THE REPORT

MARS PLANET
RESEARCH & INNOVATION

marsplanet.org

Autunno 2021 - Numero 4

La Sostanza dei Sogni

A Colorful Landslide in Eos Chasma - Credits: NASA/JPL/UArizona

The Mars Planet Report

numero 4/2021

The Mars Planet Report
Periodico trimestrale dell'associazione culturale Mars Planet.
Se siete interessati a partecipare con un vostro contributo o ricerca inviato una mail a **mpreport@marsplanet.org**
Comitato di redazione: Antonio Del Mastro, Eugenio Sorrentino, Federico Monaco, Giovanni Bruno, Alex Briatico.
Progetto grafico/impaginazione: Alex Briatico

Associazione Culturale Mars Planet
Via Dalmine 10/A – 24035 Curno (BG) Italia +39 035.611.942
info@marsplanet.org

Immagine di copertina: Curiosity's Routine Inspection of Rover Wheel Wear and Tear
Credits: NASA/JPL-Caltech/MSSS

La Sostanza dei Sogni

di Alex Briatico

"Siamo fatti della stessa sostanza dei sogni"
dice una delle citazioni più incomprese e erroneamente utilizzate della storia. Sebbene gli innamorati usino questa frase considerando quel "dei sogni" nella sua affezione positiva, la realtà è che, Shakespeare, intendesse una visione più materiale della questione: i sogni sono inconsistenti, intangibili. Effimeri.
Noi tutti, secondo il Bardo, siamo effimeri.
Ma riflettendo su questo editoriale e al tema centrale di questo numero, non ho potuto fare a meno di pensare a quella frase.
Siamo fatti della stessa sostanza dei sogni.
Che a pensare bene dei sogni anche noi ce li abbiamo e quei sogni, almeno non direttamente, hanno materiali e strutture a costruirli. E sono ben lontani dall'essere effimeri.
In questi ultimi mesi, ancora sospesi su questa strana e nuova realtà, abbiamo però imparato che i sogni possono evolvere.
La notizia di qualche mese fa, per esempio, che il New Sheppard della Blue Origins ha finalmente portato i primi turisti "nello spazio", in un volo sub-orbitale oltre la linea di Karman. Dieci minuti in tutto è durato il volo, ma ha concretizzato qualcosa che tempo fa era solo un sogno deriso da qualcuno.
E per quanto possa sembrare poco romantico, quel sogno è stato fatto con acciaio, leghe di alluminio, ossigeno: materiali.
Materiali appositamente creati e perfezionati per quello scopo.
E torniamo a noi, ai nostri sogni e a come costruirli.
Con cosa costruirli e come riuscire a trovare facilmente (magari in loco) le materie prime che ci occorrono.
In questo numero affronteremo proprio questi temi e insieme cominceremo a capire di che "sostanze" sono fatti i nostri sogni.

Materiali per l'esplorazione e colonizzazione di Marte

di Antonio Del Mastro

La possibilità di colonizzare in maniera stabile il pianeta rosso è legata alla disponibilità di materiali in loco che possono essere impiegate per costruire habitat, sviluppare tecnologie e rendere compatibile con la sopravvivenza la vita dei futuri colonizzatori.
Materiali come l'olivina ((Mg,Fe)2SiO4) sono abbondanti su Marte, la sua scomposizione è possibile grazie a processi di idrolisi e i prodotti risultanti possono essere impiegati come base per creare un cemento marziano.
E' noto che la presenza di radiazioni su Marte obbliga a progettare habitat di superficie in grado di mitigare gli effetti nocivi delle radiazioni di vario tipo che arrivano sulla superficie. Il terreno superficiale marziano (denominato, come nel caso della luna, regolite) deve essere opportunamente trattato. Sono state ipotizzate vari sistemi di leganti per fornire alla regolite le necessarie caratteristiche di consistenza strutturale. Si è ipotizzato, per esempio, l'impiego di leganti a base di zolfo, oppure sistemi leganti a base di proteine biologiche. Queste soluzione e molte altre in fase di studio sono da valutare tenendo conto della limitata disponibilità di acqua ed energia sul pianeta rosso, a meno di installare impianti adeguati per la loro produzione.
Dalla CO2 che costituisce il 95% dell'atmosfera marziana è possibile ricavare carbonio essenziale per produrre plastica, carburante o combustibili come metano. Altri elementi come azoto, idrogeno e ossigeno sono ottenibili

Il meteorite ritrovato da Curiosity: Credits NASA/JPL-Caltech/MSSS

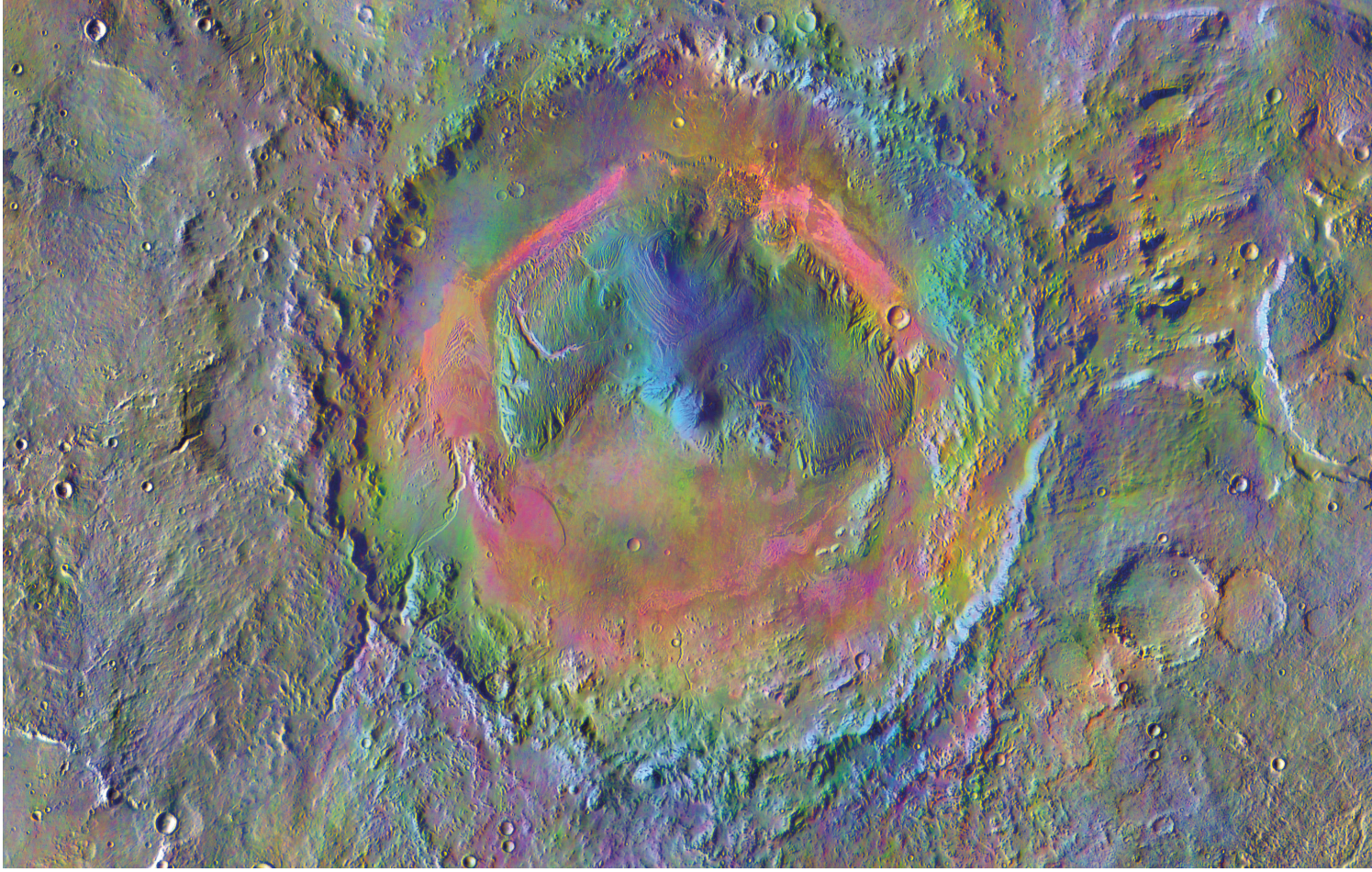


Immagine satellitare del cratere Gale scattata dall'orbiter Masr Odyssey con lo strumento THEMIS (THermalEmission Imaging System). Sono evidenziati i differenti minerali che ne compongono la superficie. Credits: NASA/JPL-Caltech/Arizona State University

