ÖSTERREICHISCHES WELTRAUM FORUM
AUSTRIAN SPACE FORUM

15OCT-15NOV 2020 / NEGEV DESERT, ISRAEL

AMADEE-20
Announcement of Opportunity

Document Titel	AMADEE-20 AO
Tracking Nr.	n/a
Version/Date	V1.0 / 30Dec2018 RELEASE
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Public

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A-20 Announcement of Opportunity for Experiments

Between 15Oct-15Nov2020, the Austrian Space Forum – in cooperation with the Israeli Space Agency as the host agency and D-MARS - will conduct an integrated Mars analog field mission in the Negev Desert in Israel. The expedition will be carried out in a Martian terrestrial analog and directed by a dedicated Mission Support Center in Austria. A small field crew of highly trained analog astronauts with spacesuit simulators will conduct experiments preparing for future human and robotic Mars exploration missions.

The Austrian Space Forum invites the scientific community to submit experiment proposals in the fields of geosciences, engineering, planetary surface operations, life sciences including astrobiology, human factors.

Submission deadline: 04Mar2019, 12:00 CET (Announcement of the selected proposals: 15Apr2019)

This AO contains the following sections:

1. AMADEE-20 Aims
2. Mission Architecture
3. Exploration Cascade
4. Administrative Aspects
5. Format for Experiment Proposals
6. A-20 Compliance Form
7. Test site description

AMADEE-20 aims

Simulating Mars Human-robotic surface activities in terrestrial analogs has evolved into an efficient tool for developing exploration mission architectures. They facilitate to understand the advantages and limitations of future Human planetary missions, becoming an added value for the development of remote science operations, helping to understand the constraints and opportunities of the technology and workflows.

The test sites will be selected for their geological and topographic similarity to Mars. The AMADEE-20 mission presents an excellent opportunity to:

- Study equipment behaviour involving the simultaneous usage of instruments with the option of humans-in-the-loop (via two high-fidelity spacesuit simulators, portable system, etc.)
- The development of platforms for testing life-detection or geoscience techniques, robotic support tools for human missions and concepts for high situational awareness of remote support teams.
- Studying the analog as a model region for their Martian counterparts.
- Serving as a catalyst to increase the visibility of planetary sciences and human exploration.
- Evolving the know-how of managing human mission to Mars deploying a realistic model for Mission Support center – Astronaut actions and the encompassing decision making framework.

Location of the AMADEE-20 test site

The AMADEE-20 test site

The test site is located in the Negev desert in southern Israel within the erosion structures of the Ramon Crater: Although not an impact crater, but a rare form of erosion structures, it has a resemblance to various Mars surface features, and a variety of terrain types relevant to Mars exploration. The test site offers a wide range of sand and rocky surfaces combined with a broad variability in inclination.

The nearest city is Mitzpe Ramon. Expected temperatures at the test site in November typically range between 10-20°C with low chance of precipitation.

Mission architecture

Bridgehead phase (days 01-07)

During the initial preparatory activities and the establishment of an operational base camp as well the local infrastructure in-situ, this period offers an opportunity for guest researchers and media to be present on site on a case-to-case base.
Instruments which cannot be operated by the OeWF field crew (e.g. due to the experiment sensitivity, operator training requirements etc.) may be operated by the researchers in the field. Selected pilot & calibration measurements may be conducted.

