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SENATE INQUIRY INTO THE CURRENT STATE OF AUSTRALIA'S SPACE SCIENCE & INDUSTRY SECTOR

MARS SOCIETY AUSTRALIA SUBMISSION

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SUMMARY

Mars Society Australia strongly supports an expansion of the Australian space sector. In believe this should include a component devoted to space exploration as well as space applications. It is our view that this would provide Australian scientists with exciting and challenging new research opportunities, Australian industry with new challenges to develop advanced technology, enable Australia to influence global developments in space governance, and inspire new generations of students with the possibilities of playing a part in the exploration of the solar system and using this knowledge to the benefit of Australia..

INTRODUCTION

Mars Society Australia Inc. (MSA) welcomes the opportunity to make a submission to the *Inquiry into the Current State of Australia's Space Science & Industry Sector.* We believe, as stated by Senator Chapman in his 2006 White Paper (http://www.senatorchapman.com/SPAG.pdf), which stated that enhanced space activities should be a national priority for Australia. With him we note with concern that Australia is one of the very few OECD countries without a space program or even a national space office. Despite this, as clearly shown in the Australian Academy of Science's report to COSPAR on Australian space research in the period 2004-2006 (http://www.science.org.au/natcoms/cospar2006.pdf), Australia has an impressive contribution in this field. It is our contention that Australia can have a much greater impact if with work was carried out within a context where space is included among Australia's national priorities.

MSA is a not-for-profit body incorporated in WA and with approved research institute status under Australian taxation law (http://www.marssociety.org.au/). Our goals include: broad education and outreach to instil the vision of pioneering Mars, support of more active government funded Mars exploration programs around the world, conducting Mars research and development on a private basis. and encourage Australian participation in Mars-related education, industry and government projects. Further details on Mars Society Australia and its activities are contained in the appendix to our submission.

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While MSA as an organisation is focussed on Mars, we recognise that for Australia to play a larger role in Mars exploration there must be a greater emphasis on, and more opportunities for, space research and development generally and planetary science in particular. Therefore we endorse the recommendations of the Academy of Science's Decadal Plan for Space Science to achieve this goal. It is our opinion that if Australia follows these recommendations that there will be more opportunities and capabilities for Australia to contribute to an exciting range programs and projects specifically related to Mars research and exploration and build on existing capabilities and achievements through the 21st century .

In our submission we will focus on aspects that are related to capabilities as they pertain to planetary exploration and science in general and Mars in particular. These are topics A(i) and A(ii), B(ii) and B(iv), and C, as laid down in the call for submissions on the Inquiry web page. The remaining topics (B(i) and B(iii) we leave to be addressed by the other stakeholders in Australian space science and technology who have specific interests in these questions.

A. AUSTRALIA'S CAPABILITIES IN SPACE SCIENCE, INDUSTRY AND EDUCATION

(i). Existing Australian activity of world-class standard

In the Apollo era Australian scientists built up a considerable reputation for being in the forefront of understanding the nature and origin of the Moon through the contribution of scientists such as Prof. Ross Taylor, Prof, Ted Ringwood, Prof. David Green, Dr. Brian O'Brien, and others. Almost all of these researchers were at the start of their careers but had the opportunity to play a leading role in analysing samples and other data brought back from the Moon.

Australia still has many leading scientists in the fields of geology, geophysics, geomorphology, palaeoclimatology, and palaeontology, with interests in the formation and early history of the Earth and life and long term environmental change and evolution. Many of these are interested in applying this expertise to understanding other planets in the solar system, including Mars. Their ability to have as high of level impact as that which occurred during the Apollo era is, however, hampered by the difficulty of Australian researchers becoming become part of the primary research teams of space missions and gaining access to often proprietary software to process the data. This is a deeply frustrating and unsatisfactory situation for those concerned.

Despite this, Australian scientists in the Australian Centre for Astrobiology (formerly Macquarie, now University of NSW http://aca.mq.edu.au/), the Planetary Science Institute at the ANU (http://www.mso.anu.edu.au/PSI/), as well as several in other institutions or associated with MSA, continue to publish research of international significance on Mars and other planets and satellites of the Solar System. More work could be done by such researchers through existing funding arrangements were space science were to be made one of Australia's science priorities. This would not only prevent many Australian graduate students seeking to continue their careers overseas but would also attract promising researchers to Australia.

