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K-Ar AGES OF ROCKS IN THE MOUNT HOOD AREA, OREGON

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INTRODUCTION

Age determinations reported here supplement geologic mapping and revise Miocene through Holocene volcanic stratigraphy in the Mount Hood area, Oregon, previously mapped by Wise (1968, 1969), Keith, Beeson, and Bargar (1982), and Priest and Vogt (1982). Age assignments are from the Decade of North American Geology time scale (Palmer, 1983). Previous data on ages obtained from rocks in the Mount Hood area were reported by Wise (1969), Bickerman (1970), and Evans and Brown (1981), and are listed by Laursen and Hammond (1974) and Fiebelkorn and others (1983).

GEOLOGIC BACKGROUND

Mount Hood is the northernmost Quaternary stratovolcano of the Cascade Range in Oregon and stands prominently above the Miocene to Pleistocene volcanic rocks on which it is built (fig. 1). The oldest rocks in the vicinity of Mount Hood are the Miocene Columbia River Basalt Group (Beeson and Moran, 1979). Volcaniclastic rocks with interbedded andesite lava flows overlie the Columbia River Basalt Group and comprise the Rhododendron Formation to the west and southwest, and the Chenowith Formation of the Dalles Group (Farooqui and others, 1981) to the northeast and east of Mount Hood, respectively. The age limits of the Rhododendron and the Chenowith Formations are poorly known but appear to be from approximately 16 to 7 m.y. (Wise, 1969; Farooqui and others, 1981; Priest and Vogt, 1982).

The quartz diorite pluton of Laurel Hill crops out southwest of Mount Hood and is dated at 8.4 and 8.0 m.y. on hornblende (Bickerman, 1970). Whole-rock ages of this study (sample 23) are slightly older, 8.60 ± 0.14 and 8.75 ± 0.18 m.y. Other quartz diorite crops out as a prominent group of dikes on the east side of the White River along Forest Service Road S-408. A plagioclase separate (sample 24) from the widest, freshest dike was dated at 5.26 ± 0.44 m.y.

A distinctive, coarsely porphyritic hypersthene andesite lava flow (or sequence of flows) overlies the upper flows of the Rhododendron Formation in the area west of Mount Hood and is considered the base of the Tertiary lower andesite unit. Priest and Vogt (1982) refer to this distinctive type of andesite lava as the Last Chance andesite, which has been dated at 10.5 ± 0.5 to 10.7 ± 0.5 m.y. Dates obtained from this study of the coarsely porphyritic andesite flow from Last Chance Mountain (sample 11) range from 7.65 to 9.64 m.y.

Numerous similar-appearing lava flows of olivine and pyroxene andesite erupted from numerous vents prior to the development of the Mount Hood stratovolcano (Wise, 1968; 1969). Dates obtained during the present study suggest continuous volcanic activity, though from different volcanic centers in the area, from the oldest layer of the Rhododendron Formation through the present. A time gap between 5.44 and 3.28 m.y. separates older rocks with at

least some effects of alteration from younger rocks with virtually no alteration.

A pre-Mount Hood volcano, the Sandy Glacier volcano of Wise (1969), is exposed on the west side of Mount Hood and is partly covered by Mount Hood lava flows. The Sandy Glacier volcano is younger than the Tertiary andesite flows and not much older than the earliest activity of Mount Hood. Wise (1969) obtained an age of 3.2 m.y. on a pyroxene andesite lava flow from Sandy Glacier volcano. However, the 1.14 to 1.35 m.y. age range (sample 5) obtained during this study seems more compatible with geologic field evidence.

