486958 2014 MU_{69} Ultima Thule Surface Composition Overview. W. M. Grundy[1], R. P. Binzel[2], D. T. Britt[3], M. W. Buie[4], J. C Cook[5], D. P. Cruikshank[6], C. M. Dalle Ore[6,7], A. M. Earle[2], L. Gabasova[8], D. E. Jennings[9], C. J. A. Howett[4], J. J. Kavelaars[10], I. E. Linscott[11], A. W. Lunsford[9], C. B. Olkin[4], A. H. Parker[4], J. W. Parker[4], E. Quirico[8], S. Protopapa[4], D. C. Reuter[9], S. J. Robbins[4], B. Schmitt[8], F. Scipioni[6], K. N. Singer[4], J. R. Spencer[4], J. A. Stansberry[12], S. A. Stern[4], A. J. Verbiscer[13], H. A. Weaver[14], and L. A. Young[4], [1]Lowell Observatory (Flagstaff AZ; w.grundy@lowell.edu), [2]Massachusetts Institute of Technology, [3]University of Central Florida, [4]Southwest Research Institute, [5]Pinhead Institute, [6]NASA Ames Research Center, [7]SETI Institute, [8]Université Grenoble Alpes, CNRS, [9]NASA Goddard Space Flight Center, [10]National Research Council of Canada, Victoria BC & Department of Physics and Astronomy, University of Victoria, [11]Stanford University, [12]Space Telescope Science Institute, [13]University of Virginia, [14]Johns Hopkins University Applied Physics Laboratory.

Introduction: In the opening hours of 2019, NASA's New Horizons spacecraft flew past the small transneptunian object (486958) 2014 MU_{69} nicknamed "Ultima Thule" at a distance of ~3500 km [1]. The low eccentricity (0.04) and low inclination (2.5°) of Ultima Thule's heliocentric orbit make it part of the "Cold Classical" Kuiper belt, which is distinct from more dynamically excited components of the Kuiper belt (e.g., "Hot Classical", resonant, Centaur, and scattered objects). Compared with these other Kuiper belt sub-populations, Cold Classical Kuiper belt objects (hereafter CCKBOs) have a redder color distribution [2-3], a steeper size distribution [4], and higher albedos [5-6], on average. Many of them are binaries [7]. These distinct properties of CCKBOs presumably result from their having formed *in situ*, in what would have been the outermost fringe of the planetesimal-forming part of the protoplanetary disk. That nebular environment may have differed in significant ways from the closer in, denser, giant-planet-forming regions of the disk where the more excited components of the Kuiper belt originated prior to having been perturbed into their present-day orbits by migrating giant planets [8]. A distinct transition between these two planetesimal populations is suggested by the fact that Neptune's outward migration stopped where it did, rather than continuing to plow further into the region of the planetesimal disk occupied by CCKBOs. Alternatively, Neptune's stopping where it did could be related to the increasing timescale of planetesimal formation as a function of heliocentric distance [9]. New Horizons has provided humanity's first up-close look at the product of planetesimal formation toward the edge of the environment where that process was able to operate, and where subsequent collisional disruption has least obscured the record [10,11].

Instruments: New Horizons is equipped with a highly-capable suite of scientific instruments. The primary remote-sensing instruments are the Ralph [12] wide angle color camera and near-infrared spectral imager combination and the LORRI [13] panchromatic narrow angle camera. LORRI is a 1024×1024 unfiltered CCD fed by a 20.8 cm SiC telescope. It is operated in the traditional point-and-stare framing mode. Ralph consists of two focal planes fed by a 75 mm telescope. The MVIC focal plane has a 128×5024 CCD array operated in framing mode. Additionally, there are four 32×5024 CCDs fitted with color filters plus two 32×5024 panchromatic CCDs, all of which are operated in Time Delay-Integration (TDI) mode, while scanning the field of view across the target scene. The LEISA focal plane has a single 256×256 HgTeCd array mated with linear variable filters, so that each row of the detector array is sensitive to a different near-infrared wavelength between 1.25 and 2.5 µm. This detector package is swept across the scene while recording frames so that, eventually, each portion of the scene has been imaged in each of LEISA's wavelengths.

Observations: New Horizons used its instruments to perform numerous observations during the approach, flyby, and departure phases of the Ultima Thule encounter. Some of the most eagerly anticipated remote sensing data sets include LORRI and MVIC panchromatic images at spatial scales from 30 to 200 m/px. MVIC color imagery at a spatial scale of 300 m/px, and LEISA spectral imaging at a spatial scale of 1.8 km/px. It could take approximately 20 months for New Horizons to transmit all of the data back to Earth. But for many of the highest value data sets, versions cropped to exclude large expanses of empty sky of will already have been received by the time of LPSC and will be presented at the meeting.

Results: Ultima Thule was revealed by the flyby to be a contact binary [1,14-15]. Two approximately spherical objects are joined by a narrow neck, implying the two precursor bodies come together in an exceedingly gentle merger [16]. Ultima Thule's low albedo and reddish color at visible wavelengths are typical of the CCKBOs [5-6,17-18], and the near-equal colors of its two lobes are consistent with the near-equal colors of the two components of more widely-separated Kuiper belt binaries, pointing to accretion from a locally homogeneous portion of the nebula [19]. Most infrared wavelengths were not yet received at Earth by the time of the abstract deadline but the few that were indicate a near-infrared reflectance higher than the reflectance at visible wavelengths, similar to colors that were seen by New Horizons on Pluto's Cthulhu and Charon's Mordor Macula, both regions thought to be predominantly pigmented by organic macromolecules, albeit produced via distinctly different mechanisms [20-21]. Compositional comparisons to other solar system populations and also to models involving potential constituent materials such as ices, silicates, sulfides, and tholins will be presented at the LPSC meeting [22-26].

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