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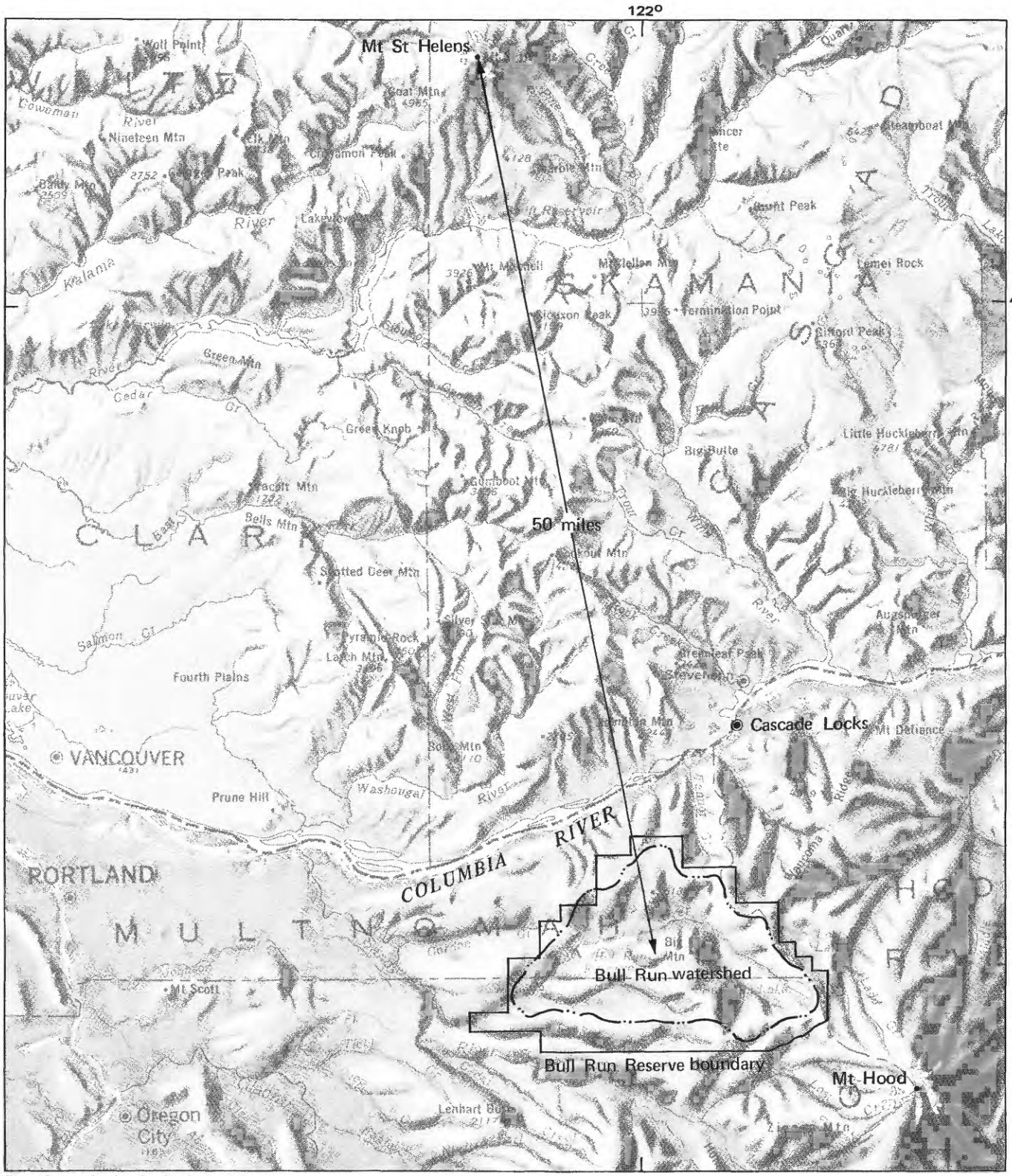
INTRODUCTION

On March 27, 1980, Mount St. Helens in southwestern Washington began ejecting gas and volcanic ash for the first time in more than 100 years. Eruptions have continued for several weeks, accompanied by periodic seismic activity. As of May 12, 1980, no magma had broken the surface of the mountain, although volcanologists report that an eruption of lava could occur at any time.

