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OPEN FILE REPORT

# Chemical analyses of 305 basalt samples from the Columbia River Plateau, Washington, Oregon and Idaho

By. Maurice R. Brock 1922- and
Maurice Jean Grolier 1918-

U.S. Geological Survey

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1. Chemical analyses of 305 basalt samples from the Columbia River Plateau, Washington, Oregon, and Idaho, by Maurice R. Brock and Maurice J. Grolier. 35 p.

2. Sampling and milling tests of chromite ore in the Hindubagh mining district, Quetta Division, Pakistan, by Richard G. Bogue. 34 p., 2 figs., 7 tables.

3. Reconnaissance for phosphate in Pakistan, by Anthony S. Stanin and Mirza Saeed Hasan. 22 p., 5 figs., 5 tables.

4. Map showing localities and amounts of metallic mineral production in Colorado, by William R. Marsh and Roberta W. Queen. 7 p., 1 pl. (scale 1:500,000). 1012 Federal Bldg., Denver, Colo. 80202; 8102 Federal Office Bldg., Salt Lake City, Utah 84111. [Material from which copy can be made at private expense is available at 1012 Federal Bldg., Denver, Colo.]

5. Mineral resources of the Clear Creek-Upper Big Deer Creek study area, contiguous to the Idaho Primitive Area, Lemhi County, Idaho, by Fred W. Cater, Darrell M. Pinckney, and Ronald B. Stotelmeyer. 79 p., 1 pl., 11 text figs., 3 tables. 1012 Federal Bldg., Denver, Colo. 80202; 8102 Federal Office Bldg., Salt Lake City, Utah 84111; 678 U.S. Court House Bldg., West 920 Riverside Ave., Spokane, Wash. 99201; U.S. Bureau of Mines, 447 Federal Bldg., 550 W. Fort St., Boise, Ida. 83702; Idaho Bureau of Mines and Geology, Moscow, Ida. 83843; Montana Bureau of Mines and Geology, Montana College of Mineral Science and Technology, Butte, Mont. 59701.

# CHEMICAL ANALYSES OF 305 BASALT SAMPLES FROM THE COLUMBIA RIVER PLATEAU, WASHINGTON, OREGON, AND IDAHO

By. Maurice R. Brock

and

Maurice J. Grolier

This report presents major-element chemical analyses of basalt samples from the Columbia River Plateau which were collected and analysed during 1970-1971. Analyses were made in a mobile analytical laboratory and in the rock analysis laboratory of the U.S. Geological Survey, Center of Astrogeology, Flagstaff, Arizona.

The Columbia River Plateau in the states of Washington, Oregon and Idaho is underlain for many thousands of square miles by flows of flood basalt, collectively known as the Columbia River Basalt (Waters, 1961). The lateral continuity of some individual flows had previously been shown to extend for tens of kilometers. In the past, field identification and correlation of these basalt flows was in large part accomplished by conventional stratigraphic techniques, making use of characteristics clearly observable in the field such as color, texture, jointing pattern, erosional form, and position relative to key sedimentary interbeds that served as stratigraphic markers

(Mackin, 1961; Bingham and Grolier, 1966; Grolier and Bingham, 1971). That approach utilizes a minimum of petrographic and chemical analysis.

Many of the flows studied are so similar in megascopic appearance that they defy positive identification at the outcrop. An approach involving the use of field criteria plus petrographic and chemical analyses was first used in these flows by A.C. Waters (1961). Later H.U. Schmincke (1967) used chemical and petrographic data to distinguish four basalt layers occuring in the upper part of the Columbia River Basalt, and to trace them over several hundred square miles of the western part of the lava field. The same methods were used by the authors in their attempt to identify and correlate flows and sequences of flows throughout most of the Plateau, and the tabulated analyses included in this paper are a product of that study.

This study of the Columbia River Basalt was undertaken in support of the U.S. Geological Survey's astrogeology program in an attempt to further the knowledge of the internal character of a thick sequence of flows that constitute a basalt filled basin equal in dimension to a lunar mare. During a preliminary two-week field trip undertaken in April 1970, the writers collected 56 basalt samples in the states of Washington and Oregon. Many of the samples were collected at the type locality of well known basalt flows. These samples were returned to the Center of Astrogeology, Flagstaff, Arizona, where they were analysed in a mobile truck-mounted chemical laboratory, and later re-analyzed using the Center's rock laboratory facilities.

In June 1970, the writers spent one month in the states of Washington, Oregon and Idaho collecting another 199 basalt samples from exposed sections and also from isolated exposures selected at intervals of a few tens of miles throughout most of the Columbia Plateau. At night or at intervals of two or three days, the basalt samples were brought back to the mobile chemical laboratory at conveniently located stations. The samples were analyzed immediately for major elements at a rate of 10-12 samples per day. The analytical procedures used in the mobile chemical laboratory are described by R.L. Swenson elsewhere (Brock, in preparation).

At the end of the field study, rock samples including the remainder of the pulverized portion used for earlier analyses were brought back to the rock laboratory in Flagstaff, Arizona, and each sample was again analyzed to confirm the results obtained in the mobile unit. The reliability of the chemical data obtained in the mobile unit has been further substantiated by analyses of selected samples in other U.S. Geological Survey chemical laboratories. Where an error in the composition of an element was indicated by the later analyses in the Flagstaff laboratory, the field-determined value was replaced by that obtained in the established laboratory. These substituted values are followed by an asterisk in Table 1-A. To supplement our coverage of the Columbia River Basalt in Idaho a suite of samples provided by John Bond, of the Idaho Bureau of Mines, was analyzed in Flagstaff in the spring of 1971. Many localities visited by the writers in 1970 were revisited in September 1971 by D.A. Swanson and T.L. Wright to further the study of the flow

stratigraphy. Additional localities were visited and the samples collected at that time were analyzed in the Flagstaff laboratory and the results are included in this report.

Sample location data and analyses are presented in Tables 1-4. Each table is divided into two parts: part A contains the chemical analyses, and part B shows the location and description of the samples.

The chemical analyses that follow were used in a study in the chemical variation of the basalts flows relative to their stratigraphic position (Wright and others, 1973), and the analyses form the basis for the tentative classification given in that paper. Explanation of column headings in Tables 1-B, 2-B, 3-B and 4-B is as follows:

Column 1: Field number

2: State. Abbreviated, I (Idaho), O(Oregon), or W(Washington)

3: County

4: Quandrangle. U.S. Geological Survey 7 1/2-minute series unless otherwise stated.

5: Location in terms of Section (divided into quarters or sixteenths), Township, and Range. This column also contains additional descriptive information to enable future collection at the same locality.

6: Stratigraphic unit. Keyed to the informal stratigraphy defined in Table 1 of Wright and others (1973).

7: Flow no. Numbers are given only for complete sections. Numbers increase upsection.

Column 8: Chemical type. These are abbreviated according to nomenclature given in Table 2 of Wright and others (1973) as follows:

PG = Picture Gorge, cols. 1-3

LS = Little Salmon, col. 4

RC = Rock Creek, col. 5

Y = Yakima, cols. 6-8

L = Lolo, col. 9

R = Roza, col. 10. Only flows that are inferred to be correlated with the Roza member as defined by J.H. Mackin, (1961), are designated R.

FS = Frenchman Springs

U = Umatilla

P = Pomona

EM = Elephant Mountain

IH = Flows at Ice Harbor Dam

? = chemical composition unlike or transitional among the groups defined in figure 2 of Wright and others, (1973).

These location and chemical data are being released in the hope that they may be useful to other geologists interested in the stratigraphy and geochemistry of flood basalt in the Columbia Plateau and elsewhere, to hydrologists, soil scientists, ecologists, geographers, and those doing research in other environmental sciences.

## SELECTED BIBLIOGRAPHY

Bingham, J.W., and Grolier, M.J., 1966, The Yakima Basalt and Ellensburg Formation of South Central Washington: Contrib. to stratigraphy, U.S. Geological Survey Bull. 1224-G, p. 1-15, figs.

Brock, M.R., Research in Geologic Methods 1967-1971: (in preparation)

Grolier, M.J., and Bingham, J.M., 1971, Geologic map and sections of parts of Grant, Adams, and Franklin Counties, Washington: U.S. Geological Survey, Misc. Geol. Inv. Map I-589, 6 sheets, scale 1:62,500 .

Mackin, J. Hoover, 1961, A stratigraphic section in the Yakima Basalt and the Ellensburg Formation in south-central Washington: Wash. Div. Mines and Geology Rept. Inv. 19, 45 p.

Schmincke, H.U., 1967, Stratigraphy and petrography of four upper Yakima Basalt flows in South-Central Washington: Geol. Soc. America Bull., v. 78, p. 1385-1422, figs., pl.

Waters, A.C., 1961, Stratigraphic and lithologic variations in the Columbia River Basalt: Am. Jour. Sci., v. 289, p. 583-611, figs.

Wright, T.L., M.J. Grolier, and D.A. Swanson, 1973, Chemical variation related to stratigraphy of the Columbia River Basalt: Bull. Geol. Soc. Am. (in press).

Table I-A Chemical analyses of basalt samples from Colombia River Plateau, Washington, Oregon and Idaho. Principal analyst: R.L. Swenson

| | 70-B-1 | 70-B-2 | 70-B-3 | 70-B-4 | 70-B-5 | 70-B-6 | 70-B-7 | 70-B-8 | 70-B-9 | 70-B-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.200 | 50.300 | 51.800 | 48.800 | 53.000 | 52.800 | 49.800 | 49.200 | 51.300 | 48.900 |
| AL2O3 | 13.300 | 13.300 | 13.800 | 13.500 | 13.800 | 13.900 | 13.500 | 13.300 | 15.000 | 13.200 |
| FE2O3 | 5.500 | 3.800 | 2.900 | 3.300 | 2.900 | 3.900 | 3.100 | 5.400 | 1.000 | 3.900 |
| FEO | 9.540 | 10.530 | 11.160 | 11.520 | 9.540 | 6.930 | 11.250 | 8.640 | 9.540 | 10.260 |
| MGO | 4.200* | 4.500* | 4.400* | 4.600* | 4.800 | 5.500 | 4.600* | 4.300* | 6.400 | 4.400* |
| CAO | 7.800* | 8.000* | 8.000* | 8.200* | 9.000 | 9.300 | 8.500 | 8.100* | 11.000 | 9.100 |
| NA2O | 3.000 | 2.600 | 2.800* | 2.800* | 2.600 | 2.500 | 2.800* | 2.600* | 2.200 | 2.500 |
| K2O | 1.100 | 1.400 | 1.400 | 1.200 | 1.200 | 1.300 | 1.200 | 1.100 | 0.500 | 1.400 |
| H2O | 2.090 | 1.500 | 1.040 | 1.070 | 1.200 | 1.850 | 0.840 | 3.150 | 0.590 | 1.650 |
| TIO2 | 3.000* | 2.800* | 2.860* | 3.110* | 1.600 | 1.660 | 3.080* | 2.790 | 1.530 | 3.020* |
| P2O5 | 0.580 | 0.520 | 0.520 | 0.620 | 0.290 | 0.320 | 0.600 | 0.490 | 0.230 | 0.560 |
| MNO | 0.210 | 0.210 | 0.220 | 0.220 | 0.210 | 0.200 | 0.240 | 0.240 | 0.210 | 0.240 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.120 | 0.370 | 0.070 | 0.340 | 0.600 | 0.050 |
| Total | 99.6 | 99.0 | 100.9 | 99.0 | 100.3 | 100.5 | 99.6 | 99.6 | 100.1 | 99.2 |

| | 70-B-11 | 70-B-12 | 70-B-13 | 70-B-14 | 70-B-15 | 70-B-16 | 70-B-17 | 70-B-18 | 70-B-19 | 70-B-20 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.700 | 49.500 | 49.500 | 45.900 | 49.100 | 49.800 | 50.200 | 50.100 | 53.300 | 54.100 |
| AL2O3 | 13.600 | 13.900 | 13.900 | 15.800 | 13.300 | 12.900 | 12.800 | 13.800 | 14.200 | 14.400 |
| FE2O3 | 3.600 | 4.300 | 3.900 | 6.300 | 3.900 | 5.500 | 5.600 | 3.500 | 4.100 | 2.800 |
| FEO | 10.440 | 9.360 | 9.540 | 5.400 | 10.890 | 9.090 | 8.910 | 11.160 | 7.020 | 7.830 |
| MGO | 4.700 | 4.000* | 4.800 | 7.400 | 4.900 | 4.000 | 4.500 | 3.900 | 5.100 | 5.100 |
| CAO | 9.100 | 9.300 | 9.000 | 10.100 | 8.800 | 8.200 | 9.100 | 8.800 | 8.800 | 8.400 |
| NA2O | 2.600 | 2.700* | 2.500 | 2.200 | 2.400 | 2.600 | 2.900 | 2.700 | 2.600 | 2.800 |
| K2O | 1.200 | 1.100 | 1.000 | 0.300 | 1.200 | 1.500 | 1.200 | 1.300 | 1.400 | 1.400 |
| H2O | 1.140 | 1.550 | 1.770 | 4.290 | 1.840 | 2.070 | 2.250 | 1.710 | 1.810 | 1.180 |
| TIO2 | 2.560 | 3.150* | 2.540 | 1.820 | 2.440 | 2.790 | 2.410 | 2.560 | 1.610 | 1.770 |
| P2O5 | 0.570 | 0.620 | 0.560 | 0.330 | 0.520 | 0.590 | 0.500 | 0.560 | 0.330 | 0.320 |
| MNO | 0.230 | 0.220 | 0.220 | 0.150 | 0.210 | 0.230 | 0.230 | 0.220 | 0.180 | 0.190 |
| CO2 | 0.100 | 0.050 | 0.050 | 0.070 | 0.050 | 0.050 | 0.050 | 0.150 | 0.050 | 0.070 |
| Total | 99.5 | 99.7 | 99.2 | 100.1 | 99.5 | 99.3 | 100.6 | 100.5 | 100.5 | 100.4 |

| | 70-B-21 | 70-B-22 | 70-B-23 | 70-B-24 | 70-B-25 | 70-B-26 | 70-B-27 | 70-B-28 | 70-B-29 | 70-B-30 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.500 | 50.100 | 53.700 | 50.300 | 50.700 | 50.900 | 50.500 | 50.900 | 53.700 | 50.900 |
| AL2O3 | 13.500 | 13.400 | 14.400 | 13.600 | 13.400 | 13.400 | 14.000 | 13.200 | 13.800 | 13.200 |
| FE2O3 | 3.500 | 3.600 | 4.200 | 4.100 | 2.000 | 2.800 | 4.500 | 3.600 | 1.800 | 2.400 |
| FEO | 10.710 | 10.980 | 7.560 | 10.800 | 12.870 | 11.700 | 10.350 | 10.980 | 9.450 | 11.700 |
| MGO | 4.100* | 4.000 | 4.300 | 4.000 | 4.300* | 4.200 | 4.200 | 4.500 | 4.900 | 4.200 |
| CAO | 8.500* | 8.200 | 8.300 | 8.400 | 8.500* | 8.400 | 8.100 | 8.100 | 8.[illegible] | 7.900 |
| NA2O | 3.000* | 2.200 | 2.900 | 2.800 | 2.900 | 2.900 | 2.300 | 2.700 | 2.800 | 2.900 |
| K2O | 1.280 | 1.300 | 1.300 | 1.300 | 1.600 | 1.300 | 1.100 | 1.200 | 1.400 | 1.700 |
| H2O | 1.240 | 0.950 | 1.470 | 1.240 | 0.950 | 1.530 | 1.390 | 1.010 | 1.020 | 0.870 |
| TIO2 | 2.860* | 2.710 | 1.790 | 2.710 | 3.020* | 2.750 | 2.770 | 2.640 | 1.730 | 2.720 |
| P2O5 | 0.480 | 0.540 | 0.300 | 0.530 | 0.570 | 0.560 | 0.530 | 0.470 | 0.300 | 0.540 |
| MNO | 0.260 | 0.220 | 0.190 | 0.220 | 0.240 | 0.230 | 0.230 | 0.220 | 0.220 | 0.240 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.090 | 0.060 | 0.050 | 0.060 | 0.070 | 0.050 | 0.050 |
| Total | 100.0 | 99.2 | 100.4 | 100.1 | 101.1 | 100.7 | 100.0 | 99.6 | 99.7 | 99.[illegible] |

| | 70-B-31 | 70-B-32 | 70-B-33 | 70-B-34 | 70-B-35 | 70-B-36 | 70-B-37 | 70-B-38* | 70-B-39 | 70-B-40 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.600 | 48.800 | 52.000 | 50.900 | 51.300 | 50.300 | 49.600 | 49.100 | 49.400 | 49.600 |
| AL2O3 | 14.100 | 13.000 | 14.200 | 13.300 | 13.800 | 13.400 | 13.300 | 13.800 | 13.200 | 13.900 |
| FE2O3 | 2.600 | 4.800 | 3.700 | 3.000 | 4.000 | 3.100 | 4.200 | 5.100 | 4.700 | 4.100 |
| FEO | 11.430 | 10.260 | 9.000 | 11.340 | 9.180 | 11.700 | 10.530 | 9.720 | 9.810 | 9.720 |
| MGO | 4.100 | 4.100 | 4.200 | 4.500 | 4.200 | 4.200 | 4.100 | 4.600* | 4.200 | 4.800 |
| CAO | 8.600 | 8.500 | 8.400 | 7.900 | 8.300 | 8.300 | 8.300 | 8.800* | 8.300 | 8.400 |
| NA2O | 2.400 | 2.700 | 2.600 | 2.800 | 2.300 | 2.300 | 2.700 | 2.700* | 2.700 | 2.200 |
| K2O | 1.800 | 1.300 | 1.300 | 1.400 | 1.400 | 1.500 | 1.300 | 1.300 | 1.500 | 1.300 |
| H2O | 0.960 | 2.110 | 1.380 | 0.680 | 1.780 | 1.190 | 1.420 | 2.170 | 1.960 | 1.540 |
| TIO2 | 2.790 | 3.100 | 2.640 | 2.810 | 2.620 | 2.740 | 3.060 | 3.010* | 3.000 | 2.910 |
| P2O5 | 0.560 | 0.650 | 0.470 | 0.520 | 0.470 | 0.470 | 0.650 | 0.540 | 0.540 | 0.560 |
| MNO | 0.230 | 0.230 | 0.210 | 0.240 | 0.220 | 0.240 | 0.220 | 0.210 | 0.230 | 0.200 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.2 | 99.6 | 100.1 | 99.4 | 99.6 | 99.4 | 99.4 | 101.1 | 99.6 | 99.2 |

* Revised value. Where significant differences appeared between field-determined values and those obtained with the more elaborate equipment in the Flagstaff laboratory, the latter were used in this table.

