MARSIS: NEW DISCOVERY OF A COMPLEX SYSTEM OF HYPERSALINE WATER PONDS

UNDER THE MARTIAN SOUTH POLAR CAP.

**EMBARGO LIFTS 28 September 2020 at 16:00 (London time), 28 September 2020 at 11:00 (US Eastern Time).**

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Two years after the discovery of a lake beneath the Martian south polar cap, published in 2018 in the prestigious scientific journal Science by an Italian group led by Roberto Orosei (National Institute for Astrophysics: INAF, Italy), Elena Pettinelli (University Roma Tre, Rome, Italy) and Enrico Flamini (ASI: Italian Space Agency), a team of scientists from University Roma Tre, National Research Centre (CNR-IREA, Naples, Italy), Jacobs University (Bremen, Germany), University of Southern Queensland (Centre for Astrophysics: Toowoomba, Australia) and INAF, has found evidence pointing to the existence of multiple ponds of hypersaline water trapped beneath the ice at Mars’s south polar region.

In the paper published in 2018 the team had announced that the radar sounder MARSIS, one of the scientific instruments on board the ESA spacecraft Mars Express, had detected an area of strong reflectivity approximately 1.5 km beneath the South Polar Layered Deposits, a thick polar cap formed by layers of ice and dust. According to Orosei and colleagues, the high intensity of the radar signal reflected from an area about 20 km in extent, could have been explained by the presence of a water lake, with water prevented from freezing owing to its high concentration of salts. The announcement was followed by efforts, both from the original team and other international research groups, to confirm the initial finding and to further understand the conditions that would allow liquid water to persist under the Martian ice cap.

A new study, just published in the journal Nature Astronomy by a multidisciplinary 13-member team comprising physicists, geologists and engineers, explains how newly acquired radar data revealed unexpected results.

“Not only did we confirm the position, extent and strength of the reflector from our 2018 study” Elena Pettinelli, who co-led the team with Sebastian Lauro (also at Roma Tre University), says, “but we found three new bright areas”.

“We borrowed a methodology commonly used in radar sounder investigations of subglacial lakes in Antarctica, Canada and Greenland, and we adapted the method to analyze old and new MARSIS data. The interpretation that best reconciles all the available evidence is that the high intensity reflections are coming from extended pools of liquid water”, Sebastian Lauro explains.

“The main lake is surrounded by smaller bodies of liquid water, but because of the technical characteristics of the radar, and of its distance from the Martian surface, we cannot conclusively determine whether they are interconnected”, Elena Pettinelli specifies.

“Any process of formation and persistence of sub-ice water beneath the ice polar caps requires the liquid to have high salinity” coauthor Graziella Caprarelli, Adjunct Research Fellow with the Centre for Astrophysics at the University of Southern Queensland, who was not involved in the 2018 study, adds. “Laboratory experiments aimed at studying the stability of hypersaline aqueous solutions (brines), convincingly demonstrate that these can persist for geologically significant periods of time even at the temperatures typical of the Martian polar regions, considerably below the freezing temperature of pure water”.

Enrico Flamini, the current President of the International Research School of Planetary Sciences (IRSPS) at the University of Chieti-Pescara (Italy), formerly Science Mission Programs Manager with the Italian Space Agency (ASI), commented the discovery thus: “To state that these new results make me happy is not enough. The biggest unanswered question from our earlier paper was: is this the only evidence of sub-ice liquid water? At the time we did not have enough evidence to address this question, but this new research demonstrates that the 2018 discovery was only the first piece of evidence of a widespread system of liquid water bodies in the Martian subsurface. It is exactly what I would have hoped: a great result, indeed!”

Roberto Orosei, Principal Investigator of the MARSIS experiment, comments: "While the existence of a single subglacial lake could be attributed to exceptional conditions such as the presence of a volcano under the ice sheet, the discovery of an entire system of lakes implies that their formation process is relatively simple and common, and that these lakes have probably existed for much of Mars' history. For this reason, they could still retain traces of any life forms that could have evolved when Mars had a dense atmosphere, a milder climate and the presence of liquid water on the surface, similar to the early Earth."

For Angelo Olivieri, ASI’s coordinator for the MARSIS radar sounder, this latest discovery justifies ASI’s efforts, over the past several years, in this strategic sector of research on Mars, and further demonstrates how Italy has what it takes to consolidate its leadership in the development and data analysis of this type of radar.

With the study published in Nature Astronomy the team confirms that thick ice sheets, far from being uniformly structured wastelands, should be viewed as stratigraphically and physically complex geological formations, deserving to be fully explored in detail. At the conclusion of their report the team suggests that, because brines have been shown to have potential to sustain microbial life in extreme conditions, renewed efforts should be made to explore the polar regions of Mars, with the specific purpose of finding reservoirs of subglacial water, and of determining their composition and astrobiological potential.

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