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138. PYROCLASTIC DEPOSITS OF RECENT AGE AT MOUNT RAINIER, WASHINGTON

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A study of surficial deposits in Mount Rainier National Park has led to the recognition of six distinctive layers of relatively light-colored pyroclastic debris on the flanks of Mount Rainier volcano, and on neighboring slopes of the Cascade Range. On slopes and ridgetops the layers locally are included in deposits totaling less than 6 feet in thickness. In terrace deposits in the valleys, however, the layers may be separated by tens of feet of debris flows and alluvium.

Only two of these ash layers are known to have originated at Mount Rainier. Two other pyroclastic layers become progressively coarser and thicker toward Mount St. Helens, 50 miles to the south-southwest. These layers merge with the two sheets of pumice northeast of Mount St. Helens described by Carithers (1946, p. 16), who recognized that they were erupted by Mount St. Helens and were carried as far as Mount Rainier.

The six layers are light colored and are prominent and individually distinctive. Because they were initially deposited over wide areas and are still locally preserved, they are useful for subdividing, correlating, and dating Recent surficial deposits.

Study of the Recent pyroclastic deposits near Mount Rainier began during investigation of the Osceola Mudflow, and most of these six light-colored layers were described briefly in a section measured on the northeast side of the volcano (Crandell and Waldron, 1956). In the present study, the stratigraphy and distribution of the ash layers on and near Mount Rainier were studied by Crandell and Miller, and the stratigraphy of the pumice at Mount St. Helens and the petrography of the pyroclastic layers were examined by Mullineaux. Radiocarbon ages of interbedded organic matter were determined by Rubin.

DESCRIPTION

The 6 pyroclastic deposits include 3 composed chiefly of pumice of lapilli size or larger, and 3 of vitric and crystal ash. Most of the layers can be recognized in the field by color, size range, and stratigraphic position; laboratory study of constituent minerals and glass confirms field identifications and distinguishes those that appear outwardly similar. In many places these distinctive layers are separated by beds of dark sand, some of which probably are lithic ash from Mount Rainier. Arbitrary letter symbols are here assigned to the distinctive ash layers to permit future additions to the sequence without changes of nomenclature. The mineralogy, source, and age of the pyroclastic deposits are summarized in the following tables, and the deposits are compared with Recent events in the valleys of the Nisqually and White Rivers.

LAPILLI AND ASH LAYER R

Layer R consists of brownish-yellow (10*YR* 6/6) ash and lapilli as much as 30 mm in diameter and occurs in the north and east parts of the park. The lapilli are dark to light-brown andesitic pumice, cinders, and dense rock fragments which lie in an oxidized matrix of similar rock fragments and crystals. The glass in most lapilli is dark brown and turbid, and much of it is crowded with crystallites. The refractive index of glass in different fragments ranges from about 1.52 to about 1.57.

Northeast of Mount Rainier layer R decreases from a thickness of about 6 inches 7 miles from the summit of the volcano to 2½ inches 10 miles away. It was not seen on the southwest flank of Mount Rainier during detailed mapping there. Its coarse texture and apparent thinning away from the volcano in a north-

Table 138.1—*Mineralogy of the pyroclastic layers*

Pyroclastic layer	Source of pyroclastic material	Fe-Mg minerals		Refractive index of glass
		Mineral [1]	Abundance [2]	
G	Unknown	hy	D	1.52–1.53 and 1.49–1.50
		hb	S	
		ag	A	
		oxh	S	
W	Mount St. Helens.	hy	D	1.49–1.50
		hb	A	
C	Mount Rainier	hy	D	1.50–1.53 [3]
		hb	S	
		ag	A	
Y	Mount St. Helens.	hy	R	1.50–1.51
		hb	D	
O	Mount Mazama	hy	D	1.50–1.51
		hb	A	
		ag	A	
R	Mount Rainier	hy	V	1.52–1.57 [3]
		hb	V	
		ag	V	
		oxh	V	

[1] hy, hypersthene; hb, hornblende; ag, augite; oxh, oxyhornblende.
[2] D, >50 percent; A, 5–50 percent; S, <5 but ubiquitous; R, rare; absent in some samples; V, varied.
[3] In various pumice fragments.