Table I-A continued

| | 70-B-41 | 70-B-42 | 70-B-43 | 70-B-44 | 70-B-45 | 70-B-46 | 70-B-47 | 70-B-48 | 70-B-49 | 70-B-50 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.400 | 53.100 | 50.700 | 49.700 | 49.800 | 49.200 | 50.100 | 48.100 | 52.800 | 50.100 |
| AL2O3 | 13.900 | 15.100 | 13.600 | 13.800 | 13.400 | 13.000 | 13.200 | 13.300 | 14.700 | 13.400 |
| FE2O3 | 4.700 | 2.200 | 3.300 | 3.700 | 2.500 | 3.400 | 2.700 | 5.200 | 2.200 | 3.500 |
| FEO | 9.450 | 8.640 | 10.080 | 10.350 | 11.970 | 11.520 | 11.250 | 9.900 | 9.450 | 10.530 |
| MGO | 4.600 | 5.100 | 4.000 | 4.700* | 4.700 | 4.300 | 4.500 | 4.300* | 4.700 | 4.600 |
| CAO | 8.800 | 9.300 | 8.400 | 8.500* | 8.800 | 8.800 | 8.700 | 8.400* | 8.800 | 8.700 |
| NA2O | 2.400 | 2.700* | 2.900 | 2.700* | 2.600 | 2.100 | 2.800 | 2.300* | 2.300 | 2.400 |
| K2O | 1.100 | 1.200 | 1.500 | 1.300 | 1.500 | 1.500 | 1.600 | 1.300 | 1.200 | 1.300 |
| H2O | 1.620 | 0.880 | 1.010 | 1.430 | 0.960 | 1.430 | 1.360 | 1.650 | 0.990 | 1.400 |
| TIO2 | 3.190 | 1.740* | 3.150 | 3.020* | 3.220 | 3.460 | 2.950 | 3.520 | 1.990 | 2.890 |
| P2O5 | 0.570 | 0.280 | 0.550 | 0.510 | 0.590 | 0.660 | 0.510 | 0.660 | 0.290 | 0.480 |
| MNO | 0.200 | 0.180 | 0.190 | 0.210 | 0.230 | 0.240 | 0.240 | 0.240 | 0.210 | 0.220 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.060 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.9 | 100.5 | 99.4 | 100.0 | 100.3 | 99.6 | 99.9 | 98.9 | 99.6 | 99.5 |

| | 70-B-51 | 70-B-52 | 70-B-53 | 70-B-54 | 70-B-55 | 70-B-56 | 70-B-57 | 70-B-58 | 70-B-59 | 70-B-60 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.700 | 49.400 | 50.700 | 52.900 | 48.200 | 48.400 | 48.600 | 48.900 | 53.100 | 52.800 |
| AL2O3 | 14.500 | 13.600 | 13.800 | 14.800 | 14.600 | 13.100 | 13.500 | 13.700 | 14.200 | 13.500 |
| FE2O3 | 3.200 | 2.200 | 2.100 | 1.500 | 6.900 | 4.000 | 1.600 | 2.200 | 2.200 | 2.800 |
| FEO | 10.620 | 12.780 | 11.250 | 9.090 | 8.100 | 11.430 | 12.510 | 11.970 | 9.630 | 9.360 |
| MGO | 4.100 | 4.000 | 4.100 | 4.900 | 3.000 | 4.400 | 5.400 | 5.300 | 4.700 | 3.900 |
| CAO | 8.600 | 8.200 | 8.400 | 8.900 | 8.600 | 8.400 | 9.000 | 8.900 | 8.000 | 7.700 |
| NA2O | 2.500 | 2.100 | 2.600 | 3.000 | 2.300 | 2.700 | 2.700 | 2.700 | 3.100 | 3.200 |
| K2O | 1.400 | 1.400 | 1.400 | 1.400 | 1.300 | 1.600 | 1.200 | 1.200 | 1.400 | 1.700 |
| H2O | 0.800 | 1.260 | 0.920 | 0.590 | 2.010 | 1.800 | 0.510 | 0.510 | 1.400 | 1.740 |
| TIO2 | 3.080 | 3.530 | 3.490 | 1.700 | 3.240 | 3.900 | 3.200 | 3.200 | 2.100 | 2.400 |
| P2O5 | 0.540 | 0.650 | 0.580 | 0.300 | 0.580 | 0.700 | 0.750 | 0.750 | 0.320 | 0.370 |
| MNO | 0.220 | 0.290 | 0.210 | 0.220 | 0.330 | 0.240 | 0.260 | 0.260 | 0.210 | 0.210 |
| CO2 | 0.050 | 0.050 | 0.090 | 0.400 | 0.880 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 100.3 | 99.4 | 99.6 | 99.7 | 100.0 | 100.7 | 99.2 | 99.6 | 100.4 | 99.7 |

| | 70-B-61 | 70-B-62 | 70-B-63 | 70-B-64 | 70-B-65 | 70-B-66 | 70-B-67 | 70-B-68 | 70-B-69 | 70-B-70 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 53.800 | 55.400 | 55.900 | 56.500 | 54.000 | 53.400 | 53.600 | 48.600 | 48.800 | 49.700 |
| AL2O3 | 13.900 | 13.500 | 13.500 | 12.900 | 13.900 | 14.100 | 13.800 | 13.700 | 13.800 | 13.600 |
| FE2O3 | 2.900 | 2.200 | 2.100 | 2.100 | 2.400 | 2.400 | 2.500 | 1.900 | 2.500 | 1.800 |
| FEO | 9.180 | 9.540 | 9.450 | 9.180 | 9.630 | 9.450 | 9.450 | 12.510 | 11.700 | 12.240 |
| MGO | 4.000 | 3.000 | 3.000 | 3.000 | 4.300 | 4.400 | 3.900 | 5.300 | 5.200 | 5.100 |
| CAO | 7.500 | 6.500 | 6.600 | 6.900 | 7.800 | 7.900 | 7.600 | 9.100 | 9.000 | 8.900 |
| NA2O | 3.100 | 3.300 | 3.200 | 3.100 | 3.200 | 3.100 | 3.100 | 3.100 | 3.200 | 2.700 |
| K2O | 1.700 | 2.100 | 2.200 | 2.200 | 1.600 | 1.500 | 1.600 | 1.300 | 1.200 | 1.300 |
| H2O | 1.700 | 1.260 | 1.280 | 1.270 | 0.750 | 0.850 | 1.020 | 0.480 | 0.950 | 0.400 |
| TIO2 | 2.300 | 2.200 | 2.200 | 2.200 | 1.900 | 1.800 | 2.200 | 3.200 | 3.200 | 3.200 |
| P2O5 | 0.350 | 0.330 | 0.320 | 0.310 | 0.340 | 0.300 | 0.370 | 0.740 | 0.730 | 0.780 |
| MNO | 0.210 | 0.230 | 0.240 | 0.220 | 0.220 | 0.230 | 0.230 | 0.270 | 0.250 | 0.250 |
| CO2 | 0.050 | 0.230 | 0.170 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 100.6 | 99.8 | 100.2 | 99.9 | 100.0 | 99.4 | 99.4 | 100.2 | 100.5 | 100.0 |

| | 70-B-71 | 70-B-72 | 70-B-76 | 70-B-77 | 70-B-78 | 70-B-79 | 70-B-83 | 70-B-84 | 70-B-85 | 70-B-86 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 48.000 | 49.300 | 48.700 | 49.500 | 53.700 | 50.500 | 49.600 | 50.500 | 50.700 | 50.800 |
| AL2O3 | 13.900 | 14.100 | 14.100 | 13.400 | 13.800 | 13.100 | 13.000 | 13.400 | 13.300 | 13.100 |
| FE2O3 | 2.700 | 2.800 | 2.800 | 2.800 | 2.100 | 3.200 | 5.000 | 3.000 | 3.200 | 2.500 |
| FEO | 11.430 | 10.080 | 11.250 | 11.520 | 9.720 | 12.060 | 9.540 | 11.430 | 10.800 | 11.700 |
| MGO | 5.200 | 4.700 | 5.200 | 4.300 | 4.400 | 4.200 | 4.200 | 4.100 | 4.300 | 4.400 |
| CAO | 9.200 | 9.700 | 9.100 | 8.200 | 7.900 | 8.100 | 8.200 | 8.100 | 8.200 | 8.200 |
| NA2O | 2.600 | 2.600 | 2.600 | 2.900 | 2.600 | 2.400 | 2.400 | 2.800 | 2.600 | 2.600 |
| K2O | 1.300 | 1.300 | 1.200 | 1.500 | 1.900 | 1.300 | 1.000 | 1.300 | 1.300 | 1.300 |
| H2O | 0.770 | 1.240 | 1.030 | 1.330 | 1.340* | 1.370 | 2.820 | 1.460 | 1.660 | 1.250 |
| TIO2 | 3.300 | 3.200 | 3.200 | 3.200 | 1.910* | 3.500 | 3.100 | 3.020 | 2.840 | 2.880 |
| P2O5 | 0.750 | 0.750 | 0.730 | 0.670 | 0.370 | 0.540 | 0.630 | 0.620 | 0.580 | 0.580 |
| MNO | 0.250 | 0.270 | 0.250 | 0.250 | 0.210 | 0.230 | 0.230 | 0.240 | 0.220 | 0.230 |
| CO2 | 0.590 | 0.050 | 0.050 | 0.050 | 0.050 | 0.070 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 100.0 | 100.0 | 100.2 | 99.6 | 100.0 | 100.6 | 99.7 | 100.0 | 99.7 | 99.5 |

Table I-A continued

| | 70-B-87 | 70-B-88 | 70-B-89 | 70-B-90 | 70-B-91 | 70-B-92 | 70-B-93 | 70-B-94 | 70-B-95 | 70-B-96 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.700 | 51.000 | 51.900 | 51.400 | 54.000 | 54.000 | 50.500 | 50.700 | 50.800 | 50.400 |
| AL2O3 | 13.400 | 13.500 | 13.400 | 13.200 | 13.700 | 13.500 | 13.200 | 13.400 | 14.600 | 13.200 |
| FE2O3 | 4.200 | 2.600 | 3.800 | 3.500 | 3.200 | 2.400 | 2.000 | 3.800 | 2.400 | 1.700 |
| FEO | 9.900 | 11.430 | 10.260 | 10.800 | 9.180 | 10.170 | 11.970 | 10.260 | 8.100 | 13.140 |
| MGO | 4.400 | 4.400 | 3.900 | 4.100 | 2.500 | 2.600 | 4.200 | 3.800 | 6.600 | 4.100 |
| CAO | 8.000 | 8.200 | 7.700 | 7.900 | 5.900 | 5.900 | 8.400 | 8.100 | 10.900 | 8.200 |
| NA2O | 2.700 | 2.600 | 2.900 | 2.700 | 3.300 | 3.100 | 2.400 | 2.600 | 2.400 | 2.400 |
| K2O | 1.200 | 1.300 | 1.400 | 1.300 | 2.600 | 2.400 | 1.300 | 1.600 | 0.900 | 1.500 |
| H2O | 1.660 | 1.120 | 1.430 | 1.620 | 1.390 | 1.530 | 1.160 | 2.150 | 1.690 | 0.950 |
| TIO2 | 2.880 | 2.890 | 2.900 | 3.000 | 2.520 | 2.490 | 3.490 | 2.810 | 1.620 | 3.340 |
| P2O5 | 0.560 | 0.580 | 0.680 | 0.640 | 1.070 | 1.060 | 0.570 | 0.540 | 0.240 | 0.540 |
| MNO | 0.230 | 0.230 | 0.230 | 0.230 | 0.220 | 0.220 | 0.220 | 0.230 | 0.190 | 0.220 |
| CO2 | 0.050 | 0.050 | 0.060 | 0.050 | 0.050 | 0.050 | 0.050 | 0.060 | 0.060 | 0.050 |
| Total | 99.8 | 99.9 | 100.6 | 100.4 | 99.6 | 99.4 | 99.4 | 100.1 | 100.5 | 99.7 |

| | 70-B-97 | 70-B-98 | 70-B-99 | 70-B-100 | 70-B-101 | 70-B-102 | 70-B-103 | 70-B-104 | 70-B-105 | 70-B-106 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 51.300 | 50.200 | 52.900 | 53.600 | 53.300 | 53.500 | 54.500 | 52.000 | 54.500 | 53.300 |
| AL2O3 | 14.700 | 13.200 | 14.000 | 14.100 | 14.000 | 14.100 | 14.400 | 13.600 | 14.100 | 14.400 |
| FE2O3 | 2.100 | 2.400 | 2.200 | 2.500 | 1.800 | 2.800 | 2.700 | 3.300 | 2.800 | 2.700 |
| FEO | 8.460 | 12.330 | 9.720 | 9.810 | 10.260 | 9.900 | 8.550 | 10.800 | 8.190 | 7.920 |
| MGO | 6.900 | 4.200 | 4.500 | 4.800 | 4.700 | 4.900 | 4.300 | 4.200 | 4.300 | 5.000 |
| CAO | 10.700 | 8.300 | 8.200 | 8.400 | 8.300 | 8.400 | 8.100 | 7.900 | 8.200 | 8.600 |
| NA2O | 2.400 | 2.400 | 2.900 | 2.800 | 2.900 | 2.600 | 2.800 | 2.800 | 2.900 | 2.600 |
| K2O | 0.800 | 1.200 | 1.200 | 1.200 | 1.300 | 1.100 | 1.200 | 1.300 | 1.200 | 1.100 |
| H2O | 0.770 | 1.630 | 1.110 | 0.920 | 1.110 | 0.890 | 1.260 | 1.250 | 1.680 | 2.280 |
| TIO2 | 1.450 | 3.310 | 1.910 | 1.960 | 1.920 | 1.840 | 1.840 | 2.860 | 1.790 | 1.620 |
| P2O5 | 0.310 | 0.530 | 0.310 | 0.310 | 0.390 | 0.350 | 0.340 | 0.560 | 0.330 | 0.280 |
| MNO | 0.200 | 0.230 | 0.220 | 0.230 | 0.220 | 0.220 | 0.190 | 0.230 | 0.220 | 0.190 |
| CO2 | 0.050 | 0.050 | 0.060 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.290 | 0.050 |
| Total | 100.1 | 99.9 | 99.2 | 100.6 | 100.2 | 100.6 | 100.2 | 100.8 | 100.5 | 100.0 |

| | 70-B-107 | 70-B-108 | 70-B-109 | 70-B-110 | 70-B-111 | 70-B-112 | 70-B-113 | 70-B-114 | 70-B-115 | 70-B-116 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 54.300 | 54.300 | 53.500 | 53.200 | 52.300 | 53.000 | 53.100 | 53.500 | 53.300 | 52.600 |
| AL2O3 | 14.200 | 14.300 | 14.200 | 14.200 | 14.100 | 14.200 | 14.100 | 14.100 | 14.200 | 13.900 |
| FE2O3 | 1.700 | 1.600 | 2.200 | 2.500 | 3.500 | 2.300 | 2.400 | 1.800 | 2.600 | 2.800 |
| FEO | 9.540 | 9.810 | 9.450 | 9.000 | 8.190 | 9.180 | 9.680 | 10.350 | 8.820 | 8.370 |
| MGO | 4.800 | 4.600 | 4.700 | 5.100 | 5.000 | 4.800 | 4.900 | 4.400 | 4.800 | 4.800 |
| CAO | 8.300 | 8.300 | 8.300 | 8.700 | 9.100 | 8.400 | 8.500 | 8.200 | 8.700 | 8.600 |
| NA2O | 2.600 | 2.800 | 2.600 | 2.400 | 2.400 | 2.700 | 2.600 | 2.700 | 2.500 | 2.300 |
| K2O | 1.300 | 1.200 | 1.200 * | 0.900 | 1.000 | 1.100 | 1.100 | 1.200 | 1.100 | 1.000 |
| H2O | 1.060 | 1.550 | 1.330 | 1.660 | 2.160 | 1.970 | 1.540 | 1.170 | 1.620 | 2.650 |
| TIO2 | 1.710 | 1.750 | 1.820 | 1.720 | 1.820 * | 1.750 | 1.860 | 1.930 | 1.770 | 1.720 |
| P2O5 | 0.320 | 0.340 | 0.300 | 0.270 | 0.300 * | 0.280 | 0.320 | 0.320 | 0.300 | 0.290 |
| MNO | 0.190 | 0.200 | 0.200 | 0.200 | 0.190 | 0.190 | 0.200 | 0.200 | 0.200 | 0.190 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.060 |
| Total | 100.0 | 100.8 | 99.8 | 99.9 | 100.1 | 99.6 | 100.3 | 99.9 | 99.9 | 99.3 |

| | 70-B-118 | 70-B-119 | 70-B-120 | 70-B-121 | 70-B-122 | 70-B-123 | 70-B-124 | 70-B-125 | 70-B-126 | 70-B-127 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.200 | 48.000 | 46.400 | 61.600 | 50.800 | 50.600 | 50.800 | 50.800 | 49.900 | 50.300 |
| AL2O3 | 15.200 | 16.100 | 14.900 | 16.900 | 13.600 | 13.900 | 15.000 | 15.100 | 15.500 | 14.200 |
| FE2O3 | 4.200 | 2.700 | 4.500 | 3.800 | 3.400 | 3.300 | 4.200 | 4.800 | 6.400 | 4.100 |
| FEO | 7.020 | 8.370 | 6.750 | 2.250 | 11.250 | 10.080 | 9.360 | 7.830 | 6.570 | 9.000 |
| MGO | 6.100 | 7.000 | 6.900 | 2.100 | 4.600 | 5.000 | 4.800 | 4.400 | 5.000 | 5.100 |
| CAO | 10.600 | 10.800 | 9.800 | 2.400 | 8.700 | 9.100 | 9.200 | 9.100 | 9.500 | 8.500 |
| NA2O | 2.500 | 2.500 | 2.400 | 2.400 | 2.900 | 2.300 | 2.600 | 2.600 | 2.500 | 2.900 |
| K2O | 0.500 | 0.500 | 0.800 | 1.400 | 0.800 | 0.900 | 0.700 | 0.700 | 0.600 | 1.000 |
| H2O | 1.480 | 1.290 | 5.040 | 5.910 | 0.870 | 1.540 | 0.850 | 1.860 | 1.160 | 2.200 |
| TIO2 | 1.500 | 1.700 | 1.640 | 1.070 | 2.140 | 1.780 | 1.920 * | 1.730 | 1.830 | 2.090 |
| P2O5 | 0.230 | 0.290 | 0.270 | 0.080 | 0.350 | 0.310 | 0.340 | 0.330 | 0.350 | 0.420 |
| MNO | 0.210 | 0.190 | 0.190 | 0.140 | 0.250 | 0.240 | 0.250 | 0.230 | 0.220 | 0.290 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.070 | 0.050 | 0.050 | 0.050 | 0.060 | 0.050 | 0.140 |
| Total | 99.7 | 99.4 | 99.6 | 100.1 | 99.7 | 99.1 | 100.1 | 99.5 | 99.5 | 100.2 |

