

Team discovers adaptations to explain strategies for survival on Mars

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Research from the University of Maryland School of Medicine has revealed key features in proteins needed for life to function on Mars and other extreme environments.

The researchers, funded by NASA, studied [organisms](#) that survive in the extreme environment of Antarctica. They found subtle but significant differences between the core proteins in ordinary organisms and Haloarchaea, organisms that can tolerate severe conditions such as high salinity, desiccation, and [extreme temperatures](#). The research gives scientists a window into how life could possibly adapt to exist on Mars.

The study, published online in the journal [PLoS One](#) on March 11, was

led by Shiladitya DasSarma, Ph.D., Professor in the Department of Microbiology and Immunology at the University of Maryland School of Medicine and a research scientist at the Institute of Marine and [Environmental Technology](#).

Researchers found that Haloarchaeal microbes contain proteins that are acidic, with their surface covered with negatively charged residues. Most ordinary organisms contain proteins that are neutral on average. The [negative charges](#) found in the unusual organisms keep proteins in solution and help to hold on tightly to water, reversing the effects of high salinity and desiccation.

In the current study, the scientists identified additional subtle changes in the proteins of one Haloarchaeal species named *Halorubrum lacusprofundi*. These microbes were isolated from Deep Lake, a very salty lake in Antarctica. The changes found in proteins from these organisms allow them to work in both cold and salty conditions, when temperatures may be well below the freezing point of pure water. Water stays in the [liquid state](#) under these conditions much like snow and ice melt on roads that have been salted in winter.

"In such [cold temperatures](#), the packing of atoms in proteins must be loosened slightly, allowing them to be more flexible and functional when ordinary proteins would be locked into inactive conformations" says Dr. DasSarma. "The surface of these proteins also have modifications that loosen the binding of the surrounding water molecules."

"These kinds of adaptations are likely to allow microorganisms like *Halorubrum lacusprofundi* to survive not only in Antarctica, but elsewhere in the universe," says Dr. DasSarma. "For example, there have been recent reports of seasonal flows down the steep sides of craters on Mars suggesting the presence of underground brine pools. Whether microorganisms actually exist in such environments is not yet known, but

expeditions like NASA's Curiosity rover are currently looking for signs of life on Mars."

"Dr. DasSarma and his colleagues are unraveling the basic building blocks of life," says E. Albert Reece, M.D., Ph.D., M.B.A., Vice President for Medical Affairs at the University of Maryland and John Z. and Akiko K. Bowers Distinguished Professor and Dean of the University of Maryland School of Medicine. "Their research into the fundamentals of microbiology are enhancing our understanding of life throughout the universe, and I look forward to seeing further groundbreaking discoveries from their laboratory."

More information: Dr. DasSarma and his colleagues are conducting further studies of individual proteins from *Halorubrum lacusprofundi*, funded by NASA. The adaptations of these proteins could be used to engineer and develop novel enzymes and catalysts. For example, the researchers are examining one model protein, β -galactosidase, that can break down polymerized substances, such as milk sugars, and with the help of other enzymes, even larger polymers. This work may have practical uses such as improving methods for breaking down biological polymers and producing useful materials (see Karan et al. *BMC Biotechnology* 2013 13:3 www.biomedcentral.com/1472-6750/13/3).

Provided by University of Maryland

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