253 Mathilde

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NASA image of 253 Mathilde

Discovery	
Discovered by	Johann Palisa
Discovery date	November 12, 1885
Designations	
Alternative names	A915 TN; 1949 OL_1
Minor planet category	Main belt
Orbital characteristics[2]	
Epoch January 30, 2005 (JD 2453400.5)	
Aphelion	501.334 Gm 3.35121 AU
Perihelion	290.564 Gm 1.94230 AU
Semi-major axis	395.949 Gm 2.64676 AU
Eccentricity	0.266157
Orbital period	1572.787 d (4.31 yr)
Average orbital speed	17.98 km/s[1]
Mean anomaly	111.960°
Inclination	6.738°
Longitude of ascending node	179.633°
Argument of perihelion	157.475°
Physical characteristics	
Dimensions	52.8[2] km (66×48×46 km[3])
Mass	$1.033(\pm0.044)\times10^{17}$[4] kg
Mean density	1.3[4] g/cm^3
Surface gravity	0.0025[5] m/s^2
Escape velocity	16.2[6] m/s
Rotation period	17.406±0.010[7] d (17 d 9 h 45 min)
Albedo	

	0.0436[2]
Temperature	~174[8] K
Spectral type	Cb[2]
Absolute magnitude *(H)*	10.20[2]

253 Mathilde is a main belt asteroid found by Johann Palisa in 1885. It has a fairly elliptical orbit that takes more than four years to circle the Sun. This asteroid has an unusually slow rate of rotation, taking 17.4 days to complete a 360° revolution about its axis. It is a primitive C-type asteroid, which means the surface has lots of carbon; giving it a dark surface that reflects only 4% of the light that falls on it.[9]

This asteroid was visited by the NEAR Shoemaker spacecraft during June 1997, on its way to asteroid 433 Eros. The spacecraft took pictures of one side of the asteroid, finding many big craters that have gouged out depressions in the surface. It is currently the biggest asteroid to be visited by a spacecraft, and the first C-type asteroid to be so explored.

Description

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> One of the big craters on 253 Mathilde. *NASA image*.

253 Mathilde is very dark.[10] The asteroid has a number of very big craters, with the individual craters being named for coal fields and basins around the world.[11] The two biggest craters, Ishikari (29.3 km) and Karoo (33.4 km), are as wide as the asteroid's average radius.[3] The impacts appear to have blown big volumes off the asteroid, as suggested by the angular edges of the craters.[9]

The density measured by NEAR Shoemaker, 1,300 kg/m³, is less than half that of a normal carbonaceous chondrite; this may indicate that the asteroid is very loosely packed rubble pile (an asteroid that has been broken apart by a collision and pulled back together by gravity).[4] The same is true of several C-type asteroids studied by ground-based telescopes with adaptive optics systems (45 Eugenia, 90 Antiope, 87 Sylvia and 121 Hermione). Up to 50% of the volume inside of 253 Mathilde has open space. However, the existence of a 20-km-long scarp may indicate that the asteroid does have some structural strength, so it could contain some big internal components. The low interior density is an inefficient transmitter of impact shock through the asteroid, which also helps to preserve the surface features to a high degree.[3]

Mathilde's orbit is eccentric, taking it to the farther reaches of the Main belt. Nonetheless, the orbit lies between the orbits of Mars and Jupiter; it

does not cross the planetary orbits. It also has one of the slowest rotation periods of the known asteroids — most asteroids have a rotation period in the range of 2 – 24 hours.[12] Because of the slow rotation rate, NEAR Shoemaker was only able to take pictures of 60% of the asteroid's surface. The slow rate of rotation may been accounted for by a moon orbiting the asteroid, but a search of the NEAR images revealed none bigger than 10 km in diameter out to 20 times the radius of 253 Mathilde.[13]

