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K-Ar AGES OF RHYOLITES FROM THE WESTERN SNAKE RIVER PLAIN AREA, OREGON, IDAHO, AND NEVADA

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The western Snake River Plain area of southeastern Oregon, southwestern Idaho, and northern Nevada (fig. 1) is a geologically complex region due to its location at the boundaries of the Columbia River and Snake River basins and the northern portion of the Basin and Range Province. The late Cenozoic geologic record of this area is dominated by bimodal basalt-rhyolite volcanism locally interbedded with thick sequences of lacustrine sediment. The most abundant basalt compositions include low K, high-alumina olivine tholeiite, olivine tholeiite, and alkaline olivine basalt ranging in age from 0 to 10.5 m.y. (Armstrong and others, 1975; Hart and Mertzman, 1983; Hart and others, 1983). Older, ~ 15-m.y.-old basalts of Columbia River affinity outcrop in the northern Owyhee River region. Underlying the 0–10.5 m.y. mixed basalt-sediment sequences are non-mineralized silicic volcanic rocks and interbedded volcanic ash-rich sediments of the Idavada volcanics (Malde and Powers, 1962). Ages ranging from 13.8 to 5.7 m.y. have previously been reported for Idavada samples from the western Snake River Plain area (summaries in Armstrong and others, 1975; Bennett, 1976). An older age of 15.6–15.7 m.y. is noted for the upper rhyolite of the Silver City area, Owyhee Mountains (Pansze, 1975), which has also been suggested to be Idavada (Bennett and Galbraith, 1975). Due to ambiguous stratigraphic relationships this correlation remains tenuous.

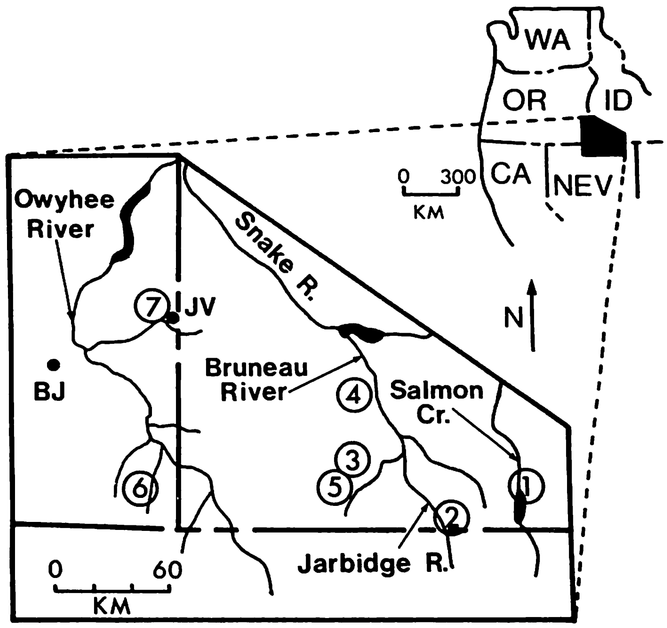

FIGURE 1. Location map of study area. Sample locations are numbered and correspond to the data given and table 1. Jordan Valley and Burns Junction, Oregon, are designated by JV and BJ, respectively.

RESULTS

We report seven new K-Ar ages for silicic material petrographically and chemically correlative to previously analyzed Idavada rhyolite. The K-Ar data are given below and the whole-rock chemical analyses for the dated samples are listed in table 1. The age of these rhyolites ranges from 14.4 to 7.6 m.y. Furthermore, a progression is noted from oldest in the west to youngest in the east. This trend is consistent with previous observations documenting a northeastward migration in the inception of volcanism throughout the entire Snake River Plain (Stearns, 1926; Armstrong and others, 1975). Significant thicknesses (up to 200 m) of Idavada material are exposed at the base of the Owyhee River Canyon throughout much of southeastern Oregon, but no age data are available for these exposures due to their extreme alteration.

The basalt-rhyolite volcanism of this region is typical of that observed in much of the Basin and Range Province and is considered characteristic of extensional tectonic regimes (Christiansen and Lipman, 1972). Combining the rhyolite data of this study with the chronology of the associated basalts allows accurate determination of the timing of both the inception of rhyolitic volcanism and the changeover from rhyolitic to basaltic volcanism at a particular location. Further work on this subject is in process.

Constants used in calculating ages are: $\lambda_\epsilon = 0.581 \times 10^{-10} yr^{-1}$; $\lambda_\beta = 4.962 \times 10^{-10} yr^{-1}$; $^{40}K/K = 1.167 \times 10^{-4}$ mol/mol.

