Dawn @ Ceres: Evidence for a Once Frozen Ocean World

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Before Dawn arrived, estimates of Ceres' mass and size showed that the density of Ceres was intermediate between water and silicate rock. This suggested that Ceres contained a significant amount of water in its interior, either free or bound in hydrates or clathrates. The precision gravity and topography data obtained by Dawn revealed that the crust was much stronger than water-ice but less dense than silicate, suggesting that the crust was an intimate mixture of rock, ice, and hydrates about 50 km thick. This crust had preserved recent "small" craters, but ancient large basins were subdued or absent. Dawn's camera revealed that the small very bright areas, now known as Cerealia and Vinalia Faculae, are mostly composed of sodium carbonate, probably created inside Ceres in a hydrothermal system. These observations are consistent with the present surface of Ceres being the product of an ancient ocean that first froze and was then eroded by meteor impact. Ceres once was and probably still is an active water world, as suggested by Ahuna mons, a geological feature believed to be of cryovolcanic origin. Ceres has water on its surface in the form of small ice patches, and it has a transient water atmosphere formed when strong fluxes of solar energetic protons strike the surface and liberate water molecules. This water world is further revealed by evidence for a global ice/water table that approaches the surface at high latitudes. Ceres awaits further landed and orbital exploration. Its low gravitational field, relative proximity to the Sun and benign radiation environment make Ceres an appropriate, accessible candidate in our exploration of ocean worlds.

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