SPRING MOUNDS IN EASTERN TUNISIA AS ANALOGS TO OPEN PINGOS IN ARGYRE. Alberto G. Fairén[1,2], Esther R. Uceda[3], Elhoucine Essefi[4], J. Alexis P. Rodríguez[5], [1]Centro de Astrobiología (CSIC-INTA), 28850 Madrid, Spain (agfairen@cab.inta-csic.es); [2]Department of Astronomy, Cornell University, Ithaca, NY 14853, USA; [3]Universidad Autónoma de Madrid, 28049 Madrid, Spain; [4]Higher Institute of Applied Sciences and Technology, University of Gabes, Gabes, Tunisia; [5]Planetary Science Institute, Tucson, AZ 85719, USA.

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Pingos on Argyre: Possible ice-cored mounds, including candidate open-system pingos (OSPs), have been identified in Argyre [1]. We have shown that, on the basis of the available photo-geology, the OSPs within the Argyre basin are very recent features, dating from the Late Amazonian, and possibly still having some kind of activity. We proposed a combination of hydraulic, tectonic, and hydro-tectonic models of formation and functioning of the OSPs, involving freeze-thaw cycling [2]. The OSPs within the floor of Argyre basin could bear exceptional astrobiological interest, because the heat gradients produced hydrothermal activity resulting in upwelling processes: this upwelling of deep-seated water rich in volatiles and organic material would act as exhumation pockets into ancient environments, and therefore the groundwater associated with OSPs formation could be capable of delivering evidence of past/current microbial activity in the subsurface to the surface or near-surface, making fossilized or extant life more available to reconnaissance by in situ missions. In addition, mantling and sedimentation by eolian drifts or icy periods would have formed protecting layers, reducing the rates of sublimation and therefore providing a secluded environment for existing life or its remains. In summary, OSPs could be host to past (and maybe present) heat fluxes, ice, liquid water, and nutrients.

Biosignatures and habitats in mounds: Spring mounds on Earth and Mars would represent optimal niches for life development. At the MCSH system in Eastern Tunisia [3], depressions contain briny (salts content ~300 g/L) and slightly acid (pH=5.8) water, while springs mounds inject relatively fresh water (salts content 7.25 g/L) with neutral pH (6.8). On early Mars, both aqueous systems could have been appropriate for life. First, cold brines with similar salt concentrations to that measured at the MCSH depressions have been proposed to have existed on a “cold and wet” Early Mars [4], potentially adequate for biological development. Second, fresher water associated with springs might have not been as briny or acidic as water in terrestrial evaporating pools [5], and this may have provided a long-term habitable environment on a “warm and wet” early Mars [6]. Therefore, if life ever developed on Mars, ancient spring deposits would be excellent localities in which to search for morphological or chemical remnants of that life [5], with proper drilling into the accumulated materials [7]. These favorable conditions for life, which are exceptionally shown at the surface through spring mounds, may have been more frequent in the Martian subsurface, indicating that geodynamic and hydraulic conditions within the Martian subsurface could have been favorable for biological development.

Conclusions: OSP-like mounds within Argyre basin have an exceptional astrobiological interest. We have proposed that OSP-like mounds form and function following a combined hydraulic, tectonic and hydro-tectonic model [2], similar to the mounds in Eastern Tunisia [3], making them the best candidates for life development and protection on Mars. On the one hand, their formation through the upwelling of water, volatiles, and organic-rich material provides with the necessary elements for life development; and this upwelling also resulted in a significant hydrothermal activity, enhancing life development by providing energy (heat). On the other hand, the protecting layers, formed due to the wet eolian sedimentation or icy periods, provide with a safe cover shielding life or its remains. We propose that the MCSH system in Eastern Tunisia is an exceptional terrestrial analog which continuing analysis will help to make informed decisions regarding where to search for biosignatures on Mars.

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Acknowledgements: The research leading to these results is a contribution from the Project “icyMARS”, funded by the European Research Council, Starting Grant no 307496.