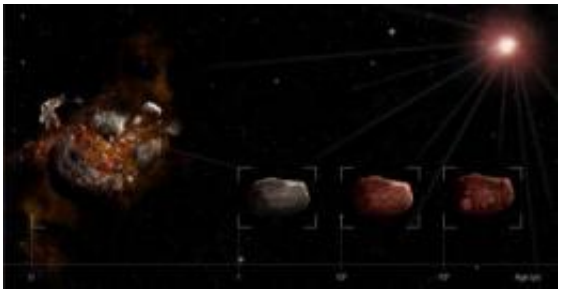
Solar wind tans young asteroids

April 22 2009



This is an artist's impression of how the solar wind makes young asteroids look old. After undergoing a catastrophic collision, the color of an asteroid gets modified rapidly by the solar wind so that it resembles the mean color of extremely old asteroids. After the first million years, the surface "tans" much more slowly. At that stage, the color depends more on composition than on age. Credit: ESO/M. Martins

A new study published in *Nature* this week reveals that asteroid surfaces age and redden much faster than previously thought -- in less than a million years, the blink of an eye for an asteroid. This study has finally confirmed that the solar wind is the most likely cause of very rapid space weathering in asteroids. This fundamental result will help astronomers relate the appearance of an asteroid to its actual history and identify any after effects of a catastrophic impact with another asteroid.

"Asteroids seem to get a 'sun tan' very quickly," says lead author Pierre Vernazza. "But not, as for people, from an overdose of the Sun's ultraviolet radiation, but from the effects of its powerful wind."

It has long been known that asteroid surfaces alter in appearance with time — the observed asteroids are much redder than the interior of meteorites found on Earth[1] — but the actual processes of this "space weathering" and the timescales involved were controversial.

Thanks to observations of different families of asteroids[2] using ESO's New Technology Telescope at La Silla and the Very Large Telescope at Paranal, as well as telescopes in Spain and Hawaii, Vernazza's team have now solved the puzzle.

When two asteroids collide, they create a family of fragments with "fresh" surfaces. The astronomers found that these newly exposed surfaces are quickly altered and change colour in less than a million years — a very short time compared to the age of the Solar System.

"The charged, fast moving particles in the solar wind damage the asteroid's surface at an amazing rate[3]", says Vernazza. Unlike human skin, which is damaged and aged by repeated overexposure to sunlight, it is, perhaps rather surprisingly, the first moments of exposure (on the timescale considered) — the first million years — that causes most of the aging in asteroids.

By studying different families of asteroids, the team has also shown that an asteroid's surface composition is an important factor in how red its surface can become. After the first million years, the surface "tans" much more slowly. At that stage, the colour depends more on composition than on age. Moreover, the observations reveal that collisions cannot be the main mechanism behind the high proportion of "fresh" surfaces seen among near-Earth asteroids. Instead, these "fresh-looking" surfaces may be the results of planetary encounters, where the tug of a planet has "shaken" the asteroid, exposing unaltered material.

Thanks to these results, astronomers will now be able to understand

better how the surface of an asteroid — which often is the only thing we can observe — reflects its history.

More information: This result was presented in a paper published this week in the journal *Nature*, "Solar wind as the origin of rapid reddening of asteroid surfaces", by P. Vernazza et al. The team is composed of Pierre Vernazza (ESA), Richard Binzel (MIT, Cambridge, USA), Alessandro Rossi (ISTI-CNR, Pisa, Italy), Marcello Fulchignoni (Paris Observatory, France), and Mirel Birlan (IMCCE, CNRS-8028, Paris Observatory, France).

Notes

[1] Meteorites are small fragments of asteroids that fall on Earth. While a meteorite enters the Earth's atmosphere its surface can melt and be partially charred by the intense heat. Nevertheless, the meteorite interior remains unaffected, and can be studied in a laboratory, providing a wealth of information on the nature and composition of asteroids.

[2] An asteroid family is a group of asteroids that are on similar orbits around the Sun. The members of a given family are believed to be the fragments of a larger asteroid that was destroyed during a collision.

[3] The surface of an asteroid is affected by the highly energetic particles forming the solar wind. These particles partially destroy the molecules and crystals on the surface, re-arranging them in other combinations. Over time, these changes give formation of a thin crust or irradiated material with distinct colours and properties.

Source: ESO (news : web)