The geochronometry of Idaho

Richard Lee Armstrong

Isochron/West, Bulletin of Isotopic Geochronology, v. 14, pp. 1-50

This page is intentionally left blank to maintain order of facing pages.

THE GEOCHRONOMETRY OF IDAHO

Richard Lee Armstrong
Department of Geological Sciences
University of British Columbia
Vancouver, B.C., Canada V6T 1W5

> Due to the length of this article the second part will be printed in the next issue, *Isochron/West*, no. 15, April 1976.

Introduction

More than 500 age determinations for rocks from the state of Idaho are summarized and briefly discussed in this paper. A majority of the dates were determined at Yale during the past decade and many are from recently published papers or from papers now in preparation (Armstrong and Hills, 1967; Armstrong, 1974; Armstrong, 1975; Armstrong and others, 1975a; Armstrong and others, 1975b). Other dates are not likely to be published soon, if ever, and so this review provides an opportunity to make the results widely available. For most of the Yale dates published in other journals this tabulation contains supplementary analytical and geographic data.

A review of all previous geochronometric work was prerequisite to writing the series of papers cited above which deal with rocks ranging from Precambrian to Pleistocene. It was logical to cast all the information collected into a uniform format. Only a moderate increase in effort was required to prepare this listing for publication in Isochron/West. For many dates that were incompletely documented in published papers supplemental information was sought through correspondence with authors. In addition, some unpublished material from government, industry, and university sources has been generously provided.

Latitude and longitude are used as universal location coordinates and I urge that these be provided for every published date. To recreate such information from obscure locality data is frustrating, time consuming, and an operation where errors may be created and propagated unwittingly. Sometimes it is an impossible task. This tabulation of data should be readily convertible to a computer readable file. One can reasonably expect computers to play an increasing role in handling the type and amount of information involved in the geochronometry of large regions.

Excluded Material

Some geochronometric data have been ignored. Carbon-14 dates exist for a few Pleistocene samples but have not been included in the tabulation. Data from two papers that report Sr and Pb isotopic analyses of Snake River Plain lavas and review previous work (Leeman and Manton, 1971; Leeman and Manton, 1972) and from papers dealing with ore Pb isotopic compositions (summarized by Zartman and Stacey, 1971; Small, 1968; Small and Slawson, 1969; Zartman, 1974) are likewise omitted from the tabulation. This was done to keep the size of this paper within reasonable limits and because the geochronometric information provided by isotopic data obtained from such suites of samples is usually vague and imprecise. The Pb isotope data, recently reviewed for the entire western U.S. by Zartman (1974), support in a general fashion the basement dates obtained by more direct methods. A few unpublished Sr isotope analyses of Snake River Plain volcanic rocks are included. They are unworthy of a separate publication but potentially useful to other workers.

All Sr isotope data obtained for Mesozoic igneous rocks in Idaho have been included because they were often obtained with the intention of determining whole-rock isochrons. These efforts have met with only limited success, however, because of the unusual variability of initial Sr isotopic compositions throughout the state.

Impending New Data

Two major Idaho geochronometric studies are in the process of manuscript preparation and processing for publication. Miller and Engels (1975) and Miller (1974) have dated approximately 60 micas and amphiboles in the northern panhandle (largely in the Sandpoint 1° quadrangle) where they recognized two episodes of plutonic activity, one at about 100 m.y. and another at 45 to 50 m.y., in accord with other results reviewed in this compilation. A series of abstracts (Hofmann, 1971, 1972a, 1972b, Hofmann and Grauert, 1973a, 1973b, Grauert and Hofmann, 1973) report the results of K-Ar, Rb-Sr, and zircon U-Pb isotope studies of rocks from the northwest part of the Idaho batholith and surrounding metamorphosed Belt sediments. In addition to distinct intrusive events at 53.5 and 71 m.y. and a whole rock isochron of ~1490 for Belt sediments they observe a scatter of dates – strongly discordant zircons, Rb-Sr slab isochrons of intermediate age (340 m.y., 530 m.y.) and uncertain significance, and K-Ar and Rb-Sr mineral dates ranging from 43 m.y. (final cooling of region) to 1750 m.y. (excess Ar?). The details of these two significant studies were not available for inclusion in the present compilation. They would have pushed the list of dates well over 600, a rather amazing figure. This tabulation is believed to be complete up to the end of 1974.

Deletions from the Record

Two dates that have been quoted in the literature have been repudiated by the sources to which they were attributed. These dates should be shunned as they do not represent analyses that are reliable or even extant! There are probably dates included in the compilation that deserve similar treatment, and some will be called into question in discussions, but none have been formally withdrawn from the record. This paper is a complete summary of the published record. It should be viewed skeptically by any user.

A K-Ar date of 1200 m.y., quoted by Long and others (1960) and later by Reid and others (1973) for an argillite sample from the Sunset Minerals Mine, Pine Creek, Coeur d 'Alene district, is completely fictitious. According to S. S. Goldich of Northern Illinois University (personal communication, 1974) the result was mentioned in a telephone conversation and later discovered to be wrong due to a slipped decimal point, and unacceptable as well because of a poor quality Ar run. The result should be completely ignored, the sample was not rerun and should be considered undated.

Swanberg and Blackwell (1973) cited a Rb-Sr date by S. C. Reeve of the University of Texas at Dallas who requests (personal communication, 1974) that the result be ignored because it is based on unconfirmed whole rock and biotite analyses with a relatively small Rb enrichment in the biotite separate and thus is not regarded as very accurate.

Analytical Techniques used at Yale

Potassium and argon were determined using conventional atomic absorption spectrophotometry and isotope dilution techniques, respectively (Armstrong, 1970a). Potassium-argon dates were computed using the following constants in every case: K^{40} = 0.0119 atom percent, $K\lambda_\beta = 4.72 \times 10^{-10} yr^{-1}$, and $K\lambda_\epsilon = 0.584 \times 10^{-10} yr^{-1}$. Analyses of standards indicate that calibrations are accurate within 2%. Uncertainties reported are for analytical error only and represent one standard deviation (about 3% for most K-Ar dates).

Rubidium and strontium concentrations and ratios were measured by X-ray fluorescence using U. S. Geological Survey rock standards to establish working curves. Occasional cross checks were made using isotope dilution with pure Sr^{84} spike. Estimated errors for concentration are 5% or 1 ppm (whichever is greater) and for Rb/Sr ratio are ~2%, if the ratios lie between 0.05 and 10.

Some early Sr analyses done at Yale were measured on a six-inch Nier-type mass spectrometer equipped with expanded scale recorder (1σ = 0.0006, E & A standard = 0.7080). Most Sr data were measured on a 60 degree sector, 12 inch radius, solid-source mass spectrometer of modified U. S. National Bureau of Standards design, constructed by H. Faul. Data output is digitalized and operation of the spectrometer, including data reduction to normalized ratios with 1σ errors is entirely automated using an on-line digital computer (Nova 1210). Interfacing and programming were done at Yale by R. L. Armstrong. Digital data produced by this system have 1σ errors of 0.0001. All results have been adjusted so that the E & A standard gives a value of .70800. The actual value observed for the E & A standard was .70826 ± .00003 and for the NBS standard $SrCO_3$, SRM 987, the observed value was .71035 ± .00005. Several different Rb decay constants have been in use, ranging from 1.39 to 1.47 x $10^{-11} yr^{-1}$. The constant associated with any date is that used in the published discussion of that date. I presently prefer the 1.42 value but have used 1.47 and 1.43 in the past. Other labs favor the 1.39 value. The situation at present is in flux with new values likely to be in general use for K, U, Th, and Rb in a few years so we have refrained from recalculating any dates and instead we report the Rb decay constant used for any suite of samples.

Acknowledgments

Geochronologic studies in Idaho were supported by a succession of NSF grants (GP 5383, GA1694, and GA 26025). For several years P. N. Taylor ably assisted in running the Yale K-Ar dating lab. Peter Hales provided invaluable aid in running the Sr isotope analyses during a final productive surge before the Yale lab shut down. Terry Eisensmith and Barbara Kimler assisted in various laboratory operations. The numerous individuals who supplied samples for dating are recorded in the date abstracts. Peter Scholle, Richard L. Stocker, Richard F. Wright, James R. Besancon, Georgia Hoffman, Mike Hascall, Richard Sweeting, and Robert Gamble assisted in the field.

I am grateful to the following individuals who supplied supplemental information or comments, reviewed date abstracts, or contributed unpublished dates to the list: G. H. Chase, G. Faure, C. W. Field, R. Fleck, S. S. Goldich, J. Harrison, A. Hietanen, P. Le Couteur, B. F. Leonard, R. F. Marvin, E. H. McKee, F. Miller, J. Obradovich, Z. Peterman, L. D. Ramspott, S. C. Reeve, A. H. Sorensen, T. W. Stern, and R. E. Zartman. Their respective contributions should be evident from the citations in the date abstracts. Several individuals known to be alive and active do not answer their mail. They shall remain unnamed!

Karen Hayne typed this rather difficult manuscript. Her patience is appreciated.

Overview

The large number of samples, and their geographic and lithologic variety, insure that most important igneous-plutonic events in the history of Idaho are represented, although the record may be blurred by discordant or composite results. Figures 1 and 2 are histograms, subjectively annotated, but untreated for monograph effects. Regardless of any reservations or uncertainties that might be expressed a distinctly episodic history is evident and the discussion of groups of dates will be subdivided accordingly.

During the Cenozoic there were two distinct periods of igneous activity, one in Eocene time (the Challis volcanic-plutonic episode), and the other beginning in the Miocene (the eruption of Columbia River and related basalts and the volcanic evolution of the Snake River Plain). Sample localities for dates related to these Cenozoic episodes are shown on figure 3. Mesozoic dates do not define such sharp episodes – the pattern is rather diffuse – but a review of the dates, their geographic distribution, and consideration of possible discordancies permits an episodic history to be recognized. Late Triassic, Late Jurassic-Early Cretaceous, and Middle and Upper Cretaceous plutonic events may be distinguished. Mesozoic-date sample localities are plotted on figure 4. The remaining dates, all pre-Mesozoic, come from localities shown in figure 5. All Paleozoic dates are felt to be discordant and not related to any real geologic event of Paleozoic age. The only possible exception are the dates from the Beaverhead Range. Two distinct ages of Precambrian basement have been recognized in Idaho (~2500 m. y. and ~1500 m. y.). Plutonic activity and mineralization during Beltian sedimentation are recorded by several dates, one date is thought to record the East Kootenay orogeny and two come from the Late Precambrian Ramey Ridge Complex.

Exhaustive K-Ar and Rb-Sr geochronometric studies of the Albion Range have recently been completed. Early results were reported by Armstrong and Hills (1967) and a summary paper will eventually be prepared. Because of the abundance of data, complexity of interpretation, and unusual history of the area these results will be discussed separately in a final section of the compilation.

SAMPLE DESCRIPTIONS

NEOGENE AND QUATERNARY

SNAKE RIVER PLAIN AND CORRELATIVE LAVAS

Armstrong and others (1975a) discuss nearly all the dates included in this tabulation. Figure 6, from their paper illustrates the chronometric relations deciphered for the Snake River Plain – a steady eastward shift of three volcanic-sedimentary facies. At the east end, and oldest in any local section are rhyolitic lava and ash with interbedded sediment and minor basalt. West, or above, comes abundant basalt floods with local rhyolite domes and ash. Farthest west, and youngest if present, is a complex of sediment and basalt flows interbedded and nested in various and confusing ways. The eastward transgression began about 16 m.y. ago near Silver City

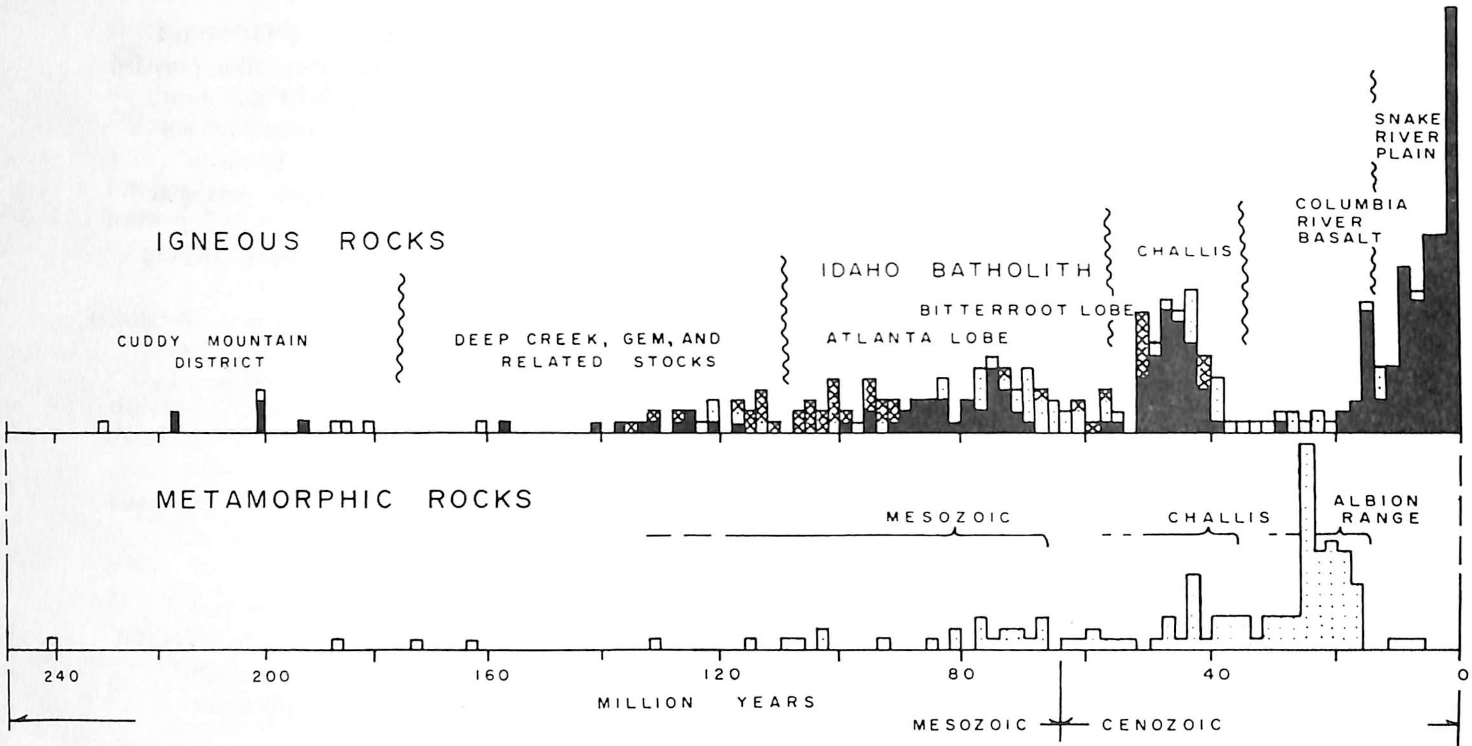

Figure 1. Histogram of Mesozoic and Cenozoic dates for Idaho rocks. Each square represents a single age determination. Black squares are for igneous rock dates that are thought to be reasonably close to emplacement age. Open squares are for dates on metamorphic rocks and for igneous rock dates known or suspected to be far out of line with emplacement age due to later metamorphism or alteration. Lead alpha dates for igneous rocks or detrital zircons are marked with an x. In general they are probably a bit too old in the case of Mesozoic–Cenozoic rocks and too young in the case of Precambrian rocks. Prominent episodes in the geologic history of Idaho are indicated by labels, brackets, and break symbols (wavy lines). Dates for igneous and metamorphic rocks have been separated to reduce clutter and confusion. The unusually prominent Albion Range metamorphic peak is a real event exaggerated by the monograph effect.

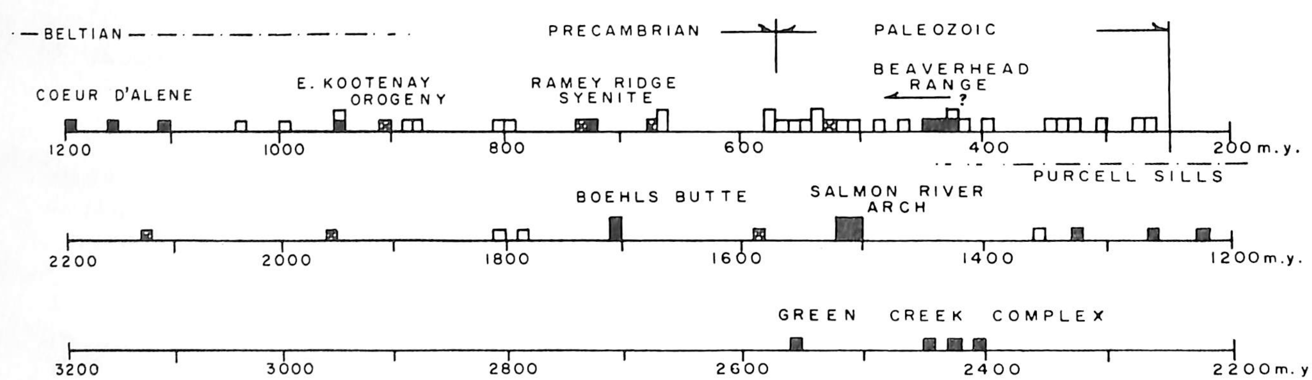

Figure 2. Histogram of pre-Mesozoic dates for Idaho rocks. The time scale is more compressed than in figure 1 but the symbols are the same. There is some doubt as to whether the Beaverhead Range granitic rock dates are real, indicating a Paleozoic age, or the result of updating of Precambrian basement. Otherwise the events are arrayed in their proper chronologic sequence.

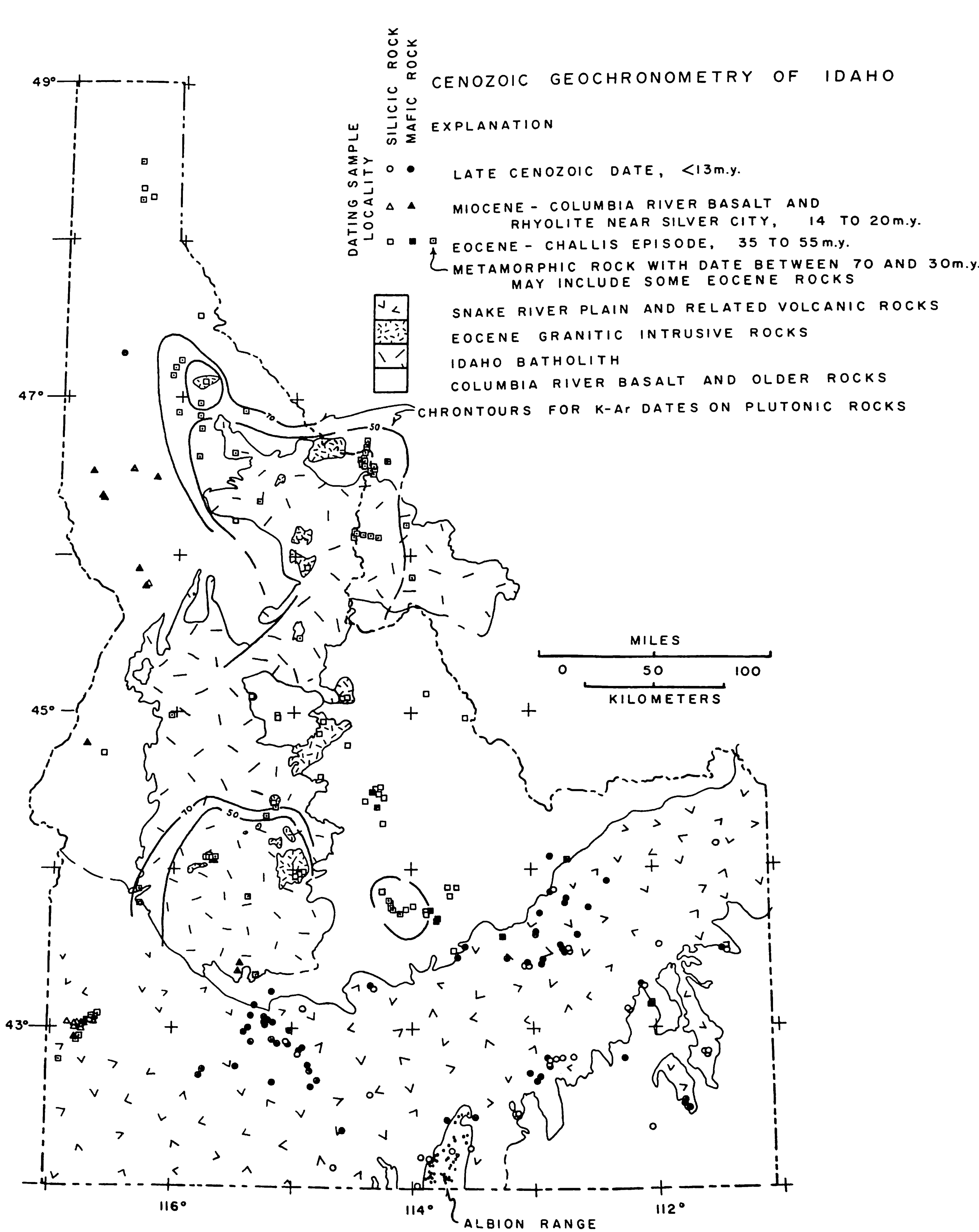

Figure 3. Map of Idaho showing the distribution of Cenozoic-date sample localities. Base modified from Renfro and Feray (1972) and Armstrong (1975b).

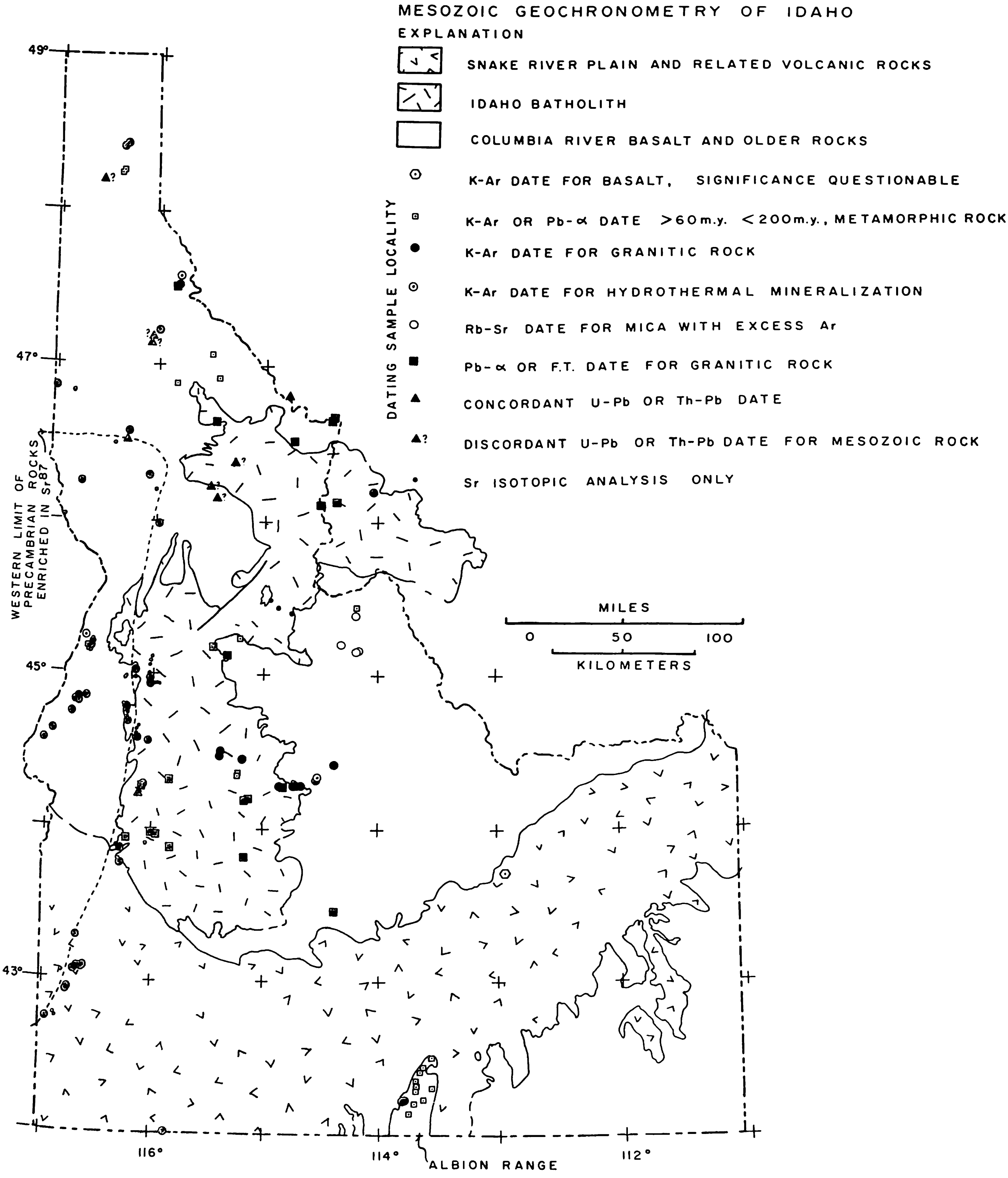

Figure 4. Map of Idaho showing Mesozoic-date sample localities.

