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Isochron/West, Bulletin of Isotopic Geochronology, v. 33, pp. 27-32

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K-Ar AND ^{40}Ar-^{39}Ar AGES OF MID-TERTIARY VOLCANIC ROCKS FROM THE WESTERN CASCADE RANGE, OREGON

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The K-Ar and ^{40}Ar-^{39}Ar age data presented here are for volcanic rocks from two formations found in the northern half of the Western Cascade Range, Oregon (Figure 1). The older is the Little Butte Volcanic Series (LBVS) which is composed of pyroclastic and volcanic rocks which range in composition from basalt to rhyolite (Beaulieu, 1971). The sources of the LBVS are volcanic vents which are scattered about the Western Cascade Range (McBirney, 1978). The younger formation is the Columbia River Basalt Group (CRB) which is composed of tholeiitic basalts (Swanson and others, 1979). The sources of the CRB are dike swarms in central and eastern Oregon and Washington (Swanson and others, 1979). As the CRB were erupted they flowed westward through a topographic low in the Cascade Range into the region of the Western Cascades and Willamette Valley. The CRB are easily distinguished from the mainly calc-alkaline volcanic rocks of the northern half of the Western Cascade Range, and for that reason they have been used as a stratigraphic marker between the underlying LBVS and the overlying Sardine Formation (Peck and others, 1964). The data presented here were generated as part of a study which investigated the distribution of CRB and basalts assumed to be time-equivalents in the Western Cascade Range, Oregon and thereby defined the extent of their usefulness as stratigraphic markers. The work was supported by the National Science Foundation (Grant no. EAR 77-27099) and a Penrose Bequest Grant from the Geological Society of America while working towards a Ph.D. at Ohio State University.

DISCUSSION

Basalts from the CRB were identified by their chemical and petrographic characteristics (Lux, 1981) as well as the age data presented here. The CRB in the Western Cascade Range are represented by the Grande Ronde and Wanapum Basalts. The total range in measured ages is 14.6 ± 0.6 Ma to 16.5 ± 0.3 Ma. All of the CRB in the study, with the exception of analyses of sample 7703 (16.5 ± 0.3 Ma) and sample 7798 (14.7 ± 0.2 Ma), have radiometric ages which are in statistical agreement with the mean value of all the measured ages, 15.3 ± 0.4 Ma, using the critical value test (Dalrymple and Lanphere, 1969). Since the Grande Ronde and Wanapum Basalts are interstratified in some localities (Swanson and others, 1979) their isotopic age equivalence is no surprise. In addition, this age estimate agrees with the best age estimate for the Picture Gorge Basalt, 15.6 ± 0.6 Ma (corrected to post-1977 decay constants), which was presented by Baksi (1974). In certain localities the Picture Gorge and Grande Ronde Basalts are also known to be interstratified (Nathan and Fruchter, 1974). The basalts mentioned above all have equivalent isotopic ages and are distinctly older than apparent ages calculated for various members of the Saddle Mountain Basalt Formation (McKee and others, 1977), the youngest formation of the CRB. This is consistent with the field observations which indicate that the basalts of the Saddle Mountain Basalt Formation only occur with marked erosional unconformity upon the underlying rocks. According to these age measurements and the volume estimates of the various CRB formations given by McKee and others (1977), 99% of the entire 200,000 km³ of CRB was erupted in a short time, less than the time span indicated by the analytical precision of the age measurements.

A southern limit for CRB outcrop in the Western Cascades is established at Hungry Hill, about 8 miles north of Lebanon, Oregon. This is approximately the point established by Lux and Sutter (1978).

Dating of lava flows from the LBVS indicates that rocks of this formation range in age from 41.5 to 15.6 Ma. The oldest of these samples are among the oldest rocks found in the Cascade Range. In many cases, samples of equivalent radiometric age crop out in restricted geographic areas indicating that the LBVS may be composed of smaller mappable units. Detailed field mapping and radiometric age determination could facilitate such a subdivision.

