Mount St. Helens Ash Some Properties and Possible Uses*

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On May 18 of this year, after a dormant period of over 125 years, Mount St. Helens erupted violently sending over three-quarters of a cubic mile of volcanic ash into the atmosphere. This represented the first major eruption of a volcano in the contiguous United States since the eruption of California's Mount Lassen in 1914.

In the discussion that follows, we will cover some physical and chemical properties of the ash, as well as its possible uses, but before we enter into this discussion we would like to comment briefly on major events that occurred several weeks prior to, and shortly after, the May 18 eruption of the mountain.

On March 20 the first significant seismic activity, consisting of a minor earthquake of 4.1 Ricter magnitude, was recorded in the vicinity of Mount St. Helens. On March 27, after continued seismic activity, the first eruption since the mid-1800s occurred. As a result of this eruption, steam and ash rose to elevations in excess of 16,000 feet from a newly formed vent on the north summit of the mountain. In weeks that followed, steam and ash eruptions became common and the snow covered peak, because of accumulating ash, assumed a dark color. As a result of continued eruptions, the vent progressively grew to several thousand feet in diameter, a large bulge developed on the northern slope of the mountain, and harmonic tremors related to moving magma indicated that a major eruption was imminent.

On Sunday May 18 at 8:32 A.M., PDT, immediately following a gigantic landslide on the north slope of the mountain and a prodigious cannon-like blast to the north, the mountain sent clouds of steam and ash over 50,000 feet into the atmosphere. On the north slope of the mountain ash flows, pyroclastic flows and mudflows slid down the mountain into Spirit Lake and the valley of the Toutle River.

Within hours the ash cloud had moved into eastern Washington. At 10:00 A.M. darkness descended upon Yakima; by 12:30 P.M. the ash had reached Moses Lake; by 3:30 P.M. Spokane, which lies 236 miles east of the mountain, was in darkness. By 5:00 P.M. the ash had traveled 645 miles east from Mount St. Helens and was falling in Missoula, Montana, as it continued its easterly route across the United States.

Numerous aerial surveillances on May 19 revealed the catastrophic power of the eruption. North and northwest of St. Helens all trees had been ripped from the earth, stripped of their branches, and deposited like match sticks upon the barren, ash-covered terrain. For as far as 12 miles north from the mountain trees were blown down and foliage was destroyed; few living creatures survived. At the foot of the mountain, crystal clear Spirit Lake was nothing more than a gigantic mud puddle, the surface of which was strewn with thousands of delimbed trees, much of the lake having been displaced by mud and ash flows from the mountain. Northwest and west of Mount St. Helens, the valley of the Toutle River no longer contained beautiful stands of timber, but was filled with thick accumulations of mud, mixed with fallen trees.

East of Mount St. Helens, much of eastern Washington was covered by up to 3 inches of volcanic ash that resembled newly fallen snow. Travel on most roads came to a standstill and ash cleanup became a major problem for counties that lay in the path of the ash fallout. A conservative estimate of the volume of ash that fell in Washington is one-third cubic mile; 49% of the state received a trace or more of ash; about 30% received one-eighth or more. Counties receiving the most ash were Yakima, Grant, Adams, Whitman, and Spokane. Up to three-quarters of an inch fell in Yakima; two to three inches fell in Moses Lake and Ritzville; and around one-half inch fell in Spokane.

As a result of cleanup operations in Washington, cubic yards of ash have been stockpiled in several eastern Washington counties. Does this ash in excess of 375,000 have any value—yes and no. To counties such as Grant and Adams, its value is negative, costing five to nine dollars per ton to remove. To enterprising merchants of Mount St. Helens souvenirs, who sold one-ounce packets of ash for one dollar, its value is definitely positive. Before we consider the realistic value of the ash, we would like to mention some of is properties.

Properties of Mount St. Helens Ash

Volcanic ash of the May 18 eruption consists of composite ashfalls composed of crystal, vitric and lithic fractions. Volcanic glass, plagioclase feldspar, hypersthene and magnetite predominate, and are accompanied by one or several accessory minerals. The ash is typical light-medium gray and closely resembles portland cement in color and fineness. About 90% of eastern Washington ash falls in the .061 to .044 mm size range, which is equivalent to 250 to 325 mesh.

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Table 1. average properties of Mount St. Helens ash.

Chemical composition (percent)

SiO_2	64	Na_2O	4.5	TiO_2	0.64
Al_2O_3	17.5	MgO	2	MnO	0.09
Fe_2O_3	5	K_2O	1.49	P_2O_5	0.18
CaO	5				

Mineral composition (percent)

Glass	75
Plagioclase feldspar	18
Multimineralic particles	5
Accessory minerals	2

Color

Light gray

Particle size

0.044 to 0.061 mm (325 to 250 mesh)

Density

Loose dry	0.88 g/cm^3 (55 lb/ft^3)
Compacted	1.29 g/cm^3 (80 lb/ft^3)

Acidity

pH 5.2 to 7.2

Compaction

Loose dry	40 percent at 10 psi
	50 percent at 10,000 psi
Settled	11 percent at 10 psi
	20 percent at 10,000 psi

Radioactivity

Insignificant

Magnetism

Slight to high

Mineral Composition

Ash samples examined to date by petrographic and x-ray analyses vary considerably in mineral composition. Minerals identified in order of decreasing abundance include: glass, plagioclase, hypersthene, magnetite, hornblende, augite, sanidine, microcline, biotite, olivine, quartz, and cristobalite. In addition to these minerals, multi-mineralic particles are present in most ashes.