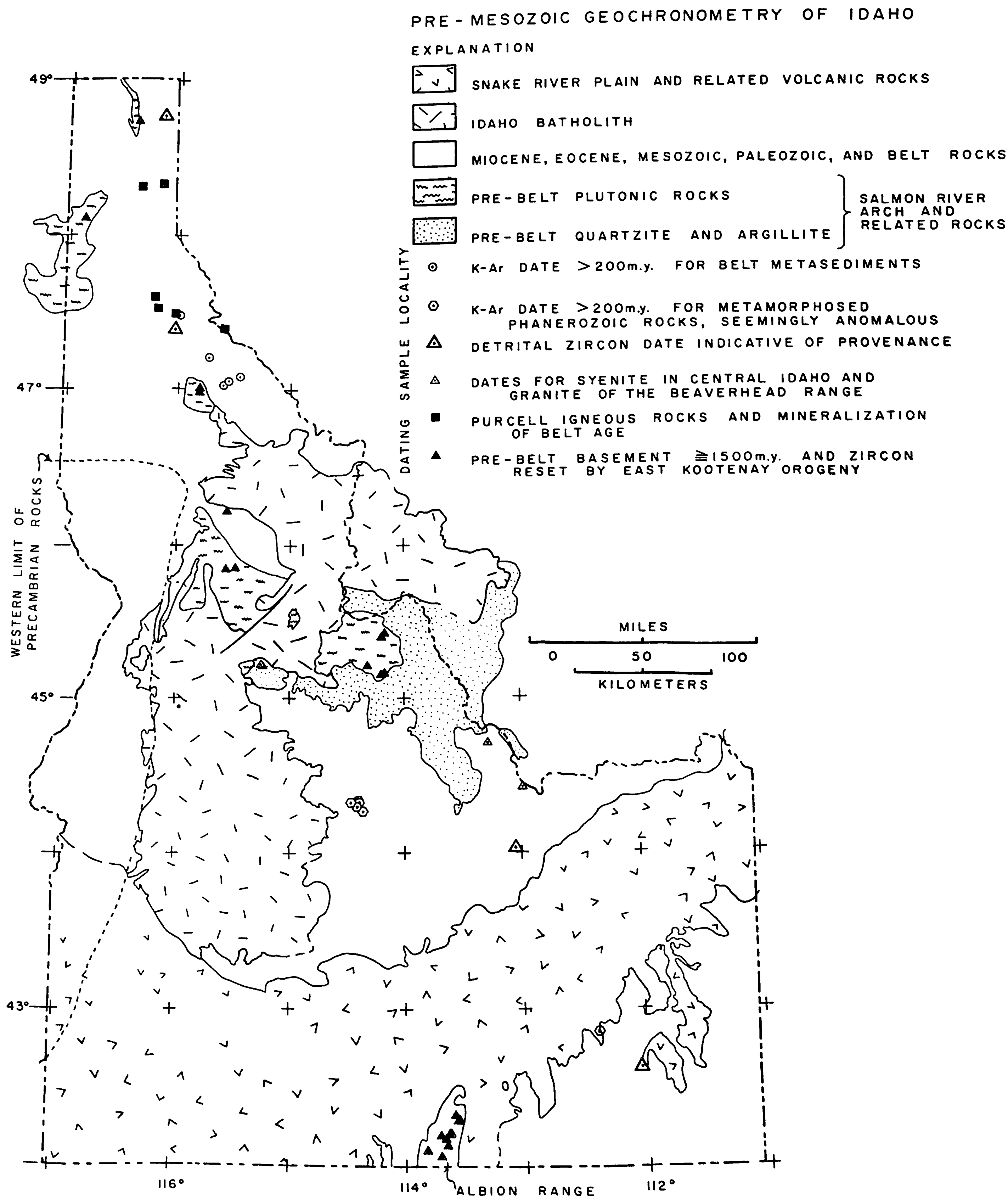

Figure 5. Map of Idaho showing pre-Mesozoic-date sample localities.

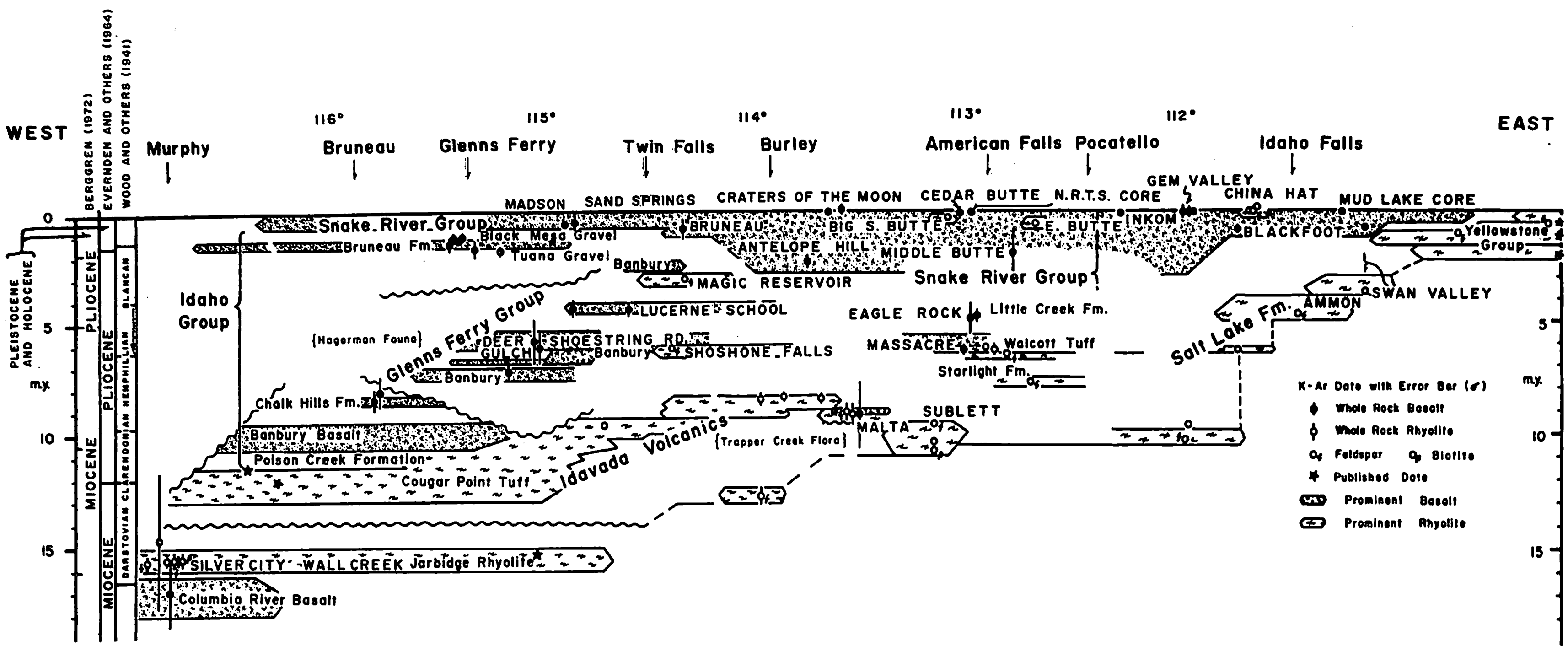

Figure 6. Space-time profile along the Snake River Plain, Idaho (from Armstrong and others, 1975a). Local stratigraphy is more complex than this diagram implies, but the essence of the stratigraphic story is presented. Unpatterned areas represent erosion intervals, sedimentary deposits, and other rock units unimportant to the discussion. Many names are not formally defined stratigraphic terms – these informal names and geographic references are given in capital letters only.

and has now reached the Yellowstone National Park area, the average rate of migration being about 3.5 cm per year. The significance of this transgression rate is discussed by Minster and others (1974) and Suppe and others (1975). Volcanic centers are visible only around Silver City and in the Island Park and Yellowstone areas. Other centers from which large volumes of silicic lava and ash erupted are probably buried beneath younger lavas of the plain.

SILVER CITY AREA

Dates on volcanic rocks indicate a first pulse of silicic igneous activity at ~15.7 m.y. in southwestern Idaho. Mineralization in the district occurred shortly thereafter, ~15.3 m.y. ago.

1. Pansze, 1972 K-Ar (sanidine) 15.7±0.3 m.y.
   YU-PZ (A 325) Upper rhyolite, rhyolite porphyry flow (43°01′05″N, 116°51′35″W; NE¼SW¼sec. 6, T. 5 S., R. 4 W.; Owyhee Co., ID) Silver City region. Analytical data: K = 4.21, 4.18%; $^*Ar^{40}$ = 2.64 x 10^{-6} cc/gm (63% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

2. Pansze, 1972 K-Ar (sanidine) 15.6±0.3 m.y.
   YU-PZ (A98) Upper rhyolite; rhyolite porphyry vitrophyre flow (42°58′55″N, 116°45′05″W; SE¼SE¼sec. 13, T. 5 S., R. 4 W.; Owyhee Co., ID) Silver City region. Analytical data: K = 7.32, 7.36%; $^*Ar^{40}$ = 4.58 x 10^{-6} cc/gm (84% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

3. Pansze, 1972 K-Ar (whole rock) 15.6±0.2 m.y.
   YU-PZ (A26) Upper rhyolite, rhyolite porphyry flow (43°00′15″N, 116°47′55″W; center sec. 10, T. 5 S., R. 4 W.; Owyhee Co., ID) Silver City region. Analytical data: K = 3.89, 3.87%; $^*Ar^{40}$ = 2.41, 2.44 x 10^{-6} cc/gm (81, 89% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

4. Pansze, 1972 K-Ar (biotite) 15.8±0.3 m.y.
   YU-PZ (A345) Upper rhyolite, rhyolite porphyry flow (43°00′05″N, 116°45′00″W; NE¼SE¼sec. 12, T. 5 S., R. 4 W.; Owyhee Co., ID). Silver City region. Analytical data: K = 6.73, 6.81%; $^*Ar^{40}$ = 4.25, 4.33 x 10^{-6} cc/gm (61, 61% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

5. Pansze, 1972 K-Ar (whole rock)15.6±0.3 m.y.
   YU-PZ (A45) Upper rhyolite, rhyolite porphyry flow (43°00′30″N, 116°46′45″W; NE¼NW¼sec. 11, T. 5 S., R. 4 W.; Owyhee Co., ID) Silver City region. Analytical data: K = 4.09, 3.99%; $^*Ar^{40}$ = 2.43, 2.62 x 10^{-6} cc/gm (87, 65% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

6. Pansze, 1972 K-Ar (biotite) 17.3±0.3 m.y.
   YU-PZ (A34) Upper rhyolite, rhyolite porphyry flow (42°59′30″N, 116°48′20″W; NE¼NE¼sec. 16, T. 5 S., R. 4 W.; Owyhee Co., ID). A date of 15.6 m.y. was expected. The older result is a mystery and must be due to contamination with older xenocrysts. Analytical data: K = 6.06, 6.04%; $^*Ar^{40}$ = 4.20, 4.18 x 10^{-6} cc/gm (40, 52% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

7. Pansze, 1972 K-Ar (whole rock) 14.7±3 m.y.
   YU-PZ (A350) Lower basalt, alkali olivine basalt (42°56′30″N, 116°47′50″W; NW¼SE¼sec. 34, T. 5 S., R. 4 W.; Owyhee Co., ID) Silver City region. Date probably a bit low, 16 m.y. would be more reasonable, and is included by the analytical error. Analytical data: K = 0.437, 0.446%; $^*Ar^{40}$ = 0.295, 0.226, 0.230 x 10^{-6} cc/gm (4, 2, 2% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

8. Pansze, 1972 K-Ar (adularia) 14.8±0.6 m.y.
   G - F 1415 (A383) Vein on Florida Mountain (43°00′30″N, 116°45′15″W; SE¼sec. 12, T. 5 S., R. 4 W.; Owyhee Co., ID). Analytical data: K = 11.27, 11.32%; $^*Ar^{40}$ = 0.0119, 0.0121 ppm (58, 69% Σ Ar^{40}); collected by: O. H. Rostad, AMAX Exploration, Inc.; dated by: Geochron Labs. for AMAX Exploration, Inc.

9. Pansze, 1972 K-Ar (adularia) 15.2±0.2 m.y.
YU-PZ (A43) Oro Fino vein (43°00'45"N, 116°41'50"W; SW¼SE¼sec. 4, T. 5 S., R. 3 W.; Owyhee Co., ID). Analytical data: K = 12.48, 12.61%; $*Ar^{40}$ = 7.62, 7.61 x 10^{-6} cc/gm (61, 73% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

10. E. H. McKee, K-Ar (adularia) 16.2±0.5 m.y.
written communication, 1974
DRS-23-69 Wallrock of the vein at Trade Dollar Mine (43°00'40"N, 116°44'40"W; NW¼NW¼sec. 7, T. 5 S., R. 3 W.; Owyhee Co., ID) Silver City area. Analytical data: K_2O = 15.78%; $*Ar^{40}$ = 3.795 x 10^{-10} moles/gm (81.1 Σ Ar^{40}); collected by: D. R. Shawe, U.S.G.S.; dated by: E. H. McKee, U.S.G.S.

SNAKE RIVER PLAIN WEST OF 114°

Except for the King Hill dates, which are anomalously old and may be due to excess Ar, these results are considered reliable, although of variable precision. Most are plotted on figure 6.

1. YU-69-52 L K-Ar (whole rock) 0.5±0.5 m.y.
Armstrong and others, 1975
Sand Springs Basalt (42°43'50"N, 114°51'10"W; NE¼SE¼sec. 18, T. 8 S., R. 14 E.; Twin Falls Co., ID) cliff along Snake River, along US-30, 2.5 mi N of Banbury Hot Springs road. Normal magnetic polarity. Analytical data: K = 0.628, 0.637%; $*Ar^{40}$ = 0.0103, 0.0159 x 10^{-6} cc/gm (0.4, 2.4% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

2. YU-69-53 L K-Ar (whole rock) 0.54±0.08 m.y.
Armstrong and others, 1975
Madson Basalt (42°52'40"N, 114°54'10"W; NW¼NW¼sec. 27, T. 6 S., R. 13 E.; Gooding Co., ID) 0.5 mi NW of Malad River along US-30. Normal magnetic polarity. Analytical data: K = 0.511, 0.502%; $*Ar^{40}$ = 0.0110, 0.0107 x 10^{-6} cc/gm (5, 4% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

3. YU-69-39 L K-Ar (whole rock) 0.8±0.5 m.y.
Armstrong and others, 1975
Basaltic lava flow (43°15'40"N, 114°18'40"W; SE¼SW¼sec. 10, T. 2 S., R. 18 E.; Blaine Co., ID) US-93, 4.5 mi N of Big Wood River. Normal magnetic polarity. Shown as Bruneau Formation by Maide and others, 1963. Analytical data: K = 0.516, 0.506%, $*Ar^{40}$ = 0.0153, 0.0185 x 10^{-6} cc/gm (1.4, 1.0% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

4. YU-70-8 L K-Ar (whole rock)1.2±0.2 m.y.
Armstrong and others, 1975
Morrow Reservoir lava flow, basalt (43°00'20"N, 115°21'00"W; SW¼NE¼sec. 11, T. 5 S., R. 9 E.; Elmore Co., ID) capping mesa W of Morrow Reservoir. Reversed magnetic polarity. Analytical data: K = 0.715, 0.721%, $*Ar^{40}$ = 0.0367, 0.0311 x 10^{-6} cc/gm (7, 3% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

5. YU-59 P 271 HP K-Ar (whole rock)1.2±0.2 m.y.
Armstrong and others, 1975
Hammett lava flow, slightly diktytaxitic olivine basalt (42°58'40"N, 115°24'40"W; SE¼NW¼sec. 20, T. 5 S., R. 9 E.; Elmore Co., ID). Looks fresh. Analytical data: K = 0.587, 0.580%; $*Ar^{40}$ = 0.0313, 0.0246 x 10^{-6} cc/gm (5, 4% Σ Ar^{40}); collected by: H. A. Powers, U.S.G.S.; dated by: R. L. Armstrong, Yale U.

6. YU-69-59 L K-Ar (whole rock) 1.35±0.07 m.y.
Armstrong and others, 1975
Deadman Canyon lava flow, basalt (42°55'50"N, 115°21'20"W; NE¼SE¼sec. 2, T. 6 S., R. 9 E.; Elmore Co., ID) 3 mi SW of Glenns Ferry in NE mouth of Deadman Canyon. Reversed magnetic polarity. Analytical data: K = 0.686, 0.686%; $*Ar^{40}$ = 0.0392, 0.0357 x 10^{-6} cc/gm (16, 13% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

7. YU-70-4 L K-Ar (whole rock) 1.5±0.3 m.y.
Armstrong and others, 1975
Hammett lava flow, basalt (42°58′40″N, 115°24′40″W; SE¼NW¼sec. 20, T. 5 S., R. 9 E.; Elmore Co., ID) along W side Cold Springs Creek, S of old McGinnis Ranch. Reversed magnetic polarity. Analytical data: K = 0.501, 0.497%; $^*Ar^{40}$ = 0.0250, 0.0345 x 10^{-6} cc/gm (2, 4% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

8. YU-70-7 L K-Ar (whole rock) 1.7±0.4 m.y.
Armstrong and others, 1975
Berry Ranch lava flow, basalt (43°04′50″N, 115°19′40″W; NW¼NE¼sec. 13, T. 4 S., R. 9 E; Elmore Co., ID) along E side of Alkali Creek. Reversed magnetic polarity. Analytical data: K = 0.770, 0.758%; $^*Ar^{40}$ = 0.0487, 0.0543 x 10^{-6} cc/gm (1, 4% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

9. YU-70-13 L K-Ar (whole rock) 1.8±0.2 m.y.
Armstrong and others, 1975
Basaltic lava flow (43°14′30″N, 115°10′05″W; SE¼SE¼sec. 17, T. 2 S., R. 11 E.; Elmore Co., ID) caps mesa above small creek in Mount Bennett Hills. Reversed magnetic polarity. Analytical data: K = 0.296, 0.307%; $^*Ar^{40}$ = 0.0231, 0.0233, 0.0189 x 10^{-6} cc/gm (4, 6, 6% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore; dated by: R. L. Armstrong, Yale U.

10. YU-69-61 L K-Ar (whole rock) 2.50±0.05 m.y.
Armstrong and others, 1975
King Hill lava flows, upper part, basalt (43°02′40″N, 115°13′40″W; SE¼SE¼sec. 26, T. 4 S., R. 10 E.; Elmore Co., ID) Kings Crown near King Hill. Anomalously old – excess radiogenic Ar suspected. Analytical data: K = 2.03, 2.00%; $^*Ar^{40}$ = 0.204, 0.199 x 10^{-6} cc/gm (31, 38% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

11. YU-69-60 L K-Ar (whole rock) 2.8±0.2 m.y.
Armstrong and others, 1975
King Hill lava flows, upper part, basalt (43°02′40″N, 115°13′40″W; SE¼SE¼sec. 26, T. 4 S., R. 10 E.; Elmore Co., ID) Kings Crown near King Hill. Reversed magnetic polarity. Anomalously old – excess radiogenic Ar suspected. Analytical data: K = 2.27, 2.26%; $^*Ar^{40}$ = 0.261, 0.246, 0.266 x 10^{-6} cc/gm (9, 8, 5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

12. YU-59 P79 HP K-Ar (whole rock) 3.75±0.1 m.y.
Armstrong and others, 1975
King Hill lava flows, basalt (43°03′30″N, 115°11′30″W; SE¼sec. 19, T. 4 S., R. 11 E.; Elmore Co., ID). Anomalously old – excess radiogenic Ar suspected. Material looks quite fresh. Analytical data: K = 3.00, 2.99%; $^*Ar^{40}$ = 0.447, 0.456 x 10^{-6} cc/gm (25, 26% Σ Ar^{40}); collected by: H. A. Powers, U.S.G.S.; dated by: R. L. Armstrong, Yale U.

13. YU-69-40 L K-Ar (feldspar) 3.00±0.06 m.y.
Armstrong and others, 1975 (feldspar) 3.13±0.06 m.y.
Rhyolite of Magic Reservoir (43°14′15″N, 114°18′00″W; SE¼NE¼sec. 22, T. 2 S., R. 18 E., Blaine Co., ID) 3 mi N of Big Wood River, 0.6 mi E of US-93. Average date 3.06 ± 0.04 m.y. Analytical data: K = 7.21, 7.20%; $^*Ar^{40}$ = 0.864 x 10^{-6} cc/gm (58% Σ Ar^{40}) K = 8.08, 8.13%; $^*Ar^{40}$ = 1.016 x 10^{-6} cc/gm (58% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

14. YU-69-51 L K-Ar (whole rock) 4.2±0.4 m.y.
Armstrong and others, 1975 (whole rock) 5.0±1.3 m.y.
Lucerne School lava flow, basalt (42°38′40″N, 114°50′10″W; SW¼NE¼sec. 17, T. 9 S., R. 14 E.; Twin Falls Co., ID) along Deep Creek, 1 mi E of US-30 near Buhl. Looks fresh. Reversed magnetic polarity. Weighted mean date 4.4 ± 0.4 m.y. Analytical data: K = 0.505, 0.510%; $^*Ar^{40}$ = 0.080, 0.092 x 10^{-6} cc/gm (11, 8% Σ Ar^{40}) K = 0.524, 0.523%; $^*Ar^{40}$ = 0.126, 0.0842 x 10^{-6} cc/gm (3, 3% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

15. YU-70-44 L K-Ar (whole rock) 4.4±0.6 m.y.
Armstrong and others, 1975
Upper Banbury Basalt, looks fresh (42°45'40"N, 114°52'30"W; NW¼SE¼sec. 1, T. 8 S., R. 13 E.; Gooding Co., ID) roadcut on E side of US-30, N of Snake River Bridge, S of Hagerman. Normal magnetic polarity. Analytical data: K = 0.426, 0.424%; $*Ar^{40}$ = 0.0712, 0.0772 x 10^{-6} cc/gm (5, 5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

16. YU-69-42 L K-Ar (whole rock) 4.5±0.3 m.y.
Armstrong and others, 1975
Glenns Ferry basaltic lava flow (42°23'20"N, 114°34'25"W; SW¼SW¼sec. 10, T. 12 S., R. 16 E.; Twin Falls Co., ID) on US-93, 2.5 mi N of Hollister. Looks fresh. Reversed magnetic polarity. Mapped as Banbury by Malde and others, 1963. Analytical data: K = 0.398, 0.401%; $*Ar^{40}$ = 0.0739, 0.0698 x 10^{-6} cc/gm (11, 11% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

17. YU-69-47 L K-Ar (whole rock) 4.9±0.6 m.y.
Armstrong and others, 1975
Lower Banbury Basalt (42°40'20"N, 114°45'30"W; NW¼SE¼sec. 1, T. 9 S., R. 14 E.; Gooding Co., ID) near Snake River, N of Buhl. Fairly fresh. Normal magnetic polarity. Analytical data: K = 0.197, 0.186%; $*Ar^{40}$ = 0.0342, 0.0467, 0.0327 x 10^{-6} cc/gm (8, 6, 6% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

18. YU-70-16 L K-Ar (whole rock) 5.9±1.0 m.y.
Armstrong and others, 1975
Deer Gulch lava flow, basalt (42°54'50"N, 115°09'55"W; NW¼SW¼sec. 9, T. 6 S., R. 11 E.; Elmore Co., ID) roadcut, W side of Snake River above small power station. Sample looks fresh. Reversed magnetic polarity. Analytical data: K = 0.496, 0.492, 0.494%; $*Ar^{40}$ = 0.121, 0.112 x 10^{-6} cc/gm (4, 5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

19. YU-69-55 L K-Ar (whole rock) 6.2±0.7 m.y.
Armstrong and others, 1975
Shoestring Road lava flow, basalt (42°54'10"N, 115°01'50"W; SE¼NE¼sec. 16, T. 6 S., R. 12 E.; Twin Falls Co., ID). Better looking than YU-54 P93 HP, not completely fresh. Normal magnetic polarity. KA 832, hydrated ash dated 3.2 m.y. (Evernden and others, 1964), lies immediately above this sample. Analytical data: K = 0.303, 0.301%; $*Ar^{40}$ = 0.0800, 0.0684 x 10^{-6} cc/gm (7, 5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

20. YU-69-45 L K-Ar (whole rock(a)) 5.6±0.2 m.y.
Armstrong and others, 1975 (whole rock(a)) 5.7±0.3 m.y.
(feldspar(a)) 6.0±0.2 m.y.
(whole rock(b)) 5.8±0.11 m.y.
(feldspar(b)) 6.5±0.16 m.y.
Idavada Volcanics, Shoshone Falls, vitrophyre (42°35'15"N, 114°21'30"W; NE¼NW¼sec. 4, T. 10 S., R. 18 E.; Twin Falls Co., ID) from cliffs ENE of the city of Twin Falls. Analytical data: K = 4.05, 4.00%; $*Ar^{40}$ = 0.886, 0.902 x 10^{-6} cc/gm (20, 18% Σ Ar^{40}) K = 3.94, 3.92%; $*Ar^{40}$ = 0.891 x 10^{-6} cc/gm (18% Σ Ar^{40}) K = 1.52, 1.51%; $*Ar^{40}$ = 0.366 x 10^{-6} cc/gm (31% Σ Ar^{40}) K = 3.84, 3.98, 3.96%; $*Ar^{40}$ = 0.924, 0.896 x 10^{-6} cc/gm (33, 40% Σ Ar^{40}) K = 1.41, 1.44%; $*Ar^{40}$ = 0.373 x 10^{-6} cc/gm (41% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

21. YU-62 P 111 HP K-Ar (whole rock) 7.3±0.3 m.y.
Armstrong and others, 1975
Banbury Basalt (42°40'00"N, 115°10'40"W; SW¼sec. 4, T. 9 S., R. 11 E.; Owyhee Co., ID) Notch Butte, 3rd valley filling flow up from notch. Looks fresh, somewhat oxidized, much iddingsite. U.S.G.S. No. I-4121. Analytical data: K = 0.233, 0.232%; $*Ar^{40}$ = 0.0676, 0.0677 x 10^{-6} cc/gm (17, 12% Σ Ar^{40}); collected by: H. A. Powers, U.S.G.S.; dated by: R. L. Armstrong, Yale U.

22. YU-70-3 L K-Ar (whole rock) 8.2±0.7 m.y.
Armstrong and others, 1975
Basalt of Chalk Hills Formation (42°43'35"N, 115°45'40"W; SE¼SE¼sec. 17, T. 8 S., R. 6 E.; Owyhee Co., ID) E side of Hot Creek, 5.3 mi S of Hot Spring. Looks very fresh. Analytical data: K = 0.509, 0.493%; $*Ar^{40}$ = 0.175, 0.152 x 10^{-6} cc/gm (8, 8% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

23. YU-69-50 L K-Ar (whole rock) 8.6±0.5 m.y.
Armstrong and others, 1975
Basalt of Chalk Hills Formation (42°41'15"N, 115°46'45"W; NE¼SE¼sec. 31, T. 8 S., R. 6 E.; Owyhee Co., ID) 20 mi SE of Bruneau, along Hot Creek. Normal magnetic polarity. Analytical data: K = 0.320, 0.314%; $*Ar^{40}$ = 0.109, 0.109 x 10^{-6} cc/gm (15, 10% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

24. YU-69-43 L K-Ar (whole rock) 9.7±0.16 m.y.
Armstrong and others, 1975 (whole rock) 9.6±0.14 m.y.
Idavada Volcanics, dark welded ash flow (42°08'20"N, 114°41'00"W; SW¼NE¼sec. 10, T. 15 S., R. 15 E.; Twin Falls Co., ID) quarry along US-93, 17 mi S of Hollister. Reversed magnetic polarity. Analytical data: K = 4.16, 4.16%; $*Ar^{40}$ = 1.61, 1.62 x 10^{-6} cc/gm; (64, 40% Σ Ar^{40}) K = 4.40, 4.33%; $*Ar^{40}$ = 1.64, 1.69 x 10^{-6} cc/gm (74, 70% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

25. YU-70-11 L K-Ar (whole rock) 13.5±1.5 m.y.
Armstrong and others, 1975
Banbury Basalt (43°07'20"N, 115°17'30"W; NW¼NE¼sec. 32, T. 3 S., R. 10 E.; Elmore Co., ID) bluff on W side of Little Canyon Creek. Looks fresh. Normal magnetic polarity. Analytical data: K = 0.302, 0.290%; $*Ar^{40}$ = 0.167, 0.153 x 10^{-6} cc/gm (5, 6% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

26. Evernden and others, 1964 K-Ar (whole rock) 1.36±0.07 m.y.
KA 1188 Bruneau Basalt (43°02'55"N, 115°08'30"W; 3500'N, 4100'W of SE corner sec. 27, T. 4 S., R. 11 E.; Elmore Co., ID). Excellent sample. Analytical data: K = 0.62%; $*Ar^{40}$ (44% Σ Ar^{40}); collected by: H. Powers, U.S.G.S.; dated by: Evernden and others, U. Calif., Berkeley.