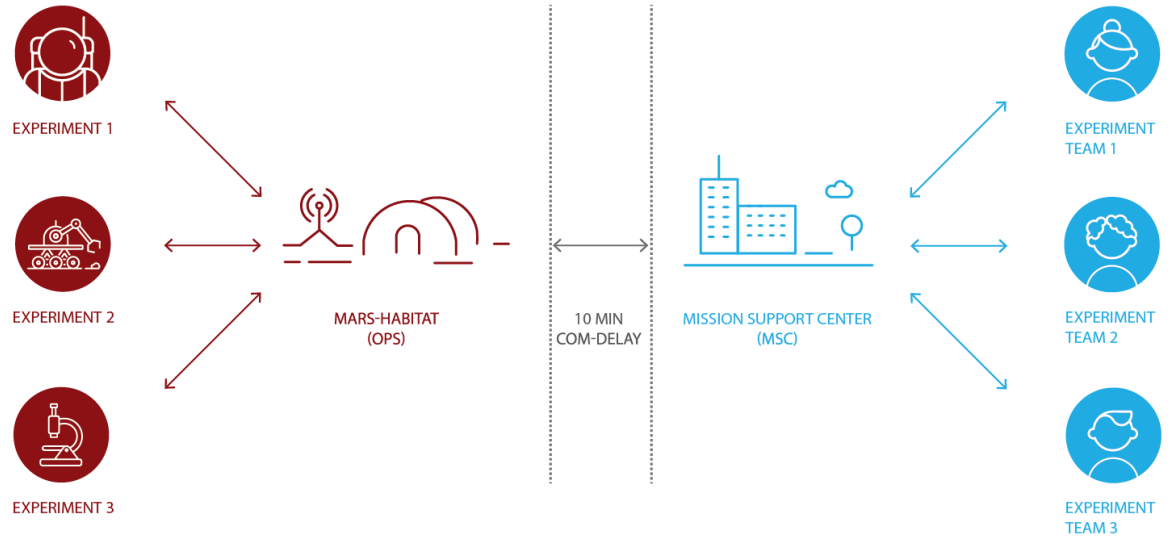

Figure 1. *Conceptual architecture of the AMADEE-20 expedition: A 10min time delay reflects the signal travel time between Earth and Mars. The Mission Support Center in Innsbruck/Austria is the single-line-of-contact between "Earth" and "Mars".*

Isolation phase (days 08-25)

After the preparatory phase, research teams leave the site, the Mission Support Center (MSC) Innsbruck/Austria will now direct the crew limited to six crewmembers who will conduct experiments according to a flight plan. The analog astronauts are supported by a small "On-Site Support"-team (OSS), performing activities necessary for the simulation, but not available on Mars (e.g. Safety, managing local W-LAN infrastructure etc). OSS will not directly interact with the analog astronauts. The field data will be analyzed in near-real time by the remote science support team at the MSC Innsbruck in cooperation with the experimenters' teams. A 10 minutes time-delay between "Earth" and "Mars" mimics the signal travel time between Earth and Mars.

During both phases, the following infrastructure will be available*:

- General logistics (accommodation in base station or nearby Mitzpe Ramon, water/food/medical care, basic hygiene, site security)
- Broadband internet access and 230V/50Hz electrical power
- A basic mechanical and electrical workshop (including 3d-printer) & basic mobility (tbc)
- Remote support team (Mission Support Center, Innsbruck/Austria)

Timeline & Selection process

Jan2019	Announcement of Opportunity released
04Mar2019	**Submission deadline for experiment proposals**
15Apr2019	Notification of Acceptance/Non-Acceptance
May2019	AMADEE-20 Science Definition Workshop
Nov2019	Experiment interactions defined, preliminary mission definition, release of the first iteration for the AMADEE-20 Mission Manifest (the main expedition planning reference document)
Jun2020	Hardware arrives in Innsbruck/Austria
Jul-Sep2020	3 (tbc) Dress Rehearsals, Innsbruck/Austria
Sep2020	Shipping to target site starts
15Oct-15Nov2020	**Field Mission**
Dec2020-Jan2021	Return of hardware to Innsbruck, shipping back to home institutions
May2021 (tbd)	AMADEE-20 Science & Technology Workshop (location tbd)

Experiment selection process

The Austrian Space Forum encourages potential Principal Investigators to contact the AMADEE-20 leadership before submitting a proposal in order to discuss potential opportunities and challenges to the experiment.

1. The submissions of proposals MUST reach the Austrian Space Forum via Email no later than **04Mar2020, 23:59 CET** in electronic form.

