Age of Imnaha Basalt—oldest basalt flows of the Columbia River Basalt Group, northwest United States

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AGE OF IMNAHA BASALT—OLDEST BASALT FLOWS OF THE COLUMBIA RIVER BASALT GROUP, NORTHWEST UNITED STATES

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Four K-Ar age determinations on different lava flows of the Imnaha Basalt from southeastern Washington and surrounding regions of Oregon and Idaho are reported here. The Imnaha Basalt unconformably overlies Triassic and Jurassic intrusive rocks in the type section (Dug Bar, fig. 1). It is the oldest formation in the Columbia River Basalt Group and marks the beginning of the tremendous flood basalt eruptions of the Columbia River region. The mean of the four ages is 16.9 ± 0.3 m.y. (0.3 is the deviation from the mean), and this value represents very nearly the inception of volcanism of the Columbia River Basalt Group as can be best determined within the uncertainty of these K-Ar analyses.

During the following 3.4 m.y., from 16.9 to 13.5 m.y. ago, more than 99 percent of the basalt was erupted (McKee and others, 1977). This includes, from oldest to youngest, the Imnaha Basalt, the Picture Gorge Basalt, and Grande Ronde, and the Wanapum Basalt. The Picture Gorge is the same age as the Grande Ronde (Swanson and others, 1979). It is postulated that eruptions occurred every few thousand years during this time, with probably no hiatus longer than 100,000 years (McKee and others, 1977). The last 1 percent forms the Saddle Mountains Basalt which was erupted at a lower rate between 13.5 and 6.0 m.y. ago (Swanson and others, 1979).

The location of the type section (Dug Bar) of the Imnaha Basalt is shown in figure 1; the stratigraphic position of the samples and with respect to under- and overlying rock units is shown in figure 2. The K-Ar age is included at the appropriate horizon on the stratigraphic column.

SAMPLE PREPARATION AND ANALYSIS

The samples of basalt were prepared and analyzed at the U.S. Geological Survey in Menlo Park, Calif. Chips of fresh rock were ground to approximately 80 to 100 mesh, leached in HNO_3 and HF solutions, and washed and dried immediately before loading in the high-vacuum gas extraction system. This procedure reduces atmospheric argon content (Keeling and Naughton, 1974). Splits of the treated basalt were powdered and analyzed for potassium by flame photometry using a lithium metaborate fusion technique, the lithium serving as an internal standard (Ingamells, 1970). Argon analysis was by standard isotope dilution mass spectrometry techniques using procedures described in Dalrymple and Lanphere (1969). The constants used in age determination are those from the Subcommission on Geochronology (Steiger and Jager, 1977). Errors reported as plus or minus for each age are estimates of the standard deviation of analytical precision (Cox and Dalrymple, 1967). We thank Marvin A. Lanphere and Donald A. Swanson for their review and helpful suggestions on this report.

SAMPLE DESCRIPTION

1. *DB-12* K-Ar
Medium-grained plagioclase-phyric basalt. (45°49'N, 116°43'W). *Analytical data:* K_2O = 0.848 %; $^{40}Ar^*$ = 2.0632 x 10^{-11} mol/g; $^{40}Ar/^{40}Ar$ = 29.4 %. *Collected by:* W. D. Kleck, G. S. Holden, and P. R. Hooper.
(whole rock) 16.8 ± 0.9 m.y.

2. *DB-15* K-Ar
Medium-grained plagioclase-phyric basalt. (45°49'N, 116°43'W). *Analytical data:* K_2O = 0.970 %; $^{40}Ar^*$ = 3.8513 x 10^{-11} mol/g; $^{40}Ar^*/^{40}Ar$ = 23.3 %. *Collected by:* W. D. Kleck, G. S. Holden, and P. R. Hooper.
(whole rock) 16.5 ± 1.1 m.y.

3. *DB-19* K-Ar
Medium- to coarse-grained plagioclase-phyric basalt. (45°49'N, 116°43'W). *Analytical data:* K_2O = 1.003 %; $^{40}Ar^*$ = 2.5298 10^{-11} mol/g; $^{40}Ar^*/^{40}Ar$ = 55.7 %. *Collected by:* W. D. Kleck, G. S. Holden, and P. R. Hooper.
(whole rock) 17.4 ± 0.3 m.y.