27. Evernden and others, 1964 K-Ar (whole rock) 10.0±0.5 m.y.
KA 830 Ash bed in Hole-in-the-Wall Diatomite, Hemphillian (43°06'50"N, 114°53'35"W; 400'N, 1200'W of SE corner sec. 34, T. 3 S., R. 13 E.; Gooding Co., ID) Stroud Claim, near Hagerman. Analytical data: K = 4.72%; $*Ar^{40}$ (48% Σ Ar^{40}); collected by: D. Taylor and H. Powers, U.S.G.S.; dated by: Evernden and others, U. Calif., Berkeley.

SNAKE RIVER PLAIN WEST OF 114°
ALTERED ROCKS AND DISCORDANT DATES

These samples all yield dates that are much younger than the age indicated by their stratigraphic setting and/or dates on fresh rocks. Alteration of the samples resulting in Ar loss during maximum burial about 3 m.y. ago is suspected.

1. Evernden and others, 1964 K-Ar (whole rock) 3.2±0.17 m.y.
KA 832 Ash, Glenns Ferry Formation, Blancan (42°54'05"N, 115°01'50"W; 2600'N, 350'W of SE corner sec. 16, T. 6 S., R. 12 E.; Twin Falls Co., ID) 90' above Deer Gulch Basalt, near Hagerman. Hydrated ash. Analytical data: K = 3.20%; (19% Σ Ar^{40}); collected by: H. Powers, U.S.G.S.; dated by: Evernden and others, U. Calif., Berkeley.

2. Evernden and others, 1964 K-Ar (whole rock) 3.3±0.17 m.y.
KA 831 Ash, Glenns Ferry Formation, Blancan (42°49'20"N, 114°56'30"W; 4300'N, 3400'W of SE corner sec. 16, T. 7 S., R. 13 E.; Twin Falls Co., ID) 90' below Deer Gulch Basalt, near Hagerman. Hydrated ash with detrital component removed. Analytical data: K = 3.82%; $*Ar^{40}$ (23% Σ Ar^{40}); collected by: H. Powers, U.S.G.S.; dated by: Evernden and others, U. Calif., Berkeley.

3. Evernden and others, 1964 K-Ar (plagioclase-pyroxene mixture) 3.5±0.3 m.y.
KA 1173 Glenns Ferry Formation, Deer Gulch lava flow, basalt, Blancan (42°53'30"N, 115°07'50"W; 4600' N, 900'W of SE corner sec. 22, T. 6 S., R. 11 E.; Elmore Co., ID). Sample crushed and acid treated in HF. Analytical data: K = 0.232%; $*Ar^{40}$ (8% Σ Ar^{40}); collected by: H. Powers, U.S.G.S.; dated by: Evernden and others, U. Calif., Berkeley.

4. YU-70-10 L K-Ar (whole rock) 2.8±0.3 m.y.
Armstrong and others, 1975
Glenns Ferry Formation, Devils Playground lava flow, basalt (43°04'10"N, 115°12'15"W; SE¼SE¼sec. 13, T. 4 S., R. 10 E.; Elmore Co., ID). W side of tributary to King Hill Creek, N of Devils Playground. Age should be ~6 m.y., looks slightly altered. Reversed magnetic polarity. Analytical data: K = 0.506, 0.513%; $*Ar^{40}$ = 0.0606, 0.0477; 0.0447 x 10^{-6} cc/gm (7, 6, 4% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

5. YU-OB9 HP K-Ar (whole rock) 3.2±2 m.y.
Armstrong and others, 1975
Glenns Ferry Formation, Clover Creek lava flow, basalt (42°59'30"N, 115°01'45"W; SE¼NE¼sec. 16, T. 5 S., R. 12 E.; Gooding Co., ID). Age should be ~6 m.y., looks altered, 55% glassy groundmass. Reversed magnetic polarity. Analytical data: K = 0.478, 0.478%; $*Ar^{40}$ = 0.0707, 0.0490 x 10^{-6} cc/gm (2, 1% Σ Ar^{40}); collected by: H. A. Powers, U.S.G.S.; dated by: R. L. Armstrong, Yale U.

6. YU-59P318 HP K-Ar (whole rock) 3.5±0.6 m.y.
Armstrong and others, 1975
Upper Banbury Basalt (42°45'35"N, 115°27'15"W; NE¼NE¼SE¼sec. 1, T. 8 S., R. 8 E.; Owyhee Co., ID). Distinctly altered, 30% glassy groundmass, 1% clay. Age should be ~6 m.y. Analytical data: K = 0.647, 0.657, 0.654%; $*Ar^{40}$ = 0.113, 0.072 x 10^{-6} cc/gm (5, 3% Σ Ar^{40}); collected by: H. A. Powers, U.S.G.S.; dated by: R. L. Armstrong, Yale U.

7. YU-54 P93 HP K-Ar (whole rock) 4.0±0.3 m.y.
Armstrong and others, 1975
Glenns Ferry Formation, Shoestring Road lava flow, basalt (42°49'45"N, 114°55'50"W; SE¼SE¼sec. 9, T. 7 S., R. 13 E.; Twin Falls Co., ID). Age should be ~6 m.y., looks somewhat altered, 24% glassy groundmass, 2% clay. Analytical data: K = 0.581, 0.575%; $*Ar^{40}$ = 0.080, 0.107 x 10^{-6} cc/gm (8, 8% Σ Ar^{40}); collected by: H. A. Powers, U.S.G.S.; dated by: R. L. Armstrong, Yale U.

SNAKE RIVER PLAIN AND VICINITY EAST OF 114°

Most of these samples are quite fresh and yield reasonable dates. The Little Creek (YU-69-10 L) and Eagle Rock (YU-70-45 L) basalts may be slightly altered, and thus Ar deficient because their dates are much less than the 6.3 m.y. date for a later, crosscutting, unit (Massacre Volcanics, YU-69-41 L). The dates reported by Chase (1972) seem consistently slightly older and less precise than the Yale dates. They are not plotted on figure 6 although they support the chronology shown there.

1. YU-69-27 L K-Ar (whole rock)-0.02±0.05 m.y.
Armstrong and others, 1975 (whole rock) 0.07±0.09 m.y.
Grassy Cone basalt flow (Murtaugh, 1961) (43°27'15"N, 113°35'20"W; SW¼SW¼sec. 34, T. 2 N., R. 24 E.; Butte Co., ID) 1.6 mi NW of Craters of the Moon park entrance. Normal magnetic polarity. Analytical data: K = 1.44, 1.47%; $*Ar^{40}$ = 0.0013, −0.0028 x 10^{-6} cc/gm (0.3, −0.7% Σ Ar^{40}) K = 3.82, 3.76%; $*Ar^{40}$ = 0.0117, 0.0096 x 10^{-6} cc/gm (0.6, 0.5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

2. YU-69-22 L K-Ar (whole rock) -0.1±0.2 m.y.
Armstrong and others, 1975
Lava Creek basalt flow (Anderson, 1929) (43°31′15″N, 113°33′25″W; SE¼NE¼sec. 11, T. 2 N., R. 24 E.; Butte Co., ID) Pioneer Mountains, near Craters of the Moon, 2.7 mi N of US-26. Normal magnetic polarity. Analytical data: K = 1.22, 1.21%; *Ar = 0.0015, −0.0099 x 10^{-6} cc/gm (0.4, −0.5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

3. YU-70-28 L K-Ar (whole rock) -0.1±0.1 m.y.
Armstrong and others, 1975
Pumiceous rhyolite (42°49′10″N, 111°35′40″W; SE¼NW¼sec. 18, T. 7 S., R. 42 E.; Caribou Co., ID) SW side, Middle Cone, S of Blackfoot River Reservoir. Analytical data: K = 3.72, 3.87%; *Ar^{40} = -0.009, -0.019 x 10^{-6} cc/gm (-0.4, -1.1% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

4. YU-70-27 L K-Ar (whole rock) 0.04±0.02 m.y.
Armstrong and others, 1975
Pumiceous rhyolite (42°58′50″N, 111°36′20″W; NE¼SE¼sec. 13, T. 7 S., R. 41 E.; Caribou Co., ID) NW side of China Hat, S of Blackfoot River. Analytical data: K = 3.87, 3.79%; *Ar^{40} = 0.004, 0.009 x 10^{-6} cc/gm (0.8, 1.6% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

5. YU-70-26 L K-Ar (feldspar) 0.08±0.04 m.y.
Armstrong and others, 1975
Perlitic rhyolite (42°48′50″N, 111°36′20″W; NW¼NE¼SE¼sec. 13, T. 7 S., R. 41 E.; Caribou Co., ID) NW side of China Hat, S of Blackfoot River Reservoir. Analytical data: K = 4.21, 4.04%; *Ar^{40} = 0.020, 0.025, 0.003, 0.007 x 10^{-6} cc/gm (1.2, 4.6, 0.3, 0.4% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

6. YU-69M9 M K-Ar (whole rock) 0.09±0.14 m.y.
Armstrong and others, 1975
Basalt, lower of two flows in drill hole (43°54′20″N, 112°22′20″W; S½sec. 29, T. 7 N., R. 35 E.; Jefferson Co., ID) near Mud Lake on the slope of Clay Butte, 4837′ elev. Fresh, subophitic, diktytaxitic sample from 50.5 feet below surface. Analytical data: K = 0.569, 0.571%; *Ar^{40} = -0.0005, 0.0034 x 10^{-6} cc/gm (-0.1, 0.7% Σ Ar^{40}); collected by: H. E. Malde, U. S. G. S.; dated by: R. L. Armstrong, Yale U.

7. YU-900 O K-Ar (whole rock) 0.10±0.03 m.y.
Armstrong and others, 1975
Porphyritic olivine basalt (42°29′20″N, 111°43′45″W; SW¼SE¼sec. 1, T. 11 S., R. 40 E.; Caribou Co., ID) Gem Valley, 1 mi S of Niter, Lake Thatcher Basin. Analytical data: K = 0.700, 0.706%; *Ar^{40} = 0.003 (1.0% Σ Ar^{40}) (average of 13 analyses); collected by: S. S. Oriel and L. Platt, U. S. G. S.; dated by: R. Armstrong, Yale U.

8. YU-902 O K-Ar (whole rock) 0.1±0.3 m.y.
Armstrong and others, 1975
Porphyritic olivine basalt (42°32′40″N, 111°46′55″W; NE¼NE¼sec. 21, T. 10 S., R. 40 E.; Caribou Co., ID) Gem Valley, W of Grace, Lake Thatcher Basin. Analytical data: K = 0.826, 0.827%; *Ar^{40} = 0.003 (0.3% Σ Ar^{40}) (average of 3 analyses); collected by: S. S. Oriel and L. Platt, U. S. G. S.; dated by: R. L. Armstrong, Yale U.

9. YU-903 O K-Ar (whole rock) 0.1±0.4 m.y.
Armstrong and others, 1975
Porphyritic olivine basalt (42°32′00″N, 111°47′30″W; SE¼SW¼sec. 21, T. 10 S., R. 40 E.; Caribou Co., ID) Gem Valley, W of Grace, Lake Thatcher Basin. Analytical data: K = 0.871, 0.875%; *Ar^{40} = 0.004 x 10^{-6} cc/gm (0.3% Σ Ar^{40}); collected by: S. S. Oriel and L. Platt, U. S. G. S.; dated by: R. L. Armstrong, Yale U.

10. YU-69-13 L K-Ar <u>(whole rock) 0.1±0.2 m.y.</u>
Armstrong and others, 1975
Cedar Butte Basalt, flow near base of Cedar Butte (42°43'00"N, 113°01'55"W; NE¼NW¼sec. 23, T. 8 S., R. 29 E.; Power Co., ID) 10.5 mi SE of American Falls Dam. Normal magnetic polarity. <u>Analytical data</u>: K = 0.612, 0.616%; $^*Ar^{40}$ = 0.0005, 0.0049 x 10^{-6} cc/gm (0.1, 0.8% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

11. YU-69-2 L K-Ar <u>(whole rock) 0.14±0.06 m.y.</u>
Armstrong and others, 1975 <u>(whole rock) 0.14±0.04 m.y.</u>
Basalt (42°47'45"N, 112°14'55"W; NE¼SE¼sec. 21, T. 7 S., R. 36 E.; Bannock Co., ID) lowest flow at Inkom, along I-15. Normal magnetic polarity. <u>Analytical data</u>: K = 0.835, 0.810, 0.789%; $^*Ar^{40}$ = 0.0072, 0.0015 x 10^{-6} cc/gm (4, 0.4% Σ Ar^{40}). K = 0.857, 0.889, 0.832%; $^*Ar^{40}$ = 0.0047, 0.0051 x 10^{-6} cc/gm (3, 2% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

12. YU-70-38 L K-Ar <u>(whole rock)0.30±0.02 m.y.</u>
Armstrong and others, 1975
Rhyolite (43°24'25"N, 113°02'30"W; NE¼NW¼sec. 22, T. 1 N., R. 29 E.; Butte Co., ID) NW side of Big Southern Butte, capping slope above Lookout Road, W of road. <u>Analytical data</u>: K = 3.87, 3.92%; $^*Ar^{40}$ = 0.0404, 0.0535 x 10^{-6} cc/gm (9, 10% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

13. YU-62P73 HP K-Ar <u>(whole rock) 0.4±0.1 m.y.</u>
Armstrong and others, 1975
Basalt, lowest of four flows at 197' below surface (43°33'45"N, 112°56'55"W; SE¼SW¼sec. 13, T. 3 N., R. 29 E.; Butte Co., ID) National Reactor Test Site (see no. 30) U.S.G.S. No. I-4125. <u>Analytical data</u>: K = 0.455, 0.458%; $^*Ar^{40}$ = 0.0098, 0.0056 x 10^{-6} cc/gm (5, 2% Σ Ar^{40}); <u>collected by</u>: H. A. Powers, U. S. G. S.; <u>dated by</u>: R. L. Armstrong, Yale U.

14. YU-70-36 L K-Ar <u>(whole rock) 0.6±0.1 m.y.</u>
Armstrong and others, 1975
Crystal Tuff (43°29'45"N, 112°39'40"W; NW¼NW¼SW¼sec. 13, T. 2 N., R. 32 E.; Bingham Co., ID) E side of East Butte, roadcut at second switchback from base. <u>Analytical data</u>: K = 4.29, 4.23%; $^*Ar^{40}$ = 0.092, 0.102 x 10^{-6} cc/gm (5, 5% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

15. YU-69-3 L K-Ar <u>(whole rock) 0.90±0.2 m.y.</u>
Armstrong and others, 1975
Basalt flow (43°15'50"N, 112°06'15"W; SW¼NE¼sec. 10, T. 2 S., R. 37 E.; Bingham Co., ID) above Blackfoot River, 10 mi E of Wapello. Normal magnetic polarity. <u>Analytical data</u>: K = 1.70, 1.71%; $^*Ar^{40}$ = 0.0712, 0.0572 x 10^{-6} cc/gm (3, 2% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

16. YU-69-8 L K-Ar <u>(whole rock) 0.8±0.1 m.y.</u>
Armstrong and others, 1975
Basalt flow, overlies 69-6 (43°27'05"N, 111°23'40"W; NW¼NE¼sec 4, T. 1 N., R. 43 E.; Bonneville Co., ID) 3 mi W of Swan Valley, along US-26. Normal magnetic polarity. <u>Analytical data</u>: K = 0.605, 0.619, 0.608%; $^*Ar^{40}$ = 0.0237, 0.0155 x 10^{-6} cc/gm (7, 4% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

17. YU-69-5 L K-Ar <u>(feldspar) 0.94±0.05 m.y.</u>
Armstrong and others, 1975 <u>(feldspar) 1.09±0.04 m.y.</u>
Rhyolite tuff, probably Mesa Falls Tuff on the Yellowstone Group (44°07'30"N, 111°26'25"W; SE¼NE¼sec. 12, T. 9 N., R. 42 E.; Fremont Co., ID) Island Park area, along US-191, N of Ashton, Precaldera ash flow (Qrs) of Hamilton (1965). <u>Analytical data</u>: K = 7.76, 7.70, 7.69%; $^*Ar^{40}$ = 0.294, 0.290 x 10^{-6} cc/gm (5, 41% Σ Ar^{40}) K = 4.26, 4.44%; $^*Ar^{40}$ = 0.198, 0.183 x 10^{-6} cc/gm (18, 26% Σ Ar^{40}); <u>collected by</u>: W. P. Leeman, U. Ore.; <u>dated by</u>: R. L. Armstrong, Yale U.

18. YU-70-35 L K-Ar (whole rock) 1.9±1.2 m.y.
Armstrong and others, 1975
Basalt (43°29'45"N, 112°44'30"W; NE¼SE¼sec. 18, T. 2 N., R. 32 E.; Bingham Co., ID) N side Middle Butte, Nuclear Reactor Test Site. Large analytical error, result not terribly useful. Analytical data: K = 0.388, 0.390%; $*Ar^{40}$ = 0.0207, 0.0409 x 10^{-6} cc/gm (0.9, 1.5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

19. YU-928 A K-Ar (whole rock) 2.3±0.3 m.y.
Armstrong and others, 1975 Sr^{87}/Sr^{86} = 0.7073±.0006
(Alb 1324) Olivine basalt, subophitic-intergranular (42°24'42"N, 113°43'18"W; NE¼NW¼sec. 1, T. 12 S., R. 23 E.; Cassia Co., ID) summit of Antelope Hill, SE of Burley. Analytical data: K - 0.343, 0.333%; $*Ar^{40}$ = 0.027, 0.037 x 10^{-6} cc/gm (6, 5% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

20. YU-69-6 L K-Ar (whole rock) 3.65±0.1 m.y.
Armstrong and others, 1975
Felsic lava (43°27'00"N, 112°22'45"W; NE¼NW¼sec. 3, T. 1 N., R. 43 E.; Bonneville Co., ID) along US-26, 2.3 mi W of Swan Valley. Reversed magnetic polarity. Analytical data: K = 0.979, 0.987; $*Ar^{40}$ = 0.140, 0.145 x 10^{-6} cc/gm (29, 20% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

21. YU-69-9 L K-Ar (whole rock) 4.10±0.13 m.y.
Armstrong and others, 1975 (whole rock) 4.13±0.14 m.y.
(feldspar) 4.70±0.10
Welded ash flow (43°29'15"N, 111°54'15"W; NW¼NW¼SW¼sec. 20, T. 2 N., R. 39 E.; Bonneville Co., ID) overlies bedded tuff at quarry, 3 mi E of Ammon. Analytical data: K = 4.18, 4.19%; $*Ar^{40}$ = 0.694, 0.678 x 10^{-6} cc/gm (22, 23% Σ Ar^{40}) K = 4.29, 4.23%; $*Ar^{40}$ = 0.709, 0.697 x 10^{-6} cc/gm (22, 21% Σ Ar^{40}) K = 2.29, 2.44%; $*Ar^{40}$ = 0.448 x 10^{-6} cc/gm (38% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

22. YU-69-10 L K-Ar (whole rock) 4.8±0.3 m.y.
Armstrong and others, 1975
Little Creek Basalt (42°46'40"N, 112°52'45"W; SE¼SW¼sec. 30, T. 7 S., R. 31 E.; Power Co., ID) below American Falls Dam, W side of Snake River. Reversed magnetic polarity. Analytical data: K = 0.255, 0.247, 0.242%; $*Ar^{40}$ = 0.0452, 0.0491 x 10^{-6} cc/gm (11, 12% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

23. YU-69-11 L K-Ar (whole rock) 4.9±0.17 m.y.
Armstrong and others, 1975 (whole rock) 5.7±0.21 m.y.
Rhyolite welded ash flow, probably Walcott Tuff (42°46'25"N, 112°52'30"W; NW¼NW¼NE¼sec. 31, T. 7 S., R. 31 E.; Power Co., ID) below American Falls Dam. Hydrated glass. Analytical data: K = 4.57, 4.56%; $*Ar^{40}$ = 0.805, 0.965 x 10^{-6} cc/gm (24, 20% Σ Ar^{40}) K = 4.54, 4.51%; $*Ar^{40}$ = 1.03, 1.03 x 10^{-6} cc/gm (22, 23% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

24. YU-69-12 L K-Ar (whole rock) 6.2±0.09 m.y.
Armstrong and others, 1975
Obsidian pellets from spherulitic welded ash flow tuff above Walcott Tuff(?) sample 69-11 L (42°46'25"N, 112°52'30"W; NW¼NW¼NE¼sec. 31, T. 7 S., R. 31 E.; Power Co., ID) below American Falls Dam. Best date for Walcott Tuff, in agreement with other Yale and U.S.G.S. dates but not with result from hydrated glass 69-11 L which has lost some radiogenic Ar. Analytical data: K = 4.22, 4.24%; $*Ar^{40}$ = 1.06, 1.03 x 10^{-6} cc/gm (80, 59% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

25. YU-776 A K-Ar (whole rock) 6.3±0.3 m.y.
Armstrong and others, 1975
Walcott Tuff, densely welded vitric tuff (42°46'45"N, 112°50'50"W; NW¼NW¼sec. 33, T. 7 S., R. 31 E.; Power Co., ID) near American Falls. Analytical data: K = 4.21, 4.16%; $*Ar^{40}$ = 1.04, 1.05 x 10^{-6} cc/gm (16, 14% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

26. YU-QT V2 A K-Ar (whole rock) 6.3±0.1 m.y.
Armstrong and others, 1975
Rhyolite ash flow (43°15'10"N, 112°04'55"W; NE¼NE¼sec. 14, T. 2 S., R. 37 E.; Bingham Co., ID) Blackfoot River, E of Blackfoot. Analytical data: K = 4.20, 4.24%; $^*Ar^{40}$ = 1.066, 1.067 x 10^{-6} cc/gm (61, 54% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

27. YU-70-19B L K-Ar (feldspar) 6.5±0.1 m.y.
Armstrong and others, 1975
Starlight Formation, vitric crystal tuff, vitrophyre in upper part of the formation (42°47'15"N, 112°50'15"W; SW¼NE¼sec. 28, T. 7 S., R. 31 E.; Power Co., ID) SE of American Falls along I-15. Analytical data: K = 3.04, 3.01%; $^*Ar^{40}$ = 0.791, 0.768, 0.833 x 10^{-6} cc/gm (43, 28, 33% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

28. YU-70-20 L K-Ar (feldspar) 7.7±0.1 m.y.
Armstrong and others, 1975
Starlight Formation, Arbon Valley Tuff marker in middle of the formation (42°46'50"N, 112°40'55"W; SE¼ sec. 26, T. 7 S., R. 32 E.; Power Co., ID) in hills between Blind Spring and Bannock Creeks. Analytical data: K = 4.33, 4.42%; $^*Ar^{40}$ = 1.37, 1.32 x 10^{-6} cc/gm (55, 58% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

29. YU-794 A K-Ar (whole rock) (Glass) 8.5±0.3 m.y.
Armstrong and others, 1975
Vitric ash flow (42°11'44"N, 113°55'32"W; NW¼NW¼sec. 19, T. 14 S., R. 22 E.; Cassia Co., ID) Trapper Creek Road, Goose Creek Reservoir. Analytical data: K = 4.09, 4.06, 4.11%; $^*Ar^{40}$ = 1.40 x 10^{-6} cc/gm (44% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

30. YU-929 A K-Ar (whole rock) 8.4±0.2 m.y.
Armstrong and others, 1975
(Alb 1582) Vitric ash flow, devitrified (42°10'51"N, 113°50'52"W; NE¼NE¼sec. 27, T. 14 S., R. 22 E.; Cassia Co., ID) S of Oakley, N of Middle Mountain. Analytical data: K = 4.02, 3.95%; $^*Ar^{40}$ = 1.34 x 10^{-6} cc/gm (50% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

31. YU-805 A K-Ar (whole rock) 8.5±0.2 m.y.
Armstrong and others, 1975
Tridymite-rich vitric ash flow, devitrified (42°15'27"N, 113°38'52"W; SE¼SE¼sec. 28, T. 13 S., R. 24 E.; Cassia Co., ID) Elba-Oakley road, Albion Range. Analytical data: K = 4.05, 4.11, 4.09%; $^*Ar^{40}$ = 1.40 x 10^{-6} cc/gm (69% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

32. YU-801 A K-Ar (whole rock) 9.2±0.5 m.y.
Armstrong and others, 1975 (feldspar) 9.1±0.4 m.y.
Vitrophyre of rhyolite flow (42°16'17"N, 113°31'02"W; SW¼SE¼sec. 22, T. 13 S., R. 25 E.; Cassia Co., ID) Malta Range, NE of Elba. Analytical data: K = 3.22, 3.24%; $^*Ar^{40}$ = 1.18 x 10^{-6} cc/gm (18% Σ Ar^{40}) K = 1.54, 1.53%; $^*Ar^{40}$ = 0.560 x 10^{-6} cc/gm (22% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

33. YU-927 A K-Ar (whole rock) 9.2±1.5 m.y.
Armstrong and others, 1975 Sr^{87}/Sr^{86} = 0.7067±.0006 m.y.
(Alb 1467) Ophitic olivine basalt (42°27'30"N, 113°28'30"W; NW¼NE¼sec. 24, T. 11 S., R. 25 E.; Cassia Co., ID) Malta Range NE of Albion. Analytical data: K = 0.099, 0.112, 0.095%; $^*Ar^{40}$ = 0.035, 0.040 x 10^{-6} cc/gm (5, 6% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

34. YU-70-21 L K-Ar (whole rock) 9.6±0.1 m.y.
Armstrong and others, 1975
Tuff of Arbon Valley (?), crystal vitric tuff (43°05'25"N, 112°14'00"W; NE¼NW¼sec. 10, T. 4 S., R. 36 E.; Bingham Co., ID) along Cosgrove Road on crest of divide, S of Lincoln Creek. Analytical data: K = 3.76, 3.77%; $^*Ar^{40}$ = 1.46, 1.46, 1.40 x 10^{-6} cc/gm (69, 78, 50% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

35. YU-TAV1 A K-Ar (feldspar) 10.3±0.14 m.y.
Armstrong and others, 1975
Tuff of Arbon Valley (?), crystal tuff (43°05'45"N, 112°14'20"W; SW¼SW¼sec. 3, T. 4 S., R. 36 E.; Bingham Co., ID) summit, Cosgrove Road. In good agreement with 70-21 L but distinctly older than dates on feldspar for the same unit closer to American Falls. Analytical data: K = 6.85, 6.91%; $^*Ar^{40}$ = 2.83, 2.87 x 10^{-6} cc/gm (86, 76% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

36. YU-924 R K-Ar (whole rock) 10.4±0.14 m.y.
Armstrong and others, 1975
Vitric ash flow, devitrified, near top of section (42°27'20"N, 113°07'30"W; NW¼NE¼sec. 24, T. 11 S., R. 28 E.; Cassia Co., ID) Sublett Range, SE of Heglar. Analytical data: K = 4.31, 4.26%; $^*Ar^{40}$ = 1.81, 1.79 x 10^{-6} cc/gm (55, 51% Σ Ar^{40}); collected by: L. Rychener, Yale U.; dated by: R. L. Armstrong, Yale U.