The 102-square-mile (264-square-kilometer) Bull Run watershed is south of the Columbia River approximately 50 mi (80 km) south of Mount St. Helens (fig. 1), and supplies water to more than 600,000 Portland area users. Because of the proximity of the mountain to the watershed, Portland residents have been concerned that ash could fall in the Bull Run watershed if a volcanic eruption occurred during a period of northerly windflow. On March 30, such conditions did occur and resulted in a thin dusting of ash over much of the watershed. On April 2, the Water Resources Division of the U.S. Geological Survey placed precipitation and ash collectors at seven locations in the basin to obtain data on future ash falls (fig. 2). The collection sites were integrated with a hydrologic data network established earlier for an ongoing water-qualtiy investigation of the Bull Run watershed in cooperation with the city of Portland.

This report presents the data obtained immediately after the March 30, 1980 ash fall in the Bull Run watershed. Water analyses include pH, alkalinity, specific conductance, temperature, sulfate, nitrate plus nitrite, and other major ions. Chemical analyses also were made of volcanic ash collected from the Bull Run watershed and from Mount St. Helens.



Base from the U. S. Geological Survey
Oregon and Washington (Shaded relief)
1:500,000; 1966

Figure 1.-Location of the Bull Run watershed and its distance from Mount St. Helens.

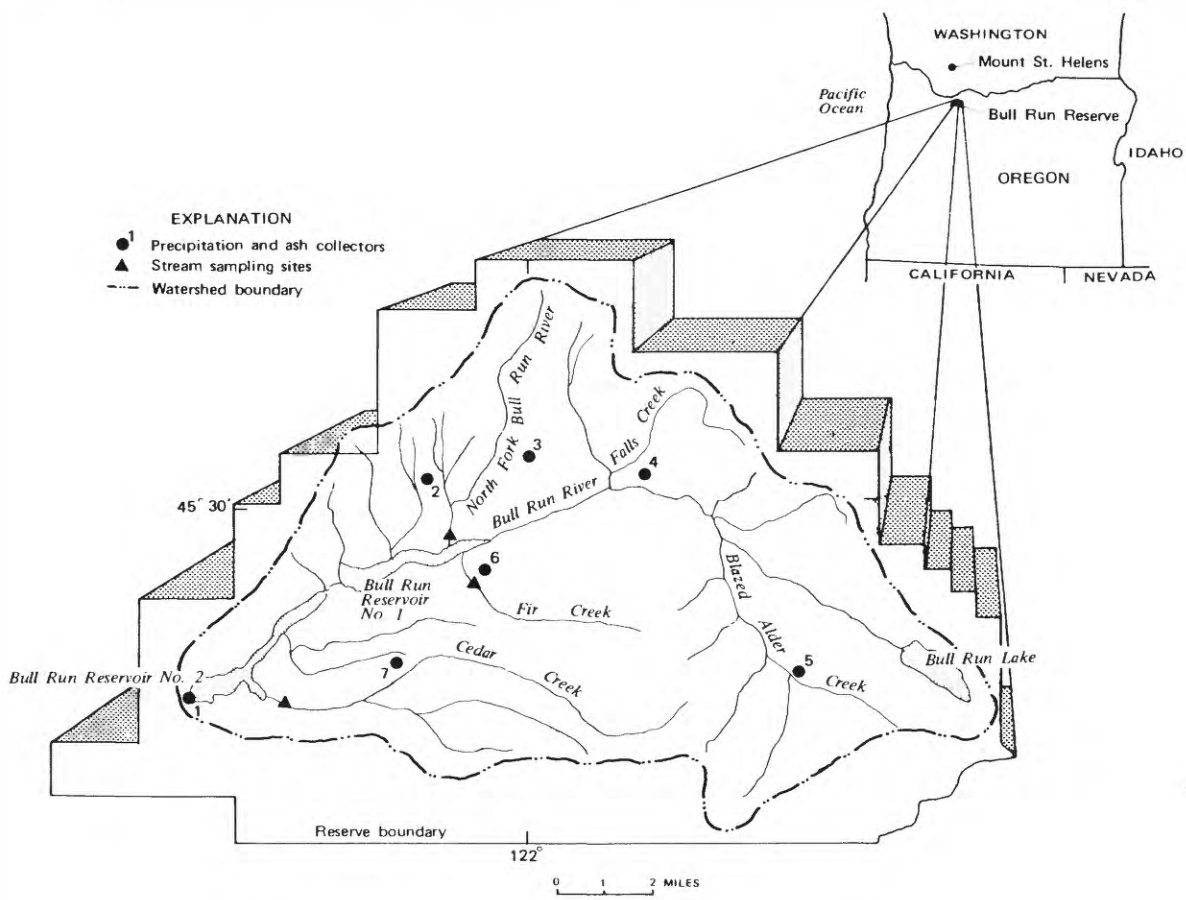


Figure 2.—Location of sampling sites in the Bull Run watershed.

