

Theia (planet)

Theia (/ˈθiːə/) is a hypothesized ancient planet in the early Solar System that, according to the 'giant impact hypothesis', collided with Gaia (the early Earth) around 4.5 billion years ago.^{[1][2]} According to the hypothesis, Theia was an Earth trojan about the size of Mars, with a diameter of about 6,102 km (3,792 miles). Geologist Edward Young of the University of California, Los Angeles, drawing on an analysis of rocks collected by Apollo missions 12, 15, and 17, proposes that Theia collided head-on with Earth,^[3] in contrast to the previous theory that suggested a glancing impact. Models of the impact indicate that Theia's debris gathered around Earth to form the early Moon.

Some scientists think the material thrown into orbit originally formed two moons^{[4][5]} that later merged to form the single moon we know today. The Theia hypothesis also explains why Earth's core is larger than would be expected for a body its size: according to the hypothesis, Theia's core and mantle mixed with Earth's.^[6]



An artist's depiction of the hypothetical impact of a planet like Theia and the Earth

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Orbit

Theia is thought to have orbited in the L4 or L5 configuration presented by the Earth–Sun system, where it would tend to remain. In that case, it would have grown, potentially to a size comparable to Mars. Gravitational perturbations by Venus could have eventually put it onto a collision course with the Earth.^[7]

Name

Theia was named for the titaness Theia, who in Greek mythology was the mother of Selene, the goddess of the moon,^[8] which parallels the planet Theia's collision with the early Earth that is theorized to have created the Moon.^[9]

An alternative name, **Orpheus**, is also used.^[10]

Collision

According to the giant-impact hypothesis, Theia orbited the Sun, nearly along the orbit of the proto-Earth, by staying close to one or the other of the Sun–Earth system's two more stable Lagrangian points (i.e. either L4 or L5).^[7] Theia was eventually perturbed away from that relationship by the gravitational influence of Jupiter and/or Venus, resulting in a collision between Theia and Earth.

Computer simulations suggest that Theia was traveling no faster than 4 km/s when it struck Earth at an estimated 45 degree angle.

Originally, the hypothesis supposed that Theia had struck Earth with a glancing blow^[11] and ejected many pieces of both the proto-Earth and Theia, those pieces either forming one body that became the Moon or forming two moons that eventually merged to form the Moon.^[4] Such accounts assumed that if Theia had struck the proto-Earth head-on both planets would have been destroyed, creating a short-lived second asteroid belt between the orbits of Venus and Mars.

In contrast, evidence published in January 2016 suggests that the impact was indeed a head-on collision and that Theia's remains can be found both in the Earth and the Moon.^{[12][13]}

Hypotheses

From the beginning of modern astronomy there have been at least four hypotheses for the origin of the Moon:

1. that a single body split into Earth and the Moon;
2. that the Moon was captured by Earth's gravity (as most of the outer planets' smaller moons were captured);
3. that Earth and the Moon formed at the same time when the protoplanetary disk accreted; and
4. that the Theia scenario occurred.

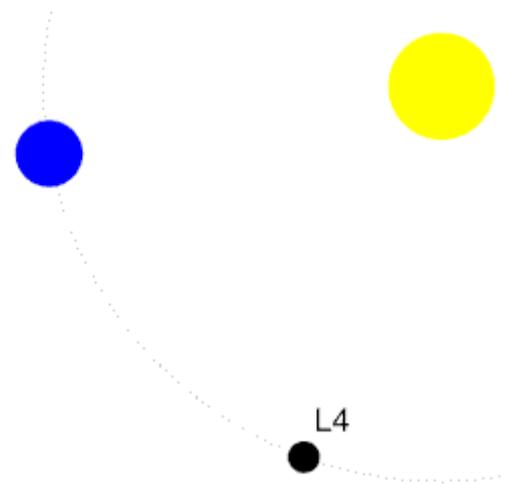
The lunar rock samples retrieved by Apollo astronauts were found to be very similar in composition to Earth's crust, and so were likely removed from Earth in some violent event.^{[3][14][15]}

See also

- Disrupted planet
- Phaeton (hypothetical planet)
- Synestia

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Animation of collision event between Earth (blue) and Theia (black), forming the Moon (grey). Celestial bodies are not to scale.

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