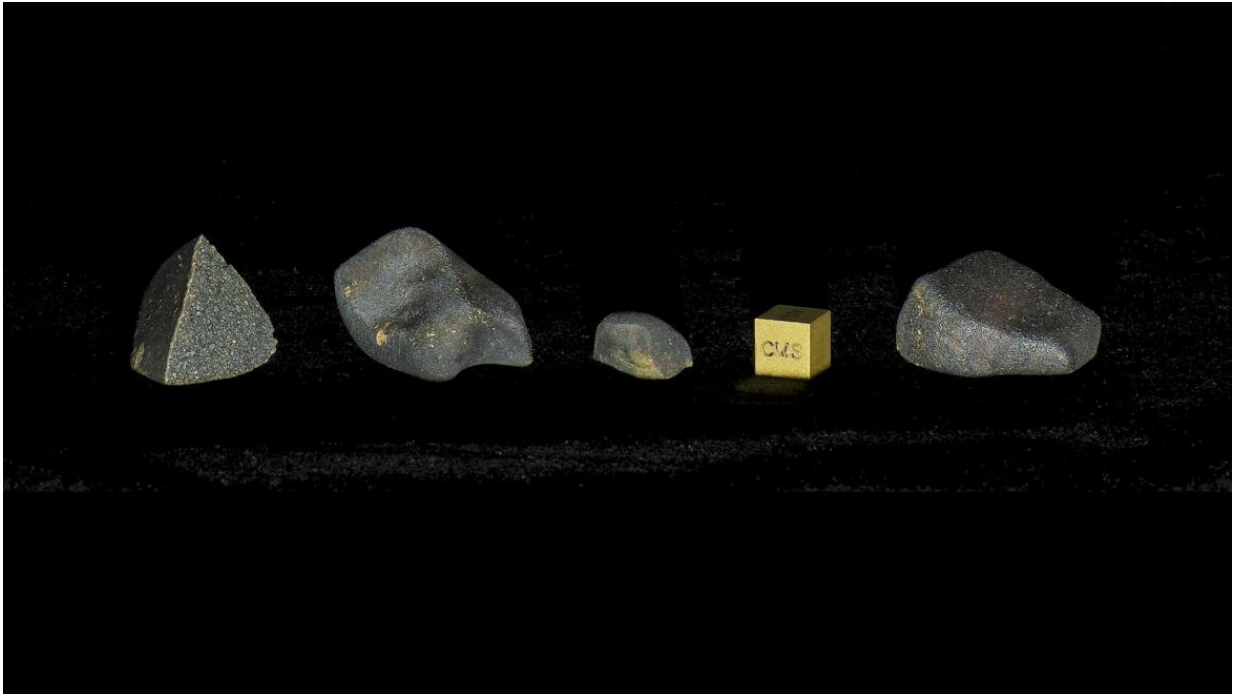


# The first extraterrestrial mud ball in 50 years

May 21 2019

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Credit: Arizona State University

On April 23 at 9:09 p.m. local time, residents of Aguas Zarcas, a small town in Costa Rica, [saw a large "fireball" in the sky](#).

The reported fireball was a meteor about the size of a washing machine. As it entered Earth's atmosphere, it broke apart and rained hundreds of meteorites in and around the [small town](#), including a two-pound rock that crashed through the roof of a local house, smashing the dining room

table below.

While meteorite falls happen around the world on a regular basis, early reports indicated that this meteorite belongs to a special group called "carbonaceous chondrites" that are rich in [organic compounds](#) and full of water.

"Many carbonaceous chondrites are mud balls that are between 80 and 95 percent clay," said Laurence Garvie, a research professor in the School of Earth and Space Exploration and a curator for Arizona State University's Center for Meteorite Studies. "Clays are important because water is an integral part of their structure."

From these early reports, the race was on to collect samples and bring them back to labs around the world for [scientific analysis](#).

"These had to be collected quickly and before they got rained on," Garvie explained. "Because they are mostly clay, as soon as these types of meteorites get wet, they fall apart."

