THERMAL INERTIA MAPPING OF MARS ON THE BASE OF VD AND IR-IMAGING BY TERMOSCAN INSTRUMENT. R.O.Kuzmin, V.K.Borozdin (V.I.Vernadsky Inst.USSR Academy of Science, Moscow 117975), A.S.Selivanov, M.K.Naraeva, Yu.M.Gektin, V.D.Kharlamov, A.V.Romanov, D.A.Fomin, A.V.Dulytsky(Inst.of Space Devices Engineering,Moscow 111024,USSR),A.M.Shirenev(Central Inst. of Geodezy,Aerial photography and Cartography, Moscow 125413).

The previous reports [1,2,3,4] shown that the Termoscan data display the thermal features with the high resolution, which are connected directly with variations of physical properties of the surface material. Significant thermal contrasts both between the large regions and between the individual geological features with the size close to the image resolution (1.8x1.8 km for the altitude 6 300 km) have been found. from [5].

A comparison of averaged brightness temperatures profile deduced from IR-imagery with temperature profile calculated for averaged thermal model of Mars (I=6.5, A=0.25 [5,6]) allowed to find the large scale thermal inhomogeneities. They were found through the prominent asymmetry of the brightness profile relatively the noon (Fig.1).The same thermal asymmetry was found also at the smaller scale for the individual surface features of about 2-10 km across. Figure 2 displays the change of the day-time brightness temperatures of various surface materials (session 01.03.89) relatively of the model temperatures. As one can see from fig.2 the material of the remnant deposits inside the craters and the light material(both inside and outside of the craters) are characterized by the lower thermal inertia values(I<4), than the darkest materials (I>6).In the same time values of thermal inertia only of the bright materials very by factor 2 from the area imaged after the noon (Terra Meridiani and crater Schiaparelli) to the area imaged before the noon (Xanthe Terra and Simud Valles). These results have demonstrate good ability of the Termoscan data to distinguish different geological objects and to study thermal inhomogeneities in complex lithological formation (i.e. in Terra Meridiani). The most effective for such kind of the studies is the analysis of the thermal inertia maps. Because the Termoscan made only four morning to evening sessions it is not possible to compose the thermal inertia maps from these data by the traditional methods [6,7]. To process the Termoscan data in the thermal inertia maps we elaborated the another method. For this the brightness measurements in VD- and IR-range were corrected and then the method of the correlation diagrams was used. The image processing has been performed with the help of GEOCOLOR system designed in V.I.Vernadsky Institute by V.K.Borozdin. Because for the low phase angle of the IRTM data the assumption about Lambertian function of photometric behavior led the satisfactory results [9] we used the same assumtion in our processing of the Termoscan VD data.

Using of the spectral characteristics for Termoscan instrument [3] and the values of the Sun constant in the spectral visual range (0.5-1.0 μm) the effective brightness (B_{eff}) has been determined for each of the session. The normal albedo values (p^*) were taken through the ratio of the measured values of VD-brightness (after correction by Cosines low) to the values of B_{eff}. Then the IR-temperatures in each of the session have been normalized to the temperatures of the average thermal Mars model (I=6.5, A=0.25), which characterized by the best approach to the temperatures measured in midday (see Fig.1). Thus the brightness temperature for the each pixel of IR-image has been transformed to the midday temperature. After such corrections the method of the correlation diagram has been used. The data shown on the correlation diagram represent the sum of all combinations of I and A parameters, which are typical for the imaged area. Then the data field on the diagram was subdivided into bands corresponding to the inverse dependence of brightness temperatures from albedo for the midday time (Fig.3).Such dependence was obtained based on thermal model [5] for the range of I and A parameters,which are known for the imaged area from IRTM data [7].For example for the session 26.03.89 area the values of I vary from 2 to 14 [7].As result all IR-image pixels belonging to the given band, corresponds to some I value,were mapped using darker-lighter code(the low values of I -darker,the high -lighter).The result of such processing for Valles Marineris region is demonstrated on Fig.4. Comparison of the produced thermal inertia maps with the map based on IRTM data [7, 8] revealed their principle similarity. This shows that the used method of the producing of the thermal inertia map from the day-time Termoscan data is workable.

