



Comet Mysteries Cracked

In ancient cultures, comets were believed to be demons or divine messengers and were regarded as omens of impending disaster and tragedy. Compared to stars, whose positions were known, and planets, whose courses were predictable, comets were capricious and their movements erratic. Their existence seemed to contradict the idea—popular in ancient times—that the universe was a neat and orderly place.

Modern science has changed that view dramatically. Instead of being just heralds of misfortune, many scientists now believe comets are actually harbingers of life, responsible for bringing precious water and organic material to Earth.

Ideas about what comets are made of have changed too, even in the past decade. In the 1950s, comets were portrayed as dirty snowballs. Now scientists suspect they're heavier on the dirt and lighter on the water ice.

“Comets are thought to be icy dirtballs made up of exotic ices, dust, and rock particles,” explained Donald Yeomans, manager of NASA’s Near Earth Objects Program and a co-investigator of the agency’s Deep Impact mission. Among the chemicals in a comet: frozen carbon dioxide, frozen ammonia, and solid methane.

This spectacular image of comet Tempel 1 was taken 67 seconds after it obliterated Deep Impact’s impactor spacecraft. Image credit: NASA/JPL-Caltech/UMD



Up close look

Comet Tempel 1, hit in early July by an 820-pound probe, appears to be coated with fine powder rather than solid ice and rock. The powder is even finer than sand, scientists had reported shortly after the impact.

A thorough analysis confirms that and other preliminary conclusions about the 7-mile-long icy world, which appears to be rather fluffy.

The outer tens of meters (yards) of the comet is less strong than a snow bank, said Deep Impact’s Principal Investigator Michael A’Hearn, an astronomer at the University of Maryland.

Still, the object’s gravity holds it all together.

Dust emanates from the comet in frequent outbursts, likely a result of being warmed by the Sun. The dust kicked up by the impact was not the same as surface dust, but it spread through space and dissipated in a manner similar to the natural outbursts.

While more analysis is needed, the interior is clearly different from the surface.

Inside, the comet harbors a relatively high concentration of organic compounds, the stuff from which life is made.

The organics were more prevalent during and after the outburst than the water and carbon dioxide that

routinely escape from the nucleus, or hard core of the comet.

Comets are leftovers from the formation of the solar system. They're frozen vaults of primordial material, stuff that escaped the planet-formation process and therefore holds clues to what the raw materials of Earth and other worlds was like.

In recent years, our impression of comets has shifted from dirty snowballs to snowy dirtballs. That latter description holds true with comet Tempel 1, A'Hearn said.

There is more dust than ice, A'Hearn said, but the ratio is less than 10-to-1. More significant to the new data is the revelation that there's not much there.

"The comet is mostly empty," A'Hearn said, adding that it is probably more than 75 percent porous with perhaps no solid core. Instead, it's likely made of ice grains loosely packed through and through.

That conclusion would not alter how comets might have delivered water and organic material to early Earth, A'Hearn said. One leading theory for the formation of life on our planet holds that the raw material was delivered by comets.

A'Hearn explained that when a comet plummets through the atmosphere, it creates a shock wave in front. Such a shock wave, not a comet's composition, is the primary factor that allows a large comet to make it to the surface intact, delivering water and organics.

A'Hearn said scientists are still analyzing the chemicals that came out of the Tempel 1, from ammonia and acetylene to hydrogen cyanide. None of the molecules are different from what previous ground-based observations had revealed, however.

Tempel 1 is also dotted with round depressions that the scientists think are impact craters, which have not been seen before on comets.



Comet Hale-Bopp, 1997 Courtesy: Wally Pacholka/www.astropics.com

Where are they from?

Most comets are believed to come from the Oort cloud, a swarm of small, rocky and icy bodies at the outermost fringes of the solar system -- just barely within grasp of the Sun's gravity. Astronomers believe that the tug of neighboring stars occasionally loosens one of these objects from its icy post and sends it careening either inward, through our solar system, or outward, into interstellar space, where they will drift forever unless lassoed by another star's gravity.

Comets are believed to be remnants of the dust and debris that once swirled around the infant Sun and which coalesced into planets approximately 4.5 billion years ago. They might therefore be frozen time capsules, containing material from the early solar system.

"If you wish to study what the solar system is made of you study comets," Yeomans told SPACE.com.

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