VOLCANIC EVENTS

On March 30, gray-black ash and steam from Mount St. Helens were ejected to altitudes of 11,000 to 16,000 ft (3,400 to 4,900 m) above mean sea level during several eruptions (fig. 3). At 4 a.m. and 4 p.m., north-northwesterly winds were recorded gusting to speeds as high as 100 mi/h (160 km/h) at altitudes between 10,000 to 20,000 ft (3,000 to 6,000 m) as shown in figure 3. The high altitude wind measurements are taken above Salem, Oregon. U.S. Forest Service aerial observers reported, at 5:30 a.m., that the plume from a 4:11 a.m. ejection had traveled about 30 mi (50km) southeast of Mount St. Helens and was drifting toward Mount Hood (fig.4). At 9:47 a.m., they also noted that the plume from a 7:03 a.m. ejection had drifted nearly to Cascade Locks, Oreg. (U.S. Forest Service, written communication, April 1980).

Other volcanic ash ejections, precipitation, and speeds of northerly winds above Salem are also shown in figure 3.

DATA COLLECTION AND ANALYSIS

On April 2, 1980, precipitation and ash collectors were placed at the locations shown in figure 2. Each precipitation collector is an 8-in. (200-mm) plastic funnel mounted on a metal post connected to flexible plastic tubing that conveys the precipitation to a 0.3-gallon (1-liter) sample bottle. Ash collectors are arrays of 8 to 12 0.3-gallon (1-liter) open-top bottles supported by a wire cage. Visits to collect samples are made as required by the frequency of storms and of volcanic activity.

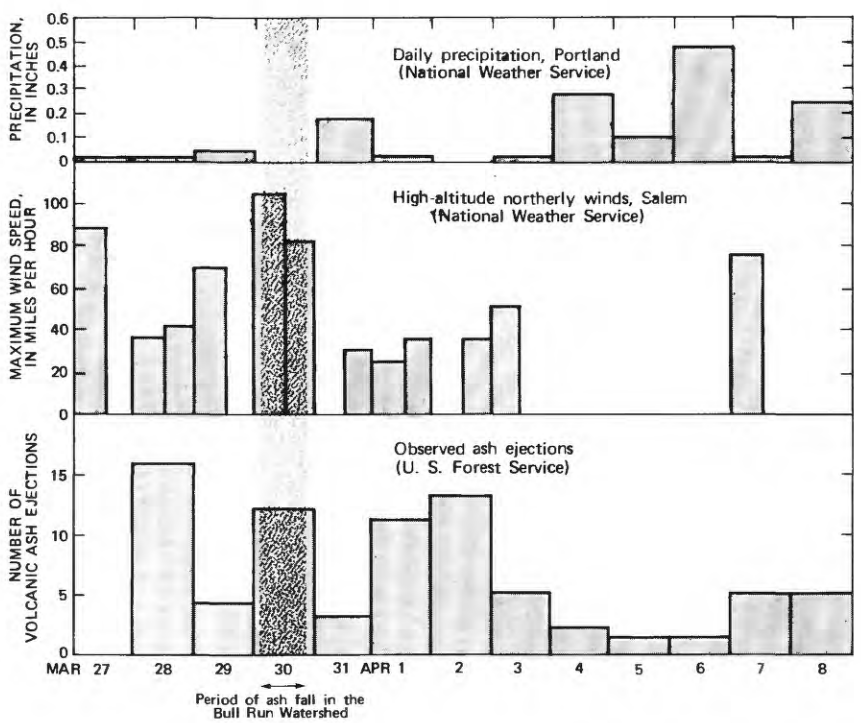


Figure 3.—Precipitation, high-altitude northerly wind speeds, and ash ejections during the period March 27–April 8, 1980.

