Meteorite fragments found in El Dorado County a scientific gold mine

By Matt Weiser, Sacramento Bee

The meteorite fragments that crashed down in El Dorado County in April contain some of the best-preserved elements from the dawn of the solar system ever recovered, according to a study.

The Sutter's Mill meteorite, as it has been called, entered Earth's atmosphere at about 8am on April 22 with the force of a 4-kiloton bomb. The explosion when it broke apart could be heard as far away as Washington state, and it produced a fiery streak seen across large areas of Northern Nevada and California.

The meteorite weighed about 100,000 pounds and was as big as a minivan. The 77 fragments recovered on the ground weigh only about 2 pounds.

Yet those 2 pounds are proving to be among the most significant meteorite finds in history, according to the study published in last week's issue of the journal Science, which includes nine co-authors from UC Davis.

The meteorite arrived at a record entry speed of nearly 18 miles per second, and it broke apart at a record altitude of about 34 miles above sea level. Much of it would have disintegrated in the heat of the entry.

"The entry was very violent," said Peter Jenniskens, an astronomer and senior research scientist at the Search for Extraterrestrial Intelligence Institute, and also lead author of the study. "We think that's why there were no big chunks, because this object came in with such a high speed."

It was called the Sutter's Mill meteorite because most of the fragments were found near the towns of Lotus and Coloma along the American River, where the Gold Rush began in California in 1848. Jenniskens himself found one piece in the parking lot of Marshall Gold Discovery State Historic Park.

The study, which includes 69 co-authors from around the globe, found that the meteorite fragments are the most pristine samples ever collected of a rare type of carbonaceous chondrite, an amalgam of minerals that formed about 4.5 billion years ago when the solar system was taking shape.

Doppler weather radar was used to track the meteorite's arrival – a relatively new technique. As a result, researchers know more about where this meteorite came from than most meteorites.

They believe it came from an asteroid belt with a highly eccentric orbit that passes between Jupiter and Mars, then swings close by the sun. They also believe it broke off from a larger object, likely an asteroid, between 15,000 and 19,000 years ago – very recent in meteorite terms.

"Among the known asteroid orbits, this one might be the most eccentric," said Qing-Zhu Yin, a geology professor at UC Davis and a co-author of the study. "As a result, its orbit may have had its outmost point all the way to Jupiter."

The meteorite contained evidence of its travels through the solar system. Among the elements detected in the fragments, using specialized equipment at UC Davis, was oldhamite, a sparkly brown crystal-like mineral thought to have originated in the solar nebula when the solar system formed.

Oldhamite is very reactive and can disappear just from being breathed on. It often vanishes before it can be examined in recovered meteorites.

In this case, Jenniskens and a few local residents were able

to recover and preserve fragments within hours of their falling from the sky. Rain that fell the next day would likely have erased the oldhamite. It marks the first time oldhamite has been detected on a recovered meteorite.

“We are suspecting that the oldhamite originated in a different type of meteorite, normally associated with Earth and Venus and not in an area of primitive asteroids from farther out …” said Jenniskens. “It’s telling us a story about mixing in the early solar system.”

The meteorite contains compounds picked up from very different regions of the solar system: one that is relatively cold and wet, and another that is hot and dry. This is unusual, indicating that parts of the meteorite had very different histories.

And according to an accompanying news article in today’s issue of Science, the researchers more recently found diamonds in the meteorite, which don’t belong in either type of environment.

Analysis by UC Davis scientists also shows evidence that minerals in the meteorite once had contact with flowing water, possibly on a parent asteroid.

This is not unusual in meteorites, Yin said, but nevertheless fascinating. Earth is thought to have originally acquired a water supply from crashing meteorites.

“You can say with one little piece in your hand, you are holding the entire solar system,” said Yin. “There’s a lot of excitement with this meteorite.”

NASA as well as the European and Japanese space agencies are all planning to land probes on asteroids over the next decade. One goal is to look for water. The first of these is a NASA probe expected to launch in 2016, Yin said.

“It so happens the target they identified, based on remote sensing, resembles this meteorite,” he said. “Basically, this material gives us an early glimpse of what we might find.”