Evaluating Flat-Crater Floor Fill Compositions: Insight into Filling Processes. C. Pan[1], C. S. Edwards[1], A.D. Rogers[2] [1]Dept. of Physics and Astronomy, Northern Arizona Univ., Flagstaff, AZ 86011 (cong.pan@nau.edu), [2]Stony Brook University, Stony Brook, NY 11794.

Introduction: The filling processes of infilled craters are not clear since they have been first observed in 1965. It has been proposed that several processes, such as impact melt ponding [e.g. 1, 2], aeolian sedimentation [e.g. 3, 4] and lacustrine sedimentation [e.g. 5, 6] may fill the craters. However, Edwards et al., [7, 8] proposed that the processes of impact melt and sedimentation cannot account for all occurrences of infilled craters. Edwards et al., [7, 8] have mapped the distribution of exposed bedrock and conducted statistical analyses of flat floored, high thermal inertia craters globally. Based on the observation of morphologies, thermophysics and composition, Edwards et al.,[7,8] indicated that volcanic infilling through fractures created by the impact event are likely the filling processes for infilled craters.

While globally comprehensive, detailed morphologic, spectral, and stratigraphic relationships were not assessed [8]. Here, we investigate the compositional, thermophysical, and morphological properties of a crater subset of high thermal inertia craters [9], and constrain the filling processes of the crater floor materials (such as volcanic, sedimentary, impact melt, etc.).

Data and Methods: In this work, we first created a subset of 160 impact craters with high thermal inertia floor materials using the selection criteria from [9]; broadly, infilled craters with higher thermal inertia in the crater floor as compared to the surrounding terrains. The craters within this subset are widespread within southern highland, especially within the regions of western and eastern Noachis, Tyrrhena, Hesperia and Cimmeria (**Figure 1**). A few isolated craters are located in Mare Sirenum and along the dichotomy boundary. We used Thermal Emission Imaging System (THEMIS) and Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) images to examine mineral compositions, and High Resolution Imaging Science Experiment (HiRISE) and Context Imager (CTX) images to analyze the morphologies.

THEMIS decorrelation stretch (DCS) images were used to distinguish between floor materials with olivine and other mafic minerals such pyroxene [e.g. 10]. Spectral indices of CRISM multispectral and targeted images were applied to identify mafic and hydrated minerals, and check whether there is mafic minearls presenting in the surrounding terrains [11, 12]. The following summary parameters are for multispectral images: BD2300, LCPINDEX, HCPINDEX, OLINDEX2. The following summary parameters are for targeted images: BD2300, BD2210, BD1900, LCPINDEX, HCPINDEX and OLINDEX2.

Next, we assigned a likely origin for the filling materials for each crater using the following criteria. Materials were assigned as "volcanic" if they met all of the following: A. the high thermal inertia floor materials are rocky crops and/or fractured, knobby/bouldery surface; B: the high thermal inertia and olivine (and/or pyroxene) rich materials only present part of the craters floor, but not in the crater wall or rim; C. no hydrated minerals present within the crater floor. Materials were assigned as "sedimentary" if: A. layering deposits present in the high thermal inertia floor and/or B. the composition is not distinct from the surroundings.

Results: The 160 craters have been classified to volcanic origin, sedimentary origin, and unknown based on the preliminary evaluation of the filling processes of high thermal inertia materials within crater floor (**Figure 1**). Ninety-nine craters have fill materials that were classified as volcanic in origin, and are plotted with gray and white squares in **Figure 1**. The white squares are craters that showed significantly stronger mafic mineral signatures than the surrounding terrains. The craters with volcanic filling processes are widely distributed within the study regions—they are not clustered. One example (**Figure 2**) of likely volcanic crater-filling materials is located in Tyrrhena with ubiquitous boulders and distinct mafic rich and high thermal inertia floor. Besides the 99 craters with volcanic origins, two craters are identified as sedimentary and 49 craters as unknown origins. One example (**Figure 3**) of sedimentary origin is a crater located in Cimmeria with clear layering and olivine-poor crater floor (DCS yellow).

Discussion and Future Work: The preliminary results suggest that the majority of craters have volcanic fill materials, which is consistent with the hypothesis that the infilled arose through volcanism, possibly impact excavating decompression melting materials [8], or infilled by some other impact related volcanism process[13]. It may also indicate that volcanic resurfacing is a widespread geologic process on martian surface. Further evaluation will be applied to the craters characterized as "unknown" to better constrain their origins. For the craters identified as volcanic, we will constrain whether decompression melting is the sole filling process. We will also investigate the relationship between filling processes and crater size, special location, elevation and mapped unit age to infer the implication to geology evolution of Mars.

