QUANTITATIVE MINERALOGY OF A SMALL CARBONATE-BEARING CRATER IN HUYGENS BASIN, MARS. A. M. Zastrow[1] and T. D. Glotch[1], [1]Stony Brook University, Stony Brook, NY, 11794 (allison.zastrow@stonybrook.edu).

Introduction: Prao crater is a small (~20km diameter) crater located on the north floor of Huygens Basin, (Fig. 1). The spectral signatures of carbonates and other hydrated mineral signatures have previously been identified in Prao [1, 2]. Carbonate signatures in particular were noted both inside the crater as well as in its ejecta blanket, primarily on the west side. The crater has been hypothesized to be one of the handful of martian craters formed by a cometary impactor [3]. Prao has a fluidized ejecta blanket and a central pit, and it appears to have been filled since its formation.

In this work, we have made a quantitative map of mineral abundances in Prao crater using a set of 11 hyperspectral visible/near-infrared images (Fig. 2) from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) that cover the crater and its ejecta blanket. The radiative transfer-based CRISM atmospheric correction (as described in [4]) allows for a more direct comparison between CRISM images despite differences in time of day/year, viewing geometry, and atmospheric conditions. CRISM I/F spectra are converted to single scattering albedo (SSA), which allows us to use a linear unmixing model to produce a quantitative map for each image.

Mapping Results: Mineral groups that show coherent distributions across Prao and its ejecta include carbonate, phyllosilicate, and hydrated silica.

Carbonate mapping (Fig. 3). The carbonate group has the highest abundances of all the aqueously altered mineral groups, particularly inside the crater (0B5AF). The abundances peak along the north rim of the crater's central pit (Fig. 3, white arrow) and in the southwest corner of the crater floor (Fig. 3, orange arrow).

On the crater's ejecta blanket, there is a low-level of carbonate abundance in all of the CRISM images that does not appear to be strongly correlated to any specific geologic feature (potentially modeling noise in the images). The exceptions to this are the elevated abundances in 06533 and 0A0A0, both of which were positively identified as having carbonate signatures by Wray et al. [1]. Three carbonate mineral endmembers (calcite, magnesite, and siderite) were available in the spectral library. In all of the images, calcite was the only carbonate mineral identified.

Phyllosilicate mapping (Fig. 4). Inside the crater, higher modeled phyllosilicate abundances are roughly correlated to the high carbonate abundances, although their maximum abundance is approximately half of the max carbonate abundance. On the ejecta blanket, phyllosilicate abundances are roughly equivalent to carbonate, but are potentially better correlated to the geologic surroundings.

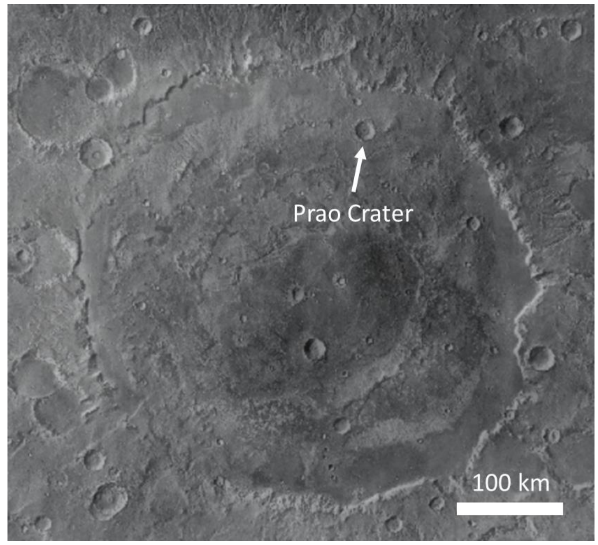

Fig. 1. THEMIS Day IR mosaic of Huygens Basin. (North is up in all figures.)

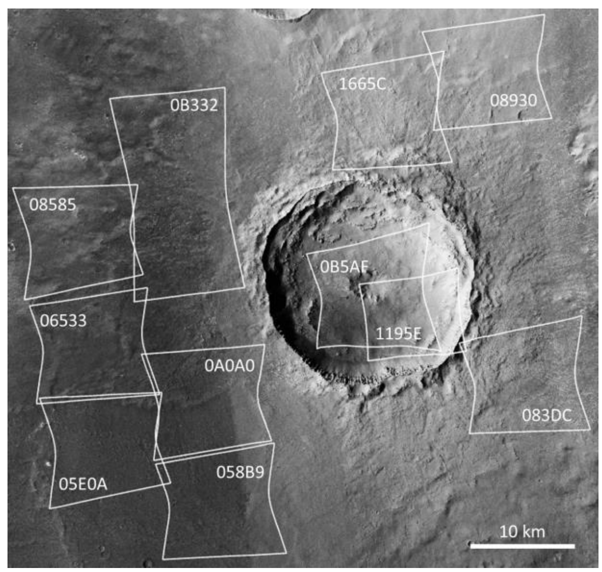

Fig. 2. Outlines of 11 CRISM images analyzed with image IDs. All images are FRTs with the exception of 0B332 (HRL) and 1195E (HRS).

