A NON-DESTRUCTIVE METHOD TO DETERMINE THE LOW TEMPERATURE HEAT CAPACITY OF METEORITES

A. Koch[1], D. Britt[1], G. Consolmango[2] and P. Rochette[3]. [1]University of Central Florida. Email: aaronk@knights.ucf.edu. [2]Vatican Observatory. [3]CEREGE, Aix-Marseille Université, CNRS.

Introduction: In many thermal models of small bodies in space, thermal properties are assumed to be weighted averages of the constituent minerals (1). However, Opeil et al. (2) have shown that the thermal conductivity of stony meteorites are influenced by their inhomogeneous nature and cannot be easily calculated based on their composition. This suggests that the thermal models of bodies that exhibit meteoritic qualities currently in use may be significantly in error. The specific heat capacity of a rocky body plays an important role its thermal evolution and can also be useful in characterizing meteorites and their physical structure. However, there are an extremely limited number of meteorites (cf. 3) whose specific heat has been determined due to the destructive nature of current methods to measure it. To make more measurements requires new, non-destructive methods.

Method: To determine the heat capacity, we use a non-reactive cryogenic fluid, liquid nitrogen, to absorb heat from sample. A dewar is filled with liquid nitrogen and the mass is measured as a function of time. Once a baseline evaporation rate is obtained, the sample is added and allowed to come to equilibrium with the system. Every gram of liquid nitrogen that is evaporated represents 199.4 joules of heat removed from the sample. Many runs with different starting temperatures are taken, to account for the change of heat capacity with temperature: we assume a quadratic relationship to temperature and integrate over the temperature ranges of the experiments (4). This method is valid in the temperature range from 77-325K, which is similar to conditions asteroids experience in space.

Current Work: We are presently working to characterize and reduce systematic errors in the procedure by measuring minerals with known specific heat capacities: a 9.8g sample of quartz and a 14.1g sample of garnet. Modifications have been made to reduce the formation of ice on the dewar, and to reduce the chaotic behavior of the evaporation.

References: [1] Ghosh A. and McSween H. Y. Jr. 1999. *Meteoritics and Planetary Science. 34*:121–127. [2] Opeil C. P. et al. 2010.*Incarus,* in press. [3] Szugot M. et al. 2008. *Crystal Research and Technology* 43:921. [4] Waples, D. W. and Waples, J. S. 2004. *Natural Resources Research.* 13:97-122. [5] Beech M. et al. 2009. *Planetary and Space Science.* 57:764-770.