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Researchers find evidence of cosmic impact at classic Clovis archaeological sites

Researchers continue to build on a body of evidence for a fragmented comet that is thought to have exploded over the Earth almost 13,000 years ago, which may have had a role in the disappearance of mammoths, mastodons and most of other megafauna at that time, and in the vanishing of the Clovis culture from the archaeological record in North America.

Reporting in PLOS One, UC Santa Barbara Emeritus Professor of Earth Science James Kennett and collaborators present their findings of shocked quartz — grains of sand deformed by extreme pressures and temperatures — at three classic Clovis culture archaeological sites in the United States: Murray Springs in Arizona, Blackwater Draw in New Mexico and Arlington Canyon in California's Channel Islands.

"These three sites were classic sites in the discovery and the documentation of the megafaunal extinctions in North America and the disappearance of the Clovis culture," said Kennett.

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Evidence for the Younger Dryas Impact hypothesis

The disappearance of the megafauna and the vanishing of the Clovis technocomplex from the archaeological record coincide with the onset of the Younger Dryas cool episode, an anomalous and abrupt return to near ice-age conditions that persisted for about a thousand or so years amid what was generally a warming transition from the Last Glacial Period.

There are several hypotheses for what may have happened to trigger that event; Kennett and team propose a scenario in which a fragmented comet exploded aboveground, sending shockwaves and extreme heat to Earth.

“In other words, all hell broke loose,” Kennett said. According to the Younger Dryas impact hypothesis, the explosions were responsible for widespread burning and the resulting smoke and soot, in addition to dust that blocked the sun, leading to an “impact winter.” Rapid melting of the ice sheets could have helped to further cool the impact zones. The shock of impact itself, followed by harsh conditions thereafter, may have contributed to the demise of the megafauna in both North and South America and the disappearance of the Clovis culture, according to the hypothesis.

For the past couple of decades, Kennett and fellow proponents of this hypothesis have been gathering evidence that increasingly supports it, including a “black mat” layer in the sediment at many sites across North America and Europe — indicative of widespread burning. Additionally, they have uncovered a growing list of impact proxies, which include unusually high concentrations of rare minerals that are common in comets, such as platinum and iridium, and mineral formations indicative of extremely high temperatures and pressures, such as nanodiamonds and metals and minerals that have melted, cooled and hardened again, including metallic spherules and meltglass.

Thanks to advances in technology, the team is homing in on another proxy that is considered the crème de la crème of cosmic impact evidence: shocked quartz — grains of sand that exhibit deformations due to extreme heat and temperature. In samples from the three North American archaeological sites — Murray Springs, Blackwater Draw and Arlington Canyon — the researchers identified quartz grains with telltale cracks, some filled with melted silica. They used a variety of techniques, including electron microscopy and cathodoluminescence, to confirm that the quartz grains had been shocked at extremely high temperatures and pressures, far beyond what could have been accomplished by volcanism or ancient human activity.

The presence of shocked quartz is particularly important in the absence of craters — the smoking gun of cosmic impact evidence. Unlike the asteroid that killed off the dinosaurs 65 million years ago and left a crater beneath the Yucatan Peninsula, “touchdown airbursts” — cosmic collisions that occur above the Earth’s surface, such as from this proposed fragmented comet — leave little, if any, evidence on the landscape. Using hydrocode modeling, the team modeled these low-altitude, above-ground explosions and the variety of impacts that could lead to the shock patterns in the quartz grains.

“There are different levels of shocked quartz,” Kennett said. While the accepted evidence for cosmic impact leans heavily on the parallel cracks in quartz found at craters, the variety of directions, pressures and temperatures that emerge around airbursts would lead to variations in the shock patterns in the quartz, he explained. “There are going to be some very highly shocked grains and some that will be low-shocked. That’s what you would expect.”

Added to the other impact proxies found in the same layer of sediment — carbon-rich black mat, nanodiamonds, impact spherules — and found at three key archaeological sites, the discovery of these shocked quartz grains “supports a cosmic impact as a major contributing factor in the megafaunal extinctions and the collapse of the Clovis technocomplex at the Younger Dryas onset,” according to the paper.

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