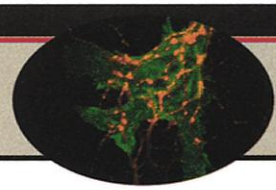
PAGE 1717
How geckos climb the walls



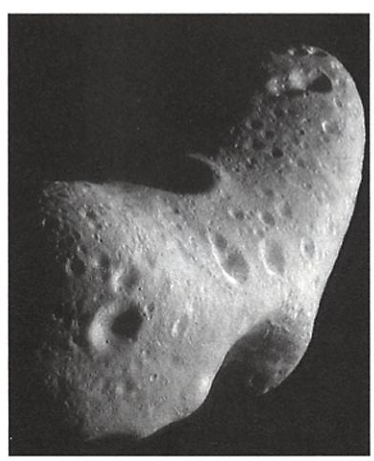
1718
Synapse formation

PLANETARY SCIENCE

Most-Common Meteorites Find A Home Among the Asteroids

WASHINGTON, D.C.—New measurements from a pioneering spacecraft may finally put to rest one of the longest running mysteries in planetary science: Where do meteorites come from?

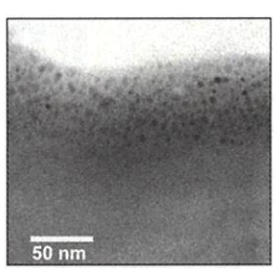
Nobody seriously doubts that the crashing and banging about of the asteroids between Mars and Jupiter yield the bits of rock that fall from our sky. But meteoriticists have spent more than a century dissecting tons of samples down to the nanometer scale, without being able to pin down their origins. The puzzle is that the most common meteorites—so-called ordinary chondrites, thought to be bits of the primordial building blocks of the solar system—don't appear to have come from the most common asteroids, the S-types. Their colors simply don't match. Last week, however, a group of researchers attending the spring meeting of the American Geophysical Union here announced that they have lifted the veil of at least one S-type asteroid—the 31-kilometer-long Eros now being orbited by the NEAR Shoemaker spacecraft—to reveal its true nature. Eros, it appears, is made of the same stuff as ordinary chondrite meteorites.



Skin deep? Tiny specks of iron (*right*) may redden the surface of Eros.

That conclusion comes from NEAR Shoemaker's first-ever analysis of the elemental composition of an asteroid. "I'm confident we've got an ordinary chondrite; everything's consistent with it," says NEAR Shoemaker team member Lucy McFadden of the University of Maryland, College Park. Some team members are anxious to see elemental analyses of more parts of Eros before they are willing to declare the meteorite mystery solved, but "you can tell which way it's going," says team member Scott Murchie of the Applied Physics Laboratory in Laurel, Maryland. The elemental link between one S-type asteroid and ordinary chondrites reinforces recent findings suggesting that long exposure of ordinary chondrite asteroids to the rigors of space has altered their appearance, to the confusion of Earth-based observers.

Ground-based astronomers searching for the source of ordinary chondrites were perplexed because wherever they looked, they saw red. Even though some of the S-type asteroids seemed to have the right mix of minerals to be ordinary chondrites—to judge by the absorption of specific wavelengths in the visible and near-infrared—they all had a subtle reddish tint. "In my dissertation, I thought Eros was a stony-iron [asteroid], a differentiated asteroid," says McFadden. Like many other planetary scientists, McFadden had concluded that heating and melting had separated Eros's rock and metal, a process called differentiation, producing chunks of metallic iron that would give the reddish tint. But it was obvious to everyone that ordinary chondrites never got heated to the point of melting.



To explain this conundrum, some researchers argued that Eros and other S-type asteroids might instead be undifferentiated ordinary chondrites reddened only on their surface by the "space weathering" of micrometeorite impacts and the solar wind. Others called such wholly theoretical agents of space weathering so much "foo-foo dust."

