US meteorite was fastest on record

Study traces object's path back to outer asteroid belt

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Sutter's Mill meteorite

An amateur captured this view of the fireball streaking through the atmosphere before it exploded, showering meteorite fragments on the Sierra Nevada on 22 April.

The Sutter's Mill meteorite caused a sensation earlier this year when its fireball was seen by many eyewitnesses over the foothills of the Sierra Nevada range in California. A detailed study has now traced the origin of this space rock with unusual precision and has revealed that it came down at a record-breaking speed.

Most of the 40,000 or so meteorites that have been recovered so far have been found to come from the asteroid belt, located between the orbits of Mars and Jupiter. But in the Sutter's Mill case, scientists have been able to give the rock a more precise origin.

In today's *Science*[1], a 70-strong international team led by Peter Jenniskens of NASA Ames Research Center in Moffett Field, California, reports how they used records of the fireball from weather radar — commonly used to track rainfall in real time — and combined that information with photographic and video images and other data. The researchers could then reconstruct the Sutter's Mill meteorite's trajectory, and found it to be similar to those of comets from the outer reaches of the asteroid belt, near Jupiter's orbit.

"We used radars to plot triangles that track where it seemed to be coming from," says Monica Grady at the Open University in Milton Keynes, UK, a member of the team. The study also determined that the meteorite entered Earth's atmosphere at a speed of 28.6 kilometres per second, the fastest ever recorded.

Chemical and physical analysis revealed Sutter's Mill to be a relatively rare 'carbonaceous chondrite' type of meteorite, and in a near-pristine state. These meteorites are seen as time capsules, barely altered since the formation of the Solar System began 4.5 billion years ago.

Carbonaceous chondrites are thought to be especially prevalent in the outer reaches of the asteroid belt, and the California rocks

confirm that theory, being a rare case for which both the composition and the provenance are known. Usually, asteroids are seen through telescopes, which reveal an object's location but give only partial information on its composition; the asteroid fragments that fall on Earth as meteorites, on the other hand, can be analysed in great detail but in most cases "we have no idea whereabout in space they originated," says Sara Russell, who heads the Division of Meteoritics and Cosmic Mineralogy at the Natural History Museum in London.

“The Sutter’s Mill story illustrates very nicely the huge added value we get when we know where our meteorites come from in the Solar System,” says geologist Philip Bland of Curtin University in Perth, Australia.

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References

1. Jenniskens, P. *et al*. *Science* **338**, 1583–1587 (2012).