Thermally and compositionally distinct crater ejecta on Mars and geological implications. Cong Pan and A. Deanne. Rogers, Stony Brook University, Department of Geosciences, 255 Earth and Space Science Building, Stony Brook, New York, 11794-2100, Cong.Pan@stonybrook.edu

Introduction: Impact craters on Mars are natural probes into the subsurface. Particularly, the subsurface mineralogy is exposed by central uplifts and impact ejecta. For example, the composition of crater ejecta blankets thermally distinct from surrounding materials have been investigated in Tyrrhena Terra with thermal infrared data [1]. Visible and near-infrared study of spectrally distinct ejecta (SDE) in Syrtis Major showed that spectrally showed that SDE represent the true composition of Syrtis Major [2-3]. The thermal distinct ejecta which are warmer or cooler than the surrounding materials are relatively unobscured by regionally derived sediment [1]. It is possible that those ejecta exhibit spectral distinction. Similar methods have been used to identifying the thermally distinct ejecta in Tyrrhena Terra, suggesting the origins of ejecta may one or combination of the scenarios that vertical variations in primary lithology, subsurface alteration, syn- or post-impact alteration and surface alteration [1]. In this study, we focus on the global survey of thermally and compositionally distinct crater ejecta (TCDE) on Mars. The goal of this study is to understand the compositions and origins of TCDE comparing to ejecta in Tyrrhena Terra, their relationship to the regional surface and subsurface composition exposed by central uplifts, and the implication to the crust evolution.

Data and Methods: We have used Thermal Emission Spectrometer (TES), Thermal Emission Imaging System (THEMIS) and Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) images to examine the thermal properties and mineral compositions of crater ejecta.

First, we conducted a global and systematic survey of thermally distinct ejecta from craters with diameters>1km [4] with THEMIS nighttime radiance mosaic [5]. Second, the Decorrelation stretch (DCS) images of THEMIS, mineral indices of CRISM and TES 465 index [6] were used to identify the compositionally distinct ejecta. Then, detailed spectral analysis of THEMIS, TES and CRISM data was conducted to the ejecta if qualified data is available.

Results: Though we have not finished examining all craters from our survey in detail, preliminary results show that there are TCDE identified in Chryse Planitia, Northern Hellas and Tyrrhena Terra regions, at least. As we complete the assessment of all craters in our survey, additional areas of interest may be found. One example of TCDE is Lismore Crater (318.38°E,27.04°N) in Chryse Planitia. Lismore Crater, diameter ~10km, is a relatively unmodified crater with symmetric single layered ejecta (**Figure 1**). In THEMIS nighttime image, the ejecta is warmer than the surrounding materials (**Figure 1**), suggesting the ejecta is rockier than the surrounding materials. THEMIS spectra of ejecta and surrounding materials were selected based on the color variation of DCS image. The ~9μm absorption feature of spectrum from surrounding materials is consistent with mafic poor materials, while the "U" shape of spectrum from ejecta is consistent with slightly more mafic materials (**Figure 2**). The spectral unit maps show that the ejecta endmember is mainly distributed in ejecta and some of the southern part of the surrounding, with high concentration in some small areas in the ejecta and the floor of a nearby small crater (**Figure 3**). The TES spectra show no difference between ejecta and surrounding composition (**Figure 4**). One possible reason may be the raw spatial resolution of TES data: the TES pixels may be the average of a larger area than the THEMIS endmember from ejecta. CRISM spectra show the ejecta is consistent with olivine mineral and there are no significant mineral features in the spectrum from surrounding (**Figure 5**).

Discussion and Future Work: The distribution of TCDE from preliminary search indicates that TCDE may be common on Martian surface. It is possible that crater ejecta provide ideal spectral evidence for subsurface composition, comparing to limited number of spectrally distinct central uplifts from surrounding materials [7-8]. As one of the possible origin of ejecta proposed in [1], the ejecta in Tyrrhena Terra may undergo alteration. However, the slightly mafic-rich ejecta in Lismore crater may suggest limited alteration in this fresh crater, representing the subsurface lithology, similar to study in Syrtis Major [2-3] and possible pre-impact alteration in Tyrrhena Terra [1]. If this is correct, it may support the hypothesis that olivine-bearing units are in shallow depths in Chryse Planitia, excavating the Hesperian basaltic materials (e.g. [9-10]).

Detail spectral investigation will be applied to candidate TCDE identified from the second step of Data and Methods. High resolution visible images will be used to study the geology contexts of the TCDE.