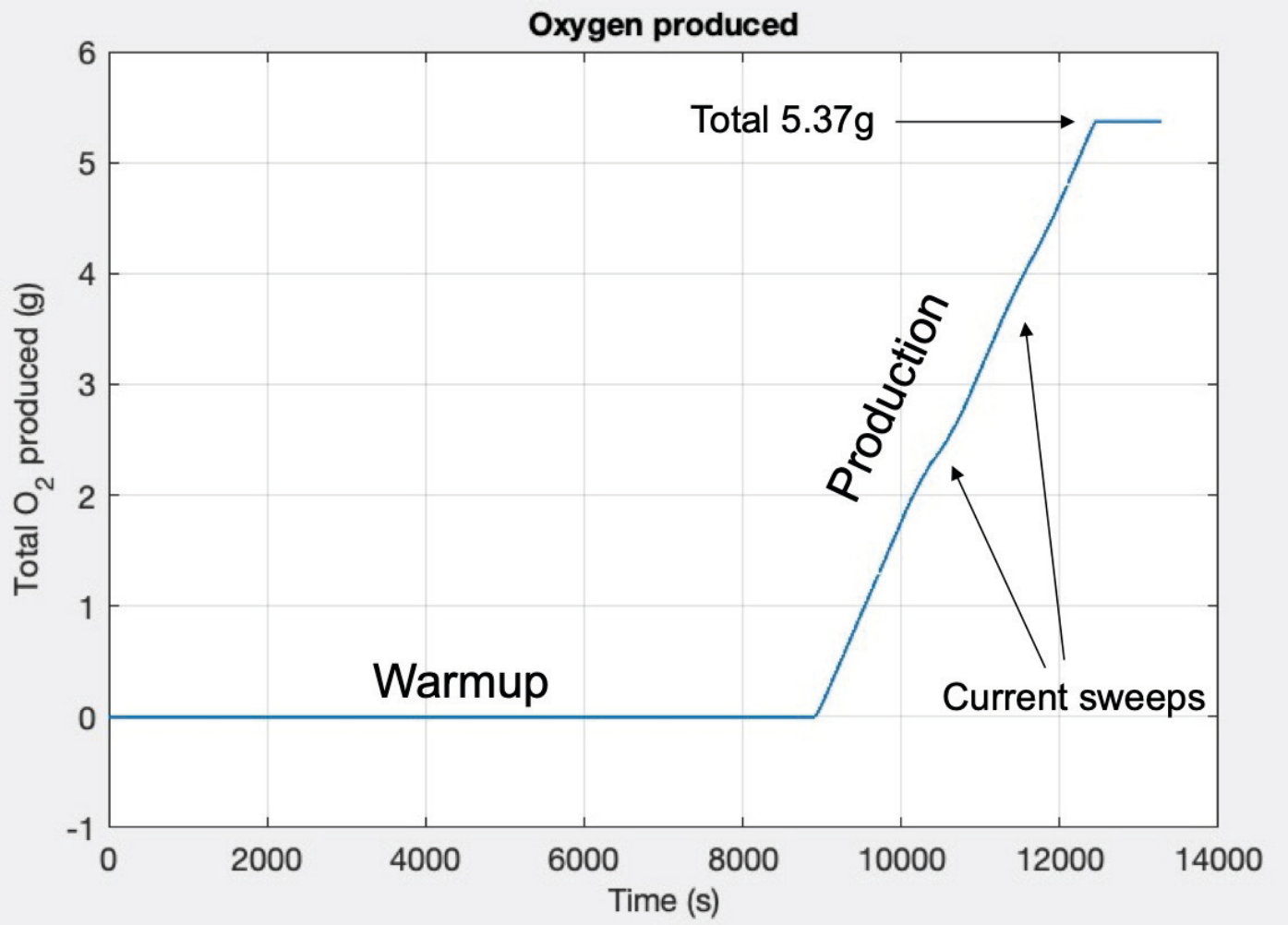
su Marte con tecnologia di non elevata complessità.
Sotto la denominazione ISRU (In Situ Resources Utilization) vengono classificate tutte le tecnologie che si occuperanno di realizzare gli impianti necessari alle future colonie marziane.
Dal biossido di silicio, ampiamente presente su Marte sarà possibile ottenere vetro essenziale per realizzare habitat a misura umana oltre che svolgere un ruolo di protezione nei confronti di venti e polveri marziane.
Lo studio dei materiali si combina strettamente alle applicazioni delle stampanti 3D in ambito spaziale. L'obiettivo e' riuscire a realizzare dei sistemi di stampa 3D autonomi, che, una volta lanciati sulla superficie di Marte, possano essere in grado di costruire gli habitat necessari ai primi colonizzatori, prima che questi arrivino sul pianeta rosso.
La stampa 3d su Marte impiegherà anche organismi biologici elementare per produrre oggetti "bio-stampati" che possa svolgere anche la fuznione di leganti dei materiali. Per questo scopo è essenziale ridurre la massa di organismi biologici da trasportare inizialmente su Marte. La ricerca sui materiali di origine biologica si focalizza sugli impieghi strutturali e comprende biomolecole, biopolimeri e strutture rigide derivanti dalla bio-mineralizzazione degli organismi.
Altra classe di materiali sono i biocomposti che sono realizzati con una matrice di fibre naturale e contengono materiali di natura biologica e non. Strutture come le stromatoliti, tra i piu' antichi abitanti del pianeta terra, potrebbero trovare una nuova casa su Marte aiutando il genere umano a realizzare strutture in grado di resistere alle avverse condizioni ambientali su Marte.
Batteri come la Sporosarcina possono essere alla base di prodotti in calcite a sua volta impiegabile per realizzare mattoni.
La maggior parte dei microbici utilizzati in questo tipo di ricerche richiedono una fonte di carbonio organico, tra questi alcuni tipi di cianobatteri sono in grado di convertire azoto in ammoniaca e anidride carbonica in materiale organico e potrebbero quindi impiegare risorse direttamente disponibili su Marte.

L'esperimento MOXIE ha estratto ossigeno dall'atmosfera di Marte per la prima volta

