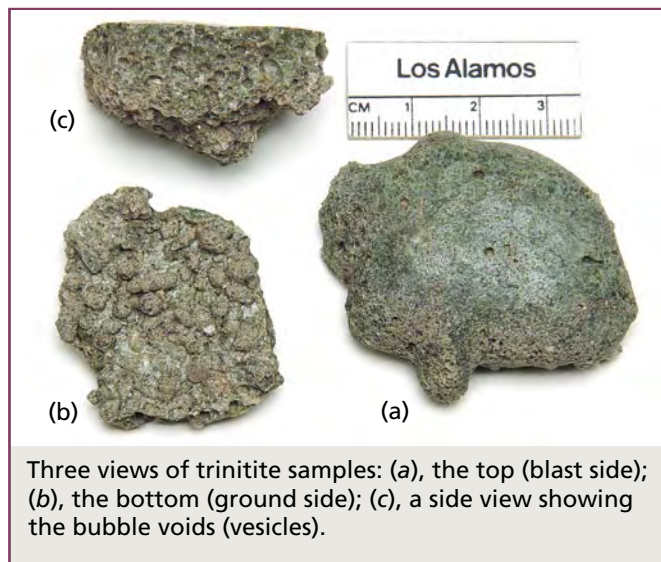


# A New Look at Trinitite

Sixty years after the July 16, 1945, test of the first nuclear bomb (originally called an atomic bomb) at Trinity Site on White Sands Missile Range (WSMR) in New Mexico, we collected many samples of the soil fused by the explosion. This very slightly radioactive green glass is called trinitite.



Three views of trinitite samples: (a), the top (blast side); (b), the bottom (ground side); (c), a side view showing the bubble voids (vesicles).

Our purposes were to use the properties of trinitite to calculate backward to the yield, fireball temperature, fireball duration, heat in the rising fireball, and the spread of ejecta from the Trinity test and to suggest that trinitite was deposited by a rain of molten droplets and puddling from the heat. Using our trinitite samples, we calculated some probable conditions of the nuclear explosion. We estimate the yield of the Trinity event was 9–18 kt, plus approximately 4.2 kt from the energy carried away by the mushroom cloud. We calculated an average fireball temperature of 8430 K, the duration of heating at approximately 3.1 s, and a crater depth of approximately 4 ft. These numbers compare reasonably well with the real-time measurements calculated 60 years ago and with unclassified published data.

If Trinity Site had not been cleaned up (bulldozed) by removing and/or burying a significant portion of the trinitite, a field survey would provide the numbers needed for our calculations. Because an explosion of plutonium formed the trinitite, most previous observations had a radiological emphasis.

Our discussion is confined to macroscopic measurements and theoretical calculations of the blast based on a few assumptions. We show how observations of nonradiological trinitite properties and relatively straightforward calculations provide estimates of the event that produced the “lake of green glass” in 1945.

## Yield Calculation

Most of our samples are approximately the size of a small pancake with similar thicknesses that include significant trapped bubble voids. The top (blast side) is smooth with a light green glassy luster. The bottom (ground side) is rough and light tan with sandy inclusions. Comparing our samples with an old photo, we conclude they are a reasonable representation of the glassy trinitite field. The average thickness of our samples is 1–2 cm; samples <1 cm or >2 cm in thickness are less common. Determining the thickness of the trinitite layer was critical in our yield calculation.

Another crucial number is the maximum radial extent  $R$  of the trinitite layer (thickness  $\Delta L$ ) from ground zero. We used aerial photos taken 28 h after the Trinity event to determine the radial extent. These photos show the trinitite layer extended to a radius of at least 300 m. We used a value of  $R = 300$  m for the radial extent of the trinitite.



Undisturbed surface of the trinitite field.