Surface Temperatures Distribution and Permafrost Depth in Gusev Crater (Mars)

A. Molina & M.A. de Pablo
Department of Geology, University of Alcalá, Madrid, Spain

M. Ramos
Department of Physics, University of Alcalá, Madrid, Spain

1 INTRODUCTION

1.1 *Permafrost on other planets: Mars*

The study of permafrost on other planets is a very interesting way to know how was the Earth and how may it would be in the future. The available data to develop these studies were acquired by different missions and they have high quality and mean spatial coverage, although they have low temporal continuity. For that reason, it is necessary to establish some new procedures by the use of all the available data, and try to obtain new results from them about the martian permafrost.

1.2 *Sensors and records*

THEMIS sensor (THermal EMission Imaging System) is acquiring visible and infrared multispectral images from all over the planet Mars, with a mean resolution of 18 and 100 m/pixel, respectively. Here, we use Brightness Temperature Records (BTR) product derived from THEMIS-IR data.

On previous work (Molina et al., 2010), we analyzed the BTR from THEMIS images available of the area of Spirit's track and Mini-TES BTR information from concordant date, local time and coordinates. There, we showed that the values of surface temperature, coming from orbital and landing sensors could be comparables, with a mean difference about 10 K. The image used on this analysis (I15397002) has a difference of about 4 K.

2 METHODS

We used BTR products released by Arizona State University (themis.asu.edu) and the HRSC altimetry data from the Free University of Berlin (hrscview.fu-berlin.de). We calculate the isotherms applying a Geographic Information System (GIS).

We applied the lineal classical equation [$T_z = T_s + g_g \cdot z$], were T_z is the underground temperature, in our case 273 K (0° C), T_s is surficial temperature, g_g is geothermal gradient and z is the deep for T_z temperature. We assumed a intermediate value of geothermal gradient in this Martian region is about 15 K/km (Clifford, 1993).
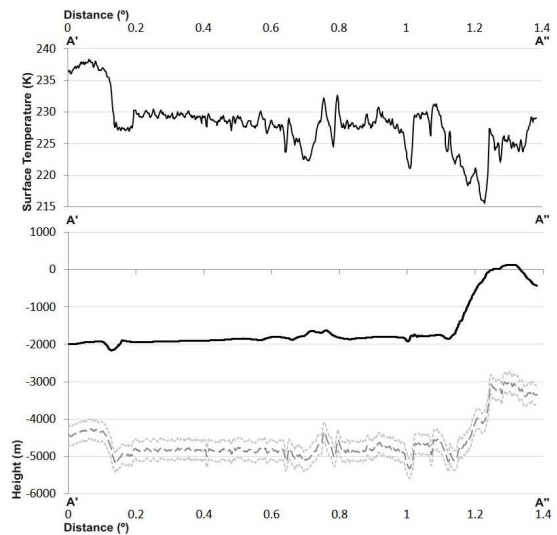

Figure 1. Surface temperature, topographical height and calculated deep of the 0°C isotherm values, though a profile A´-A´´. It is located on Gusev Crater rim (14.6°S; 175.3°E), next to the Spirit landing site.

3 RESULTS AND DISCUSSION

As it is showed on the Figure 1, the 0°C isotherm on the area is more or less 3000 m deep. Different terrain orientations and materials composition generate differences on the surface temperature, what influence on depth. Even considering the decrease of surface temperature produced by the tiny Mars' atmosphere on the data acquired by orbital sensors, this layer is considerably deeper than we can find on the Earth. We will apply this tested procedure to other Martian areas in order to determine the regional distribution of permafrost.

References

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