Asteroid is 'practice case' for potential hazards

October 12 2007

In research that could aid decisions about future asteroids on a collision course with Earth, MIT researchers have for the first time determined the composition of a near-Earth asteroid that has a very slight possibility of someday hitting our planet.

That information could be useful in planning any future space mission to explore the asteroid, called Apophis. And if the time ever were to come when this object or another turned out to be on its way toward an impact on Earth, knowing what it's made of could be one important factor in deciding what to do about it.

"Basic characterization is the first line of defense," says Richard P. Binzel, Professor of Planetary Sciences in the Department of Earth, Atmospheric, and Planetary Sciences (EAPS). "We've got to know the enemy."

Binzel presented the new findings this week at the annual meeting of the Division for Planetary Sciences of the American Astronomical Society.

Studying the composition of Apophis has been a useful "practice case," Binzel says, because "you never know when the real one will come along" that is on a collision with the Earth. For determining the composition of a threatening asteroid, Binzel says, "We don't know when the real test will come, but we're ready."

On April 13, 2029, Apophis will come relatively close to Earth (it will

miss us by about 22,000 miles). But when it comes by again in 2036, there is a very small possibility - about one chance in 45,000 - that it could be on a collision course.

So Binzel, working with EAPS graduate students Cristina Thomas and Francesca DeMeo and others, has been using telescopes on Earth to find out as much as possible about the nature of Apophis and other asteroids. Short of putting together a space mission that would take years and cost hundreds of millions of dollars, such observations are the best way to find out as much as possible about any space rock that might someday be coming our way, Binzel says.

Using the MIT Magellan telescope in Chile and NASA's Infrared Telescope Facility in Hawaii, they have now been able to figure out exactly what Apophis is made of. "The composition, I think, is really nailed," he says.

The key to understanding the mineral makeup of an asteroid is to compare it with samples of asteroidal material that have been delivered, free of charge, to the Earth, in the form of the many thousands of meteorites that have been collected over the years.

Spectral analysis - measuring how the meteorites reflect light of different wavelengths - can be used to determine their exact mineral constituents. Similarly, a spectral analysis of the light reflected from a distant asteroid shows the same telltale lines that reveal its composition. By comparing the two kinds of spectra, an asteroid that is just a faraway pinprick of light can be correlated with a piece of a space rock in the laboratory.

Binzel and his students were able to use both visible-light and infrared spectroscopy to show that Apophis is "a good match" for a rare type of meteorite, known as a type LL chondrite. These represent just 7 percent

of the known meteorite falls on Earth, and are rich in the minerals pyroxene and olivine, which are also common on Earth.

"The beauty of having found a meteorite match for Apophis is that because we have laboratory measurements for the density and strength of these meteorites, we can infer many of the same properties for the asteroid Apophis itself," Binzel says.

An object the size of Apophis (about 270 meters across) could devastate a region as large as France, or produce tsunamis over a wide area if it struck at sea. Many ideas have been proposed for how to deal with such a threat, ranging from using bombs, lasers or spacecraft to nudge it out of the way to blowing it to pieces while it is still far away. The selection of the best course of action may depend of the physical characteristics of the object, including its mineral composition.

Source: MIT