GEOMORPHOLOGICAL MAPPING OF THE ENCOUNTER HEMISPHERE ON PLUTO.
O. L. White[1], S. A. Stern[2], H. A. Weaver[3], C. B. Olkin[2], K. Ennico[1,3], L. A. Young[2], J. M. Moore[1], A. F. Cheng[2], and the New Horizons Geology, Geophysics and Imaging Theme Team. [1]NASA Ames Research Center, Moffett Field, CA, 94035-1000 (oliver.l.white@nasa.gov), [2]Southwest Research Institute, 1050 Walnut Street, Suite 300, Boulder, CO, 80302, [3]The Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD, 20723.

Introduction: Six months after its flyby of Pluto in July 2015, New Horizons has returned high quality images (achieving ~80 m/pixel in resolution) covering the encounter hemisphere of the planet, which reveal it to have a highly diverse range of terrains, implying a complex geological history. The highest resolution images that were initially received on the ground covered most of the prominent Plutonian feature informally named Sputnik Planum, and its surroundings, allowing detailed geomorphological mapping of this area to commence (Fig. 1) [1, 2]. All feature names used here are informal. See abstract #2440 [3] for an overview of the geology of Pluto.

Geomorphological Mapping To Date: Sputnik Planum, with an area of ~870,000 km^2, is notable for its smooth appearance and apparent total lack of impact craters at ~320 m/pixel resolution (see abstract #2310 [4] for details of cratering on Pluto), and consists of N_2 ice with smaller concentrations of CH_4 and CO ice [5]. The Planum displays a variety of textures across its expanse, including smooth and pitted plains in the south; high-albedo cellular terrain in the center (the cells are bounded by troughs with medial ridges); and, in the north, lower-albedo cellular terrain (perhaps due to entrained dark material), which displays lobate patterns indicative of glacial flow into the rugged, hilly, cratered terrain north of Sputnik Planum. The cells likely form as a result of solid-state convection occurring within the N_2 ice [5]. 168 individual cells have been mapped, with a mean diameter (assuming a circular planform) of 33 km ($\sigma = \pm 17$ km) [2]. The network of troughs defining the edges of the cells becomes less interconnected in central Sputnik Planum, perhaps indicating thicker N_2 ice at this location. Separating Sputnik Planum from the cratered highlands to the west are ranges of chaotically-oriented mountains that stretch all the way along its western margin, and which may represent fragments of Pluto's H_2O ice crust that have been transported and reoriented by the N_2 ice of Sputnik Planum. Bright, rugged, pitted uplands to the east may have been resurfaced by deposition of N_2 ice that sublimated from Sputnik Planum, and which is reintroduced back into the Planum via glacial flow from the uplands (see abstract #1089 [6] for further details of Pluto's glaciation). To the south of Sputnik Planum is a ~150 km-diameter edifice (Wright Mons) that shows a rough, undulating surface with very few impact craters at ~230 m/pixel resolution [4], and which features a very wide and deep summit depression. The bulk morphology of Wright Mons, (and that of Piccard Mons, an even larger edifice to the south), has caused it to tentatively be interpreted as a cryovolcanic edifice (see abstract #2276 [7] for further details of Wright Mons).

Continued Geomorphological Mapping: Mapping performed to date is presented in Fig. 1, and includes mapping of cell boundaries and isolated troughs in Sputnik Planum, as well as apparent extensional faulting in the surrounding terrain. Forthcoming mapping to be presented at LPSC XLVII will cover terrain to the east and west of the current mapping area, including the terrains discussed below.

The bright pitted uplands to the east of Sputnik Planum eventually transition to the 'bladed terrain' of Tartarus Dorsa. The stratigraphic relationship of the bladed terrain to the pitted uplands is a subject of interest. Tartarus Dorsa consists of several broad (~100 km-wide), ~NE-SW-aligned swells that are covered in ~N-S-aligned blade-like ridges. Individual ridges are typically several hundred meters high, and are spaced 5 to 10 km crest to crest. Both the pitted uplands and bladed terrain may be remnants of a formerly continuous deposit degraded either by sublimation (forming features analogous to those of degraded terrestrial snow or ice fields - penitentes and sun-cups - but much larger), or through undermining and collapse, possibly through melting at depth. However, whether both types of terrain did indeed form in the same way, with one merely being a more modified version of the other, or if the pitted and bladed textures formed through independent means, remains to be determined. See abstract #1636 [8] for further details on the pitted uplands and bladed terrain.

To the north of the pitted uplands and the bladed terrain is the 'eroded mantle terrain', i.e. material is draping underlying topography. The density of craters here is low except for a few degraded examples that are >50 km across, The mantle appears smooth with convex rounded edges. This terrain is also characterized by erosion via steep-sided pitting that reaches 3-4 km deep and tens of km across. The larger pits display elongate and irregularly-shaped planforms and may indicate that material is being sapped from the subsurface at these locations. The smaller pits are sometimes interjoined and aligned in chains, which may indicate formation via collapse through tectonic extension.

Cthulhu Regio, located to the west of Sputnik Planum, covers a swath from ~15°N to ~20°S, and stretches westward almost half way around the planet to 20°E. Cthulhu Regio appears not to be a distinct physiographic province, but instead a region of dark mantling thin enough to preserve underlying topography, superimposed upon various geological terrains, including dendritic valleys, craters, faults, and retreating scarps. Northeastern Cthulhu Regio, bounding Sputnik Planum, appears to be amongst the oldest terrains on Pluto, with a high spatial density of impact craters [4] that appear relatively unmodified.

Terrain to the west of Sputnik Planum appears more heavily tectonized than that to the east, featuring numerous extensional fractures (graben and normal faults) in various stages of degradation. At ~30°N, there exists a region of mottled plains that is bounded by an arcuate scarp (Piri Rupes, see Fig. 1) along part of its southern and western borders. These plains appear to have been exhumed through degradation of an overlying layer (perhaps through sublimation of material forming plateaus that surround the plains), and scarp retreat may be occurring at edges of the plains.

To the northwest of Sputnik Planum, smooth, flat and bright cratered plains are encountered. In some locations, these plains show a fretted appearance, whereby they are separated into polygons by a network of darker troughs reaching 3 to 4 km wide. This morphology may indicate tectonic disruption of the crust.

This mapping project is revealing the remarkable extent of Pluto's geological diversity. Several units seem to be encountered only in a particular location (as far as we can tell), and are not obviously replicated in other parts of Pluto, indicating that unique sets of landscape modification conditions may occur on Pluto.

References: [1] White O. L. et al. (2015) *AAS DPS 47th Annual Meeting*, Abstract 210.06. [2] White O. L. et al. (2015) *AGU Fall Meeting*, Abstract P41E-06. [3] Spencer J. R. et al. (2016) *LPSC XLVII*, Abstract #2440. [4] Singer K. N. et al. (2016) *LPSC XLVII*, Abstract #2310. [5] Stern S. A. et al. (2015) *Science, 350, No. 6258*: aad1815. [6] Howard A. D. et al. (2016) *LPSC XLVII*, Abstract #1089. [7] Singer K. N. et al. (2016) *LPSC XLVII*, Abstract #2276. [8] Moore J. M. et al. (2016) *LPSC XLVII*, Abstract #1636.

Fig. 1. Simple cylindrical projection of most of Pluto's encounter hemisphere. Geomorphological mapping performed to date is indicated by the multicolored region at center. Black lines indicate cell boundaries and troughs in Sputnik Planum, and thin red lines indicate extensional tectonism. Ellipses mark the locations of regions outside the currently mapped area that will be the subject of forthcoming mapping.