Table I-A continued

| | 70-B-128 | 70-B-129 | 70-B-130 | 70-B-131 | 70-B-132 | 70-B-133 | 70-B-134 | 70-B-135 | 70-B-136 | 70-B-137 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.600 | 51.100 | 50.800 | 52.600 | 51.800 | 50.500 | 48.700 | 49.500 | 49.800 | 49.800 |
| AL2O3 | 14.000 | 15.000 | 14.800 | 14.800 | 14.500 | 15.200 | 15.400 | 15.100 | 15.100 | 15.300 |
| FE2O3 | 5.500 | 5.200 | 3.900 | 2.900 | 4.500 | 4.500 | 6.700 | 5.800 | 2.700 | 3.300 |
| FEO | 8.730 | 6.750 | 8.280 | 8.460 | 7.200 | 7.020 | 4.770 | 5.400 | 8.370 | 8.640 |
| MGO | 5.100 | 4.900 | 5.700 | 5.200 | 5.400 | 5.800 | 6.300 | 6.300 | 6.600 | 6.600 |
| CAO | 9.600 | 9.400 | 10.100 | 8.900 | 9.300 | 9.900 | 10.800 | 10.200 | 10.600 | 10.600 |
| NA2O | 3.000 | 2.700 | 3.200 | 3.000 | 2.800 | 2.900 | 2.500 | 2.600 | 2.700 | 2.900 |
| K2O | 0.700 | 0.900 | 0.900 | 1.300 | 1.000 | 1.200 | 0.400 | 0.500 | 0.700 | 0.600 |
| H2O | 1.340 | 1.810 | 0.800 | 1.080 | 1.210 | 1.740 | 2.080 | 3.000 | 1.080 | 0.540 |
| TIO2 | 2.000 | 1.590 | 1.660 | 1.550 | 1.600 | 1.510 | 1.450 | 1.470 | 1.480 | 1.590 |
| P2O5 | 0.280 | 0.280 | 0.240 | 0.240 | 0.220 | 0.220 | 0.190 | 0.220 | 0.200 | 0.240 |
| MNO | 0.250 | 0.210 | 0.230 | 0.210 | 0.220 | 0.200 | 0.180 | 0.170 | 0.210 | 0.230 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.060 | 0.060 | 0.050 | 0.050 |
| Total | 100.1 | 99.8 | 100.6 | 100.2 | 99.8 | 100.7 | 99.5 | 100.3 | 99.5 | 100.3 |

| | 70-B-138 | 70-B-139 | 70-B-140 | 70-B-141 | 70-B-142 | 70-B-143 | 70-B-144 | 70-B-145 | 70-B-146 | 70-B-147 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.800 | 49.800 | 48.400 | 49.300 | 50.700 | 51.100 | 50.800 | 50.400 | 51.400 | 49.500 |
| AL2O3 | 15.400 | 15.100 | 15.100 | 15.400 | 13.500 | 13.400 | 13.400 | 13.500 | 13.600 | 15.400 |
| FE2O3 | 4.300 | 2.500 | 4.500 | 4.000 | 7.600 | 2.300 | 3.900 | 5.300 | 4.100 | 3.200 |
| FEO | 7.020 | 9.270 | 7.200 | 7.200 | 7.560 | 11.340 | 10.350 | 8.910 | 8.910 | 8.280 |
| MGO | 6.600 | 6.900 | 6.900 | 6.200 | 4.300 | 3.900 | 4.200 | 4.100 | 3.800 | 5.300 |
| CAO | 10.800 | 10.600 | 10.100 | 9.900 | 7.900 | 8.100 | 8.300 | 8.400 | 8.300 | 8.200 |
| NA2O | 2.700 | 3.000 | 2.700 | 2.800 | 2.900 | 2.400 | 2.400 | 2.500 | 2.900 | 2.900 |
| K2O | 0.400 | 0.600 | 0.600 | 0.600* | 1.400 | 1.500 | 1.400 | 1.600 | 1.400 | 1.400 |
| H2O | 1.710 | 0.860 | 2.740 | 1.870 | 1.290 | 2.540 | 2.380 | 2.000 | 2.040 | 2.360 |
| TIO2 | 1.490 | 1.570 | 1.630 | 1.590 | 2.980 | 2.720 | 2.810 | 2.850 | 2.760 | 2.350 |
| P2O5 | 0.220 | 0.220 | 0.220 | 0.240 | 0.580 | 0.520 | 0.510 | 0.530 | 0.530 | 0.300 |
| MNO | 0.210 | 0.220 | 0.210 | 0.190 | 0.230 | 0.210 | 0.260 | 0.230 | 0.240 | 0.180 |
| CO2 | 0.050 | 0.050 | 0.100 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.070 | 0.050 |
| Total | 100.7 | 100.6 | 100.4 | 99.3 | 100.9 | 100.0 | 100.7 | 100.3 | 100.0 | 99.4 |

| | 70-B-148 | 70-B-149 | 70-B-150 | 70-B-151 | 70-B-152 | 70-B-153 | 70-B-154 | 70-B-155 | 70-B-156 | 70-B-157 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.400 | 47.000 | 54.400 | 52.700 | 55.900 | 53.100 | 52.800 | 53.900 | 48.900 | 54.400 |
| AL2O3 | 14.700 | 15.900 | 13.600 | 13.800 | 13.500 | 13.600 | 13.500 | 14.200 | 14.400 | 14.300 |
| FE2O3 | 3.700 | 4.200 | 6.700 | 9.700 | 7.100 | 6.900 | 4.400 | 2.700 | 3.900 | 2.900 |
| FEO | 8.370 | 6.930 | 6.120 | 3.600 | 4.860 | 6.480 | 9.000 | 8.640 | 7.200 | 8.100 |
| MGO | 5.700 | 6.500 | 2.900 | 3.800 | 2.800 | 3.500 | 4.000 | 4.800 | 6.400 | 4.100 |
| CAO | 10.200 | 8.600 | 6.600 | 7.800 | 6.500 | 7.200 | 7.200 | 8.000 | 10.300 | 7.800 |
| NA2O | 2.600 | 1.800 | 3.000 | 2.700 | 3.100 | 2.900 | 3.200 | 2.800 | 2.500 | 3.000 |
| K2O | 0.600 | 2.000* | 1.700 | 1.500 | 1.900 | 1.700 | 1.500 | 1.300 | 0.400 | 1.600 |
| H2O | 1.610 | 5.670 | 1.920 | 1.490 | 1.180 | 1.560 | 1.350 | 1.220 | 3.280 | 0.600 |
| TIO2 | 1.650 | 1.910 | 2.310 | 2.060 | 2.070 | 2.110 | 2.230 | 1.740* | 2.200 | 2.000 |
| P2O5 | 0.200 | 0.240 | 0.440 | 0.380 | 0.340 | 0.380 | 0.410 | 0.270 | 0.300 | 0.340 |
| MNO | 0.210 | 0.170 | 0.220 | 0.190 | 0.170 | 0.220 | 0.200 | 0.190 | 0.190 | 0.200 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.070 | 0.050 |
| Total | 99.9 | 101.0 | 99.9 | 99.6 | 99.4 | 9 .7 | 99.8 | 99.8 | 100.0 | 99.3 |

| | 70-B-158 | 70-B-159 | 70-B-160 | 70-B-161 | 70-B-162 | 70-B-163 | 70-B-164 | 70-B-166 | 70-B-167 | 70-B-168 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 52.700 | 53.300 | 52.400 | 50.300 | 52.800 | 49.600 | 49.600 | 49.600 | 46.500 | 48.700 |
| AL2O3 | 14.000 | 15.300 | 14.300 | 13.900 | 13.900 | 16.700 | 15.600 | 13.500 | 15.800 | 15.900 |
| FE2O3 | 3.600 | 4.600 | 4.700 | 4.700 | 4.700 | 4.500 | 3.900 | 6.200 | 6.900 | 3.500 |
| FEO | 9.270 | 7.560 | 6.660 | 7.650 | 7.830 | 6.210 | 7.830 | 8.190 | 5.490 | 8.550 |
| MGO | 3.900 | 3.400 | 4.700 | 4.900 | 4.100 | 4.600 | 5.200 | 4.100 | 6.100 | 6.200 |
| CAO | 7.600 | 7.400 | 8.800 | 9.000 | 7.600 | 9.400 | 9.300 | 8.700 | 8.300 | 9.000 |
| NA2O | 2.700 | 3.300 | 2.600 | 2.600 | 2.900 | 2.700 | 3.000 | 2.800 | 2.600 | 2.700 |
| K2O | 1.500 | 1.600 | 1.300 | 1.300* | 1.500 | 0.800 | 0.900 | 1.200 | 0.900 | 0.800 |
| H2O | 1.470 | 0.920 | 2.550 | 2.570 | 1.310 | 2.410 | 1.590 | 1.700 | 4.900 | 1.600 |
| TIO2 | 2.360 | 2.180 | 1.940 | 2.260 | 2.490 | 2.160 | 2.380 | 2.920 | 2.280 | 2.150 |
| P2O5 | 0.340 | 0.380 | 0.290 | 0.320 | 0.380 | 0.300 | 0.340 | 0.440 | 0.300 | 0.300 |
| MNO | 0.220 | 0.200 | 0.180 | 0.200 | 0.240 | 0.170 | 0.190 | 0.240 | 0.180 | 0.180 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.060 | 0.050 |
| Total | 99.7 | 100.1 | 100.4 | 99.7 | 99.8 | 99.6 | 99.8 | 99.6 | 100.3 | 99.6 |

Table I-A continued

| | 70-B-169 | 70-B-170 | 70-B-171 | 70-B-172 | 70-B-173 | 70-B-174 | 70-B-175 | 70-B-176 | 70-B-177 | 70-B-178 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 46.900 | 48.000 | 50.500 | 50.400 | 51.000 | 50.500 | 51.300 | 50.200 | 49.600 | 49.500 |
| AL2O3 | 15.800 | 15.900 | 14.300 | 13.600 | 13.600 | 14.400 | 14.500 | 13.000 | 13.000 | 13.100 |
| FE2O3 | 6.600 | 5.600 | 5.400 | 4.500 | 3.300 | 3.900 | 2.000 | 4.100 | 3.700 | 5.500 |
| FEO | 5.270 | 5.810 | 7.920 | 9.360 | 10.620 | 9.630 | 8.820 | 10.980 | 11.520 | 8.550 |
| MGO | 5.000 | 5.000 | 4.200 | 4.300 | 4.100 | 4.200 | 6.900 | 4.000 | 4.300 | 4.000 |
| CAO | 9.200 | 9.000 | 8.300 | 7.800 | 8.100 | 8.300 | 10.500 | 8.400 | 8.700 | 8.200 |
| NA2O | 2.600 | 2.700 | 3.000 | 3.100 | 3.000 | 3.100 | 2.300 | 2.200 | 2.300 | 2.400* |
| K2O | 0.600 | 1.000 | 1.200 | 1.300 | 1.300 | 1.100 | 0.700 | 1.200 | 1.200 | 1.100 |
| H2O | 5.120 | 3.590 | 1.730 | 1.470 | 1.250 | 1.630 | 0.810 | 1.670 | 1.270 | 3.040 |
| TIO2 | 2.290 | 2.350 | 2.820 | 2.860 | 2.840 | 3.000 | 1.660 | 3.470 | 3.490 | 3.440 |
| P2O5 | 0.350 | 0.330 | 0.450 | 0.480 | 0.400 | 0.420 | 0.240 | 0.540 | 0.500 | 0.220 |
| MNO | 0.140 | 0.150 | 0.210 | 0.230 | 0.230 | 0.210 | 0.190 | 0.220 | 0.220 | 0.170 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.060 | 0.050 |
| Total | 99.9 | 99.4 | 100.0 | 99.4 | 99.7 | 100.4 | 99.2 | 100.0 | 99.9 | 99.3 |

| | 70-B-179 | 70-B-180 | 70-B-181 | 70-B-182 | 70-B-183 | 70-B-184 | 70-B-185 | 70-B-186 | 70-B-187 | 70-B-188 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.900 | 52.400 | 53.400 | 51.300 | 46.800 | 50.700 | 48.700 | 50.100 | 50.700 | 52.400 |
| AL2O3 | 14.300 | 13.400 | 13.400 | 14.700 | 12.200 | 13.500 | 13.400 | 14.500 | 14.400 | 14.400 |
| FE2O3 | 2.100 | 7.200 | 4.100 | 1.500 | 2.200 | 4.100 | 4.600 | 2.600 | 3.100 | 1.700 |
| FEO | 8.370 | 5.810 | 8.550 | 9.320 | 14.850 | 8.550 | 7.200 | 7.880 | 7.650 | 9.540 |
| MGO | 6.400 | 2.700 | 2.700 | 6.900 | 4.200 | 3.900* | 3.100 | 6.700 | 6.700 | 5.100 |
| CAO | 10.800* | 6.400 | 6.200 | 10.400 | 8.800 | 9.100* | 10.000 | 10.800 | 10.600 | 8.900 |
| NA2O | 2.000 | 3.100 | 3.100 | 2.100 | 2.500 | 2.500* | 2.800 | 2.100 | 2.000 | 2.700 |
| K2O | 0.600 | 2.500 | 2.600 | 0.700 | 1.300 | 1.100 | 1.400 | 0.500 | 0.600 | 1.600 |
| H2O | 1.630 | 1.770 | 1.750 | 0.850 | 0.800 | 2.250 | 2.300 | 2.330 | 1.700 | 0.970 |
| TIO2 | 1.660* | 2.790 | 2.480 | 1.620 | 3.710 | 3.520 | 4.080 | 1.560 | 1.610 | 1.780 |
| P2O5 | 0.220 | 0.830 | 0.990 | 0.240 | 1.720 | 0.540 | 1.780 | 0.230 | 0.230 | 0.440 |
| MNO | 0.170 | 0.200 | 0.210 | 0.190 | 0.290 | 0.240 | 0.210 | 0.180 | 0.180 | 0.180 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.200 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.2 | 99.1 | 99.5 | 99.8 | 99.4 | 100.2 | 99.6 | 99.5 | 99.5 | 99.7 |

| | 70-B-189 | 70-B-190 | 70-B-191 | 70-B-192 | 70-B-193 | 70-B-194 | 70-B-195 | 70-B-196 | 70-B-197 | 70-B-198 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 51.000 | 48.900 | 50.500 | 48.700 | 51.000 | 50.900 | 50.900 | 49.800 | 50.100 | 51.100 |
| AL2O3 | 14.800 | 13.700 | 13.200 | 13.900 | 14.700 | 13.300 | 13.300 | 13.300 | 14.300 | 14.700 |
| FE2O3 | 1.600 | 2.200 | 2.700 | 2.400 | 2.600 | 3.100 | 2.800 | 4.000 | 3.000 | 2.400 |
| FEO | 9.000 | 11.610 | 12.330 | 11.430 | 8.240 | 11.970 | 12.330 | 10.260 | 7.470 | 8.190 |
| MGO | 6.900 | 5.300 | 4.300 | 5.400 | 5.900 | 4.200 | 4.200 | 3.900 | 6.900 | 6.700 |
| CAO | 10.600 | 9.100 | 8.600 | 9.100 | 9.400 | 8.300 | 8.300 | 8.800 | 10.600 | 10.400 |
| NA2O | 2.100 | 2.500 | 2.800 | 2.200 | 2.700 | 2.300 | 2.400 | 2.100 | 2.400 | 2.000 |
| K2O | 0.700 | 1.200 | 1.200 | 1.100 | 1.200 | 1.300 | 1.300 | 1.100 | 0.400 | 0.600 |
| H2O | 0.660 | 0.880 | 0.900 | 1.200 | 1.640 | 0.580 | 0.720 | 1.860 | 2.530 | 1.470 |
| TIO2 | 1.630 | 3.120 | 3.440 | 3.090 | 1.680 | 3.450 | 3.500 | 3.450 | 1.580 | 1.560 |
| P2O5 | 0.230 | 0.730 | 0.520 | 0.710 | 0.370 | 0.560 | 0.540 | 0.540 | 0.230 | 0.200 |
| MNO | 0.200 | 0.240 | 0.230 | 0.240 | 0.170 | 0.230 | 0.230 | 0.210 | 0.170 | 0.170 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.4 | 99.5 | 100.7 | 99.5 | 99.6 | 100.2 | 100.5 | 99.3 | 99.7 | 99.5 |

| | 70-B-199 | 70-B-200 | 70-B-201 | 70-B-202 | 70-B-203 | 70-B-204 | 70-B-205 | 70-B-206 | 70-B-207 | 70-B-208 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 52.300 | 48.600 | 49.400 | 46.100 | 50.300 | 48.800 | 49.400 | 49.600 | 50.080 | 50.080 |
| AL2O3 | 13.400 | 13.700 | 13.700 | 13.100 | 13.000 | 12.900 | 13.300 | 13.700 | 13.300 | 13.300 |
| FE2O3 | 2.400 | 2.600 | 3.800 | 5.300 | 6.600 | 2.700 | 3.800 | 4.200 | 2.300 | 2.300 |
| FEO | 10.440 | 11.250 | 10.220 | 10.080 | 8.510 | 12.650 | 10.660 | 9.180 | 12.240 | 12.060 |
| MGO | 3.800 | 5.300 | 4.500 | 5.400 | 3.500 | 4.400 | 4.500 | 4.200 | 4.200 | 4.200 |
| CAO | 7.700 | 9.200 | 8.700 | 9.900 | 8.000 | 8.600 | 8.400 | 8.900 | 8.000 | 8.100 |
| NA2O | 2.700* | 2.400 | 2.300 | 2.100 | 2.400 | 2.800 | 2.900 | 2.600 | 2.700 | 2.800 |
| K2O | 1.900 | 1.100 | 1.300 | 0.600 | 1.400 | 1.400 | 1.200 | 1.200 | 1.500 | 1.500 |
| H2O | 1.300 | 1.330 | 1.740 | 2.600 | 1.780 | 1.230 | 1.580 | 2.670 | 1.490 | 1.330 |
| TIO2 | 2.880 | 3.120 | 3.050 | 3.600 | 3.430 | 3.440 | 3.430 | 2.930 | 2.980 | 2.970 |
| P2O5 | 0.400 | 0.730 | 0.620 | 0.860 | 0.590 | 0.690 | 0.690 | 0.550 | 0.570 | 0.570 |
| MNO | 0.210 | 0.250 | 0.240 | 0.210 | 0.190 | 0.260 | 0.230 | 0.210 | 0.230 | 0.230 |
| CO2 | 0.050 | 0.060 | 0.050 | 0.050 | 0.050 | 0.160 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.5 | 99.6 | 99.6 | 99.9 | 99.7 | 100.0 | 100.1 | 99.9 | 100.3 | 100.2 |