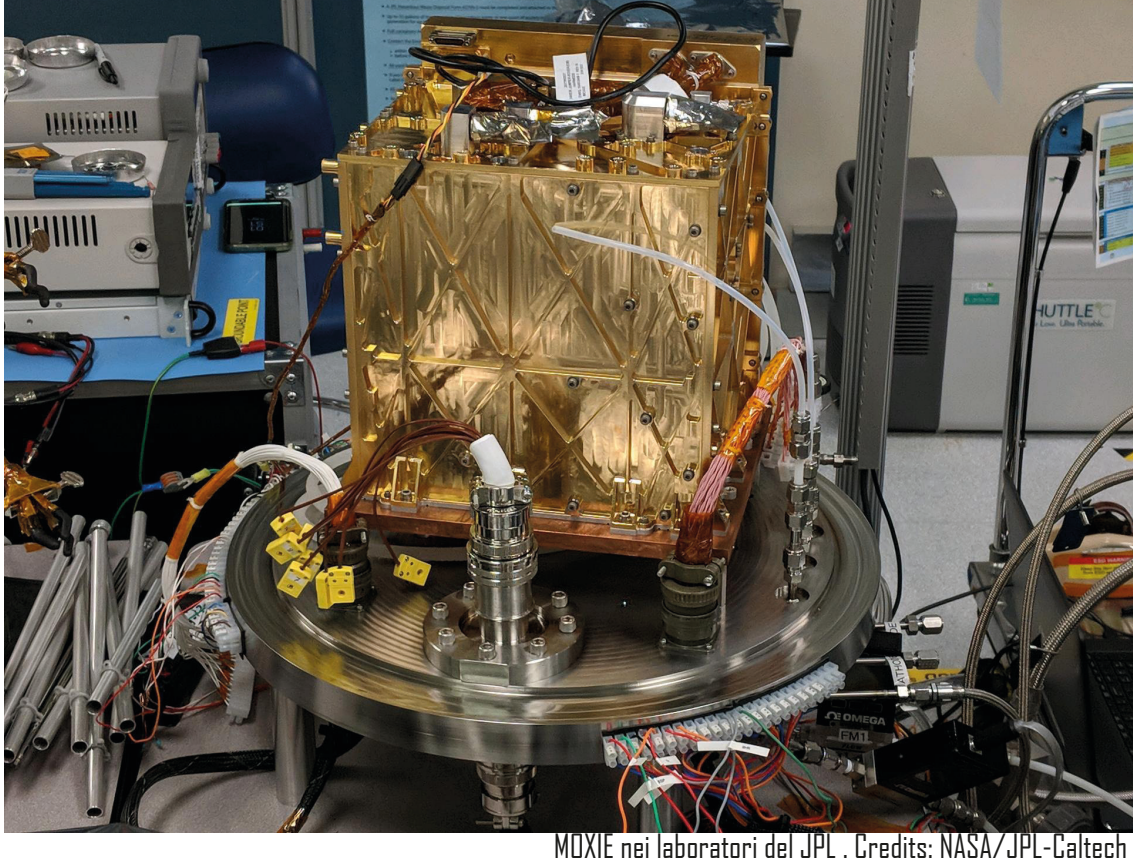
di Stefano Piccin, autore di ASTROSPACE.IT

Lo strumento MOXIE (Mars Oxygen In-Situ Resource Utilization Experiment), montato sul rover Perseverance, ha estratto per la prima volta 5 grammi di ossigeno dall'atmosfera marziana. Si tratta di un altro momento storico per l'esplorazione spaziale, ma com'è possibile estratte ossigeno da un'atmosfera che non ne possiede? Solamente lo 0.16% dell'atmosfera marziana è infatti composto di ossigeno (O2 per la precisione) ma non è questo che MOXIE ha estratto.

Lo strumento della NASA, attivato per la prima volta il 20 aprile durante il Sol numero 60, ha raccolto l'anidride carbonica (CO2), che rappresenta il 96% della composizione atmosferica. Una volta raccolta la CO2, MOXIE l'ha scomposta, raccogliendo l'ossigeno e rilasciando il monossido di carbonio nell'atmosfera marziana. L'esperimento è un altro dimostratore tecnologico, come l'elicottero Ingenuity non è quindi un vero e proprio esperimento scientifico. Ma andiamo con ordine.



Il grafico della produzione di ossigeno della prima attivazione di MOXIE. Credits: NASA



MOXIE nei laboratori del JPL . Credits: NASA/JPL-Caltech

Come funziona MOXIE

L'esperimento è posto all'interno del rover Perseverance, ed è grande circa come un tostapane, dal peso di 17 kg. Come detto, l'obbiettivo è la conversione dell'anidride carbonica in ossigeno e monossido di carbonio. Il primo viene stoccato, il secondo espulso nell'atmosfera. Con questa prima attivazione di MOXIE, sono stati prodotti 5.37 grammi di ossigeno. Questa quantità equivale a circa 10 minuti di aria rspirabile, ma MOXIE è stato progettato per produrne fino a 10 grammi all'ora.
Per effettuare questa conversione, sfrutta l'elettrolisi ad ossidi solidi, comprimendo e scaldando l'atmosfera marziana. Questo processo richiede temperature particolarmente alte, che arrivano ad 800 C°. Tutta la struttura di MOXIE è quindi costruita attentamente per supportare queste temperature e per isolarle il più possibile per non danneggiare Perseverance. Alcune componenti sono costruite in lega di nichel, che supportano sia il riscaldamento che il raffreddamento dei gas raccolti. E' inoltre presente un rivestimento dorato esterno, per riflettere le radiazioni infrarosse e impedire che si irradino all'esterno.
MOXIE opererà ora in tre fasi diverse, per testarlo in più condizioni possibile. Per prima cosa verrà verificata la condizione e il funzionamento stesso dello strumento, e la produzione appena eseguita è già un ottimo primo risultato. Poi verrà ripetuta la prova in condizioni atmosferiche diverse, come differenti momenti della giornata o della stagione. Nella terza e ultima fase MOXIE verrà portato al limite, testandolo con temperature diverse.

A cosa serve MOXIE?

L'obbiettivo primario di MOXIE è dimostrare che la produzione di ossigeno dall'atmosfera marziana è possibile. Per il futuro dell'esplorazione di Marte, l'ossigeno sarà un elemento cruciale, non solo per il supporto vitale degli astronauti. I razzi funzionano infatti alimentati anche da ossigeno liquido, e per lasciare il pianeta rosso è necessario riuscire a produrre in loco il propellente.
La NASA ha stimato che per lasciare Marte quattro astronauti avranno bisogno di circa 7000 kg di carburante, e 25000 kg di ossigeno. E' difficile che 25 tonnellate di ossigeno possano essere portate su Marte direttamente dalla Terra. Una permanenza di un anno sul pianeta comporterebbe invece il consumo di circa una tonnellata da ossigeno da parte degli astronauti.
Per questo motivo, la NASA stessa sta già pensando al successore di MOXIE, un esperimento simile, ma scalato nelle dimensioni. Uno strumento simile, pesante una tonnellata, potrebbe arrivare a produrre circa 1kg di ossigeno all'ora. Uno strumento di questo tipo potrebbe produrre 25 tonnellate di ossigeno in 3 anni terrestri. Basterebbe dotarsi di cinque o sei di questi dispositivi per ridurre il tempo a sei mesi.

Space Medicine Operations

21 Nov - 4 Dec 2021

ANALOGUE MISSION AT THE MARS DESERT RESEARCH STATION
MOAB DESERT, UTAH, USA

Mars is an incredibly harsh environment: global-covering dust storms, toxic terrain, thin atmosphere, extremely low temperatures. To push the concept of human exploration and colonization of the Red Planet, much more research needs to be done on the adaptation of human physiology to such hard conditions. After 6 months of travel in microgravity condition, having dealt with the shock of a planetary reentry and landing, the first crew on Mars will face the challenge of recovery and rehabilitation, but also the need to assess and mitigate independently any possible health emergency throughout the mission.

To enable these opportunities, we are organizing SMOPS (Space Medicine OPerationS), an analogue mission that will take place between April 24th and May 9th 2021 at the MDRS (Mars Desert Research Station), a research facility owned and managed by The Mars Society in the Moab desert, Utah, USA. For two weeks in isolation, our analogue astronauts will test different technologies and operational scenarios in the field of space medicine, in preparation for future human missions to Mars.

The conditions offered by the MDRS are in many ways similar to the ones that can be found in a possible Mars habitat: desertic environment, crew isolation, spacesuit simulators for external activities, limited living spaces and resources (water and food), local energy (solar panels), and food production (greenhouse). This will allow analogue astronauts on Earth to simulate, as best as possible, the difficulties that human crews will face on the martian surface.

RESEARCH

HEALTHCARE DRONES

PRIME INVESTIGATOR: DOME GROUP

Aerial drone technology has considerably evolved in the past years, thanks to the increasing number of potential applications. Hardware miniaturization and deep-learning algorithms brought this technology to a fundamental role in high-risk scenarios. Mars, due to its geological and atmospheric properties, represents a totally new ground to expand the boundaries of this technology. Aerial drones can become a fundamental subsystem of human activities on Mars, and are especially suitable for the use as long-range, fast-response healthcare providers on the martian surface (as on earth): logistics, safety inspections, search and rescue missions and medical devices deployment can be safely left to swarms of autonomous flying drones. We will test different hardware and scenarios to validate our researches.