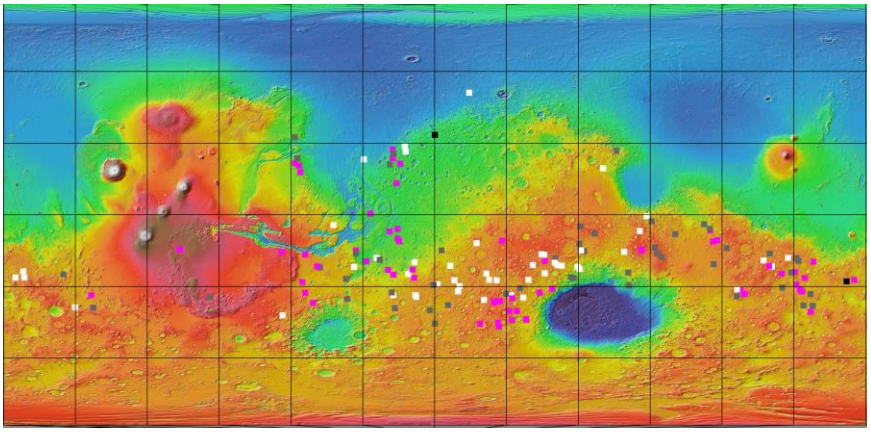

Figure 1. Distribution of crates in this study. Gray and white suqres are craters identified as volcanic origins. White squares are craters that showed significantly stronger mafic mineral signatures than the surrounding terrains. Black squares are craters identified as sedimentary origins. Magenta squares are craters identified as unknown.

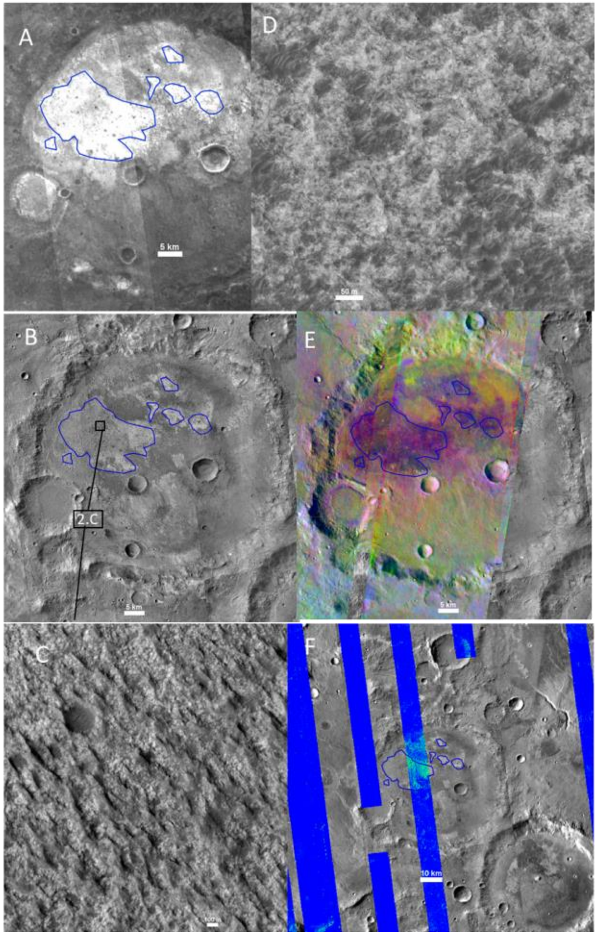

Figure 2. Crater E042 (22.15 °S, 59.81 °E) is interpreted to be volcanic origin. A. THEMIS nighttime IR image shows the regions of high thermal inertia (blue polygons). B. CTX image of the same crater. C. CTX image shows the knobby surface (black polygon in B). D. HiRISE image shows the knobby and bouldery surface. E. THEMIS DCS purple color shows the olivine rich units. F. CRISM olivine index shows there is olivine presenting in the crater floor, while no olivine presenting in the surrounding terrains.

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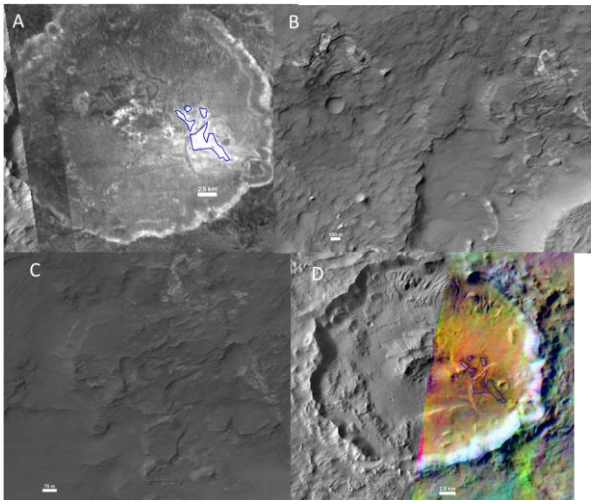

Figure 3 Crater S107 (28.12 °S, 172.16 °E) is interpreted to be sedimentary origin because of layering deposits and olivine poor. A. THEMIS nighttime IR image shows the regions of high thermal inertia (white polygons). B. CTX image shows the layering deposits. D. HiRISE image shows the layering deposits. E. THEMIS DCS yellow/orange color shows the regions of high thermal inertia are olivine poor. F. CRISM olivine index shows the floor is olivine poor.