Three major satellitic vent areas on the north flank of Mount Hood are at Cloud Cap (Qac), The Pinnacle (Qap), and Vista Ridge (Qabv). Dates obtained show that Cloud Cap (sample 19) and The Pinnacle (sample 18) vents were active about 650,000 to 490,000 and 150,000 years ago, respectively, after the onset of earliest Mount Hood volcanic activity, although the age of the earliest Mount Hood eruptions is uncertain. Construction of the cone of Mount Hood probably began less than 730,000 years ago since no flows have been found with reversed magnetization (Wise, 1969; Crandell, 1980). Ages from two Mount Hood lava flows in Zigzag Canyon (samples 20, 21, and 22) range from 570,000 to 350,000 years. Activity of Mount Hood has continued into historic time, the latest being small ash eruptions in 1859 and 1865 (Crandell, 1980). Fumaroles are presently active adjacent to the approximately 200-year-old (Crandell, 1980) dome in the crater.

PROCEDURES

Samples for whole-rock age determinations were crushed and sieved through 60- and 80-mesh-size sieves. The material between 60 and 80 mesh was washed in water to remove fine material, washed in dilute HF solution, and then rinsed in water. A plagioclase separate was obtained from one sample (sample 24) by crushing, sieving, washing in water, and then by heavy liquid separation using an acetone-methylene iodide mixture. The plagioclase was then washed in dilute HF solution and rinsed in water.

Argon measurements were made by isotope dilution using techniques described by Dalrymple and Lanphere (1969). Argon analyses were done on Nier-type and multi-collector mass spectrometers at the U.S. Geological Survey laboratories in Menlo Park, California. Potassium was measured by flame photometry. Analytical uncertainties for the calculated ages are the estimated standard deviation of precision (Cox and Dalrymple, 1967). Constants used in the calculations are $\lambda_{\beta} = 4.962 \times 10^{-10} \text{ yr}^{-1}$, $\lambda_{\epsilon} = 0.581 \times 10^{-10} \text{ yr}^{-1}$, and $^{40}\text{K}/\text{K}_{\text{total}} = 1.167 \times 10^{-4}$ atom percent.

ACKNOWLEDGMENTS

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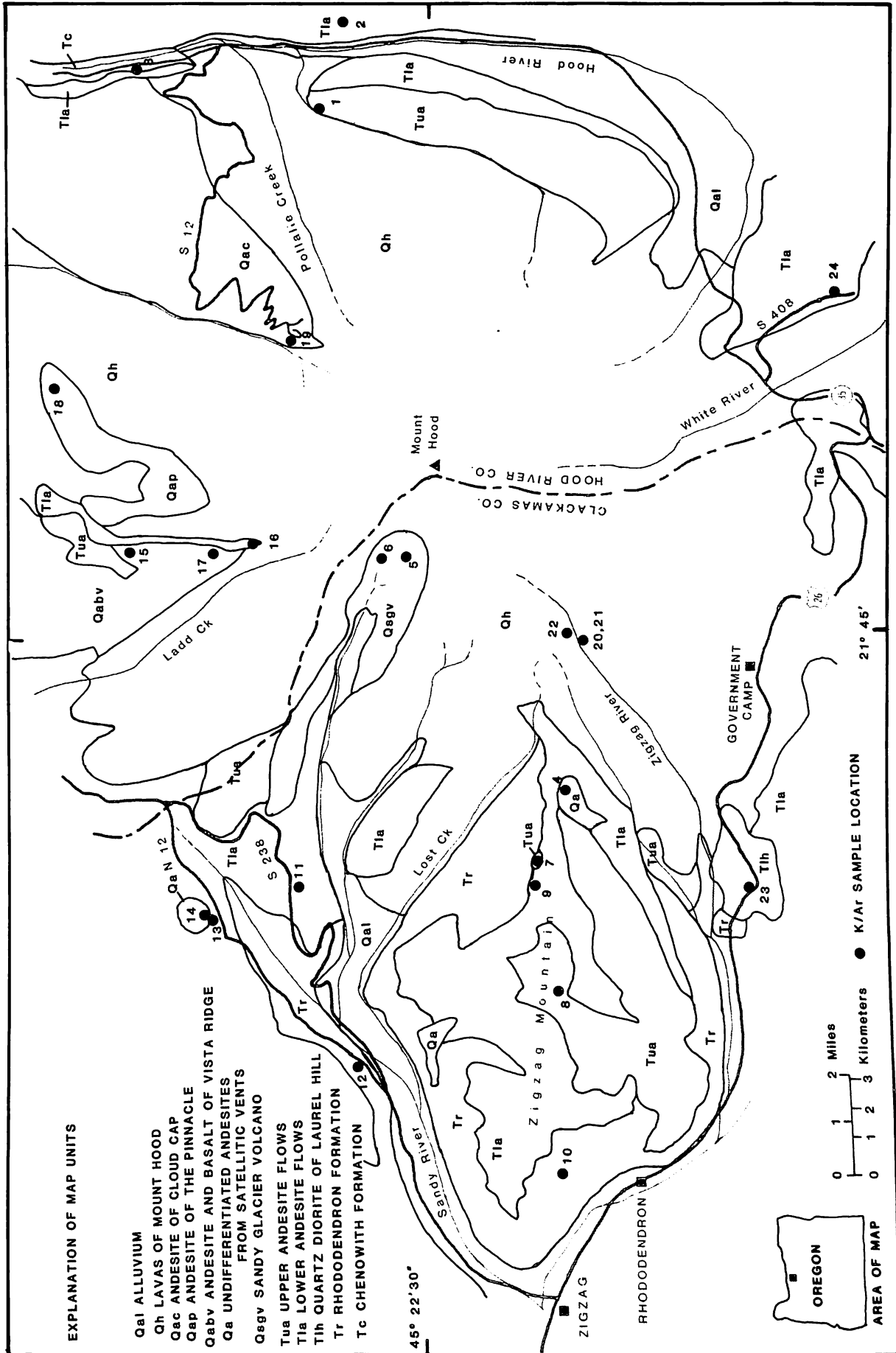


