Distant comets: Driven by carbon monoxide?

When a comet nears the sun's warming rays, some of the frozen water on its surface turns to gas, whooshing into the vacuum of space. This rushing gas drags with it dust from the comet, creating two familiar features — a comet's tail and its dusty shroud, or coma. But farther from the sun, where temperatures are too low to convert frozen water directly into vapor (a change of phase known as sublimation), some comets still manage to flaunt a tail or expel a jet of gas and dust.

What fuels such activity so far from the sun? New observations suggest that the jetlike release of carbon monoxide, which sublimes at temperatures much lower than water, provides the oomph.

In their study, Matthew C. Senay and David Jewitt of the University of Hawaii in Honolulu used two short-wavelength radio telescopes to detect gas emissions from Comet Schwassmann-Wachmann 1, which never ventures nearer to the sun than Jupiter. At the comet's closest approach, water on its surface remains frozen.

But observations with the James Clerk Maxwell Telescope atop Hawaii's Mauna Kea reveal that the comet spews a startling amount of carbon monoxide, a molecule that sublimes at a chilly 25 kelvins. The detection marks the first time that astronomers have found emission of neutral carbon monoxide molecules from a comet so distant, Senay says. He and Jewitt report their work in the Sept. 15 NATURE.

The astronomers note that the carbon monoxide has about the same velocity as the comet but that the expelled gas moves in the general direction of the sun. This suggests, they say, that the gas originates from the part of the comet's frigid surface that received the strongest illumination from the sun during their observations. The sunlight sublimates the carbon monoxide, producing a jet of gas and dust headed toward the sun, Senay and Jewitt assert.

Using a higher-resolution radio telescope, the Caltech Submillimeter Observatory on Mauna Kea, the astronomers examined the gas emissions in greater detail. They deduced that the comet expelled about 2,000 kilograms of carbon monoxide each second, roughly the rate that Comet Halley attained in 1986 during its closest approach to the sun.

Susan Ridgway/Univ. of Hawaii

Visible-light image of Comet Schwassmann-Wachmann 1 taken last year with the 2.2-meter University of Hawaii telescope shows the comet's coma. Circle denotes region observed at radio wavelengths by the James Clerk Maxwell Telescope, which astronomers used to detect carbon monoxide emissions from the comet.

Models suggest that each gram of gas that a comet expels takes with it about 2 grams of dust. Thus, the release of carbon monoxide can easily generate and replenish the dusty coma that Comet Schwassmann-Wachmann 1 sports for much of its 14.8-year orbit, Senay says. "These results provide the first direct evidence that the sublimation of volatiles [such as carbon monoxide] can drive the activity of distant comets," the astronomers write.

However, they cite other sources that might also activate faraway comets: Molecular nitrogen, for example, also sublimes at low temperatures. Michael F. A'Hearn of the University of Maryland at College Park says that to assess fully the role of carbon monoxide, researchers should observe whether its release rate increases when a distant comet undergoes an outburst and declines when it loses its coma.

A'Hearn adds that although carbon monoxide seems a plausible source of activity for distant comets that visit the inner solar system periodically, other molecules may power first-time visitors, known as "new" comets. The sublimation of a group of molecules known as radicals, thought to be created when cosmic rays bombard comets in the outer solar system, may power new comets, A'Hearn says. *— R. Cowen*

EPA: Dioxins are more than carcinogens

Dioxins are ubiquitous in the industrial world. Yet compared to other pollutants generated by human activities, dioxins appear to be released in trivial amounts. Perhaps only 30 pounds of these chemicals enter the U.S. environment annually, according to a new Environmental Protection Agency report.

In terms of the health hazards they may pose, however, even such trace releases of dioxins "are unacceptable," argues Lynn Goldman, head of EPA's toxic substances program. A pediatrician, she bases her conclusion on a second new report, this one assessing dioxins' risks to human health.

Goldman unveiled both EPA documents (each roughly 1,000 pages long) at a press briefing held this week in Washington, D.C. Over the next 4 months — and before her agency alters its policies for regulating dioxins — each report will be open to public comment and subjected to stiff peer review, she said.

Like the risk analysis of dioxins completed in 1985, EPA's new health assessment concludes that dioxins cause cancer in animals and probably in people as well. However, Goldman notes, sufficient data do not yet exist to estimate how many human cancers might trace to dioxins.

This new report also directs considerably more attention to potential noncancer effects of dioxins and related chemicals. For instance, it cites studies indicating that they may foster immune-system abnormalities (SN: 1/11/92, p.24), hormone-related disease (SN: 11/27/93, p.356), and even diabetes. And through their hormonelike action, EPA says, these compounds may even adversely affect male reproduction and fetal development (SN: 1/8/94, p.24).

EPA's report "points out that dioxins emissions have been heading in the right direction — down — for many years," notes Brad Lienhart, managing director of the Chlorine Chemistry Council in Washington, D.C. In fact, this "demonstrates that the regulatory system already is working well to protect the public and environment," he argues.

But Julia Moore, executive director of the Washington D.C.-based Physicians for Social Responsibility (PSR) disagrees. "We don't think our patchwork of regulations adequately deals with [dioxins]," she says.

A recent report by PSR and the Environmental Defense Fund (EDF), another D.C.-based group, notes that pulp and paper mills must limit dioxin releases to water, yet their emissions "to air and sludge remain uncontrolled."

Moreover, the PSR-EDF report observes, "A pulp mill in North Carolina must meet water standards that are 100 times more protective...than does a similar mill across the border in South Carolina." And though dioxin contamination pervades produce, meat, and milk, government limits pertain only to fish. Even here, the joint analysis notes, "there are no federal standards," just state and federal guidelines. *— J. Raloff*