Jarntimarra

TITLE
Jarntimarra-1 Proposal

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ACTIVITY	SUB-UNIT
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Document outlining context, objectives, planning and proposed personnel for the first MSA scouting expedition. Target audience includes Mars Society personnel and Mars researchers.

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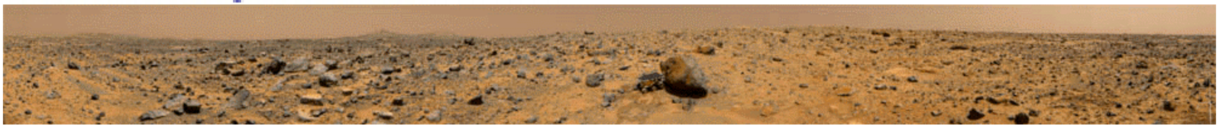
JNT Project Jarntimarra

MSAB MSA Board
MSAC MSA Council
MSAT MSA Technical
JNTC JNT Committee

Mars Society Australia



PROJECT JARNTIMARRA

Jarntimarra-1 Scouting Expedition

STEPS TOWARD MARS THROUGH THE AUSTRALIAN OUTBACK

CONTENTS

FIGURES

1 INTRODUCTION

This document outlines the context, objectives, planning and proposed personnel for the first MSA scouting expedition, Jarntimarra-1 (JNT-1).

1.1 DOCUMENT PURPOSE

This document is intended to:

1. Inform proposed expedition participants of project goals and current status with a view to an increased team effort targeting JNT-1 for September 2001,
2. Provide a generic basis for adapted documents tailored for a variety of target audiences,
3. Initiate a fundraising effort to support the expedition,
4. Strengthen the case for obtaining custody of the third Mars Analogue Research Station habitat/lander simulation facility by demonstrating concrete steps toward Australian field operations (e.g. Operation Red Centre 2002).

2 REFERENCES

Refer to MSA-TEC-MNG-STD-02-01-Glossary-ver1.doc for a Glossary of Terms. The Jarntimarra database is now available online at http://www.marssociety.org.au. This document should be read in conjunction with the Mars Analogue Research Station plan produced by The Mars Society, MSA-LIB-01-10-Analogue_Stations.pdf, which could be provided as a supplement when sending prospectus material to potential funding sources.

3 USE OF THIS DOCUMENT

This document provides a complete description of the Jarntimarra proposal. Distribution of this **Unrestricted** document in whole or in part is at the discretion of Mars Society personnel or those in the Mars research community.

4 INTRODUCTION

In August 2000, more than 30 years after the first human steps on the Moon, we took our first steps toward the planet Mars. On the remote Devon Island, in the face of a failed airdrop that rendered equipment and materials useless, a Mars Society team commissioned the world's first simulation platform representing the kind of lander/habitat spacecraft in which the first humans will touch down on the Red Planet. In doing so, they began to learn how human crews will live, work and explore on Mars.

To understand why it took a private non-profit international grass roots movement to do this, we must step back to understand the story of our fascination with the Red Planet.

4.1 WHY MARS?

The successful landing of astronauts on the Moon, Project Apollo, regarded by many as the seminal technical achievement of mankind, also heralded the beginning of a thirty year malaise at the new frontier. Rather than build on those first steps and press home the benefits awaiting a human presence beyond Low Earth Orbit (LEO), the United States space programme was swept up in the prolonged and only partially successful development of the Space Shuttle.

Yet the children of Apollo would not forget. For people all over the world inspired by the moon landings, Mars was the next destination. And a new generation, too young to remember, swelled this new "Mars underground". Mars became not only a measure of our mettle as a vital and forward looking civilisation, but a way to address degradation of the Earth by providing insight into the dynamics and evolution of a sister planet born from the same accretion process during the formation of the Solar System.

Tantalising glimpses of this strange world were captured by the Mariner 4 flyby in 1965 then by the twin Viking landers in 1976. Here was a potential new world for humanity, a place not to visit and abandon but to remain and prevail, a treasure chest waiting to unlock secrets of our own Blue Planet. Its surface appeared for all the world like the desert plains of central Australia. But this was a frigid desert, colder than Antarctica. And the atmosphere was vapour thin carbon dioxide, the very gas used by plants to produce oxygen.

Figure 1 Life, or evidence of life, may exist on Mars

Mars could have life, it could put beyond doubt the question of whether or not we are alone in universe. We have found organisms called *extremophiles* thriving in the most extraordinary places on Earth, indeed we have found nanometer sized entities (*nanobes*) kilometres within the crust that appear to be alive yet defy conventional biological definition. It is even possible that life on Earth originated from such depths, or even that life originated on Mars and was carried here by impact debris like some celestial taxi ride. Debate rages as to whether asteroids found on Earth such as ALH84001, of known Martian origin, contain evidence of this cross pollination.

What is more, Mars has water, frozen mainly at its poles. And where there is water, there can conceivably be life. Some scientists believe great oceans of liquid water once existed on Mars for long enough to allow the evolution of cellular organisms. If they are right, we should be able to find evidence of this extant life in a Martian fossil record.

Recent spacecraft such as Pathfinder have provided further insights, but raised many more questions. We see familiar geological features but paradoxically are at a loss to explain their origin. Channels have been carved by great outflows, but was the agent water or something else? Outbursts from ridges have recently come to our attention thanks to Mars Global Surveyor, but what created these? What secrets lie in the geologic record of the Red Planet?

With so many important questions, why then send robots to do a humans work? Only intuitive, dextrous, adaptable human crews can satisfy our curiosity and provide us with real benefits here on Earth by living, working and exploring on Mars. It seemed that in 1989, we were again on the cusp of making that next step. As part of the Space Exploration Initiative, NASA set to work planning a human Mars mission over 90 days. Yet hamstrung by too many cross purposes its plan was wholly inappropriate, and worse effectively scuttled any prospect of such a mission for the next decade.

