SHEDDING LIGHT ON OXO CRATER: A DETAILED INVESTIGATION OF THE GEOLOGY AND MORPHOLOGY OF ONE OF CERES' YOUNGEST FEATURES USING DAWN SPACECRAFT DATA

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Introduction and previous work: NASA's Dawn spacecraft arrived at the dwarf planet Ceres, the largest object in the asteroid belt (mean diameter of ~950 km), on March 6th 2015. Dawn is the first spacecraft to visit Ceres, which was previously studied by telescopic observations since its discovery on January 1st 1801 [e.g. 1, 2, 3]. Dawn has, and continues to acquire Ceres science data through three orbital phases of decreasing altitude: Survey, High Altitude Mapping Orbit (HAMO) and Low Altitude Mapping Orbit (LAMO). Data is collected by Dawn's radio science experiment, Framing Camera (FC), Visual and Infrared spectrometer (VIR), and Gamma Ray and Neutron Detector (GRaND).

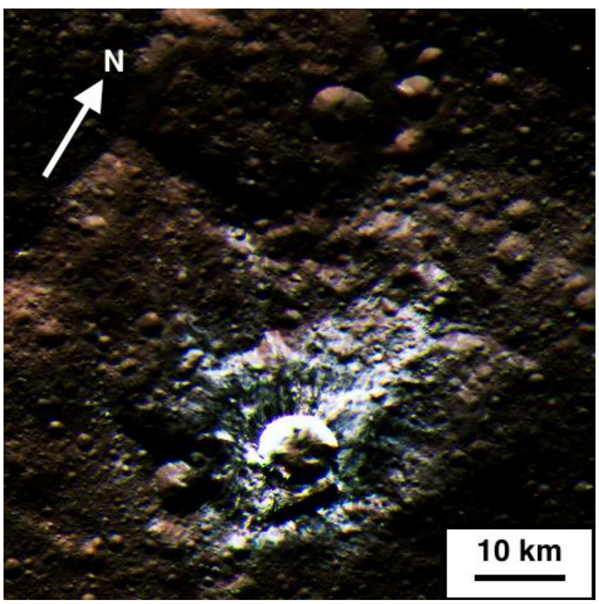

Figure 1: Enhanced color view of Oxo Crater. Red, green, and blue channel are 920 nm, 550 nm, and 440 nm respectively.

Initial VIR results from the Survey mapping campaign identified Oxo crater as a spectroscopic region of interest, and FC data from HAMO identified it as morphological object of interest (see Figure 1). As of this writing Oxo remains the only location on Ceres where a positive identification of H_2O has been made spectroscopically [4]. This detection has been made on the bright materials unit at the foot of the southern crater rim. In this presentation we present a LAMO-based analysis of the geology and morphology of Oxo crater and its immediate surroundings and discuss its place in the evolution of Ceres.

Methods and Data: The acquisition of Survey and HAMO data was completed by the submission of this abstract, along with the collection of initial LAMO data. The geologic and morphologic analysis presented in this abstract is based on HAMO (~140 m/pixel), Survey (~400 m/pixel), and initial LAMO (~35 m/pixel, clear filter only) clear and color filter FC images [5]. FC topography data derived from images via stereophotoclinometry (JPL) and stereophotogrammetry (DLR) was also used to inform this analysis [6]. A comprehensive mapping and interpretation campaign will be undertaken before LPSC, using the ~35 m/pixel LAMO Framing Camera clear and color filter images.

Geologic Setting: Centered at 42.20 °N and 359.75 °E the approximately 10 km in diameter Oxo is a moderately high latitude crater located in the northern hemisphere straddling the boundary between the Ac-H-5 Fejokoo quadrangle and the Ac-H-2 Coniraya quadrangle [7, 8 respectively]. It is predominantly surrounded by, and superimposed upon, the ancient cratered terrain found ubiquitously in Ceres' northern hemisphere, especially within the Fejokoo quadrangle [7].

Oxo is located near the northern boundary of a large regional impact basin covering both the Fejokoo and Coniraya quadrangles. This places Oxo within a relative topographic low for both quadrangles.

Oxo lies within 200 km of numerous lobate flow features located in both the Fejokoo and Coniraya quadrangles. These features bear resemblances to both long run-out landslides on Mars and outer solar system satellites, and to terrestrial and martian ice cored/cemented flows [9]. This crater is also one of only two places on Ceres (the other being Occator crater) where haze cloud development has been observed in oblique FC images [10]. These observations indicate a possible regional enrichment of near-surface ground ice in the vicinity of Oxo.

