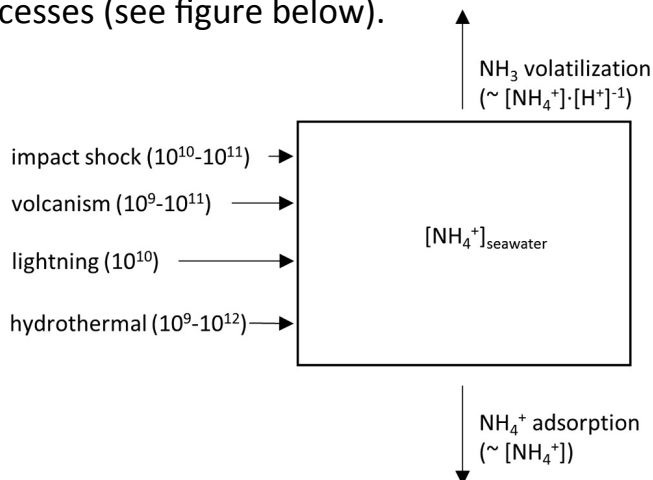


# Nitrogen in Ancient Mud: A Biosignature?

**BACKGROUND:** Nitrogen is an essential nutrient for all life on Earth and possibly elsewhere. Some organisms are capable of converting nitrogen gas into molecules that other species can use. Nitrogen fixation, as the process is called, involves breaking the powerful chemical bonds that hold nitrogen atoms in pairs in the atmosphere and using the resulting single nitrogen atoms to create molecules such as ammonia, which is a building block of many complex organic molecules, such as proteins, DNA and RNA. Nitrogen enrichments in ancient sedimentary rocks or in extraterrestrial samples, therefore, may be a useful biosignature.



**THE RESEARCH:** This study focused on 3.8 billion-year-old rocks from the Isua Supracrustal Belt in Greenland, where nitrogen enrichments of up to 430 ppm were found. While this may be a biosignature, abiotic processes such as lightning or volcanism can also fix atmospheric  $N_2$  and contribute to sedimentary nitrogen burial in the absence of life. A numerical model was developed to determine how much nitrogen enrichment could occur through only abiotic processes (see figure below).



**TAKE-HOME:** Results showed that abiotic processes alone could not explain the nitrogen levels seen in the Isua rocks. As such, the results provide more evidence of an early origin of life on Earth—before 3.8 billion years ago. This research also suggests that analyzing nitrogen levels could help detect signs of life on Mars or perhaps elsewhere in our Solar System.