2. All proposals will undergo a peer-review process following these criteria:
   - Scientific, technical or operational merits.
   - Detailed plan of the research that clearly states that:
     - Feasibility of the proposed project, including the potential for data fusion with other experiments and alignment with the aims of the OEWF research program.
     - Experiment needs versus resources available, ability to assess and mitigate programmatic, engineering and safety risks ("*Can it work reliably and safe*?")
     - Ability to process, analyze, share and publish the experiment data in a timely manner.

3. The experiments will have to be self-funded, but the scientific and logistics infrastructure will be provided by the Austrian Space Forum. Also, the option for tele-operated experiments is available.

4. Depending on the outcome of the selection board's recommendations, experiments will either be selected "as is", "with a request for modifications" (where the Principal Investigator has still the option to decline), or "not selected".

Acknowledging the short timeframe for submitting and processing proposals to national funding institutions, experiments can also be submitted as "subject to funding decisions". In this case, the OeWF and the principal investigator will agree on a deadline (ca end of 2019 latest) at which the funding decision will have to be consolidated to continue the experiment in the AMADEE-20 framework.

Exploration Cascade

The AMADEE-20 expedition will focus on the interplay of the respective instruments and experiments relevant for human-robotic Mars missions. Based upon the research question of how to identify biomarkers, which in turn is traditionally based upon the characterization of the (paleo-)geoscientific environment, the experiments will be selected to reflect a realistic sequence of activities.

This strategy is based upon the "exploration cascade", an algorithm defining an efficient deployment sequence, providing the framework for the following question: "*which instrument needs to be active where and when, leading to what kind of data sets, leading to what kind of knowledge, leading to which type of input for the tactical flight planning*"

As suggested by Neveu et al. (2018) life-detection measurements must be sensitive, contamination-free regarding the absence of interfering signals, and reproducible; one or more features must be detectable, preserved, reliable, and compatible with life on Earth. Experiments will be scheduled according to a flight plan defining the resources, location and timing as well as considering the processing pipeline between data acquisition in the field, data transfer and integrity checks and the subsequent near-real time interpretation to formulate a hypothesis. This than translates into a scientific input into the tactical flight planning for the field crew.

For details we refer to the BSc work of Stefanie Garnitschnig from 2018 on the Exploration Cascade (available via www.oewf.org → Research → Academic theses).

Engineering experiments: Robotics, operations research and material science

Besides the search for life and the preceding characterization of the (sub)surface and aeolian environment, robotic elements such as copters, rovers or human-operated tools are considered as an enabler to perform the science. Therefore, robotic experiments are selected according to their enabling potential (such as mapping, carrying an instrument or rock sample), and not on their engineering maturity or engineering demonstration alone.

Hence, proposals capable of demonstrating the following are preferred:

- **Fast turn-around times for a first data processing** leading to hypothesis building (Good example: In-situ Raman spectroscopy vs (Bad:) multi-month laboratory analysis back on "Earth"; or (Good:) near-real time robotic terrain mapping vs (Bad:) post-mission 3d-data generation).

- **Ability to provide input into hypothesis forming** (Good example: identifying water layers within 48 hrs of receiving georadar data triggering a subsurface sampling experiment vs (Bad:) stand-alone tech-demonstration of a new instrument measuring local UV-radiation).
- **Experiments that cooperate with other experiments**, where data synergies allow for additional research questions to be addressed, or to cross-validate a hypothesis. (Good example: mineralogical spectrometry verifying hydrated minerals previously identified by orbital hyperspectral imaging vs. (Bad:) singular weathering of rock surface measurement with a Schmidt-hammer).

Human factors: Medical & Psychological Research

AMADEE-20 also allows for human factors experiments utilizing the crew (and potentially also the OSS and MSC team members as comparison group). However, ethics commission approval must be obtained before a final acceptance can be provided. As astronaut time is a very limited resource during missions, there needs to be a careful balance between crew time usage and expected scientific output.

This does not apply to man-in-the-loop experiments where the focus is purely engineering-oriented. The Medical Team of the Austrian Space Forum might require ethics commission approval.

If you are unsure, if your experiment might fit into the exploration cascade or has a high potential w.r.t. human factors research, feel free to contact the Austrian Space Forum.

