Bizarre Earthquake Lights Finally Explained

Rare lights seen near earthquakes had long been called UFOs.

Brian Clark Howard, National Geographic, 1-6-14

Rare flashes of light that are sometimes seen around earthquakes are not caused by birds, or planes, or UFOs—all of which had been previously used to explain the phenomena known as earthquake lights.

Instead, the lights are caused by electrical properties of certain rocks in specific settings, report scientists in a new paper.

Sometimes called earthquake lightning, the lights can take "many different shapes, forms, and colors," says study coauthor Friedemann Freund, an adjunct professor of physics at San Jose State University and a senior researcher at NASA's Ames Research Center.

Freund says common forms of earthquake lights include bluish flames that appear to come out of the ground at ankle height; orbs of light called ball lightning that float in the air for tens of seconds or even minutes; and quick flashes of bright light that resemble regular lightning strikes, except they come out of the ground instead of the sky and can stretch up to 650 feet (200 meters).

Historic Sightings

Over the centuries, there have been many reports of earthquake lights, both before and while the ground is shaking.

Just seconds before the 2009 L'Aquila, Italy, earthquake, people saw four-inch (ten-centimeter) flames of light flickering above a stone street.

On November 12, 1988, people reported a bright purple-pink globe of light along the St. Lawrence River in Quebec, 11 days before a powerful quake.

People also reported seeing a faint rainbow of light before the great 1906 quake in San Francisco and lights before the devastating 1811-12 New Madrid earthquakes in Missouri.

Freund and colleagues studied such historic accounts going all the way back to the year 1600 and published their findings in *Seismological Research Letters*.

UFO Fodder

"In the past, people often interpreted [earthquake lights] in religious terms, and in modern times they thought of UFOs, although there is a completely rational physical explanation that we are working on," Freud says.

Jim Conacher thought he was seeing UFOs when he spied seven yellow, luminous globes floating on a mountain on Tagish Lake in Canada's Yukon territory in the early 1970s.

A retired Canadian government agriculture inspector, Conacher took a photo of the lights, which circulated widely as purported evidence of a UFO encounter.

Freund and colleagues noticed that the timing of Conacher's photo seemed to place it just a few hours before the

nearby Cross Sound earthquake of July 1, 1973, which measured 6.7 on the Richter scale.

For many years, sightings of earthquake lights were dismissed by the serious geology community.

But in the mid-1960s, during a series of earthquakes in Nagano, Japan, scientists made photos of earthquake lights that were clearly tied to the geologic activity. Since then, an increasing number of the phenomena have been captured on film and video, Freund said, in part because of the rise of surveillance cameras.

For example, cameras caught clear images of earthquake lights in Pisco, Peru, in August 2007, during a magnitude 8 earthquake there.

How Earthquake Lights Form

Over the past few years, various theories have been proposed for how earthquake lights form, including the disruption of the Earth's magnetic field by tectonic stress and the so-called piezoelectric effect, in which quartz-bearing rocks produce voltages when compressed in a certain way.

But Freund and colleagues now report that what causes earthquake lights appears to be an entirely different electrical process.

"When nature stresses certain rocks, electric charges are activated, as if you switched on a battery in the Earth's crust," he says.

The types of rocks that are particularly given to the phenomenon are basalts and gabbros, which have tiny defects in their crystals. When a seismic wave hits, electrical charges in the rocks may be released.

In some areas, basalts and gabbros are present in vertical structures called dikes, which formed as magma cooled along vertical faults and may reach as deep as 60 miles (97 kilometers) underground. These dikes may funnel electrical charges along, the scientists wrote.

"The charges can combine and form a kind of plasma-like state, which can travel at very high velocities and burst out at the surface to make electric discharges in the air," Freund added. Those discharges are what make the colorful light shows.

The right conditions for lights exist in less than 0.5 percent of earthquakes worldwide, the scientists estimate, which explains why the phenomena are relatively rare.

Earthquake lights seem to be most common in Italy, Greece, France, Germany, China, and parts of South America, though they have been observed in Japan, North America, and elsewhere.

The lights can occur weeks before major earthquakes, Freund noted, or during actual shaking. They have been recorded at distances of up to 100 miles (160 kilometers) from the epicenter.

Predicting Earthquakes?

Freund is working with other scientists on a global earthquake forecasting system and says scientists have started including earthquake lights as an indicator that a tremblor might be coming. (He avoids the term "prediction" because "it implies too much precision.")

"If we see two, three, or four characteristic phenomena, then it looks like there might be an earthquake," he said. He admitted that earthquake lights tend to be rare, but added, "If they are observed, let's watch out."

But others say that the lights will be of limited use for such forecasts.

"Earthquake lights are unlikely to be very helpful with earthquake prediction because they don't seem to be reported all that often," says Bruce Presgrave, a geophysicist with the U.S. Geological Survey's National Earthquake Information Center.

Earthquake lights have already been used to help predict quakes. Just before Italy's L'Aquila earthquake in 2009, a man in his kitchen saw bright flashes of light. Because he had reportedly read about earthquake lights before, he moved his family to a safer place.

In China in 1976, a geologist took shelter after seeing lights, which were followed by the deadly Tangshan quake.

Still, Freund says the lights are a small part of his broader work involving the electrical conductivity of rocks.

"I wasn't interested in earthquakes in the beginning, but then I realized that electrical phenomena are being activated by stress in the rocks," he says. "Earthquake lights are the tip of the iceberg, the most extreme expression of these phenomena, but underneath there are lots of other aspects, and we are considering measuring these in the context of forecasting."

As a next step, Freund hopes to reproduce earthquake lights in a laboratory. He also wants to better understand what causes the outburst of energy that leads to visible light.