Geoscientist discovers new phosphorus material after lightning strike

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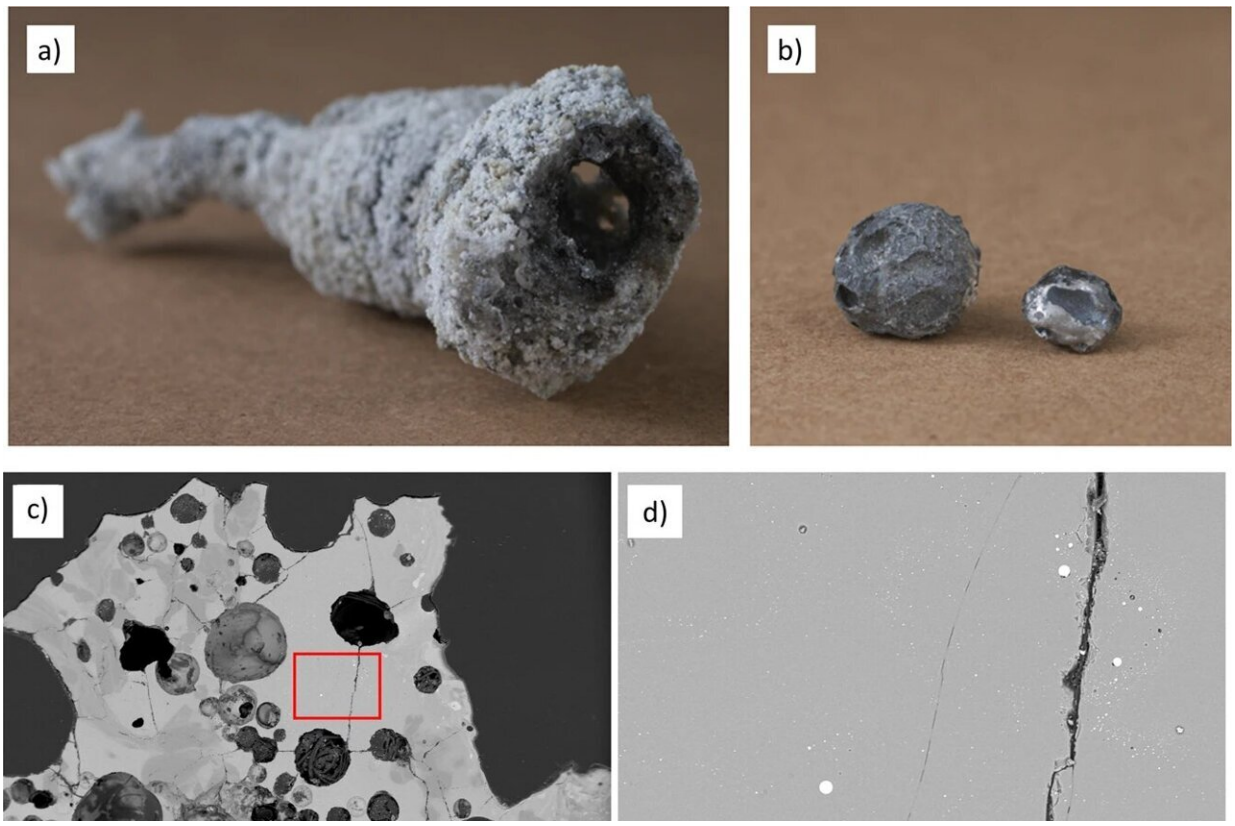

The New Port Richey fulgurite images and microscopy. a Glassy tubes that consist of a glassy melt surrounding an internal void, in turn surrounded by a crust consisting of cemented sand grains. The diameter of the fulgurite is 2 cm, and length is 7 cm. b Spherules of gray, metallic material within the fulgurite with diameters of 1.1 cm (left) and 0.5 cm (right). c BSE image of the glass of the NPR fulgurite. Varied lithologies of the glass include a darker material (left) composed of SiO2, and a lighter material (Ca, Al-rich silicate). Within this glass (red rectangle is the region expanded) are d spherules of iron metal enriched in

phosphorus. e BSE image of the large metallic spherules of the NPR fulgurite. These consist of $FeSi_2$ (medium gray), FeSi (light gray), and a Ca–P–O material that includes CaHPO3 (dark gray). f The Ca–P–O material is mostly in contact with FeSi. Credit: *Communications Earth & Environment* (2023). DOI: 10.1038/s43247-023-00736-2

After lightning struck a tree in a New Port Richey neighborhood, a University of South Florida professor discovered the strike led to the formation of a new phosphorus material. It was found in a rock—the first time in solid form on Earth—and could represent a member of a new mineral group.

"We have never seen this material occur naturally on Earth—minerals similar to it can be found in meteorites and space, but we've never seen this exact material anywhere," said geoscientist Matthew Pasek.

In a recent study published in *Communications Earth & Environment*, Pasek examines how high-energy events, such as lightning, can cause unique chemical reactions, and in this instance, result in a new material—one that is transitional between space minerals and minerals found on Earth.

"When lightning strikes a tree, the ground typically explodes out and the surrounding grass dies, forming a scar and sending electric discharge through nearby rock, soil and sand, forming fulgurites, also known as 'fossilized lightning'," Pasek said.

Sample of the New Port Richey fulgurite. Credit: Matthew Pasek

When the New Port Richey homeowners discovered the 'lightning scar', they found a fulgurite and decided to sell it, assuming it had value. Pasek purchased it, and later began a collaboration with Luca Bindi, a professor of mineralogy and crystallography at the University of Florence in Italy.

Together, the team set out to investigate unusual minerals that bear the element phosphorus, especially those formed by lightning, to better understand high-energy phenomena.

"It's important to understand how much energy lightning has because then we know how much damage a lightning strike can cause on average and how dangerous it is," Pasek said. "Florida is the lightning capital of the world and lightning safety is important—if lightning is strong enough to melt rock, it can certainly melt people too."

In wet environments, such as in Florida, Pasek says iron will often accumulate and encrust tree roots. In this case, not only did the lightning strike combust the iron on the tree roots, but it combusted the naturally occurring carbon in the tree as well. The two elements led to a chemical reaction that created a fulgurite that looked like a metal 'glob.'

Inside the fulgurite, a colorful, crystal-like matter revealed a material never before discovered.

Co-principal investigator Tian Feng, a graduate of USF's geology program, attempted to remake the material in a lab. The experiment was unsuccessful and indicates the material likely forms quickly under precise conditions, and if heated too long, will turn into the mineral found in meteorites.

"Previous researchers indicate that lightning reduction of phosphate to have been a widespread phenomenon on the early Earth," Feng said. "However, there is an environmental phosphite reservoir issue in Earth that these solid phosphite materials are hard to restore."

Feng says this research may reveal other forms of reduced minerals are plausible and many could have been important in the development of life on Earth.

According to Pasek, it's unlikely this material could be mined for uses similar to other phosphates, such as fertilizer, given the rarity of it occurring naturally. However, Pasek and Bindi plan to further investigate the material to determine if it could be officially declared a mineral and bring additional awareness to the scientific community.

More information: Luca Bindi et al, Routes to reduction of phosphate by high-energy events, *Communications Earth & Environment* (2023). DOI: 10.1038/s43247-023-00736-2

Provided by University of South Florida