MONITORING STRESS BY ACUPUNCTURE

PRIME INVESTIGATOR: MARS PLANET

Stress factors can play an essential role in the performances of future astronauts on Mars. In long-term missions such as expeditions towards Mars, stress can be triggered by predictable and unpredictable events and needs to be controlled through training, monitoring and support. In this experiment, the first layer of a spacesuit contains a system that measures and relieves stress level using electroacupuncture, a variation of the traditional medicine acupuncture technique. Sensors will be placed in the points of the body traditionally employed by acupuncture medicine. With reference to the figure below, these points are related to the measurement of:

Nervous tension and stiff neck.
Stress, fatigue, insomnia, heaviness in the head, eye fatigue
Stomach, anxiety, arm pain, elbow pain and discomfort in the chest.
Nausea, anxiety, palpitations and pain in the wrist.
Emotional imbalance, fear, nervousness, anxiety and forgetfulness.
Nervousness, stress, tightness in the chest, anxiety, depression, hysteria, etc.
The data collected by the sensors are then visualized and analyzed through a software tool.

MARS PLANET SHOES

PRIME INVESTIGATOR: MARS PLANET

Wearable devices will play a key role in future manned exploration of the Moon and Mars. In this experiment, we will test a new type of shoes used to help astronauts to identify parameters of the explored environment and biometrics of their health condition, including emotional responses. A set of sensors will be included in a new model of shoes, specifically designed and produced for this purpose. The signals detected by sensors will be transmitted to the mission control to visualize and monitor the evolution of Extra-Vehicular Activities.

ORGANISERS

OUR PARTNERS

PATRONAGES

Agenzia Spaziale Italiana

How the Analog missions can bring advantages to the terrestrial industry

It is erroneous to look at human exploration of Space as an additional investment, unrelated to our home planet. In fact, preparing to settle on other planets and use in situ resources can be seen as an excellent way to help find solutions to many terrestrial problems. Since the technological challenges foreseen in space are numerous, so are their terrestrial applications: from telecommunication to food production, from agriculture to architecture, from medicine to industrial production and entertainment.

The conception of a human space mission can be greatly helped by the use of so-called "analogue sites" on Earth, in which different technologies and methodologies can be tested, before their use for Earth and space applications. These sites are generally located in remote and sometimes extreme environments.

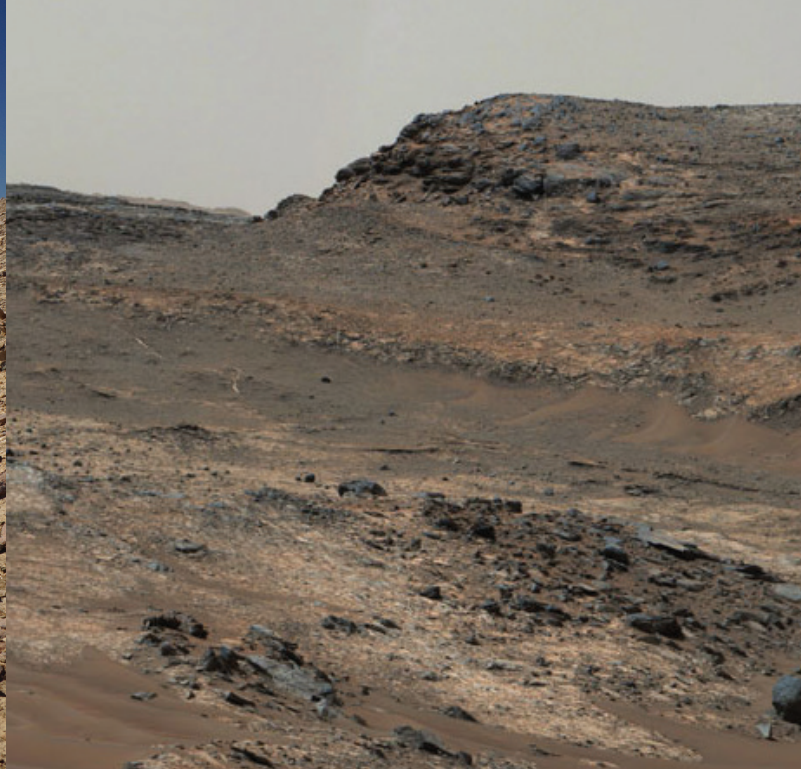
On the International Space Station, the condition of microgravity enables experiments unthinkable for Earth laboratories. Moreover, Earth's magnetic field and atmosphere prevent us from observing the effect of Space radiation from the surface. Nevertheless, analogues still allow to perform a wide set of experiments, with focus on surface exploration, for fast testing and prototyping. In recent years, the number of analogue stations has multiplied, and space research entities around the world are currently looking at analogues with growing interest.

Several experiments can be run in analogues. The effect of isolation and confinement conditions of the crew in space and hostile environments can be studied, as well as the health conditions of the astronauts. This can lead to the design and production of medical devices, including space suits, which can find easy application within the medical sector on Earth. Robotics experiments focus on the capability to autonomously explore new regions

Name	Name	Name
Antarctic Dry Valleys	--Chebbi	Lonar Crater
Atacama Desert	--Lake Maider	Meteor Crater
Australia (central)	--Maider	Mistastin
Axel Heiberg Island	-Ouarzazate	-Discovery Hill
-Saline Perennial Springs	--Ben Haddou 1	-Cote Creek
-Polygonal Terrain	--Ben Haddou 2	Mount Etna
-Colour Lake Fen	--Stromatolites	Namibia
Barberton	--Travertine	Pavilion Lake
-Buck Reef	--Adad	-Kelly Lake
-The Josefsdal Chert	--Saoun	-Cariboo Plateau Lakes
Black Point Lava Flow	-Tan Tan	Pilbara
-Edge of BPLF and SP Lava Flow	--Sebkha Tazra	Ries Crater
Cinder Lake	--Sebkha Tah	Rio Tinto
Columbia River Flood Basalt	--Sebkha Oum Dba	Sudbury
-The Yakima Folds	--Sebkha Aridal	Sunset Crater
Golden	-Zagora	Svalbard
Haughton	--Zaouia	-Bockfjord Volcanic Complex
-Hydrothermal Supersite	--Zagora	-Ebbadalen Formation
-Impact Breccia Supersite	--Mhamid	-Murchison Fjord
-Ice Wedge Polygons	Iceland	-Adventtoppen & Hiorthfjellet
Ibn Battuta	-Askja	Teide National Park
-Alnif	-Eyjafjallajokull	-Minas de San Jose
--Tinertir	-Krysuvik	-Llano De Ucanca
--Alnif	-1783-1784 Laki Flow Field	-Cuevas Negras and Sima de Vicky
-Erfoud	Kamchatka	The Turpan Desert
--Rissani 1	-Avachinsky Area	Utah Desert
--Rissani 2	-Klyuchevskaya Volcano Group	-Kissing Camel Ridge
--Rissani 3	Kilauea	Yellowstone
--Kess Kess	-Ka'u Desert	-Grand Prismatic Springs
		-Chocolate Pots

Main analogues (dArk blue) and major areas of interest (clear blue) (Credits to: ESA).

Atacama desert, Chile. Credits: NASA/JPL-Caltech



Mount Sharp, Mars . Credits NASA/JPL-Caltech/MSSS

and collect information, as well as on safety operations, human interaction and, in recent years, drones exploration. Many experiments focus on food production, waste recycling and life support systems. Building with limited resources plays an important role as well, finding applications in space and Earth alike. Special attention is also devoted to developing tools and procedures for geological experiments.
This brief overview of potential experiments to be performed in analogues opens the possibility of involvement for a wide range of terrestrial industries. The spaceindustry can find in the analogues the right place to test their technology before employing them in space, while companies not yet involved in space can develop and test new products and services to be commercialised in terrestrial markets, while building their way up to space.
Mars Planet and its partners will contribute to the spaceeconomy on Earth with the SMOPS (www.smops.space) analogue mission at the Mars Desert Research Station, managed by The Mars Society, in April 2022.

