A New Look at Trinitite

This is trinitite—a glass created during the world's first nuclear explosion at Trinity Site in southern New Mexico on July 16, 1945.

1 How was it formed?

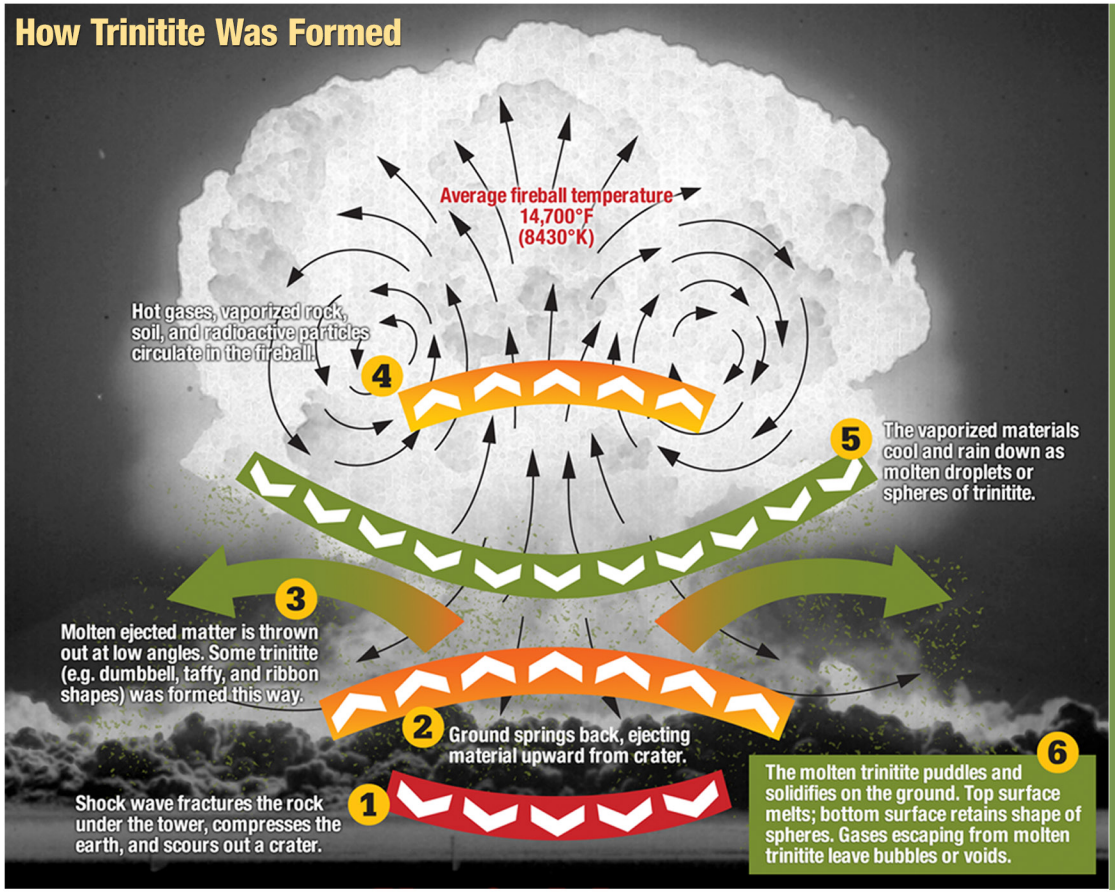
A Los Alamos scientist has recently challenged the standard explanation—that the intense heat of the explosion melted the sand, turning it into a green glass.

Ants at work at Trinity Site

Robb Hermes, a chemist, collects sand. But not any kind of sand. Hermes collects *ant* sand.

During a tour of Trinity Site, Hermes noticed many anthills and wondered if they contained trinitite. Later, through official channels, he obtained two small samples.