37. YU-922 R K-Ar (whole rock) 8.2±0.2 m.y.
Armstrong and others, 1975
Vitric ash flow, glassy, near middle of section (42°27'20"N, 113°07'30"W; NW¼NE¼sec. 24, T. 11 S., R. 28 E.; Cassia Co., ID) Sublett Range, SE of Heglar. Analytical data: K = 4.35, 4.36%; $^*Ar^{40}$ = 1.45, 1.45 x 10^{-6} cc/gm (36, 31% Σ Ar^{40}); collected by: L. Rychener, Yale U.; dated by: R. L. Armstrong, Yale U.

38. YU-921 R K-Ar (biotite) 10.8±0.2 m.y.
Armstrong and others, 1975 (feldspar) 9.4±0.14 m.y.
Vitric ash flow, at base of section (42°27'20"N, 113°07'30"W; NW¼NE¼sec. 24, T. 11 S., R. 28 E.; Cassia Co., ID) Sublett Range, SE of Heglar. Analytical data: K = 6.08, 6.07%; $^*Ar^{40}$ = 2.65, 2.59 x 10^{-6} cc/gm (43, 47% Σ Ar^{40}) K = 8.94, 8.86%; $^*Ar^{40}$ = 3.32, 3.33 x 10^{-6} cc/gm (77, 85% Σ Ar^{40}); collected by: L. Rychener, Yale U.; dated by: R. L. Armstrong, Yale U.

39. YU-Alb 2490 A K-Ar (sanidine) 12.8±0.4 m.y.
Armstrong and others, 1975
Crystal-rich rhyolite vitrophyre from dome (42°00'01"N, 113°53'40"W; NE¼NE¼sec. 32, T. 16 S., R. 22 E.; Cassia Co., ID) 4.5 mi E of Goose Creek, 0.5 mi N of Idaho-Utah state line. Analytical data: K = 5.80, 5.71%; $^*Ar^{40}$ = 2.94 x 10^{-6} cc/gm (65% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

40. YU-70-45 L K-Ar (whole rock) 4.9±0.7 m.y.
Armstrong and others, 1975
Eagle Rock Basalt (Massacre Volcanics) (42°41'45"N, 112°57'30"W; NW¼SW¼sec. 28, T. 8 S., R. 30 E.; Power Co., ID) I-15, SW of American Falls. Reversed magnetic polarity. Analytical data: K = 0.095, 0.095%; $^*Ar^{40}$ = 0.0170, 0.0196 x 10^{-6} cc/gm (4, 6% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

41. YU-69-41 L K-Ar (whole rock) 6.1±0.2 m.y.
Armstrong and others, 1975 (whole rock) 6.5±0.6 m.y.
Massacre Volcanics, basalt plug, Massacre Rocks (42°40'10"N, 112°59'15"W; NE¼NE¼sec. 6, T. 9 S., R. 30 E.; Power Co., ID) along US-30, W of American Falls. Reversed magnetic polarity. Analytical data: K = 0.373, 0.365%; $^*Ar^{40}$ = 0.0931, 0.0875 x 10^{-6} cc/gm (17, 27% Σ Ar^{40}) K = 0.347, 0.339, 0.335, 0.334%; $^*Ar^{40}$ = 0.0863, 0.0915 x 10^{-6} cc/gm (20, 5% Σ Ar^{40}); collected by: W. P. Leeman, U. Ore.; dated by: R. L. Armstrong, Yale U.

42. Marvin and others, 1970 K-Ar (whole rock) 6.1±0.3 m.y.
Walcott Tuff, nonhydrated glass near base (42°45'25"N, 112°52'28"W; Power Co., ID). Analytical data: K_2O = 5.18%; $^*Ar^{40}$ = 0.4694 x 10^{-10} moles/gm (82% Σ Ar^{40}); collected by: I. Friedman, U. S. G. S.; dated by: R. F. Marvin and H. H. Mehnert, U. S. G. S.

43. Williams, 1964 K-Ar (glass shards) 11.6±1.4 m.y.
A-Salt Lake Formation, vitric tuff close to base of section (42°22'30"N; 112°02'50"W; SE corner sec. 18, T. 12 S., R. 38 E.; Bannock Co., ID) where road to Marsh Creek Canyon leaves the north-south road, close to Red Rock Pass, 4-5 mi SE of Downey. Analytical data: none reported; collected by: J. S. Williams, Utah State Univ.; dated by: Geochron Labs. Inc.

44. Chase, 1972 K-Ar (whole rock) <1.0 m.y.
R 13 Basalt (43°43'50"N, 112°31'40"W; SE¼sec. 25, T. 5 N., R. 33 E.; Jefferson Co., ID) NE of EBR-II about 12 mi. Analytical data: K = 0.56%; $*Ar^{40}$ not measurable; collected by: G. H. Chase, U. S. G.S.; dated by: Isotopes Inc.

45. Chase, 1972 K-Ar (whole rock) <1.2 m.y.
R 12 Basalt (43°35'25"N, 112°56'55"W; N edge sec. 13, T. 3 N., R. 29 E.; Butte Co., ID) near TRA (199 feet deep). Analytical data: K = 0.42%; $*Ar^{40}$ not measurable; collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

46. Chase, 1972 K-Ar (whole rock) <1.5 m.y.
R 11 Basalt (43°33'40"N, 112°35'45"W; NW¼sec. 28, T. 3 N., R. 33 E.; Bingham Co., ID) near Tower Butte. Analytical data: K = 0.59%; $*Ar^{40}$ not measurable; collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

47. Chase, 1972 K-Ar (whole rock) 0.7±0.2 m.y.
R 6 Silicic volcanic rocks (43°23'45"N, 113°01'10"W; sec. 23, T. 1 N., R. 29 E.; Butte Co., ID) top of Big Southern Butte. Armstrong, Leeman and Malde (1974) obtained 0.30 ±0.02 m.y. for same unit. Analytical data: K = 0.71%; $*Ar^{40} = 0.10 \times 10^{-6}$ cc/gm (5% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

48. Chase, 1972 K-Ar (whole rock) 0.9±0.8 m.y.
R 14 Basalt (43°23'30"N, 112°54'35"W; N½sec. 26, T. 1 N., R. 30 E.; Bingham Co., ID) N flank of Cedar Butte. Analytical data: K = 2.78%; $*Ar^{40} = 0.1 \times 10^{-6}$ cc/gm (3% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

49. Chase, 1972 K-Ar (whole rock) 1.0±0.4 m.y.
R 9 Silicic volcanic rock (43°30'00"N, 112°39'40"W; NW¼sec. 13, T. 2 N., R. 32 E.; Bingham Co., ID) E side of East Butte. Armstrong, Leeman and Malde (1974) obtained 0.6 ± 0.1 for this same unit. Analytical data: K = 3.69%; $*Ar^{40} = 0.156 \times 10^{-6}$ cc/gm (8% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

50. Chase, 1972 K-Ar (whole rock) 1.0±0.6 m.y.
R 4 Basalt (43°24'55"N, 113°01'45"W; SW¼sec. 14, T. 1 N., R. 29 E.; Butte Co., ID) N flank of Big Southern Butte. Analytical data: K = 0.67%; $*Ar^{40} = 0.03 \times 10^{-6}$ cc/gm (4% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

51. Chase, 1972 K-Ar (whole rock) 1.7±0.8 m.y.
R 3 Basalt (43°24'40"N, 112°53'50"W; SW corner sec. 13, T. 1 N., R. 30 E.; Bingham Co., ID) rift flow NE of Cedar Butte. Analytical data: K = 0.71%; $*Ar^{40} = 0.05 \times 10^{-6}$ cc/gm (5% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

52. Chase, 1972 K-Ar (whole rock) 2.3±0.7 m.y.
R 2 Basalt (43°49'40"N, 112°41'30"W; SW corner sec. 22, T. 6 N., R. 32 E.; Butte Co., ID) near EBOR (428 ft depth). Analytical data: K = 0.55%; $*Ar^{40} = 0.050 \times 10^{-6}$ cc/gm (4% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

53. Chase, 1972 K-Ar (whole rock) 2.7±0.6 m.y.
R 1 Basalt (43°49'40"N, 112°41'30"W; SW corner sec. 22, T. 6 N., R. 32 E.; Butte Co., ID) near EBOR (59 ft depth). Analytical data: K = 0.56%; $*Ar^{40} = 0.062 \times 10^{-6}$ cc/gm (6% ΣAr^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

54. Chase, 1972 K-Ar (whole rock) 3.5±0.4 m.y.
R 7 Basalt (43°29'30"N, 112°44'15"W; sec. 20, T. 2 N., R. 32 E.; Bingham Co., ID) caprock of Middle Butte. A sample of this same unit (70-35L) run at Yale gave a date of 1.9 ± 1.0 m.y. Analytical data: K = 0.47%; $*Ar^{40}$ = 0.07 x 10^{-6} cc/gm (6% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

55. Chase, 1972 K-Ar (whole rock) 3.6±0.7 m.y.
R 8 Basalt (43°29'00"N, 112°43'45"W; center sec. 20, T. 2 N., R. 32 E.; Bingham Co., ID) E lip of small crater at southeastern base of Middle Butte. Analytical data: K = 0.71%; $*Ar^{40}$ = 0.10 x 10^{-6} cc/gm (3% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

56. Chase, 1972 K-Ar (whole rock) 5.4±0.8 m.y.
R 5 Basalt (44°04'05"N, 112°47'30"W; NW¼sec. 35, T. 9 N., R. 31 E.; Clark Co., ID) caprock of Scott Butte. Analytical data: K = 1.10%; $*Ar^{40}$ = 0.24 x 10^{-6} cc/gm (9% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

57. Chase, 1972 K-Ar (whole rock) 8.6±6.0 m.y.
R 10 Basalt (43°27'10"N, 113°14'05"W; SE¼sec. 33, T. 2 N., R. 27 E.; Butte Co., ID) Drill cuttings from 1170 - 1200 feet depth. An exceedingly inaccurate date, any use or citation should be avoided. Analytical data: K = 0.43%; $*Ar^{40}$ = 0.137 x 10^{-6} cc/gm (3% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

58. Chase, 1972 K-Ar (whole rock) 8.9±1.5 m.y.
R 18 Silicic volcanic rocks (43°52'10"N, 112°49'15"W; NE¼sec. 12, T. 6 N., R. 30 E.; Butte Co., ID) mine shaft W of TAN (225-347 ft depth). Analytical data: K = 3.59%; $*Ar^{40}$ = 1.31 x 10^{-6} cc/gm (26% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

59. Chase, 1972 K-Ar (whole rock) 10.0±5.0 m.y.
R 19 Basalt (43°52'10"N, 112°49'15"W; NE¼sec. 12, T. 6 N., R. 30 E.; Butte Co., ID) mine shaft W of TAN (115 - 190 ft depth). An exceedingly inaccurate date, any use or citation should be avoided. Analytical data: K = 0.33%; $*Ar^{40}$ = 0.21 x 10^{-6} cc/gm (6% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

WEST-CENTRAL IDAHO

A single date is available for a Pliocene basalt flow in the St. Joe Valley. Such young flows are rather rare in central and northern Idaho.

1. Gray and Kittleman, 1967 K-Ar (whole rock) 3.1±0.8 m.y.
UO-106 K Ar St. Maries basalt (47°15'30"N, 116°31'10"W; SW¼sec. 7, T. 45 N., R. 1 W.; Benewah Co., ID) roadcut on E side US Alt 95, 5 mi SE of St. Maries. Result thought to be anomalously young, by authors, but is in accord with a suggestion by Dort (1967) that the St. Maries basalt is Pliocene, distinctly younger than Columbia River Basalt. 19% glass. Analytical data: K = 0.90%; $*Ar^{40}$ = 0.11 x 10^{-6} cc/gm (7% Σ Ar^{40}); collected by: J. Gray and L. R. Kittleman, U. of Oregon; dated by: Isotopes Inc.

COLUMBIA RIVER BASALT

The definitive study of the chronology of this group of flood basalts is by Watkins and Baksi (1974). They demonstrate that eruptions occurred largely between 13 and 16 m.y. ago from several sources in and around the Columbia Plateau. These rocks have been dated at several localities along the western edge of Idaho. There, the basalts unconformably overlap deformed older rocks and intertongue with fluviatile and lacustrine sediments (Latah Formation). The several dates reported by Gray and Kittleman (1967) scatter badly and are dubious to distinctly anomalous. They thus should be used with reservation. Dikes of similar petrologic character to the basalt flows cut the Idaho batholith, and yield dates that support the correlation with Columbia River Basalt inferred by Taubeneck (1970).

1. Evernden and James, 1964 K-Ar (plagioclase) 12.1±0.4 m.y.
KA 1292 Basalt overlying Whitebird Lake Beds, Latah Formation, Hemingfordian (45°46′50″N, 116°16′40″ W; NW¼sec. 12, T. 28 N., R. 1 E.; Idaho Co., ID) 1.8 mi N of Whitebird on Highway 95. 27% glass, date may be low. Analytical data: K = 0.125%; $^*Ar^{40}$ (22% Σ Ar^{40}); collected by: G. T. James, U. Calif., Berkeley; dated by: J. F. Evernden, U. Calif., Berkeley.

2. Gray and Kittleman, 1967 K-Ar (plagioclase) 97±2 m.y.
UO-107 K Ar Potlatch Creek, Miocene, volcanic breccia (46°31′15″N, 116°44′55″W; E½sec. 30, T. 37 N., R. 3 W.; Nez Perce Co., ID) roadcut NW of Potlatch Creek on Idaho 42, 3 mi NE of Arrow Junction. Detrital? Result entirely unexpected; needs confirmation before it can be taken seriously. Contamination suspected. Analytical data: K = 1.25%; $^*Ar^{40}$ = 4.97 x 10^{-6} cc/gm (74% Σ Ar^{40}); collected by: J. Gray and L. R. Kittleman, U. of Oregon; dated by: Isotopes Inc.

3. Gray and Kittleman, 1967 K-Ar (whole rock) 25±4 m.y.
UO-108 K Ar Potlatch Creek "Lower" basalt (46°31′15″N, 116°44′55″W; E½sec. 30, T. 37 N., R. 3 W.; Nez Perce Co., ID). Date probably too old, error unusually large. 3% glass. Analytical data: K = 0.54%; $^*Ar^{40}$ = 0.54 x 10^{-6} cc/gm (27, 25, 22% Σ Ar^{40}); collected by: J. Gray and L. R. Kittleman, U. of Oregon; dated by: Rice U.

4. Gray and Kittleman, 1967 K-Ar (glass shards) 13.5±0.5 m.y.
(feldspar) 23.6±0.8 m.y.
UO-109 K Ar Whitebird Lake Beds, vitric tuff (45°47′00″N, 116°16′30″W; W½NE¼sec. 12, T. 28 N., R. 1 E; Idaho Co., ID) US-95, 1.25 mi NE of Whitebird. 100% glass and an albite and andesine mixture dated. Feldspar suspected to be contaminated. Glass date may be low. Analytical data: Glass shards: K = 5.7%; $^*Ar^{40}$ = 3.08 x 10^{-6} cc/gm, air correction not reported. Feldspar: $^*Ar^{40}$ = 1.79 x 10^{-6} cc/gm (42% Σ Ar^{40}); collected by: J. Gray and L. R. Kittleman, U. of Oregon; dated by: Isotopes Inc.

5. Gray and Kittleman, 1967 K-Ar (whole rock) 21.3±0.6 m.y.
UO-110 K Ar Rock Creek Member "Lower" basalt (45°53′50″N, 116°21′00″W; SE¼NE¼sec. 32, T. 30 N., R. 1 E.; Idaho Co., ID) 10 mi S of Cottonwood on gravel road NE of Salmon River. 6% glass. Analytical data: K = 0.76%; $^*Ar^{40}$ = 0.65 x 10^{-6} cc/gm (54% Σ Ar^{40}); collected by: J. Gray, U. of Oregon and J. G. Bond, Idaho Bur. Mines; dated by: Isotopes Inc.

6. Gray and Kittleman, 1967 K-Ar (whole rock) 19.5±0.5 m.y.
(duplicate whole rock) 23.1±2.0 m.y.
UO-111 K Ar Lolo Creek Member "Upper" basalt (46°32′20″N, 116°26′00″W; SE¼NE¼sec. 22, T. 37 N., R. 1 W.; Clearwater Co., ID) Highway 7, 2.5 mi N of Clearwater River. Rice date considered too large. 11% glass. Analytical data: K = 0.83%; $^*Ar^{40}$ = 0.65 x 10^{-6} cc/gm (46% Σ Ar^{40}) Duplicate sample: K = 0.83%; $^*Ar^{40}$ = 0.77 x 10^{-6} cc/gm (35, 25, 24% Σ Ar^{40}); collected by: J. Gray, U. of Oregon and J. G. Bond, Idaho Bur. Mines; dated by: Isotopes Inc., duplicate sample dated by Rice U.

7. Gray and Kittleman, 1967 K-Ar (whole rock) 19.5±0.6 m.y.
UO-112 K Ar Whiskey Creek Member "Upper" basalt (46°29′00″N, 116°10′35″W; NW¼sec. 11, T. 36 N., R. 2 E.; Clearwater Co., ID) gravel road on divide between Deer and Orofino Creeks, 2.25 mi E of Orofino, 52% glass. Analytical data: K = 1.39%; $^*Ar^{40}$ = 1.09 x 10^{-6} cc/gm (63% Σ Ar^{40}); collected by: J. Gray, U. of Oregon and J. G. Bond, Idaho Bur. Mines; dated by: Isotopes Inc.

8. Baksi and Watkins, 1973 K-Ar (Flow 6 whole rock) 15.0±0.5 m.y.
Watkins and Baksi, 1974 (Flow 12 whole rock) 15.4±0.5 m.y.
Lapwai Creek Basalt (46°20′N, 116°36′W; Nez Perce Co., ID). Analytical data: K = 1.21%; $^*Ar^{40}$ = 0.729 x 10^{-6} cc/gm (66% Σ Ar^{40}) K = 1.19%; $^*Ar^{40}$ = 0.737 x 10^{-6} cc/gm (79% Σ Ar^{40}); collected by: N. Watkins, U. Rhode Island; dated by: A. Baksi, U. Toronto.

9. YU-64-44 CWF K-Ar (whole rock) 17.0±1.5 m.y.
Armstrong and others, 1975
Yakima Basalt (44°47′45″N, 116°44′45″W; NE¼SW¼sec. 19, T. 17 N., R. 3 W.; Washington Co., ID) near Hornet Reservoir. Analytical data: K = 1.21, 1.21%; $^*Ar^{40}$ = 0.779, 0.807, 0.887 x 10^{-6} cc/gm (6, 8, 6% ΣAr^{40}); collected by: C. W. Field, Ore. State U.; dated by: R. L. Armstrong, Yale U.

10. YU-423 WT K-Ar (whole rock) 15.2±0.5 m.y.
Armstrong and others, 1975
Basalt dike (44°03′40″N, 115°41′30″W; SW¼NE¼sec. 1, T. 8 N., R. 6 E.; Boise Co., ID) S Fork Payette River, 5.7 mi W of Lowman, 0.3 mi E of Rattlesnake Gulch. Analytical data: K = 0.355, 0.363%; $^*Ar^{40}$ = 0.203, 0.230, 0.217 x 10^{-6} cc/gm (15, 29, 12% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: R. L. Armstrong, Yale U.

11. YU-342 WT K-Ar (whole rock) 15.1±0.7 m.y.
Armstrong and others, 1975
Basalt dike (43°22′50″N, 115°25′45″W; Center sec. 31, T. 1 N., R. 9 E.; Elmore Co., ID) near Anderson Ranch Dam. Analytical data: K = 1.29, 1.28%; $^*Ar^{40}$ = 0.771, 0.777 x 10^{-6} cc/gm (10, 20% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: R. L. Armstrong, Yale U.

12. YU-339 WT K-Ar (whole rock) 12.1±1.2 m.y.
Armstrong and others, 1975
Basalt dike (43°20′55″N, 115°27′10″W; NE¼SW¼sec. 12, T. 1 S., R. 8 E.; Elmore Co., ID) near Anderson Ranch Dam. Date seems a bit low–true age probably 15 to 17 m.y. Analytical data: K = 0.965, 0.968%; $^*Ar^{40}$ = 0.467, 0.474 x 10^{-6} cc/gm (5, 8% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: R. L. Armstrong, Yale U.

CHALLIS VOLCANIC – PLUTONIC EPISODE

Idaho was profoundly affected by a brief but intense period of igneous and metamorphic activity during the Eocene. The dates for rocks formed or metamorphosed between 38 m.y. and 54 m.y. were discussed by Armstrong (1974).

CHALLIS VOLCANIC ROCKS

These dates which range from 38.7 to 49.9 m.y. are from samples judged to be reasonably reliable indicators of the time span of volcanism.

1. YU-CWF 12-9-X K-Ar (whole rock) 47.7±1.4 m.y.
Armstrong, 1974
Welded rhyolite ash flow tuff (44°44′50″N, 116°36′50″W; NE¼NE¼sec. 18, T. 16 N., R. 2 W.; Adams Co., ID) 9 mi W of Council (King, 1971). Analytical data: K = 3.65, 3.65%; $^*Ar^{40}$ = 7.39, 7.13, 6.67 x 10^{-6} cc/gm (37, 46, 48% ΣAr^{40}); collected by: J. R. King, Ore. State U.; dated by: R. L. Armstrong, Yale U.

2. YU-TALBR3LT and K-Ar (whole rock) (LT) 46.2±1.4 m.y.
YU-TALBR3DRK (whole rock) (DRK) 41.5±1.2 m.y.
Armstrong, 1974
Volcanic breccia – fragments of andesite composed of decomposed olivine grains in an intergranular clinopyroxene-plagioclase matrix (43°09′20″N, 112°01′30″W; NE¼SE¼sec. 17, T. 3 S., R. 38 E.; Bingham Co., ID) Wood Creek, W of Blackfoot. DRK sample is noticably more altered than LT. Analytical data: K = 1.72, 1.70%; $^*Ar^{40}$ = 3.19 x 10^{-6} cc/gm (83% ΣAr^{40}) K = 1.89, 1.92%; $^*Ar^{40}$ = 3.19 x 10^{-6} cc/gm (68% ΣAr^{40}); collected and dated by: R. L. Armstrong, Yale U.

3. YU-875 K-Ar (biotite) 47.3±1.4 m.y.
Armstrong, 1974
LR5 Casto Volcanics, biotite angite andesite (44°33'50"N, 114°47'30"W; T. 14 N., R. 14 E.; Custer Co., ID) Mayfield Creek area near "Casto". Analytical data: K = 6.67, 6.67%; $*Ar^{40}$ = 12.77 x 10^{-6} cc/gm (58% Σ Ar^{40}); collected and dated by: L. Rychener, Yale U.

4. YU-1026 K-Ar (whole rock) 45.6±1.4 m.y.
Armstrong, 1974
Challis Volcanics, Latite-Andesite Member (44°30'05"N, 114°16'45"W; NE¼sec. 36, T. 14 N., R. 18 E.; Custer Co., ID) Cartwright Gulch. D. H. McIntyre reports the rock to be rhyodacite-quartz latite. The specimen is medium dark gray, aphanitic, with 2-3 mm plagioclase lath phenocrysts. Analytical data: K = 2.99, 3.00%; $*Ar^{40}$ = 5.41, 5.61 x 10^{-6} cc/gm (44, 29% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

5. YU-1027 K-Ar (whole rock) 49.0±1.5 m.y.
Armstrong, 1974
Basalt in Challis Volcanics (44°29'15"N, 114°19'15"W; NE¼sec. 3, T. 13 N., R. 18 E.; Custer Co., ID) Mill Creek, near the base of the local section according to D. H. McIntyre. The specimen is a dark gray aphanitic basalt. Analytical data: K = 1.87, 1.90%; $*Ar^{40}$ = 3.75, 3.71 x 10^{-6} cc/gm (28, 28% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

6. YU-1028 K-Ar (feldspar) 48.0±1.4 m.y.
Armstrong, 1974
Challis Volcanics "Latite" (44°27'20"N, 114°18'35"W; W½sec. 16, T. 13 N., R. 19 E.; Custer Co., ID) Highway 93. D. H. McIntyre reports that the rock is probably a rhyodacite. The specimen appears to be a yellowish brown latite-andesite with 2-3 mm plagioclase laths in an altered aphanitic groundmass. Analytical data: K = 2.30, 2.31%; $*Ar^{40}$ = 4.47 x 10^{-6} cc/gm (54% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

7. YU-1029 K-Ar (whole rock) 46.9±1.4 m.y.
Armstrong, 1974
Challis Volcanics, K-rich slightly greenish, medium dark gray aphanitic basalt in Germer Tuffaceous Member (44°21'30"N, 114°15'30"W; NE¼sec. 17, T. 12 N., R. 19 E.; Custer Co., ID) along Highway 93. D. H. McIntyre reports that this unit may be intrusive. These rocks are stratigraphically below the latite of sample YU-1028. Analytical data: K = 1.53, 1.55%; $*Ar^{40}$ = 2.90, 2.94 x 10^{-6} cc/gm (30, 26% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

8. YU-1031 K-Ar (feldspar) 38.7±1.2 m.y.
Armstrong, 1974
Challis Volcanics, latite vitrophyre dike (44°26'00"N, 114°11'50"W; NE¼sec. 27, T. 13 N., R. 19 E.; Custer Co., ID) Bradbury Flat. Intrusive (?) complex covers several square mi. D. H. McIntyre reports puzzling field relationships but the unit seems distinctly younger than the surrounding Challis latite (like sample YU-1028). Medium dark gray porphyritic latite with 2-3 mm equant plagioclase phenocrysts. Analytical data: K = 1.02, 1.03, 1.07, 1.05%; $*Ar^{40}$ = 1.65, 1.60 x 10^{-6} cc/gm (27, 33% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

9. YU-1032 K-Ar (K feldspar) 43.8±1.3 m.y.
Armstrong, 1974
Challis Volcanics, Yankee Fork Rhyolite ash flow (44°30'30"N, 114°14'05"W; SE¼sec. 29, T. 14 N., R. 19 E.; Custer Co., ID). D. H. McIntyre reports that the distribution and relationships of this unit are still unclear. Rhyolite ash flow, crystal-lithic-vitric tuff, densely welded. Analytical data: K = 5.79, 5.84%; $*Ar^{40}$ = 10.29 x 10^{-6} cc/gm (55% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

10. Axelrod, 1966 K-Ar (feldspar) 45.5±1.4 m.y.
F 0441 Biotite quartz latite, Challis Volcanics, Germer Tuffaceous Member (45°06′30″N, 113°52′20″W; sec. 32, T. 21 N., R. 22 E.; Lemhi Co., ID) low cliffs E of Highway 93, 4 mi S of Salmon. Flow interfingers with fossil flora lake beds. Analytical data: K = 1.385, 1.355%; $*Ar^{40}$ = 0.00445, 0.00455 ppm (26, 23% ΣAr^{40}); collected by: D. Axelrod, U. Calif., Berkeley; dated by: Geochron Labs., Inc.