The average composition of ash from the Moses Lake-Ritzville area where most ash fell is:

Glass	75%
Feldspar	18%
Ferromagnesian	0.5%
Opaque minerals (chiefly magnetite)	0.5%
Quartz	1%
Multi-mineralic particles	5%

Individual particles of eastern Washington ash occur as irregular glass shards containing bubble cavities, finely microcrystalline particles, tabular and semirounded particles, elongated crystals and crystal fragments, and platy microlites, and crystallites. Bubble wall texture and glass finds occur on many crystal fragments.

We would now like to mention briefly some properties of the main minerals of the ash.

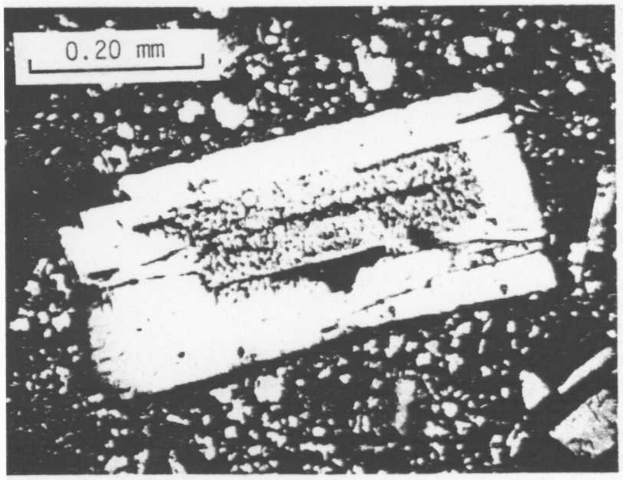
Glass

The glass occurs as colorless to light-brown, splintery, vesiculated shards, and almost always contains microlitic inclusions, from 1 to 5 microns in size, of plagioclase, hypersthene, and glass, as well as crystallitic and dustlike inclusions of magnetite. As one of the last minerals to solidify, it forms rinds on all other minerals of the ash. Refractive indices of the glass range from 1.502 to 1.505, specific gravity averages 2.5, and hardness is in the 5 to 5.5 range. Chemical analyses of the glass show 73 to 76% silica, and 13.5 to 16% Al_2O_3.

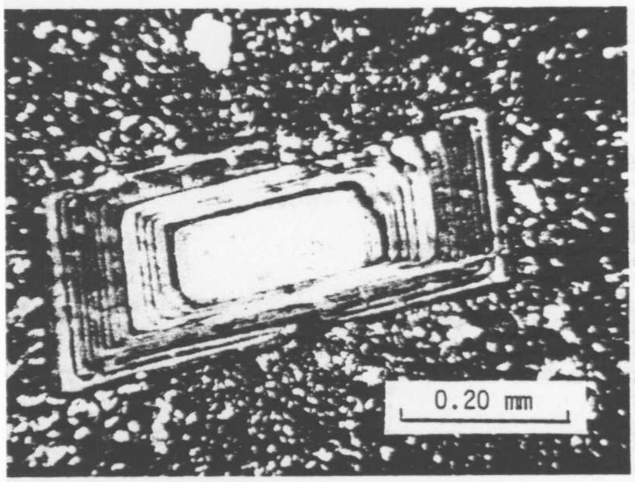
Feldspar

The feldspar of the ash consists almost wholly of plagioclase, ranging from andesine (An_{30}) to labradorite

Fig. 1. Volcanic glass. Vesiculated shards, × 3,200, SEI photo.



A



B

Fig. 2. Plagioclase feldspar crystals. A. Andesine showing dustlike inclusions of magnetite and glass, × 90-crossed nicols. B. Compositional zoning, × 90-crossed nicols.

(An_{55}), with andesine predominating. It occurs as tabular to lathlike fragments that show polysynthetic twinning and compositional zoning. Many plagioclase fragments contain dustlike particles of magnetite, and others contain microlites of plagioclase, and hypersthene. The orthoclase feldspars, microcline and sanidine, have been observed in a few ashes, but in most appear to be absent.

Ferromagnesian minerals

The most common ferromagnesian mineral is hypersthene which has been noted in all ash samples. It occurs as greenish-brown crystals that almost always contain jackets of glass. Common inclusions of the hypersthene are microlitic hypersthene and dustlike to crystallitic magnetite.

Magnetite

Magnetite has been noted in all ash samples in amounts from 0.5 to 5%. Most commonly, it occurs as dustlike particles only several microns in diameter. Spectrograph analyses of the magnetite shows that it is always titaniferous.

Multi-mineralic

Multi-mineralic particles consist chiefly of glass fragments containing inclusions of plagioclase, ferromagnesian minerals, and magnetite. Most particles are irregular in shape or finely microcrystalline.

Quartz

Although up to 5% quartz is present in some ash, the average is closer to 1%. Although a few grains as large as 0.25 mm are present the bulk of the quartz is less than 5 microns in diameter. As such, the quartz grains are seldom visible under the petrographic microscope, and rarely detectable by x-ray analyses. The quartz occurs as crystal fragments containing only minor inclusions.

Physical-Chemical Properties

Particle size

The average ash particle is in the 0.061 to 0.044 mm (250-325 mesh) range. Particle size distribution is best illustrated by ash that fell along an easterly transect from Mount St. Helens to Lookout Pass on the Idaho-Montana border, 90 mi east of Spokane. This transect is about 340 mi in length, and roughly parallels the easterly trending axis of the major ashfall of the May 18 eruption. At Ahtanum, the average particle size is 0.25 mm (60 mesh); at Moses Lake which is 100 mi farther east, the average particle size is 0.061 mm (250 mesh); at Cheney and Spokane, about 236 mi from

Fig. 3. Elongated hypersthene crystal (0.07 mm in length among glass shards, × 1,280, SEM photo.