**LUNAR ROVERS AND THERMAL WADIS BASED ON PROCESSED REGOLITH.** R. S. Wegeng[1], J. C. Mankins[2], R. Balasubramaniam[3], K. Sacksteder[3], S. A. Gokoglu[3], G. B. Sanders[4] and L. A. Taylor[5], [1]Pacific Northwest National Laboratory, operated by the Battelle Memorial Institute (robert.wegeng@pnl.gov), [2]Artemis Innovation Management Solutions, [3]NASA Glenn Research Center, [4]NASA Johnson Space Center and [5]University of Tennessee.

**Introduction:** Mobile robotic systems, tele-operated from Earth such as the rovers Spirit and Opportunity, which have been operating on the surface of Mars for more than four years, could provide substantial scientific payloads for lunar science and exploration. However, the lunar environment and particularly the 27-day diurnal cycle of the Moon present a thermal challenge that is considerably more severe than on Mars. At equatorial regions, for example, temperatures range from a high of about 400 K to a low of about 100 K, too cold for most electronics, sensors and battery systems. Unless onboard radioisotope heating is included, robotic lunar rovers may be unable to survive the extreme cold of the lunar night.

**Thermal Wadi Concept:** We propose the development of an innovative science and exploration architecture for the lunar surface based on the establishment of distributed sources of heat and power – thermal wadis – that can support tele-operated rovers and stationary science platforms for periods of years. Thermal wadis can be assembled using minimal hardware from Earth plus a locally available resource, lunar regolith, which can be processed to yield suitable thermal-mass materials for energy storage.[1]

The basic concept for a thermal wadi consists of a thermal mass plus an energy reflector that can be configured to either reflect solar energy onto the thermal mass during periods of sunlight or reflect infrared energy back to the thermal mass during periods of darkness. As depicted in Figure 1, solar energy is absorbed and stored within the thermal mass during periods of sunshine and is used to provide temperature control for rovers and other assets during periods of darkness.[2]

**Standard Rover Concept:** Thermal wadis will enable the establishment of a class of compact rovers having standard equipment for the functions of power, mobility, navigation and communications plus standard interfaces for instrument packages. Multiple rovers would be associated with each thermal wadi, allowing a wide variety of instruments and lunar science objectives to be fulfilled.

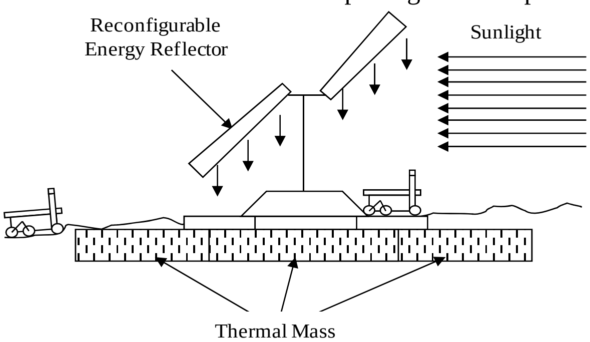


Figure 1 – Thermal Wadi Concept

**Networks of Thermal Wadis:** We contemplate the establishment of multiple thermal wadis, placed tens or hundreds of kilometers apart, based on the development and landing of wadi assembly modules on the lunar surface. In principle, each thermal wadi would be capable of providing heat (and perhaps power) for multiple lunar rovers, tele-operated from Earth by teams of researchers and engaging multiple countries. Figure 2 illustrates one notional network of thermal wadis in the vicinity of the South Pole of the Moon. In the figure, the bold red circles identify notional exploration perimeters, with one thermal wadi at the center of each, overlapping areas of interest based on data from the Clementine and Lunar Prospector spacecraft suggesting the possible presence of water-ice and other volatiles. For this figure, the exploration perimeters are based on radii of 48 kilometers – the distance that a rover could travel over a time period of about 80 hours (about 1/8th of a lunar diurnal cycle) – and enclose an area of over 7,000 square kilometers each.

**References:** [1] Wegeng, R.S., Mankins, J.C. and Taylor, L.A., and G.B. Sanders (2007), "Thermal Energy Reservoirs from Processed Lunar Regolith", Proceedings of the International Energy Conversion Engineering Conference 2007. [2] Wegeng, R.S., Mankins, J.C., R. Balasubramaniam, K. Sacksteder, S.A. Gokoglu, G.B. Sanders and Taylor, L.A., (2008), "Thermal Wadis in Support of Lunar Science and Exploration", Proceedings of the International Energy Conversion Engineering Conference 2008.

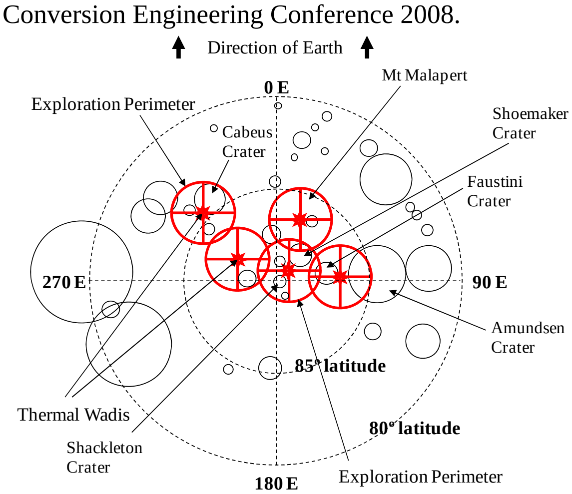


Figure 2 – Notional South Pole Network of Thermal Wadis