The designers of the NEAR Shoemaker mission hoped that their x-ray–gamma ray spectrometer (XGRS) instrument would settle the differentiation versus space weathering debate once and for all. The XGRS measures the distinctive high-energy electromagnetic emissions of specific elements. Color might be altered by space weathering, the thinking went, but elemental composition could not be. A good idea, everyone agreed, but NEAR would have to get in close to record the faint emissions reliably.

At the meeting, XGRS team leader Jacob Trombka of NASA's Goddard Space Flight Center in Greenbelt, Maryland, reported the first XGRS analyses from a distance of 50 kilometers. On 4 May, a major solar flare had bathed Eros with x-rays that stimulated x-ray fluorescence from its magnesium, aluminum, silicon, and iron, most brightly from a patch 6 kilometers across. The XGRS recorded x-ray fluorescence at specific wavelengths characteristic of each element. The result: By elemental composition, Eros falls solidly in the realm of the ordinary chondrites, Trombka reported. Specifically, it resembles the L and LL classes of ordinary chondrites. "At this point, we are indicating that Eros is undifferentiated," said Trombka, "or partially differentiated." (A few rare, "partially differentiated" meteorites come from asteroids that just began to melt, separating their rock and metal incompletely.) "The preponderance of evidence is that it's not differentiated," says meteoriticist Timothy McCoy of the XGRS team and the National Museum of Natural History in Washington, D.C., "but until we have more coverage of the asteroid, it's hard to say for sure."

McFadden reported corroborating evidence at the meeting from NEAR Shoemaker's multispectral imager system and near-IR spectrograph. Eros's color and therefore mineralogy most closely match that of ordinary chondrites, she said, in particular the same L and LL classes indicated by elemental composition, and its color is nearly uniform across the asteroid, whereas a partially differentiated body might have patchy colors. "We see no evidence for differentiated assemblages" in the spectral data, says McFadden. "We're getting the same answer from the two techniques."

Some researchers are further convinced that Eros is an ordinary chondrite in disguise, because they think they finally know how ordinary chondrites can mask themselves in a red cloak. At the Lunar and Planetary Science Conference (LPSC) last March in Hous-

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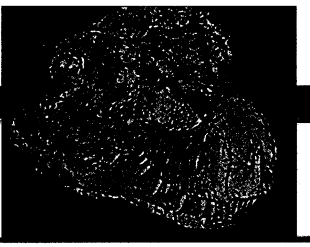
The trials of the clone rangers

Digital dinosaur dissection



Stress and Eastern Europe's coronary crisis

ton, members of the Lunar Soil Characterization Consortium reported that micrometeorite impacts and the solar wind cause reddening, at least for the only rock exposed to space weathering that they could get their hands on—lunar "soils" returned by Apollo astronauts. Microscopist Lindsay Keller of MVA Inc. in Norcross, Georgia, and consortium colleagues showed how specks of iron less than 10 nanometers in size revealed by transmission electron spectroscopy account for most of the mysterious lunar reddening. "We've identified the culprit behind the space-weathering effect," said Keller.

On the moon, according to the picture developed by the members of the consortium, micrometeorites and the charged particles of the solar wind release the iron of rock particles. It is reduced to the metallic state and deposited as "nanophase iron" on soil particle surfaces. Planetary scientist Bruce Hapke of the University of Pittsburgh told the LPSC that, according to his calculations, the solar wind alone can create enough nanophase iron to redden asteroids. "His model and the lunar soil results fit together perfectly," says planetary scientist Carlé Pieters of Brown University and the consortium. "S asteroids fit with what you'd expect for a space-weathered ordinary chondrite." Meteoriticist Harry McSween of the University of Tennessee, Knoxville, agrees. "I thought space weathering was a rather bizarre idea when I first heard it," he says, "but I can't see any way around it now. It's exciting that NEAR Shoemaker is orbiting a body that is like the most common type of meteorite that falls to Earth."