Table I-A continued

| | 70-B-209 | 70-B-210 | 70-B-211 | 70-B-212 | 70-B-213 | 70-B-214 | 70-B-215 | 70-B-216 | 70-B-217 | 70-B-218 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 51.100 | 50.100 | 50.500 | 49.100 | 50.900 | 49.900 | 50.400 | 49.600 | 48.900 | 49.400 |
| AL2O3 | 13.500 | 13.200 | 13.400 | 12.900 | 13.300 | 13.000 | 13.700 | 14.000 | 16.500 | 13.900 |
| FE2O3 | 2.500 | 4.100 | 4.300 | 5.300 | 4.700 | 3.800 | 2.500 | 1.900 | 1.900 | 1.200 |
| FEO | 11.610 | 10.220 | 10.560 | 9.090 | 9.140 | 11.160 | 10.350 | 12.020 | 9.680 | 12.420 |
| MGO | 4.500 | 4.100 | 4.100 | 4.100 | 3.600 | 4.200 | 4.800 | 5.500 | 5.800 | 5.300 |
| CAO | 8.300 | 8.200 | 8.200 | 8.100 | 8.000 | 8.200 | 9.000 | 9.300 | 9.400 | 9.600 |
| NA2O | 2.800 | 2.700 | 2.600 | 2.700 | 2.900 | 2.400 | 3.000 | 2.500 | 2.800 | 2.500 |
| K2O | 1.400 | 1.400 | 1.200 | 1.100 | 1.400 | 1.300 | 0.900 | 1.300 | 0.700 | 1.200 |
| H2O | 1.490 | 2.190 | 2.250 | 3.840 | 2.430 | 1.760 | 1.730 | 0.650 | 1.080 | 0.630 |
| TIO2 | 2.810 | 2.940 | 2.960 | 3.070 | 2.990 | 3.460 | 2.470 | 3.120 | 2.120 | 3.120 |
| P2O5 | 0.520 | 0.560 | 0.580 | 0.600 | 0.630 | 0.510 | 0.350 | 0.710 | 0.270 | 0.710 |
| MNO | 0.230 | 0.230 | 0.240 | 0.210 | 0.200 | 0.210 | 0.220 | 0.230 | 0.170 | 0.230 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.070 | 0.050 | 0.050 |
| Total | 100.8 | 99.9 | 100.9 | 100.1 | 100.2 | 99.9 | 99.4 | 100.9 | 99.3 | 100.2 |

| | 70-B-219 | 70-B-220 | 70-B-221 | 70-B-222 | 70-B-223 | 70-B-224 | 70-B-225 | 70-B-226 | 70-B-227 | 70-B-228 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.100 | 48.600 | 49.800 | 49.200 | 48.600 | 49.500 | 53.200 | 49.300 | 49.500 | 49.200 |
| AL2O3 | 13.700 | 13.600 | 13.800 | 13.800 | 13.800 | 14.100 | 14.190 | 14.000 | 14.100 | 13.800 |
| FE2O3 | 1.700 | 1.500 | 2.600 | 2.200 | 3.500 | 1.500 | 2.300 | 4.200 | 2.500 | 4.600 |
| FEO | 12.150 | 13.050 | 12.020 | 11.790 | 10.710 | 12.200 | 9.540 | 9.630 | 11.700 | 9.180 |
| MGO | 5.400 | 6.100 | 4.600 | 5.100 | 5.100 | 5.300 | 4.800 | 4.800 | 5.500 | 4.400 |
| CAO | 9.100 | 8.900 | 8.700 | 9.100 | 9.100 | 9.100 | 8.700 | 9.300 | 9.200 | 8.800 |
| NA2O | 2.500 | 2.460* | 2.700 | 2.400 | 2.100 | 2.500 | 3.000 | 2.500 | 2.600 | 2.600 |
| K2O | 1.200 | 1.100 | 1.300 | 1.300 | 1.000 | 1.200 | 1.300 | 1.100 | 1.100 | 1.200 |
| H2O | 0.940 | 0.600 | 1.060 | 0.880 | 1.510 | 0.520 | 0.900 | 1.690 | 0.850 | 2.660 |
| TIO2 | 3.050 | 2.960 | 2.950 | 3.140 | 3.120 | 3.080 | 1.810 | 3.130 | 2.940 | 2.890 |
| P2O5 | 0.710 | 0.680 | 0.580 | 0.720 | 0.710 | 0.700 | 0.320 | 0.700 | 0.690 | 0.590 |
| MNO | 0.230 | 0.250 | 0.240 | 0.240 | 0.240 | 0.230 | 0.210 | 0.230 | 0.260 | 0.270 |
| CO2 | 0.050 | 0.270 | 0.330 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.8 | 100.1 | 100.7 | 99.9 | 99.5 | 99.9 | 100.3 | 100.6 | 100.9 | 100.2 |

| | 70-B-229 | 70-B-230 | 70-B-232 | 70-B-233 | 70-B-234 | 70-B-235 | 70-B-236 | 70-B-237 | 70-B-238 | 70-B-239 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.400 | 50.000 | 50.600 | 50.700 | 51.200 | 50.700 | 50.700 | 52.200 | 50.600 | 49.400 |
| AL2O3 | 13.400 | 13.700 | 13.600 | 13.200 | 13.600 | 13.300 | 13.200 | 13.500 | 13.400 | 13.100 |
| FE2O3 | 3.500 | 2.960 | 3.600 | 4.500 | 3.500 | 3.700 | 6.900 | 3.400 | 2.700 | 4.700 |
| FEO | 11.160 | 11.030 | 11.160 | 10.400 | 10.440 | 10.530 | 8.460 | 10.580 | 11.790 | 10.350 |
| MGO | 4.600 | 4.700 | 4.400 | 4.300 | 4.100 | 4.600 | 3.700 | 3.900 | 4.200 | 4.100 |
| CAO | 8.700 | 8.700 | 8.300 | 7.900 | 8.200 | 8.200 | 7.900 | 7.860* | 8.600 | 8.700 |
| NA2O | 2.600 | 2.500 | 2.600 | 2.500 | 2.600 | 2.500 | 2.600 | 2.570* | 2.300 | 2.500 |
| K2O | 1.200 | 1.300 | 1.400 | 1.200 | 1.300 | 1.300 | 1.500 | 1.700 | 1.200 | 1.000 |
| H2O | 1.390 | 1.440 | 1.090 | 2.270 | 1.880 | 1.820 | 1.060 | 1.200 | 1.200 | 2.040 |
| TIO2 | 2.980 | 3.030 | 3.090 | 2.920 | 2.670 | 2.860 | 2.830 | 2.650 | 3.440 | 3.420 |
| P2O5 | 0.640 | 0.520 | 0.670 | 0.560 | 0.530 | 0.480 | 0.670 | 0.390 | 0.480 | 0.490 |
| MNO | 0.250 | 0.230 | 0.250 | 0.240 | 0.230 | 0.230 | 0.250 | 0.210 | 0.210 | 0.220 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.070 |
| Total | 100.8 | 100.1 | 100.8 | 100.7 | 100.3 | 100.2 | 99.8 | 100.2 | 100.1 | 100.1 |

| | 70-B-240 | 70-B-241 | 70-B-242 | 70-B-243 | 70-B-244 | 70-B-245 | 70-B-246 | 70-B-247 | 70-B-248 | 70-B-249 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.500 | 49.100 | 49.800 | 49.100 | 48.900 | 50.100 | 52.700 | 55.200 | 53.400 | 49.100 |
| AL2O3 | 13.700 | 14.500 | 13.300 | 13.100 | 13.700 | 15.900 | 14.400 | 14.300 | 13.600 | 16.100 |
| FE2O3 | 3.200 | 1.400 | 1.700 | 2.100 | 1.800 | 0.0 | 3.700 | 3.800 | 3.400 | 2.700 |
| FEO | 10.980 | 10.580 | 13.460 | 13.140 | 12.200 | 9.270 | 7.520 | 7.420 | 9.500 | 9.320 |
| MGO | 4.600 | 6.800* | 4.500 | 4.300 | 5.400 | 8.200 | 5.200 | 3.500 | 4.100 | 5.900 |
| CAO | 8.700 | 11.200* | 8.500 | 8.600 | 9.200 | 11.100 | 9.200 | 7.500 | 7.700 | 9.600 |
| NA2O | 2.500 | 2.400 | 2.700 | 2.600 | 2.400 | 2.500 | 2.900 | 3.100 | 3.000 | 3.000 |
| K2O | 1.100 | 0.700 | 1.500* | 1.300 | 1.100 | 0.500 | 1.000 | 1.700 | 1.200 | 0.800 |
| H2O | 1.310 | 0.510 | 0.700 | 1.060 | 0.780 | 0.480 | 1.380 | 1.080 | 1.290 | 1.280 |
| TIO2 | 3.030 | 2.450 | 3.590 | 3.520 | 3.150 | 1.400 | 1.600 | 2.510 | 2.250 | 2.290 |
| P2O5 | 0.530 | 0.660 | 0.680 | 0.650 | 0.630 | 0.180 | 0.260 | 0.440 | 0.390 | 0.290 |
| MNO | 0.230 | 0.210 | 0.270 | 0.280 | 0.250 | 0.170 | 0.200 | 0.210 | 0.210 | 0.190 |
| CO2 | 0.050 | 0.330 | 0.050 | 0.620 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.4 | 100.8 | 100.7 | 100.4 | 99.5 | 99.8 | 100.1 | 100.8 | 100.0 | 100.6 |

Table I-A continued

| | 70-B-250 | 70-B-251 | 70-B-252 | 70-B-259 | 70-B-260 | 70-B-261 | 70-B-262 | 70-B-263 | 70-B-264 | 70-B-265 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 51.800 | 54.200 | 53.800 | 48.300 | 48.800 | 48.200 | 53.600 | 52.000 | 49.200 | 49.200 |
| AL2O3 | 13.300 | 13.900 | 14.300 | 13.500 | 13.400 | 16.000 | 13.500 | 13.900 | 13.800 | 14.100 |
| FE2O3 | 2.700 | 3.300 | 2.700 | 3.500 | 1.800 | 2.600 | 2.800 | 4.300 | 2.700 | 3.900 |
| FEO | 9.720 | 8.820 | 9.360 | 10.590 | 12.600 | 9.540 | 9.900 | 8.600 | 11.750 | 10.440 |
| MGO | 4.300 | 4.300 | 4.900 | 5.000 | 6.400 | 5.900 | 4.000 | 3.300 | 5.400 | 5.000 |
| CAO | 8.200 | 8.100 | 8.700 | 8.900 | 8.900 | 9.700 | 7.600 | 7.500 | 9.100 | 8.600 |
| NA2O | 3.200 | 2.900 | 2.900 | 2.600 | 2.700 | 2.800 | 3.400 | 2.800 | 2.600 | 2.700 |
| K2O | 1.200 | 1.500 | 1.100 | 1.100 | 1.100 | 0.600 | 1.700 | 1.800 | 1.100 | 1.400 |
| H2O | 2.140 | 0.760 | 0.710 | 1.650 | 0.680 | 1.590 | 1.150 | 1.960 | 1.120 | 1.510 |
| TIO2 | 2.280 | 1.940 | 1.640 | 3.090 | 3.000 | 2.260 | 2.430 | 2.910 | 3.020 | 2.900 |
| P2O5 | 0.400 | 0.340 | 0.250 | 0.730 | 0.730 | 0.290 | 0.420 | 0.500 | 0.720 | 0.600 |
| MNO | 0.230 | 0.200 | 0.220 | 0.230 | 0.250 | 0.190 | 0.210 | 0.280 | 0.250 | 0.230 |
| CO2 | 0.050 | 0.050 | 0.190 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 100.1 | 99.7 | 99.2 | 99.2 | 100.4 | 99.7 | 100.7 | 99.9 | 100.8 | 100.6 |

| | 70-B-266 | 70-B-267 | 70-B-268 | 70-B-269 | 70-B-270 |
|---|---|---|---|---|---|
| SIO2 | 49.900 | 49.300 | 49.600 | 52.100 | 52.100 |
| AL2O3 | 13.600 | 13.500 | 13.300 | 14.100 | 14.100 |
| FE2O3 | 4.900 | 1.100 | 3.000 | 2.800 | 2.200 |
| FEO | 9.540 | 12.240 | 12.240 | 8.820 | 9.500 |
| MGO | 4.300 | 4.300 | 4.400 | 5.300 | 5.200 |
| CAO | 8.600 | 8.400 | 8.300 | 8.900 | 8.700 |
| NA2O | 2.600 | 2.700 | 2.700 | 2.800 | 2.800 |
| K2O | 1.300 | 1.000 | 1.300 | 0.900 | 1.000 |
| H2O | 2.120 | 3.480 | 1.450 | 1.820 | 1.510 |
| TIO2 | 2.840 | 2.780 | 3.040 | 1.730 | 1.770 |
| P2O5 | 0.520 | 0.500 | 0.590 | 0.260 | 0.280 |
| MNO | 0.230 | 0.200 | 0.260 | 0.200 | 0.210 |
| CO2 | 0.050 | 0.050 | 0.060 | 0.050 | 0.050 |
| Total | 100.5 | 99.5 | 100.2 | 99.7 | 99.5 |

Table I-B. Location and description of Columbia River Basalt samples collected by M. J. Grolier and M. R. Brock, spring and summer of 1970. Analyses are given in Table I-A.

