OPTICAL MATURITY (OMAT) OF INA 'D-CALDERA', THE MOON. W. B. Garry[1], B. R. Hawke[2], S. Crites[2], T. Giguere[2], and P. G. Lucey[2] [1]Planetary Geodynamics Laboratory, Code 698, NASA Goddard Space Flight Center, Greenbelt, MD 20771, william.b.garry@nasa.gov, [2]Institute of Geophysics and Planetology, SOEST, University of Hawaii at Manoa, Honolulu, HI.

Introduction: The origin and age of Ina have been questioned since the enigmatic feature was first discovered during the Apollo missions **[1-3]**. Ina (18°40'N, 5°18'E) is a 3 km wide depression located at the summit of a dome that is situated atop a horst within Lacus Felicitatis (Figure 1). The morphology of the feature is distinctive, but not completely unique to the lunar surface **[e.g. 4]**. Three distinctive morphologic units are observed in Ina: the higher elevation, irregular shaped mounds, a lower elevation, hummocky unit, and a blocky material unit **[5-7]**. The depression has been interpreted to be a volcanic caldera **[3,5]**. The mounds are thought to have formed by individual vent eruptions **[3,5]** or through lava flow inflation processes, based on a morphologic and topographic comparison with terrestrial inflated lava flows **[6]**.

Ina appears to have a geologically young age due to the presence of the unweathered blocky material and a low number of large craters preserved on the mounds and even fewer craters present on the lower elevation unit **[7,8]** compared to the surrounding terrain. The exposure of fresh, blocky material on the floor of Ina is thought to be the result of geologically recent (10s of Ma) degassing of subsurface volatiles **[7,9]**.

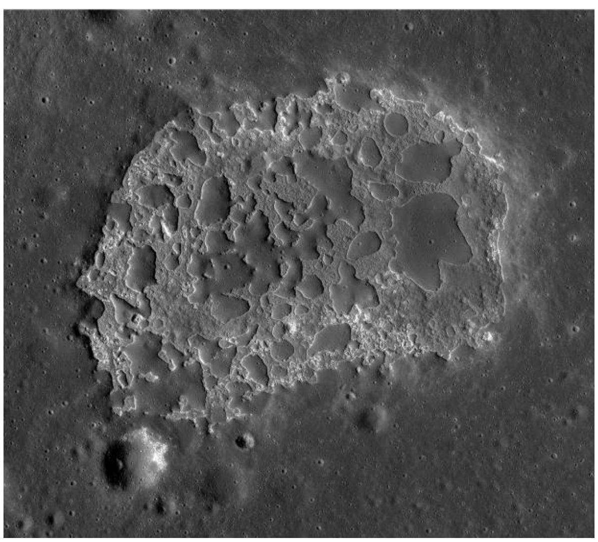
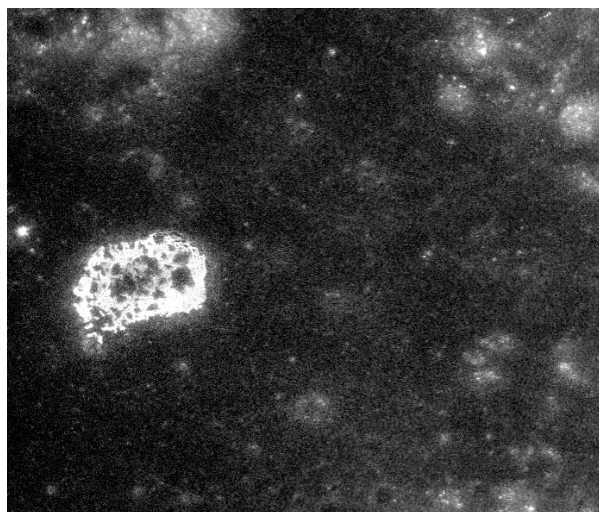


Figure 1. The morphology of Ina is very distinctive, with the bulbous mounds LRO Narrow Angle Camera (NAC) image M119815703. Ina is ~3km wide. [NASA/GSFC/ASU].

Characteristics of the mounds and lower unit suggest multiple phases of formation and possibly different overall ages. Based on the differences in morphology and crater statistics of the mounds and lower unit, we hypothesize that we should see a difference in the nature of surface weathering and maturity of the soils that have developed on the two units. Here, we look at the optical maturity (OMAT) of Ina to see if there is a difference in regolith development between units.

Data: Kaguya Multiband Imager (20 m/pixel) data were used to create the OMAT (Figure 2) and the 750 nm reflectance (Figure 3) maps of Ina and surrounding area. An OMAT/FeO algorithm was applied to the 750 nm and 950 nm bands to create the maps **[e.g. 10-12]**.



