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UNITED STATES
DEPARTMENT OF THE INTERIOR
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GEOLOGIC EFFECTS OF THE GREELEY EVENT, NEVADA TEST SITE

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Abstract

The intermediate yield Greeley event, in which a nuclear device was detonated at a depth of 3,990 feet in Pahute Mesa at the Nevada Test Site, caused fracturing in rocks and spalling of rock from cliffs as far as 3 and 8 miles, respectively, from the detonation point.

Introduction

The Greeley event with an explosion of intermediate yield was set off December 20, 1966, in the U20g drill hole on Pahute Mesa at the Nevada Test Site (fig. 1). Pahute Mesa consists mostly of welded tuff, vitric and zeolitic bedded tuff, and rhyolite in alternating units. Details of the geology are shown on maps by Noble and others (1967), and Ekren and others (1966). The explosion was in devitrified zeolitized partially welded tuff at a depth of 3,990 feet.

Because of the large area affected by the explosion and the roughness of the terrain, it was not practical to traverse all of the possible affected ground. After some of the area near ground zero

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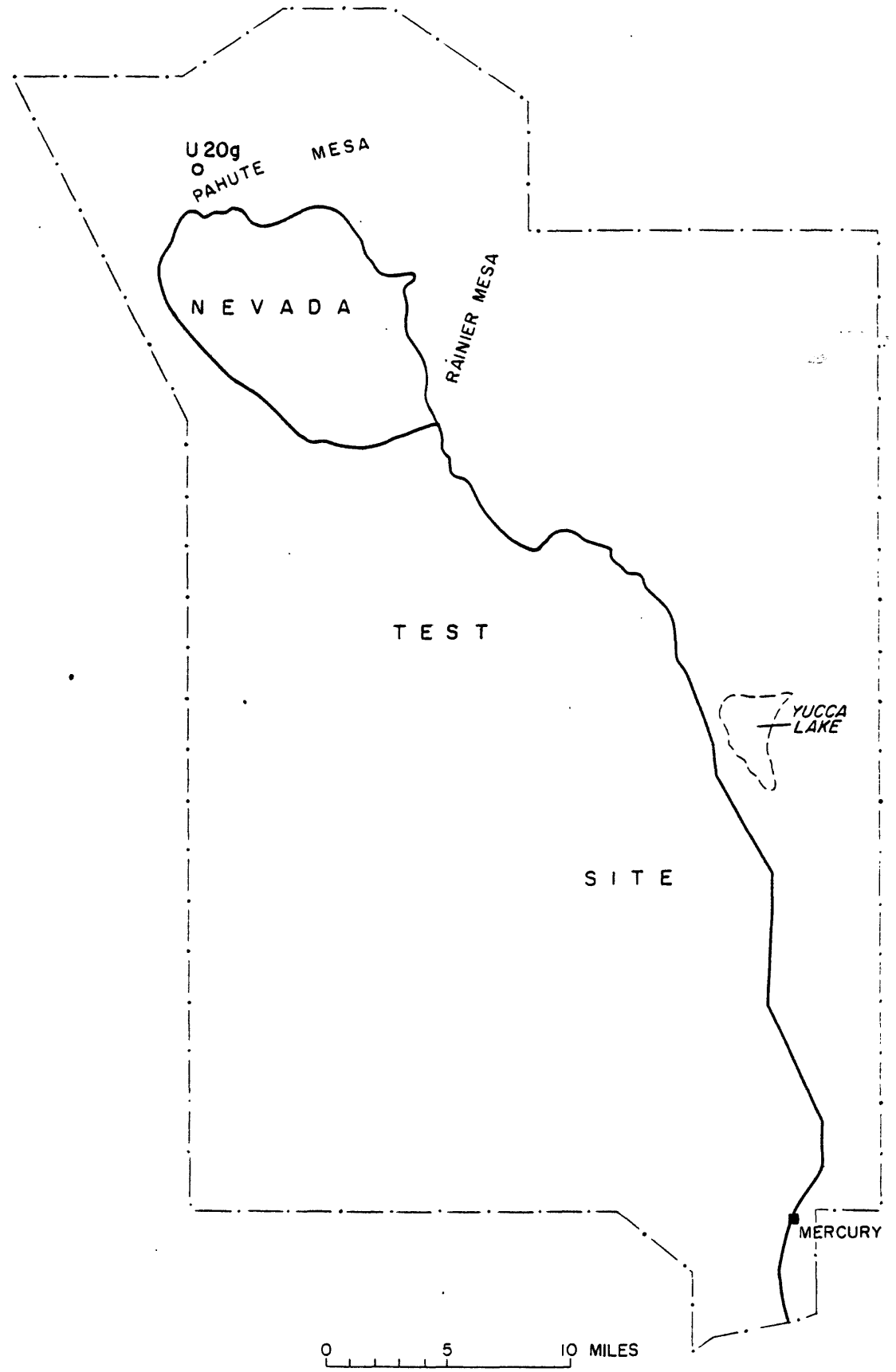

Figure 1.—Index map showing the Nevada Test Site, and location of U 20 g site

had been mapped, it became apparent that most of the fractures beyond a radius of 2,500 feet from ground zero were controlled by north-trending preexplosion natural fractures (fig. 2). The search for fracturing due to the Greeley event was, therefore, more thorough along the natural fractures than between them.

The ground within about 2,000 feet of ground zero was not examined in detail. Access to this ground was not permitted for several weeks after the explosion because of occasional seismic activity below ground zero, which was indicative of possible cavity collapse. Fracture mapping was completed in the GZ area using the 1:2,400-scale postexplosion photographs, which show all of the larger fractures. Although many of the individual fractures probably were not observed on the photographs and, therefore, were not mapped, the gross fracture pattern is well represented on figure 2.

Some of the fracture mapping is diagrammatic in that each individual crack is not plottable at the scale used. For example, the right-lateral fault movement shown in the north-central part of figure 2a is manifested in some places on the ground by discontinuous en echelon fractures with right-lateral displacement. Probably some fractures in the canyons were not mapped because the spalled rocks, debris, and short unmappable fractures caused by the falling rock have obscured otherwise prominent fractures.

Geologic Effects

The geologic effects of the Greeley event are more conspicuously controlled by preexplosion natural fractures than any prior event detonated at the Nevada Test Site. Figure 2 clearly shows that explosion-produced fractures correlate closely to natural fractures and occur as far as about 3 miles from ground zero. Continuously fractured ground along some of the north-trending faults occurs for as much as 13,000 feet. Discontinuously fractured ground occurs for as much as 20,000 feet. Vertical displacement is commonly only a few inches, but ranges to as much as 4 feet. The direction of displacement caused by the explosion is generally the same as that of the natural fault. A few faults such as the one 5,000 feet east of ground zero and along part of one 10,000 feet north of ground zero have as much as 6 inches right-lateral displacement. The maximum separation between fault blocks is about 4 feet. Though fracturing was intense at many places along natural faults the ground between them has surprisingly few fractures, except where the ground was highly favorable for cracking such as roadbeds or well-packed soil.

Rock falls were another very conspicuous effect of the Greeley event, though they are not documented. Faces of cliffs and boulders on steep slopes were dislodged at many places as far as 8 miles, possibly more, from ground zero.

Two of the three concrete pads at ground zero did not crack, but a small trench caused by their vibration developed around them. The third concrete pad was borken as a result of differential uplift and protrusion of the drill hole casing through it.

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