LONG DAY'S DRIVE: AN ALTERNATIVE PARADIGM FOR MARTIAN ROBOTIC EXPLORATION. M. H. Sims\(^1\) and C. P. McKay\(^1\), NASA Ames Research Center, Moffett Field CA, 94035, Michael.H.Sims@nasa.gov, NASA Ames Research Center, Moffett Field CA, 94035, cmckay@mail.arc.nasa.gov.

**Introduction:** The Log Day's Drive proposed Martian polar exploration rover mission represents a different place in the space of designs from previous missions including MER, and in part represents an alternative to future deep drilling missions. This mission design is characterized by:

- High power and continuous power afforded by the northern polar region in summer sunlight.
- No nighttime operations; small thermal variability over the day.
- Rapid acquisition of data by virtue of instrument selection - the full suite of instruments can collect their data in under an hour. Stylized transects and previously demonstrated pattern recognition algorithms (e.g., the recognition of rock like objects in a terrain) will be used.
- Mobility during a large fraction of the Martian day. - Vehicle self-safing. This is the fundamental technology needed for long range mobility. This ability of the vehicle to be responsible for its own well being is commonly used on earth based autonomous vehicles and is the crucial element for long traverses.
- Sufficient mobility in rover design to allow access beyond the landing ellipse. Hence, specific locations are then targets.
- Excellent access to orbital communication facilities

**Mission Overview:** LDD will investigate the north polar layered deposits (PLD). The overarching science rationale for LDD is the belief that the PLD preserve within their stratigraphy an interpretable record of recent climate and geologic history for Mars. Our primary goal is to obtain data that can provide a basis for interpreting that record. In addition, we will test the hypothesis that the ice of the PLD contains organics at higher concentrations than the aeolian dust sampled at the two Viking sites. Finally, we seek to contribute to the understanding of Mars' total volatile inventory by detailed determination of the ice content of the PLD over the traverse.

**Science Goals:** It is widely believed that the Martian polar layered deposits record climate variations over at least the last 10 to 100 million years, but the details of the processes involved and their relative roles in layer formation and evolution remain obscure.

Variations in axial obliquity and orbital eccentricity are thought to influence the climates of both Earth and Mars, but are of greater amplitude in the Martian.

A common presumption among Mars researchers has been that the polar layered deposits are the result of variations in the proportions of dust and water ice deposited over many climate cycles but their density and composition are poorly constrained. There is evidence for both topographic and albedo variations between layers in the north polar layered deposits, based on analysis of springtime images.

Traversing the PLD over the surface is the most effective way to collect a long-term record of their variation. If the LDD rover traverses 10 km up or down a 5% slope, perpendicular to the layering we could have a record corresponding to a drill depth of 500 m. If the nominal deposition rate of dust on Mars is of order a few microns per year, then the climate history captured by the layers covered would be about 10 to 100 M-yr. This time scale is significant because variations in Mars' obliquity, eccentricity, and phase of perihelion vary significantly on time scales of millions of years. As the obliquity changes the total radiation received at the polar regions changes and this changes the amount of CO\(_2\) in the atmosphere and the amount of water vapor released in the summer from the polar deposits. Changes in the pressure of CO\(_2\) and the annual water cycle should both change the amount of dust and ice deposited in the winter in the PLD. This climate record is preserved in the PLD layering and the LDD traverse will be able to document this record.

**Organics.** detection for organics on Mars would have important implications for astrobiology and future Martian missions. Any future search for organics on Mars must follow up from the Viking results. The Viking results were puzzling in three respects. First, was the total absence of organics as measured by the GCMS. The second unexpected result was the rapid release of O\(_2\) when soil samples were exposed to water vapor in the Gas Exchange Experiment (GEx) at levels of 70 - 770 nanomoles per gram. The third unexpected result was that organic material in the Labeled Release (LR) Experiment was consumed as would have been expected if life was present --- the presence of life being apparent contradiction with the results from the GCMS.

Currently, the most widely held explanation for the reactivity of the Martian soil is the presence of one or more inorganic oxidants.

It has been observed that the level of oxygen release from the GEx experiment was lower at the northernmost Viking site and suggested that the oxidant might decrease systematically toward the poles with a concomitant increase in the stability of organics. Chemically this might be due to the role of ice and thin films of water in destroying oxidants.

Thus we hypothesize that organics may be present in the PLD at concentrations significantly higher than the upper limit determined at the Viking sites.

**Ice content.** A recognized goal for Mars exploration is to map the 3D distribution of water in all its phases. We propose to contribute to the understanding of Mars' total water inventory by detailed determination of the ice content of the PLD over the length of our traverse.

**Proposed payload:** The proposed payload consisted of

- copy of MER PanCam system
- one shot panoramic camera (fish eye or mirrored sphere lens for panorama)
- Distant microscopic imager – By using telescopic optics creating microscopic quality images from a few inches to a meter or more distant
- Laser Induced Breakdown Spectrometer – Los Alamos to generate elemental analysis quickly and up to 10's of meters distant
- Raman spectrometer integrated into above Laser Induced Breakdown Spectrometer allows for organic detection
- Neutron spectrometer
- Ground penetrating radar