THERMAL DEPENDENT HEAT CONDUCTIVITY AND CAPACITY IN ASTEROID THERMAL CALCULATIONS L. Pohl and D. T. Britt, University of Central Florida Department of Physics, 4111 Libra Dr, Orlando FL 32816, pohl@knights.ucf.edu; Center of Lunar and Asteroid Surface Science, 12354 Research Pkwy Suite 214, Orlando FL 32826.

Introduction: Asteroid thermal calculations use several simplifications to minimize computational as well as theoretical difficulties. Among the major computational difficulties are solving a non-linear set of equations and computational time. The major theoretical difficulties usually cope with an incomplete knowledge of behavior of asteroidal materials, especially the functional dependence of material density on depth in the asteroid and of heat capacity and conductivity of asteroidal material on temperature. Recently, new results by [1] have become available for the temperature dependence of heat capacity and conductivity for several major meteorite groups including the important CM carbonaceous chondrites. We will use these new data, instead of the standard practice of using constant values of these parameters, to determine temperature distribution within an asteroid. The reason for this is to estimate the difference in surface temperatures on asteroids when constant parameters are used and when the temperature dependent experimental data are used.

Method: The effect of temperature on the value of heat capacity and conductivity is usually neglected because either it is not known well for asteroidal materials or because it introduces computational difficulties. Recently, [1] measured dependence of heat capacity and conductivity on temperature for several sample meteorites for the temperature range 5 - 300 K.

A simple 1D Heat Conduction Equation is solved in full form (assuming Fourier law):

$$\rho \frac{\partial}{\partial t}[c(T)T(t,x)] - \frac{\partial}{\partial x}\left[\alpha(T)\frac{\partial T(t,x)}{\partial x}\right] = 0,$$

where $c(T)$ is the temperature dependent heat capacity, ρ is material density, $\alpha(T)$ is the temperature dependent heat conductivity of the asteroidal material. We neglect any heat source within the asteroid. We solve this partial differential equation using Finite Differences.

We assume that lateral heat conduction is negligible and thus we can compose a full asteroid of 1D slabs extending from the center of the asteroid to the surface. On each such 1D slab, we solve the above equation.

Discussion: The most significant effect should be observed for asteroids with large eccentricities rather than for asteroids on circular orbits. An interesting application would be for thermal evolution of the current NEAs. However, as the data is only available up to ~300 K, we can only use this approach for main belt asteroids. Should new data at higher temperatures become available, we can extend this method to NEAs.

Besides using our results to evaluate the current standard practice of using constant values, we would also like to compare the effectivity of using the temperature dependent data: the computing time vs. the improvement of the result as one of the major reason for 1D simplification is the speed of such calculation.

Conclusions: We use newly available data on thermal dependence of heat capacity and conductivity in meteoritic materials to test this effect on temperature distribution within the main belt asteroids as compared to using constant values for these parameters.

References: [1] Opeil, C. and Britt, D. (August 2016) *Thermal Expansion, Heat Capacity and Thermal Conductivity Measurements of CM Carbonaceous Chondrites*. Abstract: PS11-A018.