How Trinitite Was Formed



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The theory developed by Hermes and Strickfaden—that trinitite was deposited by a rain of molten droplets—is now generally accepted, although it is most likely that trinitite was formed by a combination of thermal events besides "rain," including some direct melting of the sand.

Hermes and Strickfaden developed their theory using the scientific method, the basis of all research done at Los Alamos National Laboratory.

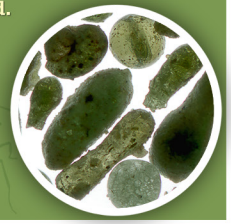
This small anthill at Trinity Site made by nocturnal ants, Myrmecocystus mexicanus, reveals green pieces of trinitite.

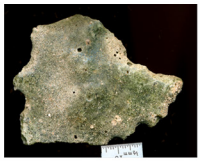
Ants are natural miners. The sand they pile up holds clues to what is underground. Geologists know that the mineral particles found in anthills can be a guide to the underlying bedrock. Paleontologists sift through anthills for evidence of prehistoric life.

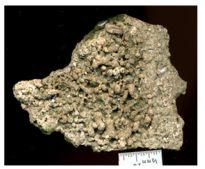
2

Hermes showed the samples to a colleague, William Strickfaden, who sorted the sand. It was he who discovered that ant sand did contain trinitite, but in unexpected shapes: mostly small spheres but also droplets, dumbbells, and aerodynamic shapes.

These shapes piqued Strickfaden's curiosity. What could they mean? Pondering that question together, the two scientists proposed a new theory describe how trinitite was created.







These photographs above illustrate the theory proposed by Hermes and Strickfaden. They show the top and bottom surfaces of a single piece of trinitite. Its top surface (top) was melted by the heat of the fireball, while its bottom surface (bottom), cooled by the ground, retains the shape of tiny spheres of "rain."

First, they asked a question:
What do the various shapes of trinitite mean?

Next, they developed a hypothesis:
Trinitite was deposited by a rain of molten droplets, which then puddled on the ground.

They tested their hypothesis with an experiment:
While it was impossible to replicate a nuclear blast, the two scientists conducted high-temperature tests on sand.

They analyzed the results and drew a conclusion:
Trinitite was formed when material melted by the nuclear explosion fell back to the ground as "rain." This conclusion is supported by the two photos of trinitite shown at left. After falling on the ground, the top surface of the trinitite layer, still being heated by the fireball, developed a smooth surface. The bottom surface, being cooler, retained a record of the first spheres deposited.

Then they communicated their research so others could test their theory independently:
Hermes has published papers and given talks about his theory, stimulating the healthy debate that is a hallmark of the scientific method.

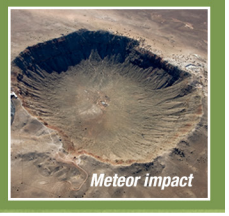
4

Is there any other process, natural or artificial, that also produces similar spheres?

Hermes, curious, asked himself that question and found that spheres are not rare; they occur commonly from any event that is hot enough to melt or fuse earth.


Lightning strike


Volcano


Meteor impact

5 One question leads to another.

Hermes wondered if fused material like trinitite had been created during the Soviet Union's first nuclear test, Joe-1, in 1949.

It had. The sample Hermes obtained from the site of that test differed externally from trinitite, but he expected its radiological signature to be the same. The Joe-1 device was an exact duplicate of the Trinity Site device.