| Field No. | State | County | Quadrangle | Location | Stratigraphic Unit | Flow No. | Chemical Type |
|---|---|---|---|---|---|---|---|
| 70-B-1 | W | Grant | Evergreen | SW1/4 sec. 21, T. 18 N., R. 23 E., Frenchman Springs Coulee, near base of S. coulee wall, above depression at east end of coulee. Alt.: 900' | middle Yakima basalt | | FS |
| 70-B-2 | " | " | " | Same as above, but north coulee wall, 500' east of power line. | " | | FS |
| 70-B-3 | " | " | " | Same as above, 200' east of power line. | " | | FS |
| 70-B-4 | " | " | " | Same as above; road cut, S. side of old US highway 10. Alt.: 1,100'. | " | | R |
| 70-B-5 | " | " | Vantage | NE1/4NE1/4 sec. 20, T. 17 N., R. 23 E., west drain, west lane of US highway 10. Alt.: 880'. | lower Yakima basalt | | Y |
| 70-B-6 | " | Kittitas | " | NE1/4NE1/4 sec. 19, T. 17 N., R. 23 E., 50' N. of Museum Bldg. in Gingko Petrified Forest State Park. Alt.: 680'. | " | | Y |
| 70-B-7 | " | " | Wymer | SE1/4SE1/4 sec. 16, T. 16 N., R. 19 E. Basalt scarp, E. of Ellensburg-Yakima hiway and Yakima R., and 100' above it. Alt.: 1,480'. | middle Yakima basalt | | R |
| 70-B-8 | " | Yakima | Pomona | SE1/4NW1/4 sec. 9, T. 14 N., R. 19 E., 50' S. of S. portal of tunnel in old State highway 3, east side of road. Alt.: 1,300'. | " | | FS |
| 70-B-9 | " | " | " | NW1/4NE1/4 sec. 17, T. 14 N., R. 19 E., North side of state highway 3, in curve at top of grade. Alt.: 1,240'. | upper Yakima basalt | | P |
| 70-B-10 | " | " | Poisel Butte NW | SE1/4SW1/4 sec. 6, T. 8 N., R. 19 E., 75' west of state highway 97 and S. of Logy Creek. Alt.: 1260'. | middle Yakima basalt | | R |
| 70-B-11 | " | " | " | NW1/4 sec. 7, T. 8 N., R. 19 E., 300' southwest of sample no. 10. Alt.: 1,160'. | " | | R |
| 70-B-12 | " | " | Logy Creek NE | NW1/4 sec. 34, T. 8 N., R. 18 E., East side of road, in Lizzy Canyon. Alt.: 2,040'. | " | | R |
| 70-B-13 | " | " | " | Same as above, but higher. Alt.: 2,100'. | " | | R |
| 70-B-14 | " | " | Kusshi Creek | SW1/4SE1/4 sec. 21, T. 7 N., R. 18 E., northwest of road bridge, west bank of Satus Creek. Alt.: 1,700'. | " | | PG? |
| 70-B-15 | " | " | " | NE1/4 sec. 28, T. 7 N., R. 18 E., Slope east of Satus Creek, and above power line. Alt.: 2,080'. | middle Yakima basalt | | FS |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-16 | W | Yakima | Kusshi Creek | Same as above, but higher, Alt.: 2,200'. | middle Yakima basalt | FS |
| 70-B-17 | " | " | " | NW1/4 sec. 27?, T. 7 N., R. 18 E. Alt.: 2,400'. | " | FS |
| 70-B-18 | " | " | " | SW1/4 sec. 22, T. 7 N., R. 18 E. North of dry gulch. Alt.: 2,250'. | " | FS |
| 70-B-19 | " | " | " | Same as above, but topographically lower. Alt.: 2,160'. | lower Yakima basalt | Y |
| 70-B-20 | " | " | " | SW1/4 sec. 21, T. 7 N., R. 18 E. Scarp on south slope of dry gulch. Alt.: 2,030'. | " | Y |
| 70-B-21 | " | Klickitat | White Salmon (15') | SW1/4 sec. 35, T. 3 N., R. 11 E., N. side of old highway, NE of Locke Lake. Alt.: 150'. | middle Yakima basalt | FS |
| 70-B-22 | " | " | " | Same as above, but 600' NW of sample #21. | " | FS |
| 70-B-23 | " | " | " | SE1/4 sec. 34, T. 3 N., R. 11 E., NW end of Locke Lake. Alt.: 150'. | lower Yakima basalt | Y |
| 70-B-24 | " | " | " | NW1/4SE1/4 sec. 2, T. 2 N., R. 12 N., 0.25 mi. E. of E. portal of road tunnel on highway 830, and 0.5 mi. E. of Lyle. | middle Yakima basalt | FS |
| 70-B-25 | " | " | The Dalles (15') | SE1/4 sec. 8, T. 2 N., R. 13 E., road cut about 1.1 mi. NW of Murdock | " | FS |
| 70-B-26 | " | " | " | NE1/4 sec. 17, T. 2 N., R. 13 E., road cut, 700'SE of sample #25. | " | FS |
| 70-B-27 | " | " | " | Same as above, but 1,200'SE of sample #26. | " | FS |
| 70-B-28 | " | " | " | NW1/4 sec. 16, T. 2 N., R. 13 E., 0.6 mi. NW of Murdock | " | FS |
| 70-B-29 | " | " | " | NW1/4SE1/4 sec. 8, T. 2 N., R. 13 E., 1,500'NW of sample #25, on north side of highway 830. | lower Yakima basalt | Y |
| 70-B-30 | " | " | The Dalles (AMS) 1:250,000 | SE1/4 sec. 24, T. 3 N., R. 18 E., West of Sand Spring Canyon, north and below road grade. | middle Yakima basalt | FS |
| 70-B-31 | " | " | " | SE1/4 sec. 24, T. 3 N., R. 18 W., Sand Spring Canyon. | " | FS |
| 70-B-32 | " | " | " | SW1/4 sec. 12, T. 3 N., R. 18 W., Creek bed in Sand Springs Canyon. | " | FS |
| 70-B-33 | O | Umatilla | Barnhart | NW1/4 sec. 3, T. 2 N., R. 31 E., west side of road, about 0.5 mi. S. of Interstate highway 30 by motel. Alt.: 1,580'. | middle Yakima basalt | ? |
| 70-B-34 | " | " | " | NE1/4SE1/4 sec. 4, T. 2 N., R. 31 E. west of and above road. | " | FS |
| 70-B-35 | " | " | " | SW1/4 sec. 5, T. 2 N., R. 31 E., east of road in creek bed | " | ? |
| 70-B-36 | W | Benton | Emerson Nipple | NE1/4NW1/4 sec. 15, T. 13 N., R. 24 E., depression at south end of China Bar west of power line, and S. of road. | middle Yakima basalt | FS |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-37 | W | Benton | Coyote Rapids (15') | NW1/4 sec. 18, T. 13 N., R. 25 E., Alt.: 500'. | middle Yakima basalt | FS |
| 70-B-38 | " | " | " | Same as above. | " | R |
| 70-B-39 | " | " | " | Same as above. | " | FS |
| 70-B-40 | " | " | " | NW1/4 sec. 13, T. 13 N., R. 24 E., Alt.: 500'. | " | FS |
| 70-B-41 | " | " | " | Same as above. | " | FS |
| 70-B-42 | " | " | Soap Lake | NW1/4 sec. 18, T. 22 N., R. 27 E., 900' S. of S. portal of siphon, on structural bench E. of Soap Lake. | lower Yakima basalt | Y |
| 70-B-43 | " | " | " | NE1/4 sec. 18, T. 22 N., R. 27 E., 500' ESE of sample #42. | middle Yakima basalt | FS |
| 70-B-44 | " | " | " | NE1/4 sec. 18, T. 22 N., R. 27 E., at top of scarp above sample #42. | " | FS |
| 70-B-45 | " | " | " | NE1/4 sec. 18, T. 22 N., R. 27 E., 3,000' north of sample #44. | " | R |
| 70-B-46 | " | " | " | SE1/4SW1/4 sec. 7, T. 22 N., R. 27 E., 3,000' north of sample #44. | " | FS |
| 70-B-47 | " | " | Mold | NW1/4 sec. 14, T. 25 N., R. 28 E., S. limb of Coulee City syncline E. of highway 155. Alt.: 1,700'. | " | FS |
| 70-B-48 | " | " | " | Same as above. | " | FS |
| 70-B-49 | " | " | " | Same as above, but 300 yards to the north. | lower Yakima basalt | Y |
| 70-B-50 | " | " | " | Same as above, but 250 yards to the north. | middle Yakima basalt | FS |
| 70-B-51 | " | " | " | Same as above. | " | FS |
| 70-B-52 | " | " | " | NW1/4 sec. 14, T. 25 N., R. 28 E., east side of highway 155, roadcut. | " | FS |
| 70-B-53 | " | Whitman | Pine City | NW1/4 sec. 29, T. 20 N., R. 42 E., road cut in road, west of Pine Creek, and west of Kenova. Alt.: 2,030'. | " | FS |
| 70-B-54 | " | " | " | NW1/4SW1/4 sec. 12, T. 20 N., R. 41 E., in scarp above bench on N. side of Rock Creek, NE of Hole in the Ground. Alt.: 2,020'. | lower Yakima basalt | Y |
| 70-B-55 | " | " | " | Same as above but higher and west. Alt.: 2,090'. | middle Yakima basalt | ? |
| 70-B-56 | " | " | " | Same as above. Alt.: 2,150'. | middle Yakima basalt? | EM |
| 70-B-57 | I | Clearwater | Ahsahka (15') | SE1/4NW1/4 sec. 22, T. 37 N., R. 1 W., roadcut E. side of road, E. of Louse Creek, 1.3 mi. S. of Cavendish. Alt.: 2,900'. | " | L |
| 70-B-58 | " | Latah | Kendrick (15') | SW1/4NE1/4 sec. 16, T. 38 N., R. 3 W., near top of Brady Gulch, small quarry E. of road from Kendrick to Troy. Alt.: 2,380'. | " | L |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-59 | I | Latah | Kendrick (15') | NW1/4NW1/4 sec. 25, T. 38 N., R. 3 W., N. side of road, 500'W. of Kendrick-Troy road junction w/road 42, at west end of Kendrick. Alt.: 1,200'. | lower Yakima basalt | Y |
| 70-B-60 | " | " | " | Same as above, N. side of road, 1,250' west of sample #59. Alt.: 1,200'. | " | Y |
| 70-B-61 | " | " | " | NE1/4 sec. 26, T. 38 N., R. 3 W., N. side of road. Alt.: 1,350'. | " | Y |
| 70-B-62 | " | " | " | SE1/4 sec. 23, T. 38 N., R. 3 W., N. side of road. Alt.: 1,475'. | " | Y |
| 70-B-63 | " | " | " | Same as above. Alt.: 1,500'. | " | Y |
| 70-B-64 | " | " | " | Same as above. Alt.: 1,580'. | " | Y |
| 70-B-65 | " | " | " | NW1/4 sec. 23, T. 38 N., R. 3 W., N. side of road. Alt.: 1,800'. | " | Y |
| 70-B-66 | " | " | " | Same as above. Alt.: 1,850'. | " | Y |
| 70-B-67 | " | " | " | NE1/4 sec. 22, T. 38 N., R. 3 W., N. side of road. Alt.: 2,000'. | " | Y |
| 70-B-68 | " | " | " | SW1/4SE1/4 sec. 15, T. 38 N., R. 3 W., N. side of road. Alt.: 2,200'. | middle Yakima basalt | L |
| 70-B-69 | " | " | " | SW1/4 sec. 15, T. 38 N., R. 3 W., N. side of road. Alt.: 2,240'. | " | L |
| 70-B-70 | " | " | " | Same as above. N. side of road. Near Bench Mark: 2,310'. | " | L |
| 70-B-71 | " | " | " | NE1/4 sec. 20, T. 39 N., R. 2 W., E. side of road, Kendrick-Deary road. Alt.: 2,721'. | " | L |
| 70-B-72 | " | " | " | SW1/4 sec. 10, T. 39 N., R. 2 W., E. of road: 2,800'. | " | FS |
| 70-B-73 | " | ? | Deary (15') | SW1/4SE1/4 sec. 34, T. 40 N., R. 3 W., in quarry, N. side of road to Troy. Alt.: 2,720'. | " | L |
| 70-B-77 | W | Asotin | Anatone (15') | SE1/4 sec. 25, T. 7 N., R. 44 E., N. valley slope of Grande Ronde R. NW side of road from Anatone to Enterprise. Alt.: 1,915'. | middle Yakima basalt-dike | FS |
| 70-B-78 | " | " | " | NW1/4 sec. 36, T. 7 N., R. 44 E., N. valley slope of Grande Ronde R., N. side of road from Anatone to Enterprise. Alt.: 1,075'. | lower Yakima basalt-dike | Y |
| 70-B-79 | O | ? | Grangeville (AMS, 1:250,000) | sec. ?, T. 5 N., R. 43 E. | middle Yakima basalt-dike | FS |
| 70-B-83 | W | Benton | Wallula | SE1/4NE1/4 sec. 32, T. 7 N., R. 31 E., Just above and west of RR track. Alt.: 370'. | middle Yakima basalt | FS |
| 70-B-84 | " | " | " | Same as above, but higher. Alt.: 380'. | " | FS |

Table I-B continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 70-B-85 | W | Benton | Wallula | Same as above, but higher. | middle Yakima basalt | | FS |
| 70-B-86 | " | " | " | Same as above, but higher. | " | | FS |
| 70-B-87 | " | " | " | Same as above, but higher. | " | | FS |
| 70-B-88 | " | " | " | Same as above, but higher. | " | | FS |
| 70-B-89 | " | " | " | Same as above, but higher. | " | | FS |
| 70-B-90 | " | " | " | Same as above, but higher. | " | | FS |
| 70-B-91 | " | " | " | Same as above, but higher. | " | | U |
| 70-B-92 | " | " | " | Same as above, but higher. | " | | U |
| 70-B-93 | " | " | " | Same as above, but higher. Alt.: 1,100'. | upper Yakima basalt? | | EM |
| 70-N-94 | " | " | " | SE1/4 sec. 29, T. 7 N., R. 31 E., E. of RR tracks, along east bank of Columbia R. in Lake Wallula. | middle Yakima basalt | | FS |
| 70-B-95 | " | Franklin | Eltopia (15') | SE1/4 sec. 35, T. 12 N., R. 30 E. Butte east of road. Alt.: 700'. | upper Yakima basalt | | P |
| 70-B-96 | " | " | " | Same as above, but higher. | " | | EM |
| 70-B-97 | " | " | " | Same as above, but lower than sample #95. | " | | P |
| 70-B-98 | " | " | Mesa (15') | SE1/4 sec. 26?, T. 14 N., R. 30 E., west side of highway 17, Alt.: 1,000'. | " | | EM |
| 70-B-99 | " | Grant | Mold | NE1/4SE1/4 sec. 26, T. 26 N., R. 28 E., east of road. Alt.: 1,600'. | lower Yakima basalt | 1 | Y |
| 70-B-100 | " | " | " | SW1/4NW1/4 sec. 25, T. 26 N., R. 28 E., east of road. Alt.: 1,650'. | " | 2 | Y |
| 70-B-101 | " | " | " | Same as above, 300' NE of sample 100. | " | 3 | Y |
| 70-B-102 | " | " | " | Same as above, 300' NE of sample #101. | " | 4 | Y |
| 70-B-103 | " | " | " | Same as above, 800' NE of sample #102. | " | 5 | Y |
| 70-B-104 | " | " | " | Same as above, 1,000'NE of sample #103. | " | 6 | FS |
| 70-B-105 | " | " | " | Same as above, 700' NE of sample #104. | " | 7 | Y |
| 70-B-106 | " | " | Vantage | NW1/4 sec. 5, T. 17 N., R. 23 E., on east side of south-going lane, Interstate 90. Alt.: 1,160'. | " | | Y |
| 70-B-107 | " | " | " | Same as above, but down the grade of pre-1940 US highway 10. Alt.: 980'. | " | | Y |
| 70-B-108 | " | " | " | Same as above. Alt.: 950'. | " | | Y |
| 70-B-109 | " | " | " | SW1/4 sec. 5, T. 17 N., R. 23 E., Alt.: 940'. | " | | Y |
| 70-B-110 | " | " | " | SW1/4 sec. 5, T. 17 N., R. 23 E., downslope from road grade. Alt.: 940'. | " | | Y |
| 70-B-111 | " | " | " | SW1/4 sec. 5, T. 17 N., R. 23 E., along old road grade. Alt.: 900'. | " | | Y |

Table I-B continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 70-B-112 | W | Grant | Vantage | NW1/4 sec. 8, T. 17 N., R. 23 E., Alt.: 780', on road grade. | lower Yakima basalt | | Y |
| 70-B-113 | " | " | " | Same as above, but lower on road grade. Alt.: 750'. | " | | Y |
| 70-B-114 | " | " | " | Same as above, at water's edge, at base of gulley about 150' below and west of old US highway grade. Alt.: 570'. | " | | Y |
| 70-B-115 | " | " | " | SW1/4 sec. 5, T. 17 N., R. 23 E., Sampled at curve in road, between sample nos. 110 and 111. Alt.: 930'. | " | | Y |
| 70-B-116 | " | " | " | Same as above. | " | | Y |
| 70-B-118 | O | Grant | Monument (15') | Probably in NE1/4 sec. 29, T. 9 S., R. 28 E. | Dike | | PG |
| 70-B-119 | " | " | " | NE1/4NE1/4 sec. 2, T. 9 S., R. 27 E. roadcut west of Monument on road to Kimberly. | " | | PG |
| 70-B-120 | " | " | " | Same as above. | " | | PG |
| 70-B-121 | " | " | " | Same as above. | Inclusion in dike | | ? |
| 70-B-122 | " | " | Kimberley (15') | Sec. 7, T. 9 S., R. 27 E. 5.1 mi. west of sample #121. | Picture Gorge | | PG |
| 70-B-123 | " | " | Picture Gorge (15') | Sec. 6, T. 10 S., R. 26 E. 1.5 mi. S. of Kimberly: exposure in field, east of road. | Dike | | PG |
| 70-B-124 | " | " | " | SE1/4NW1/4 sec. 20, T. 12 S., R. 26 E., west side of road 19. Alt.: ca. 2,400'. | Picture Gorge | 18 | PG |
| 70-B-125 | " | " | " | Same as above. | " | 17 | PG |
| 70-B-126 | " | " | " | Same as above. | " | 16 | PG |
| 70-B-127 | " | " | " | Same as above. | " | 15 | PG |
| 70-B-128 | " | " | " | Same as above. | " | 14 | PG |
| 70-B-129 | " | " | " | Same as above. | " | 13 | PG |
| 70-B-130 | " | " | " | Same as above. | " | 12 | PG |
| 70-B-131 | " | " | " | SW1/4 sec. 17, T. 12 S., R. 26 E., west side of road. Alt.: 2,240'. | " | 10 | Y |
| 70-B-132 | " | " | " | Same as above. | " | 11 | ? |
| 70-B-133 | " | " | " | Same as above. | " | 9 | ? |
| 70-B-134 | " | " | " | Same as above. | " | 8 | PG |
| 70-B-135 | " | " | " | Same as above. | " | 7 | PG |
| 70-B-136 | " | " | " | Same as above. | " | 6 | PG |
| 70-B-137 | " | " | " | Same as above. | " | 5 | PG |
| 70-B-138 | " | " | " | Same as above. | " | 4 | PG |