Data reported here and data from Sutter (1978) are plotted on an age versus frequency histogram in Figure 2. The data suggests that between 15 and 40 Ma ago the eruption of basaltic rocks in the Western Cascade Range, Oregon was episodic and had a period of about 5 Ma. This appears to be equivalent to the periodicity observed by previous workers for volcanic rocks from the Oregon Cascades that are 15 Ma or younger in age (McBirney and others, 1974). A similar 5 Ma periodicity is indicated for other circum-Pacific volcanic rocks of Middle Tertiary or younger age (Kennet and others, 1977).

The approximately 40 Ma old volcanics of the Western Cascade Range apparently represent a major westward shift in arc-type volcanism. Prior to that time much of the Mesozoic and Early Tertiary igneous activity in the Pacific Northwest occurred in relation to emplacement of batholiths in Idaho and Montana and lastly to the eruption of the Challis Volcanics during Eocene time (Armstrong and others, 1977; Armstrong, 1974). The volcanic events of the Pacific Northwest correlate well with the timing of events in the Great Basin. An abrupt start of igneous activity occurred in the Eastern Great Basin about 40 Ma ago with the emplacement of quartz monzonite and granodiorite plutons (McKee, 1971) concurrent with the earliest Cascade activity. The major volcanic episode represented by the voluminous Sardine Formation of the Western Cascades (McBirney and others, 1974) and the CRB of eastern Oregon and Washington about 15.5 Ma correlate well with the widespread eruption of olivine basalt and the inception of basin and range faulting in the Great Basin about 16 Ma ago (McKee, 1971). This correlation in the timing of major volcanic episodes over a large portion of the Western United States suggests that major reorganizations of plate tectonic movements may have occurred at about 40 and 15 Ma.

ANALYTICAL PROCEDURES

Samples were crushed and sieved and the 30–60, 60–80, and 80–100 mesh sizes are saved for analysis. Each sample was washed in an ultrasonic cleaner with reagent grade acetone, alcohol, and triple distilled water. A small portion was split from each sample and crushed to less than 100 mesh and saved for potassium analysis.

