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# Revisiting the Cerealia and Vinalia Faculae on Ceres

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## 1 Introduction

In February and March 2016, the Dawn Spacecraft [1, 2] has for the first time taken high resolution FC [3] LAMO images at short exposure times of the enigmatic bright deposits located within the fresh Occator crater on Ceres. Since then, not only the bright deposits' (faculae) composition of $Na_2CO_3$ mixed with $(NH_4)_2CO_3$, $NH_4Cl$ and Mg and Al phyllosilicates [4] but also their formation by cryovolcanic eruptions [5, 6] and salt-water fountains [7] have surprised researchers. In addition, initial analyses yielded incredibly young model formation ages of the Cerealia Facula (CF) and Vinalia Faculae (VF) of only 4 Ma [6] and about 700-760 ka [8], respectively. Here we present the results of our more sophisticated approach to further narrow down the faculae formation ages and explain the uncertainties when age dating such sparsely or even uncratered surfaces.

## 2 Methodology

Since VF only form deposits of several meters up to few tens of meters thickness [8] and gradually fade with distance (Fig. 2), gathering their areal extent for subsequent age estimates by manual mapping involves a high degree of subjectivity. The areal extent affected by resurfacing by the faculae (and/or crater obliterating extensional tectonics [9]) is, however, crucial as results of our Poisson timing analysis [10] for dating sparsely or even non-cratered surfaces basically depend on the crater-size-dependent impact rate, the area size and the resolution dependent crater recognition limit. Therefore, we calculated the mean reflectance ($(I/F)_{avg.}$ = 0.097) and standard deviation ($\sigma$ = 0.064) of a mosaic of short exposure FC clear filter data FC59292, FC59290, and FC56966, and defined the faculae as material with a reflectance of $^{+}/_{-}1\sigma$ and beyond $+1\sigma$. The resulting areas and their sizes are depicted in the lower panel of Fig. 2 and are comparable to those of a similar approach by [7]. With the absence of craters larger than 4 px in diameter (~140 m at an avg. LAMO resolution of 35 mpx$^{-1}$) on VF, we can determine the age probability density functions (PDF) for the respective area sizes and for different chronology models. Moreover, at the time of writing, Dawn, currently in its second extended mission (XM2), is supposed to acquire even higher resolution data of the faculae of about 5 mpx$^{-1}$. So as a preview, we also calculated the age PDFs given the condition that even no craters larger than 20 mpx$^{-1}$ can be found on the faculae.

## 3 Results and perspective

We applied statistical image analyses in order to more objectively define the extent of CF and VF for accurately calculating their age PDFs for two versions of the Lunar Derived- (LDM) [11, 12] and five versions of the Asteroid Derived chronology Model (ADM) [13-15], developed for Ceres. Our results confirm and expand earlier age estimates by [8] and demonstrate

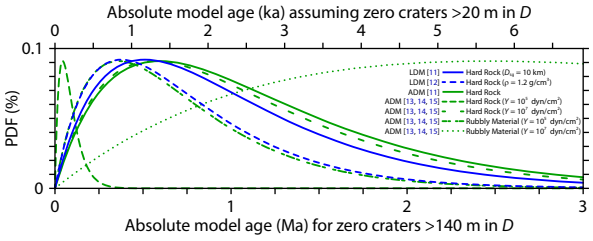


**Figure 1:** Model age likelihood functions derived for an area the size of all VF (Fig. 2) by evaluating different chronology models developed for Ceres [11-15]. The bottom axis shows the results of our Poisson timing analysis for zero craters larger than 140 m in *D*, while the top axis plots expected results in case even zero craters >20 in *D* are observed in upcoming high resolution XM2 data.

