STRATIGRAPHY AND MORPHOLOGY OF IAZU CRATER. K. E. Powell[1], M. Zanetti[1,2] and R. E. Arvidson[1,2], [1]Department of Earth & Planetary Sciences, Washington University in St. Louis, [2]McDonnell Center for the Space Sciences (kpowell@levee.wustl.edu).

Introduction: Iazu Crater is a 6.5 km-diameter impact crater in Meridiani Planum located ~25 km south of the Opportunity rover's current location at Endeavour crater. Iazu is a late Noachian- or Hesperian-aged impact with an eroded butterfly-shaped ejecta deposit that is elevated above the surrounding terrain. The crater walls show a record of pre-impact aqueous alteration in the region from Noachian basalts altered to smectite to Burns formation sulfate deposition. The northwestern crater wall has been heavily eroded, likely by wind, and exposes both an intact and and an overturned sequence of sulfate deposits and underlying smectites in the upper crater rim. Unlike older Endeavour crater, Iazu formed during or after the deposition of the Burns formation. This makes Iazu an exceptional place to study the regional alteration history of the Burns formation, and how it relates to observations made by Opportunity on its journey through Meridiani Planum. Here, we use CRISM hyperspectral images and HiRISE DEM topography to investigate the units exposed by the Iazu forming impact and the pre-impact stratigraphy of the region.

Aqueous Alteration: CRISM hyperspectral data of Iazu's walls reveals the record of aqueous alteration in the region. We use CRISM along-track oversampled (ATO) observation ATO0001E2AA, converting I/F values to Single Scattering Albedo using DISORT radiative transfer code [1].

Endmember Analysis: The ENVI SMACC (Sequential Maximum Angle Context Cone) tool [2] identifies a set of pure spectral endmembers, together with a shadow component. Endmembers in this scene were identified using CRISM's long wavelength (L) data from 1-2.6 µm. Spectra were taken from regions that show 80% or greater concentration of an endmember. Three endmembers identified at Iazu are shown in Fig. 1. The endmember shown in blue corresponds to dark basaltic sand materials. Green areas correspond to bright, dusty regions that are often topographic highs. The endmember shown in red is present mainly on the northwest side of Iazu, where a large gap exists in the crater rim, likely as the result of wind erosion (Fig. 1B). Spectra of materials in the gap contain a broad Fe electronic feature near 1 µm (Fig. 1C). Several mineral components could be responsible for this feature, including Fe-olivine and Fe-sulfates, and we interpret the strong signatures to be a consequence of enhanced wind erosion leaving behind a lag of olivine and/or exposing clean bedrock surfaces.

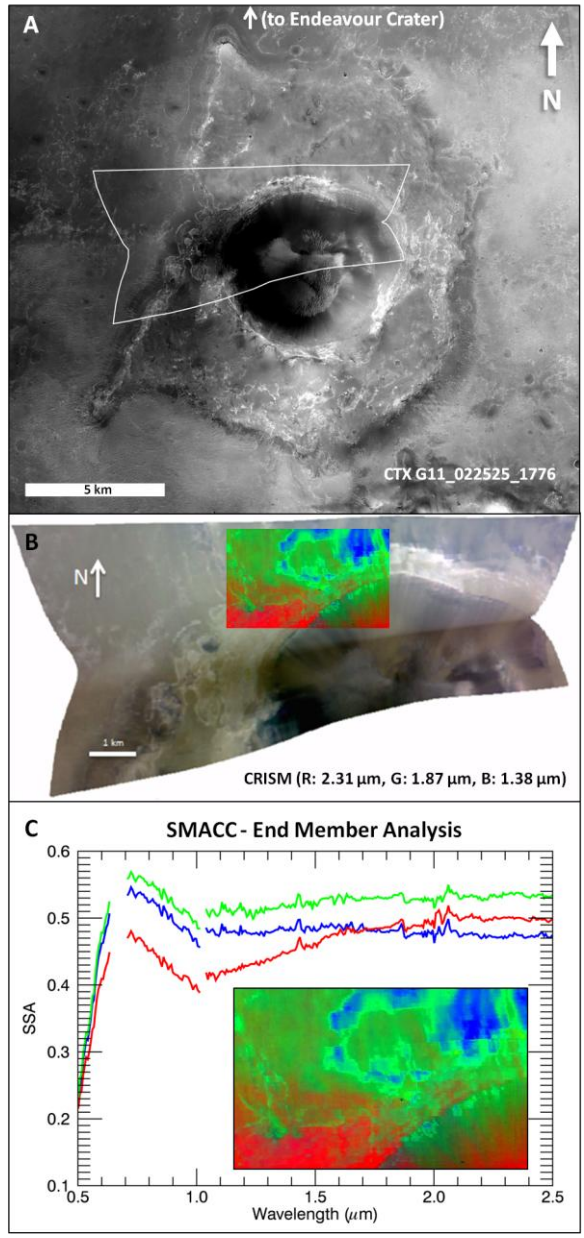

Figure 1: A: CTX image of Iazu crater with CRISM footprint. **B:** ATO0001E2AA with RGB endmember map. **C:** ENVI SMACC endmember identification. Red: Fe-rich component, possibly wind-eroded areas. Green: Bright, dusty regions. Blue: Dark basaltic sand.