–RICHARD A. KERR

PLANT GENETICS

From Genome to Functional Genomics

Plant scientists are an impatient lot. They are about to complete the first genetic sequence of a flowering plant, a wild mustard called *Arabidopsis thaliana*. But even before the last A's, C's, G's, and T's are deposited in GenBank, a group of plant scientists has hatched an ambitious plan for the next phase: figuring out the function of all 25,000 genes. Announced last week, the plan, which has the blessing of the National Science Foundation (NSF), came with another bit of good news for the *Arabidopsis* community: the unexpected release of a set of molecular markers for finding those genes.

The 130-million-base-pair *Arabidopsis* genome is expected to be fully sequenced in July and published by year's end, 3 years ahead of schedule. Already, information gleaned from decoding this simple plant—the equivalent of the lab mouse—has made "a quantitative change" in research, says Carnegie Institution plant scientist Chris Somerville, whittling the time for isolating genes from years to weeks and thus speeding genetic discoveries ranging from more healthful soybean oil to a protein that may lead to faster growing crops.

All in one. Biologists want to probe the functions of all 25,000 *Arabidopsis* genes.

Not content to rest on their laurels, *Arabidopsis* experts now want to determine what proteins are expressed by every single gene, each protein's job within the cell, and their biochemistry—a task that could take 10 years and cost $500 million. The 2010 Project, as it's called, was fleshed out at a January workshop at the Salk Institute for Biological Studies in La Jolla, California; it was recently released on the Web (www.arabidopsis.org/workshop1.html) and is also summarized in this month's issue of *Plant Physiology*. Proponents say the multinational project will shed light on a host of questions—from how gene expression in any species is influenced by environment to the minimum number of genes needed to make a plant.

The group's ultimate goal is to create a "virtual plant" on the Internet, where scientists can click on an *Arabidopsis* cell at any stage of development, from seed to seed-dropping adult, and see every protein being expressed and the connections among them. However, plan co-author Joe Ecker of the University of Pennsylvania in Philadelphia cautions that the 2010 Project will take them only partway there; for now, they will settle for knowing what all the individual proteins do.

That alone is an enormous job. The 2010 Project will first support "genome technology centers" that will supply the necessary tools, such as DNA chips for studying gene expression, libraries of cloned genes, and knockout strains. The project is likely to draw on the talents of labs already gearing up to do high-throughput functional genomics of the nematode *C. elegans*, fruit fly, and human. Firmly behind the proposal, NSF has asked for $25 million for the 2010 Project for fiscal year 2001, an amount that Ecker hopes will grow or be supplemented by other agencies.

Also last week Cereon Genomics LLC, a subsidiary of Pharmacia Corp., released a set of more than 39,000 SNPs, or single-nucleotide polymorphisms, gene hunters' new favorite tool (www.arabidopsis.org/cereon/index.html). Until now, only about 400 SNPs have been publicly available for *Arabidopsis*. "It's a huge number if you consider the genome size," says David Meinke, an *Arabidopsis* researcher at Oklahoma State University in Stillwater—enough to isolate nearly all the genes. What's more, says Somerville, Cereon is releasing the SNPs with virtually "no strings," as academic and nonprofit users are free to patent discoveries made with these SNPs. With that and a major functional genomics project in the works, *Arabidopsis* researchers are clearly on a roll.

–JOCELYN KAISER

BIOTECHNOLOGY

Disease Group Invests In Do-It-Yourself Drugs

Chafing at the slow pace of commercial drug development, a disease advocacy group set out last week to finance new medicines for its constituency. On 31 May, the Cystic Fibrosis (CF) Foundation of Bethesda, Maryland, announced that it will invest at least $30 million in a small biotech firm, Aurora Biosciences of San Diego, to identify compounds that might prove useful in treating CF. This project, fueled initially by a donation of $20 million from the Bill and Melinda Gates Foundation, marks a new departure in the growing trend of patient groups taking charge of biomedical research.

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