SUMMARY OF GEOLOGIC EFFECTS OF THE BOXCAR EVENT, NEVADA TEST SITE

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UNITED STATES
DEPARTMENT OF THE INTERIOR
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Abstract

A high-yield underground nuclear explosion at the U20i site, formed a sink 1,000 feet in diameter above the explosion point. Fractures opened as far as 20,000 feet from the explosion and rockfalls occurred as far as 15 miles. Most fractures were coincidental with north-trending naturally occurring faults. Maximum displacement along a fault was 3 feet vertically with the downthrown side the same as that on the original fault.

Introduction

A high-yield underground nuclear explosion, code named Boxcar, was detonated at 7 a.m., Pacific Daylight Time, April 26, 1968, at a depth of 3,800 feet in the U20i drill hole on Pahute Mesa (fig. 1).

The principal geologic effects of the explosion were fractures and rockfalls. Fractures occurred as much as 20,000 feet from ground zero, and rockfalls occurred as far as 15 miles from ground zero. A sink about 1,000 feet in diameter formed above the explosion site.

All known faults and strong lineaments within a distance of about 4 miles from ground zero were examined. In addition, reconnaissance traverses were made to search for fractures where no faults are known. Fractures more than 1,500 feet from ground zero were mapped in the field on aerial photos at a scale of 1:6,000; fractures within 1,500 feet of ground zero were mapped on aerial photos at a scale of 1:2,400 but were not field checked.

A pre- and postshot geodimeter survey was made of a grid of stations across a fault about 3,000 feet east of ground zero along

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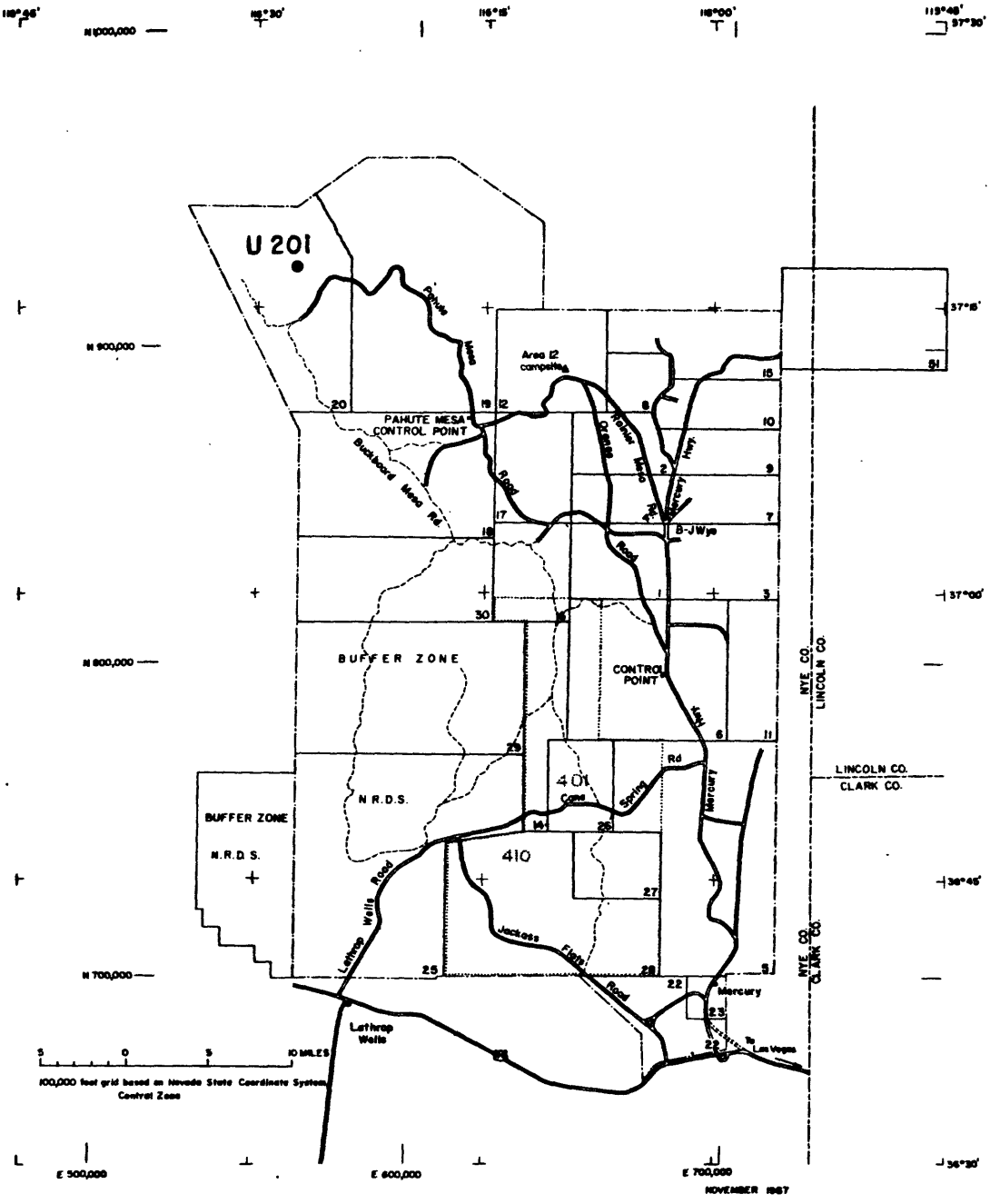

