Preliminary Results from Initial Investigations of Ceres' Cratering Record from Dawn Imaging Data

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The highly successful Dawn mission [1] finished data collection at Vesta in 2012 and is now on its way to the dwarf planet Ceres. According to the current Ceres approach timeline of the Dawn mission, the ground resolution of the Dawn FC camera [2] will be about 10 times better than Hubble data [3] at the time of the presentation of this work. This may allow for identification of craters about 15 km in diameter. Initial mapping of sample areas may provide enough information of the cratering record in order to compare it with the theoretical Ceres crater production function we present at the 46th LPSC conference (March 16-20, 2015, The Woodlands, Texas) [4]. Our preliminary crater production function for Ceres is derived from the assumption of an icy crust just below a thin surface layer of dust [5], and a projectile population that is very similar to the one that impacted the Moon [6]. In order to scale the lunar cratering record to Ceres we use the Ivanov scaling laws [7], which allow for crater scaling based on parameters that can be derived from observations. The lunar-like approach gave reasonable good results for the crater production function on the asteroids Vesta, Ida, Lutetia and Gaspra [8]. Since the lunar surface is of basaltic composition, the correct scaling between the different materials is challenging. One crucial parameter is the transition diameter from simple to complex craters. Based on the simple to complex transition diameter on Iapetus, an icy satellite of Saturn, we expect this transition at about 12 km crater size at Ceres. This value may be slightly different due to the different temperatures at Ceres and Iapetus. If the simple to complex transition is observed at much larger diameters, the reason could be a substantial fraction of rock in the shallow subsurface of Ceres. In an ice-rich surface material high relaxation rates may also be expected that could change the shape of the crater production function.

A thorough geological mapping takes much more time than is available and, thus, will not be available at the time of the presentation. First hi-res imaging data will also provide details about crater morphologies and the major geologic units that will be analyzed during later stages of the Dawn mission.

References: [1] Russell C.T. et al. (2012) Science, 336, 684-686; [2] Sierks H. et al. (2011) Space Science Reviews, 163, 263-327; [3] Li J.Y. et al. (2006) Icarus, 182, 143-160; [4] Schmedemann N. et al. (2015): 46.LPSC, The Woodlands, #1418; [5] McCord T.B. et al. (2012) Ceres: Its Origin, Evolution and Structure and Dawn's Potential Contribution. In: Russell, C.T, Raymond, C.A. (eds.) The Dawn Mission to Minor Planets 4 Vesta and 1 Ceres. Springer, New York, 63-76; [6] Neukum G. and Ivanov B. A. (1994) Crater size distribu-tions and impact probabilities on Earth from Lunar, terrestrial planet, and asteroid cratering data. In: Gehrels T. (ed) Hazards due to comets and asteroids. University of Arizona Press, Tucson, 359–416. [7] Ivanov B.A. (2001) Space Science Reviews, 96, 87-104; [8] Schmedemann N. et al. (2014), 103, 104-130.