Table 1-B continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 70-B-139 | O | Grant | Picture Gorge (15') | Same as above. | Picture Gorge | 4 | PG |
| 70-B-140 | " | " | " | Same as above. | " | 3 | PG |
| 70-B-141 | " | " | " | NE1/4 sec. 18, T. 12 S., R. 26 E., west side of state highway 19, John Day Fossil Beds State Park. Alt.: 2,240'. | " | 1 | PG |
| 70-B-142 | " | Umatilla | Pendleton | NE1/4 sec. 12, T. 2 N., R. 32 E., North side of road cut, US highway #30. Alt.: 1,180'. | middle Yakima basalt | | FS |
| 70-B-143 | " | " | " | Same as above, but south of road cut. Alt.: 1,170'. | " | | FS |
| 70-B-144 | " | " | " | Same as above, below and north of road, in scarp above R.R. tracks. Alt.: 1,155'. | " | | FS |
| 70-B-145 | " | " | " | SE1/4 sec. 2, T. 2 N., R. 32 E., at base of Owen Hill, N. of Umatilla R., at northeast edge of Pendleton. First ledge above flood plain. Alt.: 1,100'. | " | | FS |
| 70-B-146 | " | " | " | Same as above, Alt.: 1,145'. | " | | FS |
| 70-B-147 | " | Wallowa | Imnaha (15') | SW1/4 sec. 16, T. 2 N., R. 48 E., on north side of Lower Imnaha Road, 6.5 mi. N. of Imnaha, and west of Imnaha R. Alt.: 2,440'. | lower basalt | | PG |
| 70-B-148 | " | " | Cactus Mountain | T. 4 N., R. 49 E., about 0.6 mi. NW of ranchhouse at south end of trail, on Dug Bar, west of Snake R. Alt.: 1,100'. | " | | PG |
| 70-B-149 | " | " | Imnaha (15') | SW1/4NW1/4 sec. 1, T. 1 S., R. 47 E., about 4 mi. SW of Imnaha on road to Joseph, north side of road. Alt.: 2,480'. | " | 9 | Little Salmon Basalt |
| 70-B-150 | " | " | Joseph (15') | SE1/4SW1/4 sec. 31, T. 2 S., R. 46 E., in quarry, N. side of road. Alt.: 4,500'. | lower Yakima basalt | | ? |
| 70-B-151 | " | " | " | NW1/4 sec. 6, T. 3 S., R. 46 E., Broken rock, south side of road. Alt.: 4,200'. | " | | Y |
| 70-B-152 | " | " | " | NE1/4 sec. 5, T. 3 S., R. 46 E., near base of gulch tributary to Little Sheep Creek, on road to Imnaha. Alt.: 4,390'. | " | | Y |
| 70-B-153 | " | " | " | SW1/4 sec. 33, T. 2 S., R. 46 E., First flow sampled in valley of Little Sheep Creek, on road to Imnaha. Alt.: 4,300'. | " | | Y |
| 70-B-154 | " | " | " | SW1/4 sec. 22, T. 2 S., R. 46 E., Alt.: 4,000'. | " | | Y |
| 70-B-155 | " | " | " | NW1/4SE1/4 sec. 14, T. 2 S., R. 46 E., Alt.: 3,780'. | " | | Y |
| 70-B-156 | " | " | " | NE1/4 sec. 12, T. 2 S., R. 46 E., Alt.: 3,600'. | " | | PG |

Table I-B continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 70-B-157 | O | Wallowa | Harl Butte (15') | NW1/4 sec. 30, T. 1 S., R. 47 E., Alt.: 3,240'. | lower Yakima basalt | | Y |
| 70-B-158 | " | " | " | SW1/4 sec. 20, T. 1 S., R. 47 E., Alt.: 3,120'. | " | | Y |
| 70-B-159 | " | " | " | NW1/4 sec. 20, T. 1 S., R. 47 E., 0.2 mi. S. of Lightning Creek. Alt.: 3,080'. | " | | Y |
| 70-B-160 | " | " | " | SW1/4NE1/4 sec. 16, T. 1 S., R. 47 E. Little Sheep Creek Valley. Alt.: 2,880'. | " | | Y |
| 70-B-161 | " | " | " | SW1/4 sec. 11, T. 1 S., R. 47 E., on Little Sheep Creek Valley road. Alt.: 2,690'. | " | | PG |
| 70-B-162 | " | " | " | NE1/4 sec. 11, T. 1 S., R. 47 E., 0.2 mi. S. of Bear Creek. Alt.: 2,590'. | " | | Y |
| 70-B-163 | " | " | Imnaha (15') | NE1/4 sec. 1, T. 1 S., R. 47 E., Little Sheep Creek valley. Alt.: 2,460'. | lower basalt | 8 | RC |
| 70-B-164 | " | " | " | NW1/4 sec. 1, same as above. Alt.: 2,500'. | " | 10? | PG |
| 70-B-166 | " | " | " | NW1/4 sec. 6, T. 1 S., R. 48 E., near entrance to Cottonwood Creek. Alt.: 2,340'. | " | 7 | FS |
| 70-B-167 | " | " | " | SW1/4 sec. 31, T. 1 N., R. 48 E., Alt.: 2,320'. | " | 6? | LS |
| 70-B-168 | " | " | " | SE1/4 sec. 31, T. 1 N., R. 48 E., 0.15 mi. SW of Big and Little Sheep Creeks junction. Alt.: 2,240'. | " | 6 | LS |
| 70-B-169 | " | " | " | NE1/4 sec. 31, T. 1 N., R. 48 E., Valley of Big Sheep Creek, 0.2 mi. north of junction with Little Sheep Creek. Alt.: 2,220'. | " | 5 | RC |
| 70-B-170 | " | " | " | NE1/4 sec. 31, T. 1 N., R. 48 E. Big Sheep Creek valley, 0.4 mi. N. of junction between Big and Little Sheep Creeks. Alt.: 2,200'. | " | 4 | RC |
| 70-B-171 | " | " | " | NE1/4 sec. 30, T. 1 N., R. 48 E. Valley of Big Sheep Creek. Alt.: 2,076'. | " | 3 | ? |
| 70-B-172 | " | " | " | SE1/4 sec. 29, T. 2 N., R. 48 E., Lower Imnaha Road, 4 mi. N. of Imnaha, E. of Imnaha R. Alt.: 1,790'. | " | 1 | FS |
| 70-B-173 | " | " | " | NE1/4 sec. 32, T. 2 N., R. 48 E., Same as above. Alt.: 1,840'. | " | 2 | FS |
| 70-B-174 | " | " | " | NW1/4 sec. 29, T. 1 N., R. 48 E., North entrance to Squaw Gulch, 1 mi. SW of Imnaha on road from Joseph to Imnaha. Alt.: 2,050', in valley of Big Sheep Creek. | " | 3 | ? |
| 70-B-175 | W | Yakima | Pomona | NE1/4 sec. 17, T. 14 N., R. 19 E., S. side of highway 3, at north end of exposure. Alt.: 1,200'. | upper Yakima basalt | | P |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-176 | W | Yakima | Elephant Mountain | NE1/4 sec. 27, T. 12 N., R. 20 E., N. side of gulch. Alt.: 1,600'. | upper Yakima basalt | EM |
| 70-B-177 | " | Benton | Prosser | SE1/4 sec. 20, T. 8 N., R. 24 E., in east-trending gulley, above dry falls in Horse Heaven Hills, 0.2 mi. N. of Ward Gap. Alt.: 1,740'. | " | EM |
| 70-B-178 | " | " | " | Same as above, but at or below the falls. Alt.: 1,580'. | " | EM |
| 70-B-179 | " | " | " | NE1/4 sec. 20, T. 8 N., R. 24 E., North scarp of Horse Heaven Hills. Alt.: 1,960'. | " | P |
| 70-B-180 | " | " | Umatilla | SE1/4 sec. 4, T. 5 N., R. 28 E., a few feet above water level, Wallula Lake. Alt.: 350'. | middle Yakima basalt | U |
| 70-B-181 | " | " | " | SE1/4 sec. 4, T. 5 N., R. 28 E., N. side of abandoned R.R. track, 200' west of sample #180. Alt.: 360'. | " | U |
| 70-B-182 | " | " | " | SW1/4 sec. 4, T. 5 N., R. 28 E., 400' S. of road to McNary Dam. Alt.: 400'. | upper Yakima basalt | P |
| 70-B-183 | " | Franklin | Levey SW | SW1/4SE1/4 sec. 29, T. 10 N., R. 31 E., in quarry, S. of trail. Alt.: 550'. | " | IH-2 |
| 70-B-184 | " | " | Eltopia (15') | NW1/4 sec. 23, T. 11 N., R. 30 E., Esquatzel Coulee, 2.25 mi. S. of Eltopia. E. side of highway 395. Alt.: 620'. | " | EM |
| 70-B-185 | " | " | " | Same as above. | upper Yakima basalt(dike) | ? |
| 70-B-186 | " | " | " | NW1/4 sec. 12, T. 11 N., R. 30 E., Eltopia quarry, S. of highway 395, 0.5 mi. E. of junction with highway 17. Alt.: 660'. | upper Yakima basalt | P |
| 70-B-187 | " | " | " | Same as above, but lower in quarry. | " | P |
| 70-B-188 | " | Adams | Othello | NW1/4 sec. 21, T. 16 N., R. 29 E., North side of road from Othello to Half Moon Lake, in Drumheller Channels. Alt.: 900'. | " | P |
| 70-B-189 | " | " | Corfu (15') | NW1/4 sec. 16, T. 16 N., R. 28 E., Butte west of Crab Creek, overlain by tuffaceous sand. Alt.: 780'. | " | P |
| 70-B-190 | " | " | " | Same as above. | middle Yakima basalt | L |
| 70-B-191 | " | " | " | NE1/4NW1/4 sec. 9, T. 16 N., R. 28 E., Ledge in small scabland, west of Drumheller Channels. Alt.: 900'. | upper Yakima basalt | EM |
| 70-B-192 | " | Franklin | Mesa (15') | SE1/4 sec. 11, T. 14 N., R. 29 E., in dug channel, S. of Eagle Lake, and just east of Wahluke Siphon. Alt.: 810'. | middle Yakima basalt | L |
| 70-B-193 | " | " | " | Same as above, but at north end of lake. Alt.: 840'. | upper Yakima basalt | P |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-194 | W | Franklin | Mesa (15') | NE1/4 sec. 11, T. 14 N., R. 29 E., on trail east of and parallel to Wahluke Siphon on axis of Saddle Mountain anticline. Alt.: 900'. | upper Yakima basalt | EM |
| 70-B-195 | " | " | " | SE1/4 sec. 2, T. 14 N., R. 29 E., northernmost hogback, west of Wahluke Siphon, 300' west of siphon trail. | " | EM |
| 70-B-196 | " | " | " | SW1/4 sec. 24, T. 13 N., R. 30 E., east side of road cut at north end of and near top of grade, highway 17, north of Esquatzel Coulee. Alt.: 860'. | " | EM |
| 70-B-197 | " | " | " | SE1/4 sec. 23, T. 13 N., R. 30 E., east side of road. Alt.: 820'. | " | P |
| 70-B-198 | " | " | " | Same as above, but lower. Alt.: 800'. | " | P |
| 70-B-199 | " | " | " | NW1/4 sec. 25, T. 13 N., R. 30 E., Top basalt ledge in Esquatzel Coulee, 600' east of highway 17. Alt.: 780'. North valley slope of Coulee. | middle Yakima basalt | ? |
| 70-B-200 | " | " | " | Same as above, but lower. Alt.: 720'. | " | L |
| 70-B-201 | " | " | " | Same as above, but lower. | " | R |
| 70-B-202 | " | " | " | NW1/4 sec. 25, T. 13 N., R. 29 E., S. side of E-W road, in drainage ditch. Alt.: 770'. | upper Yakima basalt | IH-1? |
| 70-B-203 | " | Grant | Beverly SE | NW1/4NE1/4 sec. 3, T. 15 N., R. 24 E., Top of north-facing scarp, Saddle Mtns., at northwest-trending cross-syncline near west end of large E-W trending syncline. Alt.: 2,000'. | upper Yakima basalt? | EM |
| 70-B-204 | " | " | " | Same as above, but lower. | " | EM |
| 70-B-205 | " | " | " | Same as above, but lower. | " | EM |
| 70-B-206 | " | " | " | Same as above, but lower. | middle Yakima basalt | FS |
| 70-B-207 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-208 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-209 | " | " | " | Same as above, but lower. | " | R |
| 70-B-210 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-211 | " | " | " | SE1/4 sec. 34, T. 16 N., R. 24, E., within enclave of Columbia National Wildlife Refuge. | " | FS |
| 70-B-212 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-213 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-214 | " | " | Smyrna (15') | SW1/4NW1/4 sec. 17, T. 16 N., R. 26 E., west side of road, low on road grade at base of vertical scarp, at northwest end of Natural Corral. Alt.: 730'. | upper Yakima basalt | EM |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-215 | I | Nez Perce | Lapwai | SW1/4NW1/4 sec. 7, T. 36 N., R. 3 W., on road to Kendrick, 300 yards S. of Howard Gulch, near Arrow, west of Potlach R. Alt.: 840'. | lower basalt | PG |
| 70-B-216 | " | " | Kendrick (15') | NE1/4SW1/4 sec. 32, T. 39 N., R. 3 W., in quarry on road from Troy to Kendrick. Alt.: 2,480'. | middle Yakima basalt | L |
| 70-B-217 | " | " | Lapwai | SW1/4SW1/4 sec. 7, T. 36 N., R. 3 W., where road curves northward into valley of Potlach R., away from Clearwater R. valley. Alt.: 820'. | lower basalt | RC |
| 70-B-218 | " | " | Kendrick (15') | NE1/4SW1/4 sec. 32, T. 39 N., R. 3 W., in quarry on road from Troy to Kendrick. Alt.: 2,480'. | middle Yakima basalt | L |
| 70-B-219 | W | Whitman | Pullman? | SW1/4 sec. 3, T. 14 N., R. 45 E., in small borrow pit north side of highway 270, in Paradise Creek valley. Alt.: 2,460'. | " | L |
| 70-B-220 | " | " | " | SE1/4SW1/4 sec. 4, T. 14 N., R. 45 E., probably in Whitlow quarry, S. of RR tracks and elevator. Alt.: 2,420'. | " | L |
| 70-B-221 | " | " | Colfax South | NW1/4NW1/4 sec. 25, T. 16 N., R. 43 E., on US highway 195, 2 mi. SE of Colfax courthouse. Alt.: 2,120'. | " | R |
| 70-B-222 | " | " | " | SW1/4SE1/4 sec. 25, T. 16 N., R. 43 E., on US highway 195, 3.1 mi. SE of Colfax courthouse. Alt.: 2,220'. | " | L |
| 70-B-223 | " | " | " | NE1/4SW1/4 sec. 6, T. 15 N., R. 44 E., on US highway 195, 5.5 mi. from Colfax courthouse. Alt.: 2,270'. | " | L |
| 70-B-224 | " | " | Colfax North | NE1/4NE1/4 sec. 14, T. 16 N., R. 43 E., 0.65 mi. E. of Colfax on highway 272, north side of road. Alt.: 2,270'. | " | L |
| 70-B-225 | " | " | " | NE1/4SW1/4 sec. 11, T. 16 N., R. 43 E., NW junction of highways 195 and 295 in Colfax. Alt.: 1,970'. | lower Yakima basalt | Y |
| 70-B-226 | " | " | " | NE1/4 sec. 2, T. 16 N., R. 43 E., on new highway 195 at top of Buck Canyon. Two mi. No. of junction of highways 195 and 295. Alt.: 2,320'. | middle Yakima basalt | L |
| 70-B-227 | " | Adams | Haas (15') | NE1/4 sec. 32, T. 15 N., R. 36 E., 1 mi. SW of Washtucna on highway 260, (old 11B). Alt.: about 1,200'. | " | L |
| 70-B-228 | " | " | " | Same as above, but lower. | " | R |
| 70-B-229 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-230 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-232 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-233 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-234 | " | " | " | Same as above, but lower. | " | FS |
| 70-B-235 | " | " | " | Same as above, but lower. | " | FS |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-236 | W | Franklin | Connell (30') | SE1/4SW1/4 sec. 4, T. 13 N., R. 34 E., junction of Pasco-Kahlotus road and Devils Canyon damsite road, SW of Kahlotus. Alt.: 1,150'. | middle Yakima basalt | FS |
| 70-B-237 | " | " | Mesa (15') | SW1/4NW1/4 sec. 25, T. 13 N., R. 30 E., on highway 17, S. of Esquatzel Coulee. N. end of Mesa. Alt.: 680'. | " | ? |
| 70-B-238 | " | " | Rye Grass Coulee | NE1/4SE1/4 sec. 1, T. 11 N., R. 30 E., on old gravel road, east of highway 395, near mouth of Smith Canyon. Alt.: 760'. | upper Yakima basalt | EM |
| 70-B-239 | " | " | " | SE1/4SE1/4 sec. 1 T. 11 N., R. 30 E. Alt.: 800'. | " | EM |
| 70-B-240 | " | Adams | Ritzville NE | SE1/4SW1/4 sec. 8, T. 19 N., R. 36 E., in gravel pits east of Highway 90. Alt.: 1,830'. | middle Yakima basalt | R |
| 70-B-241 | " | Lincoln | Ritzville (AMS, 1:250,000) | NE1/4 sec. 28, T. 21 N., R. 38 E., Rest stop at NE end of Sprague Lake, west of highway 90. Alt.: 1,900'. | " | L |
| 70-B-242 | " | " | " | Same as above. | " | FS |
| 70-B-243 | " | Whitman | Texas Lake | NW1/4SW1/4 sec. 29, T. 19 N., R. 40 E., road cut in highway 23, 2.5 mi. N. of Rock Creek. Alt.: 1,850'. | " | EM |
| 70-B-244 | " | " | Colfax North | E1/2 sec. 13, T. 17 N., R. 43 E., road cut in highway 23, 2.5 mi. N. of Rock Creek. Alt.: 1,850'. | " | L |
| 70-B-245 | I | Nez Perce | Sweetwater | NE1/4NE1/4 sec. 2, T. 34 N., R. 4 W., across from house at roadside. Alt.: 2,320'. | lower Yakima basalt | Y |
| 70-B-246 | " | " | " | NW1/4NE1/4 sec. 2, T. 34 N., R. 4 W., Alt.: 2,200'. | " | Y |
| 70-B-247 | " | " | " | SE1/4SW1/4 sec. 35, T. 35 N., R.4 W., Alt.: 2,080'. | " | Y |
| 70-B-248 | " | " | " | SE1/4SE1/4 sec. 34, T. 35 N., R. 4 W., Alt.: 1,770'. | " | Y |
| 70-B-249 | " | " | CuldeSac (15') | SW1/4SE1/4 sec. 19, T. 35 N., R. 2 W., in Camas Creek valley. Alt.: 1,880'. | lower basalt | RC |
| 70-B-250 | " | " | " | SE1/4SE1/4 sec. 19, T.35 W., R. 2 W., Alt.: 1,940'. | lower Yakima basalt | Y |
| 70-B-251 | " | Lewis | " | NW1/4NW1/4 sec. 25, T. 35 N., R. 2 W., in Lapwai Creek valley. Alt.: 2,920'. | " | Y |
| 70-B-252 | " | " | " | Probably NW1/4NE1/4 sec. 32, T. 34 N., R. 2 W., in Lapwai Creek valley, 0.5 mi. N. of junction Highway (business) 95 and Bypass 95, which is 1 mi. NE of Winchester. Alt.: 3,800'. | " | Y |
| 70-B-259 | " | Latah | Troy | NE1/4NE1/4 sec. 5, T. 38 N., R. 4 W. west side of Little Potlach Creek valley. Alt.: 2,560'. | middle Yakima basalt | L |
| 70-B-260 | " | Nez Perce | Kendrick (15') | SW1/4SW1/4 sec. 24, T. 38 N., R. 2 W., near sec. corner. Alt.: 2,720'. | " | L |

