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Using an Australian Mars Analogue Research Facility for Astrobiology, Education and Outreach

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Abstract. The Mars Society is an international private organisation advocating the exploration and settlement of Mars. Part of its mission involves selecting areas for Martian analogue research, to test hardware, technology, strategies and human factors relevant to sending people to Mars. Mars Society Australia has selected an area in the Arkaroola region in the Flinders Ranges as the site for the first Australian analogue facility. The facility will be an invaluable public education and outreach tool for Australian science, focusing on astrobiology, and its role in future human Mars missions; demonstrating Australian contributions to astrobiology related science and work on terrestrial analogues to Martian environments.

1. Introduction

Mars Society Australia (MSA) has selected a site in the Lake Frome Plains near Arkaroola in the northern Flinders Ranges of South Australia as the location for an Australian MARS Analogue Research Station (MARS-OZ). It was one of six potential sites in the Australian Outback chosen by MSA during the Jarntimarra-1 expedition.

The preferred site offers a wide range of terrain types, with interesting and diverse geology, is relatively easy to access logistically, has outreach opportunities, and includes a number of localities previously studied as Mars analogues. Astrobiology research will be a key component of the research program to be developed for MARS-OZ. The station will provide a laboratory to study how humans will live and work on Mars, and will complement the research stations built or proposed by the Mars Society in Utah, Devon Island, and Iceland.

This paper will discuss the broad educational and outreach opportunities afforded by MARS-OZ in the astrobiology discipline.

2. Mars Society Australia

Mars Society Australia MSA is an incorporated non-profit organisation that is dedicated to promoting the exploration and eventual human settlement of the planet Mars. MSA is affiliated with The Mars Society, established in 1997 and based in Colorado, USA. Its technical program is based on Mars analogue research, looking at challenges and issues that would be similar or *analogous* to those encountered when sending humans to Mars. The idea behind this program is to develop an integrated field exercise in the Australian Outback known as Operation Red Centre or ORC. It will provide data for Mars analogue research and be a visible public demonstration of elements of a future human Mars mission.

3. Mars Analogue Research in the Australian Outback

Australia offers a number of advantages for Mars analogue research (Clarke, J. quoted in Laing 2002). Australia's red soil and rocky terrain provides visual similarities to a Martian landscape, an advantage capitalised on by many directors of recent films based on Mars, such as *Red Planet*. Features in the Outback have been identified that closely resemble those observed or anticipated on Mars, such as mound springs, thermal springs and fresh or salty discharge channels, and stream channels of infrequent mega-floods that also interface with sand dunes. Open stretches of land will allow unimpeded testing of the Starchaser Marsupial Rover in a variety of directions and terrains. Copious amounts of dust will allow testing of technology and dust control under these potentially hazardous conditions. Australia's ancient regolith (weathered rocks, groundwater, and sediments) and ancient eroded landscapes also provides a valuable analogue to those present on Mars.

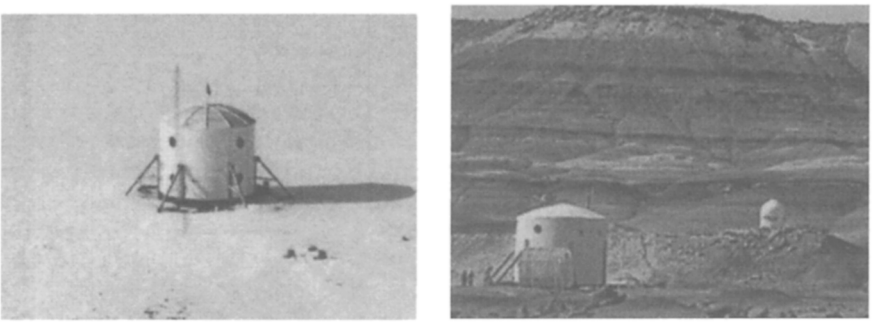

Figure 1. Flashline Arctic Mars Research Station (MARS) on the remote Canadian Devon Island (left) and Mars Desert Research Station (MDRS) in desolate Southern Utah (right).

4. The Mars Analogue Research Base (MARS) Project

The U.S Mars Society has raised US $1 million to fabricate, deploy and operate a series of human Mars mission simulation platforms around the world. These Mars Analogue Research Stations (MARS) (see Fig. 1), are located on Devon Island in the Canadian Arctic and Utah in the South-west of the United States. A third MARS (EURO-MARS) is planned for Iceland in 2003.