In the eventuality of colonizing other planetary bodies (e.g., Moon, Mars), the exploitation of natural resources could pave the way to our wellbeing on Earth. The best way to prepare for something of this relevance is to test and evaluate current technologies in environments like those in which we will find ourselves in the future. These so-called space analogues are generally located in remote and extreme environments (e.g., Antarctica) and allow space-like situations as well as to perform psycho-physical stress to which astronauts could be subjected to.
The creation of research hubs has allowed the human race to perform a great number of experiments related to isolation and communication delay that potential astronauts would have to face on another planet. Unfortunately, Earth analogues have some limitations in terms of space radiation and gravity.

Future human outposts will not survive without having at their disposal recycling and building systems designed to sustain human civilization. Many industries and laboratories have already been involved in space research and space economy. This is the reason why space analogues are essential to perform experiments on Space agriculture, Life support systems, etc.

The Experiments and Technologies of the SMOPS mission

by Paolo Guardabasso

The Space Medicine Operations (SMOPS) analogue mission will take several experiments and technologies to the Mars Desert Research Station this November. The mission is mainly focused on future astronauts' health monitoring, and on technologies that could support their activities in remote locations (both on Earth and on other planets). The mission will also include experiments that take advantage of the station's remote desertic location. Four main categories of experiments have been identified: space suits and biomonitoring, crew health, support technology and planetary science.

Space suit simulators are a necessary element of analogue space research, because they can increase the degree of fidelity of simulations and they pave the way for space suit technology development. In the frame of space suit and biomonitoring research, the SMOPS crew will test both a space suit simulator prototype, the BG Suit, produced by Mars Planet, and a pair of sensorised smart shoes, engineered by Vibram and E-Novia group. Both experimental technologies will include several sensors able to measure the crew's health conditions and the surrounding environment. Moreover, the health parameters of crew members will also be continuously monitored thanks to the Astroskin biomonitor. Such wearable biomonitors include integrated sensors designed to measure the body activity, heart rate, blood pressure and body temperature.

Making sure that the crew is healthy and safe is of paramount importance for any research mission. In the case

A MDRS's panorama. Credits: Mars Society

of an analog space mission this includes monitoring physical health, but also the mental states of the members of the crew, to ensure that they remain healthy in isolation. The SMOPS crew will perform a daily kinesiology exercise routine, measuring its impact on their health and wellbeing and how they cope with stress. Moreover, they will perform several cortisol tests, playing an important role in understanding (but also preventing) potential health risks including high blood pressure, anxiety, high blood sugar, muscle weakness, etc..; the results of this experiment will be analyzed and published by one of the crew members who is a medical researcher at the University of Calgary, Canada. Another experiment will make use of electroencephalography to observe the changes in the crew members' brains during meditation sessions.

Every space mission will need key, cutting-edge technologies to support the activity of crews on other planets. During the SMOPS missions, the crew will run different experiments aimed at the development of several emerging technologies. For example, the quality of air will be monitored within the MDRS habitat, thanks to a life support system device developed by the italian company D-Orbit. Moreover, the use of drones on Mars will be investigated by the Drone Operations for Martian Environment (DOME) research group, performing mapping and station inspection flights with a VTOL (Vertical Take Off Landing) drone. Finally, as additive manufacturing paves the way for in situ resources utilisation, several 3D printed tools will be tested and more will be printed directly at the station, thanks to an industrial-level printer provided by Roboze.

Manned space missions will not only mean taking care of the astronauts; the knowledge we have of the universe is still a very very small fraction of what is out there. It is important to take advantage of the remote location of the MDRS, in the middle of one of the widest deserts on Earth, to train for planetary science experiments as well. One of the SMOPS astronauts will carry out two separate analyses on terrain samples, looking for traces of DNA and micrometeorites.

Mission support for SMOPS:

what's behind the scenes of an analog astronaut mission

by Paolo Guardabasso

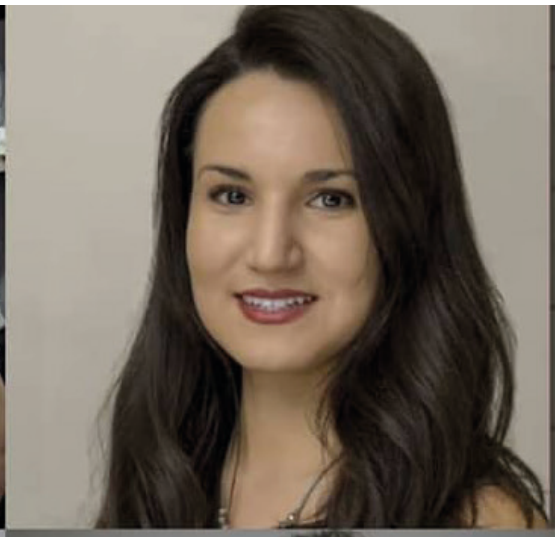
As any research expedition, analogue astronaut missions require great effort in organisation and planning. Every aspect must be designed, managed, and scheduled to reduce uncertainty and increase the probability of success. In such an endeavour, an information-integrated approach is needed, and every practise should be informed by protocols and databases. This is the case for the SMOPS mission at the Mars Desert Research Station (MDRS) in Utah, USA, where six analog astronauts will live for two weeks, confined in a small shared habitat, with very limited access to the outside. The scheduling and management are currently being run by an "invisible team" scattered around Europe, with a majority of Italian experts, engineers and scientists who provide the support for the mission.

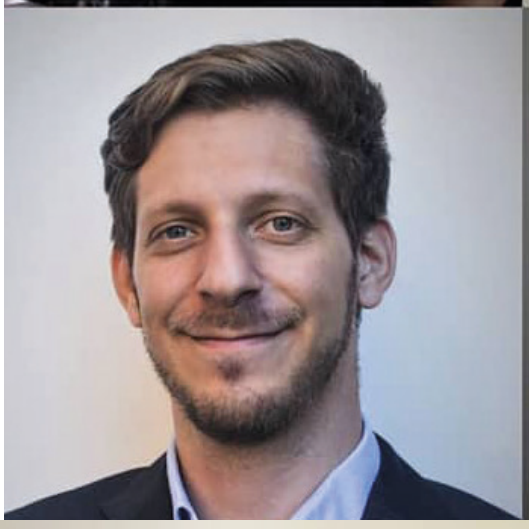
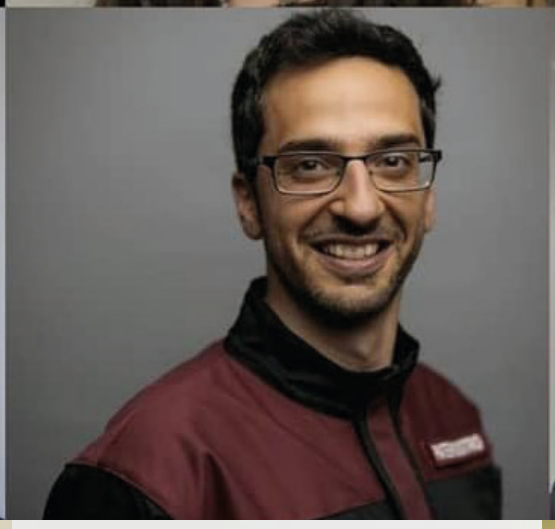
The methodology that entails small and continuous deliveries of the project adopts an agile method and is being coordinated by Federico Monaco, a sociologist expert in human factors in harsh environments from the Department of Medicine and Surgery of the University of Parma. The Crew members and organisers Vittorio Netti, PhD Candidate at Politecnico di Bari, and Paolo Guardabasso, PhD Candidate at ISAE-SUPAERO Toulouse, actively contribute to the coordination of the mission support, having already participated in an MDRS mission in 2019.