References

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1. ↑ For semi-major axis a, orbital period T and eccentricity e, the average orbital speed is given by:
$$\begin{aligned} v_o &= \frac{2\pi a}{T}\left[1 - \frac{e^2}{4} - \frac{3e^4}{64} - \dots\right] \\ &= 18.31\ \mathrm{km/s}\left[1 - 0.0177 - 0.00008 - \cdots\right] \\ &\approx 17.98\ \mathrm{km/s} \end{aligned}$$
For the circumference of an ellipse, see: H. Stèocker, J. Harris (1998). *Handbook of Mathematics and Computational Science*. Springer. p. 386. ISBN 0-387-94746-9.
2. ↑ 2.0 2.1 2.2 2.3 2.4 Unless otherwise noted, parameters are per: Yeomans, Donald K. (August 29, 2003). "253 Mathilde". *JPL Small-Body Database Browser*. NASA. Retrieved 2007-08-29.
3. ↑ 3.0 3.1 3.2 J. Veverka; et al. (1999). "NEAR Encounter with Asteroid 253 Mathilde: Overview". *Icarus*. **140** (1): 3–16. Bibcode:1999Icar..140....3V. doi:10.1006/icar.1999.6120. Retrieved 2007-08-29.
4. ↑ 4.0 4.1 4.2 D. K. Yeomans; et al. (1997). "Estimating the mass of asteroid 253 Mathilde from tracking data during the NEAR flyby". *Science*. **278** (5346): 2106–9. doi:10.1126/science.278.5346.2106. PMID 9405343. Retrieved 2007-08-29.
5. ↑ With asteroid mass m, radius r and G equal to the gravitational constant, Newton's law of universal gravitation gives an average surface gravity g of:
$$\begin{aligned} g &= G\frac{m}{r^2} \\ &= 6.67 \times 10^{-11}\mathrm{m^3/kg\,s^2} \cdot \frac{1.03 \times 10^{17}\ \mathrm{kg}}{(5.28 \times 10^4\ \mathrm{m})^2} \\ &= 0.0025\ \mathrm{m/s^2} \end{aligned}$$
6. ↑ For surface gravity g and radius r, the escape velocity is:
$$\begin{aligned} v_e &= \sqrt{2gr} \\ &= \sqrt{2 \cdot 0.0025\ \mathrm{m/s^2} \cdot 52800\ \mathrm{m}} \\ &= 16.2\ \mathrm{m/s} \end{aligned}$$

7. ↑ Stefano Mottola; et al. (1995). "The slow rotation of 253 Mathilde". *Planetary and Space Science*. **43** (12): 1609–1613. Bibcode:1995P&SS..43.1609M. doi:10.1016/0032-0633(95)00127-1. Retrieved 2007-02-04.
8. ↑ For asteroid albedo α, semimajor axis a, solar luminosity L_0, Stefan-Boltzmann constant σ and the asteroid's infrared emissivity ε (~0.9), the approximate mean temperature T is given by:

$$T = \left(\frac{(1-\alpha)L_0}{\epsilon\sigma 16\pi a^2}\right)^{\frac{1}{4}}$$

$$= \left(\frac{(1-0.0436)(3.827\times 10^{26}\ \mathrm{W})}{0.9(5.670\times 10^{-8}\ \mathrm{W/m^2K^4})16\cdot 3.142(3.959\times 10^{11}\ \mathrm{m})^2}\right)^{\frac{1}{4}}$$

$$= 173.7\ \mathrm{K}$$

   See: Torrence V. Johnson, Paul R. Weissman, Lucy-Ann A. McFadden (2007). *Encyclopedia of the Solar System*. Elsevier. p. 294. ISBN 978-0-12-088589-3.
9. ↑ 9.0 9.1 Williams, David R. (December 18, 2001). "NEAR Flyby of Asteroid 253 Mathilde". NASA. Retrieved 2006-08-10.
10. ↑ Pon, Brian (June 30, 1999). "Pavement Albedo". Heat Island Group. Archived from the original on 2007-08-29. Retrieved 2007-08-27.
11. ↑ Blue, Jennifer (August 29, 2007). "Categories for Naming Features on Planets and Satellites". USGS. Retrieved 2007-08-29.
12. ↑ Lang, Kenneth R. (2003). "2. Asteroids and meteorites, Size, color and spin". *NASA's Cosmos*. NASA. Archived from the original on 2012-08-06. Retrieved 2007-08-29.
13. ↑ W. J. Merline; et al. (1998). "Search for Satellites of 253 Mathilde from Near-Earth Asteroid Rendezvous Flyby Data". *Meteoritics & Planetary Science*. **33**: A105. Bibcode:1998M&PSA..33..105M. Retrieved 2007-08-29.

Other websites

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