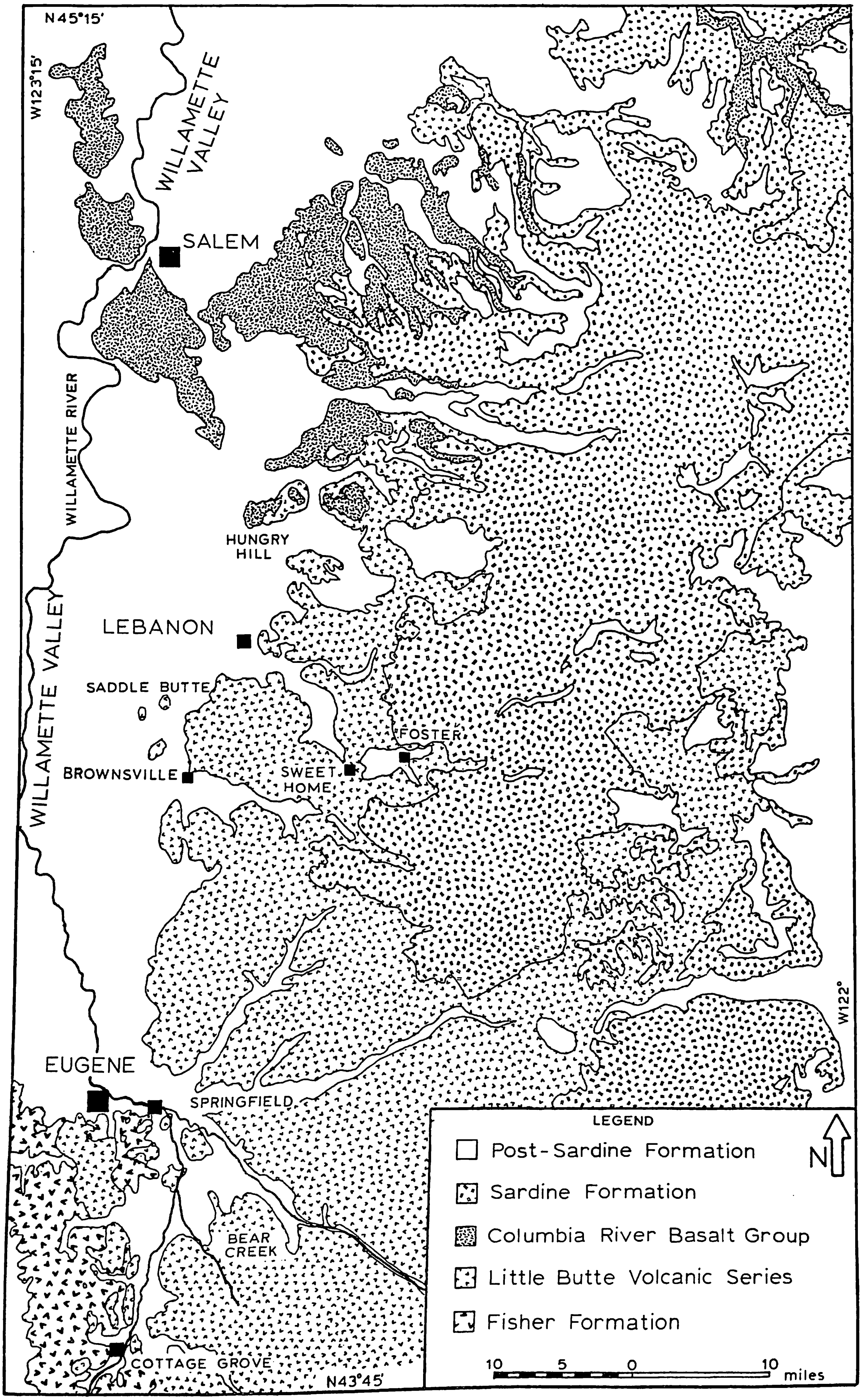

FIGURE 1. Generalized geologic map of a part of the Western Cascade Range, Oregon showing the distribution of basalts of the Columbia River Basalt Group and Little Butte Volcanic Series (after Wells and Peck, 1961). Other than samples 7757 and 7755, which were collected along the Columbia River at Multnomaha Falls, all samples were collected from within the area shown.

