

EUROMOONMARS ATACAMA (CHILEMOONMARS): PROSPECT FOR THE INSTALLATION OF AN MARTIAN BASE ANALOGUE IN THE ARID CENTRAL ANDES (PUNA) AND DEVELOPMENT OF PLANETARY SCIENCES IN THE ATACAMA REGION (CHILE) A. Tavernier¹, A. Garcia¹, G. Pinto^{2,3}, C. Ulloa¹, T. Santibañez⁴, D. C. Nascimento⁵, R. Osés⁶ and B. H. Foing^{7,8,9}

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Introduction & Context : the increasingly credible prospects of advanced robotic and manned space missions to the Moon or Mars [1] are leading to an increase in the number of simulations of scientific field work on Moon-Mars terrestrial analogues in order to better understand the technical, scientific, logistical, organizational and socio-medical challenges of this new stage of space exploration [2,3,4]. The EuroMoonMars program [5] is placed in this perspective by involving, in a participative way, students and young professionals coming from various backgrounds but ready to get involved in the preparation, organization and realization of Martian or lunar scientific field campaign simulations. Hawaii, Reunion Island, the Utah desert, Iceland, Rio-Tinto, Volcanic Eifel are particular geographical locations where these campaigns have already been organized. In Chile, the Atacama Desert and the neighboring Arid Central Andes (Puna) represent a geographical site whose particular environmental conditions are very close to those Mars may have experienced during its geological history [6,7].

Indeed, the geological records of the Atacama Desert show a climatic stability of the arid or semi-arid character of the region and its surroundings for tens of Myrs, giving this geographical area unique characteristics [8]. Thus, this region of the globe has regularly been used as a terrestrial analogue of Mars, for example to test rovers intended to be sent to the Red Planet [9] or for astrobiological purpose [10]. If punctual field campaigns are regularly carried out in the Atacama Desert and in the Puna, there is however to date no perennial base for the simulation of inhabited Martian field campaigns. The University of Atacama (UDA, Atacama Region, Chile) is thus seeking to enhance the incredible environment of the Cordillera by attempting to set up an ambitious multidisciplinary research program including planetary sciences. A high-altitude laboratory with a surface area of 225 m² will thus be built at the beginning of 2021 above 3800 meters above sea level (masl) in the immediate vicinity of the Salar de Maricunga (Figure

1, Project ATA1799) [11]. From this advanced camp, an 18-month prospecting campaign will be carried out in order to find the ideal location, in terms of technical and logistical facilities but also in terms of scientific goals, of a second laboratory which would be located at more than 5200 masl close to the Ojos del Salado (Figure 1), the highest active volcano on Earth (6893 masl) whose potential as an analogue of Mars has been highlighted in recent publications [12].

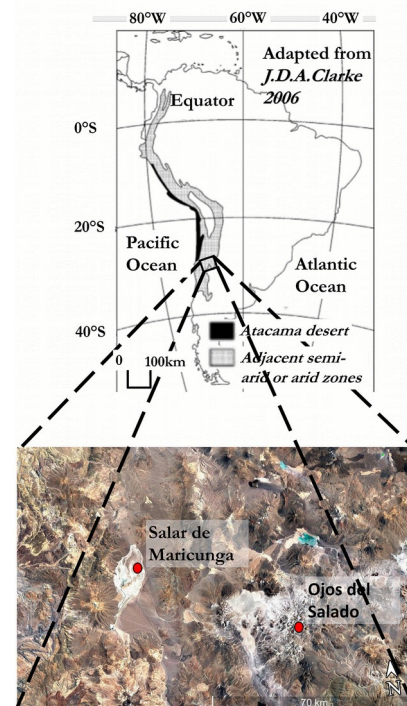


Figure 1 : Area of interest for the implementation of the Atacama high-altitude laboratory, Atacama region, Chile (bottom : images from GoogleEarth®). The whole area is above 3500 masl and peaks at 6893 masl on the Ojos del Salado

In this context, a collaboration between the EuroMoonMars program and UDA will allow a synergy of logistical means, a sharing of scientific

expertise and would give a local anchorage to research of international scope in planetary and space sciences.

Methodology & Objectives : the first step towards the installation of a permanent base from which to organize simulations of extra-vehicular activities on Mars is the choice of a location that meets scientific, technical and logistical criteria similar to those for prospecting a lunar or martian landing site of a planetary exploration probe [13]. This requires first of all an estimation of the potential of the Puna to represent a Martian analogue, through:

- 1) an in-depth bibliographical research, carried out in a participative way, including scientific publications in international specialized journals and Chilean and Argentinean environmental technical reports. This bibliographical work would lead to the elaboration of a cartographic database recapitulating and identifying the geographical places of interest and their main environmental characteristics.
- 2) a systematization, using remote sensing data and methods linked to artificial intelligence [14], for the inventory of the geomorphological and mineralogical characteristics of the region, a work already initiated in the field at UDA [15,16]. This systematization would be carried out in a context of comparative planetology by coupling terrestrial satellite observations and those from probes orbiting Mars (Table 1). Regional environmental and mining data from the Chilean National Service of Geology and Mining (Sernageomin) would also be included in this global characterization attempt.

		Terrestrial	Martian
Visible/ Near Infrared (Multispectral)	Moderate Resolution	MODIS / Landsat	MOC
	High Resolution	SPOT 6-7 / Sentinel-2	HRSC / HiRISE
Hyperspectral		Hyperion / DESIS / PRISMA	OMEGA
DEM (Digital Elevation Model)		SRTM / ASTER	MOLA

Table 1 : Combination of satellite data envisaged (in green, data available, in orange data subject to proposals, in red commercial data)

The final objective would be to achieve a global mapping of the Martian analogue potential of the region, an essential step in the determination of the optimal location to install a Martian analogue base in the Puna. This prospecting work could be associated with exploratory EuroMoonMars campaigns including Chilean and European scientists and initially carried out using the UDA Mobile Laboratory (Figure 2).



Figure 2 : UDA Mobile laboratory (credit : LICA)

Summary & Conclusion : the setting-up of an Atacama section within the EuroMoonMars program (ChileMoonMars) and dedicated to setting up a similar Mars base in the medium term constitutes a unique opportunity for the University of Atacama to realize the development of ambitious research in planetary sciences based on the enhancement of the exceptional environmental characteristics of the region. This abstract presents the first stages of prospective and inventory aimed at mapping the region's potential in terms of planetary analogues, through exchanges between Chilean and European students, as well as through the pooling of logistical and technical infrastructures, data sharing and scientific expertise.

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