SAMPLE DESCRIPTIONS

1. *H-9-3A* K-Ar
Rhyolite (border S17,18,T14S,R15E; basal silicic material underlying basalt at Salmon Creek Reservoir, ID). Scattered microphenocrysts of plagioclase (andesine), sanidine, clinopyroxene, oxide, and quartz in matrix of fresh flow-banded glass; scattered rounded vesicles—not flow aligned. *Analytical data:* Sample weight = 1.0417 gm; K_2O = 5.49 (wt)%; $^*Ar^{40} = 6.038 \times 10^{-11}$ moles/gm; $^*Ar^{40}$ = 46.02%.
(whole rock)7.62 ± 0.40 m.y.

2. *H-9-6C* K-Ar
Rhyolite (SE¼ S14,T16S,R9E; basal silicic material underlying mixed basalt, sediment, and talus along East Fork of the Jarbidge River at Murphy Hot Springs, ID). Glassy to cryptocrystalline matrix with crystals and microphenocrysts of feldspar up to 2 mm (oligoclase/andesine and orthoclase), twinned clinopyroxene (diopsidic augite), quartz, oxide, and zircon; some glomeroporphyritic clumps of feldspar, clinopyroxene and oxide; apatite inclusions in plagioclase; scattered pumice balls. *Analytical data:* Sample weight = 2.0172 gm, 2.0501 gm; K_2O = 4.81 (wt)%, 4.81 (wt)%; $^*Ar^{40} = 5.706 \times 10^{-11}$ moles/gm, 5.552×10^{-11} moles/gm; $^*Ar^{40}$ = 79.73%, 83.95%.
(whole rock)8.22 ± 0.38 m.y.
(whole rock)8.00 ± 0.38 m.y.

TABLE 1. Major and trace element chemistry, weight percent and ppm, respectively.[1]

Sample #	H-9-3A	H-9-6C	H-9-10	H-9-11	H-9-15A	H-9-26A	H-9-41
Map #	1	2	3	4	5	6	7
SiO_2	72.56	72.07	75.82	70.65	74.09	69.32	72.47
TiO_2	0.35	0.53	0.35	0.67	0.35	0.54	0.45
Al_2O_3	11.66	12.75	12.05	13.39	11.90	13.09	12.77
Fe_2O_3	0.77	2.98	2.02	3.20	2.12	2.41	2.32
FeO	1.92	1.32	0.96	2.08	0.90	1.28	0.96
MnO	0.04	0.05	0.01	0.11	0.01	0.05	0.05
MgO	0.18	0.26	0.00	0.48	0.14	0.49	0.20
CaO	0.89	1.39	0.65	2.32	0.78	1.49	1.04
Na_2O	2.78	3.07	3.07	3.25	2.76	3.18	3.20
K_2O	5.43	4.65	5.17	4.02	5.12	5.21	5.06
P_2O_5	0.05	0.10	0.03	0.14	0.10	0.11	0.09
L.O.I.	3.87	1.02	0.57	0.63	1.12	3.73	1.13
TOTAL	100.50	100.32	100.70	100.94	99.41	100.90	99.94
Rb	173	155	178	137	187	184	172
Sr	46	114	58	157	63	94	88
Ba	1125	1200	1275	1133	1456	1256	1478
Zr	500	570	567	563	507	471	484
V	9	23	23	39	25	31	35
Y	87	73	121	88	127	74	73
K/Rb	262	249	241	244	227	235	244
K/Ba	40	32	34	29	29	34	28
Rb/Sr	3.74	1.36	3.07	0.87	2.97	1.96	1.95

[1]The analyses were performed by XRF techniques described in Hart (1982). L.O.I. = loss on ignition.

3. *H-9-10* K-Ar
Rhyolite (NE¼ S7,T13S,R5E; silicic flow cut by Hwy. 51 south of Grassmere, ID). Porphyritic feldspar up to 3 mm (oligoclase and orthoclase), quartz and highly oxidized mafics (hornblende/clinopyroxene?) in matrix of glass, mafic microlites, pumice fragments, feldspar, and quartz; apatite and zircon needles associated with feldspar. *Analytical data:* Sample weight = 3.0717 gm; K_2O = 5.17 (wt)%; $^*Ar^{40}$ = 8.689 × 10^{-11} moles/gm; $^*Ar^{40}$ = 91.48%.
(whole rock) 11.65 ± 0.53 m.y.

4. *H-9-11* K-Ar
Rhyolite (S6,T10S,R5E; flow cut by Hwy. 51 ~43.5 mi N of NV–ID border, ID). Porphyritic-glomeroporphyritic plagioclase (An_{42-46}) up to 3 x 3 mm and twinned clinopyroxene (pigeonite-subcalcic augite) up to 1.5 mm in a glassy, felsitic matrix; some apatite needles in plagioclase. *Analytical data:* Sample weight = 3.0 gm; K_2O = 4.02 (wt)%; $^*Ar^{40}$ = 5.733 × 10^{-11} moles/gm; $^*Ar^{40}$ = 86.30%.
(whole rock) 9.88 ± 0.46 m.y.