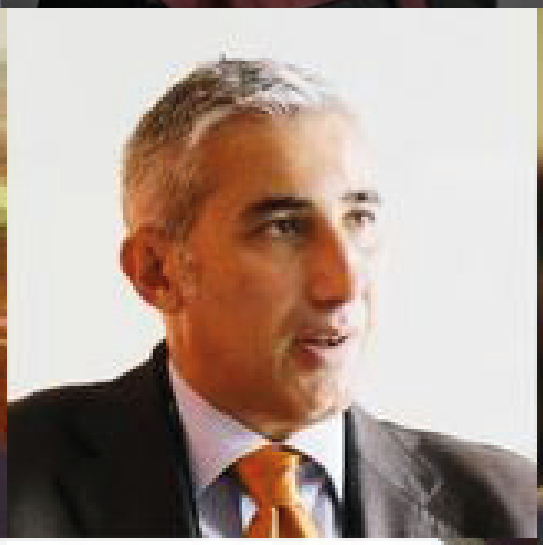
Two members from Mission Support, the Italian aerospace engineer Laura Sopegno and Guillaume Thirion, a space engineer from France with a background in space exploration and geophysics, are taking care of the experiments. Their main task is to remotely support the Crew during the experiments/tests. The two mission support experts are in charge of the definition of the experiments' protocols, creating a unified structure to describe and detail the number of tasks to perform, timing, etc. The compliance to safety requirements is also considered, analysing each experiment with respect to the MDRS regulations. Time and resources also need accurate planning for the experiment execution during the 2-week mission. Together with Anna Nelson, a physician with a master in Aviation Medicine, Laura and Guillaume are focusing on defining a routine for Crew members to be able to balance work, leisure, and sports, coordinating the numerous activities during the mission.

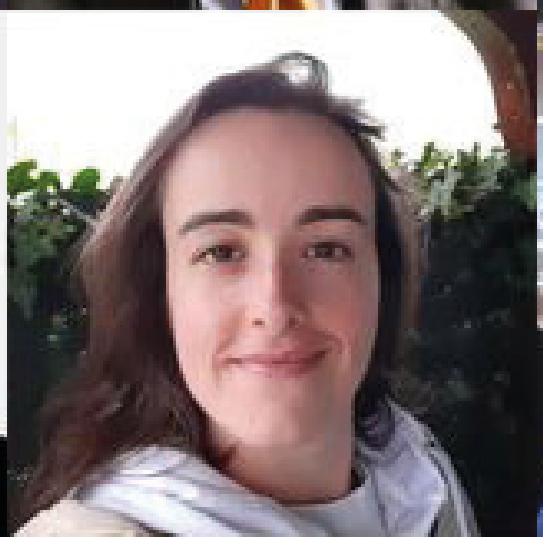
Federico and Paolo, along with Giovanni Garofalo, a mechanical engineer from Cagliari, take care of the mission outreach, preparing informative material, sharing it with the community through social media platforms and taking care of follower interactions, etc. The same team maintains and creates content for the mission website http://www.smops.space/. Relationship with the press are taken care of by Eugenio Sorrentino, vice-president of Mars Planet and

Before the mission, an important part of the activities regards the relationships with potential sponsors such as defining sponsorship benefits and agreement documents. For this mission in particular , budget management (i.e. keeping track of expenses and funding with respect to the overall mission budget) is tackled by Mars Planet. Each month an online meeting takes place, to collect ideas, fix changes and deliver what is ready "on the plate". The number of meetings will increase as the mission approaches. The members of the selected Crew sometimes participate in the support meetings to give their advice, based on experience, for whatever comes at hand.


V. NETTI
COMMANDER
H&S OFFICER


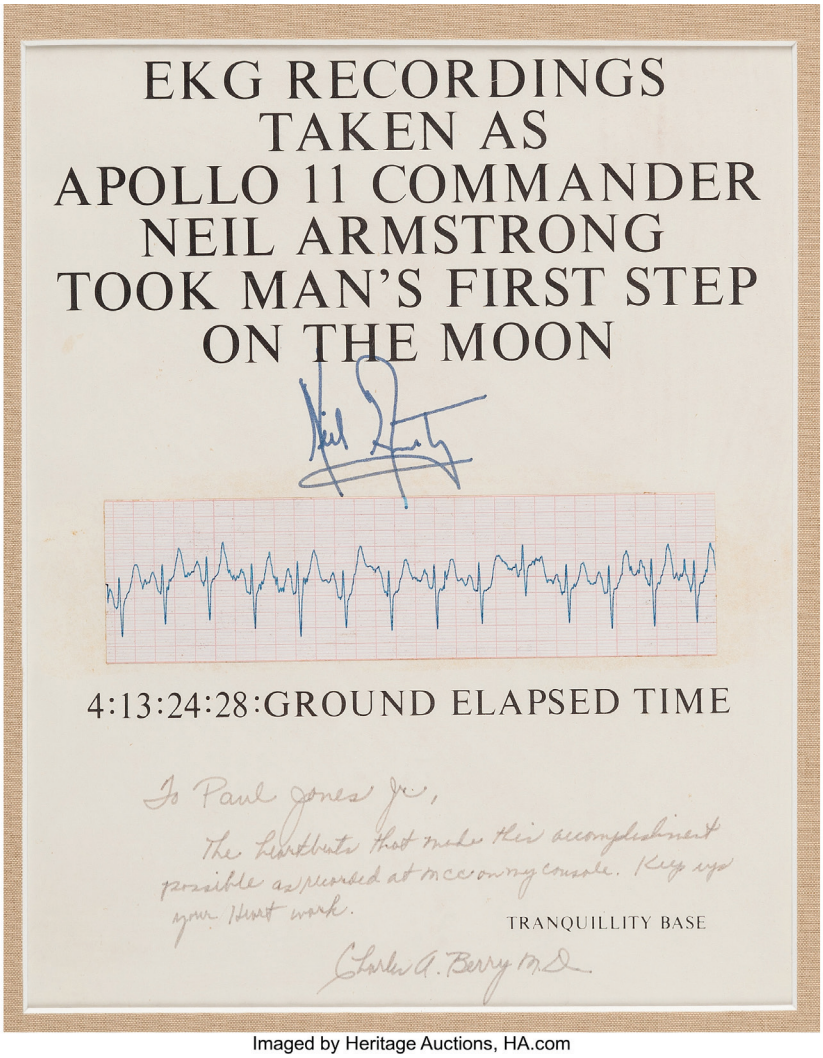




ECG for Space Applications

The Internet of Things (IOT) concept is gaining much attention and popularity; The related technologies as spacesuits and embedded ECG acquisition device is already existed. However, there are important issues to be resolved when an application is in a space environment. The ECG signal may be measured by different mobile conditions when embedded in spacesuits, requiring a more robust algorithm to remove exercise and noise issues.

After almost 60 years of human spaceflight, there is good evidence on detrimental effects on the human body associated with long-term space missions.Two of the main causes underlying those effects are ionizing radiation and changes in gravity conditions. Specifically, microgravity-induced cardiac arrhythmias are a major concern for national space agencies, as very prolonged periods of time in the International Space Station or in a mission to Mars or the Moon might set the stage for the development of ventricular tachycardia or ventricular fibrillation that could end up in sudden cardiac deat. Although the probability of undergoing serious cardiac arrhythmias in the course of a space mission is low, with the estimated probability of suffering a life-threatening event being of 1% per year in short to mid-duration spaceflights, currently available data are limited and more sophisticated techniques should be employed to identify potential in-flight abnormalities in the electrical activity of the heart . Several factors may enhance predisposition to ventricular arrhythmias during spaceflight. Commonly reported bradycardia, changes in electrolyte composition of blood plasma, psychological stress, and, very relevantly, adaptation of cardiac autonomic modulation may all concur to adversely affect ventricular electrophysiology. In particular, reported alterations in the sympathetic nervous system might contribute to the documented increase in spatio-temporal inhomogeneity of ventricular repolarization, thus potentially providing an electrophysiological substrate for arrhythmias. Nevertheless, further evidence on elevated arrhythmic risk during long-term space missions and its underlying mechanisms is yet to be established. ECG acquisition devices on the body of the astronauts will become a key components in the future application of bio-monitoring of the astronauts health. As part of the IoT technology they will contribute to detect possible problems in the astronauts performances, but also will another tool at disposal of the space crews to control and monitor other objects located inside the spaceship.



