REGOLITH MATERIALS FOR ISRU IN VACUUM CONDITIONS: EFFECTS ON PHASE EVOLUTION, CHARACTER, AND COMPOSITION BY X-RAY PHOTOELECTRON SPECTROSCOPY AND IN SITU CALORIMETRY. C. J. Neal[1], L. Pohl[2], T. S. Sakthivel[1], D. Britt[1], and S. Seal[1,3], [1] Materials Science & Engineering Department, Advanced Materials Processing & Analysis Center, Nanoscience Technology Center, University of Central Florida, [2] Physics Department, University of Central Florida, [3] College of Medicine, University of Central Florida

Introduction: Efficient, effective in situ resource utilization (ISRU) will require substantial investigation prior to implementation. In particular, material engineering parameters must be evaluated on earth, in processing environments which closely model the microgravity environments of space. Serpentine minerals ($[Mg,Fe]_3Si_2O_5[OH]_4$) are abundant in hydrated near-earth asteroids with mineralogies similar to CI/CM carbonaceous chondrites and therefore viable candidates for ISRU. These materials possess a low density layered structure of alternating tetrahedral and octahedral planes, comprised by silicon and oxygen, coordinated by hydroxyl groups. Studies into technological applications of such materials have demonstrated exceptional performance; particularly in energy storage and catalytic applications. It has also been shown that iron-containing serpentines can evolve nano-phase iron particles, potentially standing as a new mode of application. In this study we highlight the character of the Mg-rich serpentine antigorite's dehydration process as well as related changes in phase composition and character in an in situ, vacuum environment. Differential scanning calorimetry was performed (to 1200ºC (20ºC/min) in 100 mL/min nitrogen or vacuum environment (0.01 torr) to elucidate both temperature-dependent and kinetic parameters in phase evolution. XRD measurements were additionally performed on samples heated to 300, 600, 900, or 1200ºC in the chemically inert or vacuum environments. Given the significant change in phase chemical character/composition upon antigorite dehydration, X-ray photoelectron spectroscopy (XPS) was performed and analyzed. Samples were evaluated under charge compensation and spectroscopic data was deconvoluted to ascribe changes to elemental chemical environments (e.g. atomic bonding character/coordination). Granularity was demonstrated to strongly influence phase change kinetics (due to grain size effects). Therefore, samples were sieved to exclude larger grains (< 52 μm fraction retained for characterization), limiting size dispersion. The collective results of this study suggest the value in developing strict materials engineering parameters for ISRU applications in model environments.