11. Axelrod, 1966 K-Ar (whole rock) 49.0±2.0 m.y.
R 0411 Welded rhyolite tuff, Challis Volcanics. (44°57′20″N, 115°08′25″W; Valley Co., ID) on slope above Dewey gold mine, Thunder Mountain District, 150′ above fossil flora lake beds. Analytical data: K = 3.99, 3.97%; $*Ar^{40}$ = 0.0139, 0.0143 ppm (63, 67% ΣAr^{40}); collected by: D. Axelrod, U. Calif., Berkeley; dated by: Geochron Labs., Inc.

12. YU-RAP 71-18 K-Ar (whole rock) 42.0±1.3 m.y.
Armstrong, 1974
Mafic volcanic, basal Challis (43°39′50″N, 113°46′15″W; NW¼sec. 19, T. 4 N., R. 23 E.; Custer Co., ID). Slightly altered, probably somewhat older than measured date. Analytical data: K = 2.50, 2.50%; $*Ar^{40} = 4.24 \times 10^{-6}$ cc/gm (70% ΣAr^{40}); collected by: R. A. Paull, U. Wisc., Milwaukee; dated by: R. L. Armstrong, Yale U.

13. R. E. Zartman, K-Ar (biotite) 49.9±1.7 m.y.
written communication, 1974
BL-203 Rhyodacite (?) vitrophyre of Challis Volcanics (44°24.6′N, 114°23.1′W; Custer Co., ID). Analytical data: K_2O = 7.48, 7.42%; $*Ar^{40} = 5.557 \times 10^{-10}$ moles/gm (94% ΣAr^{40}); collected by: D. H. McIntyre, U. S. G. S.; dated by: R. F. Marvin, H. H. Mehnert, and Violet Merritt, U. S. G. S.

14. R. E. Zartman, K-Ar (biotite) 42.3±1.4 m.y.
written communication, 1974 (sanidine) 40.3±1.4 m.y.
MHS-94-71 Welded tuff of Challis Volcanics (44°58′N, 113°32′W; sec. 19, T. 19 N., R. 25 E.; Lemhi Co., ID). Analytical data: K_2O = 7.34, 7.40%; $*Ar^{40} = 4.648 \times 10^{-10}$ moles/gm (56% ΣAr^{40}) K_2O = 2.21, 2.19%; $*Ar^{40} = 1.322 \times 10^{-10}$ moles/gm (78% ΣAr^{40}); collected by: M. H. Staatz, U. S. G. S.; dated by: R. F. Marvin, H. H. Mehnert and Violet Merritt, U. S. G. S.

CHALLIS VOLCANIC ROCKS, DISCORDANT OR SUSPECT DATES

The altered nature of some of these samples or the observed low dates suggest that none of these results should be considered indicative of the true age of the Challis Volcanics.

1. YU-RAP 71-17 K-Ar (whole rock) 38.3±1.1 m.y.
Armstrong, 1974
Mafic volcanic, basal Challis (43°40′15″N, 113°46′10″W; SW¼sec. 18, T. 4 N., R. 23 E.; Custer Co., ID). Unconformable on type Smiley Creek Conglomerate, not very fresh, date thus unreliable. Analytical data: K = 2.35, 2.32%; $*Ar^{40} = 3.60 \times 10^{-6}$ cc/gm (63% ΣAr^{40}); collected by: R. A. Paull, U. Wisc., Milwaukee; dated by: R. L. Armstrong, Yale U.

2. YU-RAP 71-16 K-Ar (whole rock) 35.8±1.1 m.y.
Armstrong, 1974
Mafic volcanic – "basalt", basal Challis (43°45′50″N, 113°50′15″W; E½sec. 16, T. 5 N., R. 22 E.; Custer Co., ID). Unconformable on Smiley Creek Conglomerate, not very fresh, date thus unreliable. Analytical data: K = 1.99, 1.99%; $*Ar^{40} = 2.87 \times 10^{-6}$ cc/gm (73% ΣAr^{40}); collected by: R. A. Paull, U. Wisc., Milwaukee; dated by: R. L. Armstrong, Yale U.

3. Cater and others, 1973 K-Ar (whole rock) 28.4±1.4 m.y.
R. F. Marvin, written communication, 1974
Black columnar jointed latite flow, glassy (44°58.5′N, 115°08′W; Valley Co., ID). Unconformably overlies

Challis Volcanics. Probably older than date – loss of radiogenic Ar likely in this type of sample. Analytical data: K_2O = 3.21, 3.26%; $^*Ar^{40}$ = 1.370 x 10^{-10} moles/gm (94% Σ Ar^{40}); collected by: B. F. Leonard, U. S. G. S.; dated by: H. H. Thomas and R. F. Marvin, U. S. G. S.

4. Chase, 1972 K-Ar (whole rock) 32±2 m.y.
R 16 Basalt (44°03'20"N, 112°39'45"W; N½sec. 2, T. 8 N., R. 32 E.; Jefferson Co., ID) west side of mouth of Warm Springs Creek. Analytical data: K = 1.33%; $^*Ar^{40}$ = 1.74 x 10^{-6} cc/gm (20% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

5. Chase, 1972 K-Ar (whole rock) 26±15 m.y.
R 15 Basalt (43°34'00"N, 113°14'55"W; SW¼sec. 21, T. 3 N., R. 27 E.; Butte Co., ID) gorge of Big Lost River, about 4 mi W of N.R.T.S. boundary. An exceedingly inaccurate date. Any use or citation should be avoided. Analytical data: K = 0.27%; $^*Ar^{40}$ = 0.29 x 10^{-6} cc/gm (3% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

6. YU-1030 K-Ar (glass) 7.7±2.5 m.y.
Challis Volcanics, vitrophyre in Germer Tuffaceous Member (44°15'30"N, 114°12'05"W; NW¼sec. 27, T. 11 N., R. 19 E.; Custer Co., ID) Spar Canyon. Dark gray, bituminous coal-like, glass. Astounding discordance with stratigraphic setting – apparently gross Ar loss from glass. Analytical data: K = 0.766, 0.764%; $^*Ar^{40}$ = 0.264, 0.206 x 10^{-6} cc/gm (2, 2% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

CHALLIS INTRUSIVE ROCKS

Granitic rocks of Eocene age are more widespread than previously indicated on geologic maps of Idaho, and their extent may still be seriously underestimated on figure 3. The following results, ranging from 39 to 54 m.y., are for plutons that are almost certainly of Challis age. There is a faint suggestion that the age of Challis plutons decreases slightly from north to south, consistent with regional time-transgressive volcanic patterns (Lipman and others, 1972; Christiansen and Lipman, 1972; Armstrong and Higgins, 1973).

1. YU-872 K-Ar (biotite) (9% Chlorite) 45.9 ± 1.4 m. y.
(impure hornblende) 54.3 ± 1.6 m. y.
Armstrong, 1974
LR2 Biotite – hornblende diorite stock cutting Idaho batholith (44°25'30"N, 115°11'30"W; sec. 33, T. 13 N., R. 11 E.; Custer Co., ID) Marsh Creek, N of Lola Creek Campground, 20 mi NW of Stanley. It is not clear whether this stock is of Eocene age or older, and slightly metamorphosed in Eocene time. Analytical data: K = 6.40, 6.37, 6.33%; $^*Ar^{40}$ = 11.81 x 10^{-6} cc/gm (60% Σ Ar^{40}) K = 1.42, 1.47%; $^*Ar^{40}$ = 3.18 x 10^{-6} cc/gm (66% Σ Ar^{40}); collected and dated by: L. Rychener, Yale U.

2. YU-862 K-Ar (biotite) (7% Chlorite) 44.7 ± 1.3 m.y.
Armstrong, 1974
JD 66-74 Adamellite (43°43'54"N, 114°02'55"W; SE¼sec. 27, T. 5 N., R. 20 E.; Blaine Co., ID) Pioneer Mountains (Dover, 1969). Analytical data: K = 6.75, 6.74%; $^*Ar^{40}$ = 12.17 x 10^{-6} cc/gm (63% Σ Ar^{40}); collected by: J. Dover, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

3. YU-863 K-Ar (biotite) (9% Chlorite) 46.0 ± 1.4 m. y.
Armstrong, 1974
JD 66-336 Pophyritic adamellite (43°47'06"N, 113°58'48"W; N½sec. 8, T. 5 N., R. 21 E.; Custer Co., ID) Pioneer Mountains. Analytical data: K = 6.17%, 6.09%; $^*Ar^{40}$ = 11.39 x 10^{-6} cc/gm (74% Σ Ar^{40}); collected by: J. Dover, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

4. YU-864 K-Ar (biotite) (15% Chlorite) 45.3 ± 1.4 m.y.
Armstrong, 1974
JD 66-11 Leuco adamellite (43°51'18"N, 114°14'12"W; NE¼sec. 18, T. 6 N., R. 19 E.; Custer Co., ID) Pioneer Mountains. Analytical data: K = 5.10, 5.05%; $^*Ar^{40}$ = 9.28 x 10^{-6} cc/gm (58% Σ Ar^{40}); collected by: J. Dover, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

5. YU-RAP 71-15 K-Ar (biotite) (30% Chlorite) 47.7±1.4 m.y.
Armstrong, 1974
Lake Creek Intrusive (43°44′45″N, 113°52′00″W; S½sec. 20, T. 5 N., R. 22 E.; Custer Co., ID) Copper Basin. Postdates "early" Challis volcanics. Analytical data: K = 2.66, 2.67%; $^*Ar^{40}$ = 5.14 x 10^{-6} cc/gm (64% Σ Ar^{40}); collected by: R. A. Paull, U. Wisc., Milwaukee; dated by: R. L. Armstrong, Yale U.

6. Harrison and others, 1972 K-Ar (hornblende) 50.2±1.5 m.y.
2 Granodiorite porphyry dike (48°16′10″N, 116°19′40″W; W½sec. 27, T. 57 N., R. 1 E.; Bonner Co., ID). Analytical data: K_2O = 0.758%; $^*Ar^{40}$ = 0.569 x 10^{-10} moles/gm (70.4% Σ Ar^{40}); collected by: J. E. Harrison, U. S. G. S.; dated by: J. D. Obradovich, U. S. G. S.

7. Harrison and others, 1972 K-Ar (biotite) 50.7±3.0 m.y.
(hornblende) 51.0±1.5 m.y.
1 Granodiorite porphyry dike (48°19′50″N, 116°24′20″W; S½sec. 36, T. 58 N., R. 1 W.; Bonner Co., ID). Analytical data: K_2O = 7.94%; $^*Ar^{40}$ = 6.02 x 10^{-10} moles/gm (85.2% Σ Ar^{40}) K_2O = 0.864%; $^*Ar^{40}$ = 0.660 x 10^{-10} moles/gm (76.3% Σ Ar^{40}); collected by: J. E. Harrison, U. S. G. S.; dated by: J. D. Obradovich, U. S. G. S.

8. McDowell, 1971 K-Ar (biotite) 50.7±1.5 m.y.
(hornblende) 57.0±1.8 m.y.
L-1048 Medium grained lamprophyre dike (47°29′55″N, 115°52′30″W; NW¼sec. 19, T. 48 N., R. 5 E.; Shoshone Co., ID) Star Mine, SW of Gem. Analytical data: K = 5.68%; $^*Ar^{40}$ = 5.19 x 10^{-10} moles/gm (82% Σ Ar^{40}) K = 0.726%; $^*Ar^{40}$ = 0.883, 0.778, 0.671, 0.648 x 10^{-10} moles/gm (78, 36, 60, 56% Σ Ar^{40}); collected by: A. H. Sorensen, Hecla Mining Co.; dated by: F. W. McDowell, Columbia U.

9. YU-1033 K-Ar (biotite) 47.5±1.4 m.y.
Armstrong, 1974
Massive coarse-grained biotite adamellite, Cathedral Rock – Bighorn Crags batholith (45°03′55″N, 114°33′00″W; Lemhi Co., ID) near Yellowjacket Lake. Analytical data: K = 5.80, 5.70%; $^*Ar^{40}$ = 11.04 x 10^{-6} cc/gm (82% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

10. YU-1034 K-Ar (biotite) 44.2±1.3 m.y.
Armstrong, 1974
Massive – coarse-grained biotite adamellite, Cathedral Rock – Bighorn Crags batholith (45°03′55″N, 114°33′30″W; Lemhi Co., ID) near Yellowjacket Lake. Biotite appears slightly oxidized (weathered?). Analytical data: K = 5.86, 5.84%; $^*Ar^{40}$ = 10.45 x 10^{-6} cc/gm (74% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

11. YU-1035 K-Ar (biotite) 47.4±1.4 m.y.
Armstrong, 1974
Fine-grained aplite with a trace of biotite and scattered 1-2 mm diameter quartz grains, Cathedral Rock – Bighorn Crags batholith (45°03′55″N, 114°33′30″W; Lemhi Co., ID) near Yellowjacket Lake. Analytical data: K = 5.72, 5.63%; $^*Ar^{40}$ = 10.89 x 10^{-6} cc/gm (68% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

12. Cathedral Rock – Bighorn Crags batholith Rb-Sr (λ = 1.43) (2 point isochron for rocks)
Armstrong, 1974
1033, 1034 51±5 m.y.
Initial Sr^{87}/Sr^{86} = 0.715
(2 point isochron for rocks)
1034, 1035 35±4 m.y.
Initial Sr^{87}/Sr^{86} = 0.718
(average date) 42 m.y.

Specimen	N Latitude	W Longitude	County	State
1 YU-1033 Adamellite	45°03′55″	114°33′00″	Lemhi	ID
2 YU-1034 Adamellite	45°03′55″	114°33′30″	Lemhi	ID
3 YU-1035 Aplite	45°03′55″	114°33′30″	Lemhi	ID

12. (continued)

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	244	99	2.47	.72044
2	260	52	5.04	.72591
3	322	23	14.2	.7393
		*25.2	12.8	*.7362

*Spiked run; collected and dated by: R. L. Armstrong, Yale U.

13. YU-802 K-Ar (phlogopite) 44.4±1.3 m.y.
Armstrong, 1974
Granite, Sawtooth batholith (43°57'50"N, 114°58'25"W; T. 7 N., R. 13 E.; Custer Co., ID) collected on Trail NW of Toxaway Lake. Sample given to RLA by John Obradovich. Analytical data: K = 8.16, 8.17%; $*Ar^{40}$ = 14.64 x 10^{-6} cc/gm (51% Σ Ar^{40}); collected by: V. L. Freeman and T. H. Killsgaard, U. S. G. S.; dated by: R. L. Armstrong, Yale U.

14. Sawtooth batholith Rb-Sr (λ = 1.43) (whole rock) (1023) 42±4 m.y.
Armstrong, 1974
Assumed Initial Sr^{87}/Sr^{86} = 0.705
(whole rock) (1022) 39±4 m.y.
Assumed Initial Sr^{87}/Sr^{86} = 0.705
Average date 41 m.y.

Specimen	N Latitude	W Longitude	County	State
1 YU-1023 Granite	43°59'15"	114°55'10"	Custer	ID
2 YU-1022 Granite	43°59'00"	114°55'45"	Custer	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	264	5	57.5	.8058
		*4.85		*.8045
2	296	6	49.0	.7830
		*6.05		*.7868

*Spiked run; collected and dated by: R. L. Armstrong, Yale U.

15. YU-1023 K-Ar (biotite) 44.1±1.3 m.y.
Armstrong, 1974
Pink medium-to fine-grained miarolitic biotite granite, Sawtooth batholith (43°59'15"N, 114°55'10"W; T. 8 N., R. 13 E.; Custer Co., ID) between Farley and Yellowbelly Lakes along trail. Slightly weathered. Analytical data: K = 5.66, 5.57%; $*Ar^{40}$ = 10.01 x 10^{-6} cc/gm (79% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

16. YU-1022 K-Ar (biotite) 43.7±1.3 m.y.
Armstrong, 1974
Pink medium-grained biotite granite, Sawtooth batholith (43°59'00"N, 114°55'45"W; T. 8 N., R. 13 E.; Custer Co., ID) near Farley Lake. Analytical data: K = 4.46, 4.45%; $*Ar^{40}$ = 7.86 x 10^{-6} cc/gm (66% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

17. YU-FWC 6-67 K-Ar (biotite) 42.7±1.3 m.y.
Armstrong, 1974 Rb-Sr (λ = 1.43) (whole rock) 47±9 m.y.
Assumed Initial Sr^{87}/Sr^{86} = 0.705
Medium-to fine-grained pink biotite granite, Tertiary pluton (44°55'15"N, 114°43'50"W; S edge sec. 3, T. 18 N., R. 14 E.; Lemhi Co., ID) Middle Fork of Salmon River, SW of Yellowjacket Mountains. Analytical data: Biotite: K = 3.25, 3.24%; $*Ar^{40}$ = 5.60 x 10^{-6} cc/gm (58% Σ Ar^{40}) Rock: 217 ppm Rb, 83 ppm Sr, Rb/Sr = 2.62, Sr^{87}/Sr^{86} = .71405; collected by: F. W. Cater, U. S. G. S.; dated by: R. L. Armstrong, Yale U.

18. Reid and Greenwood, 1968 K-Ar (biotite) 41±1.8 m.y.
Roundtop batholith granodiorite (approximately 47°05'N, 115°48'W; Shoshone Co., ID). Analytical data: None available; collected by: R. R. Reid, U. of Idaho; probably dated by: Isotopes Inc.

19. Percious and others, 1967 K-Ar (biotite) 48.0±1.4 m.y.
HJO-1-65 Quartz biotite hornblende monzonite porphyry, satellite stock (44°04'15"N, 115°44'00"W; S½sec. 34, T. 9 N., R. 6 E.; Boise Co., ID). Intrudes batholith W of Lowman. Analytical data: K = 7.15, 7.16%; $*Ar^{40} = 6.187 \times 10^{-10}$ moles/gm (85.9% ΣAr^{40}); collected by: H. J. Olson, U. of Ariz.; dated by: J. K. Percious and P. E. Damon, U. of Ariz.

20. Percious and others, 1967 K-Ar (biotite) 44.0±1.3 m.y.
HJO-2-65 Monzonite porphyry stock, near edge of dike swarm (44°04'10"N, 115°42'55"W; S½sec. 35, T. 9 N., R. 6 E.; Boise Co., ID). Intrudes batholith W of Lowman. Analytical data: K = 7.17, 7.17%; $*Ar^{40} = 5.664 \times 10^{-10}$ moles/gm (91.8% ΣAr^{40}); collected by: H. J. Olson, U. of Ariz.; dated by: J. K. Percious and P. E. Damon, U. of Ariz.

21. Greenwood and Morrison, 1973 K-Ar (biotite) 49±3 m.y.
(feldspar) 46±3 m.y.
Coarse granite of Running Creek pluton (approximately 45°55'N, 114°53'W; Idaho Co., ID). Analytical data: K = 4.13%; $*Ar^{40} = 3.65 \times 10^{-10}$ moles/gm (72% ΣAr^{40}) K = 4.90%; $*Ar^{40} = 4.06 \times 10^{-10}$ moles/gm (53% ΣAr^{40}); collected by: W. R. Greenwood, N.A.S.A., Houston; dated by: K. V. Rogers, Lockheed Electronics, M.S.C., Houston and J. B. Hartung, Rice U.

22. Cater and others, 1973 K-Ar (biotite) 30±2 m.y.
R. F. Marvin, written communication, 1974 (sanidine) 42±2 m.y.
Rhyolite or Granite porphyry dike (45°7.6'N, 115°19.5'W; Valley Co., ID) near Big Creek settlement. The biotite may be hydrothermally altered, the sanidine date appears most reasonable. Analytical data: K_2O = 4.02%; $*Ar^{40}$ = 0.00776, 0.00660 ppm (27, 26% ΣAr^{40}) K_2O = 5.96%; $*Ar^{40}$ = 0.0148 ppm (59% ΣAr^{40}); collected by: B. F. Leonard, U. S. G. S.; dated by: H. H. Thomas and R. F. Marvin, U. S. G. S.

23. E. H. McKee, K-Ar (hornblende) 50.9±2 m.y.
written communication, 1974 (biotite) 46.8±2 m.y.
DRS-22-69 South Mountain granodiorite (42°47'10"N, 116°55'40"W; SW¼NE¼sec. 28, T. 7 S., R. 5 W.; Owyhee Co., ID) along Williams Creek road. Same locality as YU-WT 268. Analytical data: K_2O = 0.790%; $*Ar^{40} = 0.6017 \times 10^{-10}$ moles/gm (73.7% ΣAr^{40}) K_2O = 8.74%; $*Ar^{40} = 6.109 \times 10^{-10}$ moles/gm (89.6% ΣAr^{40}); collected by: D. R. Shawe, U. S. G. S.; dated by: E. H. McKee, U. S. G. S.

24. YU-WT 268 K-Ar (biotite) 45.2±1.4 m.y.
(hornblende) 49.7±1.5 m.y.
Hornblende biotite granodiorite from undeformed stock (42°47'10"N, 116°55'40"W; NE¼sec. 28, T. 7 S., R. 5 W.; Owyhee Co., ID) South Mountain. Analytical data: Biotite: K = 7.00, 7.06%; $*Ar^{40} = 12.85 \times 10^{-10}$ cc/gm (66% ΣAr^{40}) Hornblende: K = 0.905, 0.956%; $*Ar^{40} = 1.873 \times 10^{-6}$ cc/gm (18% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

CHALLIS INTRUSIVE ROCKS, DUBIOUS DATES

These dates on whole-rock samples are probably unreliable because of Ar loss from nonretentive feldspar or fine grained alteration mineral phases, or loss at the time of alteration.

1. YU-RAP 71-17 K-Ar (whole rock) 38.3±1.1 m.y.
Mafic volcanic, basal Challis (43°40'15"N, 113°46'10"W; SW¼sec. 18, T. 4 N., R. 23 E.; Custer Co., ID) Unconformable on type Smiley Creek Conglomerate, not very fresh, date thus unreliable. Analytical data: K = 2.35, 2.32%; $*Ar^{40} = 3.60 \times 10^{-6}$ cc/gm (63% ΣAr^{40}); collected by: R. A. Paull, U. Wisc., Milwaukee; dated by: R. L. Armstrong, Yale U.

2. YU-RAP 71-16 K-Ar (whole rock) 35.8±1.1 m.y.
Mafic volcanic – "basalt", basal Challis (43°45′50″N, 113°50′15″W; E½sec. 16, T. 5 N., R. 22 E.; Custer Co., ID). Unconformable on Smiley Creek Conglomerate, not very fresh, date thus unreliable. Analytical data: K = 1.99, 1.99%; $^*Ar^{40} = 2.87 \times 10^{-6}$ cc/gm (73% Σ Ar^{40}); collected by: R. A. Paull, U. Wisc., Milwaukee; dated by: R. L. Armstrong, Yale U.

3. Cater and others, 1973 K-Ar (whole rock) 28.4±1.4 m.y.
R. F. Marvin, written communication, 1974
Black columnar jointed latite flow, glassy (44°58.5′N, 115°8′W; Valley Co., ID). Unconformable overlies Challis Volcanics. Probably older than date – loss of radiogenic Ar likely in this type of sample. Analytical data: K_2O = 3.21, 3.26%; $^*Ar^{40} = 1.370 \times 10^{-10}$ moles/gm (94% Σ Ar^{40}); collected by: B. F. Leonard, U. S. G. S.; dated by: H. H. Thomas and R. F. Marvin, U. S. G. S.

4. Chase, 1972 K-Ar (whole rock) 32±2 m.y.
R 16 Basalt (44°03′20″N, 112°39′45″W; N½sec. 2, T. 8 N., R. 32 E.; Jefferson Co., ID) west side of mouth of Warm Springs Creek. Analytical data: K = 1.33%; $^*Ar^{40} = 1.74 \times 10^{-6}$ cc/gm (20% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

5. Chase, 1972 K-Ar (whole rock) 26±15 m.y.
R 15 Basalt (43°34′00″N, 113°14′55″W; SW¼sec. 21, T. 3 N., R. 27 E.; Butte Co., ID) Gorge of Big Lost River, about 4 mi W of N.R.T.S. boundary. An exceedingly inaccurate date, any use or citation should be avoided. Analytical data: K = 0.27%; $^*Ar^{40} = 0.29 \times 10^{-6}$ cc/gm (3% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

6. YU-1030 K-Ar (glass) 7.7±2.5 m.y.
Challis Volcanics, vitrophyre in Germer Tuffaceous Member (44°15′30″N, 114°12′05″W; NW¼sec. 27, T. 11 N., R. 19 E.; Custer Co., ID). Spar Canyon. Dark gray, bituminous coal-like, glass. Astounding discordance with stratigraphic setting – apparently gross Ar loss from glass. Analytical data: K = .766, .764%; $^*Ar^{40}$ = .264, 2.06×10^{-6} cc/gm (2, 2% Σ Ar^{40}); collected by: W. H. Hayes, U. S. G. S. and R. L. Armstrong, Yale U.; dated by: R. L. Armstrong, Yale U.

7. Percious and others, 1967 K-Ar (whole rock) 38.5±1.2 m.y.
HJO-5-65 Quartz latite porphyry dike (44°03′50″N, 115°42′15″W; NE¼sec. 2, T. 8 N., R. 6 E.; Boise Co., ID). Intrudes batholith W of Lowman. Date probably low. Analytical data: K = 3.69, 3.71%; $^*Ar^{40}$ = 2.557×10^{-10} moles/gm (85.5% Σ Ar^{40}); collected by: H. J. Olson, U. of Ariz.; dated by: J. K. Percious and P. E. Damon, U. of Ariz.

8. Pansze, 1972 K-Ar (whole rock) 26.7±0.5 m.y.
YU-PZ (A326) Chloritized biotite dacite porphyry (43°00′35″N, 116°42′15″W; NW¼NE¼sec. 9, T. 5 S., R. 3 W.; Owyhee Co., ID). Intensely altered, probably much older than date reported. Analytical data: K = 2.71, 2.67%; $^*Ar^{40}$ = 2.98, 2.79×10^{-6} cc/gm (68, 67% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

CHALLIS INTRUSIVE ROCKS, LEAD-ALPHA DATES

1. Nelson and Ross, 1968 Pb-α (zircon) 50±10 m.y.
R. E. Zartman, written communication, 1974
MI-87 White porphyry dike (43°53′25″N, 113°41′00″W; SE¼sec. 35, T. 7 N., R. 23 E.; Custer Co., ID) 0.5 mi S of White Knob, near Empire open cut. Analytical data: 10.2 ppm Pb, 493 α/mg/hr; collected by: C. P. Ross, U. S. G. S.; dated by: T. W. Stern, M. J. Rose, Jr., and H. W. Worthing, U. S. G. S.

2. R. E. Zartman, Pb-α (zircon) 50±10 m.y.
written communication, 1974
MI-85 Granitic rock (43°45′25″N, 113°47′30″W; SE Corner, sec. 18, T. 5 N., R. 22 E.; Custer Co., ID) 2.1 mi

up Lake Creek from point on road marked 8016 feet, S side of Copper Basin. Analytical data: 6.6 ppm Pb, 343 α/mg/hr; collected by: C. P. Ross, U. S. G. S.; dated by: T. W. Stern, M. J. Rose, Jr., and H. W. Worthing, U. S. G. S.