Table I-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| 70-B-261 | I | Nez Perce | Kendrick (15') | SE1/4SW1/4 sec. 33, T. 37 N., R. 3 W., probably in old quarry on US highway 12, just west of mouth of Cottonwood Creek. Alt.: 880'. | lower basalt | RC |
| 70-B-262 | " | " | " | NW1/4NE1/4 sec. 4, T. 36 N., R. 3 W., probably just East of mouth of Cottonwood Creek, on US highway 12. Alt.: 900'. | lower Yakima basalt | Y |
| 70-B-263 | " | Lewis | CuldeSac (15') | NE1/4 sec. 21, T. 34 N., R. 2 W. Alt.: 3,800'. | middle Yakima basalt | ? |
| 70-B-264 | " | Clearwater | Pullman (AMS, 1:250,000) | NW1/4 sec. 35, T. 40 N., R. 2 E., S. of town of Elk River, SW of lake. Alt.: 2,800'. | " | L |
| 70-B-265 | " | Nez Perce | Lewiston Orchards North | NW1/4NW1/4 sec. 32, T. 36 N., R. 5 W., in North Lewiston, N. of Clearwater R., and N. of highway 95 and 410 intersection. Alt.: 750'. | " | L |
| 70-B-266 | O | Wasco | Sherar's Bridge | NE1/4NE1/4 sec. 4, T. 4 S., R. 14 E., N. of highway 216 and Winter Water Creek. Alt.: 1,190'. | " | FS |
| 70-B-267 | " | " | " | NW1/4NW1/4 sec. 4, T. 4 S., R. 14 E., N. side of highway 216. Alt.: 1,150'. | " | FS |
| 70-B-268 | " | " | " | SE1/4NW1/4 sec. 4, T. 4 S., R. 14 E., N. side of highway 216. Alt.: 1,080'. | " | FS |
| 70-B-269 | " | " | " | SW1/4NE1/4 sec. 4, T. 4 S., R. 14 E., N. side of highway 216. Alt.: 1,030'. | lower Yakima basalt | Y |
| 70-B-270 | " | " | " | SE1/4NE1/4 sec. 4, T. 4 S., R. 14 E., N. side of highway 216. Alt.: 920'. | " | Y |

Table 2-A. Chemical analyses of samples described in Table 2-B. U.S. Geological Survey rock analysis laboratory, Flagstaff, Arizona. Principal analyst: R. Swenson.

| | PJB-1 | PJB-3 | PJB-4 | PJB-5 | PJB-6 | PJB-7 | PJB-8 | PJB-9 | PJB-10 | PJB-11 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 51.600 | 47.100 | 46.500 | 46.400 | 48.100 | 46.500 | 47.100 | 46.000 | 50.200 | 49.300 |
| AL2O3 | 14.000 | 15.700 | 15.700 | 16.600 | 15.900 | 15.700 | 15.900 | 15.400 | 14.800 | 14.400 |
| FE2O3 | 2.800 | 6.000 | 3.200 | 4.200 | 2.800 | 1.500 | 4.600 | 5.200 | 5.400 | 6.700 |
| FEO | 9.270 | 6.210 | 9.270 | 6.930 | 9.990 | 10.440 | 7.830 | 7.740 | 7.650 | 6.750 |
| MGO | 5.000 | 5.300 | 6.000 | 4.600 | 6.000 | 6.000 | 6.000 | 5.900 | 4.600 | 4.200 |
| CAO | 9.000 | 8.500 | 8.200 | 8.000 | 9.000 | 8.900 | 8.500 | 9.000 | 8.300 | 8.700 |
| NA2O | 3.300 | 2.800 | 2.200 | 2.400 | 3.300 | 2.500 | 3.300 | 2.500 | 3.200 | 3.200 |
| K2O | 0.900 | 0.900 | 1.700 | 1.600 | 0.900 | 1.200 | 0.800 | 1.400 | 1.200 | 1.200 |
| H2O | 1.770 | 4.320 | 4.600 | 5.450 | 1.340 | 4.070 | 3.160 | 4.510 | 1.850 | 2.320 |
| TIO2 | 2.420 | 2.700 | 2.750 | 2.580 | 2.750 | 2.520 | 2.640 | 2.480 | 2.630 | 2.990 |
| P2O5 | 0.350 | 0.400 | 0.370 | 0.360 | 0.390 | 0.350 | 0.360 | 0.390 | 0.350 | 0.450 |
| MNO | 0.210 | 0.180 | 0.190 | 0.170 | 0.200 | 0.180 | 0.180 | 0.180 | 0.190 | 0.190 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 100.6 | 100.1 | 100.7 | 99.3 | 100.7 | 99.9 | 100.4 | 100.7 | 100.4 | 100.4 |

| | PJB-12 | PJB-13 | PJB-14 | PJB-15 | PJB-16 | PJB-17 | PJB-18 | PJB-19 | B-1 | B-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 50.600 | 49.000 | 46.900 | 52.100 | 52.100 | 51.800 | 52.400 | 52.500 | 52.300 | 53.300 |
| AL2O3 | 13.600 | 15.200 | 15.200 | 14.200 | 13.400 | 14.300 | 13.900 | 13.600 | 13.800 | 14.000 |
| FE2O3 | 3.600 | 4.800 | 4.900 | 3.500 | 4.300 | 5.100 | 4.200 | 3.600 | 5.200 | 8.600 |
| FEO | 10.260 | 7.830 | 7.110 | 8.460 | 8.160 | 6.570 | 8.010 | 8.460 | 7.200 | 3.240 |
| MGO | 4.300 | 5.800 | 5.900 | 4.700 | 4.200 | 4.100 | 4.300 | 4.900 | 4.100 | 3.900 |
| CAO | 8.500 | 8.700 | 8.400 | 8.700 | 8.000 | 8.300 | 8.100 | 8.600 | 7.900 | 8.200 |
| NA2O | 3.300 | 3.200 | 2.200 | 3.200 | 3.100 | 3.000 | 2.900 | 3.000 | 3.000 | 3.500 |
| K2O | 1.200 | 1.000 | 1.800 | 1.300 | 1.400 | 1.400 | 1.500 | 1.200 | 1.800 | 1.600 |
| H2O | 1.540 | 1.990 | 5.440 | 1.640 | 1.980 | 2.590 | 2.400 | 1.470 | 1.300 | 1.400 |
| TIO2 | 3.140 | 2.500 | 2.140 | 2.280 | 2.410 | 2.240 | 2.300 | 2.290 | 1.640 | 2.300 |
| P2O5 | 0.430 | 0.350 | 0.320 | 0.350 | 0.380 | 0.370 | 0.350 | 0.330 | 0.800 | 0.330 |
| MNO | 0.230 | 0.180 | 0.190 | 0.200 | 0.220 | 0.180 | 0.210 | 0.200 | 0.190 | 0.180 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 100.7 | 100.6 | 100.5 | 100.6 | 99.6 | 99.9 | 100.6 | 100.2 | 99.2 | 100.6 |

| | B-3 | B-4 | B-5 | B-6 | B-7 |
|---|---|---|---|---|---|
| SIO2 | 52.500 | 53.900 | 52.400 | 48.500 | 49.200 |
| AL2O3 | 13.400 | 13.700 | 14.000 | 15.100 | 13.700 |
| FE2O3 | 3.300 | 5.400 | 3.700 | 3.500 | 1.900 |
| FEO | 8.870 | 7.200 | 8.820 | 7.290 | 12.690 |
| MGO | 4.400 | 3.700 | 3.800 | 8.000 | 5.300 |
| CAO | 8.000 | 7.700 | 7.800 | 11.200 | 9.100 |
| NA2O | 3.000 | 3.200 | 3.500 | 2.200 | 2.800 |
| K2O | 1.700 | 1.600 | 1.400 | 0.400 | 1.200 |
| H2O | 1.270 | 1.270 | 1.000 | 2.070 | 0.830 |
| TIO2 | 2.270 | 2.160 | 2.480 | 1.860 | 3.110 |
| P2O5 | 0.330 | 0.360 | 0.350 | 0.360 | 0.680 |
| MNO | 0.210 | 0.210 | 0.210 | 0.190 | 0.260 |
| CO2 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Total | 99.2 | 100.4 | 99.5 | 100.7 | 100.8 |

Table 2-B. Location and description of Columbia River basalt samples collected by Patsy S. Breesor and John Bond, both of the University of Idaho, in 1970. Analyses are given in Table 2-A.

| Field No. | State | County | Quadrangle | Location | Stratigraphic Unit | Flow No. | Chemical Type |
|---|---|---|---|---|---|---|---|
| PJB-1 | I | Adams | Indian Mountain | NW1/4SE1/4 sec. 27, T. 22 N., R. 1 E., West of Little Salmon River and US Highway 95. Alt.: About 3,000'. | lower basalt | | PG |
| PJB-3 | " | " | " | Same as above, but higher. | " | | PG |
| PJB-4 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-5 | " | " | " | Same as above, but higher. | " | | RC |
| PJB-6 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-7 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-8 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-9 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-10 | " | " | " | NE1/4SW1/4 sec. 27, T. 22 N., R. 1 E., West of Little Salmon River and US Highway 95. | " | | ? |
| PJB-11 | " | " | " | Same as above, but higher. | " | | ? |
| PJB-12 | " | " | " | Same as above, but higher. | " | | FS |
| PJB-13 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-14 | " | " | " | Same as above, but higher. | " | | LS |
| PJB-15 | " | " | " | Same as above, but higher. | lower Yakima basalt | | Y |
| PJB-16 | " | " | " | Probably NW1/4SW1/4 sec. 27, T. 22 N., R. 1 E., West of Little Salmon River and US Highway 95. | " | | Y |
| PJB-17 | " | " | " | Same as above, but higher. | " | | Y |
| PJB-18 | " | " | " | Same as above, but higher. | " | | Y |
| PJB-19 | " | " | " | Same as above, but higher. Probably near Camp Az Mark benchmark. Alt.: about 4,560'. | " | | Y |
| B-1 | " | " | Hornet (15') | NE1/4SE1/4 sec. 10, T. 19 N., R. 2 W., Along road high above and west of Grouse Creek. Alt.: 5,920'. | " | | Y |
| B-2 | " | " | " | Same as above, but to north along road. | " | | Y |
| B-3 | " | " | " | Same as above, to the north along road. Alt.: about 5,860'. | " | | Y |
| B-4 | " | " | " | SE1/4NE1/4 sec. 10, T. 19 N., R. 2 W., Alt.: about 5,760'. | " | | Y |
| B-5 | " | " | " | Same as above. Alt.: about 5,800'. | " | | Y |

Table 2-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| B-6 | I | Idaho | Riggins | NE1/4SW1/4 sec. 26, T. 25 N., R. 1 E., East of Salmon River and US Highway 95. Alt.: about 1,800'. | lower basalt (dike) | PG |
| B-7 | W | Whitman | Pullman AMS 1:250,000 | SE1/4SW1/4 sec. 4, T. 14 N., R. 45 E., in Whitlow quarry, S. of RR tracks and elevator. Alt.: 2,420'. Same as 70-B-220. | middle Yakima basalt | L |

Table 3-A. Chemical analyses of samples described in Table 3-B. U.S. Geological Survey rock analysis laboratory, Flagstaff, Arizona. Principal analyst: D. Emmons. Analysis made in November, 1971.

| | 71-4 | 71-5 | 71-57 | 71-58 | 71-59 | 71-60 | 71-72 | 71-73 | 71-74 | 71-75 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 52.600 | 52.100 | 49.900 | 50.400 | 51.000 | 50.800 | 52.600 | 58.200 | 49.200 | 49.900 |
| AL2O3 | 14.200 | 14.800 | 14.200 | 13.500 | 13.700 | 13.400 | 13.300 | 15.600 | 13.800 | 14.000 |
| FE2O3 | 2.800 | 3.300 | 5.800 | 3.600 | 2.700 | 3.100 | 2.200 | 2.900 | 2.400 | 4.700 |
| FEO | 9.930 | 6.350 | 4.900 | 11.160 | 11.950 | 11.580 | 11.180 | 2.680 | 11.580 | 9.830 |
| MGO | 2.500 | 5.400 | 6.000 | 4.500 | 4.200 | 4.200 | 2.300 | 1.400 | 5.100 | 4.300 |
| CAO | 6.200 | 9.500 | 10.300 | 8.500 | 8.200 | 8.100 | 6.000 | 6.300 | 9.200 | 8.600 |
| NA2O | 3.400 | 3.100 | 2.900 | 3.000 | 2.700 | 2.600 | 3.000 | 3.700 | 2.500 | 2.700 |
| K2O | 3.200 | 0.900 | 0.700 | 1.300 | 1.400 | 1.500 | 2.900 | 3.300 | 1.300 | 1.100 |
| H2O | 0.920 | 1.760 | 3.040 | 0.400 | 0.420 | 0.490 | 1.100 | 1.920 | 0.640 | 0.870 |
| TIO2 | 2.620 | 1.550 | 1.440 | 3.160 | 3.020 | 3.020 | 2.630 | 2.860 | 3.180 | 2.990 |
| P2O5 | 0.870 | 0.360 | 0.320 | 0.620 | 0.580 | 0.560 | 0.880 | 0.830 | 0.730 | 0.790 |
| MNO | 0.250 | 0.190 | 0.160 | 0.240 | 0.230 | 0.230 | 0.280 | 0.090 | 0.240 | 0.220 |
| CO2 | 0.930 | 0.180 | 0.310 | 0.150 | 0.160 | 0.300 | 1.930 | 0.180 | 0.140 | 0.150 |
| Total | 100.4 | 99.5 | 100.0 | 100.5 | 100.3 | 99.9 | 100.3 | 100.0 | 100.0 | 100.2 |

| | 71-76 | 71-77 | 71-78 | 71-102 | 71-103 | 71-108 | 71-109 | 71-110 | 71-111 | 71-112 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 52.800 | 53.900 | 53.900 | 51.200 | 53.500 | 47.500 | 47.900 | 47.200 | 49.600 | 46.000 |
| AL2O3 | 14.300 | 14.700 | 14.100 | 14.000 | 14.700 | 13.500 | 12.800 | 13.300 | 13.300 | 12.300 |
| FE2O3 | 1.900 | 1.600 | 5.600 | 2.700 | 3.200 | 3.400 | 3.200 | 2.100 | 2.700 | 3.900 |
| FEO | 9.690 | 9.270 | 7.860 | 11.990 | 8.060 | 11.770 | 10.890 | 11.570 | 12.580 | 14.490 |
| MGO | 5.100 | 4.800 | 3.300 | 4.200 | 4.200 | 5.700 | 4.100 | 6.200 | 4.400 | 4.400 |
| CAO | 9.000 | 8.400 | 6.600 | 8.100 | 8.400 | 9.500 | 10.600 | 10.800 | 8.800 | 8.700 |
| NA2O | 2.800 | 2.900 | 3.300 | 2.700 | 2.800 | 2.400 | 2.300 | 2.500 | 2.400 | 2.400 |
| K2O | 1.400 | 1.300 | 1.800 | 1.500 | 1.200 | 0.900 | 1.200 | 1.200 | 1.500 | 1.400 |
| H2O | 0.340 | 1.150 | 1.140 | 0.360 | 1.640 | 1.000 | 1.400 | 0.530 | 0.630 | 0.570 |
| TIO2 | 1.770 | 1.680 | 2.250 | 2.970 | 1.740 | 3.370 | 3.350 | 3.280 | 3.450 | 3.630 |
| P2O5 | 0.260 | 0.260 | 0.420 | 0.500 | 0.320 | 0.740 | 0.470 | 0.720 | 0.500 | 1.510 |
| MNO | 0.200 | 0.160 | 0.200 | 0.270 | 0.200 | 0.220 | 0.340 | 0.230 | 0.230 | 0.330 |
| CO2 | 0.150 | 0.150 | 0.150 | 0.150 | 0.190 | 0.160 | 1.840 | 0.160 | 0.160 | 0.340 |
| Total | 99.7 | 100.3 | 100.6 | 100.6 | 100.2 | 100.2 | 100.4 | 99.8 | 100.3 | 100.0 |

| | 71-113 | 71-115 | 71-116 | 71-117 | 71-118 |
|---|---|---|---|---|---|
| SIO2 | 46.600 | 51.100 | 49.000 | 47.100 | 47.400 |
| AL2O3 | 12.000 | 15.200 | 14.600 | 14.800 | 14.000 |
| FE2O3 | 3.600 | 1.700 | 2.500 | 5.500 | 2.900 |
| FEO | 13.690 | 9.330 | 12.760 | 8.550 | 12.020 |
| MGO | 4.300 | 7.200 | 4.400 | 5.000 | 5.600 |
| CAO | 8.800 | 10.600 | 8.600 | 10.100 | 9.400 |
| NA2O | 2.300 | 2.400 | 2.300 | 2.500 | 2.400 |
| K2O | 1.300 | 0.700 | 1.300 | 0.700 | 1.000 |
| H2O | 1.730 | 0.210 | 0.570 | 1.280 | 0.700 |
| TIO2 | 3.600 | 1.630 | 3.380 | 3.550 | 3.410 |
| P2O5 | 1.520 | 0.230 | 0.480 | 0.730 | 0.700 |
| MNO | 0.310 | 0.180 | 0.230 | 0.210 | 0.240 |
| CO2 | 0.270 | 0.120 | 0.050 | 0.140 | 0.140 |
| Total | 100.0 | 100.6 | 100.1 | 100.2 | 99.9 |

Table 3-B. Location and description of samples collected by D. A. Swanson and T. L. Wright, Fall 1971. Analyses are given in Table 3-A.

