DAWN ARRIVES AT CERES: EXPLORATION OF A SMALL VOLATILE-RICH WORLD. C.T. Russell[1], C.A. Raymond[2], E. Ammannito[1], D.L. Buczkowski[3], M.C. DeSanctis[4], H. Hiesinger[5], R. Jaumann[6], H.Y. McSween[7], A. Nathues[8], R.S. Park[2], C.M. Pieters[9], T.H. Prettyman[15], S.P. Joy[1], C.A. Polanskey[2], M.D. Rayman[2], J.C. Castillo-Rogez[2], J.-P. Combe[10], A. Ermakov[11], M. Hoffmann[8], Y.D. Jia[1], J-Y. Li[12], S. Marchi[13], F. Preusker[6], T. Roatsch[6], O. Ruesch[5], P. Schenk[14], M.N. Villarreal[1], N. Yamashita[15]. [1]Earth Planetary and Space Sciences, University of California, Los Angeles (603 Charles Young Drive, Los Angeles, CA 90095-1567, ctrussell@igpp.ucla.edu), [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109-8099, USA, [3]Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723-6099, USA, [4]Istituto di Astrofisica e Planetologia Spaziali, Istituto Nazionale di Astrofisica, 00133 Roma, Italy, [5]Institut fur Planetologie, 48149, Munster, Germany, [6]Deutsches Zentrum fur Luft- und Raumfahrt, Institute of Planetary Research, 12489 Berlin, Germany, [7]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN 37996-1410, USA, [8]Max-Planck-Institut fur Sonnensystemforschung, 37191 Katlenburg-Lindau, Germany, [9]Brown University, Department of Environmental and Planetary Sciences, Providence, RI 02912, USA, [10]The Bear Fight Institute, Winthrop, WA 98862, USA, [11]Massachussetts Institute of Technology, Cambridge, MA 02139, USA, [12]Department of Astronomy, University of Maryland at College Park, College Park, MD 20742-2421, USA, [13]Southwest Research Institute, Boulder, CO 80302, USA, [14]Lunar and Planetary Institute, Houston TX 77058, USA, [15]Planetary Science Institute, Tucson, AZ 85719, USA.

Introduction: In March 2015, Dawn arrived at Ceres after its 7.5-year journey. It had orbited and mapped Vesta before arriving at its final target, the largest body in the main asteroid belt. There it found a dark, desiccated, heavily cratered surface, punctuated by small bright spots. Ceres suffered a similar cratering population as Vesta and is just as cratered at smaller sizes, but it is absent the largest expected craters and is gravitationally relaxed at lowest orders, implying a mechanically strong thick lithosphere with a weaker warm asthenosphere, both part of a volatile-rich mantle. Ceres' crust is a thin deposit containing ammoniated clay of probable endogenous origin, carbonates and dark material, and exhibits bright patches of possible salt concentrations. Beneath this crust is a mechanically strong layer, a mixture of water-ice and rock, with carbonates and salt. Smooth crater floors, flows of material across the surface, isolated mountains at least one of which appears to be an ice volcano, all point to the importance of volatile-driven activity on Ceres that likely involves brine-driven cryovolcanism.

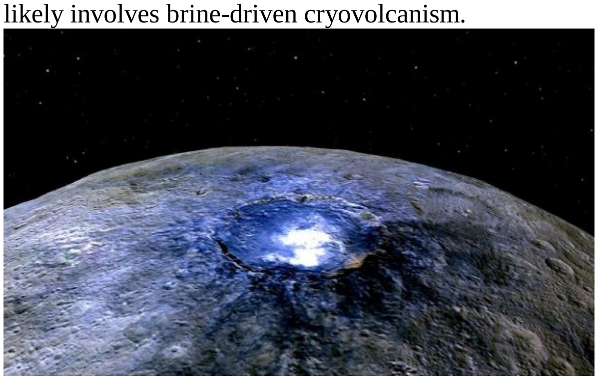

Figure 1. Occator crater, the home of the brightest and largest set of bright spots.

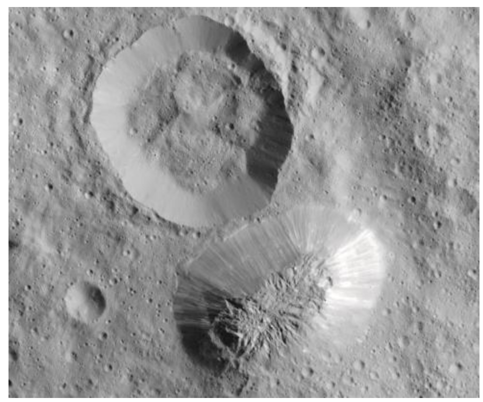

Figure 2. Ahuna Mons, possibly an ice volcano.

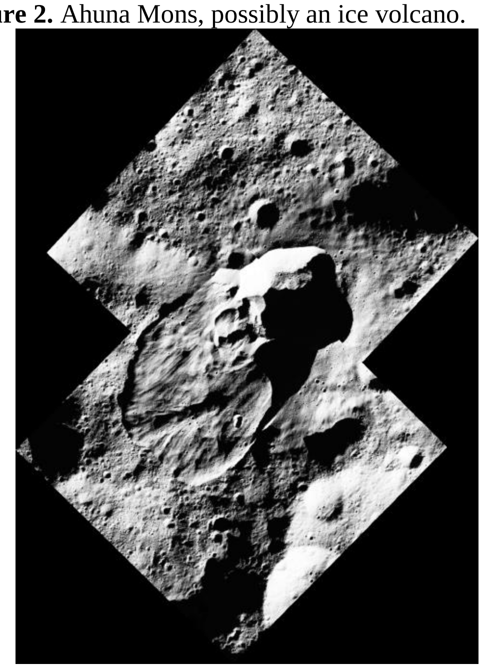

Figure 3. A recent flow apparently produced by an impact.