Imaged by Heritage Auctions, HA.com

Mission Specialist Bonnie Dunbar and Payload Specialist Lawrence DeLucas in the spacelab with the Lower Body Negative Pressure Study. DeLucas is encased in the suit and Dunbar is administering and overseeing the procedure. Credits: NASA

Description of effects of space on the human body and countermeasures

Space medicine plays a central role in space exploration. The human body has not evolved to travel through space and settle in environments where gravity is different from Earth. In fact, gravity on Earth has affected the formation of our skeletal system, our upright posture, our sense of orientation in space, and how our cardiovascular system works. There are now consolidated studies carried out by astronauts that show how the human body changes, sometimes significantly, in space. These studies must be carefully evaluated to prepare for permanent human presence outside the Earth's atmosphere. The identified changes concern mainly the skeletal structure, affected by a decalcification process, and the circulatory system. These studies were carried out on the ISS where the acceleration on the body is negligible (microgravity).

Furthermore, future human missions in space will foresee long periods in microgravity. Exposure to microgravity causes a shift of body fluids and can cause medical problems which can undermine the mission's safety. The change in fluid distribution is the main cause of what is called Spaceflight Associated Neuro-ocular Syndrome (SANS) which normally implies changes in eye anatomy and reduced visual capability. Special devices based on Lower-body Negative Pressure (LBNP) techniques are used as a countermeasure to distribute fluids to the lower part of the astronaut's body to reduce the effects of the shift in the upper body. Increased intracranial pressure (ICP) is one of the negative consequences of fluid shifting. Several studies are now under development to understand if LBNP devices can contribute to reducing it.

In the future, new devices and countermeasures must be designed to solve the problems caused to the human body by its long term or continuous presence in space. The design and production of such devices will also contribute to understanding and cure medical issues on Earth, especially in the domain of medical rehabilitation and in studies related to the reduction of negative effects due to ageing of the human body.

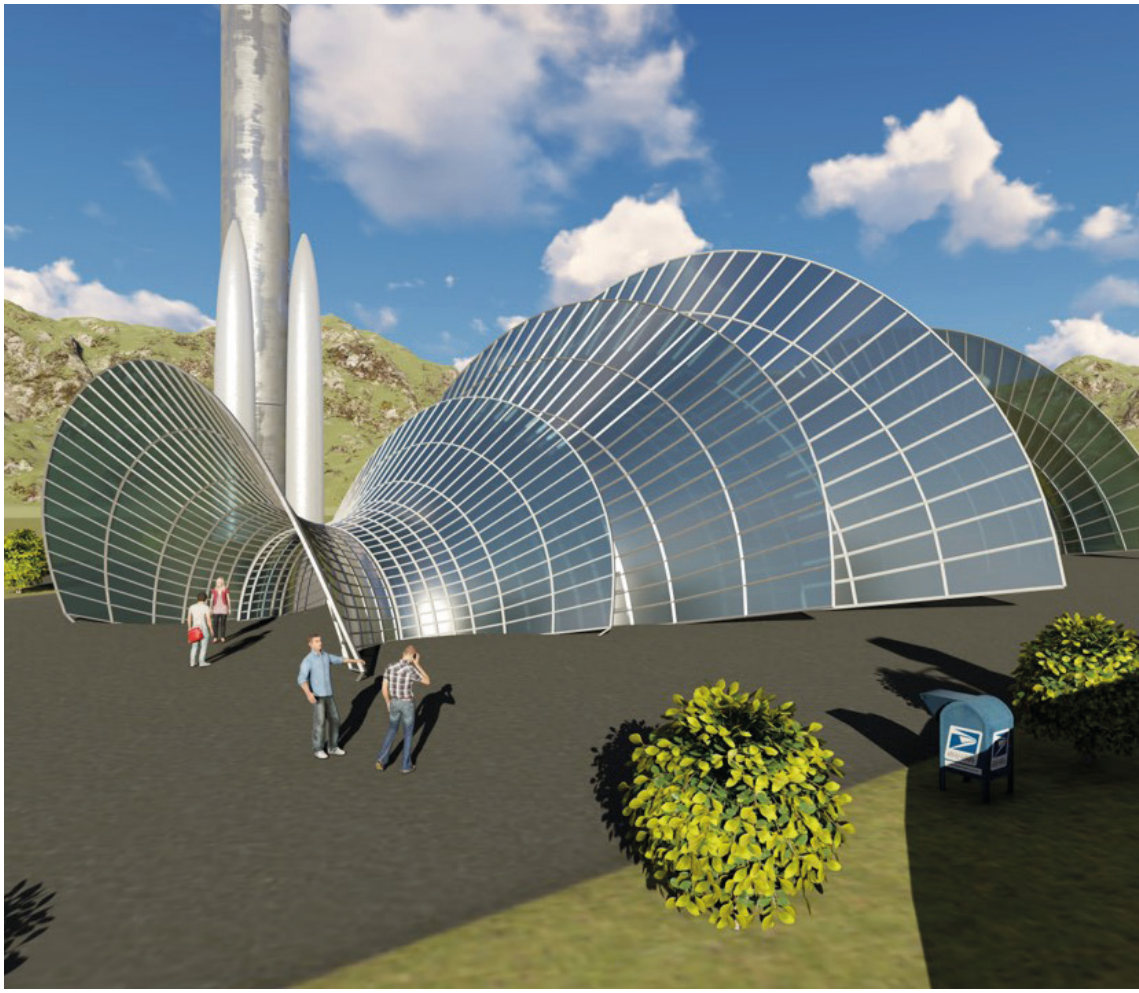
A new ecosystem for the Space Economy is raising

Mars City will be the first private European Space research and innovation hub. It will arise in Lombardy, Italy, founded by Mars Planet Technologies and the Swiss Institute for Disruptive Innovation.

MARS

We provide the tools for the next generation

Mars City is an ecosystem where you can set your entrepreneurial sprint to Space. Research, develop, test products, and take your business to the next level. You can now seize this opportunity thanks to a hub in the center of Europe equipped with Martian and Lunar simulators. The Mars City is the place to be for all those who want to unlock the potential of the next generation of ventures.



DISCOVER A NEW CULTURE

Space Economy is a cross-sector and multidisciplinary industry. Incredible new business opportunities are emerging not only for innovative and start-up companies but also for traditional companies. Technologies developed for Space activities disrupt traditional market. The Mars City is a hub where research, technology and know-how come together to seize these opportunities.

SCITY

RESEARCH AND DISSEMINATION

Mars City Labs offer companies an ideal environment where they can develop innovative solutions, stay current on the trendiest discoveries, and experience the high value of a diverse network. Taking advantage of the proximity of the research area aside from the simulators, Mars City's unique logistics will foster the research and development of new products and accelerate the entrance of new businesses into the Space Economy.

