https://www.nationalgeographic.com/magazine/article/alien-minerals-never-found-on-earth-identified-in-meteorite

The weave-like pattern of the crystals seen in these slices of the El Ali meteorite is common for iron meteorites. But this meteorite contained a surprise: three new minerals never before seen in nature on Earth.

ABDULKADIR ABIIKAR HUSSEIN, ALMAAS UNIVERSITY

‘Alien’ minerals never found on Earth identified in meteorite

The minerals discovered in a 33,400-pound meteorite offer an exciting peek into the collisions that rocked our early solar system.

BY MAYA WEI-HAAS
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A pockmarked ruddy red boulder sat for many years on the edge of the town **El Ali in Somalia**, near a popular well where herders and their animals gather to slake their thirst. Knowledge of the stone, which weighs more than 33,400 pounds, had been passed down through generations of camel herders, who used its metallic surface as an anvil to sharpen their blades. But the boulder’s history reaches even deeper into the past, to the early days of our solar system.

Known as the El Ali meteorite, the hunk of metal plunged through Earth's atmosphere at some unknown date in the past. It brought with it at least three minerals not found naturally on Earth, scientists recently announced. Hidden within each mineral's chemistry and crystal form are clues to events millions of miles away and billions of years in the past.

Although the minerals may not dramatically alter our understanding of our celestial neighborhood, researchers hope these cosmic secrets discovered in plain sight could help fill in the details about the chaotic collisions of our early solar system.

"Every new mineral—each and every one—has a voice and a story to tell," says Chi Ma, a meteorite mineralogist at the California Institute of Technology, who discovered one of the new minerals and helped confirm the other two.

The discovery of three new minerals is the latest twist in the multi-year dispute over the fate of the El Ali meteorite. Prospectors of a small mining company found the stone in 2019 while searching for opal. The following year, after the Somali government was unwilling to pay the multi-million dollar price tag, the

mining company exported the meteorite to China, says geologist Abdulkadir Abiikar Hussein of Almass University in Mogadishu, Somalia, who inspected the meteorite upon the government's request.

Now the space rock still has no buyer and Hussein fears that it will be cut into smaller chunks for sale, forever destroying a priceless piece of national heritage. He hopes the new discoveries will nudge "the government to awake from their sleep and buy that thing and return it back to Somalia."

A small mining company, hoping to sell the 33,400-pound meteorite, removed it from its original location and exported it to China.

Surprises in stone

While generations of camel herders had known about the meteorite, which is the ninth largest ever found, it wasn't scientifically documented until a few years ago. The oddly smooth boulder caught the eye of prospectors, and when they hit it with a hammer, a metallic tone resounded. They suspected it was an iron meteorite—an object from space largely made of iron and nickel, many of which are believed to have come from the cores of smashed asteroids or planetesimals, similar to our own planet's metallic center.

The prospectors sent small samples of the meteorite to scientists for confirmation and further analysis, and a piece fell into the hands of Chris Herd, curator of the meteorite collection at the University of Alberta.

While studying the slice of rock, he noticed several crystals with unusual compositions. Later analysis, including a comparison to synthetically created minerals, confirmed his hunch: the composition and structure of the minerals had never been seen before in nature. Herd named one mineral elaliite, after the meteorite itself, and the second elkinstantonite, after Lindy Elkins-Tanton, a planetary scientist at Arizona State University and principal investigator of NASA's upcoming Psyche mission that will explore a metallic asteroid.

Elkins-Tanton learned of Herd's plan for the mineral's name soon after the Psyche mission missed its launch date because of issues during software testing, and her morale was low. "To say it lifted my spirits—" she says, pausing. "I was just so touched."

CalTech's Ma, who has previously discovered dozens of new minerals, identified the third mineral, calling it Olsenite to honor the late Edward Olsen, a former curator at the Field Museum of Natural History in Chicago who had postulated the existence of the mineral that now bears his name.

Mineral memoirs

Our planet has roughly 5,800 minerals, while only about 480 have been found in meteorites. Many of those meteoritic minerals are truly alien—some 30 percent don't form naturally on Earth.

The newly discovered minerals were found in inclusions, which look like microscopic polka dots scattered across the sample slices of the meteorite. The team is still working out the precise conditions in which they formed, Herd says, but the presence of the new minerals within the polka dots gives clues to the timing of their growth.

As the molten metal of a meteorite slowly cools and solidifies, different minerals crystallize at different times, which leaves behind certain "incompatible" elements that concentrate in the dwindling pool of liquid. The new minerals formed when almost all the metal had already cooled and just tiny molten blobs remained, eventually crystallizing to form the inclusions.

The overall chemistry of the rock reveals that this cooling process likely didn't happen in the core of an asteroid, as is believed happened for most other iron meteorites. Instead, the metal likely crystallized near the surface of a planetary body after a high-speed collision turned solid surfaces molten.

These colliding bodies may have been the cores of destroyed asteroids, or perhaps they were primitive space rocks known as chondrites, which have a significant amount of metal mixed with rock. Either way, they likely smashed together at stunning speeds—these collisions happen in the asteroid belt today with objects speeding faster than 11,000 mph.

Studying the mineralogy of meteorites is "armchair solar system exploration, in a lot of ways," Herd says. "We're trying to constrain the variety of conditions that have existed within different planetary bodies."

Meanwhile, on Earth, the debate about the meteorite's future continues. If the meteorite does sell to a third party, part of the money will be given to the local government, according to Hussein. But he adds that **many Somalis find the solution unsatisfactory and believe it shouldn't have been moved out of the country in the first place. "It should be at home."**

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