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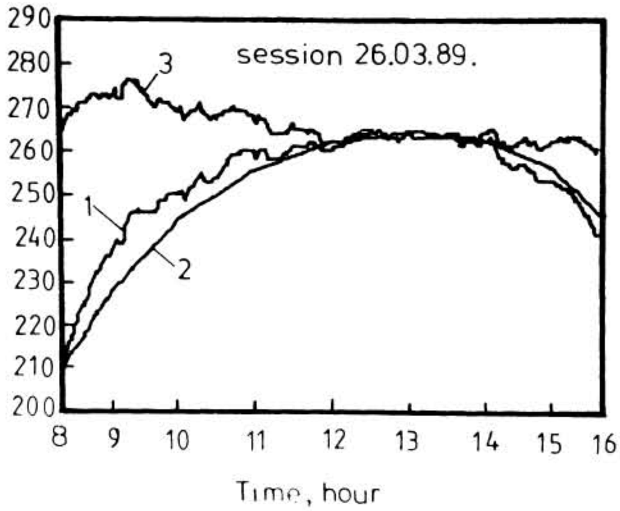

Fig.1. Averaged brightness temperature profile for session 26.03.89 befor correction (1) and after (3);2-temperature profile calculated for average thermal model of Mars (I=6.5, A=0.25).

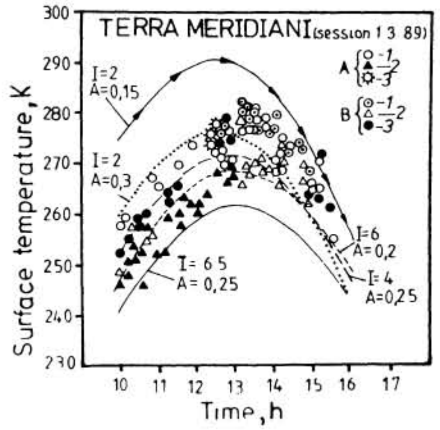

Fig.2. Brightness temperature of the various surface materials in Terra Meridiani (session 01.03.89). Materials inside craters(A) : remnants of sedimentary deposits(1), dark (2) and bright(3) material. Materials outside craters(B): more bright(1), dark(2) and grey-bright(3) materials.The lines in this plot are modeled temperatures for the surface of varying thermal inertia values.

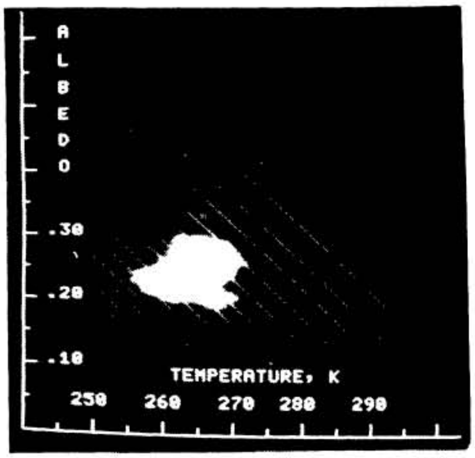

Fig.3.Correlation diagram of the albedo and the brightness temperature for session 26.03.89.The parallel lines corresponding to the inverse dependence of brightness temperatures from albedo for the midday time.

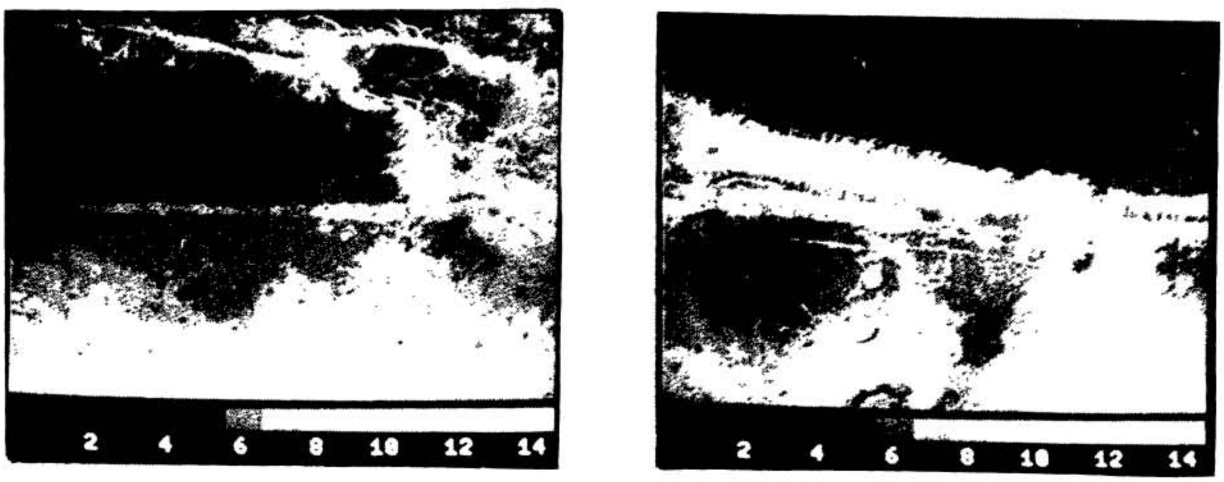

Fig.4.The fragments of the thermal inertia map for area imaged in session 26.03.89 (part of Valles Mariner region).The thermal inertia in units of 10^{-3} cal.cm^{-2}.s$^{-1/2}$.K^{-1}.