A brand new analog environment:the Space area

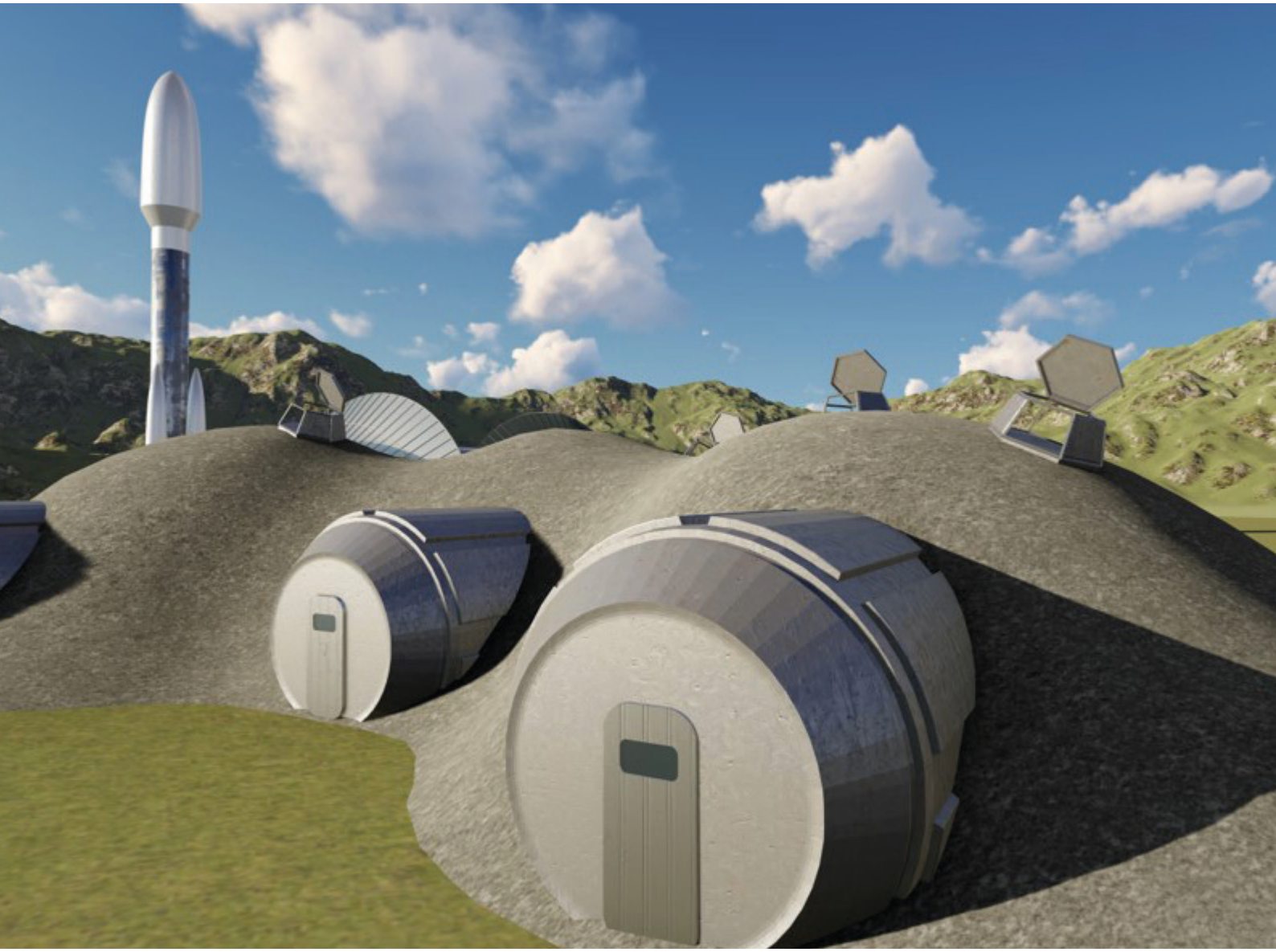
The Space analogs are the beating heart of the hub. Simulators are available to simulate a manned space mission in a lunar or Martian environment. Space labs allow you to operate under the same restrictions as a space station. Mars City provides tools, technologies, and procedures for testing space-related systems. The simulations accelerate the products and services development in fields like medicine, robotics, biotechnology, and sociology. Thanks to the presence of living modules, the analogs can host missions that last for periods ranging from some weeks to some months. Many studies can be conducted about Space psychology, privacy, and behavior. Companies and researchers can monitor the activities through control rooms remaining at the center of the City.

Mars Simulator

The Mars analog is composed of a unique dome in which is located a Mars Station where astronauts can live and conduct different experiments. A Mars alike regolith around the area can be used to test extravehicular activities and robotics exploration of Mars. The dome of the Mars analog will be equipped with systems able to simulate Mars wind and temperature, to host experiments on dust and environmental protection.

Lunar Simulator

The Moon analog has a pressurized environment with special instrumentation for Space medicine experiments, to test future pressurized habitats on the moon. Another laboratory to test 3d printing technology for moon exploration application, study on moon materials, radiation protection techniques, and space telecommunications tests.



READY FOR THE CHALLENGE?

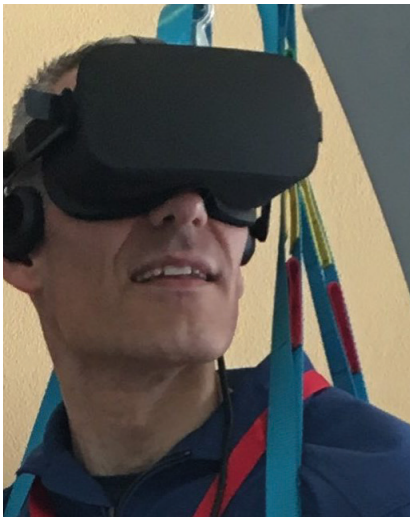
Space has always been a powerful driver for human development. Our present has derived enormous high-tech benefits from space research. But we are only at the beginning of the race that will completely disrupt our future. Researchers are taking on new challenges to make life beyond our planet possible. The same goals drive the spirit of Mars City. We will be ready for the new era of the Space Economy. Want to come aboard?

Explore our Project

mars-city.org

Vuoi provare l'esperienza di camminare su Marte?

Abbiamo due diverse tipologie di postazioni, a seconda delle necessità: **Motigravity** fornisce un'esperienza completa che simula anche una situazione di bassa gravità. È dotata, inoltre, di software che consentono il rilevamento e l'analisi dei movimenti degli utenti, anche a fini medici. Motigravity può essere fornita con diverse tipologie di basi, dalla piana, alla parabolica o con tapis roulant, a seconda delle preferenze e scopi di utilizzo. **Motivity** fornisce un'esperienza senza la simulazione di bassa gravità, ma non per questo meno coinvolgente. Questa postazione è spesso impiegata in musei, centri di divulgazione o eventi sulla realtà virtuale



MARS VIRTUAL SYSTEMS

Per maggiori info
visita il sito:
WWW.MARSVRSYS.COM

ECSEC
EUROPEAN CENTER FOR SPACE EXPLORATION AND COLONIZATION

IL FUTURO È ARRIVATO

Da una collaborazione MARS PLANET e la Svizzera SIDI, nasce l'European Center for Space Exploration and Colonization.

ECSEC vuole diventare un punto di riferimento nel panorama dell'industria Spaziale. Un settore destinato a cambiare radicalmente l'economia del pianeta terra come mai prima d'ora.

DIVENTA PARTNER

www.ecsec.space

Aderisci alla Mars Planet
The Italian Mars Society

La Italian Mars Society si pone l'obiettivo di favorire:

- Un vasto coinvolgimento del pubblico per instillare la visione della conquista di Marte.
- Il sostegno a programmi di esplorazione sempre più intensivi finanziati dai governi e dalle grandi società del settore spazio.
- Coinvolgere le piccole e medie imprese nella ricerca collegata all'esplorazione di Marte e contribuire con loro a creare una nuova economia basata sulla colonizzazione dello spazio.

L'adesione ha lo scopo di sostenere il programma di diffusione delle informazioni tecnico-scientifiche e promozionali della Italian Mars Society.
I soci hanno diritto a sconti consistenti sul materiale promozionale e sui costi di registrazione agli eventi organizzati dalla Italian Mars Society.

Unisciti a Noi
Think Beyond Your Planet

www.marsplanet.org

Channel Heads in Northern Arsia Chasmata - Credits NASA/JPL/UArizona