TABLE 138.2—*Age of pyroclastic deposits*

Pyroclastic layer	Source of pyroclastic material	Radiocarbon age and sample nos.[1] of organic matter (years)	Inferred age of pyroclastic layers (years)	Correlative unit in measured section of Crandell and Waldron (1956)	Principal events in valleys of Nisqually and White Rivers	
					Recession of glaciers	
G	Unknown		>65–<215	8		Deposition of debris flows and alluvium on valley floors
		290±200 (W–1120)				
W	Mount St. Helens		300			
		320±200 (W–1119)				
					Advance of glaciers	
C	Mount Rainier		1, 000–3, 000	7		
		1, 640±250 (W–922)				
		2, 550±200 (W–930)				
		2, 980±250 (W–1118)				
Y	Mount St. Helens		3, 200	6		
		3, 500±250 (W–1115)				
		4, 000±250 (W–1116)				
		4, 800±300 (L–223A)		5	Osceola Mudflow	
O	Mount Mazama		6, 500	3		
		8, 750±280 (W–950)				
R	Mount Rainier		>8, 750			

[1] W, U.S. Geological Survey; L, Lamont Geological Observatory.

easterly direction indicate that it originated in an eruption of Mount Rainier. The layer is well exposed in a road cut 1.1 miles east of Sunrise Lodge at Yakima Park on the northeast side of Mount Rainier.

Layer R underlies carbonized wood dated as about 8,750 years old, but it postdates the glaciation of late Wisconsin age at Mount Rainier.

ASH LAYER O

Ash layer O consists chiefly of light-yellowish-brown (10*YR* 6/4) to yellow (10*YR* 7/6) silt to sand-size pumiceous glass and crystals, and at some places aggregates of iron oxide and clay. Particles in this ash have an iron-oxide-rich film, beneath which crystals and glass are clear and seem to be unaltered.

The thickness of ash layer O near Mount Rainier ranges from 2 to 5 inches. The ash occurs all around the volcano, but we have not attempted to trace it beyond the park boundaries. It overlies layer R in road cuts at Yakima Park, where it is about 2 inches thick.

Radiocarbon analysis of carbonized wood underlying layer O gave an age of about 8,750 years. In the White River valley, the ash underlies the 4,800-year-old Osceola Mudflow (Crandell and Waldron, 1956). According to Ray E. Wilcox, U.S. Geological Survey (oral communication, 1962), the mineralogic and petrographic characteristics of ash layer O correspond closely to those of the pumice and ash from the eruption of Mount Mazama that formed the Crater Lake caldera in southern Oregon. This eruption is considered to have occurred about 6,500 years ago (Williams, 1953, p. 46).

LAPILLI AND ASH LAYER Y

Layer Y in the park is a relatively thick deposit of dacitic pumice lapilli and vitric and crystal ash, and is generally very pale brown (10*YR* 7/4) to light yellowish brown (10*YR* 6/4). It is the most widespread, thickest, and most conspicuous of the Recent pyroclastic deposits at Mount Rainier. In addition, it is the only ash layer in these deposits in which pyroxene is rare. It is well exposed in a road cut adjacent to State Highway 5, 1.8 miles east of Ashford, Wash., where it is 22 inches thick.

A progressive decrease in grain size from south to north is apparent: 5 miles south of the summit the layer contains lapilli as large as 12 mm, and more than 30 percent of the deposit is larger than 1 mm, but 7 miles northeast of the summit the largest fragments are about 3 mm, and only about 5 percent of the layer is larger than 1 mm. Layer Y extends at least to Keechelus Lake (fig. 138.1) 25 miles northeast of Mount Rainier, where fragments as large as 1 mm have been found.

