Annex: Expression of Interest (EoI) for a PhD candidate

Title: Earth-Mars Analogues: Iceland as a Window into Martian Geology and Habitability

Keywords: Analogues of Mars, Habitability, Early Earth, Weathering, Geochemistry, Clay minerals, Basalts, Hydrothermal vents, Remote sensing, Mars mineralogy

Project summary:

The project "Leveraging Earth-Mars Analogues: Iceland as a Window into Martian Geology and Habitability" (MARS-GH) is centered on a comparative study of Martian geology and habitability, utilizing Iceland's geological features as analogues to Martian environments. This research proposal emphasizes exploring and understanding Mars' geological history and potential for life by investigating Earth-Mars analogues. Key activities include extensive fieldwork for the selection of regions in Iceland that closely resemble Martian terrains, alongside high-resolution mapping and sample collection from these areas. The project also involves conducting detailed laboratory experiments under conditions simulating the Martian environment. Experiments will address the (i) alteration of basalts in batch reactors to simulate weathering of basaltic bedrock in low -salinity solutions with no organic ligands, (ii) alteration of basalts at hydrothermal fields conditions where Mg or Fe/Mg-clays formed (batch reactors), and (iii) formation of low-crystallinity Mg-clays in Strýtan-type hydrothermal fields, by interaction of silica-rich alkaline hydrothermal fluid with fjord water (chemical garden experiments). This interdisciplinary approach integrates fields like planetary science, geochemistry, geology, astrobiology, and microbiology. The aim is to deepen our knowledge of Mars' past climate and assess its potential for harboring life, which has significant implications for future space missions.

Training program planned in the context of the requested project

The PhD student will be enrolled at the Doctoral Program in Earth Sciences (University of Granada) and will benefit from complementary training activities that include a number of courses, seminars, and lectures. The training plan includes the following points: (I) Introduction to the topic and updating of the background. Selection of specific training schools / courses / workshops in techniques directly related to the PhD work plan. Review of literature; (II) Selection and characterization of the study areas, using methodologies similar to those used in Mars exploration: satellite images available in repositories, analysis of data obtained by UAV/drones in restricted areas, field mapping campaign and sampling; (III) Mineralogical and geochemical characterization of samples, using several techniques such as PLM, XRD, SEM-TEM-EDS, FTIR (VNIR and MIR), EELS, Mössbauer spectroscopy, etc.; (IV) Stay (3 months) in a foreign institution, with project collaborators such as the Natural History Museum at London

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(acquisition and analysis of VNIR spectra in samples, correlation with remote sensing data), ISOR (Iceland GeoSurvey)-University of Akureyri (mapping and sampling of selected areas of study; preliminary study of microorganism proxies in field samples), Middlebury College (correlation of analysis of field and laboratory samples; identification of alteration patterns in PLM, and electron microscopy techniques); (V) Periodic seminars to present the progress of the work program and discuss the results with the research team and collaborators; (VI) Communication of results in national and international scientific conferences (e.g. meeting of clay and mineralogy societies, international clay conferences, AGU, EGU, Goldschmidt, etc.). At least one per year; (VII) Publication of research papers in peer-review scientific journals, according to the recommendations of open science (e.g. Journal of Geophysical Research, Icarus, Scientific Reports, Geology, Nature Astronomy, Chemical Geology, Astrobiology; (VIII) Participation in dissemination and outreach activities in local and institutional campaigns; and (IX) Writing and defense of the PhD thesis, preferentially at the end of the third year to benefit from the postdoctoral orientation period and apply to postdoctoral positions.

Supervisors:

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Deadline for IACT-CSIC revision: January 23rd, 2026

Call: Junta de Andalucía PhD contracts (https://www.juntadeandalucia.es/servicios/sede/tramites/procedimientos/detalle/25908.html)

Background: Degree or Master in Geology or Chemistry, or closely related fields

Duration: 4 years, to start in fall 2026.

Salary: 1560 € (1st year) to 2125 € (4th year)

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Pictures of some sampling areas of Mars' analogues in Island, that include lake margins, ephemeral lakes, and hydrothermal fields