While not a capability as such, Australia has a unique natural endowment of features of considerable interest as analogues to features found on Mars, and of processes thought to operate, or have operated, on that planet. Examples include:

- The rocks of the "North Pole" region of the Pilbara Craton in Western Australia, which contain the oldest evidence of life on Earth.
- The acid salt lakes of south-western Western Australia, the Eyre peninsula of South Australia, and the Mallee region of Victoria and South Australia which may mimic processes operating on the martian surface when water was able to flow freely.
- The springs associated with the Great Artesian Basin, including the Dalhousie Spring Complex, which provide insight into how groundwater processes on Mars have shaped the surface of that planet.
- Inverted river channels are common in almost every part of Australia but are relatively rare in other parts of the world. They are also common on Mars, and Australia provides an excellent example to examine how these features form and what they can tell us about the evolution of landscapes.
- The Arkaroola region of South Australia which has unequalled diversity in geological and geomorphological features, many of which are of interest to planetary geologists.

In addition, there are a number of other features that are of more general interest to planetary scientists, such as:

- A diverse collection of impact craters of ages ranging from a few thousand years to more than one billion, and in size from 20 metres to 100 km. One, of these, a small crater in the Henbury group in the Northern territory, is the only known terrestrial rayed crater, and thus of particular significance to lunar scientists.
- An extensive and diverse record of Archaean geology, composed of rocks dating from between 4.0 and 2.5 billion years and mineral grains of even grater age. These rocks record major events in the history of the planet including early crustal and mantle processes, the chemical evolution of the atmosphere and oceans, and the early history of life.
- The seas of longitudinal dunes in all the Australian deserts are some of the best developed examples in the world. They provide excellent counterparts to those found on the largest satellite of Saturn, Titan.

These analogue features are not only important for research purposes, but for the education of school and university students in planetary science. They give students first hand experience of planetary analogues and research methods, and stimulate their imagination as to how space exploration can be carried out and the type of questions that need to be addressed.

Lastly these analogue environments can make excellent providing grounds for the field testing of instruments and machines for use on planetary surfaces. These can include spectrometers, cameras, sampling tools, field robots, and equipment for astronaut use.

(ii). Areas in which there is currently little or no activity but that are within the technical and intellectual capacity of the country

Australia has considerable expertise in the design, construction manufacture, and marketing of hyperspectral instruments for us in the mining industry, such as the PIMA hand held spectrometer (http://members.ozemail.com.au/~tdc/pima/pima.htm), the Hymap airborne sensor (http://www.hyvista.com/hyvistaweb/index.php), and the Hylogger down-hole logging tool (http://www.csiro.au/org/HyLoggingSystemsGroup.html). Such instruments could be readily adapted to planetary exploration missions, to Mars and elsewhere. However, because Australian institutions are not able to tender for contracts and research funds to supply

instruments for missions, the nation is not able to apply such expertise to planetary exploration. Other analytical techniques using ion beams, may also be adapted to analysing the surfaces of airless bodies such as the Moon and asteroids. One such instrument in the SHRIMP ion probe (http://www.anuenterprise.com.au/asi/shrimpii.htm)

Similarly, Australia has considerable experience in field robotics and unmanned aerial vehicles (UAVs), through the work of institutions such as the Centre for Field Robotics (http://www.acfr.usyd.edu.au/), the ANU's Biorobotic Vision laboratory (http://cvs.anu.edu.au/bioroboticvision/), and companies such as BAE Systems (http://www.baesystems.com/Newsroom/NewsReleases/autoGen_10715135038.html). These technologies could be readily adapted to the exploration of Mars and other bodies of the solar system, where the institutions able to tender for contacts and research funds.

Australian hypersonic research at the University of Queensland Centre for Hypersonics (http://www.uq.edu.au/hypersonics/) and at ADFA/UNSW and the ANU (http://www.anu.edu.au/aldir/Canberra_Hypersonics/index.htm) has the potential to greatly influence the development of new atmospheric entry and deployment systems for the planetary applications. While these institutions are able to undertake specific projects requested by overseas organisations, their ability to carry out innovative research related to the development of entry systems is extremely limited by current funding.