Even so, recently the head of NASA during this period, Administrator Daniel Goldin stated he could envisage an international human Mars initiative by the year 2020. Evidently Mars will not be left to future generations, it will be scaled in our lifetime. This might not have been so if not for a small group of engineers who decided to challenge the status quo, think outside the box and draw on a wide range of ideas and technologies put forward by a variety of individuals and promoted by the Mars underground…

4.2 THE SMART WAY TO MARS

In 1991, a team at US aerospace firm Martin Marietta, now Lockheed Martin, re-examined the approach taken to Mars mission planning and proposed a landmark concept – *Mars Direct*. In 1994, NASA (effectively acknowledging its earlier errors) adopted Mars Direct as the core of a revised human Mars mission plan (the Design Reference Mission – DRM, now at version 3.0).

The central features of these plans include direct launch of payloads to Mars rather than via LEO assembly and most importantly, use of materials abundant on the Martian surface – In Situ Resource Utilisation (ISRU). Instead of carrying all the rocket fuel necessary to reach Mars and return to Earth in gigantic “Battlestar Galactica” spaceships, Mars explorers need only take with them enough fuel to reach the Red Planet, and a sufficient stock of hydrogen. The raw materials necessary for manufacturing return fuel already exist on Mars.

By employing an ISRU system already demonstrated in labs on Earth, based on a century-old chemical process, carbon dioxide extracted from the Martian atmosphere can be combined with hydrogen to produce enough fuel to power exploration vehicles and a direct return to Earth for the crew. In one stroke these central enabling features helped slash programme cost from the US$550 billion of the 1991 SEI 90 day study to around US$50 billion for NASA’s 1994 DRM (for scale, the current Australian GDP is approximately

US$450 billion, all figures in 2001 dollars). By exercising even greater design discipline, Mars Direct proposes to further halve the cost – US$25 billion or just 20% per annum of the yearly NASA budget of US$13 billion over a ten year period.

Unfortunately, with NASA efforts now consumed by the International Space Station (ISS), reminiscent of the Space Shuttle development during the 1970's, and pressure from recent robotic failures (Mars Polar Lander and Mars Climate Orbiter), plans for human Mars missions have been delayed. Although the ISS is seen by many Mars advocates as a misdirection of energy, it nonetheless points to a human Mars programme being international in nature. ISS pre-occupation creates an opportunity for others to seize the initiative, and for small nations like Australia to position themselves for the big game where jobs, export revenue, technological development and inspiration for our children will be up for grabs when the time comes.

And so we see how the journey to Mars has been a tortuous one of fits and starts. It is a story of uplifting vision and missed opportunities, good intentions and bureaucratic goal setting, inspired engineering motivated by poor design. And still, surveys show that the majority of people in developed nations believe Mars is our next great test, that we should go.

We return to August 2000 and the cold wind-swept crater high in the arctic circle on lonely Devon Island where the initiative was seized by a bold young private organisation. This set in motion a world wide programme in which Australia is playing an important part.

4.3 THE MARS SOCIETY

In 1997, widespread support for increased exploration of the Red Planet crystallised at a convention in Boulder, Colorado into *The Mars Society*. In some ways like the first visionary Rocket Societies that fuelled the early space programmes of Europe, heralding the space age, this new organisation brought together space scientists and engineers, professionals and enthusiasts committed to action encouraging and facilitating increased exploration and future human colonisation of Mars.

Led by its first President, Dr Robert Zubrin, principal architect of Mars Direct, the Society quickly raised around US$1 million in donations, grants and sponsorship to begin the first of several phases of escalating technical activities. The first phase, Earth bound analogue research, is intended to build up a knowledge base to improve planning of the first human missions.

How will crews explore the surface? How will they interact with each other, their equipment, the environment and with mission controllers in the face of such remoteness? There has been no sustained, integrated research programme attempting to address these kinds of issues and so mission planners have been forced to rely on outdated and inappropriate assumptions, at the expense of mission simplicity and economy.

4.3.1 International Mars Analogue Research Station (MARS) Project

The Mars Society Mars Analogue Research Station (MARS) project will spearhead this effort with establishment of simulated hardware platforms at four locations across the globe including Australia and Iceland. The Devon Island Flashline-MARS station (*Flashline*, an internet company, is the major sponsor) was deployed in conjunction with the NASA-led Haughton Mars Project (HMP). Since 1998 HMP has seen more than 50 Mars scientists from all over the world gather annually for two months at the ancient Haughton impact crater – an environment considered analogous in some ways to Mars – to field test hardware, science and strategies for exploring a planetary surface.