4. *DB-23* K-Ar
(45°49'N, 116°43'W). *Analytical data:* K_2O = 0.900 %; $^{40}Ar^*$ = 2.2094 x 10^{-11} mol/g; $^{40}Ar/^{40}Ar$ = 37.2 %. *Collected by:* W. D. Kleck, G. S. Holden, and P. R. Hooper.
(whole rock) 17.0 ± 0.2 m.y.

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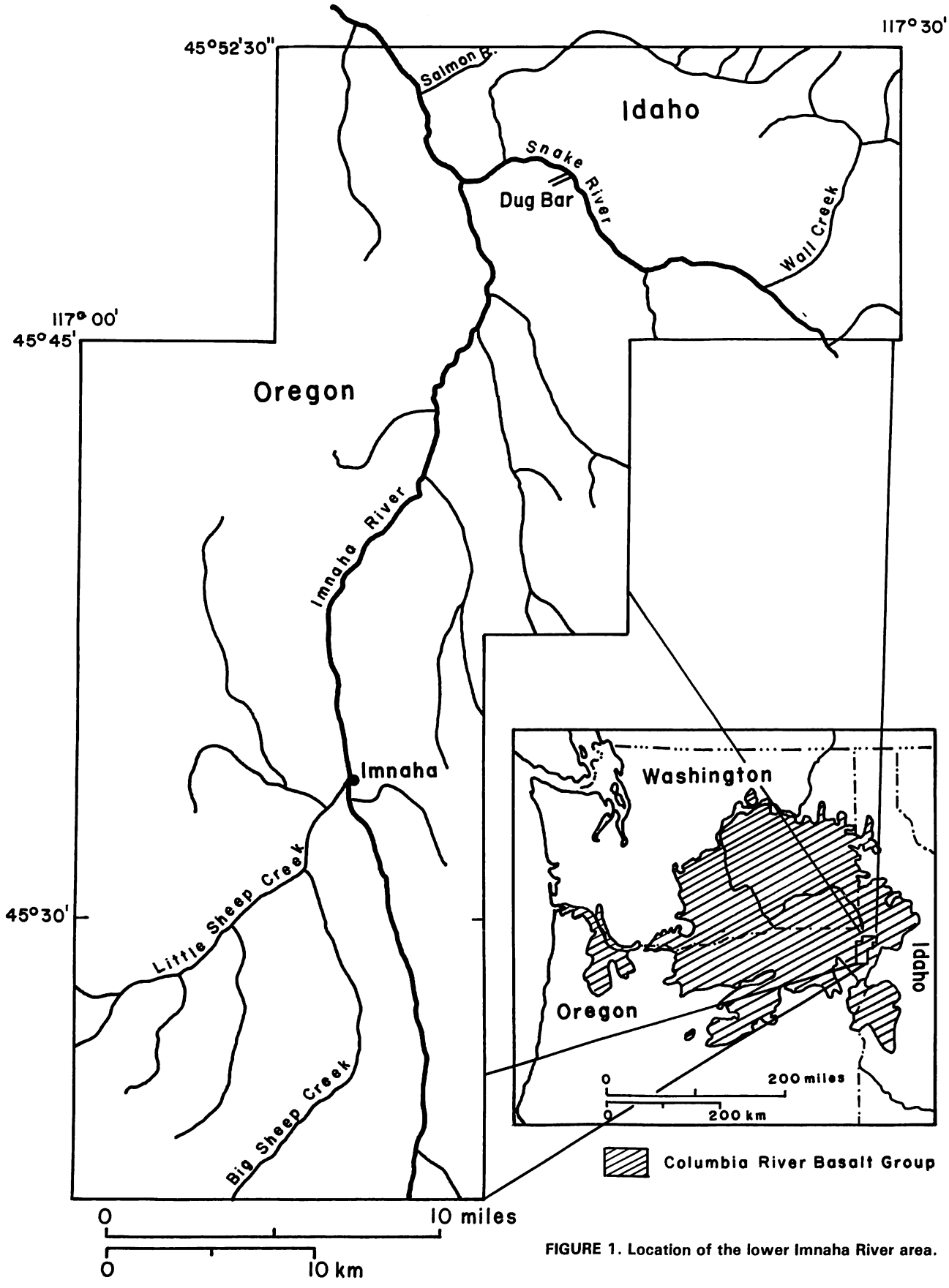

FIGURE 1. Location of the lower Imnaha River area.

