THE ARKAROOLA MARS ANALOGUE REGION, SOUTH AUSTRALIA. Jonathan D. A. Clarke[1], Matilda Thomas[2], and Marc Norman[3], [1]CRC LEME, Geoscience Australia, PO Box 378, Canberra, ACT 2601, Australia Jon.Clarke@ga.gov.au, [2]Geoscience Australia, PO Box 378, Canberra, ACT 2601, Australia, [3]Research School of Earth Sciences, Australian National University, ACT 0200, Australia..

Introduction: The Arkaroola region was selected out of six candidate regions as a prime Mars analogue area by the Mars Society of Australia (MSA), see Figure 1 [1]. The main region of interest includes the immediate Arkaroola area and adjacent Mt Painter Wildlife Sanctuary in the northern Flinders Ranges, and surrounding hinterland. The region comprises many notable Mars analogue landscape features including the dry salt lakes of Lake Frome andLake Eyre, numerous mound springs, dunes fields of the Strzelecki Desert, and Sturts Stony Desert. The Arkaroola region is of substantial technical interest, summarised below.

Bedrock Geology: The Arkaroola area is well known for its remarkable mineralization and complex geology. The rugged bedrock exposures of the Adelaide fold belt at Arkaroola range in age from Palaeoproterozoic to Cambrian, and include marine and non-marine sediments, basalts, and felsic intrusives [2]. The mineralised haematite-rich fossil hydrothermal system at Mount Gee (Figure 2) provides an impressive analogue to putative haematite-depositing hydrothermal systems on Mars [3][4]. The Neoproterozoic sediments of the Adelaide Geosyncline of the region record a number of important events in terrestrial history, including the Marinoan and Sturtian glacial deposits relevant to the "Snowball Earth" hypothesis [5] and the Acraman Proterozoic impact ejecta horizon [6].

Geomorphology and Regolith: The landscapes of the Northern Flinders Ranges and the Cainozoic history of the Lake Frome Plain records a complex landscape evolution under changing climatic conditions [7, 8]. Major alluvial fan systems occur along the range front and drain into the adjacent salt lakes Frome, Grace, Blanche, and Callabonna, or the dune fields on the margin of the Strzelecki Desert. The fans are variably duricrusted and dissected and record a long history through the Cainozoic of fan deposition and incision related to both climate change and tectonics. The various surfaces, duricrusts and sediments provide an analogue for the complex landforms likely to be found that would need to be interpreted on Mars. Some of these deposits, such as the mobile sand dunes at Gurra Gurra Waterhole have previously been studied as Mars analogues [9].

Paleontology: The Neoproterozoic sediments in the region contain many stromatolitic horizons and cherts that may contain microfossils [2]. The younger Neoproterozoic successions host the renowned Ediacara fauna, the controversial assemblage that is believed to represent the first assemblage of large animals on earth [10]. Slightly younger sediments to the south of Arkaroola contain records of the "Cambrian explosion", the radiation of skeletal organisms that transformed the interaction between organisms and sediments [11].

Hydrology: There are many hydrogeological features in the region. They include the radioactive Paralana Hot Spring [12], uranium-mineralising waters of the Lake Frome Plain, numerous salt lakes such as Lake Frome, and mound springs complexes [13] of the Great Artesian Basin hydrological system.

Biology: A diversity of opportunities exists for the study of dry-land ecology, endolithic and cryptoendolithic organisms. Of particular interest is the presence of radiation resistant extremophiles in the waters of Paralana hot spring [14, 15]. There are several other occurrences of radioactive minerals occur in the Mount Painter complex [12] which may also provide niches for radiation resistant extremophiles, presenting many opportunities for further investigations.. Extremophile populations occurring in salt lakes in the region are largely unknown. The nature of the biota in ephemeral water bodies could also shed light on the dynamics of such systems and how possible Martian equivalents, might be studied [16].

Geophysics: Many of the faults in the Arkaroola area are seismically active [2, 7]. These play a key role in geomorphic evolution. The many types of aquifers in the Arkaroola region, including artesian aquifers and others associated with the radiogenic and mound springs, and perched and shallow ground waters, present excellent targets to test a range of geophysical techniques designed to determine the occurrence of sub-surface water.

Remote sensing: The multifarious geology of the region, including the broad range of surficial materials, diverse bedrock geology, and complex alteration haloes surrounding fossil hydrothermal systems, makes the region ideal for the evaluation and comparison of various remote sensing systems for mineral mapping such as Radiometrics, Landsat, Aster= and HyMap. Ground truthing of remotely sensed data can also be preformed and is useful to test the accuracy of the remote systems, using instruments such as the Portable Infrared Mineral Analyser (PIMA) and XRD analyses of surface mineralogy [3].