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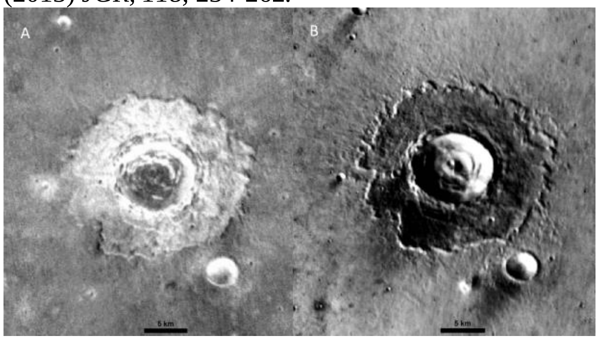

Figure 1. THEMIS daytime (A) and nighttime (B) images of Lismore Crater showing the morphology and thermal property.

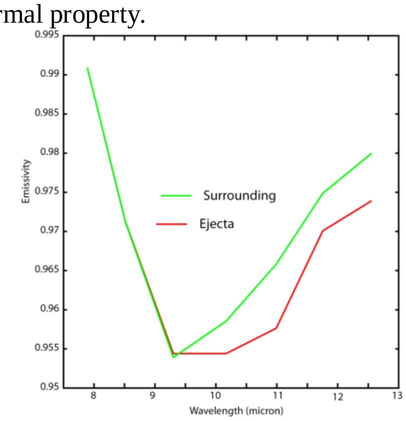

Figure 2. THEMIS spectra from ejecta and surrounding materials, which are the endmembers for spectral unit maps in **figure 3**.

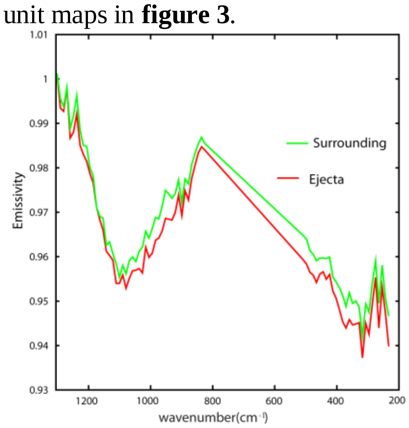

Figure 4. TES spectra from ejecta and surrounding materials. Selection of TES pixels is in **Figure 3.**

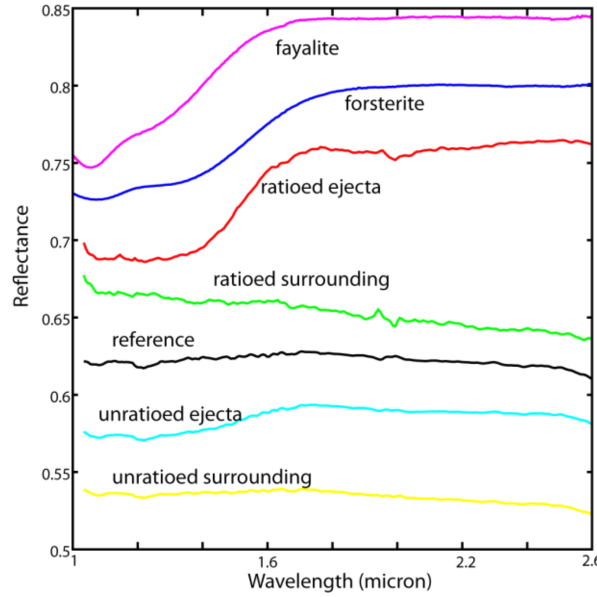

Figure 5. CRISM spectra from ejecta and surrounding materials. Laboratory spectra of olivine were plotted for comparison.

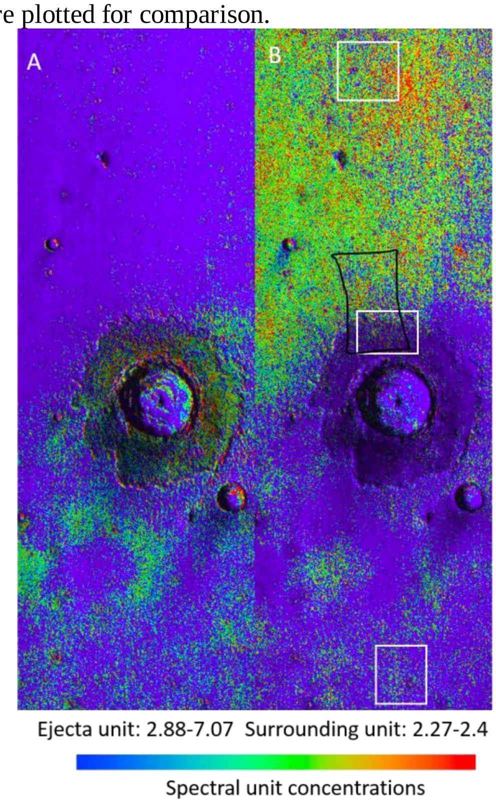

Figure 3. THEMIS spectral unit maps using the endmembers in **Figure 2**. A. distribution of ejecta unit, B. distribution of surrounding unit. Black polygon is the coverage of CRISM image (**Figure 5**). White polygons are selection of TES pixels (**Figure 4**).