Layer Y is about 2 feet thick in the Nisqually River valley just west of the park, only 8 inches thick 4 miles east of Elbe, and is absent at Elbe. In addition, it is about 1 foot thick in all but the southeastern part of the park, where it is thin or absent. Southwest from Mount Rainier it increases markedly in grain size and thickness toward Mount St. Helens; near Randle it is as much as 4 feet thick and contains fragments as large as 3 inches.

Its stratigraphic position, distribution, and southwesterly increase in size and thickness clearly indicate

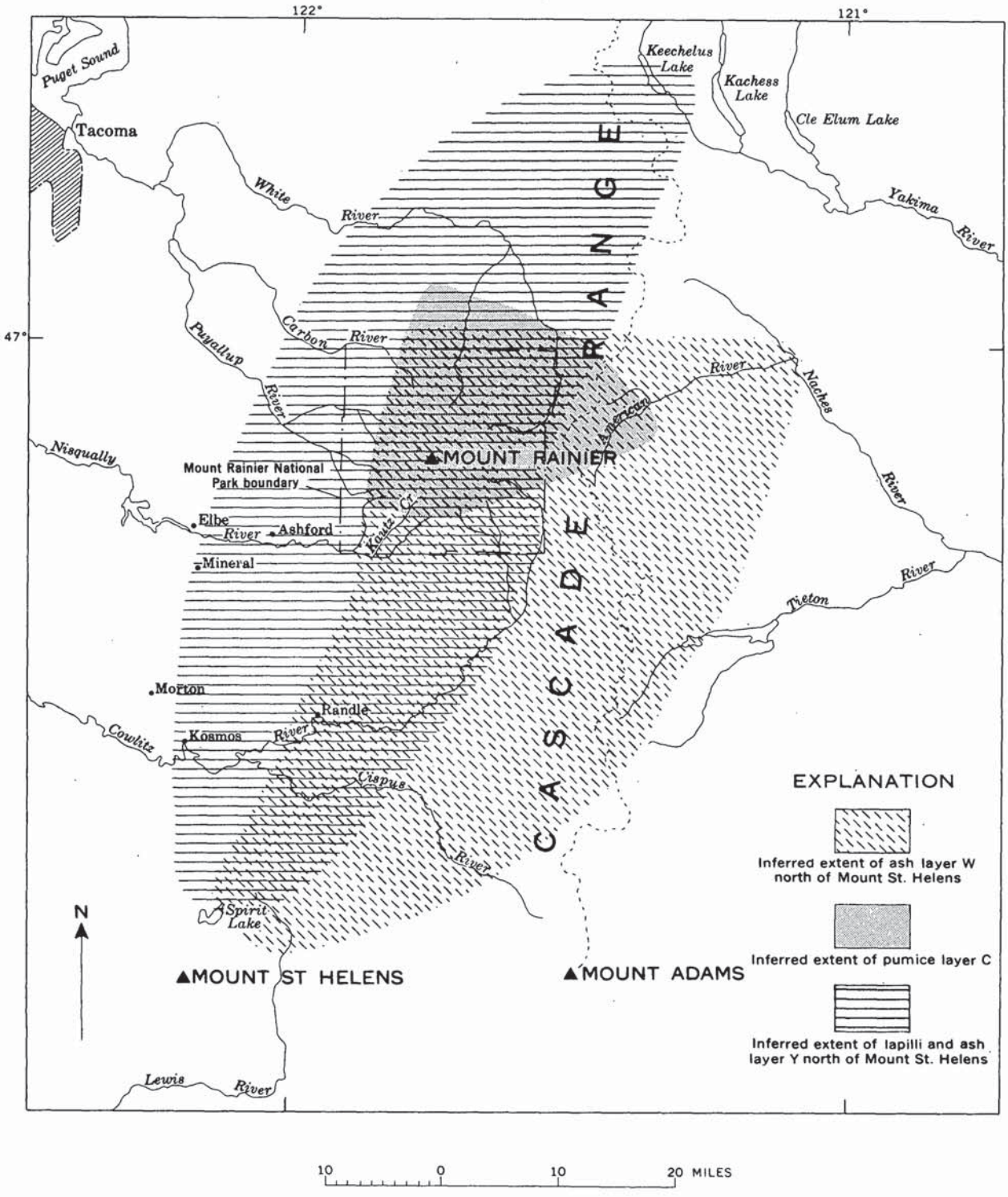

FIGURE 138.1.—Inferred extent of ash and lapilli layers W, Y, and C.

that layer Y is the same as the "older pumice" of the Cowlitz River valley described by Carithers (1946, p. 16). Layer Y is not exposed on the flanks of Mount St. Helens, for the present cone postdates it.

