

Early evaporation proven to be responsible for Earth's lack of volatile elements

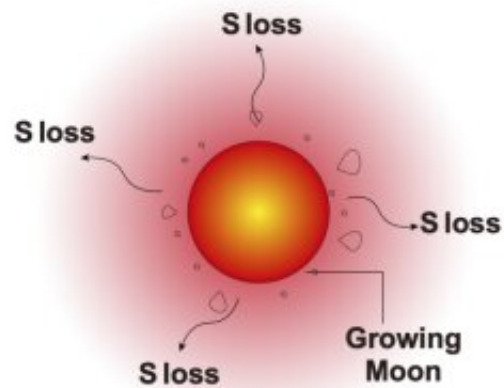
November 15 2021, by Liu Jia

A: Evaporation of planetesimal melts



$$\delta^{34}\text{S}_{\text{Earth}} < \delta^{34}\text{S}_{\text{chondrites}}$$

B: Moon-forming giant impact



$$\delta^{34}\text{S}_{\text{Moon}} > \delta^{34}\text{S}_{\text{Earth}}$$

Isotope effect of sulfur caused by its volatilization during the melting early-stage protoplanetary embryo and formation of the moon. Credit: Wang Wenzhong et al.

Volatile elements, such as carbon, hydrogen, nitrogen and sulfur (S), are of profound importance for the formation, the differentiation and the habitability of a planet. However, today's Earth, though rich in life, contains relatively little volatile matter. This fact offers numerous

insights into the proliferation and the evolution of volatile content in terrestrial planets.

In a [study](#) published in *Nature Geoscience*, a research group led by Prof. Wu Zhongqing from University of Science and Technology of China (USTC) of the Chinese Academy of Sciences discovered that under the environment of solar nebula, protoplanetary embryo's melting and evaporation are the major causes of Earth's lack of [volatile elements](#).

According to previous researches, Earth possesses a considerable absence of volatile elements, compared with the early solar system. This phenomenon was controversial with several mechanisms postulated, such as meteorites carrying volatile matter or evaporation during Earth's evolution. Accurate data regarding the ratio of S [isotopes](#) rose to prominence as a result. However, since large amount of S infiltrated Earth's core during the core-mantle differentiation, its isotopes' ratio in the entire Earth has long puzzled scientists.

In this study, with first-principles calculations, researchers succeeded in measuring the S isotope fractionation factor between the mantle and the core. The core-mantle differentiation was in fact, found trivial for isotope fractionation.

Employing thermodynamic calculations, researchers discovered that when the protoplanetary embryo was melting, heavy isotopes of S volatilized in the form of hydrogen sulfuric, which is in accordance with the low ratio of S isotopes on Earth. In addition, they found that large amount of S was lost during the giant impact which formed the moon, leaving lighter S isotopes for Earth.

The study shows that initially the Earth was abundant in volatile content, and it was the evaporation in early stages that led to Earth's composition today. It provides new insights regarding the origin of volatile substance

on terrestrial planets.

More information: Wenzhong Wang et al, Sulfur isotopic signature of Earth established by planetesimal volatile evaporation, *Nature Geoscience* (2021). [DOI: 10.1038/s41561-021-00838-6](https://doi.org/10.1038/s41561-021-00838-6)

Provided by Chinese Academy of Sciences

Citation: Early evaporation proven to be responsible for Earth's lack of volatile elements (2021, November 15) retrieved 12 May 2024 from <https://phys.org/news/2021-11-early-evaporation-proven-responsible-earth.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.