3. Ross, 1962 (p. 101) Pb-α (zircon) 59±10 m.y.
Granite (approximately 44°50'N, 114°47'W; Valley or Lemhi Co., ID) Middle fork of Salmon River. It is not entirely clear whether this is a separate date or merely a slightly modified version of CPR 121, 60 m.y. old, from nearby. Analytical data: None available; collected by: C. P. Ross, U. S. G. S.; dated by: U. S. G. S.

4. Jaffe and others, 1959 Pb-α (zircon) 73±10 m.y.
G 203 Granite (43°29'N, 113°35'W; Butte Co., ID). Paymaster mine, Craters of the Moon Monument. Analytical data: 9.0 ppm Pb, 305 α/mg/hr; collected by: D. Gottfried, W. L. Smith, U. S. G. S.; dated by: Jaffe and others, U. S. G. S.

5. Jaffe and others, 1959 Pb-α Original (zircon) 60±10 m.y.
B. F. Leonard, written (zircon) 62±10 m.y.
communication, 1973 Redetermined (zircon) (200 mesh) 50±10 m.y.
CPR 121 Coarse pink biotite granite (44°52.4'N, 114°33.9'W; Lemhi Co., ID) Camas Creek below Myers Cove, 1500 ft upstream from Anvil Creek, Casto 30' Quad. Analytical data: 9.7 ppm Pb, 403 α/mg/hr; 15.5 ppm Pb, 625 α/mg/hr; 33 ppm Pb, 1696 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: Jaffe and others, U. S. G. S. Redetermination 12/13/61 by T. W. Stern.

6. Jaffe and others, 1959 Pb-α Original (zircon) 42±10 m.y.
B. F. Leonard, written (zircon) 23±10 m.y.
communication, 1973 (zircon) 40±10 m.y.
Redetermined (zircon) 40±10 m.y.
CPR 120 Biotite granite porphyry (44°04.5'N, 115°44'W; Boise Co., ID) dike zone, South Fork Payette River, N side of river W of Lowman, road cut 1.4 mi W of Rattlesnake Creek and 7.7 mi downstream from road intersection at Lowman. Analytical data: 10.5 ppm Pb, 624 α/mg/hr; 4.1 ppm Pb, 440 α/mg/hr; 10 ppm Pb, 624 α/mg/hr; 9.6 ppm Pb, 606 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S. Redetermination 12/13/61 by T. W. Stern, U. S. G. S.

7. Nelson and Ross, 1968 Pb-α (zircon) 40±10 m.y.
R. E. Zartman, written communication, 1974
MI-32 Granitic rock, Mackay Granite. (43°53'05"N, 113°36'10"W; NE¼sec. 4, T. 6 N., R. 24 E.; Custer Co., ID) along road to Champion mine about 1000 ft up mine road from intersection with Mackay-Alder Creek road. Somewhat weathered. Analytical data: 11.0 ppm Pb, 701 α/mg/hr; collected by: C. P. Ross, U. S. G. S.; dated by: T. W. Stern, M. J. Rose, Jr., and H. W. Worthing, U. S. G. S.

8. Nelson and Ross, 1968 Pb-α (zircon) 40±10 m.y.
R. E. Zartman, written communication, 1974
MI-33 Granitic rock, Mackay Granite (43°50'00"N, 113°40'00"W; SE¼sec. 34, T. 6 N., R. 23 E.; Custer Co., ID) along North Alder Creek on road to Mammoth Canyon a short distance above road from Mackay to Alder Creek. Sample from boulders. Analytical data: 10.8 ppm Pb, 652 α/mg/hr; collected by: C. P. Ross, U. S. G. S.; dated by: T. W. Stern, M. J. Rose, Jr., and H. W. Worthing, U. S. G. S.

9. Reid and others, 1973 U-Pb (zircon) age indeterminant, may be 50 to 150 m.y.
$Pb^{206}/Pb^{207} = 2355$
$Pb^{206}/U^{238} = 104$
$Pb^{207}/U^{235} = 291$
126 Rhyolite dike (46°12'35"N, 115°32'25"W; SE¼sec. 11, T. 33 N., R. 7 E.; Idaho Co., ID) Canyon Creek, Idaho Highway 12, along Lochsa River. Large common Pb correction, result inaccurate and discordant. Eocene dike contaminated with older zircon but older age not well established, could even be 1500–1800 m.y. Analytical data: 4348 ppm U, 586 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 1.19, 28.90, 19.78, 50.13; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

MESOZOIC IGNEOUS ROCKS AND MINERALIZATION

Out of a somewhat blurred and confused record we feel that at least three episodes of Mesozoic plutonic activity can be distinguished in Idaho (Armstrong and others, 1975b). Many dates have been reset by later events, particularly the high heat flow associated with Challis volcanism, so that few K-Ar or Rb-Sr mineral dates for Mesozoic granitic rocks are close to the true age of emplacement. On the other hand, zircon dates are almost invariably discordant due to the presence of older zircons (xenocrysts). Consequently the U-Pb dates, either by the Pb-α or isotopic dating techniques, tend to be too high. This problem will only be resolved when the results of studies of zircon suites are published. Attempts to date the Idaho batholith using the whole-rock Rb-Sr technique have been frustrated by the variability of initial Sr isotopic composition as shown dramatically on figure 7. The assimilation of variable amounts and types of Precambrian basement by the Mesozoic magmas results in the scatter of points evident on the figure. Where the Precambrian basement is absent along the west-central edge of Idaho (Taubeneck and Armstrong, 1974) (figure 4) the initial Sr ratios are lower and the effects of contamination much less evident. This may not mean that less contamination has occurred there – only that the country rocks, largely Mesozoic and Paleozoic volcanic rocks, were not rich in radiogenic Sr. For those plutonic rocks without Precambrian Sr contamination there is an approach to isochrons of ~100-150 m.y. age. The Rb/Sr ratios are low, however, and the scatter of points still significant, so that precise dates cannot be obtained.

MESOZOIC INTRUSIVE GRANITIC ROCKS WITH K-AR AND RB-SR DATES OF 60 TO 217 M.Y.

These mineral dates can only be considered as minimum values for the true age of the host plutons. West of the Idaho batholith there are two distinct groupings of dates: ~200 to 217 m.y. and ~125 to ~160 m.y. which represent plutonic episodes important elsewhere in the Cordillera (Armstrong and Suppe, 1973; Lanphere and Reed, 1973). Within the southern, Atlanta, lobe of the Idaho batholith the maximum dates approach 100 m.y., and those granitic rocks are probably similar in age to the central Sierra Nevada batholith and numerous plutons in Nevada, northern Washington, and northern Idaho. The dates from the northern, Bitterroot, lobe of the Idaho batholith and for the granitic rocks near Silver City in southern Idaho are all less than 70 m.y. It is quite likely that these rocks are genuinely younger, similar in age to the Boulder and other plutons that lie to the east in Montana (Tilling and others, 1968).

1. McDowell and Kulp (1969) K-Ar (biotite) 73.1±2.2 m.y.
McDowell (1971)
L-957 Idaho batholith coarse-grained granodiorite (44°16'05"N, 116°04'25"W; SW¼sec. 23, T. 11 N., R. 3 E.; Valley Co., ID) 2 mi S of Smiths Ferry along Idaho 15. Analytical data: K = 7.24%; $*Ar^{40} = 9.58 \times 10^{-10}$ moles/gm (79% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

2. McDowell and Kulp (1969) K-Ar (biotite) 115±3 m.y.
McDowell (1971) (hornblende) 124±4 m.y.
L-1027 Idaho batholith medium-grained tonalite (46°15'25"N, 116°04'45"W; SE¼sec. 28, T. 34 N., R. 3 E.; Lewis Co., ID) US-12 about 3.5 mi N of Kamiah. Analytical data: K = 6.73%; $*Ar^{40} = 14.2 \times 10^{-10}$ moles/gm (93% Σ Ar^{40}) K = 0.947%; $*Ar^{40}$ = 2.19, 2.12 x 10^{-10} moles/gm (81, 86% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

3. McDowell and Kulp (1969) K-Ar (biotite) 77.0±2.3 m.y.
McDowell (1971)
L-1028 Idaho batholith coarse grained tonalite (44°55'40"N, 116°01'30"W; NE¼sec. 1, T. 18 N., R. 3 E.; Valley Co., ID) Yellow Pine road about 4 mi NE of McCall. Analytical data: K = 7.11%; $*Ar^{40} = 9.91 \times 10^{-10}$ moles/gm (89% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

4. McDowell and Kulp (1969) K-Ar (hornblende) 156±6 m.y.
McDowell (1971)
L-1122 Idaho batholith medium-grained quartz gabbro (45°59'45"N, 115°57'55"W; NE¼SW¼sec. 28, T. 30 N., R. 4 E.; Idaho Co., ID) Idaho 13 N of Harpster. Analytical data: K = 0.360%; $*Ar^{40}$ = 1.07, 1.01 x 10^{-10} moles/gm (78, 53% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

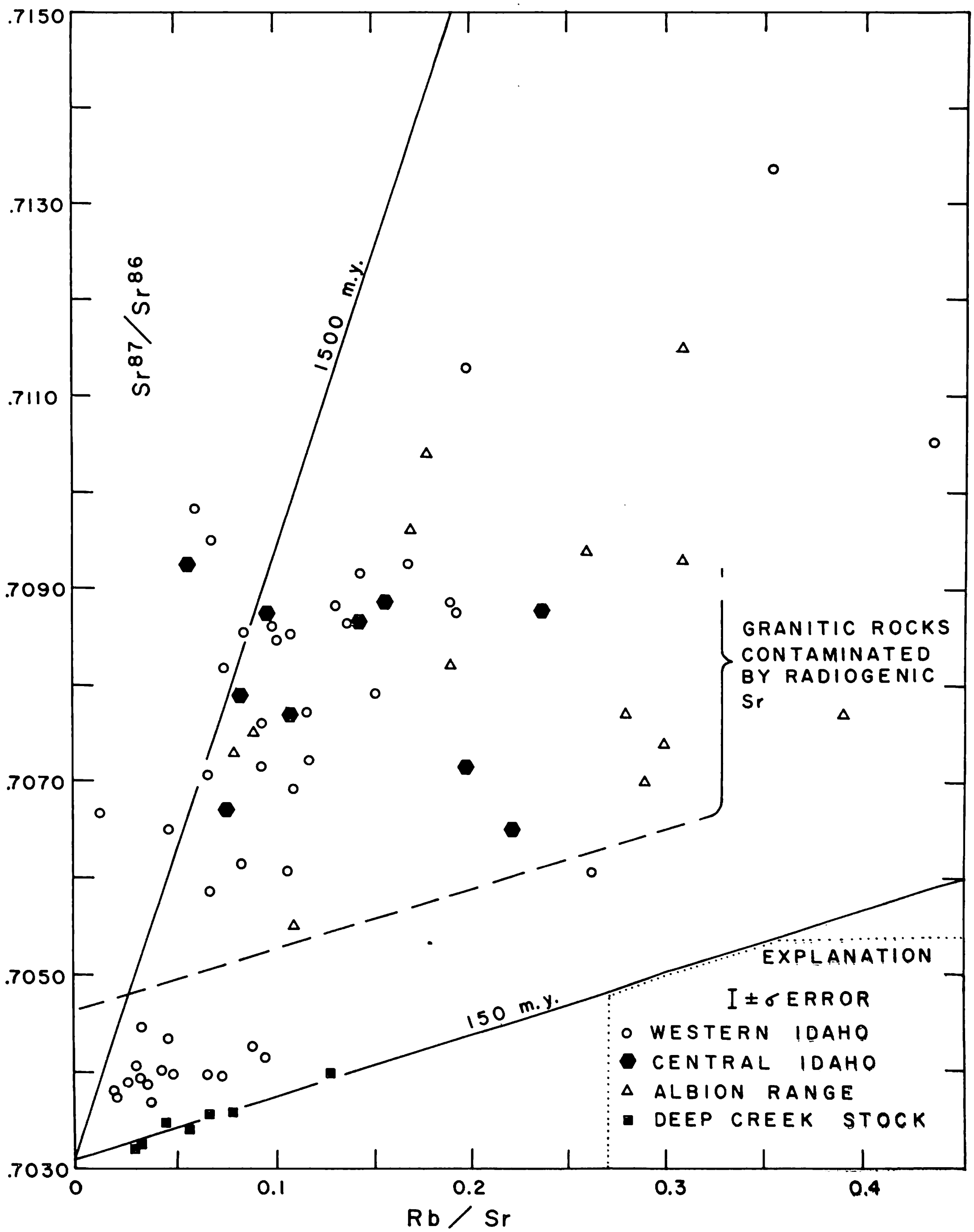

Figure 7. Strontium isotopic composition of Idaho granitic rocks. A few samples, mostly leucocratic dikes, Precambrian rocks, and Challis granitic rocks plot outside the diagram. Two reference isochrons are shown. Samples from the lower part of the diagram come from a limited area along the Oregon–Idaho boundary that is enclosed by the dashed line on figures 4 and 5. Samples from throughout the rest of the state lie in the scatter of points with ratios ranging from .705 upwards. The significance of this diagram is discussed by Armstrong and others (1975b). A crude calculation indicates that the fraction of Precambrian crust digested and dissolved by Mesozoic magmas is between 5 and 25 percent on the average, consistent with estimates of the superheat available in magmas derived from depths on the order of 100 km (W. Fyfe, oral communication, 1974).

5. McDowell and Kulp (1969) K-Ar (biotite) 60.6±1.8 m.y.
McDowell (1971)
L-1026 Idaho batholith, medium-grained granite gneiss (46°10'30"N, 114°02'40"W; SW¼sec. 24, T. 5 N., R. 20 W.; Ravalli Co., MT) Skalkaho Creek, 4.75 mi ESE of Grantsdale. Analytical data: K = 7.92%; $^*Ar^{40}$ = 8.87, 8.43 x 10^{-10} moles/gm (88, 86% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

6. McDowell (1971) K-Ar (biotite) 68.3±2.0 m.y.
(muscovite) 67.0±2.0 m.y.
L-956 Idaho batholith outlier, coarse-grained quartz monzonite (46°49'00"N, 117°00'25"W; S edge sec. 7, T. 40 N., R. 5 W.; Latah Co., ID) 2 mi S of Viola along US-95. Analytical data: K = 7.13%; $^*Ar^{40}$ = 8.80 x 10^{-10} moles/gm (93% Σ Ar^{40}) K = 8.49%; $^*Ar^{40}$ = 10.1, 10.4 x 10^{-10} moles/gm (71, 89% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

7. McDowell (1971) K-Ar (hornblende) 131±4 m.y.
L-955 Gem stock medium-grained monzonite (47°30'30"N, 115°52'15"W; SW¼sec. 18, T. 48 N., R. 5 E.; Shoshone Co., ID) Idaho Route 4 just S of Gem. Analytical data: K = 1.08%; $^*Ar^{40}$ = 2.55, 2.67 x 10^{-10} moles/gm (75, 84% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

8. YU-984 K-Ar (chloritized biotite) 200±6 m.y.
Armstrong and Besancon (1970) (hornblende) 217±7 m.y.
(biotite*) 216±5 m.y.
66-136a Biotite hornblende quartz diorite (44°47'45"N, 116°44'30"W; SE¼sec. 19, T. 17 N., R. 3 W.; Washington Co., ID) Cuddy Mountain District (Fankhauser, 1968; Bruce, 1970; King, 1971), youngest and freshest pluton in complex. Analytical data: K = 2.93, 2.94%; $^*Ar^{40}$ = 24.60 x 10^{-6} cc/gm (74% Σ Ar^{40}) K = 0.366, 0.373, 0.388, 0.393%; $^*Ar^{40}$ = 3.52, 3.46 x 10^{-6} cc/gm (63, 61% Σ Ar^{40}) K = 3.16%; $^*Ar^{40}$ = 28.7 x 10^{-6} cc/gm (95% Σ Ar^{40}); collected by: C. W. Field, Ore. State U.; dated by: R. L. Armstrong, Yale U. and *Isotopes Inc.

9. YU-979 K-Ar (chloritized biotite) 181±5 m.y.
Armstrong and Besancon (1970) (hornblende) 201±6 m.y.
F-48-G Porphyritic hornblende biotite granodiorite (44°43'20"N, 116°48'15"W; NW¼SE¼sec. 15, T. 16 N., R. 4 W.; Washington Co., ID) Cuddy Mountain District. Analytical data: K = 2.46, 2.45%; $^*Ar^{40}$ = 19.18, 18.35, 18.23 x 10^{-6} cc/gm (87, 85, 87% Σ Ar^{40}) K = 0.258, 0.257%; $^*Ar^{40}$ = 2.17, 2.19 x 10^{-6} cc/gm (55, 56% Σ Ar^{40}); collected by: C. W. Field, Ore. State U.; dated by: R. L. Armstrong, Yale U.

10. YU-985 K-Ar (hornblende-pyroxene mixture) 187±6 m.y.
66-105 Hornblende biotite pyroxene metagabbro (44°48'50"N, 116°43'50"W; NW¼sec. 17, T. 17 N., R. 3 W.; Washington Co., ID) Cuddy Mountain District, oldest phase of plutonic complex. Date probably low, should be $>$ 200 m.y. Analytical data: K = 0.357, 0.348, 0.336%; $^*Ar^{40}$ = 2.67, 2.79 x 10^{-6} cc/gm (74, 61% Σ Ar^{40}); collected by: C. W. Field, Ore. State U.; dated by: R. L. Armstrong, Yale U.

11. YU-986 K-Ar (biotite-hornblende mixture) 192±6 m.y.
WB 86 Hornblende pyroxene biotite metagabbro (44°48'00"N, 116°45'05"W; NW¼sec. 19, T. 17 N., R. 3 W.; Washington Co., ID) Cuddy Mountain District, oldest phase of plutonic complex. Date probably low, should be $>$ 200 m.y. Analytical data: K = 1.71, 1.62, 1.61%; $^*Ar^{40}$ = 13.29 x 10^{-6} cc/gm (83% Σ Ar^{40}); collected by: C. W. Field, Ore. State U.; dated by: R. L. Armstrong, Yale U.

12. Pansze (1972) K-Ar (muscovite) 66.8±1.3 m.y.
YU-PZ (A56) Silver City biotite-muscovite granodiorite (43°00'50"N, 116°43'00"W; SW¼SE¼sec. 5, T. 5 S., R. 3 W.; Owyhee Co., ID). Analytical data: K = 8.44, 8.41%; $^*Ar^{40}$ = 22.88 x 10^{-6} cc/gm (79% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

13. Pansze (1972) K-Ar (muscovite) 65.6±2.0 m.y.
G-M1416 (A384) Silver City biotite-muscovite granodiorite (43°01'30"N, 116°43'00"W; NW¼NE¼sec. 5, T. 5 S., R. 3 W.; Owyhee Co., ID). Analytical data: K = 8.13, 8.20%; $^*Ar^{40}$ = 0.0374, 0.0404 ppm (70, 74% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: Geochron Labs. for AMAX Exploration.

14. Pansze (1972) K-Ar (muscovite) 62.1±1.2 m.y.
YU-PZ (A346) Silver City biotite-muscovite granodiorite (43°01′30″N, 116°42′10″W; NE¼NW¼sec. 4, T. 5 S., R. 3 W.; Owyhee Co., ID). Analytical data: K = 8.29, 8.32%; $^*Ar^{40}$ = 20.94 x 10^{-6} cc/gm (83% Σ Ar^{40}); collected by: A. J. Pansze, Colo. Sch. Mines; dated by: R. L. Armstrong, Yale U.

15. Henricksen and others (1972) K-Ar (biotite) 200±4 m.y.
YU-I-161 Iron Mountain pluton quartz diorite (44°31′59″N, 117°03′24″W; Washington Co., ID). Analytical data: K = 5.13%; $^*Ar^{40}$ = 43.1 x 10^{-6} cc/gm (88% Σ Ar^{40}); collected by: T. A. Henricksen, Ore. State U.; dated by: Donald Parker, Ore. State U. and R. L. Armstrong, Yale U.

16. Henricksen and others (1972) K-Ar (biotite) 120±2.4 m.y.
YU-SS-60-A Mann Creek pluton porphyritic granodiorite (44°37′07″N, 116°56′24″W; Washington Co., ID). Analytical data: K = 6.64, 6.64%; $^*Ar^{40}$ = 32.9 x 10^{-6} cc/gm (94% Σ Ar^{40}); collected by: S. J. Skurla, Ore. State U.; dated by: Donald Parker, Ore. State U. and R. L. Armstrong, Yale U.

17. Coats and McKee (1972) K-Ar (biotite) 86.0±3 m.y.
(biotite) 89.2±3 m.y.
66 NC 100 Cottonwood Creek pluton (42°00′05″N, 115°50′30″W; Owyhee Co., ID). Analytical data: K = 9.43, 9.46%; $^*Ar^{40}$ = 12.28 x 10^{-10} moles/gm (82% Σ Ar^{40}) K = 8.37, 8.38%; $^*Ar^{40}$ = 11.30 x 10^{-10} moles/gm (74% Σ Ar^{40}); collected by: R. R. Coats, U. S. G. S.; dated by: E. H. McKee and L. Schlocker, U. S. G. S.

18. Harrison and others (1972) K-Ar (biotite) 73.2±2.0 m.y.
3 Seriate porphyritic granodiorite stock – part of Kaniksu batholith (48°24′35″N, 116°23′45″W; NE¼sec. 1, T. 58 N., R. 1 W.; Bonner Co., ID). Analytical data: K_2O = 8.13%; $^*Ar^{40}$ = 8.96 x 10^{-10} moles/gm (93.5% Σ Ar^{40}); collected by: J. E. Harrison, U. S. G. S.; dated by: J. D. Obradovich, U. S. G. S.

19. Harrison and others (1972) K-Ar (biotite) 76.1±2.1 m.y.
(muscovite) 77.5±2.2 m.y.
(hornblende) 95.2±3.8 m.y.
5 Seriate porphyritic granodiorite stock – part of Kaniksu batholith (48°26′50″N, 116°21′10″W; SE¼sec. 20, T. 59 N., R. 1 E.; Bonner Co., ID). Analytical data: K_2O = 7.26%; $^*Ar^{40}$ = 7.40 x 10^{-10} moles/gm (91.7% Σ Ar^{40}) K_2O = 8.59%; $^*Ar^{40}$ = 6.24 x 10^{-10} moles/gm (89.2% Σ Ar^{40}) K_2O = 0.510%; $^*Ar^{40}$ = 0.516 x 10^{-10} moles/gm (64.4% Σ Ar^{40}); collected by: J. E. Harrison, U. S. G. S.; dated by: J. D. Obradovich, U. S. G. S.

20. Field and others, 1973 K-Ar (hornblende-chloritized) 161±11 m.y.
C. W. Field, written communication, 1974
Quartz diorite of Peck Mountain complex (44°49′30″N, 116°38′00″W; sec. 7, T. 17 N., R. 2 W.; Washington Co., ID) Biotite completely altered to chlorite, hornblende partly altered due to regional metamorphism or possibly hydrothermal activity. Analytical data: K = 0.247, 0.245%; $^*Ar^{40}$ = 0.003026, 0.002875 ppm; collected by: C. W. Field, Ore. State U.; dated by: Krueger Enterprises (Geochron Labs.) Inc.

21. E. H. McKee, written communication, 1974 K-Ar (muscovite) 68.4±2 m.y.
DRS-15-69 Altered granite selvage in vein (42°55′40″N, 116°46′02″W; NE¼SE¼sec. 2, T. 6 S., R. 4 W.; Owyhee Co., ID) Silver City area. Analytical data: K_2O = 9.86%; $^*Ar^{40}$ = 10.147 x 10^{-10} moles/gm (74.2% Σ Ar^{40}); collected by: D. R. Shawe, U. S. G. S.; dated by: E. H. McKee, U. S. G. S.

22. E. H. McKee, written communication, 1974 K-Ar (biotite) 69.5±2 m.y.
DRS-16-69 Muscovite – biotite granite (42°55′39″N, 116°46′02″W; NE¼SE¼sec. 2, T. 6 S., R. 4 W.; Owyhee Co., ID) below Crescent claim, Silver City area. Analytical data: K_2O = 8.23%; $^*Ar^{40}$ = 8.607 x 10^{-10} moles/gm (94.9% Σ Ar^{40}); collected by: D. R. Shawe, U. S. G. S.; dated by: E. H. McKee, U. S. G. S.

23. E. H. McKee, written communication, 1974 K-Ar (biotite) 67.2±2 m.y.
DRS-24-69 Granitic intrusion (43°02′25″N, 116°39′50″W; N½NW¼sec. 35, T. 4 S., R. 3 W.; Owyhee Co., ID) Silver City area. Analytical data: K_2O = 8.76%; $^*Ar^{40}$ = 8.85 x 10^{-10} moles/gm (90.8% Σ Ar^{40}); collected by: D. R. Shawe, U. S. G. S.; dated by: E. H. McKee, U. S. G. S.

24. R. E. Zartman, written communication, 1974 K-Ar (biotite) 95.5±3.3 m.y.
R-130 Quartz monzonite-granodiorite stock (44°23'30"N, 114°22'00"W; Custer Co., ID). Analytical data: K_2O = 8.86, 8.83%; $^*Ar^{40}$ = 12.83 x 10^{-10} moles/gm (94% Σ Ar^{40}); collected by: S. W. Hobbs; dated by: R. F. Marvin, H. H. Mehnert, and Violet Merritt, U. S. G. S.

25. R. E. Zartman, written communication, 1974 K-Ar (biotite) 88.4±3.0 m.y.
SWH-45-72 Quartz monzonite stock (44°18'30"N, 114°32'30"W; Custer Co., ID). Analytical data: K_2O = 8.94, 8.93%; $^*Ar^{40}$ = 11.94 x 10^{-10} moles/gm (91% Σ Ar^{40}); collected by: S. W. Hobbs; dated by: R. F. Marvin, H. H. Mehnert, and Violet Merritt, U. S. G. S.

26. Z. E. Peterman, written communication, 1974 Rb-Sr E & A = 0.7080 Age indeterminant
Foliated quartz diorite to granodiorite of Square Top and Waugh Mountain quadrangles

Specimen	N Latitude	W Longitude	County	State
1 FWC 70-69	45°24'	114°44'	Idaho	ID
2 FWC 71-69	45°28'	114°58'	Idaho	ID
3 FWC 72-69	45°28'	114°58'	Idaho	ID
4 FWC 73-69	45°25'	114°53'	Idaho	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Rb^{87}/Sr^{86}	Sr^{87}
1	124	562	0.221	0.640	0.70
2	52.6	626	0.084	0.243	0.70
3	52.8	484	0.109	0.316	0.70
4	48.3	636	0.076	0.220	0.70

Thought to be older than intrusive phases of the Idaho batholith. Whole rock samples fail to produce an isochron but are similar to other Idaho batholith samples in this respect; collected by: F. W. Cater, U. S. G. S.; dated by: Z. E. Peterman, U. S. G. S.

