1.39%; $^*Ar^{40}$ = 0.1883 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 58%. *Comments:* A very fine-grained, intersertal, non-porphyritic basalt composed of plagioclase, clinopyroxene, opaques, and minor interstitial brown glass. Basalt is part of the Toll Gate Basalt (McIntyre, 1972). Calculated age is a minimum age for the basalt.
whole-rock 9.4 ± 0.3 Ma

63. *USGS(D)R79-5A* K-Ar
Basalt (42°32′16″N, 112°03′24″W; NW¼SE¼SE¼ S19,T10S,R38E; a roadcut in new housing development SSW of Lava Hot Springs, Lava Hot Springs 7.5′ quad., Bannock Co., ID). *Analytical data:* K_2O = 1.39, 1.38%; $^*Ar^{40}$ = 0.1539 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 20%. *Submitted by:* S. S. Oriel. *Comments:* A basalt flow in the Salt Lake Formation. Calculated age is a minimum age for the flow.
whole-rock 7.7 ± 0.3 Ma

64. *USGS(D)R79-5D* K-Ar
Basalt (42°32′16″N, 112°03′24″W; NW¼ SE¼SE¼ S19,T10S,R38E; roadcut in new housing development SSW of Lava Hot Springs, Lava Hot Springs 7.5′ quad., Bannock Co., ID). *Analytical data:* K_2O = 1.38, 1.37%; $^*Ar^{40}$ = 0.1423 × 10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 22%. *Submitted by:* S. S. Oriel. *Comments:* Holocrystalline basalt flow in the Salt Lake Formation; calculated age is minimum age for the flow.
whole-rock 7.2 ± 0.3 Ma

65. *USGS(D)WCH-353* Fission-track
(Williams and others, 1976)
Rhyolite (Jim Sage Mountains, Cassia Co, ID). *Analytical data:* Ps = 1.66 × 10^6 tracks/cm² (177), Pi = 12.3 × 10^6 (655), O = 1.195 × 10^{15} n/cm², U = 330 ppm. *Comments:* Apparent age of a rhyolite flow in the upper unit of the volcanic member at Jim Sage Mountain (named Jim Sage Volcanic Member, Williams, Covington, and Pierce, 1982), Salt Lake Formation. Sample locality is not accurately known. Williams and others (1976) listed the age as 9.4 Ma, but it has been recalculated with a revised uranium-fission constant and neutron-dose calibration. Armstrong and others (1975) dated the flow by the K-Ar method at 9.2 Ma (old potassium-40 decay constants).
zircon 9.65 ± 1.7 Ma

66. *USGS(D)WK-470* Fission-track
(Williams and others, 1976)
Thin glassy rhyolite ash-flow tuff (42°09′30″N, 113°26′W; S32 or 33,T14S,R26E; Cedar Knoll area, Kane Canyon 7.5′ quad., Cassia Co., ID). *Analytical data:* Ps = 0.81 × 10^6 tracks/cm² (60), Pi = 8.00 × 10^6 tracks/cm² (296), O = 1.184 × 10^{15} n/cm², U = 220 ppm. *Comments:* Published age of 7.0 Ma has been recalculated with a revised uranium-fission constant and neutron-dose calibration.
zircon 7.2 ± 2.1 Ma

67. *USGS(D)WK-471* Fission-track
(Williams and others, 1976)
Rhyolite (42°10′40″N, 113°25′W; NE¼ S28,T14S,R26E; Sheep Mountain area, Kane Canyon 7.5′ quad., Cassia Co., ID). *Analytical data:* Ps = 0.842 × 10^6 tracks/cm² (234), Pi = 7.42 × 10^6 tracks/cm² (1031), O = 1.184 × 10^{15} n/cm², U = 200 ppm. *Comments:* Apparent age of rhyolite dome (Sheep Mountain dome) is 8.0 Ma. Published age of 7.8 Ma has been recalculated with a revised uranium-fission constant and neutron-dose calculation. Sample locality is not accurately known.
zircon 8.0 ± 1.2 Ma

68. *USGS(D)R-76* (Smith, 1982) Fission-track
Ash-bed (42°12′30″N, 113°02′45″W; NW¼NE¼ S15,T14S,R29E; NE slopes of Black Pine Mountains, Strevell 15′ quad., Cassia Co., ID). *Analytical data:* (6 grains) Ps = 1.05 × 10^6 tracks/cm² (161), Pi = 7.46 × 10^6 tracks/cm² (570), O = 1.23 × 10^{15} n/cm², U = 170 ppm. *Collected by:* J. F. Smith.
zircon 10.4 ± 1.9 Ma

69. *USGS(D)WST-462* Fission-track
(Williams and others, 1976)
Rhyolite (42°02′N, 113°13′50″W; W½ S18,T16S,R28E; Round Mountain area, Strevell 15′ quad., Cassia Co., ID). *Analytical data:* Ps = 1.08 × 10^6 tracks/cm² (120), Pi = 8.89 × 10^6 tracks/cm²