Contact

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Administrative aspects

Junior Researchers Program

The Austrian Space Forum has a tradition of implementing a “Junior Researchers” program: Students at high school or university level may submit research projects for AMADEE-20. Their experiments shall allow for experiencing the full life-cycle of an experiment from formulating a research question to data interpretation. The review process for Junior Researchers will be independent from the formal selection.

Media activities

A major global media attention is expected for the mission, as it was the case in previous simulations. The Austrian Space Forum as project owner will coordinate and manage all media activities to ensure a professional media campaign.

Experiment funding

Experiments must be self-funded, including the development of the hardware, documentation, transport of hardware and personnel to and from Innsbruck (Austria). The hardware transfer between Innsbruck to the test site in Israel and back to Innsbruck will be organized and funded by the OeWF. For experiment-specific personnel participating in the field, the expenses for infrastructure and consumables will be distributed amongst the experiments. (Ca. € 300-500 /field person-week, tbd).

Legal Disclaimer

Although very unlikely, the Austrian Space Forum reserves the right to cancel the field mission. Hence, teams submitting a research proposal do so at their own discretion, expenses and risks without guarantee of success. Experiment teams will be asked to enter a legal agreement for their respective experiment after a successful review.

Next steps after selection & Science Definition Workshop

Upon selection, representatives of the OeWF Remote Science Support and the Flight Planning team will get in touch with the experiments' Principal Investigators, discussing the experiment implementation, training requirements for the field crews, bandwidth and power topics, as well as experiment specific hazards and risks. These deliberations lead to the creation of the Standard Experiment Information Form (to be compiled by the PI) which is the basis for the operational and contingency procedures.

The principal investigators will convene for a first mandatory science planning workshop in Innsbruck, Austria to a) present their experiments to the science teams and flight planners b) discuss potential synergies and c) learn about the operational capabilities of the mission architecture, decision making processes and the field crew executing the experiments.

Useful references

- Groemer, G. et al. (2016): The AMADEE-15 Mars Simulation, Acta Astronautica, Vol 129, pp 277–290
- Zanardini, L. et al. (2018): Training for Analog Mars Simulations, Proc. of the 2018 SpaceOps Conference, 28 May - 1 June 2018, 2018, Marseille, France. 10.2514/6.2018-2449
- Neveu, M. et al. (2018): The Ladder of Life Detection. In: Astrobiology. DOI: 10.1089/ast.2017.1773
- Garnitschnig, S. (2018): Development of a supportive method for the detection of biomarkers during future human-robotic Mars missions, BSc thesis, University of Innsbruck.
- Sejkora, N., et al. (2018): Geodata workflow for the AMADEE-18 Mars analog mission, In EPSC Abstracts Vol. 12, EPSC2018-442, European Planetary Science Congress 2018
- Groemer, G. et al. (2018): AMADEE-18 Mission Report, online at: https://oewf.org/en/download/14445/

Format for experiment proposals

Title, Summary & Contact details	An informative title such that by reading the title a person can understand the goal of the proposed investigation; plus a one-word name or acronym for the proposal. The full contact coordinates of every member in the proposing team (name, affiliation, postal address, email, telephone).	Cover page ≤ 1 page
Expertise	A brief outline of the expertise that each investigator will contribute to the proposed investigation.	one paragraph per person
A-20 Compliance form	Signed checklist for experiment submissions stating ability to comply with mission requirements	1-page form, signed
Scientific description *This part of the proposal is to demonstrate that the proposed work is scientifically/technically sound and feasible.*	A detailed description of the experiment should follow the standard outline of a scientific proposal: • Research rationale: why it is important to perform your experiment, including a brief literature review. • Scientific, engineering or operational hypothesis (articulate a testable statement, hypothesis or research question), including a suggested methodology and expected results • What kind of experiment hypothesis can be expected in near real-time (<24h) to be used by the flight planning team? • A publication plan (which journal/conference & when)	≤3 pages
Technical and logistics description	The scientific, technical and management implementation description, including instrument heritage and maturity, where applicable. This section should include: • Duration of experiment in the field (e.g. 10 x 2 hrs total), analog astronaut time requested (projected training and actual test time) • Power requirements (if >100 W: e.g. 1500 W, 4 hrs per day) Communication (if >500 kB/s: for how long/day?) • Do you have any other special needs? (e.g. legal/IPR issues, ITAR-restrictions, ethics approval required, special frequency licenses needed, safety-relevant information (eg such as explosives or hazardous chemicals), etc.)	≤ 3 pages

