INVESTIGATING A CRYOVOLCANIC COLLAPSE FEATURE IN CTHULHU REGION, PLUTO. C. J. Ahrens[1], V. F. Chevrier[1]. [1]Arkansas Center for Space and Planetary Science, University of Arkansas, Fayetteville, AR 72701, (ca006@email.uark.edu).

Introduction: The possibility of cryovolcanic structures on Pluto after the spectacular images from the New Horizons probe have led to questions regarding the tectonic evolution and underlying materials possible for making these features [1-3]. Cthulhu Region to the west of the Tombaugh Region shows a heavily cratered and reddish-material covered land, marking this region considerably more aged than its surrounding terrain. Observation of this region on Pluto has led to the discovery of a peculiar irregular depression that the authors hypothesize to be of cryovolcanic origins. This potential caldera has been compared to other Solar System calderas, relating to key factors of similar fractures, flows, and other structure features of the interior and exterior. It was also contrasted with other Pluto craters and depressions that could be due to impact or mass sublimation events.

The primary datasets used to evaluate the geologic observations in the Cthulhu Region were from the Ralph payload, mainly the Linear Etalon Imaging Spectral Array (LEISA): a shortwave-IR camera instrument onboard the New Horizons probe. Additional data products used for the manipulation of the images and measurements was the SAOImage DS9 imaging software produced by the Smithsonian Astrophysical Observatory.

Our feature (Figure 1) is a large, irregularly shaped topographic depression (~90.5 km by 59.9 km in diameter, N-S and E-W respectively) located at ~152 E, 7.8 N. This feature includes one large depression bounded by flow markings and thin, long fissures.

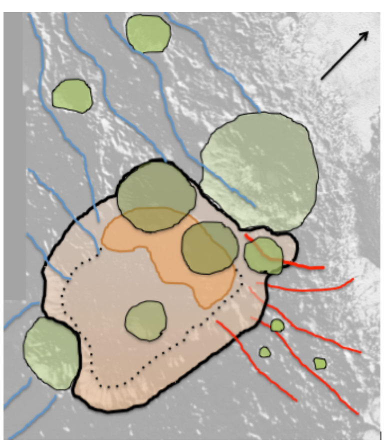

Figure 1: A geologic interpretation was sketched for identifying certain aspects of a caldera-like structure.

Observations:

Internal.

The caldera floor is smooth, though its northern region shows unevenness, possibly due to the unevenness of the collapse faulting. The distance from where the southern wall meets the primary floor to the start of the secondary floor is measured to be approximately 53.8 km. The depression walls are fluted.

External.

The cryocaldera is not circular, although disturbed by close craters on the north and south part. The possible lava flow west of our feature is compared with lava field flows on Mars near known volcanic regions, which were found to be similar in geometry in that the flow features were not linear, but rather sinuous flows outward from a source. We see the same flow on a smaller scale on the western side of the observed caldera. To the south of the caldera are broader flow features. To the southeast are very thin ring fractures parallel to the caldera rim. Further up the eastern rim are longer fractures radiating outward. The longest fracture is measured at about 39.8 km.

Interpretation: The tectonics of the region is still under speculation. One possibility we suggest is rather the movement of the underlying magma chamber from the impact that created the Tombaugh Region. It has been suggested that this Tombaugh Region is the aftermath of a basin impact aftermath [4]. From this massive impact, the magma chamber would have been forced to erupt then collapse rapidly (Figure 2) and migrated south to the current Wright Mons. This would explain the slight unevenness of the caldera floor in post-collapse restructuring from uneven faulting.

Comparisons: Icy bodies have been found to mask ejecta if the ice is active or result in halo effects, have secondary craters, heavily eroded walls, and fill on the crater floor, usually of different albedo [5]. However, the craters shown in the relatively same area on Pluto show significant weathering, the usual secondary craters or uplift, and variable uneven crater floors. Depressions throughout the Cthulhu Region have been identified as craters due to their relative distribution in this area. The other depressions north of this region show heavily fluted walls and some slumping, but no evidence of fracture markings and faulting.

Our feature does show preserved observable fractures related to a faulting mechanism, no secondary crater, no ejecta blanket or compositional halo, and a relatively smooth floor.

All icy satellites show evidence of mass movement and degradation, by several processes: mass wasting by gravity, bombardment, irradiation, or sublimation [6-8]. However, such icy body depressions show commonalities: 1) uneven walls, 2) lack of smooth floor, 3) no clear flow direction. These other depressions are on the size of several kilometers, irregularly shaped, show heavily fluted walls and some slumping, but no evidence of fracture markings and faulting. These depressions on Pluto show observable surface degradation and are possibly sublimation-driven.

Cryo-slurries also have motion in a subsurface context. On several icy bodies, there is substantial evidence of reservoirs of subsurface water [9]. We've seen several examples of depressions on other icy bodies, such as Ganymede, having scalloped depressions for possible cryo-volcanic venting [10,11].

In addition, the large volume of our collapse feature is a strong indication of the origin and constraints of formation. Different caldera faulting each has specific collapse geometry based on the underlying magma chamber [12,13]. A caldera with a relatively smooth floor, even with slight disorientation or secondary upwelling, requires either trapdoor or downsag subsidence [13].

Discussion: Constructs of calderas on Earth, Mars, and Ganymede were observed to have the following common characteristics: 1) outward flow features with possible fractures [14], 2) uneven low-relief depression, 3) mass-wasting [8] or erosion [15] only at wall-floor contact, and 4) evidence of stratigraphy of the crater wall. The presence of currently known volcanic features on Pluto, such as Wright Mons, suggests an active slurry subsurface acting as a cryo-magma [1,16]. Our feature is to the north of the currently observed volcanic structure, which may suggest a migration of the cryo-magma and a tectonic relationship of compositionally opposing areas [17]. This migration could be closely associated with a volcanic-arc type [18] where partial melting of the subsurface is combined with slight subduction of the surface.

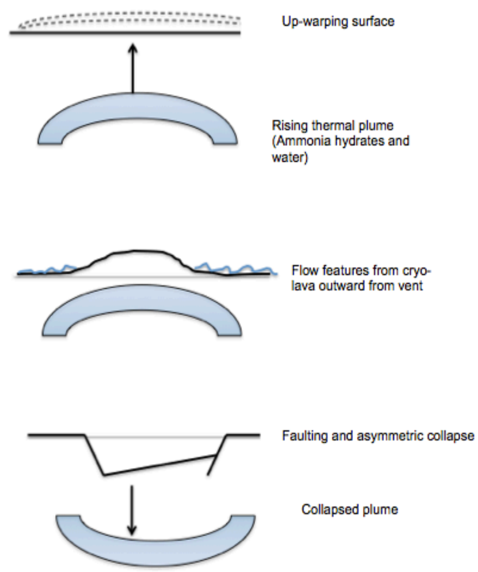

Figure 2: Simple schematic of an underlying cryo-magma chamber and collapse.

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