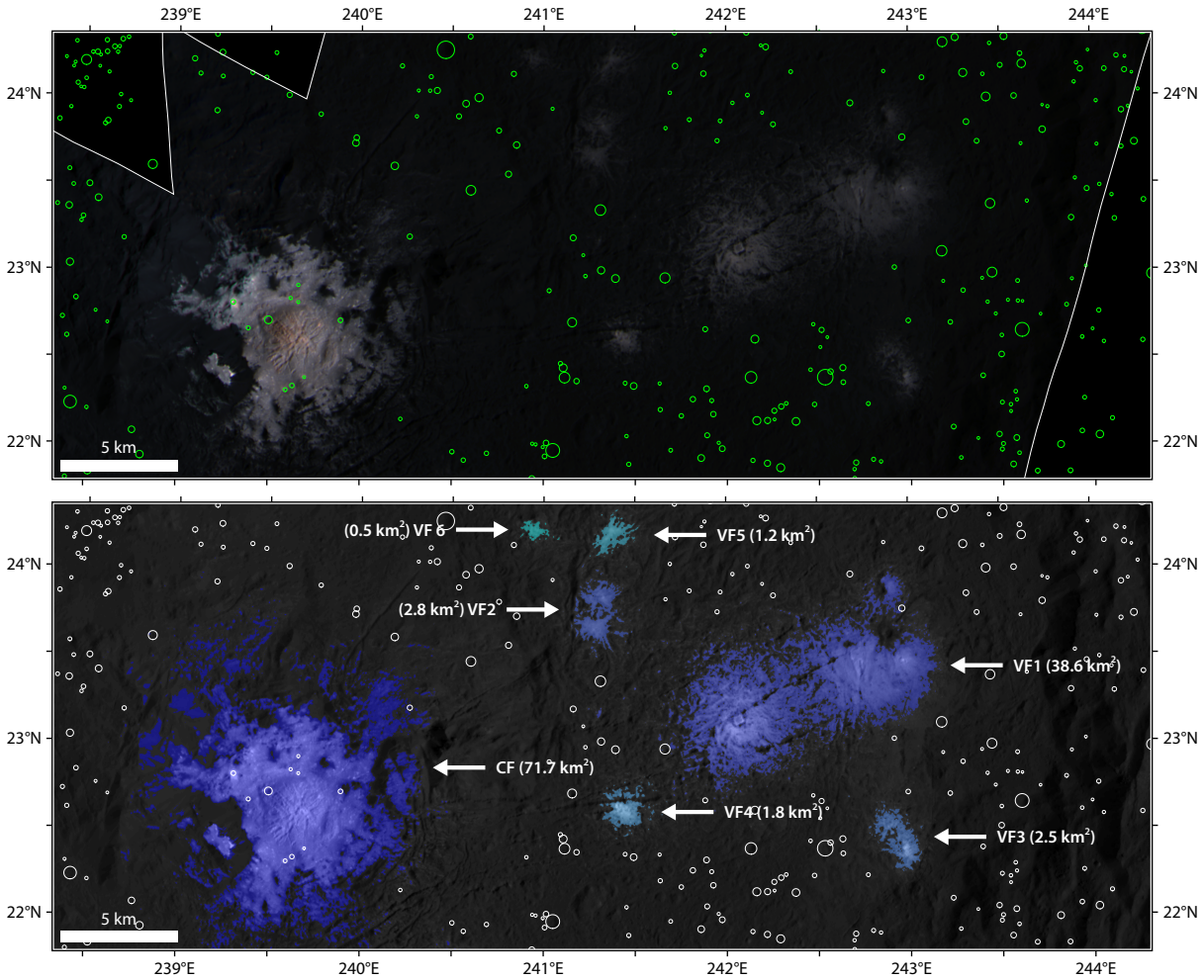


**Figure 2:** Top: Color composite of the interior of Occator crater using FC LAMO filters F7, F2, and F8 [3] data (R = 0.65 $\mu$m, G = 0.55 $\mu$m, B = 0.43 $\mu$m. Bottom: Mosaic of short exposure FC LAMO clear filter data (FC59292, FC59290, FC57273, FC56966) superimposed by the statistically derived areal extent of the faculae.

how the absence of craters >140 m in *D* around VF theoretically translates into model formation ages of not more than 0.5 Ma. In case Dawn successfully captures the faculae at 5 mpx$^{-1}$ during the XM2, we will be able to confirm our age perspectives for zero craters >20 m in *D* (Fig. 2) of only a few ka or amend the lower crater size boundary for the Poisson timing analysis.

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## References

[1] Russell et al. (2007), Earth, Moon, and Planets **101**. [2] Russell and Raymond (2011), Space Science Reviews **163**. [3] Sierks et al. (2011), Space Science Review **163**. [4] De Sanctis et al. (2016), Nature **536**. [5] Krohn et al. (2016), Geophysical Research Letters **43**. [6] Nathues et al. (2017), The Astronomical Journal **153**. [7] Ruesch et al. (in press), Icarus. [8] Nathues et al. (in press), Icarus. [9] Buczkowski et al. (in review), Icarus. [10] Michael et al. (2016), Icarus **277**. [11] Hiesinger et al. (2016), Science **353**. [12] Schmedemann et al. (pers. comm.). [13] O'Brien et al. (2014), Planetary and Space Science **103**. [14] Marchi et al. (2014), Planetary and Space Science **103**. [15] Neesemann et al. (in review), Icarus.