27. YU-McC McCall Migmatite Rb-Sr Age indeterminant

Specimen	N Latitude	W Longitude	County	State
1 2 Sphene Biotite Epidote Hornblende Plagioclase Gneiss	44°57'30"	116°12'30"	Adams	ID
2 2a Sphene Biotite Epidote Hornblende Plagioclase Gneiss	44°57'30"	116°12'30"	Adams	ID
3 8 Biotite Quartz Diorite Gneiss	44°57'50"	116°07'05"	Valley	ID
4 9a Hornblende Biotite Quartz Diorite Gneiss	45°00'00"	116°07'40"	Valley	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	34	726	0.047	0.70434
2	47	634	0.075	0.70819
3	16	1210	0.013	0.70668
4	35	746	0.047	0.70650

Collected by: A. J. Stewart, Yale U.; dated by: R. L. Armstrong, Yale U.

28. YU-McC McCall Tonalite-Granodiorite Rb-Sr Age indeterminant

Specimen	N Latitude	W Longitude	County	State
1 21b Hornblende Biotite Granodiorite	44°57'50"	116°03'10"	Valley	ID
2 22 Sphene Hornblende Biotite Tonalite	44°58'30"	116°03'20"	Valley	ID
3 33 Biotite Adamellite	45°02'20"	116°03'30"	Valley	ID

28. (continued)

Specimen	N Latitude	W Longitude	County	State
4 35 Biotite Hornblende Granodiorite	45°03′35″	116°03′10″	Valley	ID
5 36 Biotite Hornblende Tonalite	45°04′15″	116°02′45″	Valley	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	91	839	0.109	0.70852
2	56	815	0.069	0.70950
3	102	530	0.193	0.70873
4	107	562	0.190	0.70883
5	92	667	0.137	0.70862

Collected by: A. J. Stewart, Yale U.; dated by: R. L. Armstrong, Yale U.

29. YU-Mc McCall Granodiorite-Adamellite Rb-Sr Age indeterminant

Specimen	N Latitude	W Longitude	County	State
1 50 Sphene Hornblende Biotite Tonalite	44°55′20″	115°57′15″	Valley	ID
2 48c Garnet Biotite Adamellite Gneiss	44°55′05″	115°57′50″	Valley	ID
3 49 Biotite Granodiorite Gneiss	44°55′10″	115°58′20″	Valley	ID
4 45 Biotite Adamellite	44°55′05″	116°00′15″	Valley	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	84	500	0.168	0.70925
2	115	325	0.354	0.71336
3	108	541	0.199	0.71128
4	137	316	0.434	0.71051

Collected by: A. J. Stewart, Yale U.; dated by: R. L. Armstrong, Yale U.

30. YU-876 (McC-22) K-Ar (biotite–6% chlorite) 65.2±2 m.y.
Sphene hornblende biotite tonalite (44°58′30″N, 116°03′20″W; Valley Co., ID) E of Payette Lake near McCall. Analytical data: K = 7.44, 7.47, 7.40%; $*Ar^{40}$ = 19.67 x 10^{-6} cc/gm (71% Σ Ar^{40}); collected by: A. J. Stewart, Yale U.; dated by: L. Rychener, Yale U.

31. YU-877 (McC-9a) K-Ar (biotite–20% chlorite) 77.0±2 m.y.
Biotite hornblende quartz diorite gneiss (45°00′00″N, 116°07′40″W; Valley Co., ID) 1.5 mi S of Brundage Mountain. Analytical data: K = 5.59, 5.54%; $*Ar^{40}$ = 17.35 x 10^{-6} cc/gm (58% Σ Ar^{40}); collected by: A. J. Stewart, Yale U.; dated by: L. Rychener, Yale U.

32. YU-Idaho Batholith near Stanely Rb-Sr Age indeterminant

Specimen	N Latitude	W Longitude	County	State
1 925 Faintly Gneissic Biotite Granodiorite/Adamellite	44°27′00″	115°23′50″	Valley	ID
2 926 Faintly Gneissic Biotite Granodiorite/Adamellite	44°26′10″	115°23′55″	Valley	ID
3 1040 Biotite Granodiorite	44°15′50″	114°42′30″	Custer	ID
4 1041 Biotite Granodiorite	44°16′00″	114°43′25″	Custer	ID
5 1042 Faintly Gneissic Biotite Granodiorite	44°16′10″	114°44′40″	Custer	ID
6 1043 Biotite Granodiorite	44°15′35″	114°50′10″	Custer	ID

32. (continued)

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	117	751	0.156	0.70885
2	139	587	0.237	0.70878
3	89	911	0.097	0.70873
4	65	1144	0.057	0.70926
5	117	596	0.198	0.70716
6	111	777	0.143	0.70864

Collected and dated by: R. L. Armstrong, Yale U.

33. YU-925 K-Ar (biotite) 69.6±2 m.y.
Faintly gneissic medium-grained porphyritic biotite granodiorite/adamellite (44°27'00"N, 115°23'50"W; Valley Co., ID) on Bear Valley Mountain. Analytical data: K = 7.20, 7.17%; $^*Ar^{40}$ = 20.33 x 10^{-6} cc/gm (86% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

34. YU-926 K-Ar (biotite) 71.2±2 m.y.
Rb-Sr (λ = 1.42) (whole rock-biotite) 77±4 m.y.
Faintly gneissic medium-grained porphyritic biotite granodiorite/adamellite (44°26'10"N, 115°23'55"W; Valley Co., ID) on Bear Valley Mountain. Analytical data: K = 7.34, 7.21%; $^*Ar^{40}$ = 21.07 x 10^{-6} cc/gm (78% Σ Ar^{40}).

	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
Whole rock:	139	587	0.237	0.70878
Biotite:	753	22	34.2	0.8159

Collected and dated by: R. L. Armstrong, Yale U.

35. YU-1040 K-Ar (biotite) 95±3 m.y.
Rb-Sr (λ = 1.42) (whole rock-biotite) 78±4 m.y.
Medium-grained massive grayish yellow biotite granodiorite (44°15'50"N, 114°42'30"W; Custer Co., ID) Highway 93, near and E of Robinson Bar, 12 mi SNE of Stanley. Analytical data: K = 6.09, 6.17%; $^*Ar^{40}$ = 23.7 x 10^{-6} cc/gm (93% Σ Ar^{40}).

	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
Whole rock:	89	911	0.097	0.70873
Biotite:	433	48	9.1	0.7378

Collected and dated by: R. L. Armstrong, Yale U.

36. YU-1041 K-Ar (biotite) 79±2 m.y.
Massive medium-grained biotite granodiorite (44°16'00"N, 114°43'25"W; Custer Co., ID) Highway 93, near and W of Robinson Bar. Analytical data: K = 7.10, 7.19%; $^*Ar^{40}$ = 23.0 x 10^{-6} cc/gm (87% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

37. YU-1042 K-Ar (biotite) 82±2 m.y.
Faintly gneissic medium to fine-grained biotite granodiorite (44°16'10"N, 114°44'40"W; Custer Co., ID) Highway 93, W of Sunbeam. Analytical data: K = 7.10, 7.04%; $^*Ar^{40}$ = 23.6 x 10^{-6} cc/gm (85% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

38. YU-1043 K-Ar (biotite) 79±2 m.y.
Medium-grained biotite granodiorite (44°15'35"N, 114°50'10"W; Custer Co., ID) Highway 93, NE of Stanley. Analytical data: K = 7.03, 7.00%; $^*Ar^{40}$ = 22.7 x 10^{-6} cc/gm (89% Σ Ar^{40}); collected and dated by: R. L. Armstrong, Yale U.

39. YU-871 K-Ar (biotite–4% chlorite) 62.6±1.9 m.y.
Biotite granodiorite (44°24'40"N, 115°11'10"W; Custer Co., ID) March Creek, near Lola Creek Campground, 19 mi NW of Stanley. Analytical data: K = 7.70, 7.71%; $^*Ar^{40}$ = 19.58 x 10^{-6} cc/gm (79% Σ Ar^{40}); collected and dated by: L. Rychener, Yale U.

40. Deep Creek Stock — Rb-Sr (λ = 1.42) — (W.R.-aplite) (1009) 133±6 m.y.
Initial Sr^{87}/Sr^{86} = 0.70315±0.00004
(W.R. without aplite) 184±21 m.y.
Initial Sr^{87}/Sr^{86} = 0.70302±0.00006

Specimen	N Latitude	W Longitude	County	State
1 H2 Mafic Q. diorite	45°10′13″	116°37′27″	Adams	ID
2 1003 Q. diorite	45°09′45″	116°39′31″	Adams	ID
3 1004 Q. diorite	45°09′42″	116°39′28″	Adams	ID
4 1005 Granodiorite	45°09′59″	116°37′44″	Adams	ID
5 1006 Granodiorite	45°09′58″	116°37′46″	Adams	ID
6 1007 Granodiorite	45°09′05″	116°38′08″	Adams	ID
7 1008 Granodiorite	45°09′12″	116°38′09″	Adams	ID
8 1009 Narrow aplite dike	45°09′14″	116°38′10″	Adams	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	22	669	0.033±.0003	0.70320, 0.70333
2	36	631	0.057±.002	0.70340
3	25	826	0.030±.0003	0.70312, 0.70329
4	40	506	0.079±.002	0.70359
5	64	495	0.128±.002	0.70391, 0.70408
6	32	693	0.046±.001	0.70349
7	42	632	0.067±.001	0.70356
8	90	145	0.623±.008	0.70642

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

41. YU-WT 1003 — K-Ar — (biotite) 117±4 m.y.
(hornblende) 137±4 m.y.

Quartz diorite, Deep Creek Stock (45°09′45″N, 116°39′31″W; sec. 14, T. 21 N., R. 3 W.; Adams Co., ID). Analytical data: Biotite: K = 6.63, 6.63%; $^{*}Ar^{40}$ = 31.83 x 10^{-6} cc/gm (79% Σ Ar^{40}) Hornblende: K = 0.586, 0.577, 0.611%; $^{*}Ar^{40}$ = 3.40, 3.28 x 10^{-6} cc/gm (59, 31% Σ Ar^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

42. YU-983 — K-Ar — (biotite) 121±4 m.y.
White, 1973 — (hornblende-biotite mixture) 127±4 m.y.

WHW 10 Hornblende-biotite quartz diorite, Deep Creek Stock (45°09′20″N, 116°38′15″W; SE¼sec. 13, T. 21 N., R. 3 W.; Adams Co., ID). Analytical data: Biotite: K = 6.69, 6.72%; $^{*}Ar^{40}$ = 33.37 x 10^{-6} cc/gm (81% Σ Ar^{40}) Hornblende: K = 1.82, 1.88%; $^{*}Ar^{40}$ = 9.80, 9.64 x 10^{-6} cc/gm (76, 87% Σ Ar^{40}); collected by: W. H. White, Ore. State U.; dated by: R. L. Armstrong, Yale U.

43. Donnelly Quartz Diorite — Rb-Sr (λ = 1.42) — Age indeterminant
Initial Sr^{87}/Sr^{86} variable ≈ 0.7083

Specimen	N Latitude	W Longitude	County	State
157 Hornblende-biotite quartz diorite	44°37′15″	116°10′44″	Adams	ID
159 Hornblende-biotite quartz diorite	44°34′48″	116°10′54″	Adams	ID
160 Hornblende-biotite quartz diorite	44°34′20″	116°10′31″	Adams	ID
173 Biotite-hornblende quartz diorite	44°38′04″	116°10′02″	Valley	ID

43. (continued)

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
157	62	614	0.101±.002	0.70848
159	74	564	0.132±.004	0.70890, 0.70874
160	63	630	0.100±.002	0.70860
173	59	695	0.085±.0005	0.70854

44. YU-WT 160

(W.R.-biotite) 82±4 m.y.
Initial Sr^{87}/Sr^{86} = 0.70825

Analytical data:

Specimen	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
Whole Rock YU-WT 160	63	630	0.100±.002	0.70860
Hornblende	6	61	0.103±0.14	0.70869
Biotite	329	147	2.24±.02	0.71577

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

45. YU-WT 160 — K-Ar

(biotite) 76±2 m.y.
(hornblende) 90±3 m.y.

Donnelly quartz diorite – hornblende biotite quartz diorite (44°34′20″N, 116°10′31″W; sec. 2, T. 14 N., R. 2 E.; Adams Co., ID). Analytical data: Biotite: K = 6.72, 6.93%; $^*Ar^{40}$ = 21.15 x 10^{-6} cc/gm (83% Σ Ar^{40}) Hornblende: K = 1.080, 1.079, 1.067%; $^*Ar^{40}$ = 3.89, 3.94 x 10^{-6} cc/gm (70, 65% Σ Ar^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

46. YU-WT 258 — K-Ar

(biotite) 75±2 m.y.
Initial Sr^{87}/Sr^{86} = 0.7087

Cascade Granodiorite, biotite granodiorite (44°31′31″N, 116°03′00″W; sec. 25, T. 14 N., R. 3 E.; Valley Co., ID) deep railroad cut near Cascade. Analytical data: Biotite: K = 7.38, 7.41%; $^*Ar^{40}$ = 22.49 x 10^{-6} cc/gm (80% Σ Ar^{40}) Whole rock: 90 ppm Rb, 622 ppm Sr, Rb/Sr = 0.144±0.002, Sr^{87}/Sr^{86} = 0.70914; collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

47. Council Mountain Quartz Diorite — Rb-Sr (λ = 1.42)

Age indeterminant
Initial Sr^{87}/Sr^{86} variable ≈ 0.7035

Specimen	N Latitude	W Longitude	County	State
133 Biotite-hornblende quartz diorite	44°40′23″	116°16′08″	Adams	ID
134 Biotite hornblende quartz diorite	44°40′56″	116°16′15″	Adams	ID
137 Hornblende-biotite quartz diorite	44°42′54″	116°15′53″	Adams	ID
142 Biotite-hornblende quartz diorite	44°43′30″	116°16′06″	Adams	ID
144 Hornblende-biotite quartz diorite	44°44′20″	116°15′55″	Adams	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
133	31	810	0.038±.0003	0.70375, 0.70362
134	23	843	0.027±.001	0.70394, 0.70385
137	33	747	0.044±.001	0.70400
142	18	875	0.020±.001	0.70380
144	46	699	0.066±.0005	0.70397, 0.70395

48. YU-WT 133

(W.R.-mineral-biotite) 82±4 m.y.
Initial Sr^{87}/Sr^{86} = 0.70354±0.00004
(W.R.-mineral without biotite) 98±29 m.y.
Initial Sr^{87}/Sr^{86} = 0.70352±0.00005

Analytical data:

Specimen	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
Whole Rock YU-WT 133	31	810	0.038±.0003	0.70375, 0.70362
Epidote	0.4	1239	0.0003±.0004	0.70360, 0.70341
Plagioclase	5	780	0.007±.0006	0.70356
Hornblende	6	60	0.097±.01	0.70390
Biotite	239	35	6.78±.01	0.72637

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

49. YU-WT 133 K-Ar (biotite) 82.0±2 m.y.
(hornblende) 117±4 m.y.

Biotite-hornblende quartz diorite, Council Mountain (44°40′23″N, 116°16′08″W; sec. 6, T. 15 N., R. 2 E.; Adams Co., ID). Analytical data: Biotite: K = 7.20, 7.20%; $^*Ar^{40}$ = 24.04 x 10^{-6} cc/gm (84% Σ Ar^{40}) Hornblende: K = 1.176, 1.156, 1.176%; $^*Ar^{40}$ = 5.66, 5.55 x 10^{-6} cc/gm (69, 37% Σ Ar^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

50. Deserette Quartz Diorite Rb-Sr Age indeterminant
Initial Sr^{87}/Sr^{86} variable ≈ 0.7037

Specimen		N Latitude	W Longitude	County	State
143	Biotite quartz diorite	44°44′13″	116°16′15″	Adams	ID
150	Biotite quartz diorite	44°44′16″	116°16′26″	Adams	ID
151	Biotite quartz diorite	44°44′54″	116°16′22″	Adams	ID
152	Biotite quartz diorite	44°46′18″	116°17′05″	Adams	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
143	17	803	0.021±.001	0.70372
150	29	803	0.036±.0004	0.70388
151	26	783	0.033±.001	0.70393
152	25	792	0.031±.001	0.70406

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

51. YU-WT 151 K-Ar (biotite) 84.0±3 m.y.
Deserette biotite quartz diorite (44°44′54″N, 116°16′22″W; sec. 1, T. 16 N., R. 1 E.; Adams Co., ID). Analytical data: K = 7.68, 7.65%; $^*Ar^{40}$ = 26.34 x 10^{-6} cc/gm (79% Σ Ar^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

52. Idaho Batholith N of Boise Rb-Sr Age indeterminant
Initial Sr^{87}/Sr^{86} variable

Specimen		N Latitude	W Longitude	County	State
236	Biotite adamellite	43°45′40″	116°16′14″	Ada	ID
237	Biotite granodiorite	43°45′38″	116°16′02″	Ada	ID
241	Biotite granodiorite	43°52′50″	116°02′26″	Boise	ID
242	Biotite granodiorite	43°51′11″	116°18′14″	Gem	ID
243	Biotite granodiorite	43°51′23″	116°19′10″	Gem	ID

52. (continued)

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
236	77	656	0.117±.003	0.70771
237	109	714	0.152±.002	0.70803, 0.70780
241	46	691	0.067±.0005	0.70717, 0.70702
242	76	803	0.094±.002	0.70716
243	94	791	0.118±.003	0.70721

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

53. YU-WT 242 K-Ar (biotite) 64±2 m.y.
Biotite granodiorite (43°51′11″N, 116°18′14″W; Gem Co., ID) N of Boise. Analytical data: K = 6.97, 6.93%; $*Ar^{40} = 18.16 \times 10^{-6}$ cc/gm (79% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

54. YU-WT 236 K-Ar (biotite) 69±2 m.y.
Biotite adamellite (43°45′40″N, 116°16′14″W; Ada Co., ID) N of Boise. Analytical data: K = 7.72, 7.67%; $*Ar^{40} = 21.65 \times 10^{-6}$ cc/gm (77% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

55. Idaho Batholith Outliers Rb-Sr Age indeterminant
S of Snake River Plain Initial Sr^{87}/Sr^{86} variable

Specimen	N Latitude	W Longitude	County	State
204 Biotite granodiorite	43°16′49″	116°41′01″	Owyhee	ID
256 Biotite quartz diorite	43°02′30″	116°50′57″	Owyhee	ID
South Mountain				
261 Hornblende biotite quartz diorite	42°45′30″	116°58′30″	Owyhee	ID
267 Hornblende biotite granodiorite	42°45′37″	116°52′39″	Owyhee	ID
268 Hornblende biotite quartz diorite	42°47′10″	116°55′40″	Owyhee	ID
269 Hornblende biotite granodiorite	42°46′14″	116°53′49″	Owyhee	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
204	81	732	0.110±.001	0.70691
256	99	380	0.262±.002	0.70610, 0.70600
261	40	1175	0.034±.001	0.70448
267	60	881	0.068±.0002	0.70586
268	71	843	0.084±.001	0.70614
269	79	736	0.107±.001	0.70608

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

56. YU-WT 204 K-Ar (biotite) 72±2 m.y.
Biotite granodiorite (43°16′49″N, 116°41′01″W; sec. 3, T. 2 S., R. 3 W.; Owyhee Co., ID) N of Silver City, just S of Snake River Plain. Analytical data: K = 7.52, 7.50%; $*Ar^{40} = 21.89 \times 10^{-6}$ cc/gm (83% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

57. YU-WT 261 K-Ar (biotite) 87±3 m.y.
Hornblende biotite quartz diorite (42°45′30″N, 116°58′30″W; sec. 9, T. 8 S., R. 5 W.; Owyhee Co., ID) South Mountain. Analytical data: K = 6.98, 7.07%; $*Ar^{40} = 24.97 \times 10^{-6}$ cc/gm (68% ΣAr^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

58. Granitic Steptoes — Rb-Sr — Age indeterminant
Clearwater Embayment, Idaho — Initial Sr^{87}/Sr^{86} variable

Specimen	N Latitude	W Longitude	County	State
1 25 Biotite quartz diorite	46°48′43″	116°50′06″	Latah	ID
2 714 Hornblende-biotite quartz diorite	46°33′21″	116°15′36″	Clearwater	ID
3 769 Biotite-hornblende quartz diorite	46°28′09″	116°25′06″	Nez Perce	ID
4 791 Biotite-hornblende quartz diorite	46°14′09″	116°41′14″	Nez Perce	ID
5 801 Hornblende-biotite quartz diorite	46°00′35″	116°54′46″	Nez Perce	ID
6 869 Biotite-hornblende quartz diorite	46°11′31″	116°00′33″	Idaho	ID

Analytical data:	ppm Rb	ppm Sr	Rb/Sr	Sr^{87}/Sr^{86}
1	59	969	0.061±.001	0.70981
2	62	649	0.095±.001	0.70762
3	40	450	0.088±.001	0.70426
4	45	477	0.095±.002	0.70415
5	27	551	0.049±.001	0.70398
6	41	555	0.074±.001	0.70394

Collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

59. YU-WT 714 — K-Ar — (biotite) 71±2 m.y.
(hornblende) 82±2 m.y.

Hornblende-biotite quartz diorite (46°33′21″N, 116°15′36″W; sec. 18, T. 37 N., R. 2 E.; Clearwater Co., ID). Analytical data: Biotite: K = 7.25, 7.26%; $^{*}Ar^{40}$ = 20.94 x 10^{-6} cc/gm (85% Σ Ar^{40}) Hornblende: K = 1.25, 1.28, 1.26%; $^{*}Ar^{40}$ = 4.27, 4.12 x 10^{-6} cc/gm (72, 68% Σ Ar^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

60. YU-WT 791 — K-Ar — (biotite) 121±4 m.y.
(hornblende) 141±4 m.y.

Biotite-hornblende quartz diorite (46°14′29″N, 116°41′14″W; sec. 34, T. 34 N., R. 3 W.; Nez Perce Co., ID). Analytical data: Biotite: K = 7.35, 7.47%; $^{*}Ar^{40}$ = 37.10 x 10^{-6} cc/gm (80% Σ Ar^{40}) Hornblende: K = 0.589, 0.583, 0.614%; $^{*}Ar^{40}$ = 3.57, 3.39 x 10^{-6} cc/gm (53, 49% Σ Ar^{40}); collected by: W. H. Taubeneck, Ore. State U.; dated by: Peter Hales, Ore. State U. and R. L. Armstrong, Yale U.

61. P. Le Couteur, — Rb-Sr (λ = 1.42) — (feldspar-muscovite) Isochron 68.8±1.2 m.y.
written communication, 1975 — NBS = 0.71015±.00008 — Initial Sr^{87}/Sr^{86} = 0.76469

Pegmatite (47°14′35″N, 116°00′00″W; SW¼sec. 18, T. 45 N., R. 4 E.; Shoshone Co., ID). Quartz-plagioclase-muscovite pegmatite lens, about 40 ft long and 3 to 6 ft wide, emplaced in tightly folded Burke Formation. Stop 6 on St. Joe field trip of R. Reid (Belt Symposium, 1973). Analytical data: Feldspar: 11.0 ppm Rb, 269.2 ppm Sr, Rb^{87}/Sr^{86} = 0.1189±0.0024, Sr^{87}/Sr^{86} = 0.76480±0.00034; Muscovite: 445.7 ppm Rb, 20.27±.047 ppm Sr, Rb^{87}/Sr^{86} = 64.4±1.3, Sr^{87}/Sr^{86} = 0.82765±0.00037; collected and dated by: P. Le Couteur, U. of British Columbia.

MESOZOIC MINERALIZATION

These dates for mineralized veins are consistent with the dates for nearby granitic rocks and thus support the inferred ages for major plutonic events in Idaho.

1. Marvin and others, 1973 K-Ar (muscovite) 85.9±3.0 m.y.
(biotite) 86.9±3.0 m.y.

D 2215 Molybdenite bearing vein (44°19'09"N, 114°32'09"W; NE¼sec. 2, T. 11 N., R. 16 E.; Custer Co., ID). Analytical data: K_2O = 9.95, 9.81%; $*Ar^{40} = 12.81 \times 10^{-10}$ moles/gm (88% ΣAr^{40}) K_2O = 9.56, 9.51%; $*Ar^{40} = 12.51 \times 10^{-10}$ moles/gm (87% ΣAr^{40}); collected by: C. M. Tschanz, U. S. G. S.; dated by: Marvin, Mehnert, and Merritt, U. S. G. S.

2. Field and others, 1973 K-Ar (sericite) 125±5 m.y.
C. W. Field, written communication, 1974
Red Ledge hydrothermal sericite (45°13'40"N, 116°40'05"W; sec. 23, T. 22 N., R. 3 W.; Adams Co., ID). Pervasively sericitized (sericite ~ 55%) quartz-feldspar porphyry of Red Ledge stock, believed to be a comagmatic derivative of Deep Creek stock which lies 4-5 miles to the S. Analytical data: K = 2.58, 2.24%; $*Ar^{40}$ = 0.0221, 0.0223 ppm; collected by: Giles E. Walker, Amax Exploration Inc.; dated by: Geochron Labs Inc.

3. R. E. Zartman, written communication, 1974 K-Ar (biotite) 123±6 m.y.
(biotite) 100±5 m.y.

VCF-23, VCF-30 (47°34'N, 115°49'W; Shoshone Co., ID) Hercules Mine, Coeur d'Alene District. Sample from mineralized vein. Analytical data: K_2O = 3.04%; $*Ar^{40}$ = 0.0220 ppm (72% ΣAr^{40}) K_2O = 7.17%; $*Ar^{40}$ = 0.0442 ppm (89% ΣAr^{40}); collected by: V. C. Fryklund, Jr., U. S. G. S.; dated by: H. H. Thomas and P. L. D. Elmore, U. S. G. S.

4. Rosenberg and others, 1970 Th-Pb (parisite) (Pb^{208}/Th^{232}) 73±2 m.y.
and in preparation (parisite) (Pb^{208}/Th^{232}) 75±2 m.y.
Th mineral from Snowbird deposit (46°46'41"N, 114°47'30"W; S½SW¼sec. 19, T. 12 N., R. 25 W.; Mineral Co., MT). Ore cuts Beltian rocks (Wallace Formation). Near Idaho-Montana boundary W of Missoula. Pb^{206}/U^{238} dates are 78±2, 79±2 and Pb^{207}/U^{235} dates are 73±4, 72±9 m.y., respectively, but these are considered less significant than the Pb^{208}/Th^{232} date. Analytical data: 57.5 ppm U, 17100 ppm Th, 55.2 ppm Pb; $Pb^{204}:Pb^{206}:Pb^{207}:Pb^{208}$ = 0.0062, 1.228, 0.1455, 98.62; 53.2 ppm U, 14500 ppm Th, 48.4 ppm Pb; $Pb^{204}:Pb^{206}:Pb^{207}:Pb^{208}$ = 0.0146, 1.466, 0.2790, 98.24; common Pb (measured on pyrite with 5 ppm Pb) $Pb^{204}:Pb^{206}:Pb^{207}:Pb^{208}$ = 1.00, 19.79, 15.67, 40.59; collected by: P. E. Rosenberg, Wash. State U.; dated by: R. Zartman, U. S. G. S.

