Space Sciences

Jonathan Eberhart reports from Providence, R.I., at the American Astronomical Society's Division for Planetary Sciences meeting

Carbonaceous meteorites and asteroids

Scientists have long sought to identify similarities between certain types of meteorites, chunks of space rock that fall on Earth, and asteroids, large blocks of rock orbiting the sun, which astronomers study largely by spectra measured through telescopes. A kind of meteorite called eucrites, for example, has been tentatively associated with the large asteroid Vesta, though this link is typical of such studies in that the limited data available fall far short of proving the eucrites actually came from Vesta.

A particularly intriguing possible parallel exists between a class of meteorites known as carbonaceous chondrites (primarily types C1 and C2) and the so-called C-type asteroids. Studies of their compositions suggest that water was involved in the formation of both. Such an association interests astronomers, in part because some believe both types of objects represent examples of some of the solar system's more primitive material. Now, new results tighten the link between them.

Two overlapping lines of evidence are involved. Larry A. Lebofsky of the University of Arizona in Tucson and Thomas D. Jones, now with the Central Intelligence Agency in McLean, Va., report that the infrared spectra of some C-type asteroids include absorption bands with a 3.0-micron wavelength characteristic of water-of-hydration — a sign that water was present when the asteroids formed — and indicating the presence of clay minerals called phyllosilicates. At the same meeting, Faith Vilas of NASA's Johnson Space Center in Houston, and Michael J. Gaffey of Rensselaer Polytechnic Institute in Troy, N.Y., report high-resolution, visible-light spectral absorption features that they say are due to iron oxide in such clays. Spectral measurements of the asteroids indicate the oxidation state of the iron, which researchers can compare to the iron oxide in carbonaceous chondrites.

The spectral features and phyllosilicates have both been found in carbonaceous chondrites, but Lebofsky and Vilas agree that the linkage with specific asteroids will require collecting samples from the asteroids themselves.

Martian impacts and Phobos' grooves

Scientists continue to propose new explanations for the unusual surface grooves on the Martian moon Phobos, including debris tossed out by meteorite impacts, the release of trapped gas deposits, and cracks associated with the formation of the crater named Stickney (SN: 11/4/89, p.301). Now two scientists suggest the grooves on Phobos resulted from debris ejected when other Phobos-sized objects collided with Mars.

According to Peter H. Schultz and David A. Crawford of Brown University in Providence, R.I., observations of both Phobos and Mars, primarily by the two U.S. Viking orbiters, appear "consistent with separate epochs of collisions by linear chains of Mars-orbiting debris."

A few years ago, Schultz cited several examples of what he said looked like scars on Mars caused by an unusually large number of objects that struck its surface at angles of less than 15 degrees. Such shallow impacts, he and Crawford now maintain, provide independent support for the idea of several short-lived, close-in Martian satellites. The grazing impacts are too large for small ring-particles to make, but Schultz says laboratory studies show that oblique impacts onto the surface of Mars as the orbits of bigger objects decayed could have produced expanding vapor clouds that would have injected significant amounts of material into orbit. On Phobos, the authors report, the grooves caused by running into such material would be limited to parallel or nearly parallel arcs less than 180 degrees long, and indeed show a similarity to the grooves in the spacecraft photos of the Martian moon.

Technology

Turning plants into antibody factories

Disease-fighting or pollution-reducing antibodies could become a large-scale agricultural crop, suggest molecular biologists who have genetically engineered tobacco plants to produce large amounts of specifically designed antibody molecules. Like the antibodies of an animal's immune system, the plant-made antibodies, which the scientists call "plantibodies," strongly and selectively bind to only one or a few types of molecules. Normally, plants do not manufacture antibodies and instead deploy other kinds of defensive molecules to disarm biologically threatening chemicals, bacteria or viruses.

To get plants to make antibodies, Andrew Hiatt, Robert Cafferkey and Katherine Bowdish of the Research Institute of Scripps Clinic in La Jolla, Calif., use a series of steps to shuttle two mouse genes, which together code for an antibody molecule, into the nuclei of two different tobacco plant cells. Once in their respective cells, the foreign genes become inserted into the cells' own genetic code. The two genes are derived from a modified line of mouse immune-system cells that other Scripps researchers had developed to produce unusual, catalytic antibodies that not only bind to specific chemical targets called carboxylic esters, but also chemically slice them in two (SN: 9/2/89, p.152).

The scientists use the genetically altered cells to grow entire tobacco plants, some of which produce one or the other of the two antibody parts. After crossing two plants, each of which makes one antibody part, researchers find a certain proportion of the progeny plants produce fully assembled antibodies. "Preliminary results show that catalytic activity is maintained [in plantibodies]," Hiatt told SCIENCE NEWS.

"It's a new technology that's going to be applicable to some pretty important problems such as environmental pollution and possibly cancer therapy," Hiatt says. "I also think there is the possibility of introducing into plants an almost unlimited amount of [disease] resistance" for protecting the food supply, he added. With an admittedly optimistic and rough calculation, Hiatt predicts that a pound of plant-made antibodies could sell for under $100, compared with the $2 million-plus price tag for an equivalent load of identical antibodies made using existing monoclonal antibody technology.

By growing crops of antibody-producing plants, scientists for the first time would have access to industrial quantities of antibody molecules. In one type of large-scale application, plants containing, say, dioxin-binding antibodies might serve as biofilters that could draw in dioxin and clean contaminated soils. To further the cancer-fighting prospects of plantibodies, the researchers now are working with a Scripps immunologist in an attempt to put genes for human-tumor-attacking antibodies into plant cells.

Scientists must overcome severe challenges before plantibodies become mainstream. For one, antibody-making tobacco plants contain lots of naturally toxic chemicals that would have to be removed before their antibody cargo could be used for medical purposes. "No one has developed the capability of purifying kilogram quantities of antibody," Hiatt says. To make purification easier, the researchers are trying to transform less toxic plant cells, such as alfalfa or soybeans, into antibody-makers. Another potential problem lies in the possibility that plantibodies will elicit autoimmune or other health-threatening responses in people.

Molecular biologist Hermann Oppermann of Creative Biomolecules, a biotechnology company in Hopkinton, Mass., says the Scripps approach to producing proteins such as antibodies is slower than bacteria-based processes, though he agrees that plants might prove better suited for the large-scale applications Hiatt envisions.