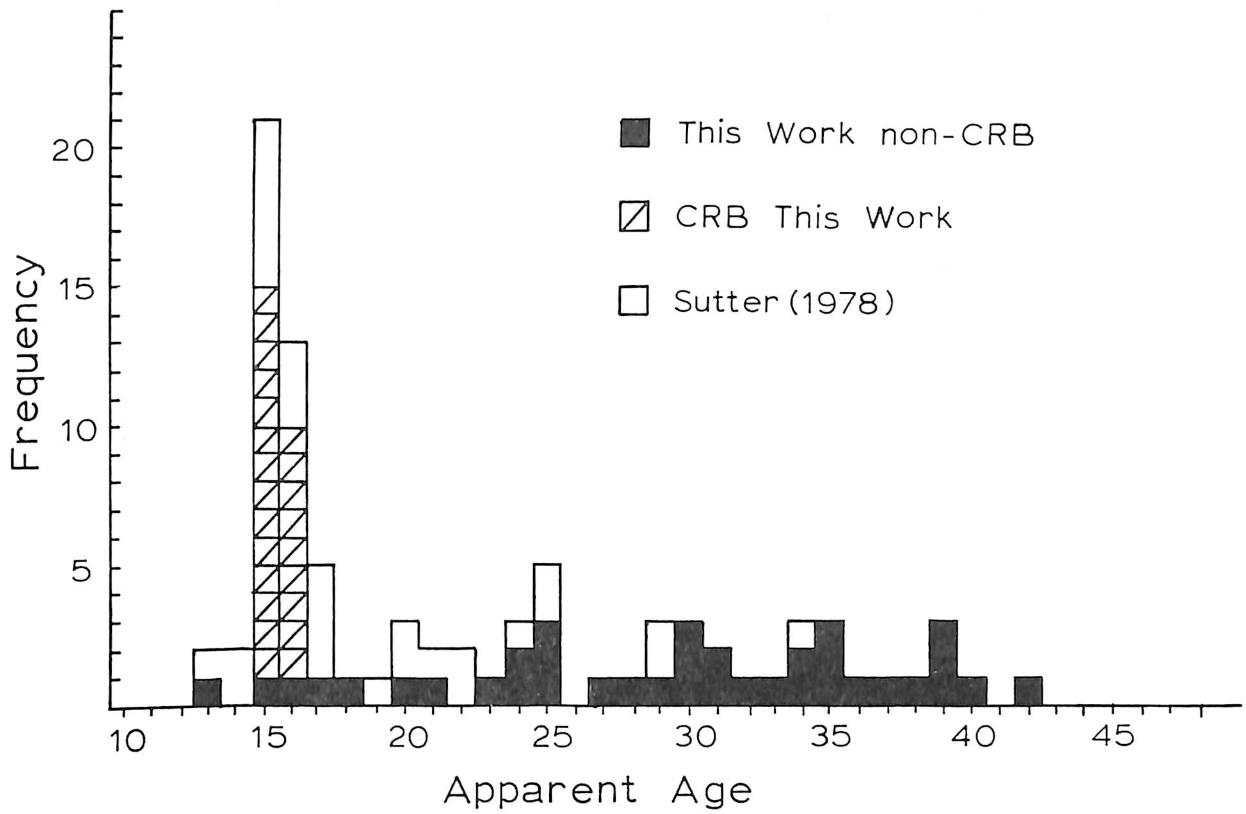

FIGURE 2. Histogram of the apparent ages presented here and by Sutter (1978). The data suggests a periodicity of about 5 Ma between periods of maximum volcanic activity.

At Ohio State University samples were carefully weighed and encapsulated in Al foil, and loaded into a glass vacuum line for Ar extraction. Samples were melted in a Mo crucible within the vacuum line by radiofrequency-induction heating. A tracer greatly enriched in ^{38}Ar was added from a tracer reservoir by a pipette of known volume. The ^{38}Ar tracer and sample gas were allowed to equilibrate. The gas mixture was then purified by removing chemically active gasses with a zeolite molecular-sieve dessicant, a Cu-CuO getter, and a Ti getter. The extraction system is on line to a Nuclide Corporation (Model SGA-6-60) 6 inch Neir-type mass spectrometer. Analyses were performed in the static mode. Data was collected with both digital and strip chart output. All data was extrapolated to the time of admission to the mass spectrometer to correct for any fractionation or memory effects. The method of Ar extraction and purification is similar to that described by Dalrymple and Lanphere (1969).

At the Scottish Universities Research and Reactor Centre (SURRC) carefully weighed samples were encapsulated in Cu foil and loaded into the glass and stainless steel extraction line. The samples were fused in a Mo crucible within the extraction system by radiofrequency-induction heating. A tracer greatly enriched in ^{38}Ar was added to the sample gas from a tracer reservoir through a pipette of known volume. The sample gas and ^{38}Ar tracer were allowed to equilibrate. The gas mixture was purified by removing reactive gasses by means of a zeolite molecular sieve dessicant and a titanium sublimation pump. The entire extraction system was degassed by heating and pumping on a Hg diffusion pump between each sample analysis. The extraction system is on line to an AEI MS-10 mass spectrometer. Analyses were performed in the static mode and data was collected with a strip chart recorder.

At OSU about 100 mg of sample was used for potassium determination. The samples are digested overnight in platinum crucibles using hydrofluoric and sulfuric acids. In the morning HNO_3 was added and the solution was heated until SO_2 fumes appeared assuring the evaporation of any excess HF. Water was added and heated until solution was achieved. The solution was then neutralized with ammonium hydroxide causing the precipitation of Al and Fe oxides. Ammonium carbonate was added to precipitate $CaCO_3$. This mixture was filtered and the filtrate was collected in volumetric flasks to which a lithium internal standard was added. The flasks were diluted to volume and a portion of the solution was analyzed on a Zeiss (model PF-5) flame photometer in an air-propane flame. The potassium concentration was determined by comparison to K standard solutions prepared from ultra-pure KCl in a manner similar to the unknown samples.

At the SURRC approximately 50 mg of sample was weighed in a teflon beaker for potassium determination. The samples were dissolved overnight in a sulfuric and hydrofluoric acid solution and evaporated to dryness. The residue was then brought back into solution with 1 ml of nitric acid and water and added to a 250 ml volumetric flask. A solution containing a Na buffer and a lithium internal standard was added and the solutions were diluted to volume. The sample solutions were analyzed with a Corning-EEL (model 450) flame photometer in an air-propane flame. Potassium determinations were made by comparison to standard solutions with known potassium contents.

