

Meteorite study suggests Earth may have been wet since it formed

27 August 2020, by Talia Ogliore



Piece of the meteorite Sahara 97096 (about 10 cm long), an enstatite chondrite that contains about 0.5 weight % of water. If Earth formed entirely of this material, it would have received 23 times the total mass of water present in the Earth's oceans. Credit: L. Piani, Museum of Natural History in Paris

A new study finds that Earth's water may have come from materials that were present in the inner solar system at the time the planet formed—instead of far-reaching comets or asteroids delivering such water. The findings published Aug. 28 in *Science* suggest that Earth may have always been wet.

Researchers from the Centre de Recherches Petrographiques et Geochimiques (CRPG, CNRS/Universite de Lorraine) in Nancy, France, including one who is now a postdoctoral fellow at Washington University in St. Louis, determined that a type of meteorite called an enstatite [chondrite](#) contains sufficient hydrogen to deliver at least three times the amount of [water](#) contained in the Earth's oceans, and probably much more.

Enstatite chondrites are entirely composed of material from the inner solar system—essentially

the same stuff that made up the Earth originally.

"Our discovery shows that the Earth's building blocks might have significantly contributed to the Earth's water," said lead author Laurette Piani, a researcher at CRPG. "Hydrogen-bearing material was present in the inner solar system at the time of the rocky planet formation, even though the temperatures were too high for water to condense."

The findings from this study are surprising because the Earth's building blocks are often presumed to be dry. They come from inner zones of the solar system where temperatures would have been too high for water to condense and come together with other solids during planet formation.

The meteorites provide a clue that water didn't have to come from far away.

"The most interesting part of the discovery for me is that enstatite chondrites, which were believed to be almost 'dry,' contain an unexpectedly high abundance of water," said Lionel Vacher, a postdoctoral researcher in physics in Arts & Sciences at Washington University in St. Louis.

Vacher prepared some of the enstatite chondrites in this study for water analysis while he was completing his Ph.D. at Universite de Lorraine. At Washington University, Vacher is working on understanding the composition of water in other types of meteorites.

Enstatite chondrites are rare, making up only about 2 percent of known meteorites in collections.

But their isotopic similarity to Earth make them particularly compelling. Enstatite chondrites have similar oxygen, titanium and calcium isotopes as Earth, and this study showed that their hydrogen and nitrogen isotopes are similar to Earth's, too. In the study of extraterrestrial materials, the abundances of an element's isotopes are used as a

distinctive signature to identify where that element originated.

"If enstatite chondrites were effectively the [building blocks](#) of our planet—as strongly suggested by their similar isotopic compositions—this result implies that these types of chondrites supplied enough water to Earth to explain the origin of Earth's water, which is amazing!" Vacher said.

The paper also proposes that a large amount of the atmospheric nitrogen—the most abundant component of the Earth's atmosphere—could have come from the enstatite chondrites.

"Only a few pristine enstatite chondrites exist: ones that were not altered on their asteroid nor on Earth," Piani said. "In our study we have carefully selected the enstatite chondrite meteorites and applied a special analytical procedure to avoid being biased by the input of terrestrial water."

Coupling two analytical techniques—conventional mass spectrometry and secondary ion mass spectrometry (SIMS)—allowed researchers to precisely measure the content and composition of the small amounts of water in the meteorites.

Prior to this study, "it was commonly assumed that these chondrites formed close to the sun," Piani said. "Enstatite chondrites were thus commonly considered 'dry,' and this frequently reasserted assumption has probably prevented any exhaustive analyses to be done for hydrogen."

More information: L. Piani et al., "Earth's water may have been inherited from material similar to enstatite chondrite meteorites," *Science* (2020). science.sciencemag.org/cgi/doi/10.1126/science.aba1948

"The origins of water," *Science* (2020). science.sciencemag.org/cgi/doi/10.1126/science.abc1338

Provided by Washington University in St. Louis
APA citation: Meteorite study suggests Earth may have been wet since it formed (2020, August 27) retrieved 16 January 2021 from <https://phys.org/news/2020-08-meteorite-earth.html>

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