FIGURE 1. Generalized geologic map of the Mount Hood, Oregon area after Wise (1969) and Keith and others (1982) showing locations of samples for K-Ar dating.

Samples for the present study were collected by T. E. C. Keith and M. H. Beeson. Argon extractions and mass spectrometry were performed by J. L. Markman, M. R. Olea, G. S. Elliot, and A. E. Cook. Potassium analyses were done by P. R. Klock and Z. A. Brown. The laboratory assistance of B. M. Meyers and S. E. Kollman is gratefully acknowledged.

SAMPLE DESCRIPTIONS

1. **79TF0004** K-Ar
Pyroxene andesite from a lava flow, Tua (E side Mount Hood; 45°23'57"N, 121°35'12"W; Hood River Co., OR). Abundant phenocrysts of plagioclase, augite, and hypersthene; finely crystalline groundmass consists of plagioclase, augite, and magnetite. *Analytical data:* K₂O = 1.54%, ⁴⁰Ar* = 4.165 × 10⁻¹² moles/gm, 3.730 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 9.2%; 6.4%.
(whole rock)1.88 ± 0.05 m.y.
(whole rock)1.68 ± 0.06 m.y.
2. **79SWC0010A** K-Ar
Hornblende pyroxene andesite from a lava flow, Tla (E side Mount Hood; 45°23'43"N, 121°33'33"W; Hood River Co., OR). Zoned plagioclase, hornblende rimmed by iron oxide, and hypersthene are phenocrysts; finely crystalline groundmass consists mainly of plagioclase and magnetite. *Analytical data:* K₂O = 1.69%, ⁴⁰Ar* = 6.668 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 44.3%.
(whole rock)2.7 ± 0.03 m.y.
3. **79EFO016A** K-Ar
Hornblende pyroxene andesite from a lava flow, Tc (E side Mount Hood and W side State Highway 35; 45°26'31"N, 121°34'28"W; Hood River Co., OR). This outcrop was affected by road work after the Pollalie Creek flood in December 1980. Hornblende and pyroxene phenocrysts rimmed with iron oxide, abundant plagioclase phenocrysts, and minor augite and olivine phenocrysts; finely crystalline groundmass is composed of plagioclase and magnetite. *Analytical data:* K₂O = 1.30%, ⁴⁰Ar* = 1.535 × 10⁻¹¹ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 66.2%.
(whole rock)8.18 ± 0.06 m.y.
4. **79ZM0078** K-Ar
Augite andesite from a lava flow, Qa (Zigzag Mountain, W of Mount Hood; 45°20'37"N, 121°47'20"W; Clackamas Co., OR). Phenocrysts are zoned plagioclase and euhedral augite; groundmass is trachytic and consists mostly of plagioclase laths with intergranular augite and magnetite. *Analytical data:* K₂O = 0.78%, ⁴⁰Ar* = 8.838 × 10⁻¹³ moles/gm, 7.04211 × 10⁻¹³ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 8.7%, 4.5%.
(whole rock)0.79 ± 0.06 m.y.
(whole rock)0.63 ± 0.06 m.y.
5. **79SGV1111A** K-Ar
