HUYGENS CRATER AND THE HIGHLAND TERRAINS IN WESTERN TYRRHENA TERRA: MINERALOGIC MAPPING WITH CRISM DATA. K. D. Seelos[1], O. S. Barnouin[1], and the CRISM Team, [1]JHU Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723 (kim.seelos@jhuapl.edu).

Introduction: Huygens is a relatively well preserved, ~490 km-diameter peak ring crater on Mars located in the Noachian highlands between Terras Tyrrhena and Sabaea (**Fig 1**). It is also situated along the northwestern rim of Hellas basin and further bisected by a regional SW-NE-trending fracture system. Predominant geologic units include Noachian terrains (primarily Npld), that are partially covered by Hesperian ridged plains (Hr) [1].

With greater than ~30 km of crustal stratigraphy exposed or exhumed in the crater wall, ejecta and central peak ring materials [2, 3], the Huygens impact is a unique probe of Noachian mineralogy. In a region where numerous small outcrops of alteration minerals (e.g., phyllosilicates) have been identified [e.g., 4, 5] and mafic minerals abound [e.g., 6, 7], Huygens should help to understand the spatial distribution of such outcrops as well as how and when they were emplaced.

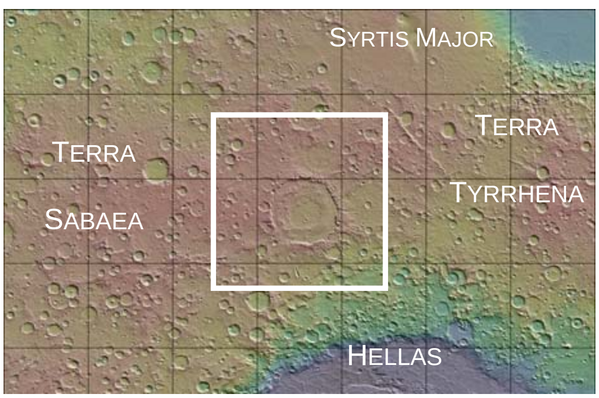

Fig. 1. Regional setting. Huygens is centered at 13.75°S, 55.5°E; the study region (white box) extends from approximately 2.5-22.5°S and 45-65°E.

Method: We investigate the mineralogy of Huygens basin and surrounding terrains through analyses of Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) visible and near infrared (0.36-3.9 µm) data [8]. CRISM multispectral mapping data mosaicked at ~230 m/pix are used to understand the regional mineralogic trends while hyperspectral targeted data (20-40 m/pix) are used to garner insight at specific locations. Mars Orbiter Laser Altimeter (MOLA) topographic data (128 pix/deg or ~460 m/pix) and Thermal Emission Imaging System (THEMIS) daytime and nighttime infrared data (256 pix/deg or ~230 m/pix) are used as basemaps.

Summary parameters that relate strengths of diagnostic spectral features [9] are utilized for first-order mineral detection and mapping. Detailed spectral analyses on hyperspectral images and comparison of extracted endmember spectra to library spectra allow confirmation of summary parameter indications and determination of mineral species.

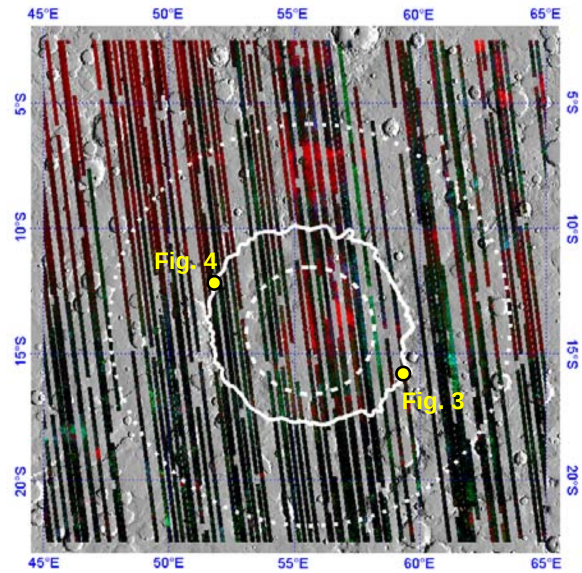

Fig. 2. CRISM multispectral map tile summary parameter composite, where R = olivine, G = low-calcium pyroxene, and B = high-calcium pyroxene indices. Huygens rim, peak ring, and expected extent of contiguous ejecta are outlined in white (solid, dashed, and dotted, respectively).

Observations: At the regional scale, mineralogic signatures are dominated by olivine-bearing plains that typically fill crater interiors and intercrater expanses (**Fig 2**). The presence of olivine is consistent with previous spectroscopic studies [e.g., 6], and is also in line with mapped occurrences of Hesperian ridged plains [1] that were likely volcanically-emplaced [10]. The increased spatial resolution of CRISM relative to prior orbital datasets reveals many additional olivine-bearing plains deposits. Other observed mafic signatures include variations in pyroxene composition, such as the small, distinct outcrop of low-calcium pyroxene shown in **Figure 3**.