CRISM Spectra: Detailed analysis of CRISM hyperspectral data of Iazu's upper walls reveals the shift from the formation of smectites to hydrated sulfates in the Meridiani region. The topmost wall and rim crest exposed Burns rocks and exhibits evidence for polyhydrated sulfate materials. Select locations contain

spectral features consistent with gypsum, identified by shallow 1.9, 2.22, 2.27 and 2.4 µm absorptions. Below these sulfate-rich layers, portions of the wall of show evidence for Fe/Mg smectites, based on the presence of a 2.3 µm metal-OH absorption, that reflect Noachian basalt alteration. The exposed crater wall stratigraphy documents the transition from aqueous alteration under relatively mild to extremely acidic and oxidizing conditions, including evidence for several basalt to sulfate minor transitions.

Structure and Stratigraphy: Burns formation sulfates in the rim occur in the ejecta along the ridge of the crater rim, as well as in intact layers stratigraphically lower on the crater wall. Because the layers are high albedo and maintain the same spectral signature, we suggest that the sequence is repeated as part of an eroded overturned flap of ejecta (e.g. [3]). The approximate position of the hinge line of the overturned flap in these materials can be identified in HiRISE images by mapping the location of competent and disrupted layering in the upper crater wall and rim. Accounting for structural uplift and deformation due to the impact, the original Burns formation thickness in this region is estimated to be 250 m. Stratigraphically below the intact sulfate layers are the altered Noachian basalts (yellow lines, Fig. 2), although corresponding deposits are not seen in the near rim ejecta deposit, and have probably been eroded away.

Iazu's western rim is a low saddle that has been significantly eroded relative to outcrops in the north and south crater rim. Dunes on the crater floor are oriented perpendicular to this gap. The lower topography acts as a wind gap that keeps the western strata free of dust, which can be seen in the red areas of Fig 1C. The erosion of the rim has infilled the crater floor (crater depth of 660 m), resulting in relatively low crater depth-diameter ratio of ~1:10 (compared to fresh craters of a similar size at 1:7.5 [4]).

References: [1] Arvidson, R. E. et al. (2014) *Science, 343*, 124097. [2] Gruninger, J.H., Ratkowski, A. J. & Hoke, M.L. (2004) *Proc. SPIE*, *Algorithms for Multispectral and Hyperspectral and Ultraspectral Imagery X*. [3] Shoemaker, E M. (1963) *The Moon Meteorites and Comets*, 301. [4] Robbins, S. J. & Hynek, B. M. (2012b) *JGR: Planets*, *117*, E06001. [5] Moratto, Z. M. et al. (2010) LPSC 41 #2364.

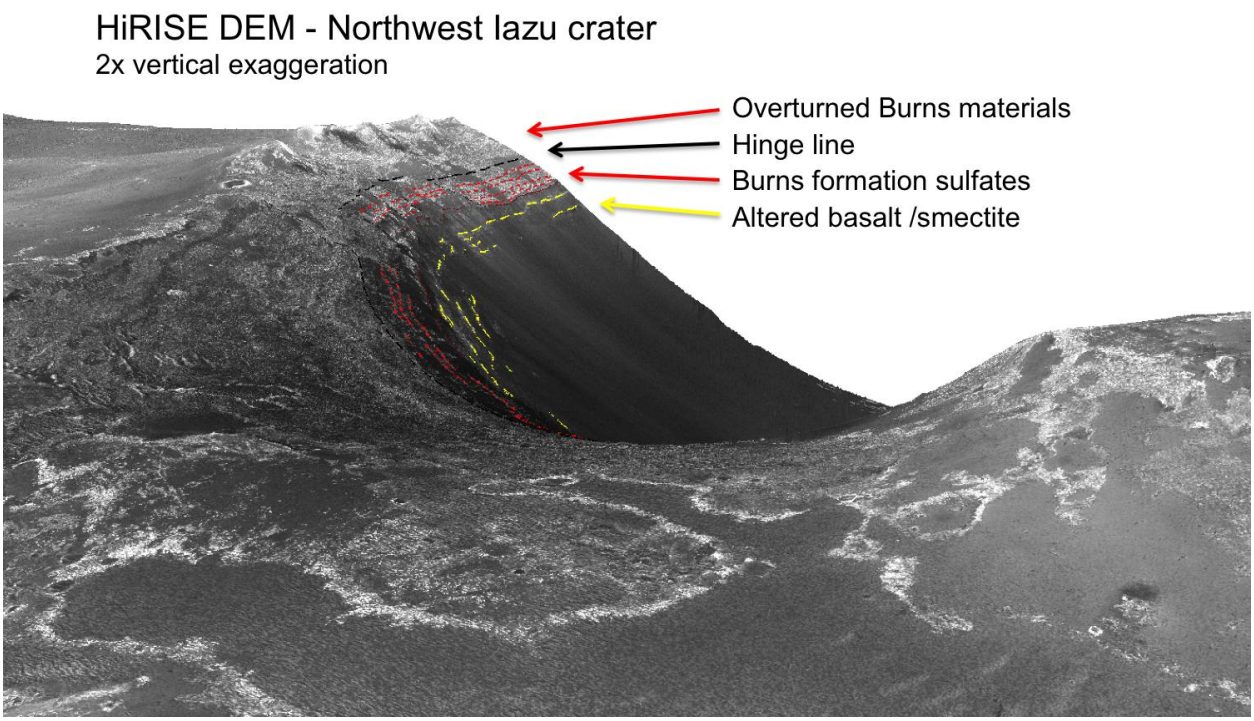

Figure 2 DEM from HiRISE stereo pair ESP_022525_1775 and ESP_02327_1775 created using Ames Stereo Pipeline [5]. Below the black line are pre-impact uplifted layers. Above the black line are Burns formation sulfates that were overturned by impact.