Constants used in both the K/Ar and $^{40}Ar/^{39}Ar$ age calculations are: $\lambda_\beta = 4.962 \times 10^{-10} yr^{-1}$, $\lambda_\epsilon = 0.581 \times 10^{-10} yr^{-1}$, and $^{40}K/K$ total $= 1.167 \times 10^{-4}$ atom/atom. All errors listed are 1σ estimates using the equation given by Cox and Dalrymple (1967).

Analytical procedures used in this study which are peculiar to the ^{40}Ar-^{39}Ar method are described in some detail in a paper by Sutter and Smith (1979).

All samples dated as part of this study were collected by the author.

SAMPLE DESCRIPTIONS

Columbia River Basalt Group

Wanapum Basalt

1. *7798* K/Ar
Basalt (44°41'45"N, 122°56'15"W; S28,T95,R2W; small quarry on the W side of the road near BM 309, Marion Co., OR). *Analytical data:* %K = 1.190; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.054 (27.1%R).
(whole rock) 14.7 ± 0.2 Ma

2. *7703* $^{40}Ar/^{39}Ar$, K/Ar
Basalt (44°52'N, 122°39'30"W; S14,T8S,R1E; at the base of South Falls, Marion Co., OR). *Analytical data:* %K = 1.119; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.221 (59.2%R); 3.101 (58.4%R).
(whole rock) 16.5 ± 0.3 Ma
(whole rock) 15.9 ± 0.4 Ma
(whole rock $^{40}Ar/^{39}Ar$ total gas) 15.9 Ma
(whole rock $^{40}Ar/^{39}Ar$ plateau) 15.7 ± 0.6 Ma

3. *7765* K/Ar
Basalt (45°1'N, 122°44'W; S30,T6S,R3E; roadcut, Clackamas Co., OR). *Analytical data:* %K = 1.147; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.955 (42.1%R).
(whole rock) 14.8 ± 0.4 Ma

4. *7723AW* K/Ar
Basalt (44°49'N, 123°1'30"W; S2,T9S,R3W; quarry along the E side of U.S. Highway 99, Marion Co., OR). *Analytical data:* %K = 1.441; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.659 (45.4%R).
(whole rock) 14.6 ± 0.4 Ma

5. *7763* K/Ar
Basalt (44°46'15"N, 122°38'15"W; S10,T8S,R1W; roadcut near creek, Marion Co., OR). *Analytical data:* %K = 1.167, 1.169; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.154 (52.3%R), 3.132 (51.3%R).
(whole rock) 15.5 ± 0.4 Ma
(whole rock) 15.4 ± 0.4 Ma

6. *7726* $^{40}Ar/^{39}Ar$
Basalt (44°51'N, 122°47'45"W; S27,T8S,R1W; roadcut just S of BM497, Marion Co., OR).
(whole rock total gas) 16.6 Ma
(whole rock plateau) 15.8 ± 1.1 Ma

Grande Ronde Basalt

7. *7727* K/Ar
Basalt (44°47'15"N, 122°39'W; S14,T9S,R1E; quarry on the SW face of Stout Mountain, Marion Co., OR). *Analytical data:* %K = 1.307; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.503 (52.3%R).
(whole rock) 15.5 ± 0.2 Ma

8. *7709* K/Ar
Basalt (44°55'15"N, 122°33'15"W; S21,T7S,R2E; roadcut along creek SW of the junction with Abiqua Creek, Marion Co., OR). *Analytical data:* %K = 1.160; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.037 (51.5%R).
(whole rock) 15.0 ± 0.4 Ma

9. *7757* K/Ar
Basalt (45°35'05"N, 122°06'30"W; at Multnomah Falls State Park along the trail to the top of the falls, Multnomah Co., OR). *Analytical data:* %K = 1.497; moles $^{40}Ar_R \times 10^{-11}/g$ = 4.082 (48.7%R).
(whole rock) 15.7 ± 0.4 Ma

10. *7722* K/Ar
Basalt (44°49'N, 123°01'30"W; S2,T9S,R3W; quarry along the E side of U.S. Highway 99, Marion Co., OR). *Analytical data:* %K = 1.079; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.934 (42.6%R).
(whole rock) 15.6 ± 0.8 Ma

