

PRIME CANDIDATE SITES FOR THE ASTROBIOLOGICAL EXPLORATION OF MARS ACCORDING TO ITS HYDROGEOLOGICAL EVOLUTION.

Esther R. Uceda (1), Alberto G. Fairén (2), Javier Ruiz (3), James M. Dohm (4), Tayfun Öner (5), Dirk Schulze-Makuch (6), Miguel A. de Pablo (7), Jens Örmö (8), and Victor R. Baker (4,9).

(1) Seminar on Planetary Sciences, Universidad Complutense de Madrid, (2) Centro de Biología Molecular, CSIC-Universidad Autónoma de Madrid, (3) Departamento de Geodinámica, Universidad Complutense de Madrid, (4) Department of Hydrology and Water Resources, University of Arizona, (5) TURKCELL İletişim Hizmetleri A.Ş., Mesrutiyet Cad. No. 153, Tepebasi, Istanbul, (6) Department of Geological Sciences, University of Texas at El Paso, (7) Área de Geología, ESCET, Universidad Rey Juan Carlos, Madrid, (8) Centro de Astrobiología, CSIC-INTA, Madrid, (9) Lunar and Planetary Laboratory, University of Arizona (Eruiz.hrc@salud.madrid.org)

Different-sized bodies of water have been proposed to have occurred episodically in the lowlands of Mars throughout the planet's history [1], largely related to major stages of development of Tharsis [1], [2]. These water bodies range from large oceans in the Noachian-Early Hesperian, to a minor sea in the Late Hesperian, and reduced lakes during the Amazonian. Assuming that the search for life is directly linked to the search for water, the possible biological history of Mars must have been largely influenced by the endogenetically-driven hydrogeological cycles. In consequence, terrestrial biological and environmental analogues can now be placed in context with the model proposed, so contributing to draw a general approach for the history of life on Mars. If the search for extant/fossil life or biomarkers on Mars is fully successful, our analysis would suggest that records of microbial activity will be reflective of the inundation phases and varying aqueous surface and subterranean environments, similar to what is observed on Earth. This analysis unfolds three prime candidate sites for the astrobiological exploration of Mars, each one corresponding to a major inundation phase of the global hydrological model:

1. Noachian to Early Hesperian: Terra Meridiani, based on (a) the geologic setting of the region [1]; and (b) the comparative analyses of hematite locations on Earth and Mars [3], which suggest an aqueous-hydrothermal origin, well according with the latest results of the *MER Opportunity*.
2. Late Hesperian to Early Amazonian: Mangala Valles, where diminishing martian episodic hydrologic events over geologic time are clearly recorded [4], particularly

representing a later pulse of Tharsis-driven hydrologic activity.

3. Amazonian: Orcus Patera, a volcanic caldera or impact crater where reduced ponded bodies of water [5] [6] may have existed during almost contemporary times.

To propose these prime candidate sites, here we perform a comprehensive analysis of the evolution of water on Mars, including:

1. Evolution of the proposed shorelines, taking into account (1) local and/or temporal changes in the effective elastic thickness of the martian lithosphere [7]; (2) possible local variations of the thermal structure of the lithosphere producing differential thermal isostasy [8,9]; (3) the emplacement of lava flows [10] and/or deposition of sediment [11] in the putative northern ocean basin region, such as recorded for the Early and the Late Hesperian, respectively; (4) water transfer between different regions [12]; and (5) degradation of basins boundaries related to endogenic or exogenic activity [13].

2. A volumetric approximation to the plains-filling proposed oceans, considering the lithosphere rebound due to water unloading associated with the disappearance of an ocean [14].

3. Geochemistry of the Noachian oceans and derived mineralogies.

4. Ultimate water evolution on Mars and the possible fate of the ancient oceans.

1 References

[1] Fairén, A.G., et al. *Icarus* 165, 53-67 (2002). [2] Dohm, J.M., et al. *J. Geophys. Res.* 106, 32,943-32,958 (2001). [3] Fernández-Remolar, D., et al. *J. Geophys. Res.* 108 (2003). [4] Dohm, J.M., et al. *Planet. Space Sci.*, in press. [5] Berman, D.C. & Hartmann, W.K. *Icarus* 159, 1-17 (2002). [6] Grin, E., & Cabrol, N. *Lunar Planet. Sci. Conf.*, XXIX, #1010 (1998). [7] McGovern, P.J., et al. *J. Geophys. Res.*, 107, 5136 (2002). [8] Ruiz, J. *J. Geophys. Res.* 108, (2003). [9] Ruiz, J., et al. *Planet. Space Sci.*, submitted. [10] Kreslavsky, M.A. & Head, J.W. *J. Geophys. Res.* 107 (2002). [11] Tanaka, K.L., et al. *Geology* 29, 427-430 (2001). [12] Leverington, D.W. & Ghent R.R. *J. Geophys. Res.*, 109 (2004). [13] Clifford, S.M. & Parker, T.J. *Icarus* 154, 40-79 (2001). [14] Öner, T., et al. *Lunar Planet. Sci. Conf.*, XXXV, #1319 (2004).