Hypersthene andesite lava, Qsgv (E side Sandy Glacier volcano; 45°22'58"N, 121°43'50"W; Clackamas Co., OR). Plagioclase phenocrysts, some glomeroporphyritic, are abundant, moderate hypersthene and scarce olivine phenocrysts; finely crystalline groundmass consists of plagioclase, clinopyroxene, and magnetite. *Analytical data:* K₂O = 1.08%, 1.08%, 1.07%, ⁴⁰Ar* = 2.015 × 10⁻¹² moles/gm, 1.944 × 10⁻¹² moles/gm, 2.046 × 10⁻¹² moles/gm, 1.769 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 23.3%, 10.9%, 18.7%, 7.8%.
(whole rock)1.30 ± 0.03 m.y.
(whole rock)1.25 ± 0.05 m.y.
(whole rock)1.35 ± 0.05 m.y.
(whole rock)1.14 ± 0.05 m.y.
6. **79SGV1085** K-Ar
Hypersthene andesite from dike cutting Sandy Glacier volcano, Qsgv (W of Mount Hood; 45°23'15"N, 121°43'50"W; Clackamas Co., OR). Zoned plagioclase phenocrysts are abundant and irregular in size, elongate hypersthene phenocrysts and subhedral magnetite phenocrysts are moderately abundant; cryptocrystalline groundmass is composed of plagioclase and magnetite. *Analytical data:* K₂O = 1.03%, ⁴⁰Ar* = 5.831 × 10⁻¹³ moles/gm, 6.323 × 10⁻¹³ moles/gm, 7.618 × 10⁻¹³ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 4.8%, 7.2%, 19.4%.
(whole rock)0.40 ± 0.05 m.y.
(whole rock)0.43 ± 0.04 m.y.
(whole rock)0.52 ± 0.04 m.y.
7. **79ZZL1085** K-Ar
Olivine andesite lava flow, Tua (Zigzag Mountain; 45°21'03"N; 121°48'51"W; Clackamas Co., OR). Phenocrysts are plagioclase and olivine; holocrystalline groundmass consists of plagioclase laths, anhedral clinopyroxene, and magnetite. *Analytical data:* K₂O = 0.78%, ⁴⁰Ar* = 2.874 × 10⁻¹² moles/gm, 3.684 × 10⁻¹² moles/gm, 2.695 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 27.0%, 16.9%, 14.2%.
(whole rock)2.56 ± 0.07 m.y.
(whole rock)3.28 ± 0.21 m.y.
(whole rock)2.40 ± 0.05 m.y.
8. **79ZM0086** K-Ar
Augite andesite lava flow, Tua (Zigzag Mountain; 45°20'47"N, 121°51'10"W; Clackamas Co., OR). Plagioclase phenocrysts are partly resorbed and rounded, irregular distribution of small augite phenocrysts; holocrystalline groundmass composed of plagioclase laths, anhedral augite, and magnetite. *Analytical data:* K₂O = 1.32%, ⁴⁰Ar* = 4.891 × 10⁻¹² moles/gm, 4.263 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 36.1%, 34.4%.
(whole rock)2.56 ± 0.11 m.y.
(whole rock)2.24 ± 0.10 m.y.
9. **79ZZL1089** K-Ar
Olivine andesite lava flow, Tla (Zigzag Mountain; 45°21'03"N, 121°49'12"W; Clackamas Co., OR). Phenocrysts of olivine and zoned plagioclase occur individually and as glomeroporphyritic clots. Olivine has rims of incipient iddingsite. Groundmass consists mostly of plagioclase laths of irregular size, anhedral augite, and magnetite. Round vesicles up to 1 mm diameter are scattered irregularly throughout the groundmass. *Analytical data:* K₂O = 0.26%, ⁴⁰Ar* = 2.376 × 10⁻¹² moles/gm, 2.315 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 9.7%, 14.2%.
(whole rock)6.25 ± 0.39 m.y.
(whole rock)6.09 ± 0.29 m.y.