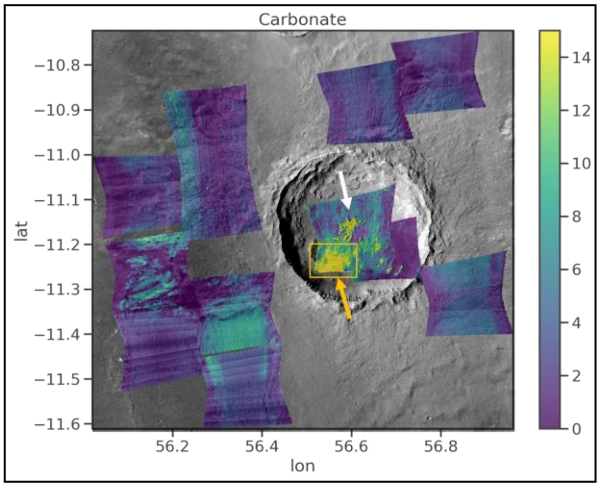

Fig. 3. Modeled carbonate abundance map.

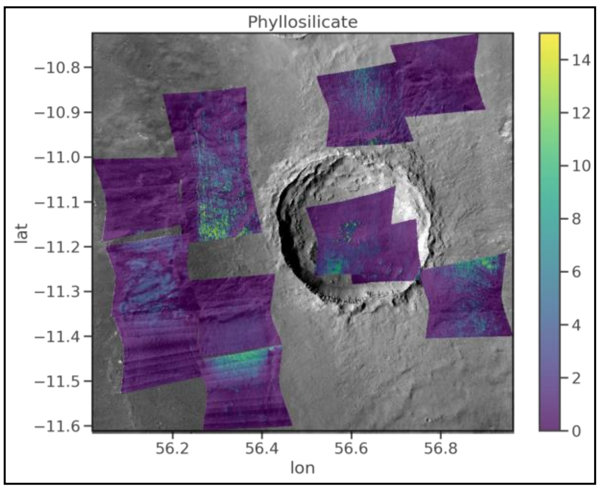

Fig. 4. Modeled phyllosilicate abundance map.

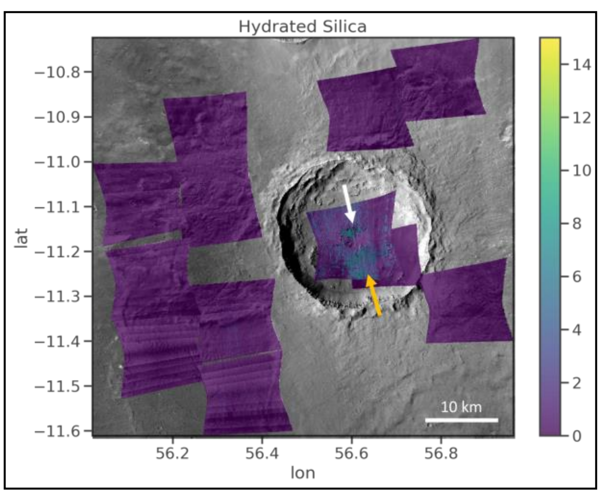

Fig. 5. Modeled hydrated silica abundance map.

Acknowledgements: This work was supported by the NASA MDAP award #80NSSC18K1372.

Hydrated silica mapping (Figure 5). Unlike the modeled carbonates and phyllosilicates, hydrated silica only appears inside the crater (0B5AF), and at generally low abundances. Its concentration is highest inside the central pit on the north side (Figure 5, white arrow) and the southeast side of the crater floor (Figure 5, orange arrow).

A closer look inside the crater. Elevated abundances of carbonate and phyllosilicate within the crater can be divided into two settings: the crater's central pit (and walls) and the crater floor (Figure 6). The outcrop on the crater floor is dark in appearance compared to the rest of the floor, and has more aeolian cover, which is enriched in olivine. The area is also enriched in diopside (HCP), which may be due to sand sourced from the south rim of the crater. The limited southern extent of 0B5AF inhibits verification of the exact source.

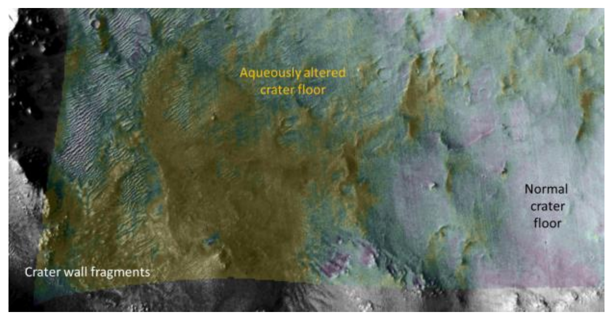

Fig. 6. Zoom of orange box from Figure 3. Modeled carbonate abundance for 0B5AF overlying CTX mosaic. Illustrates difference between dark aqueously altered crater floor, crater wall fragments with aqueously altered minerals, and the normal, light crater floor.

Discussion: It is likely that the presence of aqueously altered minerals identified by our modeling in Prao's ejecta blanket is due to volatiles present in the target rocks that allowed fluidization to occur. Based on the crater diameter, rocks in the central pit would have been exhumed from ~1.9 km below their current elevation (using the equation $SU=0.086D^{1.03}$ from [5]).

The distinct appearance of the altered crater floor carbonates, as well as the hydrated silica modeled only within the crater (although not exactly co-located with the altered floor unit), indicate that perhaps these minerals inside the crater formed in an aqueous environment that existed either because of or subsequent to the crater's formation.

References: [1] Wray J. J. et al. (2015) *JGR Planets, 121:4*, 652-677. [2] Ackiss S. E. et al. (2014) *8th Mars*, Abstract #1038. [3] Schultz P. H. and Quintana S. N. (2017) *Icarus, 292*, 86-101. [4] Liu Y. et al. (2016) *JGR Planets, 121:10*, 2004-2036. [5] Grieve R. and Pilkington M. (1996) *AGSO J. Aust. Geol. Geophys., 16*, 399-420.