Ash layer Y is estimated to be about 3,200 years old: radiocarbon ages of about 2,500 and 3,000 years were obtained from organic matter above it, and ages of 3,500 and 4,000 years from below it (see table).

PUMICE LAYER C

By far the coarsest pyroclastic material in the Recent sequence is the pale-yellow (5*Y* 8/3) to olive-gray (5*Y* 5/2) and black pumice layer C, which contains fragments as large as a foot in maximum dimension. This layer also contains dense lithic ash and lapilli. Glass in the most common pumice is andesitic (refractive index about 1.52–1.53), although fragments of dacitic glass have been found whose refractive index is between 1.50 and 1.51. The layer is thickest and the pumice coarsest on the north and east sides of Mount Rainier, where it was first described by Smith (1898, p. 418). The pumice is abundant at ground surface at Yakima Park, where fragments are as large as 2½ inches in diameter. It commonly is 8 to 12 inches thick as far as 12 miles from the summit of the volcano, but only 4 inches thick 15 miles from the summit. Scattered fragments as large as half an inch are present in the American River valley at a point 18 miles east of Mount Rainier. On the south and west sides of Mount Rainier the pumice decreases more abruptly in grain size and thickness, and generally it is absent more than 4 miles from the summit. At one locality on the south flank of Mount Rainier, material similar to layer C occurs in agglutinated masses as large as 3 feet in diameter.

Samples of pumice resembling layer C from the southwest flank of the volcano lack hornblende, although samples from the northeast side all contain at least small amounts of hornblende. Though not clearly established, the pumice lacking hornblende may represent a separate eruption.

The hornblende-bearing pumice layer on the northeast side of the volcano has not been dated directly, but as it occurs between layers W and Y, its age is bracketed by dates of about 300 and 3,200 years. No pumice was seen on a terrace in the White River valley about half a mile downstream from the position of the terminus of the Emmons Glacier in 1910. This terrace is inferred to have been forested for at least 1,000 years (Sigafoos and Hendricks, 1961); thus, layer C presumably is older than 1,000 years.

ASH LAYER W

Ash layer W at Mount Rainier is a thin layer of coarse to very coarse sand-size dacitic pumice and smaller crystals, pumice, and glass shards; it ranges in color from white (2.5*Y* 8/2) to light gray (2.5*Y* 7/2) or pale yellow (2.5*Y* 8/4). It is generally recognizable by its size range, color, and thickness; a distinctive mineralogic feature is the high refractive index of its hypersthene (n_x about 1.71) as compared to that of the hypersthenes in the other layers younger than layer R (n_x about 1.69).

This ash layer occurs in the eastern two-thirds of Mount Rainier National Park, and extends beyond the park boundaries in all directions except west and northwest (fig. 138.1). Layer W is almost continu-

Section measured in the east bank of Kautz Creek about 3,000 feet upstream from Wonderland Trail Bridge across creek