B. Arguments for Expanded Australian Activity in Space Science and Industry

(ii). The potential benefits that could accrue to Australia through further development of our space capability

We identify the following benefits as some of those following on from increased Australian participation in planetary exploration:

- Improved opportunities to Australian scientists in a range of fundamental environmental sciences including planetary evolution, atmospheric processes, climatic studies, and the role of organisms in planetary environments.
- Improved opportunities for Australian engineers to develop leading edge technologies in the fields of propulsion, hypersonics, instrumentation, robotics, and solar power, among others.
- Inspiration of future generations of students to pursue science and technology studies because of enhanced opportunities, with the resulting flow on effect to areas of science and technology beyond immediate application to space exploration.
- Through increased participation, the ability to greater influence the development of international agreements over the use of space, for example in mitigation of space debris, space arms control, reduction of space pollution, early warning of potential threats from asteroid and cometary impact, territorial claims over extraterrestrial bodies, and the management of extraterrestrial resources. A useful parallel may be drawn with Antarctica, as mentioned by Prof. Malcolm Walter in his book *The Search for Life on Mars* (1999, p. 157). Although Australia's expenditure in the Antarctic is comparatively small compared to those of some nations, the mere fact of Australia's Antarctic program and a long history of engagement with that region has meant that Australia has been able to influence international treaties and management protocols and their enforcement in the Southern ocean and the Antarctic continent.

(iv). Impediments to strengthening and expanding space science and industry in Australia

It is of considerable concern to MSA that Australian participation in planetary science missions are being hampered for both researchers and industry by the lack of enabling frameworks. These need to be set up at an inter-government level between Australia and space organisations to facilitate Australian individuals, institutions, and companies to propose projects and tender for instruments and other hardware. We note that these other organisations need not, and should not, be restricted to NASA and ESA, but the space agencies of Russia, Japan, China, and India, as well as our South and East Asian neighbours, including Indonesia, Malaysia, Thailand, Singapore, and South Korea, all of whom have emerging space programs (as discussed by Sen. Chapman in his White Paper).

We suggest, in parallel with other organisations, that this is best accomplished using the ICFO (International Collaboration and Future Opportunities) Program proposed in the Draft Decadal Space Science Plan of the Australian Academy of Science. Further, adoption of a standard process for making formal agreements at a lower level than treaties between Australian scientists/institutions and overseas groups such as NASA and ESA, and later space agencies of other nations.

v. The goals of any strengthening and expansion of Australia's space capability both in the private sector and across government

We suggest the following long term goals included amongst those being sought for Australian space capabilities:

- Participation at a level appropriate to the size and strength of the Australian economy in deep space exploration, including Mars, through international collaboration by both scientists and industry and the provision of human skills and technical abilities
- Safeguarding of Australia's involvement in space exploration against short term political volatility via robust bi-lateral relationships with a range of national space programs, not just a few.
- Diversification and strengthening of Australia's space sector in recognition of the growing importance of this sector of the global economy (valued in 2007 at 251 billion US dollars and currently growing at a rate of 11% per annum http://www.spaceref.com/news/viewpr.html?pid=25166)
- Increased awareness of inspiring opportunities for challenging careers in planetary science and technology amongst students through increased emphasis on space-centred education.

C. Realistic Policy Options

We suggest the following options be implemented to increase Australian participation in planetary exploration and included in recognition of the space sector generally in Australian science and industry policy:

- Recognition of the importance of space science, including planetary exploration, among Australian research priorities. This would mean that applications for funding of planetary science projects through existing sources would have a greater chance of success through falling within the ambit of Australian research goals.

- Adoption of the International Collaboration and Future Opportunities Program proposed in the Draft Decadal Space Science Plan of the Australian Academy of Science
- Adoption of a standard process for making formal agreements at a lower level than treaties between Australian scientists/institutions and overseas groups such as NASA and ESA, and later space agencies of other nations.
- Taking a prescriptive rather than proscriptive approach to space research policy. This would involve specific areas that should be researched without eliminating opportunities for people to pursue other avenues that may prove advantageous to the nation at a later date.
- Improved funding of space-focused integrated curriculum activities in schools via a range of programs already in place in SA, WA, and Victoria to reverse the decline in science and technology enrolments.

APPENDIX
MSA AND ITS ROLE

MSA is a not-for-profit body incorporated in WA and with approved research institute status under Australian taxation law (http://www.marssociety.org.au/). It is part of a world-wide affiliation of Mars Societies with similar goals and aspirations. Countries with active Mars Societies include Austria, Canada, France, Germany, The Netherlands, Spain, The United Kingdom, and the United States.

MSA goals are:

- Broad education and outreach to instil the vision of a human future on Mars.
- Support of more active government funded Mars exploration programs around the world.
- Conducting Mars research and development on a private basis.
- Encourage Australian participation in Mars-related education, industry and government projects.

MSA is part of a world-wide affiliation of Mars Societies with similar goals and aspirations. Countries with active Mars Societies include Austria, Canada, France, Germany, The Netherlands, Spain, The United Kingdom, and the United States.

