MEGASCALE IMPACTS INTO VESTA'S SOUTH POLE: THE MORPHOLOGIC CONSTRAINTS. P. Schenk,[1] D. O'Brien[2], H. McSween[3], D. Buczkowski[4], R. Gaskell[5], K. Otto[6], F. Preusker[6], S. Marchi[7], A. Yingst[2], S. Mest[2], C. Raymond[8], C. Russell[9], and the Dawn Science Team. [1]Lunar and Planetary Institute, Houston (schenk@lpi.usra.edu), [2]Planetary Science Institute, Tucson, [3]University of Tennessee, Knoxville, [4]JHU/Applied Physics Laboratory, Laurel, [5]Planetary Science Institute, Pasadena, [6]DLR, Institute of Planetary Research, Berlin, [7]NASA Lunar Science Inst., Boulder, [8]Jet Propulsion Laboratory, Pasadena, [9]Univ. of California, Los Angeles.

Introduction: The large 505-km-wide South Polar impact basin, Rheasilvia, on Vesta is the largest impact feature with respect to planet diameter observed to date. As such, it provides a unique window into large impacts into planetary scale bodies under near disruption conditions. Here we present an overview of Dawn mission findings for these large impact features and the constraints they place on impact models and HED's.

Description: A 450-km class impact feature on Vesta was first observed in HST data [1]. The first discovery by Dawn on approach in 2011 was that the impact feature actually consisted of two large overlapping basins [2], part of the complex impact history of Vesta [3]. The older Veneneia basin is 395-km across and is half obliterated by the younger 505-km Rheasilvia basin. The floor of Veneneia is highly disrupted and partially covered by Rheasilvia ejecta so we will focus mostly on Rheasilvia, except to note that Veneneia is associated with outcrops of dark material.

Rheasilvia: This large basin, centered at 72°S, 279°W (Claudia system), has a "complex" morphology, with a narrow rim scarp, broad floor material, quasi-conical central peak or complex. We will describe each briefly. The rim is relatively simple but variable along its circumference. In some regions it is a low ridge reflecting a break in slope. In other areas it is a narrow inward-facing scarp of a few hundred meters to ~25 km relative heights. A few large slump features have been identified, but they are not contiguous around the rim and absent in some quadrants.

The basin floor is not flat anywhere but slopes gently inward. It is highlighted by numerous minor landslides and by prominent linear to arcuate (1-2 km) scarps. These form an integrated (non-crosscutting) pattern across the entire floor arcing away from the central complex in a clockwise fashion, forming a spiral pattern nearly unique in the Solar System.

The central complex is ~200 km wide and 22 km high on average and has a rugged morphology. Hollows could be indications of impact melt but regolith formation precludes confirmation. Arcuate scarps suggest partial collapse of the complex on one side.

Varying thicknesses of heavily striated material mantles areas north of Rheasilvia, extending to the equator and beyond. This material is interpreted as ejecta 1-10 km thick (provisionally), consistent with decreasing degrees of crater erasure [3].

A set of spectacular large troughs extend along the equator. The geographic centers of these arcs are located within the basins, suggesting a causal relationship. We note that the troughs are not perfectly centered on the basins, however, suggesting a complex relationship. The only apparent radial features are a few sets of north-south crater chains.

Compositionally, the floor of Rheasilvia is heterogeneous [5]. Part of the floor is dominated by a diogenitic signature, which extends to the north beyond the rim suggesting partial excavation and ejection of deep crustal material. No unambiguous olivine signature has as yet been identified. The age of the basin is currently estimated at 1-2 Gyr [3].

Discussion: Volume calculations confirm that Rheasilvia was more than capable of ejecting enough material to form the Vestoid asteroid family and the HED meteoritie suite with it [2]. The lack of an olivine signature is not well understood, though gravity data are being interpreted with this question in mind. Impact modelers are working on refining their models using the new constraints, including trough formation. The high crater density on the troughs can be explained by ejecta landing after the stress waves pass.

One of the most surprising aspects of Rheasilvia has been the arcuate/spiral scarp pattern on the floor. These are interpreted as a record of the deformation pattern and stress field as the basin floor rebounded (and not to post-impact mass-wasting). The spiral pattern has been interpreted as due to failure during inward movement of floor material during post-excavation rebound. Two possible causes of the pattern have been suggested: coriolis deflection of floor material (the sense of rotation is correct) and failure patterns found in nature and experimentally in converging material. Both may be possible but discovery of similar patterns in natural crates suggests that coriolis may not be necessary. In the case of Rheasilvia, the absence of large volumes of impact melt leave these patterns exposed to view.

References: [1] P. Thomas, and others (1997), *Science* 277, 1492-1495. [2] P. Schenk, and others. (2012) *Science, 336,* 694-696. [3] S. Marchi and others. (2012) *Science, 336,* 690-693. [4] D. Buczkowski, and others (2012) *Geophys. Res. Lett., 39,* L18205. [5] H. McSween and others (2013) *J. Geophys. Res.*, 118, 335-346.