OPENING SESSION

MT. ST. HELENS, WASHINGTON: INITIAL ERUPTIVE EVENTS AND MORPHOLOGIC CHANGES

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INTRODUCTION

After a week of increasing seismic activity, on March 27, 1980, Mt. St. Helens erupted ash and steam to a height of some 2000 m above the new summit crater. This eruption broke a 125-year period of dormancy for this volcano, which had become a popular scenic attraction and center of outdoor recreational activity in the southwestern corner of the state of Washington (figure 1). The U.S. Geological Survey hastily called in experts from Denver, Menlo Park, and the Hawaiian volcano observatory, and geologists and volcanologists converged on the mountain from all over the world. Toward the middle of April the frequency of eruptions declined, and local newspapers and television stations confidently reported that the eruptions were over, and that scientists were packing up and leaving. However, the U.S. Geological Survey continued to monitor a bulge on the

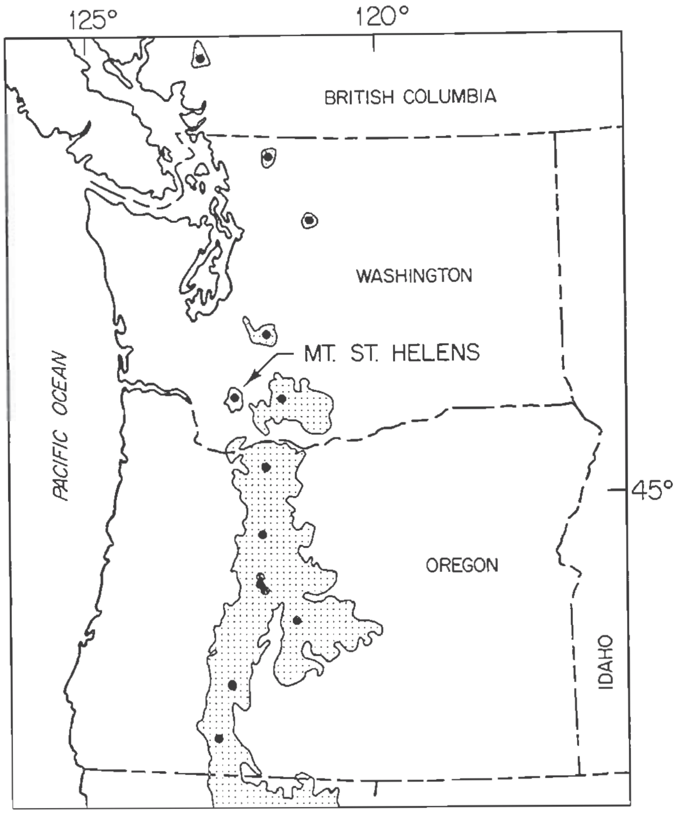

Figure 1 — Location of Mt. St. Helens. Solid dots indicate positions of other major Quaternary volcanoes and dotted area is extent of quaternary volcanic deposits.

north flank of the volcano, which grew outward at up to 2 m per day. Small phreatic eruptions took place again from May 7 to May 14, while growth of the bulge continued at a nearly constant rate. On the morning of May 18, a major eruption destroyed the summit and north flank of the mountain. In intensity and volume of material involved, this eruption appears to be equivalent to the 79 a.d. eruption of Vesuvius that destroyed Pompeii. Atlhough the remote location of Mt. St. Helens prevented major loss of life, about 60 people are known dead or remain unaccounted for as a result of this eruption.

This note summarizes observations of eruptive activity and morphologic changes in the volcano up to the eruption of May 18. Reference data include both aerial and groundbased still photography and sketches, and 16 mm movie film taken from a U.S. Geological Survey observation camp about 15 km northwest of the mountain. Additional background data and details of eruptions and compositions of eruptive products through August, 1980, are given by Hoblitt et al, 1980.

INITIAL EVENTS AND MORPHOLOGY

On March 30, the principal morphologic features that would persist until the catastrophic May 18 eruption were already established. Two nearly circular craters occupied a shallow graben running approximately east-west across the summit. Along the south side of the graben, parallel sets of normal faults produced a terraced scarp, while on the north, faults were less well-defined, with a sharp triangular peak marking the north rim of the graben. To the northeast of this peak, the surfaces of the Forsythe and Leschi glaciers were crossed by a network of fractures which marked the location of the bulge that continued to expand northward at rates up to several meters per day through May 17 (figure 2).