5. *H-9-15A* K-Ar
Rhyolite (border S21,22,27,28,T13S,R4E; silicic material underlying basalt along small stream SE of Grassmere, ID). Very fine grained microlitic biotite/oxide and glass matrix with phenocrysts up to 4 mm of highly resorbed plagioclase (oligoclase/andesine) and orthoclase; scattered grains of quartz; apatite needles in feldspar; patches of spherulitic alteration in matrix. *Analytical data:* Sample weight: 3.0716 gm; K_2O = 5.12 (wt)%; $^*Ar^{40}$ = 8.282 × 10^{-11} moles/gm; $^*Ar^{40}$ = 85.97%.
(whole rock) 11.22 ± 0.52 m.y.

6. *H-9-26A* K-Ar
Rhyolite (border S2,3,T40S,R46E; black silicic material underlying white/tan silicic material at Anderson Crossing, Little Owyhee River, OR). Porphyritic-glomeroporphyritic sanidine and plagioclase (An_{45-50}, up to 6 mm, highly resorbed/embayed), clinopyroxene (diopsidic augite), orthopyroxene and oxide in matrix of fresh perlitic glass; some clinopyroxene poikilitically enclosed in feldspar. *Analytical data:* Sample weight = 1.6770 gm, 1.1687 gm; K_2O = 5.04 (wt)%, 5.70 (wt)%; $^*Ar^{40}$ = 9.887 × 10^{-11} moles/gm, 10.761 × 10^{-11} moles/gm; $^*Ar^{40}$ = 88.71%, 90.45%.
(whole rock) 13.58 ± 0.63 m.y.
(glass) 13.07 ± 0.59 m.y.

7. *H-9-41* K-Ar
Rhyolite (SW¼ S28,T29S,R45E; uplifted rim of older silicic material bordered on SW by young alkaline basalt along Cow Lakes Rd., W of Jordan Valley, OR). Porphyritic 2–3 mm feldspar (oligoclase/andesine and sanidine/anorthoclase), 1.5 mm clinopyroxene (augite-pigeonite) and orthopyroxene and oxide (associated with pyroxene) in glassy, felsitic matrix; scattered zircon; chalcedony in vesicles; sanidine is dominant feldspar. *Analytical data:* Sample weight = 3.0187 gm; K_2O = 5.06 (wt)%; $^*Ar^{40}$ = 10.516 × 10^{-11} moles/gm; $^*Ar^{40}$ = 63.65%.
(whole rock) 14.38 ± 0.70 m.y.

REFERENCES

Armstrong, R. L., Leeman, W. P., and Malde, H. E. (1975) K-Ar dating, Quaternary and Neogene volcanic rocks of the Snake River Plain, Idaho: American Journal of Science, v. 275, p. 225–251.

Bennett, E. H. (1976) Reconnaissance geology and geochemistry of the South Mountain–Juniper Mountain Region, Owyhee County, Idaho: Idaho Bureau of Mines and Geology Pamphlet no. 166, 68 p.

Bennett, E. H., and Galbraith, J. H. (1975) Reconnaissance geology and geochemistry of the Silver City–South Mountain Region, Owyhee County, Idaho: Idaho Bureau of Mines and Geology Pamphlet no. 162, 88 p.

Christiansen, R. L., and Lipman, P. W. (1972) Cenozoic volcanism and plate tectonic evolution of western United States, II, late Cenozoic: Royal Society of London Philosophical Transactions, Series A, v. 271, p. 249–284.

Hart, W. K. (1982) Chemical, geochronologic, and isotopic significance of low K, high-alumina olivine tholeiite in the northern Great Basin, U.S.A.: Ph.D. thesis, Case Western Reserve University, Cleveland, Ohio, 410 p.

Hart, W. K., Aronson, J. L., and Mertzman, S. A. (1983) Areal distribution and age of low K, high-alumina olivine tholeiite magmatism in the northwestern Great Basin, U.S.A.: Geological Society of American Bulletin (in press).

Hart, W. K., and Mertzman, S. A. (1983) Late Cenozoic volcanic stratigraphy of the Jordan Valley area, southeastern Oregon: Oregon Geology (in press).

Malde, H. E., and Powers, H. A. (1962) Upper Cenozoic stratigraphy of the western Snake River Plain, Idaho: Geological Society of America Bulletin, v. 73, p. 1197–1220.

Pansze, A. J. (1975) Geology and ore deposits of the Silver City–De Lamar–Flint region, Owyhee County, Idaho: Idaho Bureau of Mines and Geology Pamphlet no. 161, 79 p.

Stearns, H. T. (1962) Volcanism in the Mud Lake area: American Journal of Science, 5th Series, v. 11, p. 353–363.

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