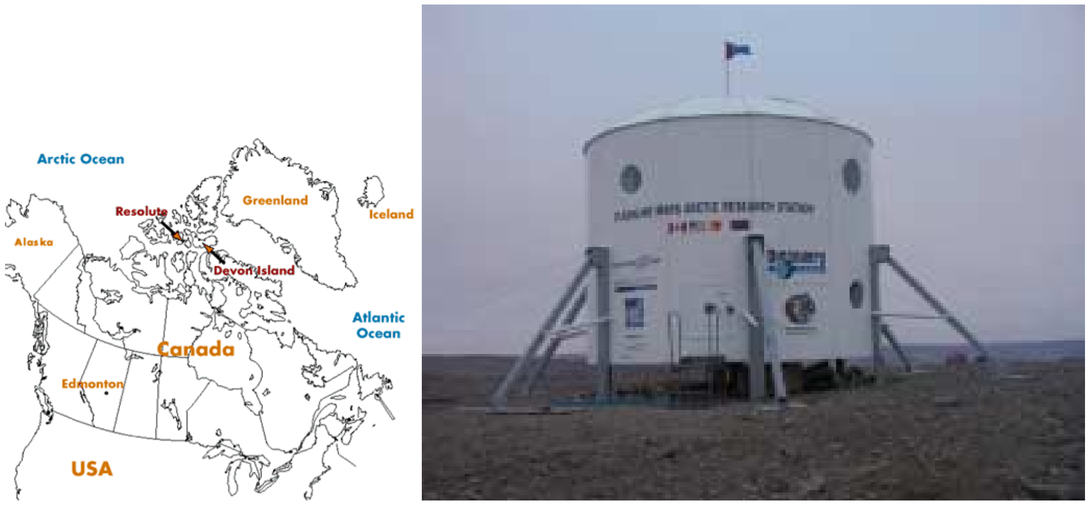


Figure 2 F-MARS after commissioning on the remote Devon Island in 2000

Flashline-MARS will be put through its paces in August 2001 during an intense 6 week field exercise with rotating crews chosen in an international selection process and including Australian born geologist Katy Quinn. Each will undertake a series of experiments relevant to Mars mission planning. Put under the same kinds of constraints expected on Mars, with analogue (i.e. *analogous to*) space suits and decompression periods for Extra-Vehicular Activity (EVA), this research will yield the first scientific harvest from the MARS programme.

A second station will be deployed in the south-western United States in the northern fall of 2002, following public display at the Kennedy Space Centre in Florida. This unit is similar in size to Flashline-MARS (a two story cylinder of diameter 8 meters), but only half its weight allowing deployment at multiple sites of interest over several years of research.

4.3.2 International Mars Pressurised Rover Initiative (MPRI)

In parallel, the Society has initiated a rover development project, involving three teams around the world constructing simulation platforms representing the kind of pressurised vehicle in which the first crews will explore the surface in a shirt-sleeves environment. Operation of these rovers in concert with analogue habitats will provide unprecedented insight into the range of design issues that must be addressed for real missions, whilst testing a variety of solutions.

Together, MARS and MPRI complement broad Phase 1 outreach initiatives of the Society, making Mars more real for more people everywhere. For many the Red Planet remains an abstract concept - the Society is bringing Mars to life, making it tangible and relevant. Rather than just a NASA budget line-item Mars is another world with all the raw materials to support a substantial human presence. Media coverage of Society activities has been extensive and is expected to grow as MARS and MPRI fully develop.

4.3.3 Future Phases

Phase 2, building on support garnered from Earth bound analogue activities, will reach for Mars initially with small, piggyback payloads. These will complement Mars scientific research and implement innovative technologies and approaches. They will demonstrate that Mars need not be the exclusive preserve of governments, that private activity can encourage greater innovation amongst public space programmes and make important scientific contributions in its own right.

Based on capabilities demonstrated in Phase 2, Phase 3 will seek to send people to Mars. A challenge not to be underestimated, nevertheless formation of partnerships with government and/or private corporations could see innovative approaches used to fund and implement a human mission programme. These include international lotteries and government backed prizes. Mars will come to be seen as the new frontier, the ultimate "extreme sport", a scientific imperative for better managing our deteriorating planet, and an insurance policy against catastrophic impact from a rogue asteroid or comet.

4.4 AUSTRALIA'S ROLE

Australia is playing a major role in this programme. The Mars Society, Australia (MSA) was one of three teams (including the University of Toronto/MIT and the University of Michigan) chosen as part of the MPRI to develop a Mars pressurised rover simulation platform. As part of *Project Marsupial*, MSA will create a family of all terrain exploration vehicles.

The *Human Operations Prototype* (HOP) is currently being built in Brisbane and will incorporate and test a novel dust containment EVA mechanism, amongst other design features.

A third research station is in fabrication in the United States, and MSA is working to secure custody of this facility. If successful, the US$150,000 *Mars-Oz* (Mars Australian Research Station), together with the HOP, will be placed on public display as part of a AU$4 million national touring "Space Exploration Exhibition" commencing at the new Museum of Australia in Canberra in October 2001. Estimates suggest exposure to as many as 1 million Australians over the 12 month duration of the exhibit as it moves amongst the capital cities.

Figure 3 MARS architect Frank Schubert and Society President Robert Zubrin with the second habitat (l), shown at the Kennedy Space Centre (r) prior to deployment in a Utah desert

MSA has initiated two additional analogue hardware projects, *SAFMARS* and *Mars Skin*. The former is developing portable ground stations allowing message-based communications between remote field crews and an online mission control. The Store and Forward Mars Analogue Research System will test protocols and technologies analogous to the kind of lightweight microsatellite system planned for use on the Red Planet to provide low level communications and service remote autonomous science stations.

Mars Skin is developing a series of suits analogous to the innovative Mechanical Counter Pressure (MCP) suit demonstrated for NASA in the 1960's. Surprisingly little interest has been shown in this concept over the past three decades, although in recent years Honeywell have received limited NASA funding to re-visit the concept (unfortunately continued funding seems doubtful). The MCP employs elastic garments rather than internal suit gas pressure offering the wearer greater flexibility and dexterity, reduced energy expenditure and reduced life support requirements while working in a near-vacuum environment. MSA believes there is merit in the MCP concept and plans to lead a resurgence of interest in their use on Mars by developing and testing analogue units.

This work is providing Australians with opportunities to participate in the greatest exploration initiative of our lifetime. MSA also aims to partner with local firms to facilitate the development, testing and marketing of niche technologies with untapped applications for future Mars missions. This scheme will focus on areas in which Australia already excels, for example renewable energy, waste regeneration, satellite communications methods, and mineral exploration, to name but a few.

Australia has no space programme, nor any real space commitment compared with many similar nations. This is despite an abundance of comparative advantages. MSA is working with its international partners to undertake a comprehensive, world-first Mars analogue research programme. By-products will include even greater international and national media coverage, and a clear demonstration that Australia can get into space without ever leaving the ground. We needn't be just a launch or even landing pad for the space vehicles of others – as the custodian of an entire planetary continent we are ideally placed to lead planetary surface exploration efforts and play a significant role in the journey to Mars.

5 OPERATION RED CENTRE

In the southern spring of 2002, we plan to bring all these projects (Marsupial, Mars-Oz, SAFMARS and Mars Skin) together for the first major Australian Mars analogue field exercise – Operation Red Centre 2002 (ORC02).

