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Not My Fault: Mysterious lights in the sky after earthquakes are real but we still don't know exactly why

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I enjoy hearing people recount their earthquake experiences. No matter how old or young you are, the topic always triggers memories. Larry Karsteadt, longtime friend and emergency response colleague, commented after last week's column about the 1992 Cape Mendocino earthquake. "What about those lights? What caused them?" Good subject for a column I thought and promised to tackle the question today.

"Luminosity" is the name for optical phenomena observed after earthquakes. It is nothing new. Descriptions of light accompanying earthquakes was mentioned mention in Aristotle's Meteorologica dating back to the third century BCE. Lights were included in early compilations of earthquakes published in the late 1800s and early 20th centuries. Most observations coincide with feeling shaking but some were reported seconds to weeks before the earthquake, and a few afterwards.

Earthquake lights fell out of favor in the instrumental era when earthquake science turned toward seismographic analyses of earthquakes. But observations continued to be made during earthquakes from all over the globe, including the great Tangshan China earthquake in 1976 and California's Napa earthquake in 2014. The one commonality in all the reports is that the earthquakes occurred at night. After that, the observations vary widely.

In April of 1992, the magnitude 7.2 mainshock occurred in bright daylight so no luminosity reports. But the M6.5 and 6.6 aftershocks provided the ideal circumstances. Both occurred in the wee morning hours of April 26th and produced strong ground shaking in both Northern Mendocino County and Southern Humboldt. In the days and weeks after the earthquakes, I talked to many people about their experiences and, when it came to the nocturnal aftershocks, they often mentioned seeing lights.

There were different types of observations. Some mentioned bright flashes of blue-white light, like a giant old-fashioned camera bulb going off. Many of these can probably be linked to transformers bursting and arcing electrical lines. That was the common response from experts to luminosity observations when I was in school. But too many of the 1992 reports were from remote areas where there were no transformers to blow. And blue-white wasn't the only color observed.

The strongest shaking in the 92 aftershocks was in sparsely populated areas. The night was clear, power was out and some people opted to sleep outside because of the many aftershocks. Several described a glow traveling across the sky that seemed to coincide with the passage of seismic waves. At first read, this may seem a bizarre idea. Seismic waves travel in the solid earth, right? Yes they do, but compressional waves (P-waves) like sound can travel in any fluid or gas. If this wasn't the case, we wouldn't be able to talk to one another as voices are nothing more than compressional waves generated by our larynx and received by our ears.

To a seismic wave, the ground surface is only an interface between two different materials. The waves won't go as quickly, but the P-waves can still travel in the air. If you have heard a very deep rumble as the earthquake waves approach you, you have experienced this phenomenon. Most of the seismic wave frequencies are below your ear's ability to detect, but a little of the wave energy may register at the lowest frequency end of your ear's range. There is no question that large earthquakes produce vibrations in the atmosphere. Vibrations mean currents and currents sometimes cause light.

Other observations in 1992 were quite different. A woman in Ferndale described a glowing orange blob pouring out of her backyard during the shaking. Some people saw bursts of orange glows in the distances. The most unusual description came from a fisherman many miles off the coast that night. He felt both the M6.5 and 6.6 aftershocks. P waves travel in water as well as air and he said it felt like the boat had suddenly dropped a foot or two. And then a most remarkable thing happened. The water began to glow. The glow increased until after a few minutes he was in the midst of a glowing aqua ocean. The glow continued for more than an hour before it slowly began to fade.

It is likely that different phenomena contribute to earthquake lights including sources in the rupture zone, near the surface and in the atmosphere. Fault rupture is a dynamic process, producing localized high temperatures and pressures as the fault grows. A 2014 paper by Thériault and colleagues in Seismological Research Letters propose that complex chemical reactions take place in that

environment, producing currents that flow outwards, some of which reach the ground surface. The currents may be strong enough to ionize the air and excite emissions in the visible range.

Another known source of light emission is caused by thermal heating when a landslide occurs. Called landslide light, the temperatures produced by the frictional heating as the slide mass moves produce photoemissions. There were dozens of slides produced by the 1992 aftershocks and some of the light observations may have come from this source.

I don't think any of these explanations work for the fisherman's report. But here is one that might. Bioluminescence is produced by living organisms that emit light. You may have seen this walking in the evening along the beach during red tides. A quick Google search will bring up dozens of photos of eerie aqua waves breaking. The glow may continue for hours all produced by millions of tiny organisms excited by the wave vibrations. If surf can cause bioluminescence, it isn't much of a stretch to think that seismic waves might as well.

It is difficult to study earthquake lights in a quantitative way. Most are extremely brief and by the time you see them they are gone. Perhaps in the era of Earthquake Early Warning, some sharp young seismologists will develop a detection system that could be quickly turned on in the few seconds before the shaking arrives and we could really begin to get a handle on luminosity.

Note: for anyone who wants to dig deeper, here is a recent summary of luminosity studies
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018JD028489

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