THE DEHYDRATION OF SERPENTINE POLYMORPHS: IMPLICATIONS FOR THE EVOLUTION OF NEA CARBONACEOUS CHONDRITE PARENT BODIES. Daniel T. Britt and Leos Pohl, University of Central Florida Department of Physics, 4111 Libra Dr, Orlando FL 32816 and the Center for Lunar and Asteroid Surface Science, dbritt@ucf.edu

Introduction: The NEA parent bodies of volatile-rich carbonaceous chondrites are significant targets for exploration and In-Situ Resource Utilization (ISRU). Their volatiles are typically “stored” in the form of hydroxyls in the crystal structure of serpentine group of minerals as well as in organics. For CI, C2, and CM carbonaceous chondrites serpentine group minerals dominate the mineralogy. In order to evaluate the hydration state of these asteroids, it is necessary to understand the dehydration temperatures and processes in the space environment. These data information is important for understanding the history of the body, regolith formation, interpretation of spectra, mission planning, and the potential for ISRU.

The main minerals found in volatile-rich carbonaceous chondrites are Mg-Serpentines and Cronstedtite [1], [2]. Although Cronstedtite is a mineral of the Serpentine group, we purposely make a distinction between Serpentines (Mg rich endmembers of the Serpentine group, which we denote Serpentines) and Cronstedtite (the Fe rich endmember of the Serpentine subgroup of minerals). Despite a general availability of measurements of dehydration temperature for Serpentines, these measurements are typically only available for high pressures (typically GPa and atmospheric levels). Data for dehydration in vacuum or for any dehydration data for Cronstedtite are very limited. We have been measuring the dehydration of Serpentines and Cronstedtite under both atmospheric and vacuum conditions while varying the experimental conditions.

Results: We determined [3] that Antigorite and Lizardite start dehydration process at around 600 C and ends at about 800 C under atmospheric conditions. Under vacuum conditions the onset temperature drops by about 50 C. Both minerals lose about 12% of their initial mass during the dehydration phase and their DSC heat flow curves are very similar with 3 peaks which suggests 3 different phase transitions. For Cronstedtite we determined that it starts its dehydration at around 400 C under inert atmosphere, almost 200 C lower than Antigorite and Lizardite under the same pressure conditions and loses almost 20% of the initial mass. Fig. 1 depicts the typical mass loss curves for Antigorite and Cronstedtite under inert gas flow.

Figure 1 - Mass loss curve for Antigorite and Cronstedtite under inert gas flow.

Conclusion and Discussion: The effect of composition (Mg rich or Fe rich endmember of Serpentine group) has much higher impact on the initial dehydration temperature than vacuum. Grain size does affect the dehydration and DSC peaks by about 30 C. We are investigating the phase transitions indicated by the DSC heat flow peaks with XRD. We are also taking spectroscopy measurements of the dehydrated samples, again at the phase transition peaks, which should provide more insight for comparison with asteroid reflectance spectra.