Figure 1.--Index map of the Nevada Test Site showing location of U20i.

which movement was expected. The survey was designed to determine lateral movement on the fault.

Fractures

The Boxcar event caused fractures along preexplosion faults as far as 20,000 feet from ground zero (fig. 2A and B). The most conspicuous set of explosion-produced fractures follows a north-trending preexplosion fault that passes within 3,000 feet east of ground zero. The explosion-produced fractures do not coincide exactly with the trace of the preexplosion fault as previously mapped, but the association is unequivocal. Explosion-produced fractures were mapped along this fault for more than 26,000 feet, with a maximum vertical displacement of 3 feet at a point about 3,500 feet east-southeast of ground zero. In general, surface displacements of the explosion-produced fractures decrease with distance from ground zero, but 1 foot of vertical displacement was measured about 8,500 feet south of ground zero and 1-1/2 feet was measured some 9,000 feet north of ground zero. All vertical displacements are down on the west, both for the explosion-produced fractures and for the preexplosion fault. More than 0.3 foot of left lateral displacement occurred east of ground zero and about 0.2 foot occurred about 7,500 feet northeast of ground zero.

The fractures that lie about 3,500 and 4,500 feet southwest and northwest of ground zero, respectively, probably are controlled by buried faults as they are approximately along the projection of the strike of natural faults that displace the Thirsty Canyon Tuff. It is likely that both the preexplosion fault and explosion-produced fractures are indicative of older and larger faults in volcanic rocks buried beneath the relatively young (about 7 million years) Thirsty Canyon Tuff that blankets most of the western part of Pahute Mesa. The two sets of north-trending fractures that lie between 7,000 and 12,000 feet northwest of ground zero are also believed to be indicative of buried preexplosion faults.

The en echelon series of fractures about 15,000 feet west-southwest of ground zero follows a preexplosion fault. These fractures, however, were probably formed by the earlier Cabriolet event at U201 and were reopened by the Boxcar event. The fracture about 11,000 feet southeast of ground zero is known to have formed prior to the Boxcar event. This fracture was initially formed by the Rex event at U20h, was reopened by the Greeley event at U20g 14,000 feet east-northeast of Boxcar, and reopened again by the Boxcar event.

The Boxcar event also produced many small fractures, most of which are not shown in figure 2. The few that are shown are along the road west of ground zero and around the sink at ground zero. Some of these fractures are several hundred feet long, but as they do not persist in narrow zones for thousands of feet, they probably don't reflect major buried preexplosion faults.

Geodimeter survey

About 20 survey stations were established in a grid of stations about 1,000 feet apart, straddling the fault 3,000 feet east of ground zero. Distances between stations in the grid were measured with a geodimeter before and after the explosion. Both the raw measurements and the measurements corrected for development of a cavity at the explosion site indicate left lateral movement of more than 0.3 foot along the fault. That is, northwest-trending survey lines that cross the fault were shortened and northeast-trending lines were lengthened. This was not confirmed by observation of the surface fractures in this area, but the direction of lateral movement is in agreement with the 0.2 foot of left lateral movement observed on this fault at the ground surface 7,500 feet northeast of ground zero. So, in addition to the large vertical displacement on this fault, there appears to have been a smaller horizontal component.