The initial eruptions in late March and continuing through the middle of April were all apparently phreatic and the associated ash consisted of finely ground rock debris, presumably derived from the summit dome. By April 6, the two craters had merged to a single pit about 300 m $\times$ 500 m, elongated in the direction of the graben and extending entirely across it. The

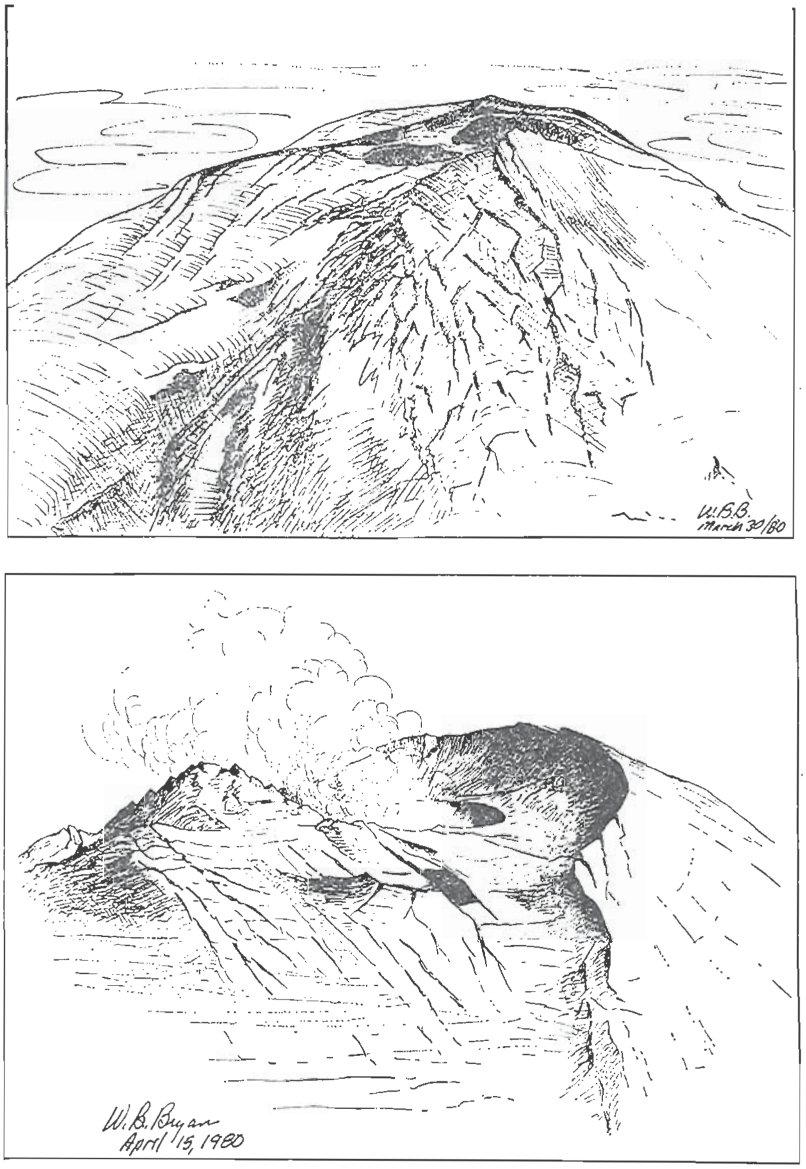

Figure 2 — A. Aerial view on March 30, 1980, looking southwest, showing double crater, summit graben, and fractured glacier above incipient bulge in foreground.

B. Sketch of summit area on April 15, 1980, as viewed from the northwest through a theodolite at USGS observation camp (Coldwater I).

crater floor was about 250 m below the southern crest of the graben (Hammond, 1980a). Through April 25, graben subsidence continued and the crater continued to grow. Eruptions became relatively less frequent, with alternating days of quiescence and activity. Some eruptions consisted almost entirely of steam, while others were heavily charged with dark ash. With increasing crater depth, eruptions were confined within the crater, and possibly more time was required to build up sufficient energy to eject material past the rim. On April 16, a series of ash eruptions occurred in a « boil-over » pattern that sent successive waves of fluidized ash and steam down the north flank. Eruptions ceased entirely from April 25 to May 6, and then resumed between May 7 and 14. Throughout this period the bulge on the north flank continued to move outward, with the movement almost entirely horizontal and reaching a maximum of 100 m (EOS, July 29, 1980).