Present and planned activities by MSA to achieve these goals include:

Broad public outreach to instil the vision of pioneering Mars.

- In 2007 MSA signed a MOU with NASA Ames to participate in the "Spaceward Bound" education program (http://quest.nasa.gov/projects/spacewardbound/). The first group of Australian teachers will be participating in a two week expedition to the Mojave Desert in April 2008. In July 2008 there will be an 8-day field trip to Woomera and Arkaroola for Australian teachers. A NASA representative will be present to help lay the ground work for a two week expedition to Arkaroola in 2009 that will include US and Australian teachers and researchers.
- MSA runs the annual Australian Mars Exploration Conference (AMEC) since 2000. Past speakers have included Dr Harrison Schmitt, Vadim Gushin (IBMP Moscow), Wendell Mendall (Johnson Space Center), and Professor Steve Squyres (PI MER mission). The 2008 conference will be at the University of South Australia in Adelaide.
- MSA is a partner in the Victorian Space Science Education Centre (VSSEC http://www.vssec.vic.edu.au/). Our role has included the supply of simulated space suits for the Mars Floor activity, providing guest speakers, and linking to Spaceward Bound activities. We are currently negotiating with the South Australian Space School (http://www.spaceschool.sa.edu.au/) regarding possible collaboration.
- MSA is a founding partner of the Centre for Planetary and Spaces Science (CPSS http://www.hobbycentre.com.au/CPSSindex.html). This is a high school-focused education program that also works with the Perth Planetarium.
- Lastly MSA provides guest lectures and seminars on request.

Support of more active national space exploration programs in Australia, particularly of Mars.

- MSA has been represented in the development of the First Decadal Plan for Australian Space Science by the Australian Academy of Sciences. A draft of the plan can be inspected at http://www.physics.usyd.edu.au/~ncss/Draft_Plan_Release.pdf. While Mars exploration is not (and should not) be the prime focus of this plan, we have strongly supported the inclusion of planetary science, astrobiology, and related disciplines.
- Made a submission in favour of enhanced space exploration to the 2020 Summit.
- Protested the closure of the Australian Centre of Astrobiology at Macquarie University, Australia's only centre for astrobiological research and one with a world class reputation.
- Argued for the protection of the Mt Gee area at Arkaroola (Flinders Ranges, South Australia), a location of great astrobiological and Mars analogue significance, from mineral exploration and mining, allowing Mars related research and education to continue in the area

Conducting Mars-related research and development on a private basis.

- MSA has participated in five analogue research expeditions to Utah, Central Australia, and Arkaroola. The results of this wok have been extensively published through the Space Science and Technology Series of the American Astronautical Society, and elsewhere.
- We have published a series of peer-reviewed papers on the Mars Oz reference mission, an conservative, low mass human mission to Mars that offers significant scientific capability on the martian surface.
- MSA has designed a research and education facility composed of modules similar ton sizde and shape to those in the reference mission to be deployed at Arkaroola, South Australia.
- MSA is currently building the Marsupial simulated pressurised rover to design concepts and human factors associated with long-range exploration on Mars (Project Marsupial).
- MSA members have been involved in the development and testing of mechanical counter pressure suit technology for Mars surface exploration. This has included demonstrating the inherent flexibility of MCP technology through a series of simulated suits (Project MarsSkin)
- MSA members have initiated a range of Mars analogue research involving mound springs, geomorphology, and landscape evolution.
- MSA is has begun testing rocket engines as part of a program to evaluate different propulsion systems using a range of propellants that could be manufactured *in situ* on the martian surface. The first tests were formed in 2006.

Encourage Australian participation in Mars-related education, industry and government projects.

MSA has provided a range of support to Australian researchers and students interested in Mars, and to those from overseas (including from government agencies). These have included:

- Signed a MOU with NASA Ames Research Centre in 2007 to bring the Spaceward Bound education program to Australia and to allow Australian participation in programs in the US (http://quest.nasa.gov/projects/spacewardbound/)
- Informal discussions suggesting topics and areas for research in fields as diverse as hypersonics, Mars geology, astrobiology, and robotics to a range of research in Australia and overseas
- Logistic, data collection, and in-kind support to projects of interest to MSA, including aeolian geomorphology, group psychology, human stress responses in extreme environments, public awareness of issues related to Mars sample return, mechanical counter pressure suits, and space tourism
- Formal supervision of students in the fields of martian geomorphology and hydrology
- Providing a range of potential graduate level research topics and supervisors.