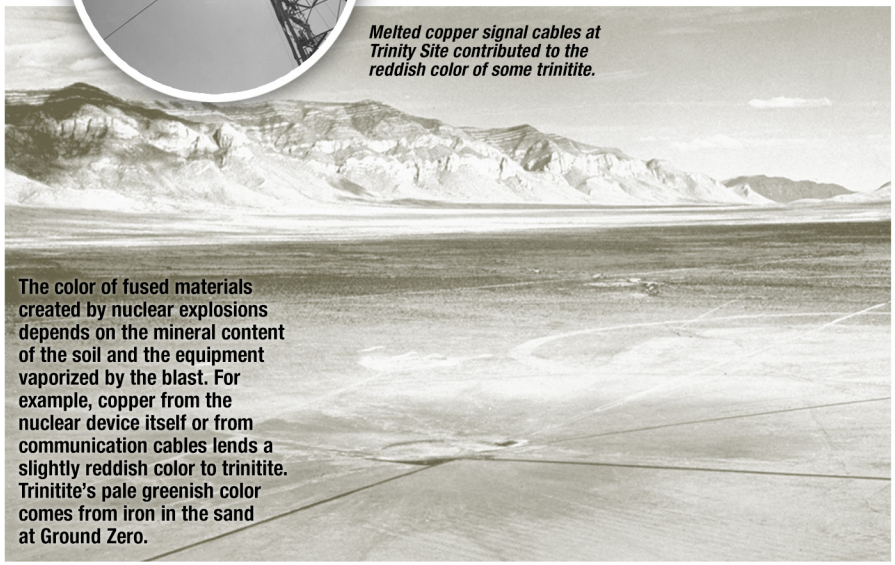
Yet gamma-ray spectroscopy showed radiological differences between the fused soil from the original American and Soviet test sites. Why?

The Soviet test of 1949 was named Joe-1 for Joseph Stalin.

Trinitite can no longer be collected from Trinity Site, but samples collected before the ban are often for sale. Do you own a sample of trinitite?

Bill Strickfaden holding a piece of trinitite outside the inner fence at Trinity Site.

Main outer fence at Trinity Site

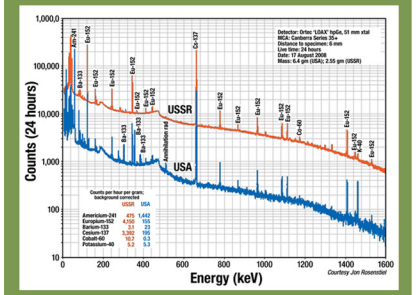


Melted copper signal cables at Trinity Site contributed to the reddish color of some trinitite.

The color of fused materials created by nuclear explosions depends on the mineral content of the soil and the equipment vaporized by the blast. For example, copper from the nuclear device itself or from communication cables lends a slightly reddish color to trinitite. Trinitite's pale greenish color comes from iron in the sand at Ground Zero.

6 Mystery solved

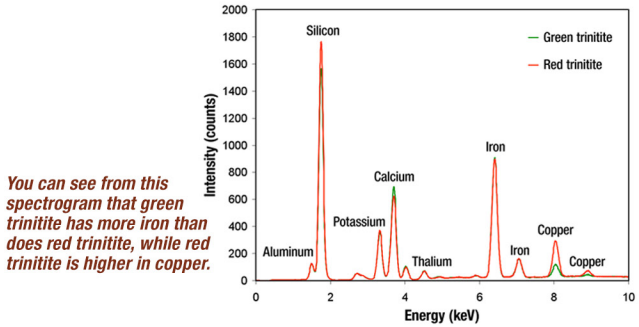
Upon inquiry, Hermes learned that the Soviets' original Ground Zero had been used a second time. The sample of fused material was a mixture of soil that had been remelted and remixed with debris from the second test.



High-energy gamma-ray spectrum of fused soil from Trinity Site and first Soviet nuclear detonations.

The story doesn't end here

In science, the questions never end. Understanding how trinitite was formed is only a step towards understanding what went on inside the radioactive cloud created during the Trinity test. Many more questions remain to be answered. That's the challenge of science!



You can see from this spectrogram that green trinitite has more iron than does red trinitite, while red trinitite is higher in copper.

Is trinitite radioactive?

Not all trinitite is equally radioactive; it depends on where in the nuclear explosion it was formed.

Checking a piece of trinitite at Trinity Site, September 1945, using a Cutie Pie—an early hand-held radiation detector. Oppenheimer is at extreme right.

Come to the Bradbury Science Museum to learn more and to see our trinitite samples.

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