Brave New Horizons: Prospects for Observations of Endogenic Activity on Pluto and Charon. William B. McKinnon, Dept. of Earth and Planetary Sciences and McDonnell Center for the Space Sci., Washington University in St. Louis, Missouri, USA, mckinnon@wustl.edu.

In August 1989, *Voyager 2* flew within 40,000 km of Triton. In July 2015 *New Horizons* will fly through the Pluto-Charon system. Carrying modern instrumentation, in particular a mapping spectrometer and a panchromatic imager of increased resolution (4.95 vs. 9.25 μrad/px), and taking advantage of a reduced encounter speed (14 vs. 18 km/s) and closer flyby distances (14,000 and 30,000 km for Pluto and Charon, respectively), 14 July 2015 promises to revolutionize our understanding of geological activity on large Kuiper belt objects.

The highest resolution images to be returned from Pluto, at 75 m/px, can be compared with the 10-frame highest resolution mosaic of Triton, at ~400 m/px (and the highest resolution Charon images will be 150 m/px). Moreover, the overlay of spectral coverage will permit compositional context of the sort that could only be speculated on by *Voyager* experimenters. Unfortunately, the encounter distances will not permit determination of the second-degree gravity field of either body, although the triaxial shapes of Pluto and Charon offer an opportunity, at least in principle, to determine moments-of-inertia (degrees of differentiation). These shape measurements will be challenging in the sense that hydrostatic radius variations are expected to be less than 1 km (Charon's will be the largest of two), and could easily be overwhelmed by nonhydrostatic effects. On the other hand, a nonhydrostatic effect of great interest is fossil tidal/spin shape, one that would provide direct evidence for post-impact-formation orbital evolution as well as constrain long-term lithosphere thickness and heat flow (as has been done for Iapetus).

For Pluto, the question is whether, given its affinity with Triton, we will observe a similar suite of terrains, structures, and phenomena: cantaloupe terrain, double ridges, plumes, polar caps, and peculiar, apparently layered terrains. Compositional information will be key to developing robust hypotheses. Triton's plumes have been modeled as caused by insolation absorbed at depth in a clear N_2-ice layer, but the example of Enceladus' tidally driven plumes revives the possibility of truly endogenic activity. Triton's surface (that so far seen) is sparsely cratered, and while some controversy surrounds the interpretation of the impactor population, all workers agree that Triton's surface is geologically youthful. It is too youthful to be tied directly to nominal models of Triton's capture, orbital circularization and tidal heating (which place capture very early in Solar System history). Either Triton was captured late in a freak rare event, or it is what it appears to be, a geologically active dwarf planet powered by radiogenic heat alone. The latter, if true, bodes well for observations of geological complexity and activity on Pluto.

For Charon, the question is highly focused: do detections of NH_3-H_2O ice (which appear robust) imply that Charon is cryovolcanically active today? Some models make this claim, but such results are not robust against more plausible parameter choices or physical assumptions. One thing is clear, the ostensible incompatibility of NH_3 and larger amounts of CO_2, argued on chemical grounds, does not seem to be true (e.g., Enceladus' plume composition refutes this). Eruptions of eu/peritectic ammonia-water melt have long been predicted in bodies like Charon, at least in the geological past. Correlations of ammonia concentration with geological units and crater densities should clarify the issue of cryovolcanic history, and focus should fall on mechanisms to preserve surface exposures of what is generally viewed as a molecule unstable against UV and charged particle radiation.

Above all, however, we should expect to be surprised, and we all know the PI loves surprises!