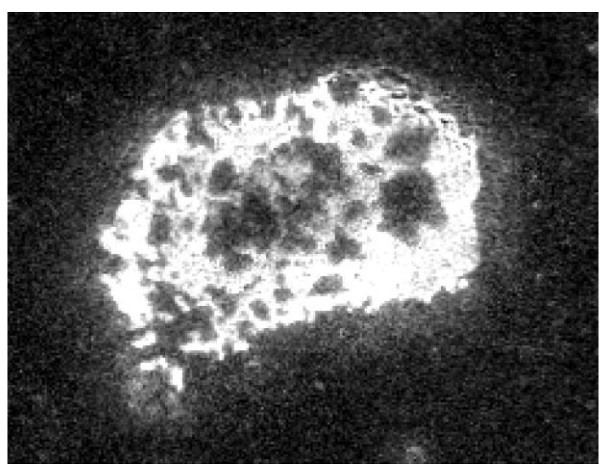


Figure 2. Optical maturity (OMAT) map of Ina. Kaguya Multiband Imager data, orbit 2352 [JAXA].

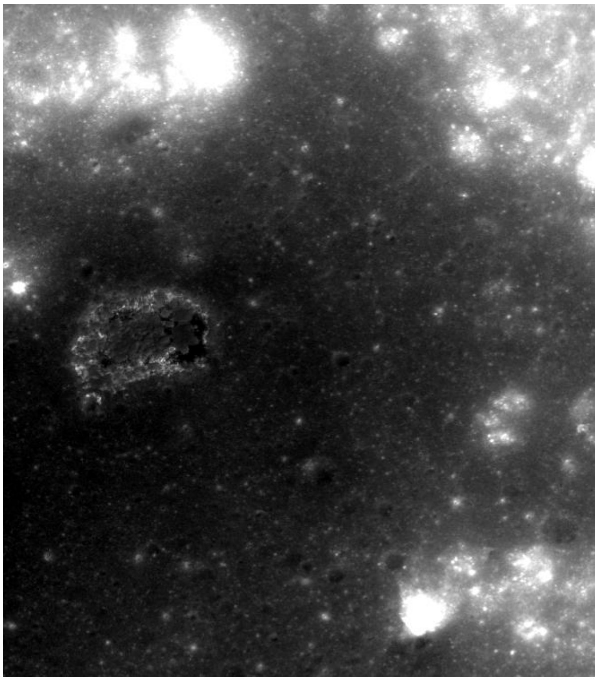


Figure 3. 750 nm visble reflectance map of Ina and the surrounding region based on Kaguya Multiband Imager data from orbit 2352 [JAXA].

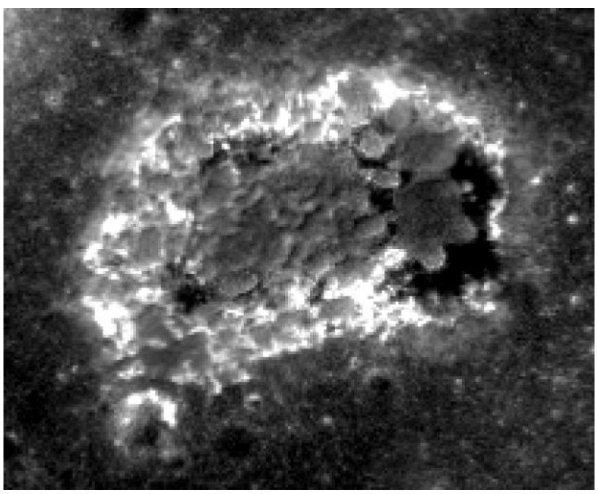


Figure 4. Reflectance map of Ina based on Kaguya Multiband Imager data from orbit 2352 [JAXA]. Image shows Band 2 with a Linear 2% stretch applied in ENVI.

Preliminary Observations: The maps show relative differences in values for OMAT and reflectance properties between the mounds and lower elevation unit.

OMAT. The OMAT map values show that the mounds have a similar 'maturity' to the material on the rim of the depression. There is a definite break between the OMAT values for the mounds and the lower elevation unit, suggesting the lower unit is more immature. OMAT values for the mounds range from 0.14-0.20 and values for the lower elevation unit range from 0.25-0.35. The collar surrounding the depression has OMAT values of 0.12-0.19.

Reflectance. There is a noticeable difference in reflectance properties between the mounds and the lower elevation unit, especially in locations where blocky material is present. The area in the southeastern part of Ina that appears darker in Figures 3 and 4 corresponds to a more hummocky area in the lower unit that surrounds one of the larger, more prominent mounds. This area does not have a lot of blocky material in the vicinity.

Discussion: The difference of maturity between soils is not necessarily due to a difference of exposure time on the lunar surface **[10]**. The primary difference in OMAT values and reflectance between the mounds and the lower elevation unit is in part due to the presence of the fresh blocky material. The origin and exact nature of the blocky material has yet to be determined, but **[7]** notes that the material is comprised of high Titanium basalts. While the origin and age of Ina remain ambiguous, there is value in looking at the optical maturity and reflectance of Ina to help characterize the properties of these features and provide insight into its geologic evolution. Future work will hopefully address remaining questions about Ina: Did two separate volcanic events form the mounds and the lower unit or are they result of non-volcanic processes? Why is there a discrepancy in the number of craters between the two morphologic units? What processes exposed the fresh blocky material and how recently did these processes occur?

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