The proposal shall be sent as a pdf-file to **amadee20@oewf.org** no later than 04Mar2019, 12:00 CET. A confirmation will be sent, triggering the review process.

A-20 Compliance Form

We kindly ask you to carefully check each item before submission and then confirm by signature. You can copy-paste this form and include it in the proposal-pdf. Without exception, experiments need to be tested and documented and the crews involved need to be trained before an experiment is being shipped to Israel.

	Compliance item	**Signature of PI**
1	Our research team is able fulfill the requirements put forward in this Announcement of Opportunity, including a strict commitment to deadlines and required documentation. We are aware, that failure to do so might result in a removal from the list of experiments for the AMADEE-20 expedition.	SIGNATURE
2	We are committed to have at least one team member physically present at the Mission Support Center Innsbruck, Austria for the duration of the mission.	SIGNATURE
3	We are open to sharing data for data fusion and joint experiments on a case-to-case basis. We do understand the importance of the Exploration Cascade as a tool to synergize between experiments and the operational workflows and agree for our data to be used in this context.	SIGNATURE
4	We can cover the funding for our experiment, to deliver the experiment hardware in time to and from Innsbruck/Austria, including documentation and customs clearances. We can also cover the travel and accommodation costs for our team members to be present in Innsbruck. If we rely on an external funding agency, we shall commit to a deadline, at which the experiment funding is secured, or the experiment will automatically be withdrawn.	SIGNATURE
5	We are committed to participate in the preparatory teleconferences and training workshops including at least one representative physically present at • The science definition workshop in 2019 • At least 2 Dress Rehearsals in 2020 • The post-mission science workshop in 2021	SIGNATURE
6	Our research team is willing and able to process, analyze and publish the results of our experiment within six months after the end of the field campaign.	SIGNATURE
7	Our team is willing to proactively participate in the media activities of the AMADEE-20 mission, adhere to the mission-wide media rules and milestones, including social media.	SIGNATURE

Maktesh Ramon test site description

Israel lies on the margins of the Arabian plate, between the Alpine Orogeny in the north and the Arabian-Nubian Shield in the south, between the Dead Sea Transform in the east and the Mediterranean Sea in the west. In the south part of Israel at the “Negev” desert there are five erosional craters.

The erosional crater (“makhtesh”) is a unique natural phenomenon in which a valley surrounded by cliffs forms at the crest of an anticline[1]. The “Ramon makhtesh” is one of the largest and most developed erosional crater-like valleys in the world. At the “Ramon makhtesh” long sequence of geological periods are expose from the Triassic (250 Ma years ago) thorough the Jurassic, Cretaceous, Paleogene, Neogene and Quaternary (recent) periods. Limestone covered by basalt can be found in smaller black hills in the southern part of the makhtesh.

The result of the long geological sequence reflected in high diversity of rocks type which including: magmatic rocks, both plutonic and volcanic which expose at ancient volcanos and igneous intrusion. Different kind of Sedimentary rocks – sandstones, carbonates rocks, evaporites and chert. Furthermore, the “makhtesh” area contains as well metamorphic rocks and variety of ore deposits.

The geodiversity and harsh climate conditions gave rise to the formation of fragile ecosystems with endemic plants and animals that have adapted to local lithologies and landforms[1].

1. Finzi Y., Ryvkin I., 2016: The erosional crater (makhtesh) – a rare but diverse phenomenon. Negev, Dead Sea and Arava Studies, 8, 4: 126–138.

Representative photos of the test site

These images were taken at various sites during a scouting visit close to Mitzpe Ramon and are a good representation of the terrains to be expected.