Elledge of Baylor College of Medicine in Houston, have recently shown that p21 also directly inhibits the DNA-replicating machinery by binding to its PCNA component. "p21 is doing something more than inhibiting the cell cycle," Stillman says.

DNA repair can still proceed after p21 binds to PCNA, the Cold Spring Harbor team finds, even though repair and replication are carried out by the same set of proteins. What apparently happens, Stillman explains, is that p21 prevents synthesis of long stretches of DNA by preventing the enzyme complex from sliding along the DNA, but it does not stop the synthesis of the shorter segments that must be remade for repair. The upshot is that p21 may allow DNA repair to be coordinated with replication even after replication gets under way, instead of just stopping it beforehand.

The picture growing out of all this is that *p53*, working through p21, may halt DNA synthesis both directly and indirectly, thereby allowing time for repair to take place. And then p53, working through Gadd45 and perhaps on its own as well, can stimulate the repair machinery. Still, a great many gaps in the picture remain to be filled. But given that both *p53* and DNA repair are among the hottest topics going these days, there will be plenty of interest in tackling the remaining questions.

–Jean Marx

PLANETARY SCIENCE

Baring the Secrets of Asteroid Ida

BETHESDA, MARYLAND—When planetary scientists poring over Galileo spacecraft images of Ida discovered last spring that this small asteroid has an even smaller moon, they got a big break. Dactyl, as the moon is called, is turning out to be a tattletale, spilling the intimate secrets of its mysterious companion. The latest of these secrets—a clue to Ida's mass and an inkling that its reddish tint might be only skin-deep—hint that Ida might be made of primordial solar system material, the same primitive stuff that falls to Earth in the stony meteorites called chondrites. If so, astronomers struggling to understand the class of asteroids to which Ida belongs, the S type, may once again have some rethinking to do.

Many planetary scientists once assumed that S types, the commonest kind of asteroid, had to be the source of the chondrites, implying that these asteroids are simply chondrites writ large: lumps of primitive solar system material. But recent evidence, including Galileo images showing color differences between Ida and Dactyl, suggests that S types are too varied for all of them to be chunks of the same primordial stuff. Instead, many astronomers concluded that most or all S types are made of material that was heated and transformed early in solar system history, separating it into rock and metal. Chondrite meteorites, in that case, must come from another source—perhaps from asteroids too small to have been recognized yet as chondritic.

But the new clues about Ida may cause the pendulum to swing at least partway back toward the idea that S-type asteroids can indeed be made of primitive, undifferentiated stuff. "I'm leaning pretty strongly away from differentiation," says asteroid specialist Clark Chapman of the Planetary Science Institute in Tucson, Arizona, who argued at the annual meeting of the American Astronomical Society's Division for Planetary Sciences (DPS) here in suburban Washington, D.C., that Ida and at least some other S types are primitive. And many researchers who learned of the new evidence think it reinvigorates arguments that at least some S types are

JPL/NASA

A red, red asteroid. An extreme false-color rendition of Galileo data emphasizes the redness of Ida relative to its moon Dactyl.

primitive, although they're not sure Chapman has really proved the case for Ida. As Torrence Johnson of the Jet Propulsion Laboratory in Pasadena, California, puts it, "I'm still not convinced that if we had samples of Ida and Dactyl in front of us that we could agree they were chondrites."

In the absence of samples, Chapman has to rely on such indirect evidence as Dactyl's orbit around Ida, at a distance of about 100 kilometers. Because Dactyl is so small, just 1.4 kilometers in diameter compared to the 60-kilometer length of Ida, its orbit depends almost entirely on Ida's mass, and therefore on Ida's density. The latest measurements of Dactyl's orbital motion imply, Chapman noted, that Ida's density must be between 2 and 3 grams per cubic centimeter. Any less, Galileo team member Michael Belton of Kitt Peak National Observatory reported at the meeting, and Dactyl could not actually be in orbit, only caught by chance as it flew by, a highly unlikely possibility. Any more, Jean-Marc Petit of Nice Observatory and colleagues at the University of Arizona found, and Dactyl should long ago have spiraled into a catastrophic collision with Ida.

Chapman uses this density range of 2 to 3 grams per cubic centimeter to rule out one composition for Ida: that of the highly differentiated meteorites of mixed rock and metal called stony irons. The less dense ordinary chondrites, though, fit the density range nicely, Chapman notes.

At the same time, he argues that the color difference between Ida and Dactyl no longer requires a differentiated composition. When Galileo's sensitive instruments first revealed that Ida's spectrum is a bit "redder" than Dactyl's (although both would look gray to the human eye), even Chapman took that subtle difference as a possible sign that Ida is differentiated (*Science*, 17 June, p. 1667). But when he looked at the latest calibrated version of the Galileo spectral data, which came out the week before the DPS meeting, he concluded that the similarities are more telling than the differences: "The color differences are significant, but they don't require substantial differences in mineralogy."

Instead, says Chapman, the color differences look like the product of space weathering, a poorly understood process in which micrometeorite impacts or some other agent reddens exposed surfaces. Because larger bodies, with their stronger gravity, would have been pummeled by higher speed impactors, Ida should have suffered more extensive weathering than Dactyl, which would explain the color difference. Ida, says Chapman, looks like an ordinary chondrite hiding in a red cloak; he thinks weathering may have also disguised other S types.

Most other researchers, however, believe that the case is far from closed. For one thing, as Jeffrey Bell of the University of Hawaii points out, Ida's relatively low density may rule out some differentiated compositions, but it could still be made of the lower density rock from a larger body that had differentiated into rocky and metallic parts. And Richard Binzel of the Massachusetts Institute of Technology adds that even if space weathering has disguised Ida, its true identity should be apparent in material freshly exposed on its surface by recent impacts. This fresh impact debris, notes Binzel, doesn't match the color of an ordinary chondrite—although Chapman responds that it may not be fresh enough to have escaped space weathering entirely.

Still, the hints that, among S types, appearances can be deceiving strengthens the possibility that at least a few of them could be primitive, Johnson says. Ida is still in the running, but researchers want to learn a few more of its intimate secrets before deciding.

–Richard A. Kerr