Geophysical Research Abstracts
Vol. 18, EGU2016-11045, 2016
EGU General Assembly 2016

Regional Heterogenity In Ceres' Subsurface

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The Dawn mission arrived at Ceres in March 2015 to find a body different than expected. Dawn found that Ceres was slightly smaller (avg radius of 470 versus 476.2 km), flatter and denser than the previous estimates, raising the question of how completely Ceres had differentiated. Dawn's gravity measurements indicate that Ceres is close to hydrostatic equilibrium and there is some degree of central condensation, suggesting a gradient in the content of volatiles within the interior. The surface is heavily cratered indicating that the outer shell is not dominated by ice, as would be expected for a differentiated body. Crater preservation at all scales, absent those larger than $\sim$300 km, and complex morphology of the surface indicate a strong outer shell comprising no more than 40% ice by volume. The global, near-hydrostatic shape is consistent with a warmer, weaker interior beneath the strong outer shell. While the lack of evidence for an ice-dominated layer near the surface could indicate that it never formed, and thus Ceres only partially differentiated, an alternate explanation is that the volatile-rich outermost shell was lost as a result of im-pacts and to mixing of the ice with the silicate-rich briny layer that formed at the base of the former frozen ocean. Understanding the composition and rheology of the outer shell is a key part of solving the interior evolution puzzle. Thus far, we see evidence in the crater record for a viscosity several orders of magnitude higher than pure water ice; however, the crater preservation state varies considerably over the surface. There is no striking latitude dependence to the variation in crater preservation state, rather there are regional and local variations that juxtapose smooth, ap-parently relaxed or resurfaced areas next to areas of well-defined impacts and tectonic features. The largest craters Kerwan and Yalode are associated with surronding smoother, more sparsely cratered terrains, and show smooth inte-riors with subdued or degraded rims. Regional-scale variations in roughness and cratering could be caused by varia-bility in the viscosity of the volatile-rich shell, or could reflect a resurfacing process. However, these two processes would yield differences that would help to distinguish them. In the case of relaxation, the degree of crater obilitera-tion would be a function of crater size and age, and possibly would vary with latitude (temperature). If caused by resurfacing, the crater size frequency distribution would be similar to but offset with respect to that of the surround-ing terrains. Some correlation is seen between variations in the visible spectrum and the areas of smooth terrain. In either case, relaxation or resurfacing would indicate an internal process that resulted in primordial heterogeneity in the volatile-rich shell, or subsequent convective processes that drove regional resurfacing.