Astronomers catch a “shooting star”

March 25, 2009
Courtesy SETI Institute
and World Science staff

Asteroid 2008 TC3 has a humdrum name but an unusual distinction: it’s the first space rock to have been spotted before it made a fiery rendezvous with our planet, astronomers say.

It streaked into the skies over northern Sudan in the early morning of Oct. 7, then burst at a high 37 km (23 miles) over the Nubian Desert. It was thought to have fully disintegrated into dust. But a meteor astronomer with the Mountain View, Calif.-based SETI (Search for Extraterrestrial Intelligence) Institute, Peter Jenniskens, thought otherwise.

Working with physicist Mauwia Shaddad of the University of Khartoum, Sudan, and students and staff from the university, he collected nearly 280 pieces of the asteroid, strewn over miles of desert. Never before had meteorites been collected from such a high-altitude explosion, according to astronomers.

As it turns out, the assembled remnants are unlike anything in our meteorite collections, and may be an important clue in unraveling the early history of the solar system, said Jenniskens. “This was an extraordinary opportunity, for the first time, to bring into the lab actual pieces of an asteroid we had seen in space,” said Jenniskens, lead author on an article in the current issue of the research journal *Nature* on the analysis.

Picked up by Arizona’s Catalina Sky Survey telescope on Oct. 6, the truck-sized asteroid abruptly ended its 4.5 billion year solar system odyssey only 20 hours after discovery, when it broke apart in the African skies. The incoming rock was tracked by several groups of astronomers, including a team at the La Palma Observatory in the Canary Islands that was able to measure sunlight reflected by the object.

Studying the reflected sunlight gives clues to the minerals at the surface of these objects. Astronomers group the asteroids into classes, and attempt to assign meteorite types to each class. But their ability to do this is often frustrated by dust on the asteroids.

Jenniskens and the SETI Institute’s Janice Bishop measured the reflection properties of the meteorite. The pair found that both the asteroid and its meteoritic remains reflected light in much the same way, similar to the known behavior of so-called F-class asteroids.

“F-class asteroids were long a mystery,” Bishop noted, as astronomers had never been able to actually hold a specimen. “The good correspondence between telescopic and laboratory measurements for 2008 TC3 suggests that small asteroids don’t have the troublesome dust layers, and may therefore be more suitable objects for establishing the link between asteroid type and meteorite properties,” he added. “That would allow us to characterize asteroids from afar.”

“2008 TC3 could serve as a Rosetta Stone, providing us with essential clues to the processes that built Earth and its planetary siblings,” said Rocco Mancinelli, a microbial ecologist at the institute and member of the research team. “In the dim past, as the solar system was taking shape, small dust particles stuck together to form larger bodies, a process of accumulation that eventually produced the asteroids. Some of these bodies collided so violently that they melted throughout.”

2008 TC3 is an intermediate case, having been only partially melted, according to researchers. The resulting material produced what's called a polymict ureilite meteorite.

Knowing the nature of F-class asteroids could conceivably pay off in protecting Earth from dangerous impactors, researchers said. That 2008 TC3 blew up very soon after hitting the atmosphere indicates it was fragile. It weighed an estimated 80 tons, of which only some 5 kg (11 lb.) has been recovered. If at some future time we discover an F-class asteroid that's, say, several kilometers or miles wide—one that could wipe out species—then we'll know its makeup and can devise ways to ward it off. Hitting such a fragile asteroid with an atomic bomb, as Bruce Willis did in the 1998 movie *Armageddon*, would merely turn it into a deadly swarm of shotgun pellets.

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