

Crater, Impact

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Keywords

Asteroid; Collision; Comet; Impact; Micrometeorite; Surface

Definition

An impact crater is a mostly circular or elliptical elongate depression, generally with a raised rim, which is created by the impact of a minor body on the solid surface of a ► [planet](#) or satellite. Impact craters range in size from microcraters seen only microscopically on surfaces of ► [rock](#) samples (e.g., rocks from the lunar surface) to large craters and ► [impact basins](#) several hundreds or thousands of kilometers across. Impacts into the atmospheres of the large gaseous planets in the outer ► [Solar System](#) can produce transitory circular or semicircular features resembling craters, as has been observed on ► [Jupiter](#) after the impact of ► [Comet Shoemaker/Levy-9](#).

Overview

Impact craters on solid surfaces of planets and satellites are created by hypervelocity collisions with smaller bodies. These bodies, termed *impactors* or *projectiles*, range in size from ► [micrometeorites](#) to large bolides up to tens or hundreds of kilometers in diameter, which form impact basins several hundreds or thousands of kilometers across (Pike 1980; Melosh 1989). Candidate impactors are (1) ► [asteroids](#) from the main belt (MBA) or from other asteroid families, for example, Near-Earth asteroids (NEA) (Neukum et al. 2001; Strom et al. 2005; Bottke et al. 2012), (2) ► [comets](#) including ► [ecliptic](#) or short-period comets (EC, orbital period <200 years) derived from the ► [Kuiper belt](#) and nearly isotropic or long-period comets (NIC, orbital period >200 years) from the ► [Oort cloud](#) (Zahnle et al. 2003), (3) bodies or debris in planetocentric orbits (Neukum 1985; Chapman and McKinnon 1986), and (4) remnants of planetary accretion (planetesimals) (Wetherill 1975).

The number or frequency of craters on a surface per unit area records its age: the higher the crater frequency, the older the age of the surface due to the longer exposure time to the incoming impactor flux. This relationship can be used as an important tool in planetary chronology.

Morphology and sizes of impact craters reflect impact conditions, projectile properties, target properties, and changes of target properties with time (Schenk et al. 2004). The smallest craters identified in camera images are simple craters, characterized by a bowl-shaped, parabolic crater morphology (e.g., Melosh 1989). With increasing diameter, crater forms become more complex. The simple-to-complex transition diameter approximately scales with the inverse of the gravity acceleration, except for icy surfaces as on ► [Mars](#) (ice in the regolith) and the icy satellites in the Outer Solar System (Chapman and McKinnon 1986; Melosh 1989; Schenk et al. 2004). Features observed in complex craters include (Pike 1980; Chapman and McKinnon 1986; Melosh 1989; Schenk et al. 2004) (a) flat crater floors,

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(b) terraces at crater wall interiors, (c) central peaks, or (d) peak rings. On icy satellites, complex crater forms include (e) central pits (also observed on Mars [e.g., Barlow 2009]), (f) central domes, or (g) bright, almost flat circular areas termed *palimpsests* (Faculae) devoid of prominent topographic features such as crater rims.

The largest impact structures are ► [impact basins](#), which exhibit two or even more rings (ridges or graben) and are termed multi-ring basins (e.g., Spudis 1993).

See Also

- [Asteroid](#)
- [Asteroid Belt, Main](#)
- [Catena, Catenae](#)
- [Chronology, Cratering and Stratigraphy](#)
- [Comet](#)
- [Comet Shoemaker-Levy 9](#)
- [Ecliptic](#)
- [Facula, Faculae](#)
- [Impact Basin](#)
- [Jupiter](#)
- [Kuiper Belt](#)
- [Mars](#)
- [Micrometeorites](#)
- [Oort Cloud](#)
- [Planet](#)
- [Planet Formation](#)
- [Planetesimals](#)
- [Rock](#)
- [Satellite or Moon](#)
- [Solar System Formation \(Chronology\)](#)

References and Further Reading

- Barlow NG (2009) Martian central pit craters: summary of northern hemisphere results. Lunar and planetary science conference 40th, abstr. 1915 [CD-Rom]
- Bottke WF, Vokrouhlicky D, Minton D, Nesvorny D, Morbidelli A, Brassier R, Simonson B, Levison HF (2012) An Archean heavy bombardment from a destabilized extension of the asteroid belt. *Nature*. doi:10.1038/nature10967
- Chapman CR, McKinnon WB (1986) Cratering of planetary satellites. In: Burns JA, Matthews MS (eds) *Satellites*. University of Arizona Press, Tucson, pp 492–580
- Melosh HJ (1989) *Impact cratering: a geologic process*, vol 11, Oxford monographs on geology & geophysics. Oxford University Press, New York, p 245
- Neukum G (1985) Cratering records of the satellites of Jupiter and Saturn. *Adv Space Sci* 5:107–116
- Neukum G, Ivanov BA, Hartmann WK (2001) Cratering records in the inner solar system in relation to the lunar reference system. In: Hartmann WK, Geiss J, Kallenbach R (eds) *Chronology and evolution of Mars*. Kluwer, Dordrecht, pp 53–86

- Pike RJ (1980) Control of crater morphology by gravity and target type: Mars, Earth, Moon. In: Proceedings of the lunar and planetary science conference 11th, Houston, pp 2159–2189
- Schenk PM, Chapman CR, Zahnle K, Moore JM (2004) Ages and interiors: the cratering record of the Galilean satellites. In: Bagenal F, Dowling T, McKinnon W (eds) Jupiter – the planet, satellites and magnetosphere. Cambridge University Press, Cambridge, pp 427–456
- Spudis PD (1993) The geology of impact basins: the moon and other planets. Cambridge University Press, Cambridge, 263 pp
- Strom RG, Malhotra R, Takashi I, Yoshida F, Kring DA (2005) The origin of planetary impactors in the inner solar system. *Science* 309:1847–1850
- Wetherill GW (1975) Late heavy bombardment of the moon and the terrestrial planets. Proceedings of the lunar and planetary science conference 6th, Houston, pp 1539–1561
- Zahnle K, Schenk P, Levison H, Dones L (2003) Cratering rates in the outer solar system. *Icarus* 163:263–289

An impact crater is an approximately circular depression in the surface of a planet, moon, or other solid body in the Solar System or elsewhere, formed by the hypervelocity impact of a smaller body. For faster navigation, this IFrame is preloading the Wikiwand page for Impact crater. Home. News. Most of Earth's impact craters have been discovered since the dawn of the space age, from satellite imaging. In fact, a geologist recently discovered an impact crater using Google Earth! Here's my list of Earth's Ten Most Impressive Impact Craters, starting with #1. the largest and oldest known impact crater, Vredefort Crater, shown above, located in South Africa. It is approximately 250 kilometers in diameter and is thought to be about two billion years old. An impact crater (impact basin, astrobleme or sometimes crater) is a circular or oval depression on a surface, usually referring to a planet, moon, asteroid, or other celestial body, caused by a collision of a smaller body (meteor) with the surface. Ancient craters whose relief has disappeared leaving only a "ghost" of a crater are known as palimpsests. Although it might be assumed that a major impact on the Earth would leave behind absolutely unmistakable evidence, in fact the gradual processes that