Ash accumulations near the summit combined with melting snow, and triggered by seismic shocks, descended the flanks of the mountain leading to erroneous early reports of lava flows and mud flows. One of these « flows » descended a gully along the course of the Forsythe glacier below the expanding bulge on the north flank of the mountain, and was examined and photographed the following day. Morphologically, this and other debris flows closely resembled flows of dark aa lava, with levee banks 2-3 m high enclosing a central « track » filled with angular, cross-ridged blocky flow material. One of these flows is illustrated by Hammond, 1980a. These « flows » however consist of poorly consolidated angular blocks of mixed snow and ash, with snow making up as much as 90 percent of the material. In spite of their appearance, they are essentially ash-pigmented snow and ice avalanches.

THE MAY 18 ERUPTION

On the morning of May 18, a magnitude 5 earthquake apparently started a major landslide on the oversteepened north slope. The consequent release of pressure is inferred to have triggered explosion of an underlying plug of gas-charged dacite magma. The initial blast was directed horizontally to the north and northwest of the mountain. The strongly directional nature of the blast is suggested by the contrasting reports of observers close to and far from the mountain ; nearby surviving eyewitnesses described the eruption as «silent!» and the shock wave was not felt by airborne observers, but the shock was felt and heard as far away as Vancouver, B.C. (Hamomnd, 1980b).

Violent plinian eruptions continued for the next 9 hours, totally destroying the summit and north flank, and excavating a large crater measuring about 1 1/2 × 3 km. Ash was ejected to a height of over 20 km, and damaged crops and disrupted transportation over a broad region extending several hundred kilometers to the northeast of the volcano. The landslide, initial blast, and subsequent pyroclastic flows destroyed over 500 km^2 of forest north and northwest of the volcano, and floods and mudflows destroyed highways and property and filled navigation channels in the Columbia river, over 100 km downstream from the site of the eruption.

The landslide and eruption removed about 400 m from the top of Mt. St. Helens and left an amphitheater — like depression 1.5 km deep, open to the north. The volume of material removed is about 2.5 km^3 (Hammond, 1980b). The contrast between the original conical form of the mountain and its present configuration is indicated in fig. 3. Since May 18, several dacite domes have grown in the floor of this amphitheater and have been

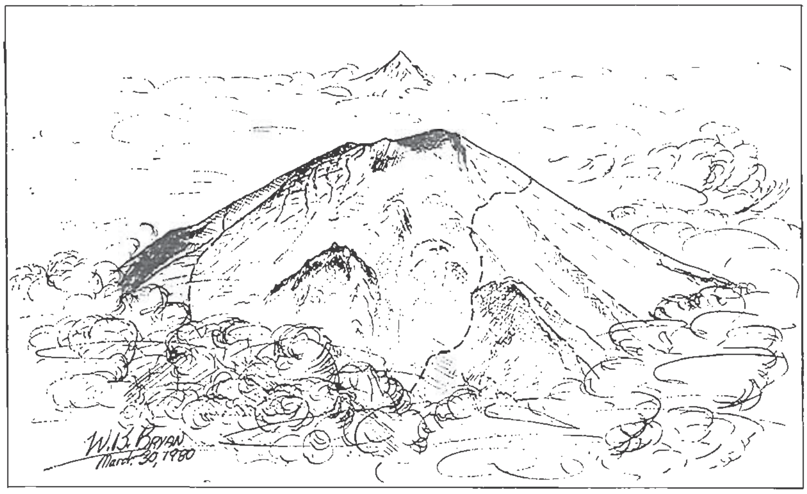

Figure 3 — Aerial view of Mt. St. Helens on March 30, 1980 looking southeast toward Mt. Hood. Dashed line shows approximate position of the crater rim after the May 18 eruption.

destroyed by subsequent eruptions. Hoblitt et al. (1980) note that this deep exposure of magma plumbing within the volcano is unprecedented in the history of the volcano, and the future course of events is uncertain. Probably it will remain active and will continue to evolve morphologically for many years to come.

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