Distinctive Surface Features on Ceres: While the surface of Vesta is a rocky regolith covering large and small craters, the surface of Ceres is very dark and includes fissures, mountains, flows, and small local bright areas. Figure 1 shows a mosaic of the Occator crater and its bright spots. Figure 2 shows the Ahuna Mons, possibly an ice volcano. Figure 3 shows a typical flow, most probably initiated by an impact into a mixed ice-rock layer. Figure 4 is a schematic interior structure consistent with observations.

The Surface of Vesta vs. the Surface of Ceres: These two Mollweide projections show the topography of Vesta (left) and Ceres (right). The vertical relief on Vesta is about 2.5 times greater than that on Ceres. The surface of Vesta is scarred by large craters and circumferential graben, whereas Ceres' surface is dominated by smaller craters and many more fissures and cracks than Vesta.

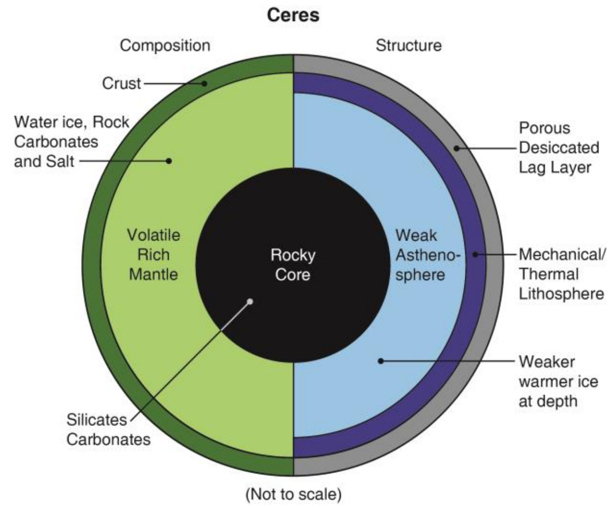

Figure 4. Possible interior structure consistent with Dawn's observation.

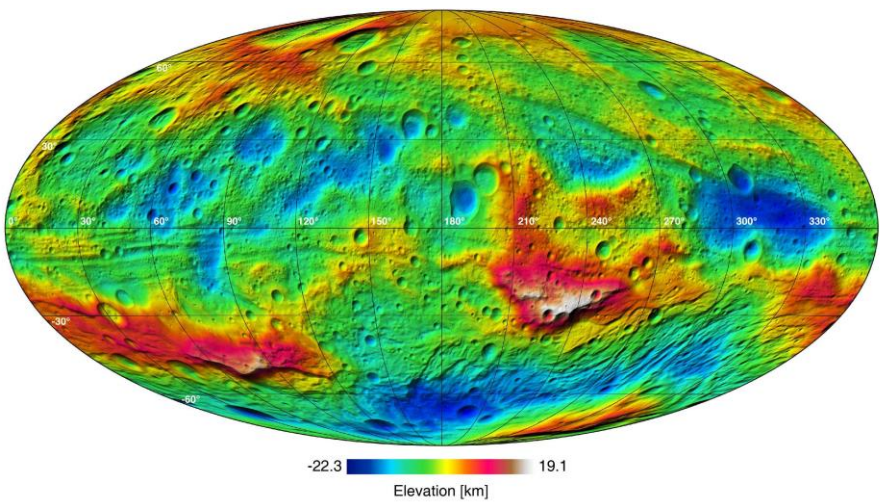

Figure 5. Mollweide projection of the colored contours of the topography of Vesta.

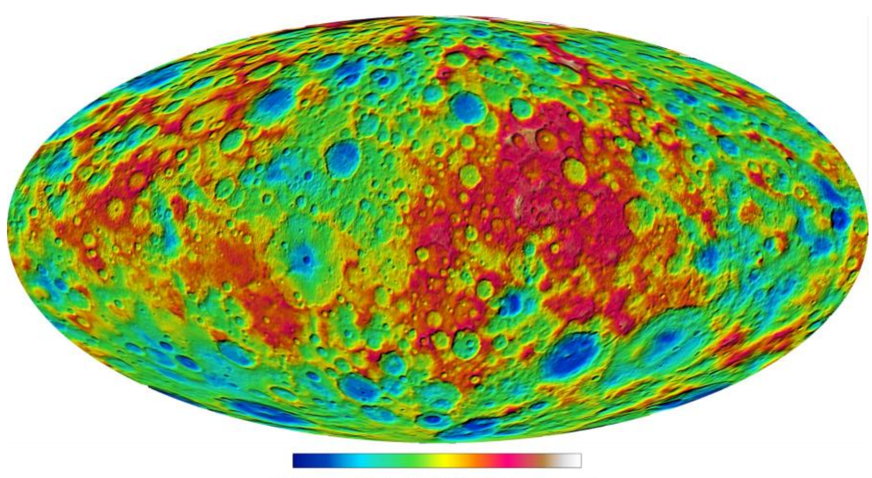

Figure 6. Mollweide projection of the colored contours of the topography of Ceres.