For years visitors to the Red Centre of Australia have marvelled at its likeness to Mars, and recent motion pictures have used location footage around areas such as Coober Pedy to portray the Red Planet. This visual analogy is strengthened by past and present studies of particular locations that take the similarity a step further. Features have been identified that bear close resemblance to those observed or anticipated on Mars.

Figure 4 Aerial view of the Henbury Craters, near Alice Springs

The *regolith* (or surface material) of central Australia bears visual and compositional likeness to Mars regolith with an abundance of oxidised iron-bearing minerals. Although

Mars has the largest volcanoes, mountains and canyons found in the Solar System, its surface on average is predominantly flat, rock strewn desert peppered with impact craters retaining a record of early formation more than 3.8 billion years ago. Geomorphologic similarity, particularly between the northern lowland plains and central Australian deserts has been the subject of a number of studies.

Australia has been of interest to manned mission planners for some time. The Henbury Craters, near Alice Springs, were studied extensively by the United States Geological Survey (USGS) in the 1960's as part of the Apollo programme. In recent times, dunes and erosional features of the Strezelecki Desert and alluvial flood plains of Hale River have been analysed as analogues of features evident in data captured by the Global Surveyor Mars Orbiting Camera (MOC) and Mars Orbiting Laser Altimeter (MOLA).

NASA has funded astrobiology research in Australia for the last decade. Recent field work has focussed on ancient hydrothermal spring formations at Mt Painter in the northern Flinders Ranges where the search for metallurgical evidence of past microbial life is regarded as analogous to the search that will be needed on Mars. This work has included use of the Australian-invented PIMA infra-red spectrometer for characterising hydrated minerals and correlating ground measurements with satellite imagery. This technology is ideally suited to searching for telltale signs of extant life from Mars orbit or on the surface by the first crews.

Despite this activity and world class research by Australians in related fields, the potential of the Red Centre as a hunting ground for Mars analogue science and a simulation stage remains largely unrealised. Some activities that could exploit unique features of arid inland areas include:

5.1 FREE RANGING INTEGRATED MISSION SIMULATIONS

Free-ranging mission simulations would use a suite of realistic analogue hardware and logistics (e.g. communications) as dress-rehearsals for Mars missions. Central Australia provides one of the best free-range Mars analogue field stages in the world.

The first human crews to Mars will be equipped with rover vehicles allowing exploration out to 100's of kilometres. The useful range of polar analogue field sites (analogous to Mars primarily by virtue of their barren isolation, hostile climates and cold temperatures) is restricted for a number of reasons, while analogue crews could roam freely across vast swathes of the Red Centre. The fidelity of simulation is improved through visual similarity, and crews could explore for days without any hint of a human presence or hazards such as crevasses.

The NASA DRM3.0 eschews the use of artificial gravity for crews travelling to and from Mars. This raises the question, how will crews function after long term zero gravity exposure upon landing? Although many believe the use of artificial gravity by spacecraft rotation is feasible and desirable, to help develop mitigation strategies and technologies for the zero-g option we could expose astronaut subjects to 6-8 months of micro gravity on the ISS (the duration of an Earth-Mars transit), then promptly have them undertaking Mars field simulations in the Red Centre over several months to observe productivity, functionality, psycho- and physiological responses.

Other points to note include the stable political situation, proximity to infrastructure and modern services and access to a scientific community with detailed knowledge of the arid environments. Although there are several places around the world that each offers its own set of features analogous to Mars - and that would be used for aspects of mission training -

few are as well suited as Australia to fully integrated dress rehearsals in the decade leading up to the first human launch.

These possibilities create a need to identify a handful of localities that could serve the purpose, encompassing a wide range of interesting features, with particular attention given to land ownership and access issues.

Figure 5 NASA Ames Engineer Larry Lemke at F-MARS on Devon Island in 2001

5.2 HARDWARE TESTING

For similar reasons, the Red Centre provides a variety of local terrain types suitable for field testing a range of mission hardware items. With just enough isolation to enforce appropriate Mars-like constraints, yet within relatively ready reach of infrastructure and services, these sites could be used by international researchers wanting to prove the functionality, durability and usability of multi-million dollar development programmes leading up to the first human missions.

MSA will use these localities in collaboration with international members of The Mars Society to field test Marsupial rovers, Mars Skin suits and SAFMARS ground stations outside integrated operational campaigns.

This creates a need to seek, characterise and catalogue a larger number of more localised sites, building up regional knowledge and contacts to facilitate more nimble field operations. Ideally some of these sites will be of scientific analogue interest, where hardware can be tested in real scientific research. Others will be largely visual and operational analogues useful for engineering research.

5.3 PROSPECTING AND SURVEYING

All of this field simulation entails a good deal of surface exploration, and probably subsurface drilling. Much of the Red Centre has rarely seen human footprints. This provides a fertile hunting ground for a range of scientific activities to capitalise on field time. These include studies in the disciplines of geology, palaeontology, and atmospheric science.

In scientific terms, the primary objective will be to explore local environment as analogues of Mars. This could involve obvious (e.g. fossil) or more obtuse prospecting. For example, recent discovery of a Mars meteorite in Oman (despite oxidation and weathering in the harsh desert environment) offers encouragement that similar artefacts await discovery in the Red Centre. Such serendipity during hardware testing or mission simulations would be ironic and of great public interest.

A secondary objective for all field work would be to contribute to terrestrial science, for example, by co-operating with the environmental departments of State and Territory governments in flora and fauna surveys. Although field crews will be drawn predominantly from the disciplines listed above, vegetation and fauna will be unavoidable in the Red Centre. It will be important to replicate as closely as possible the workload demanded of human Mars crews, as well as maximising the scientific harvest to help build a wider base of support for field operations., for example by forging links with government departments.

The need therefore exists to develop a complete understanding of past and present field research carried out in the Red Centre in all disciplines of interest.