The MARS are designed to meet three specific goals:

- To help develop and allow tests of key habitat design features, field exploration strategies, tools, technologies, and crew selection protocols, that will enable and help optimise the productive exploration of Mars by humans.
- To serve as useful field research facilities at selected Mars analogue sites on Earth, that will help further our understanding of the geological, biological, and environmental conditions both on Earth and on Mars.
- To generate public support for sending humans to Mars, by informing and inspiring people around the world.

5. Astrobiology Links of the Arkaroola Site

Professor Malcolm Walter at Macquarie University and his team at the Australian Centre for Astrobiology have been undertaking astrobiology research at Mt Painter in recent years. Thermal spring environments are well known for their rapid mineral deposition, making them particularly suitable for the preservation of a microbial fossil record. These factors make hydrothermal deposits excellent targets for looking for fossil evidence of Martian life. Extremophiles in Paralana Hot Springs in the Arkaroola district are currently being studied for their analogue value as examples of life that may have arisen on Mars.

The Mt. Gee fossil hydrothermal system also shows potential for microfossil preservation (Clarke & Mann 2002) and has been used in remote sensing experiments, comparing hyperspectral infrared imagery from the Mount Painter

fossil hydrothermal system with data gathered from a hand-held spectrometer (Thomas, unpublished hons thesis 2000). These remote sensing techniques could be used to detect the presence of such systems on Mars.

Any future research plan for the MARS-OZ site can leverage off the existing Mars analogue research being carried out in the area. Mars hardware testing or integrated analogue simulation at Arkaroola could incorporate this real field science to help us understand how future Mars surface crews may need to explore for microbial fossil evidence, and what tools and procedures may be required.

6. MARS-OZ

Unlike the other Mars Society research stations proposed or built around the world, MARS-OZ is a horizontal biconic rather than a vertical "tuna can" design. The proposed habitat consists of a cylinder 12 m long and 4.5 m in diameter with a 6-m long upswept nose cone (Clarke 2002). The structure will have two decks, each with 2.1-m headroom, and will stand on four legs, fitted with skids to allow limited repositioning, 1.0 m above the ground. The upper deck will be used for living and working space, while the lower deck will provide personal sleeping, washing, and toilet facilities. The habitat itself is part of a larger complex; which will eventually include a simulated cargo lander, also of biconic design, inflatable structures and solar power systems (Fig. 2).

Fieldwork in the northern Flinders Ranges is most practical during April-October, because of the high temperatures during the Australian summer and early autumn/late spring. MARS-OZ may be initially inhabited for only four months of the year, with a field season gradually extending to 6 or even 8 months a year as the project gains momentum. As with MDRS and FMARS, crews would initially sign up for rotations lasting from 2 to 6 weeks long. Later in the program, longer duration missions may be contemplated, to increase the analogue value of research.

The MARS-OZ concept (Clarke 2002) proposes that honours students from universities and research institutions would work on the bulk of research projects associated with MARS-OZ. Their work could, in turn, link with research projects coordinated by their senior colleagues.

7. Educational and outreach opportunities for MARS-OZ

Space activities are acknowledged as a way of fostering interest and careers in science and technology among the young. It brings science alive to students, and opens their eyes to its practical application across multiple disciplines. Astrobiology could be made more real for people by emphasising its potential links to future human Mars exploration. Tools used in the field such as the PIMA hand-held spectrometer, could be demonstrated as a means to finding life on Mars.

Linking educational curricula and programs to MARS-OZ could allow primary and secondary students to study the astrobiology work being undertaken in the Outback and provide a focus for school excursions and field trips. Students could observe astrobiology experiments and data gathering in the field, and use it as a springboard to the study of life in the Universe. Schools such as Lucas