MESOZOIC INTRUSIVE GRANITIC ROCKS – ISOTOPIC ZIRCON DATES

The large effort invested in these dates has yielded few definitive results. Of the several U-Pb isotopically dated zircons reported by Reid and others (1973) only two are close to being concordant at about 70 m.y. The rest are too discordant to indicate anything but a generalized Mesozoic age for the time of lead loss or crystallization of one component of a zircon mixture. The concordant dates are important because they support the view that much of the Idaho batholith is distinctly younger than 100 m.y. old.

1. Reid and others, 1973 U-Pb (zircon) ~ 70 m.y.
Pb^{206}/Pb^{207} = 700 m.y.
Pb^{206}/U^{238} = 74 m.y.
Pb^{207}/U^{235} = 96 m.y.

121 Quartz diorite, Idaho batholith (44°13'30"N, 116°06'25"W; S½sec. 4, T. 10 N., R. 3 E.; Valley Co., ID) Highway 55, 5.3 mi S of Smiths Ferry between McCall and Horseshoe Bend. Very nearly concordant with only a trace of older lead. Analytical data: 546.4 ppm U, 6.53 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.06, 83.31, 6.04, 10.59%; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

2. Reid and others, 1973 U-Pb (zircon) 71 m.y.
Pb^{207}/Pb^{206} = 283 m.y.
Pb^{206}/U^{238} = 68 m.y.
Pb^{207}/U^{235} = 74 m.y.

115 Orofino quartz dioritic orthogneiss (46°30'15"N, 116°18'10"W; SWsec. 35, T. 37 N., R. 1 E.; Clearwater

2. (continued)
Co., ID) 1.2 mi up road to viewpoint from junction with Ahsahka-Orofino road. Concordant with only trace of older lead component. Analytical data: 107.7 ppm U, 1.71 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.49, 66.19, 10.48, 22.84; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

3. Reid and others, 1973 U-Pb (zircon) ~ 60 m.y.
Pb^{206}/Pb^{207} = 2500±100 m.y.
Pb^{206}/U^{238} = 66±1 m.y.
Pb^{207}/U^{235} = 209±5 m.y.
X Marble Creek Gneiss (47°11′40″N, 116°04′00″W; NE¼sec. 25, T. 45 N., R. 3 E.; Shoshone Co., ID) along Marble Creek. Gneiss in core of anticline. Very discordant, some inherited old Pb or old Zircon, but predominantly Mesozoic-Cenozoic in age. Age of old component not precisely established, the Pb/Pb date should not be considered proof of the presence of 2500 m.y. rocks in this region. Analytical data: 2288.9 ppm U, 37.48 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.464, 61.954, 15.716, 21.866; assumed modern common Pb = 1.387, 25.445, 21.336, 51.832; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

4. Reid and others, 1973 U-Pb (zircon) 50 to 100 m.y.
Pb^{206}/Pb^{207} = 1230 m.y.
Pb^{206}/U^{238} = 137 m.y.
Pb^{207}/U^{235} = 218 m.y.
114 Deadman Creek quartz dioritic orthogneiss (46°13′45″N, 115°29′30″W; E Edge sec. 6, T. 33 N., R. 8 E.; Idaho Co., ID) near Junction of Van Camp Road and Highway 12 along Lochsa River. Very discordant. Mesozoic plus Precambrian xenocryst component. Analytical data: 553.5 ppm U, 13.7 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.17, 77.12, 8.56, 14.15; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

5. Reid and others, 1973 U-Pb (zircon) 50 to 150 m.y.
Pb^{206}/Pb^{207} = 1493 m.y.
Pb^{206}/U^{238} = 226 m.y.
Pb^{207}/U^{235} = 476 m.y.
123 Granodiorite of Idaho batholith (46°20′50″N, 115°18′20″W; Idaho Co., ID) Highway 12 along Lochsa River 22.7 mi past confluence of Lochsa and Selway Rivers. Very discordant, age not precisely interpretable. Mesozoic plus Precambrian xenocryst component. Analytical data: 894.4 ppm U, 44.6 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.17, 75.04, 9.23, 15.56; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

6. Reid and others, 1973 U-Pb (zircon) 50 to 150 m.y.
Pb^{206}/Pb^{207} = 1376 m.y.
Pb^{206}/U^{238} = 180 m.y.
Pb^{207}/U^{235} = 297 m.y.
125 Quartz diorite orthogneiss (46°37′N, 114°25′W; sec. 24, T. 8 N. (38 N. ?), R. 16 E.; Idaho Co., ID) (Impossible land grid locality reported in paper. Sample not plotted on map). Selway-Bitterroot Wilderness. Moderately discordant. Mesozoic zircon with component of Precambrian zircon xenocrysts. Analytical data: 320.2 ppm U, 9.34 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.02, 82.93, 7.46, 9.59; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

7. Reid and others, 1973 U-Pb (zircon) 100-300 m.y.
Pb^{206}/Pb^{207} = 818 m.y.
Pb^{206}/U^{238} = 309 m.y.
Pb^{207}/U^{235} = 375 m.y.
116 Coolwater Ridge orthogneiss (46°09′10″N, 115°27′15″W; sec. 35, T. 33 N., R. 8 E.; Idaho Co., ID) Coolwater Ridge Lookout, S of Lochsa River. Extremely discordant, probably Mesozoic moderately contaminated by Precambrian xenocrysts. Analytical data: 704.8 ppm U, 38.4 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.24, 80.65, 8.77, 10.34; assumed 1500 m.y. common Pb = 1.46, 23.73, 22.65, 52.17; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

8. Reid and others, 1973 U-Pb (zircon) 50-150 m.y.
Pb^{206}/Pb^{207} = 1795±88 m.y.
Pb^{206}/U^{238} = 426±1 m.y.
Pb^{207}/U^{235} = 717±16 m.y.

Y Marble Creek area quartz diorite, intrudes Prichard Fm. (47°07′45″N, 116°05′30″W; sec. 28, T. 44 N., R. 3 E.; Shoshone Co., ID). Very discordant, fairly large common Pb correction. Probably Mesozoic with large component of xenocryst contamination. Analytical data: 1121.7 ppm U, 178.7 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 0.8028, 49.4810, 16.0041, 33.7122; assumed common Pb = 1.485, 23.764, 22.278, 52.473; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

9. Reid and others, 1973 U-Pb (zircon) age indeterminant
Pb^{206}/Pb^{207} = 2455 m.y.
Pb^{206}/U^{238} = 39 m.y.
Pb^{207}/U^{235} = 124 m.y.

122 Granodiorite of Kaniksu batholith (48°10′25″N, 116°35′50″W; center sec. 29, T. 56 N., R. 2 W.; Bonner Co., ID) Highway 95, 5.0 mi S of bridge S of Sandpoint, 300 yards W of highway. Common Pb correction very large, dates exceedingly discordant, impossible to interpret, xenolithic contamination suspected. Age of old component not well established. Analytical data: 362.9 ppm U, 22.46 ppm Pb; Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} = 1.22, 30.58, 20.02, 48.23; assumed modern common Pb = 1.39, 25.44, 21.34, 51.83; collected by: R. R. Reid, U. of Idaho; dated by: Isotopes Inc.

MESOZOIC INTRUSIVE GRANITIC ROCKS – Pb-α AND F.T. DATES

The lead-alpha (Pb-α) dates average about 105 m.y. (omitting dates below 70 m.y.), and this has long been cited as the age of the Idaho batholith. Because of the common occurrence of xenocryst zircon (as is shown by the discordant isotopic zircon dates) these dates are probably too high. It is impossible to say more than that the lead-alpha dates provide some support for the generalized chronology and interpretation already described. Little significance can be attached to individual results because of the large analytical and contamination uncertainties involved. One fission track (f.t.) date on a sphene is evidence for an age of ~ 80 m.y. for a satellite pluton of the Bitterroot lobe. The uncertainty of xenocryst contamination does not affect f.t. dates. In general their interpretation is analogous to interpretation of K-Ar or Rb-Sr mineral dates – as a younger limit for the crystallization event.

Many lead-alpha and f.t. dates are in the range 40-60 m.y., yet the granitic host rocks are considered, for a variety of reasons, to be Mesozoic. These dates presumably reflect the intense heating of the crust associated with Challis volcanism and plutonism. It is possible that some of these granitic rocks are Eocene in age but this cannot be decided on presently available evidence.

1. Larsen and others, 1958 Pb-α original (zircon) 96±10 m.y.
Jaffe and others, 1959 (zircon) 94 (Larsen) or 92 (Jaffe) ±10 m.y.
B. F. Leonard, written communication, 1973 redetermined (zircon) 60±10 m.y.
CPR 119 Biotite – hornblende – pyroxene diorite porphyry (43° 58′N, 116°W; Boise Co., ID) 50′ E of road to Grimes Pass, 0.95 mi S of Diana School, Quartzburg district, Boise Basin. Thought by Ross (1963) to be decidedly younger than main body of batholith, possibly associated with Challis Volcanism. Analytical data: 4.5 ppm Pb, 116 α/mg/hr; 3.7 ppm Pb; 100 α/mg/hr; 2.8 ppm Pb, 111 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S., redetermination 12/13/61 by T. W. Stern, U. S. G. S.

2. Larsen and Schmidt, 1958 Pb-α (zircon) 114±10 m.y.
Jaffe and others, 1959
B. F. Leonard, written communication, 1973
CPR 118 Biotite – hornblende – pyroxene diorite (43°54.9′N, 116°12.7′W; sec. 27, T. 7 N., R. 2 E.; Boise Co., ID) near Horseshoe Bend, S side of old road to Emmett, S side of Payette River. Supposedly post-batholith, pre-Challis. Analytical data: 5.5 ppm Pb, 120 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S.

3. Larsen and others, 1958 — Pb-α — original (zircon) 115±10 m.y.
B. F. Leonard, written communication, 1973 — redetermined (zircon) 100±10 m.y.
CPR 117 Hypersthene augite biotite diorite, border facies, Idaho batholith (Ross, 1963) (43°28.7'N, 114°21' W; SE¼sec. 30, T. 2 N., R. 18 E.; Blaine Co., ID) S side of mine road, 0.3 mi above old mill site, Croesus Mine, Croesus Gulch, SW of Hailey. Isolated small pluton. Analytical data: 8 ppm Pb, 173 α/mg/hr; 7.0 ppm Pb, 182 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S., redetermination 12/13/61 by T. W. Stern, U. S. G. S.

4. Larsen and others, 1958 — Pb-α — (zircon) 102±10 m.y.
Jaffe and others, 1969 — (monazite) 112±10 m.y.
B. F. Leonard, written communication, 1973
L53-573 Porphyritic biotite granodiorite, Idaho batholith (45°10.9'N, 115°28.4'W; Valley Co., ID) E side of draw, 2000 ft NNW of peak 8520 north of Pilot Peak road, 1100' E of South Fork trail, Big Creek 15' quadrangle, NW 1/9 of quad. Analytical data: 14 ppm Pb, 340 α/mg/hr; 146 ppm Pb, 2726 α/mg/hr; collected by: B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S.

5. Larsen and others, 1958 — Pb-α — (monazite) 113±10 m.y.
B. F. Leonard, written communication, 1973
L53-88 Biotite muscovite granodiorite, Idaho batholith (45°7.6'N, 115°21.3'W; Valley Co., ID) 0.4 mi SE of TBM 6705, 1.6 mi WSW of Big Creek Ranger Station, N side of Big Creek-Warren road, cent. 9th, Big Creek 15' quad. Analytical data: 145 ppm Pb, 2678 α/mg/hr; collected by: B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S.

6. Larsen and others, 1958 — Pb-α — (zircon) 90±10 m.y.
(thorite) 102± m.y.
L 113 Tonalite (Locality uncertain, may be near 44°15'N, 114°49'W; Custer Co., ID). Published description is: Salmon River below Stanley, 1 mi below Elkhorn Creek. Not plotted on map. Analytical data: 30 ppm Pb, 825 α/mg/hr; 70 ppm Pb, 1375 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

7. Larsen and others, 1958 — Pb-α — (07) (monazite) 100±10 m.y.
(L267) (monazite) 127±10 m.y.
(L264) (monazite) 104±10 m.y.
(L269) (monazite) 112±10 m.y.
07, L 267, L 264, L 269 Muscovite quartz monzonite (43°49.5'N, 115°50'W; Boise Co., ID) placer near Idaho City, Muscovite placer. Analytical data: 155 ppm, 3241 α/mg/hr; 160 ppm, 2634 α/mg/hr; 150 ppm, 2994 α/mg/hr; 155 ppm, 2888 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

8. Larsen and others, 1958 — Pb-α — (monazite) 105±10 m.y.
M 60 Muscovite quartz monzonite (43° 56.5'N, 115°57'W; Boise Co., ID) near Placerville, Muscovite placer. Analytical data: 150 ppm Pb, 2983 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

9. Larsen and others, 1958 — Pb-α — (zircon) 135±10 m.y.
L 288 Granodiorite (43°48.5'N, 115°10'W; Elmore Co., ID) near Atlanta. Road along Middle Fork of Boise River at Vaughn Creek 31 mi NE of junction of North Fork and Middle Fork. Analytical data: 38 ppm Pb, 700 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

10. Larsen and others, 1958 — Pb-α — (zircon) 94±10 m.y.
L 110 Granodiorite (44°16'N, 114°50'W; Custer Co., ID) below Stanley. Exact locality uncertain. Analytical data: 38 ppm Pb, 1000 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

11. Larsen and others, 1958 Pb-α (zircon) 107±10 m.y.
L 70 Granodiorite (44°15′N, 116°05′W; Valley Co., ID) below Cascade. Road along Payette River 3 mi above Big Eddy. Analytical data: 9 ppm Pb, 210 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

12. Larsen and others, 1958 Pb-α (zircon) 107±10 m.y.
L 81 Tonalite (44°10′N, 115°12′W; Boise Co., ID) S Fork, Payette River, 23 mi above Lowman, 0.4 mi below Longjean Creek. Analytical data: 16 ppm Pb, 370 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

13. Larsen and others, 1958 Pb-α (zircon) 105±10 m.y.
L 217 Tonalite (46°38′N, 115°30′W; Clearwater Co., ID) near Bungalow. Analytical data: 9.5 ppm Pb, 225 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

14. Larsen and others, 1958 Pb-α (zircon) 100±10 m.y.
L 207 Muscovite quartz monzonite (46°30′N, 114°43′W; Idaho Co., ID) Indian grave near Powell, exact locality uncertain. Analytical data: 37 ppm Pb, 922 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

15. Larsen and others, 1958 Pb-α (zircon) 94±10 m.y.
(zircon) 116±10 m.y.

HCD 63, HCD 62 Granodiorite, Gem stock (47°30.5′N, 115°52′W; Shoshone Co., ID) near Coeur d'Alene. Analytical data: 11 ppm Pb, 292 α/mg/hr; 100 ppm Pb, 1739 α/mg/hr; collected by: A. B. Griggs, U. S. G. S.; dated by: Larsen and others, U. S. G. S.

16. Larsen and others, 1958 Pb-α (zircon) 131±10 m.y.
G 200 Tonalite or quartz diorite (44°10′N, 115°09′W; Boise Co., ID) near Stanley. S Fork Payette River. Analytical data: 10 ppm Pb, 190 α/mg/hr; collected by: D. Gottfried, U. S. G. S.; dated by: Larsen and others, U. S. G. S.

17. Larsen and others, 1958 Pb-α (zircon) 114±10 m.y.
(monazite) 93±10 m.y.
(xenotime) 93±10 m.y.

G 199 Muscovite quartz monzonite (44°18.5′N, 115°50′W; Valley Co., ID) 15 mi NE of Garden Valley, Silver Creek. Analytical data: 90 ppm Pb, 1970 α/mg/hr; 250 ppm Pb, 5617 α/mg/hr; 220 ppm Pb, 6025 α/mg/hr; collected by: D. Gottfried, U. S. G. S.; dated by: Larsen and others, U. S. G. S.

18. Larsen and others, 1958 Pb-α original (zircon) 53±10 m.y.
B. F. Leonard, written communication, 1973 (monazite) 57±10 m.y.
redetermined (zircon) 110±10 m.y.
(monazite) 50±10 m.y.

CPR 123 Gneissic granodiorite (46°7.5′N, 114°20′W; Ravalli Co., MT) Lost Horse Canyon, 8.15 mi from US-93. Analytical data: Zircon: 5.6 ppm Pb, 262 α/mg/hr; 10.9 ppm Pb, 254 α/mg/hr; Monazite: 80.0 ppm Pb, 2925 α/mg/hr; 64 ppm Pb, 2920 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: H. W. Jaffe, U. S. G. S.; redetermination 12/13/73 by T. W. Stern, U. S. G. S.

19. Larsen and others, 1958 Pb-α original (zircon) 63±10 m.y.
B. F. Leonard, written communication, 1973 (monazite) 55±10 m.y.
redetermined (zircon) 100±10 m.y.
(monazite) 50±10 m.y.

CPR 122 Porphyritic biotite – muscovite granodiorite, gneissic (46°6.9′N, 114°29.7′W; Idaho Co., ID) Bear Creek Pass, just south of Idaho State line, at end of Lost Horse road, 19.1 mi Lost Horse Creek from US-93. Analytical data: 6.7 ppm Pb, 257 α/mg/hr; 10.1 ppm Pb, 255 α/mg/hr; 90.0 ppm Pb, 3,385 α/mg/hr; 79 ppm Pb, 3378 α/mg/hr; collected by: C. P. Ross and B. F. Leonard, U. S. G. S.; dated by: J. W. Jaffe, U. S. G. S., redetermination 12/13/61 by T. W. Stern, U. S. G. S.

20. Ferguson, 1972 F.T. ($\lambda = 6.85 \times 10^{-17}$) (apatite) 56±5 m.y.
(sphene) 81±7 m.y.
K7 Skookum Butte stock (46°39'25"N, 114°22'10"W; NE¼sec. 7, T. 38 N., R. 17 E.; Idaho Co., ID); collected and dated by: J. A. Ferguson, U. Mont.

21. Larsen and others, 1958 Pb-α (monazite) 67±10 m.y.
47-L 166 Gneissic granodiorite or quartz monzonite (46°08'N, 114°24.5'W; Ravalli Co., MT) Lost Horse Canyon 6 mi below crest of Bitterroot Range. Analytical data: 96 ppm Pb, 2974 α/mg/hr; collected by: E. S. Larsen, Jr., U. S. G. S.; dated by: Larsen and others, U. S. G. S.

22. Larsen and others, 1958 Pb-α (zircon) 56±10 m.y.
(monazite) 51±10 m.y.
53 C 210 Gneissic granodiorite or quartz monzonite (46°08'N, 114°27'W; Ravalli Co., MT) Lost Horse Canyon. Analytical data: 6.2 ppm Pb, 275 α/mg/hr; 79.0 ppm Pb, 3213 α/mg/hr; collected by: R. W. Chapman, U. S. G. S.; dated by: Larsen and others, U. S. G. S.

23. Ferguson, 1972 F.T. ($\lambda = 6.85 \times 10^{-17}$) (apatite) 39±4 m.y.
BC 50 Idaho batholith (46°30'05"N, 114°19'10"W; SE¼sec. 26, T. 9 N., R. 22 W.; Ravalli Co., MT); collected and dated by: J. A. Ferguson, U. of Montana.

24. Ferguson, 1972 F.T. ($\lambda = 6.85 \times 10^{-17}$) (apatite) 43±3 m.y.
K 42 Idaho batholith (46°32'00"N, 114°20'35"W; SE¼sec. 15, T. 9 N., R. 22 W.; Ravalli Co., MT); collected and dated by: J. A. Ferguson, U. of Montana.

25. Ferguson, 1972 F.T. ($\lambda = 6.85 \times 10^{-17}$) (apatite) 42±4 m.y.
K 8 Skookum Butte stock (46°40'10"N, 114°21'55"W; NE¼sec. 33, T. 11 N., R. 22 W.; Missoula Co., MT); collected and dated by: J. A. Ferguson, U. of Montana.

26. Ferguson, 1972 F.T. ($\lambda = 6.85 \times 10^{-17}$) (apatite) 37±4 m.y.
K 4 Skookum Butte stock (46°36'35"N, 114°24'30"W; NE¼sec. 26, T. 38 N., R. 16 E.; Idaho Co., ID); collected and dated by: J. A. Ferguson, U. of Montana.

MESOZOIC (?) GRANITIC ROCKS WITH CHALLIS DATES

Large portions of the Idaho batholith, as shown on figure 4, yield K-Ar mineral dates younger than 60 m.y. Often the dates are even somewhat younger than Challis volcanic rocks that unconformably overlie the granitic rocks of the batholith. These low dates are either the result of heating of Mesozoic granitic rocks during Challis igneous activity or they are from granitic rocks of Challis age that have not yet been distinguished from Mesozoic granites on geologic maps. Only additional field and laboratory studies will resolve this uncertainty.

1. McDowell and Kulp, 1969 K-Ar (biotite) 43.1±1.3 m.y.
McDowell, 1971
L-1029 Idaho batholith medium-grained granodiorite (approximately 43° 19.5'N, 115° 17'W; sec. 20, T. 1 S., R. 10 E.; Camas Co., ID) Idaho 46 between Little Camas Reservoir and Hill City. Analytical data: K = 6.68%; $*Ar^{40} = 5.17 \times 10^{-10}$ moles/gm (85% ΣAr^{40}); collected and dated by: F. W. McDowell, Columbia U.

2. McDowell and Kulp, 1969 K-Ar (biotite) 43.7±1.3 m.y.
McDowell, 1971
L-1123 Idaho batholith medium-grained slightly porphyritic granodiorite (43°47'35"N, 115°25'15"W; NE¼-sec. 7, T. 5 N., R. 9 E.; Elmore Co., ID) Middle Fork Boise River 14 mi W of Atlanta. Analytical data: K = 6.29%; $*Ar^{40} = 4.93 \times 10^{-10}$ moles/gm (79% ΣAr^{40}); collected and dated by: F. W. McDowell, Columbia U.

3. McDowell and Kulp, 1969 K-Ar (biotite) 49.3±1.5 m.y.
McDowell, 1971
L-1121 Idaho batholith coarse-grained quartz monzonite (46°20'45"N, 115°18'20"W; sec. 27, T. 35 N., R.

3. (continued)
9 E.; Idaho Co., ID) Idaho 9, 43 mi W of Idaho state border. Analytical data: K = 6.90%; $*Ar^{40}$ = 6.11 x 10^{-10} moles/gm (87% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

4. McDowell and Kulp, 1969 K-Ar (biotite) 42.0±1.3 m.y.
McDowell, 1971
L-954 Idaho batholith medium-grained quartz monzonite (46°08′14″N, 114°26′17″W; NW¼sec. 3, T. 4 N., R. 23 W.; Ravalli Co., MT) Lost Horse Gulch, about 14 mi W of canyon mouth. Analytical data: K = 7.38%; $*Ar^{40}$ = 5.55 x 10^{-10} moles/gm (72% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

5. McDowell and Kulp, 1969 K-Ar (biotite) 38.3±1.1 m.y.
McDowell, 1971
L-953 Idaho batholith, medium-grained quartz monzonite, slightly gneissic (46°06′11″N, 114°15′19″W; NW¼sec. 18, T. 4 N., R. 21 W.; Ravalli Co., MT) Lost Horse Gulch, 4 mi W of canyon mouth. Analytical data: K = 6.86%; $*Ar^{40}$ = 4.71 x 10^{-10} moles/gm (84% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

6. McDowell, 1971 K-Ar (muscovite) 54.8±1.6 m.y.
L-1120 Idaho batholith, medium-grained quartz monzonite (45°50′20″N, 113°59′30″W; NE¼sec. 18, T. 1 N., R. 19 W.; Ravalli Co., MT) US-93 0.5 mi N of Sula. Analytical data: K = 8.61%; $*Ar^{40}$ = 8.50 x 10^{-10} moles/gm (88% Σ Ar^{40}); collected and dated by: F. W. McDowell, Columbia U.

7. Percious and others, 1967 K-Ar (biotite) 44.8±1.3 m.y.
HJO-6-65 Idaho batholith, porphyritic granodiorite, 0.5 mi E of dike swarm (44°03′50″N, 115°41′30″W; NE¼sec. 1, T. 8 N., R. 6 E.; Boise Co., ID) W of Lowman. Analytical data: K = 6.46, 6.47%; $*Ar^{40}$ = 5.206 x 10^{-10} moles/gm (71.3% Σ Ar^{40}); collected by: H. J. Olson, U. of Ariz.; dated by: J. K. Percious and P. E. Damon, U. of Ariz.

8. Harrison and others, 1972 K-Ar (biotite) 56.7±1.6 m.y.
4 Fine-grained granodiorite stock, part of Kaniksu batholith (48°28′30″N, 116°25′45″W; SW¼sec. 11, T. 59 N., R. 1 W.; Bonner Co., ID). Analytical data: K_2O = 9.16%; $*Ar^{40}$ = 7.78 x 10^{-10} moles/gm (91.5% Σ Ar^{40}); collected by: J. E. Harrison, U. S. G. S.; dated by: J. D. Obradovich, U. S. G. S.

9. Z. E. Peterman, written communication, 1974 K-Ar (hornblende) 46.2±1.9 m.y.
FWC-72-69 Foliated hornblende quartz diorite, Idaho batholith (45°28′N, 114°58′W; sec. 27, T. 25 N., R. 12 E.; Idaho Co., ID). Analytical data: K = 0.405%; $*Ar^{40}$ = 0.3366 x 10^{-10} moles/gm (59.7% Σ Ar^{40}); collected by: F. W. Cater, U. S. G. S.; dated by: J. D. Obradovich, U. S. G. S.

10. Hietanen, 1969 K-Ar (biotite) 43.1±1.4 m.y.
758 A Granite, Bungalow pluton (46°37′45″N, 115°29′15″W; NW corner sec. 20, T. 38 N., R. 8 E.; Clearwater Co., ID). Analytical data: K_2O = 8.715%; $*Ar^{40}$ = 5.601 x 10^{-10} moles/gm (70% Σ Ar^{40}); collected by: Anna Hietanen, U. S. G. S.; dated by: Joan Engels, U. S. G. S.

MESOZOIC (?) VOLCANIC ROCK

A single Mesozoic date for a volcanic rock has been reported and is listed below. The result is probably anomalous and should be confirmed independently.

1. Chase, 1972 K-Ar (whole rock) 72±6 m.y.
R 17 Basalt (43°42′20″N, 112°55′30″W; center sec. 6, T. 4 N., R. 30 E.; Butte Co., ID). Drill cuttings from 1407-1465 ft. depth. Significance of this isolated date, without stratigraphic control, is impossible to judge. Result is quite unexpected and needs some sort of confirmation. Analytical data: K = 0.34%; $*Ar^{40}$ = 1.02 x 10^{-6} cc/gm (14% Σ Ar^{40}); collected by: G. H. Chase, U. S. G. S.; dated by: Isotopes Inc.

Article continued in next issue

New Mexico Tech Print Plant

Type Faces:	Camera-ready copy composed on IBM MT Text 10 pt. Press Roman leaded two points Subheads 11 pt. and 8 pt. Press Roman
Presswork:	Text and cover printed on Davidson 600
Paper:	Body on 60 lb. white offset Cover on 65 lb. Russett
Ink:	Vanson rubber base plus all-purpose black