(494), 0 = 1.173×10^{15} n/cm², U = 240 ppm. *Comment:* Apparent age of the rhyolite dome at Round Mountain. Sample locality was listed by Smith (1982). Williams and others (1976) list the age as 8.3 Ma, but that age has been recalculated with a revised uranium-fission constant and neutron-dose calculation. A feldspar age for the rhyolite dome of 8.12 ± 0.20 Ma was obtained by J. D. Obradovich (Williams and others, 1976, p. 1277).

zircon 8.5 ± 1.8 Ma

70. *USGS(D)R-38* K-Ar
Argillite (42°05'40"N, 113°07'15"W; NE¼ S25,T15S,R28E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 1.68, 1.69%; $^*Ar^{40}$ = 2.534×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 75%. *Collected by:* J. F. Smith. *Comments:* Carbonaceous argillite from the Manning Canyon Shale (Mississippian and Pennsylvanian) which is part of an allochthonous block in this area. Pyroanalysis showed that this sample contained no volatile organic material. Reduced K-Ar age is a result of a thermal event(s).

The geology of the Black Pine Mountains was mapped and studied by J. Fred Smith (1982, 1983). He stated that the color alteration indices of conodonts collected from his area indicate that the rocks reached temperatures generally in the range of 190°-300°C in the northern third of the Black Pine Mountains and 300°-400°C in the southern portion of the mountains. Smith collected ten samples of argillite which were dated by the K-Ar age method in an attempt to define the time of thrusting, an important feature of the tectonic picture of this area. The thermal regime indicated by the color-alteration indices of the conodonts as reported by Smith (1983) would have reset the K-Ar ages of minerals in the sedimentary rocks. If this thermal regime was a result of thrusting, then the youngest K-Ar ages may indicate the approximate time of the last thrusting event. The ten samples of Paleozoic sedimentary rocks gave K-Ar ages ranging from Early Cretaceous to Late Cretaceous, a 35 million-year spread. Two possible explanations for these ages are as follows: (1) the sediments have been deeply buried and thus entered a zone of elevated temperatures for an extended time, they were then uplifted and/or thrust-faulted and exposed about 100-70 Ma ago; (2) the sediments were affected by a thermal regime that accompanied the thrusting-faulting about 90-80 Ma ago. At the present time, evidence is inconclusive to substantiate either hypothesis.

whole-rock 102 ± 4 Ma

71. *USGS(D)R-1* K-Ar
Argillite (42°05'35"N, 113°07'15"W; NE¼ S25,T15S,R28E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 1.46, 1.47%; $^*Ar^{40}$ = 2.421×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 85%. *Collected by:* J. F. Smith. *Comments:* Carbonaceous argillite from the Manning Canyon Shale (Mississippian and Pennsylvanian) which is part of an allochthonous block in this area. Pyroanalysis showed that this sample contained no volatile organic material. Reduced K-Ar age is a result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 111 ± 4 Ma

72. *USGS(D)R-96* K-Ar
Argillite (42°06'30"N, 113°06'10"W; NE¼ S19,T15S,R29E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 1.48, 1.47%; $^*Ar^{40}$ = 2.148×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 92%. *Collected by:* J. F. Smith. *Comments:* Argillite is from the Manning Canyon Formation (Mississippian and Pennsylvanian) which is a part of an allochthonous block in this area. Reduced K-Ar age is the result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 98.4 ± 3.3 Ma

73. *USGS(D)R-97* K-Ar
Argillite (42°06'05"N, 113°06'10"W; SE¼ S19,T15S,R29E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 2.23, 2.27%; $^*Ar^{40}$ = 3.297×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 89%. *Collected by:* J. F. Smith. *Comments:* Argillite is from the Manning Canyon Formation (Mississippian and Pennsylvanian) which is part of an allochthonous block in this area. Reduced K-Ar age is the result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 99.0 ± 3.4 Ma

74. *USGS(D)R-91* K-Ar
Argillite (42°05'40"N, 113°06'45"W; NW¼ S30,T15S,R29E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 2.56, 2.60%; $^*Ar^{40}$ = 3.269×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 93%. *Collected by:* J. F. Smith. *Comments:* Argillite is from the Manning Canyon Formation (Mississippian and Pennsylvanian) which is part of an allochthonous block in this area. Reduced K-Ar age is the result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 85.9 ± 2.9 Ma

75. *USGS(D)R-99* K-Ar
Argillite (42°05'30"N, 113°06'30"W; N of center of S30,T15S,R29E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 1.79, 1.80%; $^*Ar^{40}$ = 2.021×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 92%. *Collected by:* J. F. Smith. *Comment:* Argillite is from the Manning Canyon Formation (Mississippian and Pennsylvanian) which is part of an allochthonous block in this area. Reduced K-Ar age is a result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 76.6 ± 2.6 Ma