11. *7794* K/Ar
Basalt (44°43'15"N, 122°50'15"W; S8,T10S,R1W; roadcut at the junction of the roads at the base of the hill, Linn Co., OR). *Analytical data:* %K = 1.135; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.951 (60.8%R).
(whole rock) 14.9 ± 0.4 Ma

12. *7755* K/Ar
Basalt (45°35'05"N, 122°06'30"W; at Multnomah Falls State Park along the trail to the top of the falls, Multnomah Co., OR). *Analytical data:* %K = 1.472; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.898 (62.5%R).
(whole rock) 15.2 ± 0.2 Ma

13. *7774* K/Ar
Basalt (45°12'N, 122°13'15"W; S29,T4S,R5E; roadcut at the base of Big Cliff, Clackamas Co., OR). *Analytical data:* %K = 1.512, 1.397; moles $^{40}Ar_R \times 10^{-11}/g$ = 4.144 (31.5%R) 3.636 (30.7%R).
(whole rock) 15.7 ± 0.6 Ma
(whole rock) 14.9 ± 0.6 Ma

14. *7795* K/Ar
Basalt (44°43'25"N, 122°48'15"W; S4,T10S,R1W; roadcut at the top of the hill just below road junction, Linn Co., OR). *Analytical data:* %K = 1.056; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.754 (48.2%R).
(whole rock) 15.0 ± 0.4 Ma

15. *78SP49* K/Ar
Basalt (44°49'15"N, 122°44'45"W; S24,T10S,R1W; small quarry on the southside of the road, Linn Co., OR). *Analytical data:* %K = 1.506; moles $^{40}Ar_R$ x 10^{-11}/g = 3.997 (53.9%R).
(whole rock) 15.2 ± 0.4 Ma

16. *7797AW* K/Ar
Basalt (44°41'15"N, 122°44'45"W; S24,T10S,R1W; from a small quarry on the S side of the road, Linn Co., OR). *Analytical data:* %K = 1.388; moles $^{40}Ar_R$ x 10^{-11}/g = 3.644 (41.0%R).
(whole rock) 15.1 ± 0.5 Ma

17. *7729* K/Ar
Basalt (44°47'15"N, 122°39'W; S14,T9S,R1E; quarry on the SW face of Stout Mountain, Marion Co., OR). *Analytical data:* %K = 0.990; moles $^{40}Ar_R$ x 10^{-11}g = 2.508 (48.3%R).
(whole rock) 14.5 ± 0.4 Ma

18. *7715* $^{40}Ar/^{39}Ar$
Basalt (44°51'N, 122°59'30"W; S25,T8S,R3W; quarry on the NW side of the road, Marion Co., OR).
(whole rock total gas) 15.5 Ma
(whole rock plateau) 15.8 ± 1.1 Ma

Little Butte Volcanic Series

19. *77113* K/Ar
Basaltic andesite (42°32'N, 122°53'W; S13,T12S,R2W; roadcut at NW base of Ridgeway Butte, Linn Co., OR). *Analytical data:* %K = 1.094; moles $^{40}Ar_R$ x 10^{-11}/g = 7.971 (87.4%R).
(whole rock) 41.5 ± 0.9 Ma

20. *78LB42* K/Ar
Andesite (44°33'30"N, 122°51'30"W; S6,T12S,R1W; roadcut on the E side of the road just N of the second E-W road, Linn, Co., OR). *Analytical data:* %K = 0.993; moles $^{40}Ar_R$ x 10^{-11}/g = 6.822 (19.9%R).
(whole rock) 39.2 ± 0.5 Ma

21. *7775* K/Ar
Basaltic andesite (43°2'N, 123°0'10"W; S35,T19S,R3W; quarry on the E side of the road, Lane Co., OR). *Analytical data:* %K = 0.936; moles $^{40}Ar_R$ x 10^{-11}/g = 6.075 (23.4%R).
(whole rock) 37.0 ± 1.3 Ma

22. *7778* K/Ar
Basalt (43°46'N, 123°7'W; S1,T21S,R4W; roadcut, Lane Co., OR). *Analytical data:* %K = 0.399; moles $^{40}Ar_R$ x 10^{-11}/g = 2.525 (56.5%R).
(whole rock) 36.2 ± 0.5 Ma

