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Thermal Conductivity Measurements on consolidated Soil Analogs

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Heat transport in porous media such as soils and regolith is significantly reduced compared to the properties of compact samples of the same material. The bottle neck for solid state heat transport is the contact area between adjacent grains. For "dry" and unconsolidated materials the contact areas and thus the thermal conductivity are extremely small. Sintering and cementation are two processes that can increase the cross section of interstitial bonds signifcantly. On Mars, cementation can be caused by condensation of water or carbon dioxide ice from the vapor phase, or from salts and minerals that fall out from aqueous solutions. We produced several artificially cemented samples, using small glass beads of uniform size as soil analog. The cementation is achieved by initially molten wax that is mixed with the glass beads while liqiud. The wax freezes preferably at the contact points between grains, thus minimizing surface energy, and consolidates the samples. The thermal conductivity of these samples is then measured in vacuum. We present the results of these measurements and compare them with theoretical models. The observed range of thermal conductivity values can explain some, but not all of the variations in thermal intertia that can be seen in TES remote sensing data.