MINERALOGICAL DIVERSITY OF IMPACT MELTS ON CENTRAL PEAK OF TYCHO AND ITS VICINITY D. Dhingra and C. M. Pieters, Geological Sciences, Brown University, RI 02912, USA (deepak_dhingra@brown.edu)

Introduction: Impact cratering on planetary bodies excavates and re-distributes material from various depths. A sizable amount of energy is commonly partitioned into melting the rocks. The fate of this impact melt in terms of spatial distribution, morphology and mineralogy is varied [e.g. 1-3]. With the availability of high spatial and spectral resolution datasets for the Moon from multiple instruments onboard several missions [e.g. 4-6], a variety of new information is being made available on physical and compositional character of impact melts.

We discuss here the spectral variation in impact melts located on the central peaks of crater Tycho and its vicinity and compare them with unmelted rocks on the peaks. Recent LROC observation of Tycho's peak at Sunrise [7] captured a spectacular scene of a large clast lying over a pool of cracked impact melt providing a context for exploring the relationship between the two entities in space and time. We also attempt to understand this relationship.

Crater Tycho and its Peak: Tycho is a ~85 km diameter Copernican age complex crater located on the southern near-side lunar highlands. It's a bright crater with prominent rays, visible from Earth, even with naked eyes. Impact melt is observed all over the crater: rim, walls, floor and even the peaks, each occurrence displaying a wide diversity of morphologies. Some occur as small smooth melt pools, others have clasts of various sizes. The impact melt also drapes the rocks and is extensively fractured.

Mineralogy and morphology from coordinated high resolution datasets: Datasets from Chandrayaan-1 Moon Mineralogy Mapper (M^3), Kaguya Terrain Camera (TC) and LRO Narrow Angle Camera (NAC) were utilized in conjunction with each other to study the impact melts. The spectral diversity of sampled impact melts is illustrated in Figure 1 along with the spectra of unmelted material. The position of absorption bands around 1 and 2 µm and their relative strengths clearly demonstrate differences not only amongst unmelted material and impact melt but also between impact melts.

The smooth melt patch located north-east of the central peak, near its base, has a featureless spectra with a possibly weak feature around 1 µm and no absorption at 2 µm. The melt does not seem to contain any significant quantity of clasts based on the high resolution Kaguya TC dataset as shown in figure 2(b). A contrasting spectrum is obtained along the crack in the impact melt, possibly rich in clast fragments, located east of the smooth patch. The spectrum shows strong 1 and 2 µm absorption bands and possibly another absorption around 1.2 µm that could be due the to pyroxene or plagioclase. The immediate surroundings too share the same spectral character indicating the presence of a strong mafic composition rich in pyroxene.

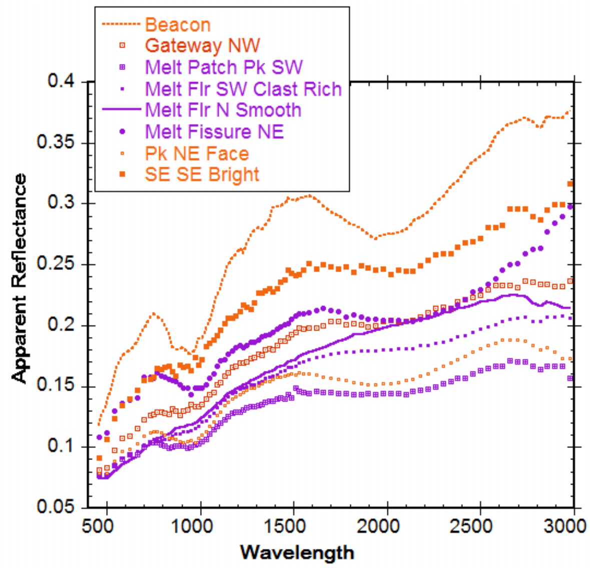

Fig.1 Diversity amongst impact melts (purple) and unmelted rock material (orange) on Tycho central peak and nearby region. Apparent reflectance in latest M^3 calibration (U2 with RC Correction)**.**

The melts on the base of the southwestern region of the peak are clast rich and have been cracked. Spectrum from a homogenous area in M^3 image shows relatively weak absorptions at 1 and 2 µm suggesting presence of high calcium pyroxene. On the central peak, a melt lobe [Fig. 2(d)] shows long wavelength 1 and 2 µm absorptions. In contrast, several unmelted regions on the peak have relatively short wavelength absorptions, especially at 2 µm, possibly hinting that the bulk properties of the melt had a different composition than what we sampled on the peak.

Possible Clast Mineralogy on the Peak: The LROC imaged clast is an interesting find and has been reported to be around ~100 meters. Although it falls below the M^3 spatial resolution of 140 meters, we attempted to locate the clast in M^3 image using 10 m resolution Kaguya TC image obtained under similar illumination conditions. The clast appears to be partially in shadow in M^3 scene. Spectra extracted from the identified pixel (that presumably contains the clast) and surrounding pixels are shown in Figure 2(a).

The possible clast bearing pixel shows a mafic signature with broad and weak 1 and 2 µm absorption features. The immediate neighboring pixels share similar character suggesting either that the clast has similar composition as the surroundings or the clast comprises of a spectrally neutral material like shocked plagioclase. The two pixels further south do seem to show slight variations in the position of 1 and 2 µm bands as well as strength of the 2 µm band and are likely to be sampling the impact melt based on TC context image. Further detailed analysis is being carried out to validate these differences.