Figure 4.–Photograph showing Mount St. Helens ejecting ash, Mount Hood in background. (Ash from this eruption, May 18, 1980, drifted eastward, whereas on March 30 ash drifted south toward Mount Hood and Bull Run watershed. U.S. Geological Survey photograph.)

All field measurements and laboratory procedures for water analyses were by methods described in Skougstad and others (1979). Water temperature and pH measurements were made in the field. Acidity and specific conductance were determined at the U.S. Geological Survey laboratory in Portland. Sulfate, nitrate plus nitrite, and other major ions were analyzed at the Survey's water-quality laboratory in Denver, Colo. The analytical results are listed in table 1.

Samples collected on April 7, 9, and 17 were analyzed for acidity. Acidity for all samples was reported to be less than 2.4 mg/l acidity as $CaCO_3$. The values were not shown in table 1 because the titration end point was determined to be less than pH 7, thus beyond the sensitivity for this analysis. (See American Public Health Association and others [1971] for additional explanation.)

Ash from the March 30 fall in the Bull Run watershed was collected on April 2 by removing 1-square-foot (0.09-square-meter) sections of snow on which the ash had been deposited. Ash residues from sites 4, 5, and 7 in the Bull Run watershed (fig. 2) had weights of 0.06 oz (1.8 g), 0.04 oz (1.2 g), and 0.1 oz (2.9 g), respectively. The volcanic ash collected at sites 5 and 7 and on Mount St. Helens was analyzed by the U.S. Geological Survey, Branch of Analytical Laboratories, Menlo Park, Calif., and results are given in table 2. Precision for the sulfur determinations is ± 1 percent. The other constituents were determined using emission spectroscopy with a precision of ± 50 percent.

SELECTED REFERENCES

American Public Health Association and others, 1971, Standard methods for the examination of water and wastewater (14th ed.): Washington, D.C., American Public Health Assocation, 1193 p.

Crandell, D. R., and Mullineaux, D. R., 1978, Potential hazards from future eruption of Mount St. Helens volcano, Washington: U.S. Geological Survey Bulletin 1383-C, 26 p.

Skougstad, M. W., Fishman, J. J., Friedman, L. C., Erdmann, D. E., and Duncan, S. S., eds., 1979, Methods for determination of inorganic substances in water and fluvial sediments: Techniques of Water-Resources Investigations of the U.S. Geological Survey, book 5, chap. A1, 626, p.

U.S. Geological Survey, 1979, Water resources data for Oregon--Water year 1978: Water-Data Report OR-78-1, 650 p.

Table 1.--Analyses of precipitation and stream samples from Bull Run watershed

[Sampling sites shown in figure 2; all chemical analyses are for dissolved constituents]

Sampling site	Date (1980)	Water temperature (°C)	pH (units)	Specific conductance (umhos/cm at 25°C)	Milligrams per liter										
					Sulfate	Nitrite + nitrate (as N)	Chloride	Fluoride	Calcium	Magnesium	Potassium	Silica	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Dissolved solids (residue on evaporation at 180°C)
Precipitation samples															
1	4- 7	7.2	4.0	8	1.1	0.053									
	4- 9	8.2	4.1	9	1.0	.059									
	4-11	5.6	4.2	21											
	4-17	11.3	4.0	11											
	4-21	8.0	4.0	15											
2	4- 7	.7	4.3	7	1.1	.050									
	4-11	21.2	4.3	11											
	4-17	14.8	4.6	7	1.1	.027	0.9	0.0	0.1	0.0	0.2	0.1	0	0	6
	4-21	7.2	3.8	12											
3	4- 7	.6	4.3	7	1.2	.061	.8	.0	.3	.0	.1	.0	0	<1	2
	4-11	21.4	4.5	8											
	4-17	15.4	4.2	11	1.2	.052	.5	.0	.1	.0	.2	.0	0	0	8
	4-21	7.6	3.8	12											
4	4- 9	9.0	5.0	6	1.3	.035									
	4-11	21.4	4.2	12	.5	.025									
	4-17	18.6	4.8	6											
	4-21	6.8	4.2	12											
6	4- 9	12.0	4.4	6	1.5	.041									
	4-11	19.7	4.4	13											
	4-17	16.3	4.2	10	.5	.032									
	4-21	8.1	4.0	10											
7	4- 9	11.0	4.3	7	1.8	.047									
	4-11	20.1	4.4	16											
	4-17	20.0	4.6	7	.3	.041									
	4-21	8.2	3.9	10											
Stream samples															
North Fork Bull Run River	4- 9	9.0	5.6	17	1.6	--	1.2	.0	1.3	.4	.2	6.2	7	5	23
	4-11	4.6	6.5	19											
	4-17	4.8	6.2	18	.7	.000	1.1	.0	1.4	.5	.2	7.3	8	6	22
	4-21	4.7	6.6	17											
South Fork Bull Run River	4- 9	11.0	6.0	18	1.9	.034	1.3	.0	1.5	.5	.2	6.6	7	6	19
	4-11	5.4	6.1	20											
	4-17	6.0	6.6	20	.5	.000	1.1	.0	1.5	.6	.2	7.8	10	6	23
	4-21	5.0	6.6	17											
Fir Creek near Brightwood	4- 9	9.0	6.1	17	1.7	.055	1.6	.0	1.3	.5	.2	6.3	4	5	16
	4-11	4.2	6.4	20											
	4-17	4.9	6.6	18	.2	.010	1.8	.0	1.4	.6	.2	7.5	3	6	22
	4-21	4.0	6.5	19											
Snow samples, filtrate															
4	4- 4	--	5.3	3	2.2	.003									
5	4- 2	--	4.0	5	3.2	.014									
7	4- 2	--	3.9	3	2.0	.002									

