DETERMINING THE EFFECT OF INTERSTITIAL NEAR-SURFACE GROUND ICE ON THE MOBILITY OF LAYERED EJECTA DEPOSITS ON CERES

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During the Survey, High Altitude Mapping Orbit, and Low Altitude Mapping Orbit phases of the primary mission Dawn’s Framing Camera observed a multitude of globally distributed lobate deposits. These flows were broadly interpreted as either similar to ice-cored/ice-cemented flows (Type 1 flows) on Earth and Mars, long run-out terrestrial or martian landslides (Type 2 flows), or highly mobile fluidized ejecta-like deposits (Type 3 flows) (Schmidt et al., 2016; Buczckowski et al., 2016; Schmidt et al., *Accepted*). The Type 3 flows are morphologically similar to fluidized/layered ejecta found on Mars and Ganymede (Mouginis-Mark, 1979; Boyce et al., 2010). The main structural difference between these putative cerean fluidized ejecta flows and their martian/ganymedean counterparts is that the latter tend to form full aprons around the entire circumference of their parent crater, while the former generally only occur around a fraction of the circumference (usually < 180º) of their parent crater.

Though there exists no consensus on the mode of fluidization for these ejecta deposits on Mars or Ganymede a large number of authors have interpreted the martian variety to be related to the presence of volatiles (particularly water ice) within the regolith target materials (such as Mouginis-Mark, 1979; Carr et al., 1977; Woronow, 1981, Weiss & Head, 2014). We address the hypothesis that the occurrence, morphology, and mobility of Type 3 cerean flows are a result of impact into, and emplacement on, a ground ice rich near-surface layer and that variations in the upper structure of Ceres and/or quantity of ground ice alters the mobility of fluidized ejecta in otherwise similar craters. We do this by cataloguing the global distribution of these flows and making comparisons to elemental abundance and mineralogical data, gathered by Dawn’s Gamma Ray and Neutron Detector and Visible and Infrared Spectrometer respectively. We also quantify the ejecta mobility as a function of crater diameter and latitude. We define ejecta mobility (EM) as the ratio of the radius of the ejecta blanket versus the radius of the parent crater, and compare measured EM values of Cerean flows with various well studied martian analogs. We also measure drop-height-to-runout-length ratios (H/L) and compare them to planetary and experimental analogs of known composition.

We further asses the effect of ground ice as a lubricating agent in the production of these features by comparing the EM values for all Type 3 Cerean flows to a kinematic sliding model similar to the one developed by Weiss et al. (2014) to model the ejecta mobility for impacts into a variety of ground ice rich substrates of differing volatile content on Mars. This model should provide constraints on the relative importance of the effective coefficient of friction of the substrate beneath these flows, as well an independent estimate of the water ice content in the near surface.

Initial results from the global classification campaign suggests that Type 3 cerean flows preferentially occur at low- to mid-latitudes, which could be indicative of preferential creation or preservation at these locations. Measured H/L for these flows plot systematically lower than comparable length landslides on other terrestrial bodies. This reinforces their interpretation as propelled phenomena rather than gravitationally induced mass wasting. Since Ceres lacks any meaningful atmosphere, the morphological differences between Type 3 cerean flows and layered ejecta on Mars should be able to help quantify the role of interstitial gases and fluid drag in the creation of these features.

Keywords: Dawn, Ceres, Ground Ice, Fluidized Ejecta