6 PROJECT JARNTIMARRA

The fifth MSA project, *Jarntimarra* (meaning "star" in the Aboriginal Warlpiri language of central Australia) will address the needs identified in the previous subsections by developing a comprehensive database of localities of interest for analogue research.

6.1 DATABASE

Version 1 of this database has been developed, with example entries in **Error! Reference source not found.**. The purpose is to:

1. Provide a list of localities of interest for Mars analogue activities,
2. Provide comprehensive information for these localities, to help Mars researchers assess the value of these to their activities and facilitate their use for analogue research,
3. Demonstrate pro-active leadership by MSA and strengthen its scientific credentials with a view to establishing closer links with organisations planning Mars missions,
4. Provide a basis for locality selection for MSA field operations

Eventually, MSA will deploy this database in a functional online version with password access for licensed users. It will be expanded to include Mars analogue sites from all over the world, as an asset and tool for The Mars Society. Users of the service are expected to include the major space agencies such as NASA as well as University researchers from around the world, with the aim of increasing field trips to analogue areas such as Australia by international scientists.

6.2 JNT-1, THE FIRST MSA FIELD EXPEDITION

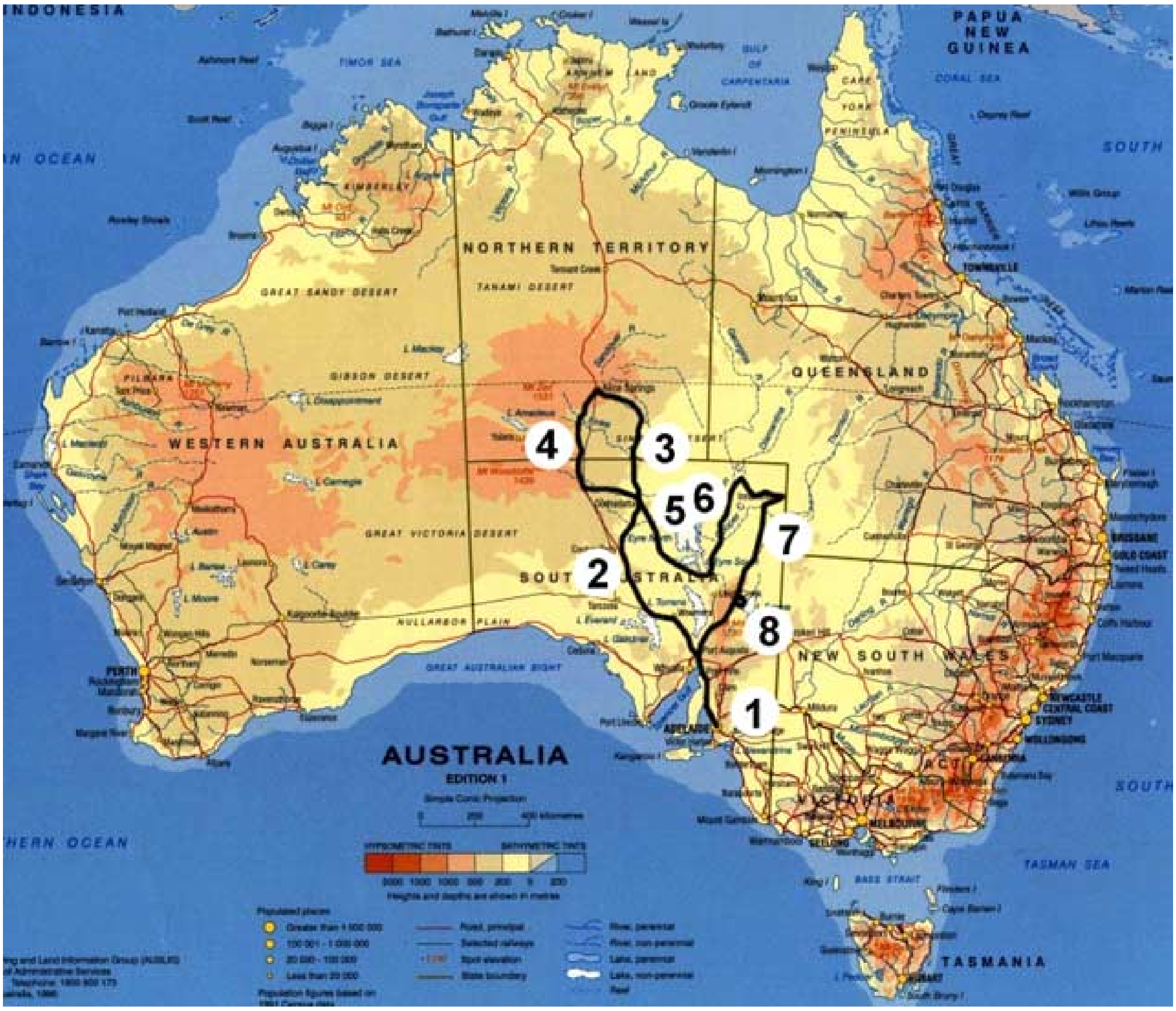


Figure 6 Planned route for JNT-1

In the southern spring of 2001, MSA will undertake a scouting trip through the Red Centre, *Jarntimarra-1* (JNT-1). Objectives (in order of priority) are to:

1. Demonstrate a commitment by MSA to establishment of Mars-Oz in Australia, to The Mars Society Steering Committee of MSA, with a view to securing earliest delivery of the third habitat unit in fabrication for display in the major national travelling “Space Exploration Exhibition” and subsequent deployment for ORC02,
2. Identify a locality suitable for initial placement of Mars-Oz and the ORC02 field campaign,
3. Build contacts and local knowledge in the chosen location to facilitate ORC02,
4. Mobilise a core group of Australian scientists as part of an ongoing effort by MSA to facilitate communication and build bridges amongst the local Mars research community,
5. Survey localities in central Australia for entry in the Jarntimarra database, collecting images and recording observations and measurements (and where appropriate taking samples for characterisation) with a view to future field exercises,
6. Build contacts and local knowledge around these various localities to facilitate future field activities,
7. Demonstrate field activity to members, increasing retention and adding value to MSA membership,
8. Raise the public profile of The Mars Society and alerting the scientific community to our objectives.

