# Our Nuclear Moon



**It may come as a surprise to many readers, but science cannot fully explain the origin of our own Moon.**

Existing models, based on the collision of a young Earth with another, Mars-sized, planet are good at reproducing the angular momentum (orbit, rotation) of the Earth-Moon system, but they can't explain why Moon rock is so very similar to Earth rock in terms of isotope composition.

We therefore need better models, says Rob de Meijer, Professor Emeritus in Nuclear Geophysics at the University of Groningen. In a paper just published in the journal *Chemical Geology* (8 May), De Meijer and his colleagues Wim van Westrenen (VU University Amsterdam) and Vladimir Anisichkin (Russian Academy of Sciences) argue that the Earth may have given birth to the Moon after a runaway nuclear explosion deep inside our planet.

'Collision models predict that 80 per cent of the Moon would originate from the impactor and just 20 per cent from the Earth', De Meijer explains. But the moon rock that the Apollo missions brought back to Earth tells a different story. It is very similar in composition to the Earth's mantle.

But could the impactor not be an Earth lookalike? Not according to De Meijer, because planet-formation models rule this out.

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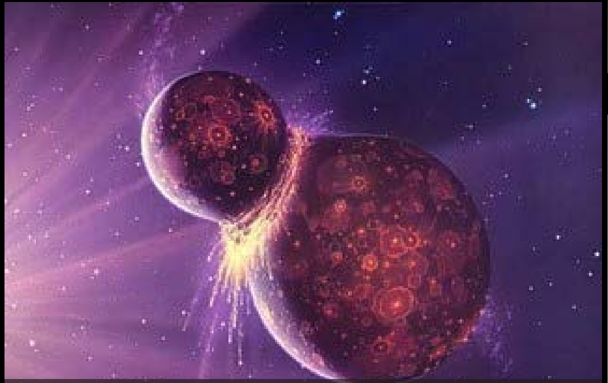

Collission of Earth with an unknown planet

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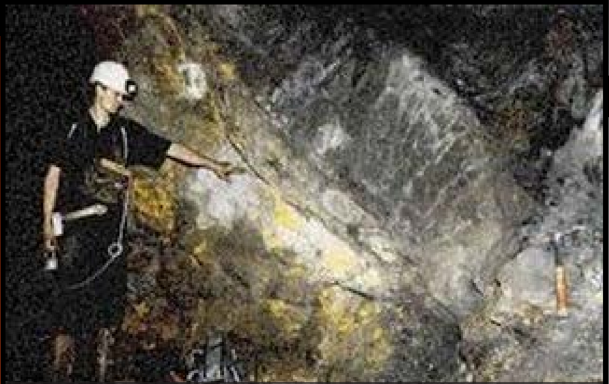
So what did happen? At this point, De Meijer and Van Westrenen introduce an idea they have put forward before: the existence of natural nuclear reactors deep inside the Earth. When the concentration of uranium at a given location reaches a threshold value, fission occurs.

Natural thermal fission reactors, although of another type, were active near the Earth's surface in the geological past, for example in Gabon. De Meijer believes that natural (fast-breeder) reactors could exist at much greater depths, just outside the Earth's core.

If that is so, could an exploding natural nuclear reactor have caused part of the Earth to break away, thus creating the Moon? 'George Darwin proposed something similar in the late nineteenth century', De Meijer says. The young, molten Earth would have rotated much faster than now.

Darwin (Charles Darwin's second son) consequently theorized that this faster rotation together with tidal waves caused by the Sun would have culminated in a chunk of rock breaking off thus creating the Moon. But it turned out that for this theory to be correct the young Earth would have had to rotate much faster than the rotational properties of the present Earth-Moon system would allow.

What if it wasn't caused by the pull of the Sun but rather by a nuclear 'push' from inside? Enter Vladimir Anisichkin, who worked during the Cold War on shockwaves produced by the H-bomb. His calculations show that an exploding natural reactor would create a



Remains of a natural nuclear reactor in Gabon.

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shockwave that could do the trick, even if the proto-Earth was rotating at a rate of 5.8 hours, which corresponds with the rotational properties of the present Earth-Moon system. A nuclear explosion on the core-mantle boundary of the young Earth could therefore have propelled a large chunk of the mantle and crust into space, which would eventually form the Moon.

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In the *Chemical Geology* paper, De Meijer and his co-authors are cautious in their claims, but they do indicate tests that could provide additional evidence for their explosive Moon model. De Meijer: ‘The nuclear reaction would produce an enhanced isotope Helium-3/Helium-4 ratio. An excess of Helium-3 on the Moon would support our model’.

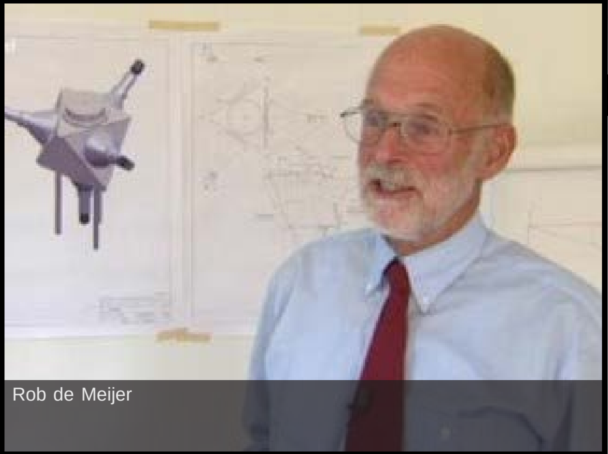
However, radiation from the Sun also produces an excess of Helium-3 on the Moon’s surface. ‘So we need samples from around 10 meters deep’. These are not currently available. ‘But future Moon missions could solve this.’

The presence of a natural fast-fission reactor at the mantle-core boundary still has to be proven as well. ‘Together with the Technical University Delft we would like to start on computer simulations of the exact workings of this reactor’, De Meijer explains. ‘We are looking for a student who is interested in working on this project, and it would be nice if a student from Groningen would reconnect the ties.’

De Meijer is also working on detectors for the anti-neutrinos emitted by the reactors. Although he retired from Groningen nearly eight years ago (he still works at the Western Cape University in South Africa), he still has plenty of research projects.

Not that he doesn’t have any hobbies: ‘The idea for the paper occurred to me when I was weeding the garden’.

*More information on the work by Rob de Meijer can be found on the EARTH*



Rob de Meijer

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