Table 2.--Semiquantitative analyses of volcanic ash from stations in the Bull Run watershed and from Mount St. Helens

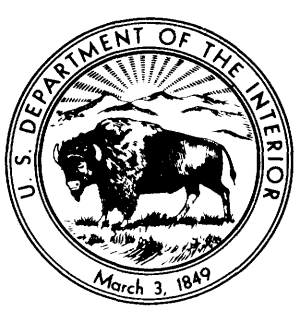
[Branch of Analytical Laboratories, Menlo Park, Calif.]

	Blazed Alder Creek (No. 5)	Cedar Creek (No. 7)	Mount St. Helens
	Percentage of sample, by weight		
Iron (Fe)	3	5	3
Magnesium (Mg)	1.5	1.5	1
Calcium (Ca)	5	5	3
Titanium (Ti)	.7	.7	.3
Silicon (Si)	>10	>10	>10
Aluminum (Al)	10	10	7
Sodium (Na)	3	3	2
Potassium (K)	1.5	1	1
Phosphorus (P)	.06	.06	.04
Sulfur (S)	.26	.17	.08
	Parts per million (ppm) of sample, by weight		
Manganese (Mn)	700	700	700
Arsenic (As)	1.5	1.5	2
Gold (Au)	< .1	< .1	< .2
Boron (B)	7	7	10
Barium (Ba)	300	300	300
Beryllium (Be)	1.5	1	2
Cadmium (Cd)	.3	.1	.2
Cobalt (Co)	15	20	20
Chromium (Cr)	15	15	7
Copper (Cu)	30	30	30
Lanthanum (La)	20	15	20
Nickel (Ni)	15	20	10
Lead (Pb)	15	10	10
Scandium (Sc)	15	15	15
Strontium (Sr)	500	500	500
Vanadium (V)	70	100	70
Yttrium (Y)	15	15	15
Zinc (Zn)	50	50	100
Zirconium (Zr)	100	70	150
Gallium (Ga)	20	20	30
Ytterbium (Yb)	1.5	1.5	2
Praseodymium (Pr)	--	--	< 20
Neodymium (Nd)	--	--	< 20
Samarium (Sm)	--	--	< 50
Europium (Eu)	--	--	< 1

Constituents below detection levels shown, in all samples

Silver (Ag)	0.2 ppm	Tellurium (Te)	1 ppm	Lithium (Li)	100 ppm
Bismuth (Bi)	.2	Uranium (U)	150	Rhenium (Re)	7
Molybdenum (Mo)	2	Wolfram (W)	10	Tantalum (Ta)	50
Niobium (Nb)	7	Cerium (Ce)	50	Thorium (Th)	150
Palladium (Pd)	1	Germanium (Ge)	7	Thallium (Tl)	1
Platinum (Pt)	5	Hafnium (Hf)	50	Mercury (Hg)	1
Antimony (Sb)	1	Indium (In)	1.5	Selenium (Se)	10
Tin (Sn)	2				

Note: Precision is ±1 percent for sulfur analyses, ±50 percent for other constituents.



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