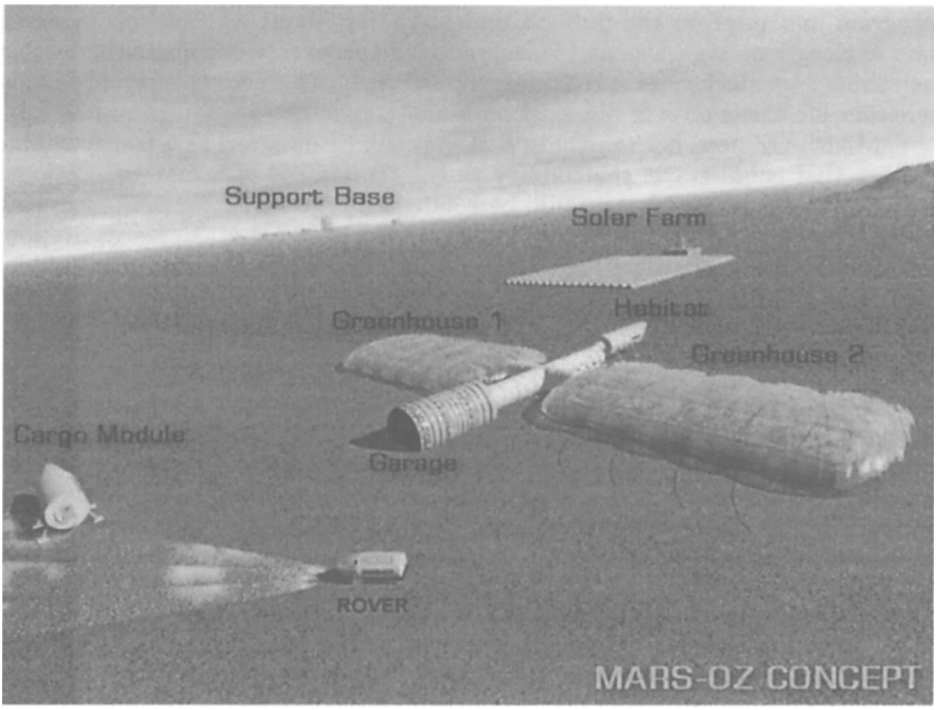

Figure 2. The MARS-OZ Concept (drawing by Jozef Michalek, MSA)

Heights Community School (Brown 2002) and North Sydney Girls High (Kumarich et al. 2002) in Sydney are already teaching astrobiology in the classroom as a context for motivating students in science.

Undergraduate and postgraduate student could also use the design and operation of MARS-OZ as a focus for their work in theses and dissertations. Universities whose work currently plays a role in the MSA Technical Programme include RMIT University in Melbourne, and the University of Sydney. The Software Engineering Support Centre at RMIT University is researching an infrastructure and tools that will support the work of a small group of researchers and explorers on Mars (TAMER project), while undergraduate students at the Faculty of Engineering at the University of Sydney have developed an analogue space helmet as an element of Project MarsSkin. There is scope for these types of projects to be broadened to encompass astrobiology research, such as further study of the Mt Painter hydrothermal system. Some of these students or their supervisors may require an increment on MARS-OZ to complete their research.

Media interest in the MARS-OZ concept has been high, with coverage in State and national newspapers, magazines and radio. MARS-OZ could capitalise on the recent headlines about the discovery of sub-surface water on Mars and speculation on the timeframe of sending humans to the Red Planet, to promote astrobiology as a field that is ripe with possibilities for finding life on Mars.

TV and video films, including documentaries, shot on location at MARS-OZ and with an astrobiology focus, would both raise revenue for the scientific

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program and improve the public's understanding about astrobiology research and exploration. Webcasts and videolinks could show crew members conducting astrobiology experiments and explaining why they may hold the key to finding whether life exists or ever did exist on Mars.

MARS-OZ need not remain in situ as it will be designed as a transportable facility that could travel the country as the centerpiece of a Mars educational exhibition. These roadshows could be conducted prior to deployment or during the off-season. There is a precedent for this, as the Mars Desert Research Station, was exhibited before its first field season at the Kennedy Space Center in Florida, and there plans to display the European Mars Society's E-Mars facility at the Chicago Planetarium before it is moved to Iceland.

8. The Future for MARS-OZ

Partnership and cooperative arrangements with educational institutions, sponsors, the Arkaroola resort owners and landowners, will need to be set up before MARS-OZ can be built and developed as a research base. International scientists and engineers paying to use the facilities at MARS-OZ might partly fund educational programs and government grants could be applied for in the areas of astrobiology education and outreach. These support mechanisms will need to be carefully investigated and incorporated into a detailed education and outreach plan, complete with costings, for MARS-OZ.

9. Conclusion

The proposed Australian Mars Analogue Research Station (MARS-OZ) to be built at Arkaroola offers a variety of opportunities for education and public outreach about astrobiology. The most likely candidates for life on Mars, whether past or present, are microbial, similar to extremophiles found in the Arkaroola region of South Australia.

Astrobiology research is likely to continue at Arkaroola for many years to come, and its space links, especially with a future human mission to Mars, will help to raise the profile of this work throughout the general community.

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