Summary: The spectra of impact melts on Tycho central peak and nearby coupled with their geological context from high spatial resolution data provides important insights into the nature of these prevalent entities on the Moon. The diverse mineralogy and morphology of these melts and their differences from unmelted lithologies on the peak suggests variation in the composition of the melted target material compared to the central peak or variable cooling history. The differences amongst impact melts suggest heterogeneity in melt composition and possibly clast composition and proportion as well.

References: [1] Howard K.A. & Wilshire H.G. (1973) *LPSC* 389-390 [2] Hawke B.R. and Head J.W. (1976) *Impact and Explosion cratering (D.J. Roddy, R.O. Peppin, R.B. Merrill Eds)*, pp 815-844 [3] Smrekar S. and Pieters C.M. (1985) *Icarus, 63,* 442-452 [4] Pieters C.M. et al. (2009) *Curr. Sci., 96*, 500-505 [5] Haruyama et al. (2008) *EPS, 60*, 243-255 [6] Robinson M.S. et al. (2010) *Space Sci. Rev., 150*, 81-124 [7] http://lroc.sese. asu.edu/news/?archives/411-Tycho-Central-Peak-Spectacular!.html

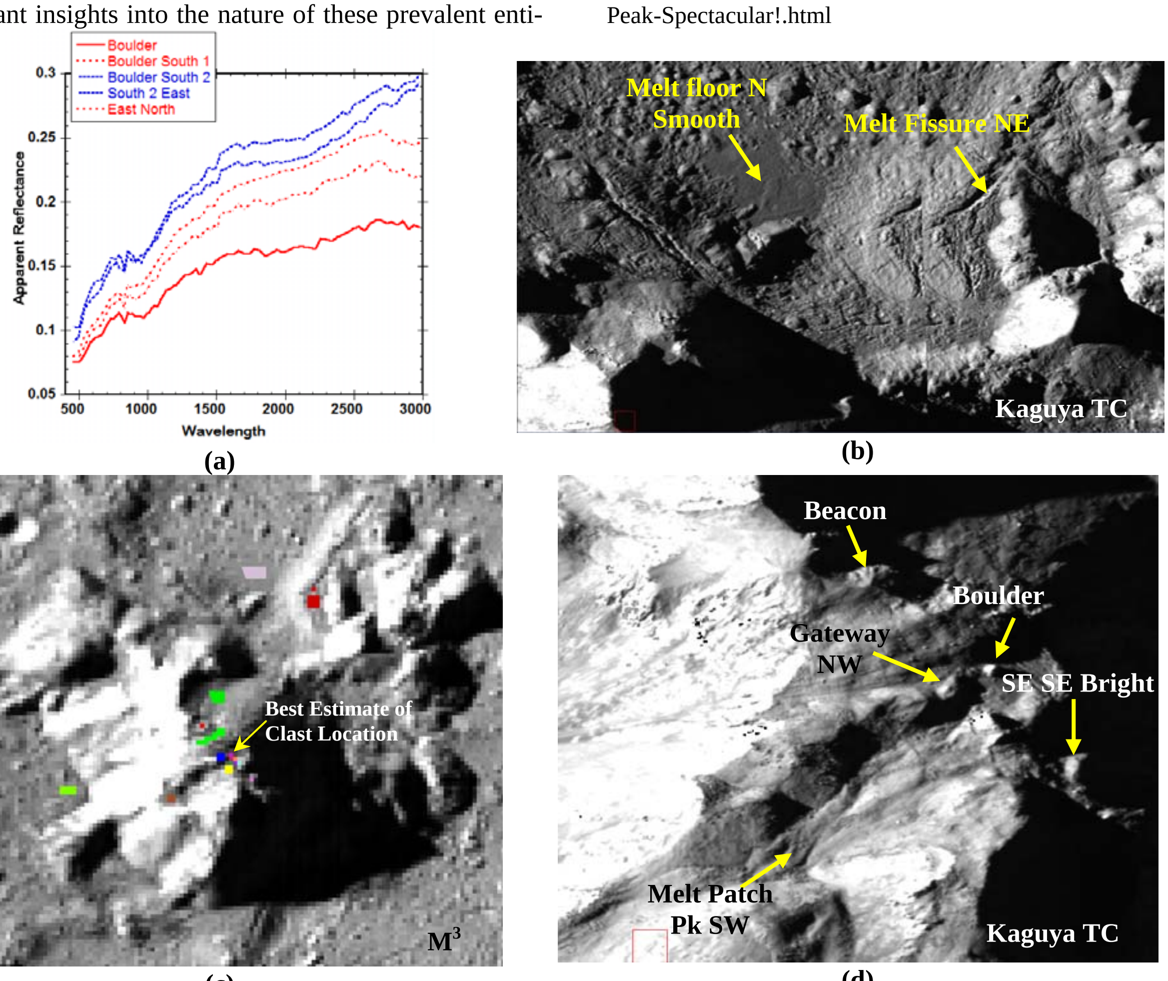

Fig. 2 (a) Spectra of the large clast and surroundings. **(b) & (d)** Kaguya TC Evening context images various parts of the peak and floor which were sampled in M^3 dataset. **(c)** M^3 image with sampled areas marked.