PRESS RELEASE

Source: ELSI, Tokyo Institute of Technology, Japan

For immediate release: 21 January, 2020

Title: Mars' water was mineral-rich and salty

Subtitle:
New study finds surface waters on early Mars may have been habitable for microbial life.

Release summary:
Presently, many scientists believe Mars is the best candidate in the search for life beyond Earth because it is relatively nearby and there is good evidence that liquid water flowed on Mars' surface billions of years ago. A new study provides evidence that some early Martian minerals were formed in watery environments that were salty and near neutral pH, similar to Earth's modern oceans, and thus habitable for microbes.

Full-text release:

Presently, Earth is the only known location where life exists in the Universe. This year the Nobel Prize in physics was awarded to three astronomers who proved, almost 20 years ago, that planets are common around stars beyond the solar system. Life comes in various forms, from cell-phone-toting organisms like humans to the ubiquitous micro-organisms that inhabit almost every square inch of the planet Earth, affecting almost everything that happens on it. It will likely be some time before it is possible to measure or detect life beyond the solar system, but the solar system offers a host of sites that might get a handle on how hard it is for life to start.

Mars is at the top of this list for two reasons. First, it is relatively close to Earth compared to the moons of Saturn and Jupiter (which are also considered good candidates for discovering life beyond Earth in the solar system, and are targeted for exploration in the coming decade). Second, Mars is extremely observable because it lacks a thick atmosphere like Venus, and so far, there are pretty good evidence that Mars' surface temperature and pressure hovers around the point liquid water—considered essential for life—can exist. Further, there is good evidence in the form of observable river deltas, and more recent measurements made on Mars' surface, that liquid water did in fact flow on Mars billions of years ago.

Scientists are becoming increasingly convinced that billions of years Mars was habitable. Whether it was in fact inhabited, or is still inhabited, remains hotly debated. To better constrain these questions, scientists are trying to understand the kinds of water chemistry that could have generated the minerals observed on Mars today, which were produced billions of years ago.

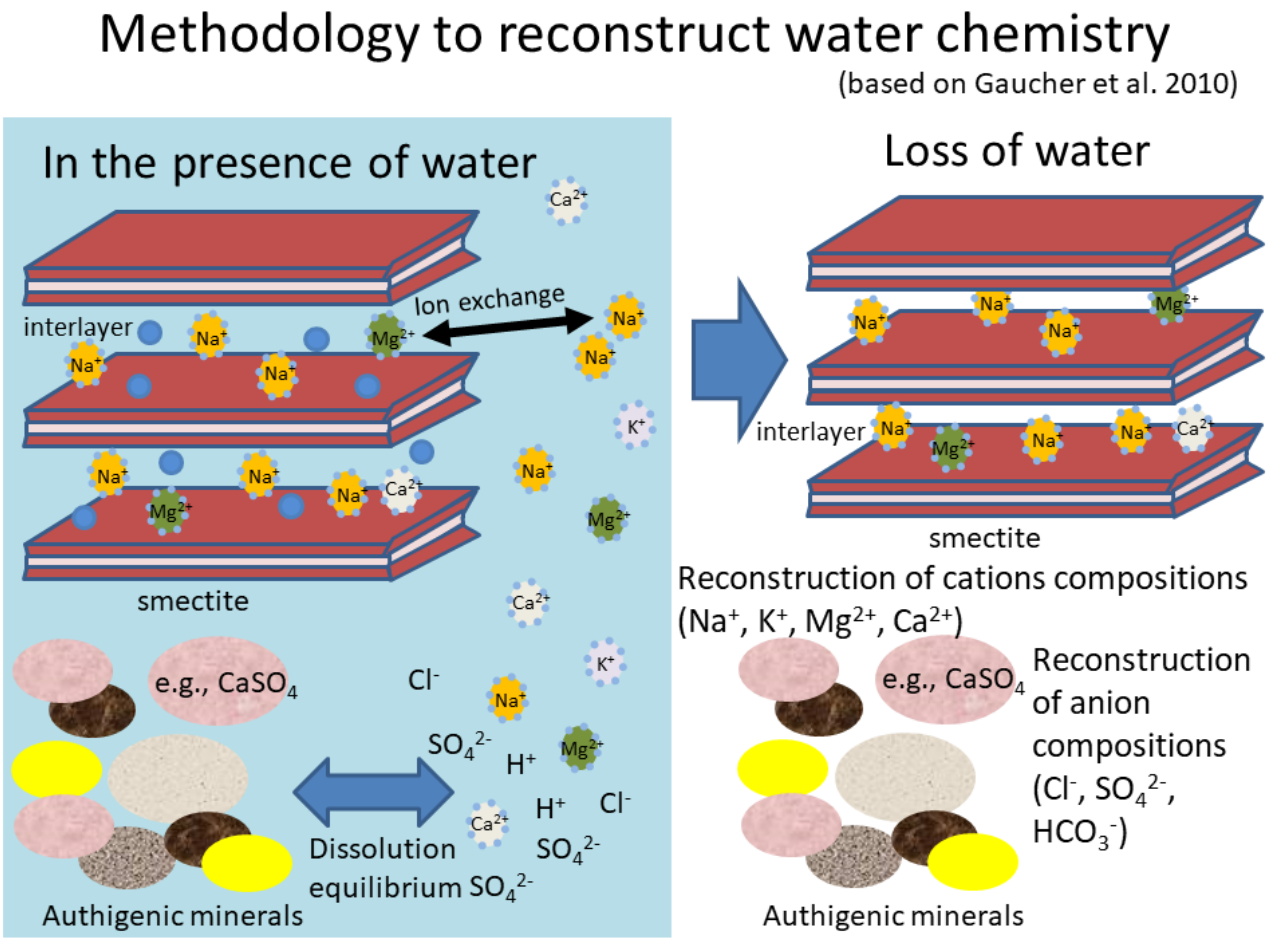
Salinity (how much salt was present), pH (a measure of how acidic the water was), and redox state (roughly a measure of the abundance of gases such as hydrogen [H_2, which are termed reducing environments] or oxygen [O_2, which are termed oxidising environments; the two types are generally mutually incompatible]) are fundamental properties of natural waters. As an example, Earth's modern atmosphere is highly oxygenated (containing large amounts of O_2), but one need only dig a few inches into the bottom of a beach or lake today on Earth to find environments which are highly reduced.

