Pluto System and Beyond –Results from New Horizons

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In July 2015 the New Horizons spacecraft flew through the Pluto system, completing reconnaissance of the classical planets and commencing the in situ exploration of the Kuiper Belt [1]. Pluto turned out to be a world of remarkable geologic diversity, and its terrains display a range of ages, suggesting geologic activity of various forms has persisted for much of Pluto’s history [2]. Images looking back at Pluto’s atmosphere led to the discovery of numerous haze layers in its thin nitrogen atmosphere [3]. We are in the early stages of understanding this complex world, but I will highlight what we have learned so far and present the latest results focusing on Pluto’s unique geology. I will also outline the plans for the New Horizons observations of distant KBOs and its close flyby of the small Kuiper Belt Object $2014MU_{69}$ on January 1, 2019.

Although Pluto’s lithosphere is thought to be predominantly water ice, the volatile ices N_2, CH_4, and CO dominate much of its surface [4]. Pluto’s terrains contain many features that are likely due to sublimation and re-deposition of these volatile ices during seasonal and climactic cycles. Some examples include pitting on various scales, a unique region referred to as “bladed terrain”, and patterns of bright and dark material (such as bright methane ice on the high altitude peaks of some mountains). The darker material found on Pluto is likely due to surface tholins, which are produced when methane is photolytically processed into heavier hydrocarbons. Additionally, NH_3 is observed on Pluto’s large moon Charon [4] and on Pluto’s smaller moons Nix and Hydra [5,6].

Several aspects of Pluto and Charon’s geology are, or were, driven by internal heat. Polygonal and cellular planform shapes in Pluto’s vast nitrogen ice plains (informally known as Sputnik Planitia) are likely formed by ongoing solid state convection. Two enormous domes on Pluto (one 4 km high and 150 km across and the other 6 km high and ~225 km across) with large central depressions may have formed through cryovolcanism [7]. There are few craters on these broad mountains, indicating they are relatively young constructs. These observations challenge us to re-evaluate how smaller bodies retain heat and drive volcanism without tidal forcing. We note also that the southern portion of Charon (informally known as Vulcan Planum) appears to have been almost completely resurfaced by a thick, viscous cryovolcanic flow early in its history.

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Keywords: Pluto, Charon, Geology, Geophysics, Kuiper Belt, Spacecraft Missions