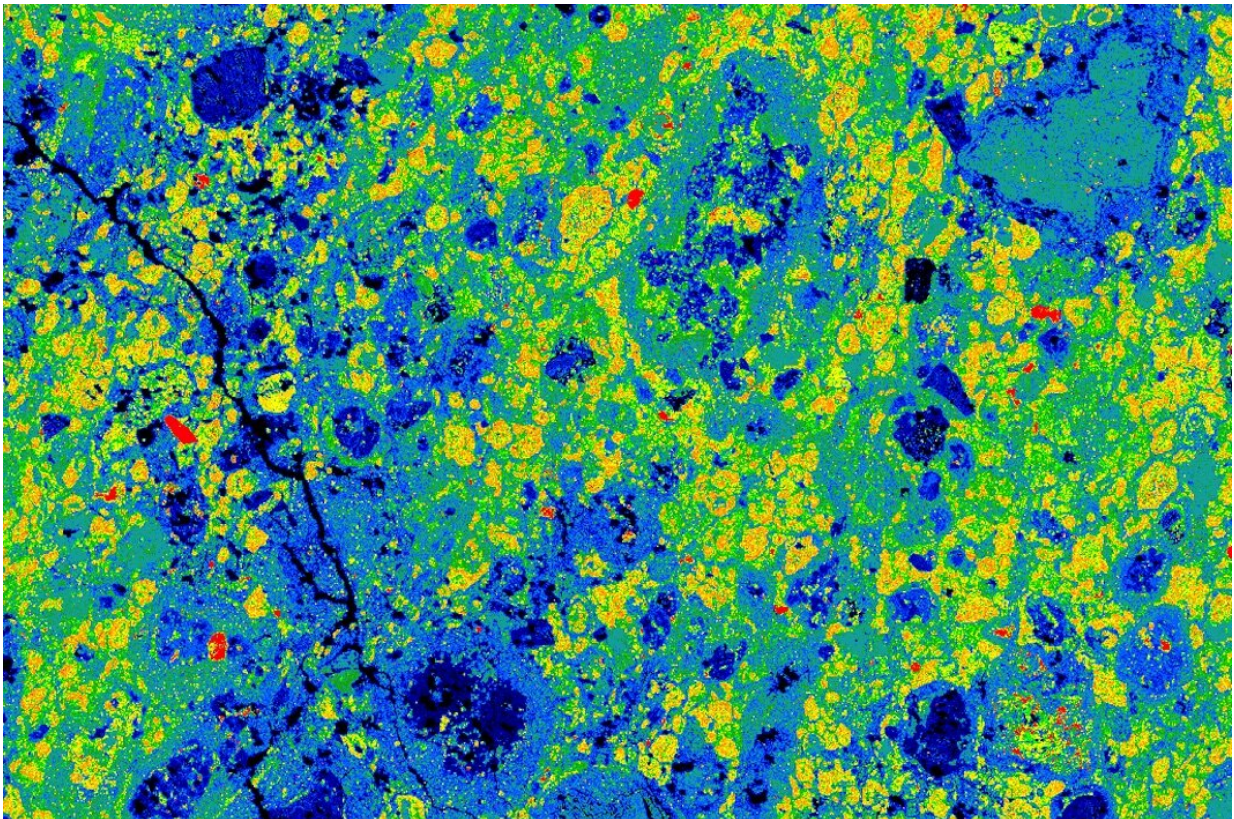
Fortunately, meteorite collectors had five rain-free days in the region to collect samples from the fall. About 55 pounds of meteorites (collectively the size of a large beach ball) have been recovered so far.

As of last week, ASU has acquired several meteorite samples from the Aguas Zarcas fall, which were donated by meteorite collector Michael Farmer. Farmer traveled to Costa Rica immediately after the meteorite fall to purchase and collect the meteorites from residents of Aguas Zarcas. A private donor has also provided funds for ASU to purchase additional meteorite samples from this fall.

Once Garvie had the donated samples, he rushed back to the lab on ASU's Tempe campus to run the analyses needed to determine the

classification of the meteorites. He is now leading an international classification effort.

"I was in the lab by 5 a.m. the next morning after picking up the samples to get them ready for the initial analyses," Garvie said. "Classification of new meteorites can be like a race with other institutions, and I needed ASU to be first so that we'll have the recognition of being the collection that holds and curates the type specimen material."



A composite element map showing distribution of different minerals at the microscopic scale in a fragment of Aguas Zarcas. Orange-yellow colors show the distribution of Fe-S-Mg rich mineral called tochilinite, which is surrounded by diffuse matrix of clays. Deep blue are olivine in chondrules. Red are Fe-Ni-S rich pentlandite and pyrrhotite. Credit: ASU/Center for Meteorite Studies

ASU's Center for Meteorite Studies has a specialized curatorial facility for meteorites, one that rivals many other international facilities. In particular, ASU has nitrogen cabinets for storage of particularly air-sensitive meteorites where the nitrogen atmosphere preserves the meteorites and stops their degradation.

"If you left this carbonaceous chondrite in the air, it would lose some of its extraterrestrial affinities," Garvie explained. "These meteorites have to be curated in a way that they can be used for current and future research, and we have that ability here at ASU."

For the meteorite classification process, Garvie is working with Karen Ziegler from the Institute of Meteoritics at the University of New Mexico. In her lab, Ziegler analyzed the samples for their oxygen isotopes, which helps determine what characteristics this [meteorite](#) shares with other [carbonaceous chondrites](#).

Garvie is also working with ASU School of Molecular Sciences' Professor Emerita Sandra Pizzarello, an organic chemist known for her work with carbonaceous chondrite meteorites. Pizzarello's analysis is helping to determine the organic inventory of the [sample](#), which may provide insights into whether these types of meteorites provided the ingredients for the origins of life on Earth.

Ultimately, the meteorites will be approved, classified and named by the Meteoritical Society's nomenclature committee, an international team of 12 scientists who approve all new classified meteorites. This approval is the first and most important step of an in-depth scientific analysis.

Provided by Arizona State University

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