	Ft.	in.
21. Debris flow; boulders and cobbles in medium- to fine-sand matrix. Deposited in October 1947	2–8	
20. Duff, silty, dark-grayish-brown; contains roots and wood fragments		6
19. Boulders, 1 to 4 feet in diameter, in stratified coarse sand and granule matrix	3	
18. Sand, fine to medium, gray, horizontally stratified and interbedded with layers of yellowish-gray silt	2	
17. Duff; contains fragments of carbonized wood		2
16. Silt and fine sand, yellowish-gray, horizontally bedded; contains pebbles and granules near top	1	
15. Duff and roots (radiocarbon sample W–1120, 290±200 years)		¼–½
14. Sand, fine, gray		¼–½
13. Ash layer W		½–2
12. Sand, fine, gray		½
11. Duff, wood and carbonized wood fragments (radiocarbon sample W–1119, 320±200 years)		½–1½
10. Sand, fine to medium, gray; contains scattered cobbles		6
9. Debris flow; pebbles and cobbles in compact sand and granule matrix; gray	2	
8. Sand, medium, mostly horizontally stratified but has some faint crossbedding; contains reworked ash of layer Y, and wood fragments	5	
7. Debris flow; boulders and cobbles in fine- to medium-sand and granule matrix	2	6
6. Duff mixed with gray fine sand; contains fragments of charcoal		½–2
5. Sand, fine, gray; contains reworked pumice of layer Y, and wood fragments	½–2	
4. Debris flow; boulders as large as 4 feet in diameter in gray sand and granule matrix	15	
3. Sand, fine to medium, stratified, lenticular	1–3	
2. Lapilli and ash layer Y		8
1. Pebble to boulder gravel and sand	1.0+	

ously exposed adjacent to the highway between Longmire and Van Trump Creek in the park, where it is 2 inches thick. The ash increases in thickness from about ½ to 2 inches from the northern to the southern boundary of the park, while the ratio of coarse sand to finer sand increases from about 15:85 to 40:60. Southwest of the park, layer W continues to increase in thickness and grain size; near Randle, for example, it is several inches thick and contains pumice lapilli as large as 8 mm. On the north flank of Mount St. Helens, it is as much as 20 feet thick and contains pumice fragments 2 feet in diameter. Between Mount St. Helens and Mount Rainier, this layer is the younger, light-gray pumice deposit of Carithers (1946, p. 16).

Radiocarbon analyses of carbon from duff layers just above and below ash layer W in the valley wall of Kautz Creek on the south side of Mount Rainier (see measured section) suggest an age of about 300 years.

ASH LAYER G

Ash layer G is the youngest pyroclastic layer recognized at Mount Rainier and is a discontinuous layer ¼ to ½ inch thick in the modern forest duff. It consists principally of reddish-gray (10*YR* 5/2) silt to very fine sand-size crystals, but also contains both brown turbid glass (refractive index about 1.52–1.53) and clear glass (about 1.49–1.50) that probably are andesitic and dacitic, respectively. It is distinguished from other ash layers by its color, fine size, stratigraphic position, and by containing a wider variety of dark minerals than other layers younger than lapilli and ash layer R (see table). The variety of minerals and glass suggests the possibility that this layer contains ash from two volcanoes, perhaps Mount Rainier and Mount St. Helens, but this has not been verified by other evidence. The ash overlies layer W along the highway between Longmire and Van Trump Creek in the park, where it is ½ inch thick. The lateral extent of the ash is not known, although it seems to be absent west of the park.

The ash is on a moraine formed about the middle of the 18th century, but is absent on a moraine formed about A.D. 1900.

OLDER ASH LAYER OR LAYERS

At least one partly oxidized crystal ash layer lies below layer R, and also postdates the last glaciation of Wisconsin age. This has been seen at only a few places, and its distribution, source, and stratigraphic relations are not well known, so that it cannot be said to be the deposit of a single ash fall. It is similar in color, thickness, and texture to ash layer O, but differs in that it contains a markedly wider variety of minerals and larger proportion of crystals. Despite its age of probably more than 10,000 years, the older ash contains much clear glass. The fine texture of the layer suggests that it did not originate at Mount Rainier.

CONCLUSIONS

Preliminary work on Recent pyroclastic deposits on the flanks of Mount Rainier volcano indicates that at least 2 and probably 3 of the most distinctive, thickest, and most widespread layers were erupted by other volcanoes. The two pyroclastic layers originating from Mount Rainier are characterized by abundant andesitic glass and lithic fragments, and those derived from other volcanoes by dacitic glass.

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