DEHYDRATION PROCESS OF CARBONACEOUS CHONDRITES. L. Pohl and Daniel T. Britt, University of Central Florida Department of Physics, 4111 Libra Dr, Orlando FL 32816, pohl@Knights.ucf.edu

Introduction: Several subtypes of carbonaceous chondrites are rich in water. Water is typically "stored" in the form of hydroxyl, typically present in the serpentine group of minerals. In order to be able to evaluate the state and level of hydration of such asteroids, it is necessary to understand how these bodies lose water, in particular, to know the temperature and the actual process of dehydration. Such information is important for understanding the history of the body, connection with a parent asteroid, interpretation of spectra, mission planning, In Situ Resource Utilization.

The main minerals found in the associated meteorites are Mg-Serpentines and Cronstedtite [1], [2]. Although Cronstedtite is a mineral fo the Serpentine group, we purposedly 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 only available for high pressures (typically GPa and atmospheric levels). Data for dehydration in vacuum or for any dehydration data for Cronstetite are very limitedt. This work contains results of measurements of Serpentine and Cronstedtite under both atmospheric and vacuum conditions while varying various experimental conditions.

Experimental methods: Two methods were employed to characterize the dehydration process: Simultaneous Thermogravimetric analysis (TGA) and Differential Scanning Calorimetry (DSC) under inert gas purge flow and vacuum. As a confirmation, an independent measurements using Temperature Programmed Desorption (TPD) under vacuum of about 10^{-10} torr. To characterize the post-dehydration mineralogical state, X-Ray Diffraction (XRD) was used.

Control parameters: The parameters that affect the dehydration process [3], beside the mineralogy and purity of the sample, are: heating rate, grain size, amount of sample, pressure or inert gas flow. The effect of pressure was investigated using TPD under ultra high vacuum (10^{-10} torr) and a combined TGA-DSC using Nitrogen gas flow at a constant rate and vacuum of about 10^{-4} torr. Samples were sieved to four grain size ranges to characterize how the process depends on the grain size. We also varied heating rate to determine how it affects the dehydration process.

Samples. Antigorite, Lizardite (Mg-Serpentines) and Cronstedtite were investigated. The samples were first analyzed using XRD to verify their composition. The typical mass of the sample ranged from 10 mg to 50 mg. Samples were kept at around 130 C for at least an hour to remove adsorbed water.

Results: We determined [3] that Antigorite and Lizardite starts dehydration process at around 600 – 650 C and ends at about 800 - 850 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 itstarts its dehydration at around 400 - 450 C under inert atmosphere, almost 200 C lower that Antigorite and Lizardinte 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. Fig. 2 depicts the effect varying grain size on dehydration of Cronstedtite. On DSC plot, one can see that the peaks are affected by grain size by about 30 – 50 C.

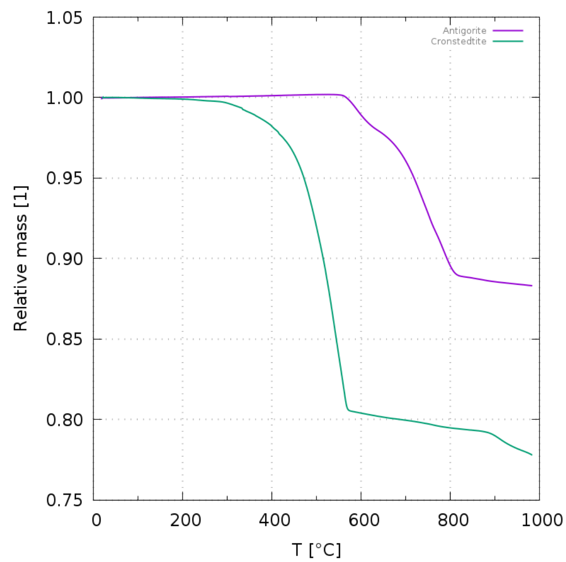

Figure 1 - Mass loss curve for Antigorite and Cronstedtite under inert gas flow.

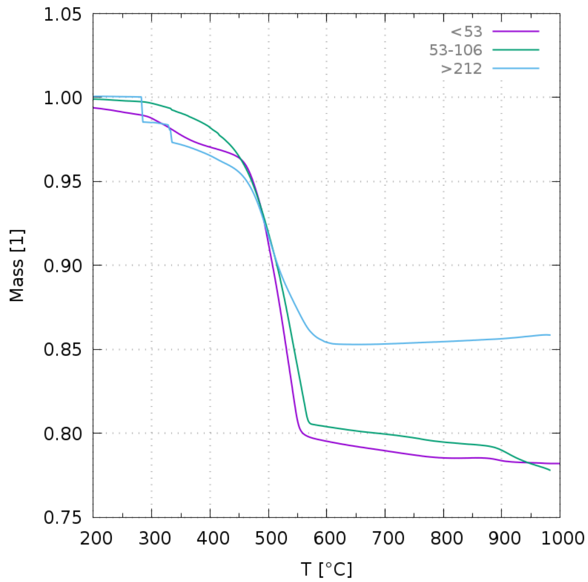

Figure 2 - Comparison of dehydration process for various grain sizes of Cronstedtite.

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 – 200 C lower dehydration temperature of Cronstedtite vs Mg-Serpentines, compared to about 50 C difference between vacuum and atmospheric runs. Grain size does affect the dehydration and DSC peaks by about 30 C. Such difference in dehydration temperature for Cronstedtite rich asteroids is significant and it makes dehydration more probable for these bodies. We are currently planning measurements on samples of Murchison meteorite. Also we will conduct further analyses to that would allow a detailed characterization of individual phase transiotion as well as spectroscopy measurements of the dehydrated samples which should provide more insight for comparison with asteroid reflectance spectra.

References: [1] Bland P. A. (2014) *MPS, 39,* 3–16. [2] Howard K. T. et al. (2015) *GCA, 149,* 206-222. [3] Pohl L. et al. (2018) In Preparation.