23. *78CG5* K/Ar
Basalt (43°53'15"N, 123°00'15"W; S25,T19S,R3W; roadcut, Lane Co., OR). *Analytical data:* %K = 0.249; moles $^{40}Ar_R$ x 10^{-11}/g = 1.733 (7.4%R).
(whole rock) 39.7 ± 1.4 Ma

24. *78CG7* K/Ar
Basalt (43°55'30"N, 123°5'W; S17,T19S,R3W; roadcut just W of T-junction, Lane Co., OR). *Analytical data:* %K = 0.662; moles $^{40}Ar_R$ x 10^{-11}/g = 4.490 (38.1%R).
(whole rock) 38.7 ± 0.5 Ma

25. *78CG2* K/Ar
Basaltic andesite (43°47'30"N, 123°1'W; S35,T20S,R3W; roadcut on the W slope of the hill, Lane Co., OR). *Analytical data:* %K = 0.720; mole $^{40}Ar_R$ x 10^{-11}/g = 4.755 (63.7%R).
(whole rock) 37.7 ± 0.9 Ma

26. *77110* K/Ar
Basaltic andesite (44°32'N, 122°52'W; S12,T12S,R2W; roadcut near T-junction, Linn Co., OR). *Analytical data:* %K = 0.723; moles $^{40}Ar_R$ x 10^{-11}/g = 4.169 (40.3%R).
(whole rock) 32.9 ± 0.4 Ma

27. *77112* K/Ar
Basalt (44°31'N, 122°49'W; S21,T12S,R1W; roadcut on the S side of the small hill just W of the creek, Linn Co., OR). *Analytical data:* %K = 1.283; moles $^{40}Ar_R$ x 10^{-11}/g = 7.622 (67.0%R).
(whole rock) 33.9 ± 0.8 Ma

28. *78HAL17* K/Ar
Andesite (44°24'45"N, 123°1'30"W; S16,T13S,R3W; roadcut in a fairly new allotment of the SW slope of Powell Hills, Linn Co., OR). *Analytical data:* %K = 0.978; moles $^{40}Ar_R$ x 10^{-11}/g = 6.037 (64.7%R).
(whole rock) 35.2 ± 0.8 Ma

29. *77121* K/Ar
Basaltic andesite (44°27'15"N, 123°3'15"W; S9,T13S,R3W; quarry at the southern end of Saddle Butte, Linn Co., OR). *Analytical data:* %K = 0.604; moles $^{40}Ar_R$ x 10^{-11}/g = 3.673 (40.7%R).
(whole rock) 34.7 ± 0.4 Ma

30. *78BR31* K/Ar
Andesite (44°20'N, 122°54'15"W; S22,T14S,R2W; roadcut near SE section boundary, Linn Co., OR). *Analytical data:* %K = 0.959; moles $^{40}Ar_R$ x 10^{-11}/g = 4.972 (42.9%R).
(whole rock) 29.7 ± 0.4 Ma

31. *78BR19* K/Ar
Basalt (44°25'15"N, 123°W; S24,T13S,R3W; roadcut on hill along the S24-S25 boundary line road, Linn Co., OR). *Analytical data:* %K = 0.363; moles $^{40}Ar_R$ x 10^{-11}/g = 1.997 (42.3%R).
(whole rock) 31.4 ± 0.5 Ma

32. *78BR22* K/Ar
Andesite (44°20'30"N, 122°59'W; S24,T14S,R3W; roadcut at S24-S19 boundary, Linn Co., OR). *Analytical data:* %K = 1.463; moles $^{40}Ar_R$ x 10^{-11}/g = 7.387 (79.2%R).
(whole rock) 28.9 ± 0.5 Ma

33. *78BR12* K/Ar
Basaltic andesite (44°17'15"N, 122°59'30"W; S12,T15S,R3W; quarry at Diamond Hill, Linn Co., OR). *Analytical data:* %K = 0.713, 0.758; moles $^{40}Ar_R$ x 10^{-11}/g = 3.970 (68.3%R), 4.115 (31.9%R).
(whole rock) 31.8 ± 0.7 Ma
(whole rock) 31.0 ± 1.2 Ma