Key Geologic and Morphologic Features: The geology and morphology of Oxo is largely defined by four units: the surrounding ejecta blanket, striped crater wall material, mixed crater floor material, and the enigmatic terrace formation (see Figures 2 & 3).

Oxo's ejecta blanket, which extends to a maximum distance of ~25 km away from Oxo, and bright striped wall material are spectroscopically and photometrically distinct from the surrounding background material. This high albedo material appears to be second only to the bright spots in Occator crater in terms of brightest features on Ceres [6]. Additionally, both Oxo crater and its ejecta appear to be practically devoid of superimposed structures (craters, faults, etc…) marking it as one of the youngest features on Ceres. Colors in the visible may be also indicators of the surface age. Exposed materials on most planetary surfaces usually become redder because of space weathering such as micrometeorite impacts and interactions with charged particles from the solar wind. If similar processes occur on Ceres, blueish colors in Figure 1 are consistent with unaltered materials, thus geologically recent [11].

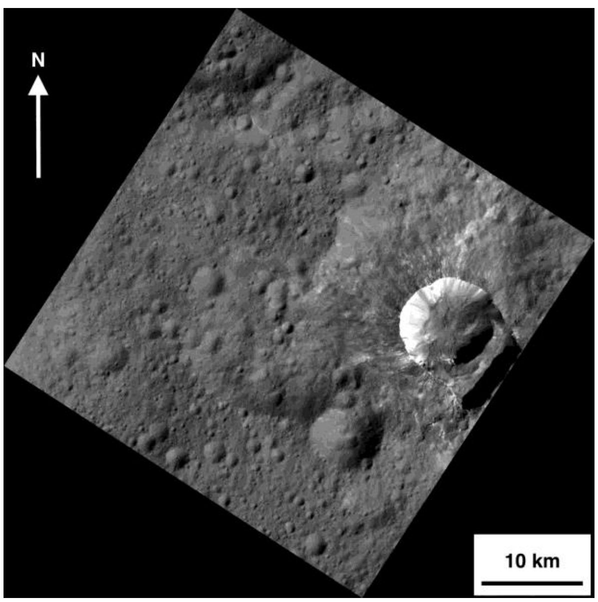

Figure 2: Highest resolution clear filter image taken of Oxo at the time of this writing.

The mixed crater floor material appears to be a complex mixture of smooth material (possibly impact melt) covered in places by rafts of sub 100 m sized angular boulders. Mass wasting lobes are prevalent on both the north and south inward facing rims.

The terrace deposit (green overlay in Figure 3) appears overall to be smoother than the mixed crater floor material; however, it contains arcuate fractures parallel to the sunken western rim, which could be indications of slumping or some degree of unconsolidation. Lobate flow deposits are also seen on the southern rim of the terrace section.

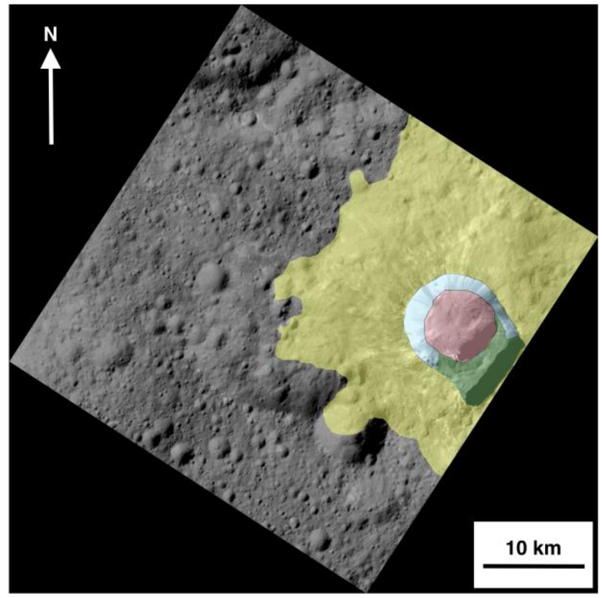

Figure 3: Same image as Figure 2, but with geologic overlays. Yellow represents Oxo's ejecta blanket, blue is the striped wall material, red is the mixed floor material, and green is the terrace formation.

Discussion: Before LPSC, we will refine and elaborate upon this geologic and morphologic analysis, and also conduct further research into:

1. The possibility that the bright material at and around Oxo is compositionally related to the bright spots found in Occator
2. The formation mechanism for the terrace formation at Oxo.
3. The types of mass wasting and landforms that occur in and around Oxo, and whether they are indicators of near surface ground ice.

References:

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