TESTING THE CRYOVOLCANISM HYPOTHESIS FOR VULCAN PLANUM, CHARON. M. E. Borrelli[1] and G. C. Collins[1], [1]Wheaton College, Norton Massachusetts; gcollins@wheatoncollege.edu.

Introduction: Portions of the southern hemisphere of Pluto's moon Charon observed by *New Horizons* are composed of smooth plains material, provisionally named Vulcan Planum. The edges of the plains material in Vulcan Planum curve downward into lower elevation "moats" [1] wherever the plains come into contact with surrounding (apparently older) terrain units. The sloping edges of the moats have been hypothesized to result from either flexure due to elastic plate bending from a load emplaced on the plains [1], or viscous flow of the plains material as it was emplaced [2]. We compare the topography at the edges of Vulcan Planum to topographic profiles that would result from either a plate bending model or a lava flow front model.

Methods: After importing the DEM of Charon into ArcGIS, topographic profiles were taken across the moat, extending into the smooth plains region. The fminsearch curve-fitting algorithm in MATLAB was used to plot the topographic profiles against the theoretical curve of a lava flow front with Bingham rheology, a lava flow front with Newtonian rheology, a loaded continuous elastic plate, and a loaded broken elastic plate. The code returns a correlation coefficient indicating how well the theoretical curve matches the observed profile, as well as the values of the parameters that best fit the curve.

Results: The four models were tested against 68 topographic profiles located along the northern boundary of Vulcan Planum, and surrounding two mountains within the plains (Clarke Mons and Kubrick Mons). While both the lava flow models and the plate bending models provided significant matches to some profiles, overall the plate bending models were more closely correlated with the shape of the topography and were significant fits for more of the profiles. For the plate bending models, the plate thickness was calculated using the flexural parameter value α found in the curve-fitting algorithm.

We recorded the results in which the correlation coefficients had values of 0.8 or higher. Out of 68 profiles, 23 of the profiles had high correlation coefficient for the Bingham flow model, and the yield stress that fit the profiles was 9830±6270 Pa. The Newtonian flow model yielded 24 profiles with high correlation coefficients, with an average flow speed of 2.3 m/s and an average slope of 1.1°, assuming ammonia-water viscosity of 2×10^4Pa s [3]. For the continuous elastic plate model, 51 profiles had high correlation coefficients and the average plate thickness was 1180±808 m. For the broken elastic plate model, 52 profiles had high correlation coefficients and the average plate thickness was 2690±3710 m.

The values for plate thickness were found to be in accordance with the values calculated for plate thickness of the terrain surrounding Serenity Chasma [4]. Additionally, the values for flow front velocity and dynamic viscosity in the Newtonian flow model are within reason, based on previous knowledge of flow velocity and behavior of ammonia-water slurries at low temperatures.

Discussion: Though the plate bending models resulted in better fitted curves to the topographic profiles, we lack an explanation for what is loading the plains material. The geomorphology of the isolated peaks and the cliffs along the northern margin all give the distinct impression that these features predate Vulcan Planum. If this interpretation was correct, it wouldn't make logical sense to treat these features as loads emplaced on top of Vulcan Planum.

The lava flow model also has its challenges. Given a lack of obvious source vents, it would have to be emplaced as some kind of flood lava. The moat would indicate that the flows encroached on the northern boundary by flowing from the south, but beyond ~100 km from the boundary, Vulcan Planum slopes downwards to the south. This could only be logically supported if the source vents were very close to the moat and flowed in both directions or if later subsidence has altered the topography to the south. It is also possible that the topography along the southern boundary is not well-constrained since it lies on the edge of the imaging coverage (Paul Schenk, pers. comm.).

We next plan on investigating whether the features in Vulcan Planum could be the result of a process that combines both plate bending and lava flow characteristics. We will be further testing the lava flow hypothesis by studying models of inflated lava flows in conjunction with models of dense material sinking into a highly viscous fluid [*e.g.* 5].

References: [1] Moore et al., Science 2016; [2] Schenk et al., ISPRS (abstract) 2016; [3] Kargel et al., Icarus 1991; [4] Beyer et al., Icarus 2017; [5] Beyer et al., in prep.