EPSC Abstracts,
Vol. 2, EPSC2007-A-00161, 2007
European Planetary Science Congress 2007


# The Thermal Conductivity of Granular Materials as a Function of Grain Size Distribution and Gas Pressure

**Erika S. Hütter and Norbert I. Kömle**

Space Research Institute, Austrian Academy of Sciences, Schmiedlstrasse 6,

A-8042 Graz, Austria

erika.huetter@gmx.net / Fax: ++43 316 4120 690

Many planetary bodies – in particular those with no or thin atmospheres – are covered by so-called regolith layers which usually constitute the uppermost metres of their surfaces. Examples are the Moon, the icy satellites of the outer solar system, asteroids and comets. The thermal conductivity of these surface layers controls to a high extent the energy balance of the body as a whole. Under low pressure conditions the effective thermal conductivity of granular materials is known to be very low, because the mutual contact area contact between individual particles is small. Therefore regolith surface layers are acting as thermal insulators.

Up to now only a few thermal conductivity measurements in an extraterrestrial environment have been carried out, namely on the Moon in the frame of the Apollo Moon Lander missions. For the future several missions involving landers on asteroids, comets, and the Moon are planned by various space agencies. Thus the development of reliable instruments for the measurement of the thermal properties of regolith is of high interest. For this purpose thermal conductivity measurements with various regolith analogue materials under low pressure conditions need to be done. In order to contribute to this goal, we have performed a series of experiments using glass beads with various size distributions as analogue materials. To sort out the influence of the environmental gas pressure on the effective thermal conductivity each sample was embedded into a nitrogen atmosphere and the pressure was systematically varied from $10^{-4}$mbar (high vacuum range) up to 1 bar. The grain sizes used for the glass spheres were in the range from 0.1 mm to 4.3 mm. Additionally a mixture of different grain

sizes was analysed.

We report on the results of thermal conductivity measurements obtained for the different size fractions as a function of gas pressure. Our results indicate a strong influence of both the gas pressure and the grain size on the value of the thermal conductivity of the glass beads samples. For all cases measured a decrease of the pressure led to a corresponding decrease of the thermal conductivity. In the high vacuum conditions it was found to be approximately 30 times smaller than under normal atmospheric pressure. The strongest decay occurs in the pressure range from $10^2$ down to $10^{-1}$mbar. At lower pressures no significant dependence of the thermal conductivity on the gas pressure was observed.

The relation between the used grain sizes and the thermal conductivity was found to be linear.