Recent remote measurements on Mars suggest its ancient environments may provide clues about Mars'

early habitability. Specifically, the properties of pore water within sediments apparently deposited in lakes in Gale Crater on Mars suggest these sediments formed in the presence of liquid water which was of a pH close to that of Earth's modern oceans. Earth's oceans are of course host to myriad forms of life, thus it seems compelling that Mars' early surface environment was a place contemporary Earth life could have lived, but it remains a mystery as to why evidence of life on Mars is so hard to find.

Images:

Title: Curiosity on ancient lake sediments at Gale Crater, Mars
Caption: NASA's Curiosity rover has obtained the mineralogical and chemical data of ancient lake deposits at Gale Crater, Mars. The present study reconstructs water chemistry of the paleolake in Gale based on the Curiosity's data.
Credit: NASA



Title: Methodology to reconstruct water chemistry
Caption: One of the clay minerals, smectite, can trap ions in water through ion exchanges in the presence of water. Even after loss of water, smectite records ion compositions within interlayers of its structure.

Reference:

Keisuke Fukushi[1*], Yasuhito Sekine[1,2], Hiroshi Sakuma[3], Koki Morida[4] & Robin Wordsworth[5], Semiarid climate and hyposaline lake on early Mars inferred from reconstructed water chemistry at Gale, *Nature Communications*, DOI：10.1038/s41467-019-12871-6

1 Institute of Nature and Environmental Technology, Kanazawa University, Kanazawa, Ishikawa, Japan.
2 Earth-Life Science Institute, Tokyo Institute of Technology, Meguro-ku, Tokyo, Japan.
3 National Institute for Materials Science, Tsukuba, Ibaraki, Japan.
4 Division of Natural System, Kanazawa University, Kanazawa, Ishikawa, Japan.
5 Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA, USA.

*Corresponding authors email: sekine@elsi.jp

Contacts:

Thilina Heenatigala
Director of Communications
Earth-Life Science Institute (ELSI),
Tokyo Institute of Technology
E-mail: thilinah@elsi.jp
Tel: +81-3-5734-3163

Yasuhito Sekine
Professor
Earth-Life Science Institute (ELSI)
Tokyo Institute of Technology
E-mail: sekine@elsi.jp
TEL: +81-80-6708-0437

More information

Tokyo Institute of Technology (Tokyo Tech) stands at the forefront of research and higher education as the leading university for science and technology in Japan. Tokyo Tech researchers excel in fields ranging from materials science to biology, computer science, and physics. Founded in 1881, Tokyo Tech hosts over 10,000 undergraduate and graduate students per year, who develop into scientific leaders and some of the most sought-after engineers in industry. Embodying the Japanese philosophy of "monotsukuri," meaning "technical ingenuity and innovation," the Tokyo Tech community strives to contribute to society through high-impact research.

The Earth-Life Science Institute (ELSI) is one of Japan's ambitious World Premiere International research centers, whose aim is to achieve progress in broadly inter-disciplinary scientific areas by inspiring the world's greatest minds to come to Japan and collaborate on the most challenging scientific problems. ELSI's primary aim is to address the origin and co-evolution of the Earth and life.

The World Premier International Research Center Initiative (WPI) was launched in 2007 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) to help build globally visible research centers in Japan. These institutes promote high research standards and outstanding research environments that attract frontline researchers from around the world. These centers are highly autonomous, allowing them to revolutionize conventional modes of research operation and administration in Japan.

Kanazawa University has contributed greatly to higher education and academic research since it was founded in 1949 as the leading comprehensive university on the Sea of Japan coast. The University has 3 colleges and 17 schools, 7 graduate schools offering courses in subjects from humanities and social sciences to natural sciences and life sciences. The University is located in Kanazawa, Ishikawa – a city where tradition and innovation are existing in harmony. Kanazawa University is divided into two main campuses: Kakuma and Takaramachi for its approximately 10,100 students including over 650 from overseas.