Numerous small outcrops of phyllosilicates occur throughout the region, typically exhumed by impact craters. Evaluation of spatial relationships to Huygens or other geologic structures is ongoing; however, phyllosilicates do seem to be exposed in Huygens crater

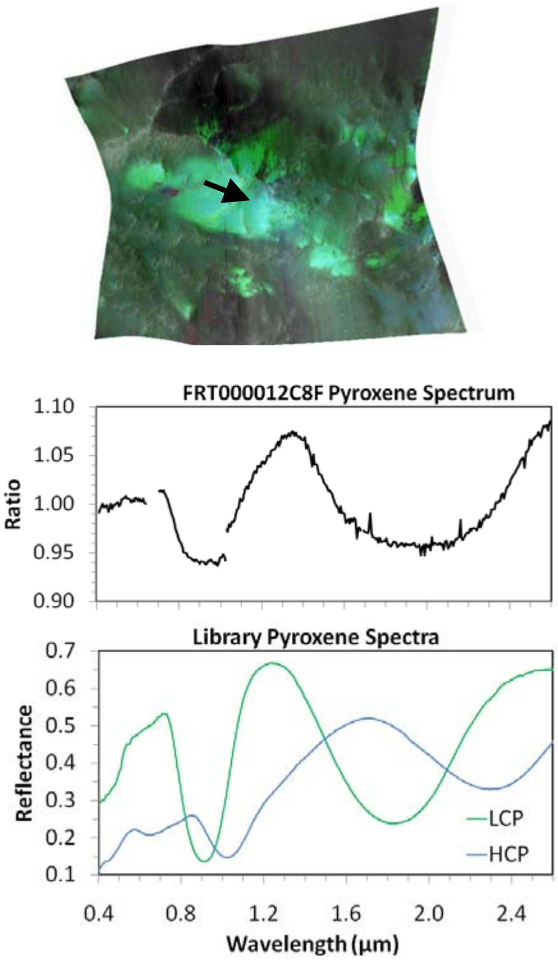

Fig. 3. CRISM hyperspectral image FRT00012C8F of a low-calcium pyroxene (LCP) outcrop on a knob along Huygens rim (top) (see Fig. 2 for placement). Mafic summary parameter composite (see Fig 2.) is overlain on infrared albedo at 1.3 µm. Ratio spectrum extracted at arrow is shown in the middle plot with library spectra for comparison below.

floor, rim, and ejecta materials which imply phyllosilicate presence at a variety of pre-impact stratigraphic positions. **Figure 4** shows an example phyllosilicate outcrop within a crater's central pit on the NW rim of Huygens. In this case, the spectra are consistent with an Fe-Mg smectite.

Discussion: Preliminary mineralogic mapping of Huygens crater and surrounding regions provides insight into lateral and stratigraphic mineral distributions within the Noachian highlands as well as subsequently emplaced Hesperian plains. The distributed presence of phyllosilicates outcrops could have several implications, including but not limited to: a) multiple phyllosilicate-bearing horizons within the Noachian crust that have been periodically exhumed from different depths and/or reworked by impact processes, or b) phyllosilicate deposits formed locally and commonly throughout the region. Ongoing spectral analyses of individual outcrops to determine the exact mineralogy will aid in the exploration of these different scenarios as well as the geochemical environment present at the time of formation.

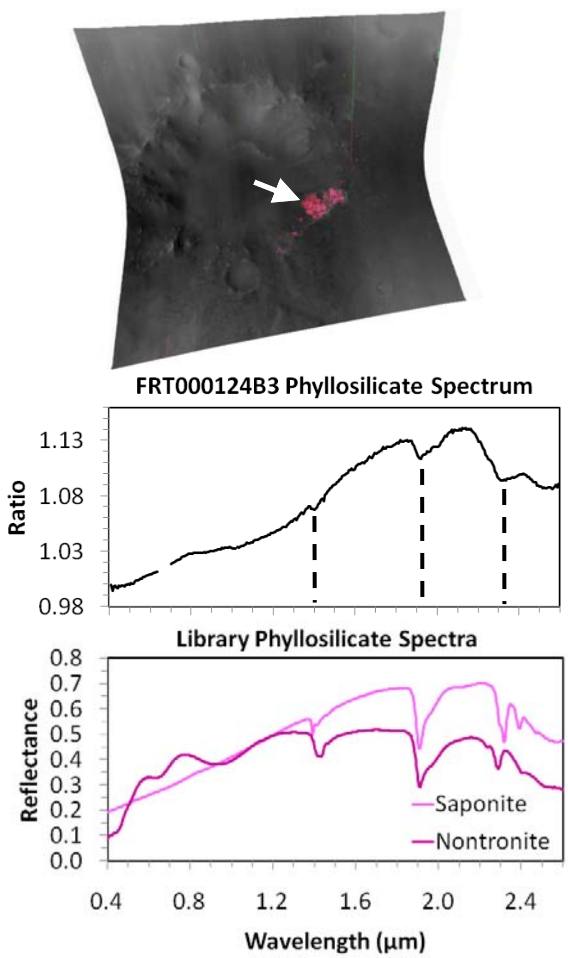

Fig. 4. CRISM hyperspectral image FRT000124B3 of a phyllosilicate outcrop in a central pit of a crater on Huygens rim (top; see Fig. 2 for placement). Phyllosilicate summary parameter composite (band depths at 2.3 µm [R], 2.2 µm [G], and 1.9 µm [B]) is overlain on infrared albedo at 1.3 µm. Ratio spectrum extracted at arrow is shown in the middle plot with library spectra for comparison below.

References: [1] Scott et al. (1987) *USGS Misc. Invest. Series*, Maps I-1802-A, B, C. [2] Croft, S. K. (1985), *LPS XVI*, 154-155. [3] Holsapple, K. A. (1993) *LPS XXIV*, 665-666. [4] Bibring, J. -P. et al. (2005) *Sci., 307*, 1576-1581. [5] Pelkey, S. M. et al. (2007) *LPS XXXVIII*, Abstract #1994. [6] Koeppen, W. C. et al. (2008) *JGR, 113*, E05001. [7] Mustard, J. F. et al. (2005) *Sci., 307*, 1594-1597. [8] Murchie, S. L. et al. (2007) *JGR, 112*, E05S03. [9] Pelkey, S. M. et al. (2007) *JGR, 112*, E08S14. [10] Head, J. W. et al. (2006) *Geo., 34*, 285-288.