10. **81MH14** K-Ar
Augite andesite lava flow (near top of Rhododendron Formation (Tr) at head of Castle Creek in type section (Barnes and Butler, 1930); 45°20'40"N, 121°54'19"W; Clackamas Co., OR). Abundant phenocrysts of plagioclase with subordinate augite and minor olivine; holocrystalline groundmass mostly of plagioclase and minor augite and magnetite. Approximately 1% clay alteration; freshest rock available. *Analytical data:* K₂O = 0.95%, ⁴⁰Ar* = 1.449 × 10⁻¹¹ moles/gm, 1.452 × 10⁻¹¹ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 55.8%, 60.3%.
(whole rock)10.52 ± 0.12 m.y.
(whole rock)10.54 ± 0.11 m.y.
11. **80CF0022A** K-Ar
Coarsely porphyritic hypersthene andesite lava flow, T1a (Last Chance Mountain [U.S. Forest Service Road S-238], W of Mount Hood; 45°24'02"N, 121°49'33"W; Clackamas Co., OR). Phenocrysts are euhedral plagioclase and hypersthene as long as 10 mm, and minor anhedral to euhedral stubby plagioclase, subhedral magnetite, and scarce anhedral clinopyroxene. *Analytical data:* K₂O = 0.90%, ⁴⁰Ar* = 9.961 × 10⁻¹² moles/gm, 1.256 × 10⁻¹¹ moles/gm, 1.128 × 10⁻¹¹ moles/gm, 1.255 × 10⁻¹¹ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 47.6%, 67.8%, 43.5%, 48.5%.
(whole rock)7.65 ± 0.10 m.y.
(whole rock)9.64 ± 0.11 m.y.
(whole rock)8.66 ± 0.09 m.y.
(whole rock)9.63 ± 0.07 m.y.
12. **81MH21** K-Ar
Porphyritic hypersthene andesite lava flow of Rhododendron Formation (Tr) (NW side Lolo Pass road [U.S. Forest Service Road N-12], S of Sugarloaf Mountain; 45°23'02"N, 121°52'30"W; Clackamas Co., OR). Abundant phenocrysts of plagioclase, hypersthene, and minor augite; microcrystalline groundmass of plagioclase and magnetite. *Analytical data:* K₂O = 0.98%, ⁴⁰Ar* = 1.581 × 10⁻¹¹ moles/gm, 1.605 × 10⁻¹¹ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 66.8%, 53.6%.
(whole rock)11.15 ± 0.12 m.y.
(whole rock)11.32 ± 0.12 m.y.
13. **79LP1108** K-Ar
Hornblende andesite lava, T1a (W side Lolo Pass road [U.S. Forest Service Road N-12], S of Hiya Mountain; 45°25'08"N, 121°49'46"W; Clackamas Co., OR). Plagioclase phenocrysts are equant, hornblende OR). Phenocrysts are subhedral and rimmed with iron oxide. Finely crystalline groundmass is composed mostly of plagioclase and minor iron oxide. *Analytical data:* K₂O = 1.22%, ⁴⁰Ar* = 1.108 × 10⁻¹¹ moles/gm, 1.072 × 10⁻¹¹ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 53.2%, 42.0%.
(whole rock)6.31 ± 0.12 m.y.
(whole rock)6.11 ± 0.22 m.y.
14. **79LP1109** K-Ar
Olivine andesite plug, Qa (W side Lolo Pass road [U.S. Forest Service Road N-12], S of Hiya Mountain; 45°25'18"N, 121°49'36"W; Clackamas Co., OR). Phenocrysts are mostly subhedral olivine with incipient iddingsite rims, and scarce augite and plagioclase. Crystalline groundmass consists of plagioclase laths, anhedral augite, and magnetite. *Analytical data:* K₂O = 0.81%, ⁴⁰Ar* = 1.717 × 10⁻¹² moles/gm, 1.517 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 13.6%, 6.2%.
