Synestia

A **synestia** is a hypothesized rapidly spinning donut-shaped mass of vaporized rock. In computer simulations of giant impacts of rotating objects, a synestia can form if the total angular momentum is greater than the co-rotational limit.[1] Beyond the co-rotational limit, the velocity at the equator of a body would exceed the orbital velocity.[2] In a synestia, this results in an inner region rotating at a single rate with a loosely connected torus orbiting beyond it.[3]

According to studies, synestia was an early-stage process for the formation of the Earth and Moon within the giant-impact hypothesis. In this model, a synestia formed following a collision with an object of high energy and high angular momentum. The synestia's surface temperatures are constrained by the boiling point of rock, around 2,300 kelvins, approximately 3,700 °F (2,040 °C).[4] As the resulting synestia cooled by radiating heat to space, magma droplets formed in its outer layers and then rained inward over a period of tens of years, causing the synestia to contract.[4] Mass remaining outside the Roche limit of the inner region accreted to form moonlets, and subsequently combined to form our moon. The Earth re-formed later, once the synestia had cooled sufficiently to fall within the co-rotational limit. By this model, the Moon's having formed within a cloud of vapor that originated from the Earth is why its isotopic ratios are similar to those of the Earth. The later formation of the Earth (after the synestia cooled) accounts for its having accreted more volatile elements than the Moon.[5]

Notes and references

1. Boyle, Rebecca. "Huge impact could have smashed early Earth into a doughnut shape" (https://www.newscientist.com/article/2132763-huge-impact-could-have-smashed-early-earth-into-a-doughnut-shape). *New Scientist*. Retrieved 7 June 2017.
2. Gough, Evan. "Scientists Propose a New Kind of Planet: A Smashed Up Torus of Hot Vaporized Rock" (https://www.universetoday.com/135701/scientists-propose-new-kind-planet-smashed-torus-hot-vaporized-rock/). *Universe Today*. Retrieved 7 June 2017.
3. Lock, Simon J.; Stewart, Sarah T. (2017). "The structure of terrestrial bodies: Impact heating, corotation limits and synestias". *Journal of Geophysical Research: Planets*. **122** (5): 950–982. arXiv:1705.07858 (https://arxiv.org/abs/1705.07858). Bibcode:2017JGRE..122..950L (https://ui.adsabs.harvard.edu/abs/2017JGRE..122..950L). doi:10.1002/2016JE005239 (https://doi.org/10.1002%2F2016JE005239).
4. Lock, Simon J. "When Earth and the Moon Were One" (https://www.scientificamerican.com/article/when-earth-and-the-moon-were-one/). *Scientific American*. Springer Nature America, Inc. Retrieved 3 July 2019.
5. Lock, Simon J.; Stewart, Sarah T.; Petaev, Michail I.; Leinhardt, Zoe M.; Mace, Mia T.; Jacobsen, Stein B.; Ćuk, Matija (2018). "The origin of the Moon within a terrestrial synestia". *Journal of Geophysical Research*. **123** (4): 910. arXiv:1802.10223 (https://arxiv.org/abs/1802.10223). Bibcode:2018JGRE..123..910L (https://ui.adsabs.harvard.edu/abs/2018JGRE..123..910L). doi:10.1002/2017JE005333 (https://doi.org/10.1002%2F2017JE005333).

External links

- TED talk about synestia (https://www.ted.com/talks/sarah_t_stewart_where_did_the_moon_come_from_a_new_theory) by Sarah T. Stewart (February 2019). Duration: 11 minutes. Retrieved 12 July 2019.