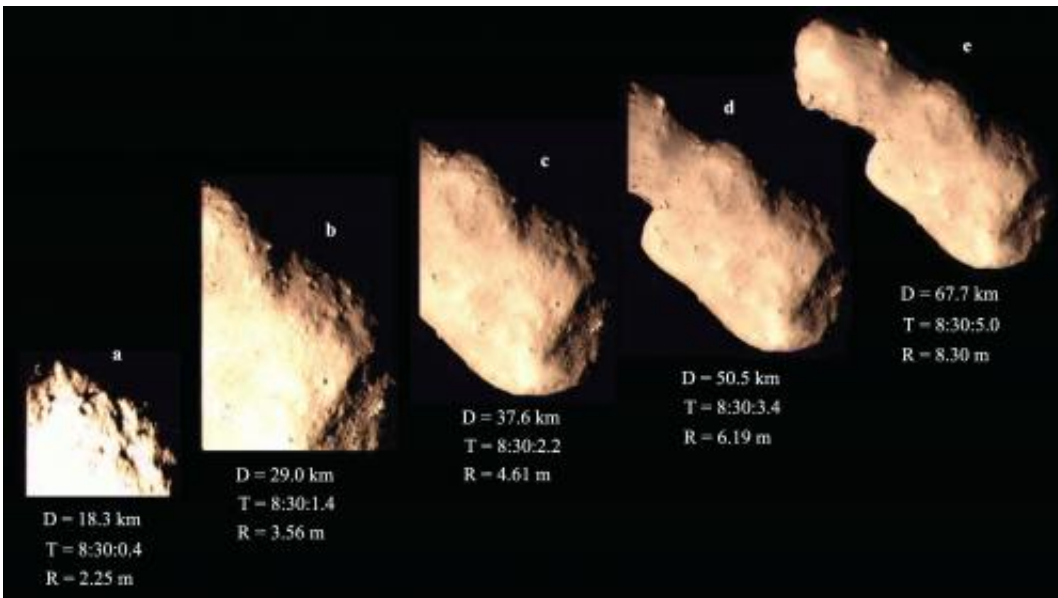


Chinese flyby of asteroid shows space rock is "rubble"

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"Outbound images of Toutatis acquired on 13 December, 2012 during Chang'e-2 flyby, indicative of the spacecraft being away from the asteroid (from a to e). The imaging distance (D), epoch of flyby (T, UTC) and resolution of each image (R) are shown for each snapshot. The nearest distance between the probe and the surface of the asteroid is about 770m." Credit: CNSA (China National Space Administration).

China's first flyby of an asteroid shows that a gigantic space rock which once triggered a doomsday scare is essentially rubble, scientists reported on Thursday.

On December 13 2012, a lunar probe called Chang'e-2 rendezvoused with asteroid 4179 Toutatis as the rock, bigger than a city block, swept by Earth at a distance of around seven million kilometres (4.4 million miles).

Describing the encounter in detail in the journal *Scientific Reports*, Chinese scientists said the flyby was brief but highly successful, the result of seven months of preparation after Chang'e-2 had completed its primary mission of orbiting the Moon.

Advancing at more than 38,000 kilometres (24,000) miles per hour, the probe came within 770 metres (yards) of the asteroid's surface, returning pictures with a resolution better than three metres (10 feet) per pixel.

The images show a rock shaped like a piece of ginger root, 4.75 kilometres (2.96 miles) long by 1.95 kms (1.21 miles) wide, with a crater at its big end showing an impact at some point in its history.

The astronomers also saw boulders and small gravel-like stones called regolith sliding over its surface, which suggest that Toutatis is not so much a single, solid rock but more an assembly of rubble.

"The rubble-pile structure is essentially a normal situation for most of the smaller asteroids" under a kilometre (0.6 of a mile) across, said Ji Jianghui of the Chinese Academy of Sciences in Beijing.

"This is also the case for Toutatis. In this structure, the asteroids are not a single rock but a loose collection of fragments under the influence of gravity, which means that it is an agglomeration of gravitationally-bound chunks," Ji said in an email exchange with AFP.

Toutatis was first spotted in 1934 and then lost from sight. It was then rediscovered in 1989 by a French astronomer, Christian Pollas, who

named it after a Celtic god, Toutatis, which also features as a name of doom in the "Asterix" comic books.

Internet panic in 2004 flyby

Toutatis is one of the biggest "potentially hazardous asteroids," or PHAs, or rogue rocks whose orbit can bring them close to our planet.

As a result, it has been closely followed by telescopes and radar on Earth.

It came by Earth in 1992, 1996, 2000, 2004, 2008 and 2012, but will not approach so close until 2069.

In the runup to the 2004 flypast, panicky rumours spread on the Internet that NASA had either lied or got its calculations wrong, and that Earth was going to take a direct hit.

As predicted, Toutatis whizzed past safely at 0.1 Astronomical Units, or 1.5 million kilometres (930,000 miles), equivalent to about four times the distance between the Earth and the Moon. In 2069, the gap is expected to be twice that, at 0.2 Astronomical Units.

Ji said that, even though Toutatis seems to have a loose structure, it was unlikely to fall apart, even when tugged by the gravity of nearby planets.

"It seems that Toutatis will not break apart into two separate parts due to its current slow rotational status when it comes to Earth or other planets," he said.

Toutatis is not a known threat, but there are plenty of other asteroids whose orbital track is unknown but which may bring them across our path.

Understanding the structure of these rocks is essential for deciding how best to defend Earth against an impact, said Ji.

"The impact threat from near-Earth objects always exists," he said.

"Currently, Toutatis will not collide Earth, whereas (there are) millions of smaller-sized objects, on the scale of several tens of metres (yards) across," he said.

"Depending on the physical features and internal structures for PHAs, different solutions are applicable to them... the mitigation may be carried out such as by blowing the entire asteroid up or pulling them away from their dangerous orbits to deflect them."

Chang'e-2 is now more than 50 million kilometres (30 million miles) from Earth, helping to test control procedures and orientation in space flight.

China is the fourth space power to have directly explored an asteroid, after the United States, Europe and Japan.

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