7 THE EXPEDITION

Table 1 Itinerary

Primary Waypoints	Outline
1	Adelaide. A convoy of four 4WD vehicles containing the 7 person support party, equipped with radios, GPS, food, camping and emergency equipment (e.g. EPIRB) will arrive from Nhill in Victoria to pick up members of the technical party, some flown in from various cities.
2	Coober Pedy. The group will visit The Breakaways, Painted Desert and Moon Plain areas. The area is very prospective in terms of fossiliferous rock and as a free ranging Mars simulation locality.
3	Oodnadatta. And northward to Dalhousie. On the way, Pedirka provides some of the roughest, stoniest, barest country seen. The Witjira National Park surrounding Dalhousie provides additional stony landscapes. Views of the western side of the Simpson Desert. Possible visit to Todd River.
4	Reprovision at Alice Springs. Visit Henbury Craters. Travel across to Oodnadatta
5	South along Oodnadatta Track to Maree via Mt Anna, Mt Toondina and William Creek.
6	Sturt Stony Desert. Viewing bare claypans, dry lakes, dune systems, stony plains, the Mingerannie Gap, and sand hills. Artesian bores will be examined and possibly sampled. This is a highly prospective area for free ranging analogue field work.
7	Innamincka. The trip to Innamincka will allow viewing of the Cobbler Desert and areas around the town that may be suitable for future analogue activities.
8	Arkaroola. Doug Sprigg, son of Reginald who founded this tourist resort in the Gammon Ranges, will host the group at an 18 bed homestead. Prof Malcolm Walter will join the expedition for 1-2 days and will provide a site tour of Mt Painter. Doug Sprigg may fly some members of the technical party on an aerial survey of the region and the remaining time will be spent identifying a suitable location for Mars-Oz and ORC02. The group will participate in astronomy sessions in the evenings at the Arkaroola observatory and the technical party will give presentations on their Mars research interests.

JNT-1 will be 13 day working field excursion through the arid and ancient terrains of the Red Centre from the Northern Flinders Ranges in South Australia to Alice Springs in the Northern Territory. The trip will enable a specialised team of scientists and engineers including geologists and astrobiologists to inspect Martian analogue sites, evaluate and compare them, and compile data and images for entry into the Jarntimarra database.

Time slots for each locality will be flexible, allowing the most promising sites to be studied in greater detail, with time on site for less suitable areas reduced. A key focus of the trip will be to find an area with as many Mars-like attributes as possible.

7.1 ARKAROOLA – AN ASTROBIOLOGY LINK

The Arkaroola area is a prime target for location of Mars-Oz and ORC02 for a number of reasons, including:

7.1.1 Subject of NASA funded field research

Technical party member Professor Malcolm Walter and research assistant Matilda Thomas have been undertaking astrobiology research at Mt Painter in recent years. The connection between life on Earth and hydrothermal environments is considered strong and significant.

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.

Mars hardware testing or integrated analogue simulation (e.g. ORC02) could incorporate this real field science to help us understand how future Mars surface crews may need to explore for microbial fossil evidence.

7.1.2 Local infrastructure and support

Support from the Sprigg family (founders of Arkaroola) and the availability of local services supported by a tourist market provides a local base to help with Mars-Oz maintenance, security and ORC02 land access issues.

7.1.3 Tourist and education potential

Being only a few hours drive from a major capital city (Adelaide), Arkaroola and its surrounds provide a good balance of difficult terrain with ease of general access. Together with the tourist focus of the resort station and local interest in space and geology (Doug Sprigg is a diesel mechanic and avid amateur geologist and astronomer and operates the observatory), potential exists for tourist and educational tours of Mars-Oz once deployed. This may provide a source of revenue or compensate the Sprigg family for any costs incurred in providing assistance to the Society.

7.1.4 Diversity of terrain

Although the Mt Painter area is vegetated with low lying shrubs, it is possible that more barren areas to the east, adjacent to Lake Frome may provide a diversity of terrain and allow free-ranging ORC02 exercises with greater visual similarity to Mars. A goal of the expedition is to explore this possibility.

7.2 METHODOLOGY

One geological target on this field expedition will be meteorite craters, which are an abundant feature on Mars. Older rock units are generally overlain by younger deposits. If there was a time in Mars history when the climate was warmer and wetter, any remaining evidence is probably covered by more recent layers, and thus cannot be seen from the surface. This makes impact craters useful to study because they can provide a cross section through sediment layers to the underlying material.

Other features include dune and alluvial flood plain systems. Using aerial photographs and remotely sensed data as a basis for further investigation, the science team will be able to guide the expedition to areas of interest for closer study. Maps of each prospective site could be produced which will include a recommended location for a habitat and suggested paths of vehicle travel to exploration sites, such as hydrothermal deposits within rover range.

Although primarily a reconnaissance mission, various rock, soil and other samples will be collected for study and analysis. Of particular interest will be determining sediment mineralogy and particle sizes for a comparison with the Martian regolith. Other field measurements are likely to include strata thickness in craters, slope measurements and dune heights for rover testing suitability. The following scientific tools may be used:

- compass and clinometer
- GPS
- thermometer
- topographic and geological maps of each area

- airphotos (preferably stereo-pairs) and/or satellite pictures of each area
- drawing paper, tracing paper, pens/pencils
- measuring pole
- tape measure
- sample bags and containers
- textas for marking samples
- geopicks
- sledgehammer
- chisel and mallet
- trowel and shovel
- digital camera and discs

7.3 PROPOSED PARTY

7.3.1 Technical party

The technical party will involve some of Australia's leading scientists and engineers in Mars related research. Table 3 outlines biographical data for each proposed member. Dr Carol Stoker and Dr Larry Lemke, both of NASA Ames Research Centre will participate. The team will harness significant local and international expertise in planetary geology, geomorphology, palaeontology, astrobiology, and engineering. The full trip technical party will number six, to be supplemented on the Arkaroola leg by three members.