| Field No. | State | County | Quadrangle | Location | Stratigraphic Unit | Flow No. | Chemical Type |
|---|---|---|---|---|---|---|---|
| DSTW71-4 | O | Wallowa | Grangeville (AMS, 1:250,000) | Sec. 35, T. 6 N., R. 42 E., Near top of grade, S. of Grande Ronde River. State Rt. 3, NE 1/4 NE 1/4 Sec. 26, T.6N., R. 44 E. | middle (?) Yakima basalt | | U? |
| DSTW71-5 | " | " | " | Lower of two porphyritic flows underlying 71-4 | " | | Y |
| DSTW71-57 | W | Garfield | Pomeroy | NW1/4NW1/4 sec. 16, T. 11 N., R. 42 E., Roadcut on Highway 128, south of Pomeroy, in Benjamin Gulch, 0.1 mi. NW of quarry. Alt: 2520'. | middle Yakima basalt | | PG? |
| DSTW71-58 | W | " | " | SW1/4SW1/4 sec. 8, T. 11 N., R. 42 E., at big bend in road, in Benjamin Gulch, south of Pomeroy. Alt.: about 2,250'. Underlies 71-57. | " | | FS |
| DSTW71-59 | " | " | " | Same as above, second flow above 71-58. | " | | FS |
| DSTW71-60 | " | " | " | NW1/4NW1/4 sec. 16, T. 11 N., R. 42 E., Small quarry along Benjamin Gulch Road, flow overlying 71-57 | " | | FS |
| DSTW71-72 | " | Whitman | Colton | NW1/4SE1/4 sec. 26, T. 13 N., R. 44 E., New roadcut on road to Yakawawa Canyon. Alt.: 2,825'. | middle Yakima basalt | | U? |
| DSTW71-73 | " | " | " | Small roadcut at junction of small side road with main road along boundary of SE1/4 sec. 26 and NE1/4 sec. 35, T. 13 N., R. 44 E. Alt.: 2,630'. Flow underlying 71-72. | " | | ? |
| DSTW71-74 | " | " | " | S1/2 sec. 26 or N1/2 sec. 35, T. 13 N., R. 44 E., near Creek bed. Alt.: 2,500'. Flow underlying 71-73. | " | | L |
| DSTW71-75 | " | " | " | SE1/4SW1/4 sec. 26, T. 13 N., R. 44 E., Northeast of Yakawawa Canyon. Alt.: 2,360'. Flow underlying 71-74. | " | | R |
| DSTW71-76 | " | " | " | Same as above, but lower, near creek bed in Yakawawa Canyon. Alt.: 2,330'. Flow underlying 71-75. | lower Yakima basalt | | Y |
| DSTW71-77 | " | " | " | Same as above, but lower. Fifteen feet above creek bed in Yakawawa Canyon. Alt.: 2,230'. Flow underlying 71-76. | " | | Y |
| DSTW71-78 | " | " | Bishop | SW1/4SW1/4 sec. 26, T. 13 N., R. 44 E., Ledge forms falls in creek of Yakawawa Canyon. Alt.: 2,160'. Flow underlying 71-77. | " | | Y |

Table 3-B continued

| | | | | | | |
|---|---|---|---|---|---|---|
| DSTW71-102 | W | Franklin | Lower monumental dam | SE1/4SW1/4 sec. 27, T. 13 N., R. 34 E., East side of Devil's Canyon road, near south end of canyon. Alt.: 650' | Middle Yakima basalt | FS |
| DSTW71-103 | " | " | " | SW1/4SW1/4 sec. 8, T. 12 N., R. 34 E., roadcut 0.75 mi. west of Windust Park along north side of Snake River. | lower Yakima basalt | Y |
| DSTW71-108 | " | Walla Walla | Humorist | SE1/4SW1/4 sec. 24, T. 9 N., R. 31 E., 0.5 mi. south of south end of Ice Harbor Dam. Alt.: 510'. Overlies bedded cinder welded spatter. | upper Yakima basalt | IH |
| DSTW71-109 | " | " | " | SE1/4NW1/4 sec. 24, T. 9 N., R. 31 E., Roadcuts, 100-200 yards south from south end of Ice Harbor Dam. Upper of two flows that underlie 71-108. | " | EM |
| DSTW71-110 | " | " | " | SE1/4SW1/4 sec. 23, T. 9 N., R. 31 E., East end of sideromelane breccia outcrop, just south of large turn-around west of Ice Harbor Dam. | " (dike or pillow) | IH |
| DSTW71-111 | " | " | " | SW1/4SW1/4 sec. 23, T. 9 N., R. 31 E., 300 yards west of sample 71-110 and probably underlying it. | upper Yakima basalt | EM |
| DSTW71-112 | " | " | " | SE1/4SE1/4 sec. 22, T. 9 N., R. 31 E., near Tiger triangulation station. | " | IH |
| DSTW71-113 | " | " | " | SE1/4SE1/4 sec. 22, T. 9 N., R. 31 E., Exposure in artificial cuts of dike cutting 71-108 correlative. | " (dike) | IH |
| DSTW71-115 | " | Franklin | Levey SE | SE1/4SE1/4 sec. 7, T. 9 N., R. 32 E., 0.5 mi. SW of Levey along railroad cut. | upper Yakima basalt | P |
| DSTW71-116 | " | " | " | SW1/4NE1/4 sec. 18, T. 9 N., R. 32 E., railroad cut 1 mi. southwest of Levey. Flow overlying 71-115. | " | EM |
| DSTW71-117 | " | " | " | NW1/4SW1/4 sec. 18, T. 9 N., R. 32 E., railroad cuts 1.5 mi. southwest of Levey. Westernmost of three dikes cutting 71-116 correlative. | " (dike) | IH |
| DSTW71-118 | " | " | " | SW1/4SE1/4 sec. 17, T. 9 N., R. 32 E., near Gar triangulation station, 0.5 mi. northeast of Ash. Flow overlies 71-116 correlative. | upper Yakima basalt | IH |

Table 4-A. Chemical analyses of samples described in Table 4-B. U.S. Geological Survey rock analysis laboratory, Flagstaff, Arizona. Principal analyst: D. Emmons. Analysis made in January, 1972.

| | 71-12 | 71-13 | 71-27A | 71-28A | 71-29 | 71-30 | 71-32A | 71-33 | 71-34 | 71-35 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 54.200 | 54.500 | 54.500 | 54.200 | 48.900 | 54.200 | 53.600 | 54.200 | 53.600 | 54.400 |
| AL2O3 | 13.000 | 13.300 | 14.100 | 13.900 | 15.000 | 12.800 | 13.700 | 13.300 | 13.200 | 12.900 |
| FE2O3 | 4.200 | 2.700 | 2.300 | 2.000 | 3.400 | 2.700 | 1.400 | 2.800 | 1.700 | 2.400 |
| FEO | 9.580 | 10.230 | 9.030 | 9.450 | 8.780 | 9.760 | 10.860 | 9.040 | 10.040 | 10.130 |
| MGO | 2.900 | 3.500 | 3.800 | 4.200 | 6.500 | 3.800 | 4.300 | 4.000 | 4.600 | 3.700 |
| CAO | 6.700 | 7.300 | 7.900 | 8.600 | 10.000 | 7.800 | 7.900 | 8.200 | 8.200 | 7.800 |
| NA2O | 3.500 | 3.400 | 3.200 | 3.200 | 2.900 | 3.000 | 3.200 | 3.000 | 3.800 | 3.700 |
| K2O | 2.000 | 1.900 | 1.700 | 1.500 | 0.400 | 1.800 | 1.600 | 1.400 | 1.400 | 1.500 |
| H2O | 0.700 | 0.870 | 0.680 | 0.870 | 1.770 | 1.350 | 0.830 | 0.880 | 0.810 | 0.900 |
| TIO2 | 2.400 | 2.210 | 2.040 | 2.080 | 2.210 | 2.490 | 2.390 | 2.060 | 2.080 | 2.020 |
| P2O5 | 0.830 | 0.380 | 0.340 | 0.310 | 0.260 | 0.360 | 0.340 | 0.300 | 0.310 | 0.360 |
| MNO | 0.280 | 0.210 | 0.210 | 0.200 | 0.200 | 0.200 | 0.200 | 0.180 | 0.200 | 0.210 |
| CO2 | 0.060 | 0.090 | 0.140 | 0.060 | 0.090 | 0.090 | 0.090 | 0.080 | 0.120 | 0.080 |
| Total | 100.4 | 100.6 | 99.9 | 100.6 | 100.4 | 100.4 | 100.4 | 99.4 | 100.1 | 100.1 |

| | 71-40 | 71-46 | 71-100 | 71-101 | 71-121 | 71-122 | 71-142 | 71-143 | 71-144 | 71-146 |
|---|---|---|---|---|---|---|---|---|---|---|
| SIO2 | 49.000 | 54.400 | 51.200 | 50.800 | 48.100 | 50.300 | 56.300 | 55.100 | 55.800 | 51.300 |
| AL2O3 | 13.700 | 12.400 | 12.400 | 12.400 | 12.200 | 12.500 | 14.100 | 13.300 | 13.300 | 13.400 |
| FE2O3 | 3.100 | 1.700 | 5.500 | 2.700 | 2.700 | 3.800 | 3.100 | 3.200 | 3.500 | 3.500 |
| FEO | 10.440 | 10.120 | 9.500 | 12.450 | 12.930 | 11.300 | 5.990 | 9.090 | 9.180 | 9.310 |
| MGO | 5.000 | 4.400 | 3.700 | 4.000 | 5.800 | 4.200 | 3.200 | 4.300 | 3.400 | 4.200 |
| CAO | 9.500 | 8.600 | 7.900 | 8.100 | 9.500 | 8.600 | 6.900 | 7.300 | 6.600 | 7.700 |
| NA2O | 2.700 | 3.100 | 2.800 | 2.500 | 2.400 | 2.400 | 3.700 | 3.200 | 3.300 | 3.300 |
| K2O | 1.200 | 1.700 | 1.300 | 1.300 | 1.000 | 1.300 | 2.400 | 1.500 | 2.000 | 2.200 |
| H2O | 0.960 | 0.630 | 1.160 | 1.320 | 0.550 | 1.110 | 1.490 | 0.500 | 0.650 | 0.790 |
| TIO2 | 3.110 | 2.090 | 3.030 | 3.520 | 3.590 | 3.310 | 2.120 | 1.920 | 2.070 | 2.630 |
| P2O5 | 0.720 | 0.310 | 0.550 | 0.520 | 0.840 | 0.490 | 0.360 | 0.310 | 0.330 | 1.280 |
| MNO | 0.220 | 0.190 | 0.240 | 0.220 | 0.250 | 0.220 | 0.140 | 0.190 | 0.190 | 0.240 |
| CO2 | 0.080 | 0.090 | 0.090 | 0.090 | 0.110 | 0.120 | 0.080 | 0.110 | 0.060 | 0.060 |
| Total | 99.7 | 94.7 | 99.4 | 99.9 | 100.0 | 99.7 | 99.9 | 100.0 | 100.4 | 99.9 |

| | 71-147 | 71-148 | 71-149 | 71-150 | 71-151 |
|---|---|---|---|---|---|
| SIO2 | 55.700 | 53.600 | 50.200 | 50.500 | 49.800 |
| AL2O3 | 13.500 | 13.400 | 13.300 | 15.200 | 15.000 |
| FE2O3 | 3.400 | 2.900 | 3.100 | 4.000 | 2.600 |
| FEO | 8.410 | 9.720 | 11.400 | 8.150 | 8.990 |
| MGO | 3.500 | 4.200 | 4.900 | 5.700 | 6.400 |
| CAO | 6.900 | 7.800 | 9.200 | 10.400 | 10.500 |
| NA2O | 3.200 | 3.200 | 2.900 | 3.100 | 3.000 |
| K2O | 1.800 | 1.300 | 1.100 | 0.500 | 0.500 |
| H2O | 1.100 | 0.550 | 0.590 | 0.720 | 0.640 |
| TIO2 | 1.930 | 1.900 | 2.150 | 1.520 | 1.510 |
| P2O5 | 0.330 | 0.310 | 0.320 | 0.220 | 0.240 |
| MNO | 0.180 | 0.240 | 0.260 | 0.220 | 0.210 |
| CO2 | 0.050 | 0.390 | 0.060 | 0.060 | 0.080 |
| Total | 100.0 | 99.5 | 99.5 | 100.3 | 99.5 |

Table 4-B. Location and description of samples collected by D. A. Swanson and T. L. Wright, fall, 1971. Analyses are given in Table 4-A.

| Field No. | State | County | Quadrangle | Location | Stratigraphic Unit | Flow No. | Chemical Type |
|---|---|---|---|---|---|---|---|
| DSTW71-12 | O | Wallowa | Grangeville AMS. 1:250,000 | SW1/4NE1/4 sec. 3, T. 3 N., R. 45 E. Thicker of two dikes exposed near hairpin turn in road along upper Joseph Creek. | lower Yakima basalt | | Y |
| DSTW71-13 | O | " | " | Do. Dike 100' downstream from 71-12. | " | | Y |
| DSTW71-27A | I | Idaho | " | NW1/4SW1/4 sec. 20, T. 29 N., R.2 E., Flow in new roadcut on highway 95 on Whitebird grade. Alt.: 4010' John's Creek flow(?) of Bond, 1963. | " | | Y |
| DSTW71-28A | I | " | White Bird | NW1/4NE1/4 sec. 30, T. 29 N., R. 2 E. Do. Alt.: 3640'. Center Creek flow(?) of Bond, 1963. | " | | Y |
| DSTW71-29 | I | " | " | NE1/4NE1/4 sec. 36, T. 29 N., R. 1 E. Do. Alt.: 2930'. Upper of two flows lying between the Grave Creek(?) and Rock Creek flows of Bond, 1963. | " | | PG |
| DSTW71-30 | I | " | " | SW1/4 sec. 30, T. 29 N., R. 2 E. Do. Alt.: 3180'. Grave Creek flow(?) of Bond, 1963. | " | | Y |
| DSTW71-32A | I | " | Grangeville AMS. 1:250,000 | Sec. 8, T. 30 N., R. 1 E. 0.2 mile up Grave Creek from its mouth at Rock Creek. Grave Creek flow of Bond, 1963. | " | | Y |
| DSTW71-33 | I | " | " | Sec. 5, T. 30 N., R. 1 E., 1.0 mile from mouth of Grave Creek. Flow overlying Grave Creek flow. | " | | Y |
| DSTW71-34 | I | " | " | Same as above, 1.35 mile from mouth of Grave Creek. Center Creek flow of Bond, 1963. | " | | Y |
| DSTW71-35 | I | " | " | Sec. 32, T. 31 N., R. 1 E., 3.2 miles from mouth of Grave Creek. Johns Creek flow of Bond, 1963. | " | | Y |
| DSTW71-40 | I | Nez Perce | Sweetwater | SE1/4NW1/4 sec. 10, T. 34 N., R. 4 W. Second flow from top of section near end of road. | middle Yakima basalt | | L |
| DSTW71-46 | I | " | Cul de Sac | NW1/4NE1/4 sec. 4, T. 36 N., R. 3 W. E. side of mouth of Cottonwood Creek in large roadcut. | lower Yakima basalt | | Y |

Table 4-B continued

| Field No. | State | County | Quadrangle | Location | Stratigraphic Unit | Flow No. | Chemical Type |
|---|---|---|---|---|---|---|---|
| DSTW71-100 | W | Franklin | Lower monumental dam | SE1/4SW1/4 sec. 9, T. 13 N., R. 34 E. Devil's Canyon Road. Alt.: 900'. | middle Yakima basalt | | FS |
| DSTW71-101 | W | " | " | SE1/4SE1/4 sec. 21, T. 13 N., R. 34 E. Devils Canyon Road, Alt.: 710'. Talus at base of western exposure of intracanyon flow. | upper(?) Yakima basalt | | EM |
| DSTW71-121 | W | " | Eltopia 15' | NE1/4SE1/4 sec. 22, T. 11 N., R. 30 E. Flow capping two knobs west of canal 2.5 mi. S. of Eltopia. | upper Yakima basalt | | IH |
| DSTW71-122 | W | Walla Walla | Levey SE | NW1/4SW1/4 sec. 8, T. 9 N., R. 32 E. Uppermost flow at top of grade above Levey. Collected off road at alt.: 620'. | " | | EM |
| DSTW71-142 | O | Wheeler | Condon 30' | NE1/4 sec. 27, T. 6 S., R. 20 E. Top of hill off unpaved road west of Fossil and SW of Butte Creek. Alt.: 3750'. | lower Yakima basalt | | Y |
| DSTW71-143 | O | " | " | SE1/4 sec. 15, T. 6 S., R. 20 E. Prominent outcrop along north side of Butte Cr. across from old house and barn. Alt.: 2270'. | " | | Y |
| DSTW71-144 | O | " | " | Boundary of NW1/4 and NE1/4 sec. 15, T. 6 S., R. 20 E. Platy flow exposed in roadcuts at prominent bend in road. | " | 9 | Y |
| DSTW71-146 | O | " | " | NE1/4NW1/4 sec. 15, T. 6 S., R. 20 E. Thick flow collected on valley wall on north side and above Butte Creek. | " | 10 | ? |
| DSTW71-147 | O | " | " | SW1/4SE1/4 sec. 10, T. 6 S., R 20 E. One or two flows above 71-146 collected on same slope. | " | 11 | Y |
| DSTW71-148 | O | " | " | SE1/4 sec. 7, T. 6 S., R. 20 E. Collected at prominent bend in road just east of intersection of w. fork with Butte Cr. Probably same flow as 71-143. | " | 6 | Y |
| DSTW71-149 | O | " | " | SE1/4 sec. 12, T. 6 S., R. 19 E. Spectacularly jointed flow collected on north side of Butte Creek road. | Picture Gorge basalt | 5 | ? |
| DSTW71-150 | O | " | " | NW1/4 sec. 10, T. 6 S., R. 19 E. Roadcut south of Butte Creek. | " | 3 | PG |
| DSTW71-151 | O | " | " | NE1/4 sec. 9, T. 6 S., R. 19 E. Collected from large Talus rocks below platy columns on south wall of Butte Creek Valley. This flow overlies and abuts against bedded tuffs of the John Day formation. | " | 1 | PG |