(whole rock)1.48 ± 0.15 m.y.
(whole rock)1.30 ± 0.13 m.y.
15. **79RH1032** K-Ar
Olivine andesite lava flow, Qabv (crest of Vista Ridge NW of Mount Hood; 45°26'30"N, 121°43'18"W; Hood River Co., OR). Small scattered phenocrysts are mostly olivine, and minor augite and plagioclase; holocrystalline groundmass consists of plagioclase laths and minor clinopyroxene and magnetite. *Analytical data:* K₂O = 1.07%, ⁴⁰Ar* = 2.273 × 10⁻¹² moles/gm, 1.679 × 10⁻¹² moles/gm, 1.750 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 21.7%, 19.4%, 16.0%.
(whole rock)1.48 ± 0.05 m.y.
(whole rock)1.09 ± 0.06 m.y.
(whole rock)1.14 ± 0.06 m.y.
16. **82MH1** K-Ar
Andesite lava flow, T1a (E side Vista Ridge NW of Mount Hood; 45°25'30"N, 121°43'12"W; Hood River Co., OR). Scarce phenocrysts of partly resorbed plagioclase with vermicular texture; trachytic groundmass composed of plagioclase laths, anhedral magnetite, and minor augite. *Analytical data:* K₂O = 0.55%; ⁴⁰Ar* = 4.314 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 5.5%.
(whole rock)5.44 ± 0.19 m.y.
17. **82MH2** K-Ar
Augite andesite lava flow, Qabv (E side Vista Ridge NW of Mount Hood; 45°26'06"N, 121°43'15"W; Hood River Co., OR). Abundant phenocrysts of irregular-sized zoned plagioclase, hypersthene, augite, and magnetite; cryptocrystalline groundmass of plagioclase and magnetite. *Analytical data:* K₂O = 1.05%, ⁴⁰Ar* = 1.839 × 10⁻¹² moles/gm, 1.547 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 7.8%, 9.4%.
(whole rock)1.22 ± 0.04 m.y.
(whole rock)1.02 ± 0.04 m.y.
18. **82MH12** K-Ar
Olivine andesite lava flow of The Pinnacle (Qap), a satellitic vent (N side Mount Hood; 45°27'12"N, 121°40'15"W; Hood River Co., OR). Microphenocrysts consist of zoned plagioclase, olivine, and minor augite; holocrystalline fine-grained groundmass consists of plagioclase laths, augite, and magnetite. *Analytical data:* K₂O = 0.95%, ⁴⁰Ar* = 1.994 × 10⁻¹³ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 1.9%.
(whole rock)0.15 ± 0.02 m.y.
19. **81MH10** K-Ar
Olivine andesite lava flow, Qac (E side of road N of Cloud Cap vent, NE side Mount Hood; 45°24'18"N, 121°39'14"W; Hood River Co., OR). Abundant irregular-sized phenocrysts of zoned plagioclase, subhedral olivine, and scarce augite. *Analytical data:* K₂O = 1.09%, ⁴⁰Ar* = 7.701 × 10⁻¹³ moles/gm, 1.015 × 10⁻¹² moles/gm, 9.822 × 10⁻¹³ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 4.8%, 15.8%, 8.8%.
(whole rock)0.49 ± 0.06 m.y.
(whole rock)0.65 ± 0.05 m.y.
(whole rock)0.63 ± 0.07 m.y.