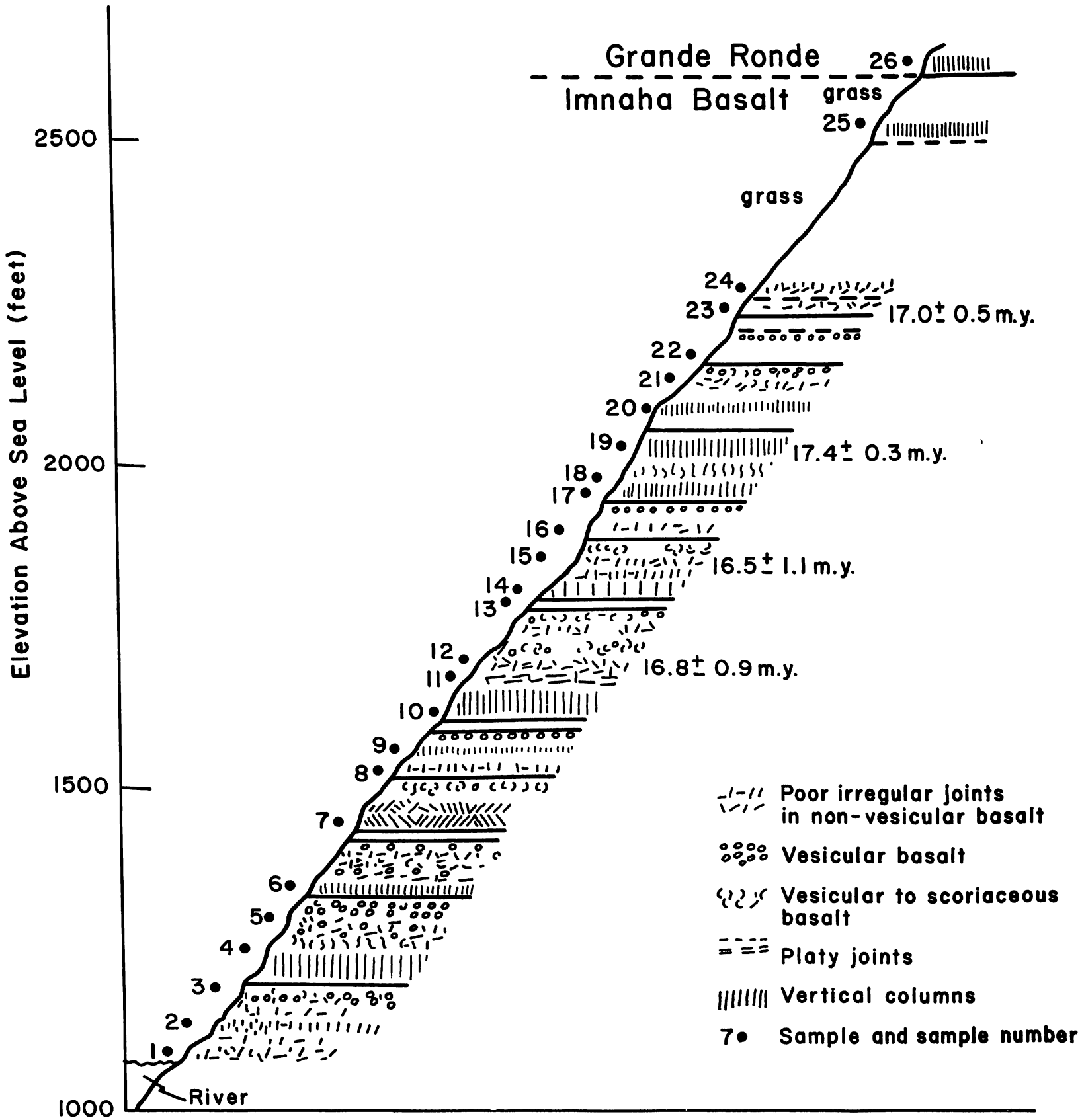

FIGURE 2. Stratigraphic section of Imnaha Basalt at Dug Bar, Oreg. Measured by W. D. Kleck, G. S. Holden, and P. R. Hooper.