34. *77118* K/Ar
Andesite (44°20'15"N, 122°54'30"W; Center S22,T14S,R2W; roadcut near road junction, Linn Co., OR). *Analytical data:* %K = 1.070; moles

$^{40}Ar_R \times 10^{-11}/g$ = 4.731 (34.2%R).
(whole rock) 25.3 ± 0.4 Ma

35. *77100* K/Ar
Andesite (44°23'45''N, 122°32'W; S35,T13S,R2E; small quarry S of the road, Linn Co., OR). *Analytical data:* %K = 0.425; moles $^{40}Ar_R \times 10^{-11}/g$ = 1.866 (30.0%R).
(whole rock) 25.1 ± 1.1 Ma

36. *7792* K/Ar
Basalt (44°25'N, 122°37'45''W; S25,T13S,R1E; prominent roadcut near junction to Green Peter Dam, Linn Co., OR). *Analytical data:* %K = 0.371; moles $^{40}Ar_R \times 10^{-11}/g$ = 1.593 (17.2%R).
(whole rock) 24.6 ± 0.3 Ma

37. *78BR36* K/Ar
Basalt (44°24'30''N, 122°46'15''W; S34,T13S,R1W; roadcut at 1080 ft contour, Linn Co., OR). *Analytical data:* %K = 0.408, 0.406; moles $^{40}Ar_R \times 10^{-11}/g$ = 1.810 (37.7%R), 1.712 (40.2%R).
(whole rock) 25.4 ± 0.9 Ma
(whole rock) 24.1 ± 0.8 Ma

38. *7799* K/Ar
Basalt (44°25'N, 122°37'45''W; S25,T13S,R1E; roadcut, Linn Co., OR). *Analytical data:* %K = 0.385, 0.390; moles $^{40}Ar_R \times 10^{-11}/g$ = 1.242 (22.4%R), 1.217 (25.2%R).
(whole rock) 18.5 ± 1.0 Ma
(whole rock) 17.9 ± 0.9 Ma

39. *7791* K/Ar
Basalt (44°24'45''N, 122°39'W; S26,T13S,R1E; roadcut, Linn Co., OR). *Analytical data:* %K = 0.352, 0.357; moles $^{40}Ar_R \times 10^{-11}/g$ = 1.298 (23.2%R), 1.310 (26.7%R).
(whole rock) 21.1 ± 1.1 Ma
(whole rock) 21.0 ± 1.0 Ma

40. *7786* K/Ar
Basaltic andesite (44°12'30''N, 122°49'45''W; S5,T15S,R1W; roadcut near small quarry, Lane Co., OR). *Analytical data:* %K = 0.610; moles $^{40}Ar_R \times 10^{-11}/g$ = 3.165 (15.8%R).
(whole rock) 29.7 ± 0.8 Ma

41. *7790* K/Ar
Basaltic andesite (44°12'45''N, 122°49'45''W; S5,T15S,R1W; roadcut at T-junction just S of Mabel, Lane Co., OR). *Analytical data:* %K = 0.428, 0.429; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.120 (32.5%R), 2.027 (36.8%R).
(whole rock) 28.3 ± 1.1 Ma
(whole rock) 27.0 ± 1.0 Ma

42. *78MAR27* K/Ar
Basalt (42°2'15''N, 123°W; S1,T18S,R3W; quarry, Lane Co., OR). *Analytical data:* %K = 0.499; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.649 (36.3%R).
(whole rock) 30.3 ± 1.1 Ma

43. *78CG29* K/Ar
Basalt (44°N, 123°6'W; S8,T18S,R3W; at T-junction just N of powerline, Lane Co., OR). *Analytical data:* %K = 0.457, 0.453; moles $^{40}Ar_R \times 10^{-11}/g$ = 2.594 (55.6%R), 2.801 (54.8%R).
(whole rock) 32.4 ± 0.8 Ma
(whole rock) 35.3 ± 0.9 Ma

44. *77104* K/Ar
Basalt (44°24'30''N, 122°36'15''W; S30,T13S,R2E; roadcut, Linn Co., OR). *Analytical data:* %K = 0.327; moles $^{40}Ar_R \times 10^{-11}/g$ = 0.979 (23.1%R).
(whole rock) 17.2 ± 1.2 Ma

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