7.3.2 Support Party

Mr John Deckert from Westprint Heritage Maps in Nhill, Victoria will assemble and lead the support party which will provide vehicles, food and other equipment. John has been travelling through outback Australia for more than 25 years, with a particular interest in European exploration and early pioneering.

He was director of an outback tour company specialising in tours of the Simpson Desert and in 1990 was contracted by National Geographic to act as a guide for a Simpson Desert expedition by a two man team from the United States. He also helped develop the first tourist map of the Simpson Desert. John currently writes a regular column for 4WD Overlander magazine.

7.3.3 Others

An Auxiliary Party of at least 4 people will accompany the expedition, including journalists and a documentary maker.

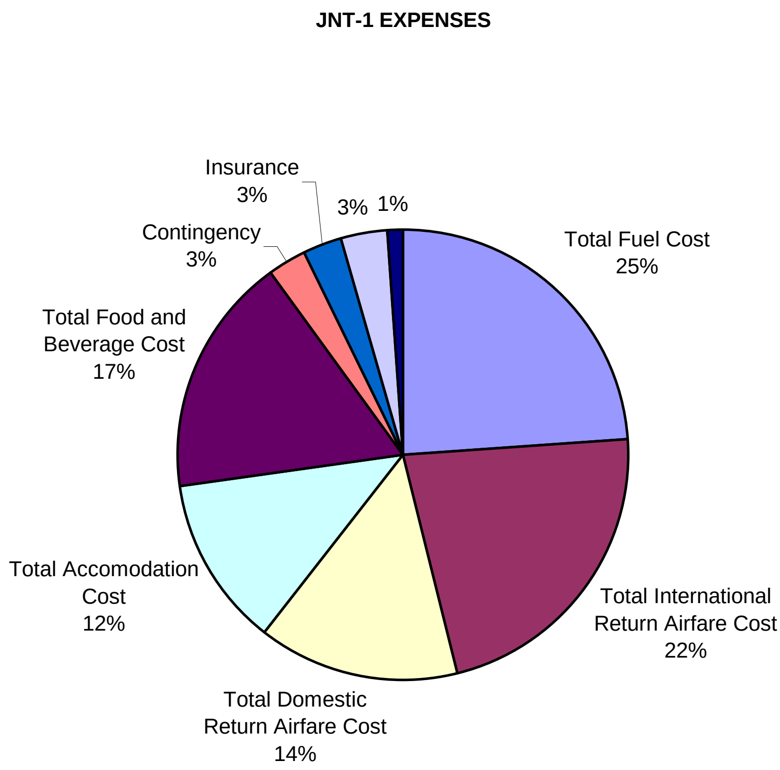
7.4 BUDGET

The following budget estimate is based on a support party of 4 vehicles and 17 people on the full route. Camping is assumed for all other nights, although party members will be free to upgrade their accommodation at personal expense where available. All figures are in Australian dollars.

Table 2 Budget Estimate

Item	Cost	Units
Total Distance	6000	km
Fuel Cost Rate	$0.18	/km/vehicle
Total Fuel Cost	$4,320.00	
Total International Return Airfare Cost	$4,000.00	
Total Domestic Return Airfare Cost	$2,600.00	
Accommodation for International Guests	$600.00	
Accommodation Rate on trip	$9.38	/person/day
Total Accommodation Cost	$2,193.75	
Food and Beverage Rate	$14.00	/person/day
Total Food and Beverage Cost	$3,094.00	
Other	$200.00	
Subtotal	$16,407.75	
Contingency	$500.00	
Insurance	$500.00	
Grand Total	**$17,407.75**	

Figure 7 Breakdown of expenditure



7.5 SCHEDULE

The expedition will leave Adelaide on the morning of **Saturday 27 October 2001** following a breakfast launch with media. It will return on the evening of **Friday 9 November** following the Arkaroola leg.

Table 3 JNT-1 Technical party

Details	Biodata	Photo
NAME Dr Carol Stoker **POSITION** Research Scientist **ORGANISATION** NASA Ames Research Centre	Dr. Carol Stoker is a planetary scientist in the Space Sciences Division at NASA Ames Research Center, Moffett Field, CA. She received her PhD in astrogeophysics from the University of Colorado in 1983. At NASA since 1985, she has done theoretical and experimental research on a variety of problems related to the origin, evolution, and search for life in the solar system. She is actively involved in planning for robotic and human exploration of Mars. Since 1990, Carol has led a NASA Ames project to develop telepresence and virtual reality technology for mission operations and scientific visualization to enhance control of mobile rovers on the surfaces of other planets. This work has focused on using telepresence-controlled scientific exploration vehicles to perform field studies of space-analog environments on the Earth. She was a participating scientist on Mars Pathfinder where she has provided a three-dimensional interactive virtual reality model of the Pathfinder landing site as an enhancement to science operations. Carol previously worked with the Voyager imaging team for the twelve year mission of exploration of the outer solar system where she studied the atmospheres of the outer planets. She edited *Strategies for Mars: A Guide to Human Exploration,* (1996) the most up-to-date and useful of several books related to Mars exploration outlining the rationale, technology assessment, and political analysis of the endeavour with historical perspective.	
NAME Larry Lemke **POSITION** Research Engineer **ORGANISATION** NASA Ames Research Centre	Prior to completing degrees in aeronautics and astronautics from Stanford University, Larry completed degrees in physics and in psychology. He is an engineer with the NASA Astrobiology and Space Research Directorate at Ames Research Centre in California. He is currently the Special Assistant for Strategic Planning, responsible for defining, acquiring, and managing advanced space and astrobiology missions, with emphasis on Mars exploration. Previously, he was Chief of the Advanced Projects Branch of the Space Projects Division, responsible for supervising activities of professional staff in execution of the center's programme of defining, acquiring, and executing advanced space missions. Projects included planetary science, life science, Earth orbital, and hypersonic flight missions. Also, he has been individually responsible for conceiving and leading advanced space mission studies within Space Projects Division.	