20. **79ZZ1048** K-Ar
Augite andesite lava flow, Qh (Mount Hood volcano, outcrop along trail E side Zigzag Canyon; 45°20'35" N, 121°44'35" W; Clackamas Co., OR). Phenocrysts are of irregular size, abundant zoned plagioclase, augite, and magnetite; finely crystalline groundmass consists of anhedral to subhedral plagioclase and magnetite. *Analytical data:* K₂O = 1.56%, ⁴⁰Ar* = 1.017 × 10⁻¹² moles/gm, 1.155 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 4.9%, 7.9%.
(whole rock)0.45 ± 0.06 m.y.
(whole rock)0.52 ± 0.05 m.y.
21. **81MH29** K-Ar
Augite andesite lava flow, Qh (Mount Hood volcano, outcrop along trail E side Zigzag Canyon; 45°20'35" N, 121°44'35" W; Clackamas Co., OR). Abundant zoned plagioclase phenocrysts of irregular size, subhedral augite and magnetite phenocrysts; finely crystalline groundmass consists of anhedral to subhedral plagioclase and magnetite. *Analytical data:* K₂O = 1.45%, ⁴⁰Ar* = 8.857 × 10⁻¹³ moles/gm, 7.485 × 10⁻¹³ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 7.4%, 9.0%.
(whole rock)0.42 ± 0.04 m.y.
(whole rock)0.36 ± 0.03 m.y.
22. **81MH28** K-Ar
Augite andesite lava flow, Qh (Mount Hood volcano, top of waterfall above trail crossing Zigzag River; 45°20'38" N, 121°44'29" W; Clackamas Co., OR). Irregular-sized phenocrysts of zoned plagioclase, some of which are partly resorbed and some which are glomeroporphyritic; subhedral augite and magnetite phenocrysts; scarce large hornblende phenocrysts rimmed with iron oxide. Cryptocrystalline groundmass of plagioclase and magnetite. *Analytical data:* K₂O = 0.96%, ⁴⁰Ar* = 7.909 × 10⁻¹³ moles/gm, 3.959 × 10⁻¹³ moles/gm, 1.139 × 10⁻¹² moles/gm, 7.840 × 10⁻¹³ moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 11.5%, 5.6%, 9.3%, 3.2%.
(whole rock)0.57 ± 0.10 m.y.
(whole rock)0.29 ± 0.08 m.y.
(whole rock)0.82 ± 0.13 m.y.
(whole rock)0.57 ± 0.05 m.y.
23. **79LH1058A** K-Ar
Hornblende diorite of Laurel Hill, Tlh (outcrop along N side U.S. Highway 26; 45°18'21" N, 121°48'52" W; Clackamas Co., OR). Phenocrysts of plagioclase and hornblende in groundmass of plagioclase, orthoclase, quartz, hornblende, and magnetite. Ages obtained are very close to those of Bickerman (1970). *Analytical data:* K₂O = 0.67%, ⁴⁰Ar* = 8.458 × 10⁻¹² moles/gm, 8.316 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 27.0%, 27.3%.
(whole rock)8.75 ± 0.18 m.y.
(whole rock)8.60 ± 0.14 m.y.
24. **79IC2039A** K-Ar
Hornblende diorite dike apparently intruding or feeding the late upper Miocene andesitic lava flows, T1a (SE of

Mount Hood on E side White River, outcrop along new roadcut [U.S. Forest Service Road S-408]; 45°17'13" N, 121°38'30" W; Hood River Co., OR). Phenocrysts of hornblende and plagioclase in groundmass of plagioclase, quartz, orthoclase, and hornblende. Hornblende is chloritized. Hydrothermal alteration minerals associated with this dike are epidote, quartz, adularia, pyrite. Plagioclase mineral separate used for dating appears unaltered by optical and x-ray diffraction examination. *Analytical data:* K₂O = 0.51%, ⁴⁰Ar* = 3.869 × 10⁻¹² moles/gm, ⁴⁰Ar*/Σ⁴⁰Ar = 5.9%.
(plagioclase)5.26 ± 0.44 m.y.

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