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Morphology of Cryogenic Flows and Channels on Dwarf Planet Ceres

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Ceres′ surface is affected by numerous impact craters and some of them show features such as channels or multiple flow events forming a smooth, less cratered surface, indicating possible post-impact resurfacing [1,2]. Flow features occur on several craters on Ceres such as Haulani, Ikapati, Occator, Jarimba and Kondos in combination with smooth crater floors [3,4], appearing as extended plains, ponded material, lobate flow fronts and in the case of Haulani lobate flows originating from the crest of the central ridge [3] partly overwhelming the mass wasting deposits from the rim. Haulani′s crater flanks are also affected by multiple flow events radiating out from the crater and partly forming breakages. Flows occur as fine-grained lobes with well-defined margins and as smooth undifferentiated streaky flows covering the adjacent surface. Thus, adjacent craters are covered by flow material. Occator also exhibits multiple flows but in contrast to Haulani, the flows originating from the center overwhelm the mass wasting deposits from the rim [4]. The flows have a “bluish” signature in the FC color filters ratio. Channels occur at relatively fresh craters. They also show the “bluish” signature like the flows and plains. Only few channels occur at older “reddish” craters. They are relatively fresh incised into flow features or crater ejecta. Most are small, narrow and have lobated lobes with predominant distinctive flow margins. The widths vary between a few tens of meters to about 3 km. The channels are found on crater flanks as well as on the crater floors. The occurrence of flow features indicates viscous material on the surface. Those features could be formed by impact melt. However, impact melt is produced during the impact, assuming similar material properties as the ejecta it is expected to have nearly the same age as the impact itself, but the flows and plains are almost free of craters, thus, they seem to be much younger than the impact itself. In addition, the source of impact melt flows is diffusely distributed but many of the observed flows originate from district sources in the crater interior and the flows, however, are well defined. The compositional differences derived from the color ratio and possible time variable effects related to cryo-processes either volcanic or glacial [1,2]. Furthermore, the suggestion of an occurrence ice within the Cerean crust [5] as well as possible salts incorporated into a regolith layer [4,5,6] indicates similar geological processes as seen on other icy bodies. Some lobate flow-like deposits on Ganymede such as at Sippar Sulcus are suggested to be formed by volcanic eruptions creating a channel and flow, and cutting down into the surface forming a depression. Thus, an endogenic formation process cannot be excluded.

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