Details	Biodata	Photo
NAME Dr Vic Gostin **POSITION** Associate Professor **ORGANISATION** Department of Geology and Geophysics, University of Adelaide	A graduate of Melbourne University, and a Ph.D. from ANU, Canberra, Vic has been actively interested in geology and astronomy since his high school days. He has lectured in geology at Adelaide University for 31 years. His has wide research interests including sedimentology, environmental geology, planetary geology (especially of Mars), meteorites and meteorite impacts. In 1985 he identified a unique layer in the ancient rocks of the Flinders Ranges formed by a giant meteorite impact splatter. This extensive layer was derived from Australia's largest meteorite impact at Lake Acraman (Gawler Ranges), and this exciting discovery turned his attention to the study of meteorites, the effects of giant impacts, and to planetary geology. As a result he has been honoured by having an asteroid named after him. He has recently compiled a book dealing with Australian environmental geoscience.	
NAME Dr Jonathan Clarke **POSITION** Researcher **ORGANISATION** CRC for Landscape, Environment and Mineral Exploration, Australian National University	Jonathan is a geologist with experience in the mineral and petroleum industry, academia, and in government surveys. He has worked in every state of Australia. mostly in the arid interior. In addition he has practiced geology in New Zealand, the Philippines, and the Atacama desert of northern Chile, one of the most Mars-like areas on earth. He presently works for the CRC for landscape, Environment, and Mineral Exploration (LEME), studying the history and evolution of the Australian landscape. Current research interests include: history of aridity in the Atacama desert, the distribution of biogenic opal in the regolith, the palaeogeography of the Nullarbor sea during the Eocene, and the evolution of the landscape of the SE Yilgarn in WA and SW Gawler craton in SA. Jonathan has written approximately 40 scientific papers. Other interests include theology, scuba diving, bushwalking, caves, maritime history, space history, and reading science fiction.	
NAME Dr Mark Bishop **POSITION** Lecturer of Digital Geomorphometry **ORGANISATION** School of Geoscience, Mining and Civil Engineering, University of South Australia	Mark is an expert in remote sensing and has researched Martian geomorphology for his M.Sc. His Ph.D. dealt with arid zone geomorphology concentrating on desert dunes and yardangs in the Strzelecki Desert, known to be analogous to features found on Mars. His work was presented to NASA Jet Propulsion Laboratory.	

Details	Biodata	Photo
NAME Dr Graham Mann **POSITION** Senior Lecturer **ORGANISATION** Murdoch University, School of Information Technology	Graham is an engineer at Murdoch University, specialising in robotics and human-machine interactions. After taking a psychology degree and doing research in psychophysiology at the University of WA's Biofeedback Laboratory, he moved the the University of NSW in Sydney, to study a Master's degree in cognitive science and later a PhD in artificial intelligence. He has designed and built a number of innovative robots, including a walking biped and a domestic floor-cleaning machine. During this time he worked with NASA scientists from Ames Research Centre on assement of robots for planetary work and an invited seminar on the Deep Space One automated probe. His presentation to the 1999 Space Frontiers Conference advocated the view that both humans and robots have important, complementary roles in space exploration.	
NAME Prof. Malcolm Walter **POSITION** Director **ORGANISATION** Australian Centre for Astrobiology, Macquarie University	Malcolm Walter is Adjunct Professor of geology at Macquarie University in Sydney, Director of the Australian Centre for Astrobiology based at that university, and Director of M. R. Walter Pty Ltd. He has worked for 35 years on the geological evidence of early life on Earth, including the earliest convincing evidence of life. Since 1989 he has been funded by NASA in their "exobiology" and "astrobiology" programs, focussing on microbial life in high temperature ecosystems, and the search for life on Mars. During 1999 his book "The Search for Life on Mars" was published by Allen & Unwin. Professor Walter has published more than 100 articles and several other books. He also works as an oil exploration consultant and a consultant to museums, and is currently curator of a special Centenary of Federation Space Exploration Exhibition.	
NAME Jason Hoogland **POSITION** Doctoral student **ORGANISATION** Centre for Hypersonics, University of Queensland	Jason is a PhD student in Mechanical Engineering at the University of Queensland. His Doctoral thesis is investigating the aerothermodynamic influence of pyrolysis injection on ablative super orbital entry heat shield flowfields. This involves simulation using scaled models in the new X3 expansion tube at the Centre for Hypersonics, one of the worlds fastest “wind tunnels”. Prior to this he worked as a Graduate Engineer with Robe River Mining Company, based in Perth. This involved R&D on vibrational removal of fines from lump iron ore, and design and management support for a AU$9 million Lump Rescreening Plant. Jason has a BE (mech, Hons) from the University of Western Australia and a BSc (physics) from the University of Melbourne. He developed the Mars Society Australia technical programme, and is MSA Technical Director. He is also active in the Institution of Engineers, Australia.	

Details	Biodata	Photo
NAME Matilda Thomas **POSITION** Research Assistant **ORGANISATION** Australian Centre for Astrobiology, Macquarie University	Matilda is a research assistant with the Australian Centre for Astrobiology (ACA) which was recently affiliated with the NASA Astrobiology Institute based in the US. In 2000 she completed an honours degree in geology at Macquarie University on the hyperspectral analysis of ancient hydrothermal deposits, making her Australia's first astrobiology graduate. This work involved collaboration with CSIRO's Mineral Mapping Technology Group and examined the application of hyperspectral mapping techniques. She compared the ancient hydrothermal deposit at Mount Painter, her field study area in the rugged Northern Flinders Ranges of South Australia, with possible Martian analogues. Matilda has also worked as a research assistant in the field of satellite communications and remote sensing for the Space Exploration Exhibition. Matilda has extensive experience as a caver and rock-climber in Australia and New Zealand.