76. *USGS(D)R-90* K-Ar
Argillite (42°05'15"N, 113°06'10"W; SE¼ S30,T15S,R29E; Black Pine Mountains, Strevell 15' quad., Cassia Co., ID). *Analytical data:* K_2O = 1.15, 1.16%; $^*Ar^{40}$ = 1.835×10^{-10} mol/gm, $^*Ar^{40}/\Sigma Ar^{40}$ = 91%. *Collected by:* J. F. Smith. *Comments:* Argillite is from the Manning Canyon Formation (Mississippian and Pennsylvanian) which has been involved in thrust-faulting and is part of an allochthonous block in this area. Reduced K-Ar age is the result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 107 ± 4 Ma

77. *USGS(D)R-89* K-Ar
Argillite (42°04'30"N, 113°05'25"W; just W of

center of S32,T15S,R29E; Black Pine Mountains, Strevell 15′ quad., Cassia Co., ID). *Analytical data:* K_2O = 0.91, 0.90%; $*Ar^{40}$ = 1.389 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 80%. *Collected by:* J. F. Smith. *Comments:* Argillite is from the Manning Canyon Formation (Mississippian and Pennsylvanian) which is part of an allochthonous block in this area. Reduced K-Ar age is a result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 104 ± 6 Ma

78. *USGS(D)R-64* K-Ar
Argillite (42°03′30″N, 113°05′00″W; SE¼ S5,T16S,R29E; Black Pine Mountains, Strevell 15′ quad., Cassia Co., ID). *Analytical data:* K_2O = 1.72, 1.72%; $*Ar^{40}$ = 3.002 × 10^{-10} mol/gm, 85%. *Collected by:* J. F. Smith. *Comments:* Argillite from a limestone member of the Oquirrh Formation (Pennsylvanian) which is part of an allochthonous block in this area. Reduced K-Ar age is a result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 117 ± 4 Ma

79. *USGS(D)R-95* K-Ar
Argillite (42°05′40″N, 113°01′05″W; NW¼ S25,T15S,R29E; Black Pine Mountains, Strevell 15′ quad., Cassia Co., ID). *Analytical data:* K_2O = 1.72, 1.72%; $*Ar^{40}$ = 2.364 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 80%. *Collected by:* J. F. Smith. *Comments:* Argillite is from the Manning Canyon Shale (Mississippian part) which is part of an allochthonous block in this area. Reduced K-Ar age is a result of a thermal event(s). (See comments for sample R-38, entry 70).

whole-rock 93.1 ± 3.2 Ma

OREGON

80. *USGS(D)S83-36a* K-Ar
Andesite (42°07′47″N, 118°22′59″W; S4, T40S,R37E; Trout Creek 7.5′ quad., Harney Co., OR). *Analytical data:* K_2O = 2.30, 2.29%; $*Ar^{40}$ = 0.5420 × 10^{-10} mol/gm, $*Ar^{40}/\Sigma Ar^{40}$ = 75%. *Collected by:* S. Minor. *Comment:* Aphyric, pilotaxitic, basaltic andesite from a dike intruding a major normal fault.

whole-rock 16.3 ± 0.6 Ma

WASHINGTON

81. *USGS(D)27a* (Tabor and others, 1982) Fission-track
Tuff (47°28′36″N, 120°17′36″W; S23, T23N,R20E; Wenatchee 7.5′ quad., Douglas Co., WA). *Analytical data:* (zircon—5 grains) Ps = 2.28 × 10^6 tracks/cm² (666), Pi = 6.05 × 10^6 tracks/cm² (882), 0 = 1.53 × 10^{15} n/cm², U = 130 ppm; (apatite—50 grains) Ps = 0.0523 × 10^6 tracks/cm² (109), Pi = 0.1138 × 10^6 tracks/cm² (237), 0 = 1.45 × 10^{15} n/cm², U = 2.5 ppm. *Comments:* An altered crystal-vitric rhyolite ash-flow tuff—Wenatchee Formation. Calculated zircon age probably dates the tuff.

zircon 34.5 ± 3.9 Ma
apatite 39.8 ± 9.0 Ma

82. *USGS(D)LS-6C* Fission-track
(Tabor and others, 1982)
Tuff (47°23′12″N, 120°20′06″W; S21, T22N,R20E; Wenatchee 7.5′ quad., Chelan Co., WA). *Analytical data:* (6 grains) Ps = 7.08 × 10^6 tracks/cm² (1180), Pi = 13.18 × 10^6 tracks/cm² (1095), 0 = 1.04 × 10^{15} n/cm², U = 400 ppm. *Comments:* An altered crystal-vitric rhyolite ash-flow tuff—Wenatchee Formation. Calculated age dates the tuff.

zircon 33.4 ± 3.2 Ma

83. *USGS(D)MS-4C* Fission-track
(Tabor and others, 1982)
Tuff (47°23′12″N, 120°20′06″W; S21, T22,R20E; Wenatchee 7.5′ quad., Chelan Co., WA). *Analytical data:* (8 grains) Ps = 5.11 × 10^6 tracks/cm² (1491), Pi = 6.51 × 10^6 tracks/cm² (950), 0 = 1.05 × 10^{15} n/cm², U = 200 ppm. *Comments:* An altered crystal-vitric rhyolitic ash-flow tuff—Wenatchee Formation. Calculated age is too old.

zircon 49.1 ± 4.6 Ma

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