Scale of investigations: Unlike many other analogue research sites, the Arkaroola area comprises a wide variety of Martian analogue features as an entire landscape, rather than one spatially constrained sites or cluster of sites. Although the Arkaroola analogue region was initially constrained to a radius of 100 km during the selection process, there are few limitations on vehicles traveling further a field to other areas of interest, such as Sturts Stony Desert or further a field [1]. Therefore, compared to other Mars analogue sites, the Arkaroola region provides a unique venue for large scale studies, whether of geological or biological systems, or of long range surface reconnaissance and mobility, from both an engineering and human factors approach.

Outreach and Education: Arkaroola village provides an opportune base for working in the region. It is Australia's largest private nature reserve receiving tens of thousands of travelers visit annually. It is operated by the Sprigg family who has a long history of scientific research and interest in ecotourism. They are strongly supportive of the establishment of a Mars analogue facility, and the many visitors to the region provide an excellent opportunity for outreach [17]. There is on-going interest in the local, national and international media in the Mars-related research of the area.

Future opportunities: MSA and its international partners are currently planning a month long reconnaissance expedition to the Arkaroola area in August 2004. The expedition is intended to collect baseline geological, biological and human factors data. A specific site will be selected for establishing the Australian Mars Analogue Research Station (MARS-OZ). MSA looks forward to new collaborations and welcomes cooperation with researchers wishing to explore the Mars analogue potential of Arkaroola.

References: [1] Mann, G. A., Clarke, J. D. A., and Gostin, V. A. (2004).*Australian Geographical Studies* 42., in press. [2] Coats, R. P. (1972) Explanatory notes for the Copley 1: 250,000 Geological series sheet SH/54-9, Department of Mines, South Australia. [3] Thomas, M. and Walter, M. R. (2002). *Astrobiology* 2, 335-351. [4] Catling, D. C. and Moore, J. M. (2003) *Icarus* 165, 277-300. [5] Hoffman, P. F. and Schrag, D.P. (2002) *Terra Nova* 14, 129–155. [6] Gostin, V. A., et al.. (1986) *Science*. 233, 198-200. [7] Twidale et al. (1996) Occ. Pub. Roy. Soc. South Australia 7 pp. 46-62. [8] Twidale, C. R. and Wopfner, H. (1990) Occ. Pub. Roy. Soc. South Australia 6 pp. 45-60. [9] Bishop, M.A. (1999) *LPI Contribution 972* Abstract #6069 [10] Jenkins, R. J. F. (1996) Occ. Pub. Roy. Soc. South Australia 7 pp. 46-62. pp. 33-45. [11] Bengtson, S. (1990) *Aust. Ass. Pa. Mem.* 9, 364p. [12] Coats, R. P. and Blissett, A. H. (1971) *Geol. Sur. South Australia Bull.* 43. [13] Haberhehl, M. A. (1982) *BMR Report* 235. [14] Anitori, R. P. et al. (2002 *Astrobiology* 2, 255-270. [15] Anitori R. P. et al. (2003) *Proc. Aust. Soc. Pacific Int As. Union Symp. Series* (in press). [16] Boulton, A. J. and Williams W. D. (1996) pp. 102-112. [17] Laing, J. H. et al. In press. *Proc. Bioastronomy 2002*: IAU Symposium 213, 2002.

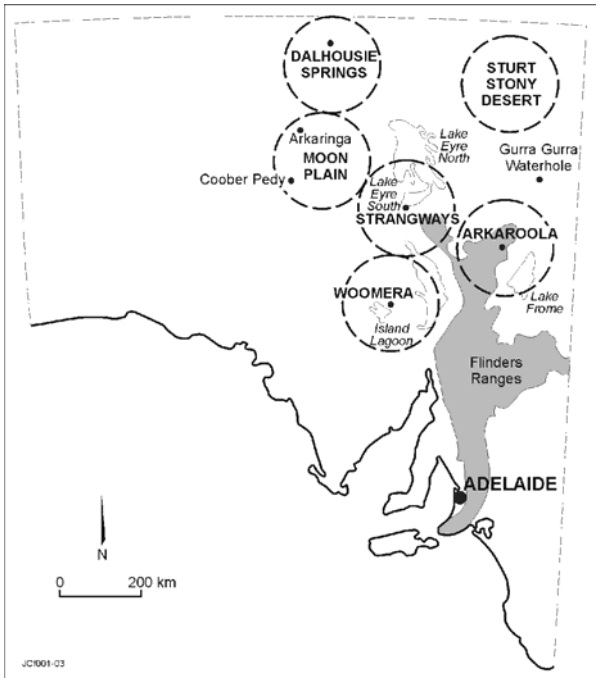

Figure 1: Location of the Arkaroola Mars analogue region and relation to other sides investigated in South Australia.

Figure 2: Haematite-quartz vuggy hydrothermal breccia from the 320 Ma Mt. Gee complex, Arkaroola