REMOTE MINERALOGICAL ASSESSMENT OF IMPACT MELT DEPOSITS: THEIR ROLE IN CRUSTAL COMPOSITIONAL DIVERSITY AND EVOLUTION Deepak Dhingra, Dept. of Physics, University of Idaho, 875 Perimeter Dr MS0903, Moscow, ID 83844 (Email: deepdpes@gmail.com)

Introduction: Mineralogical diversity of the lunar crust has been extensively studied using samples and through remote sensing [e.g.1,2]. Recent lunar missions have provided wealth of new insights in this context [e.g. 3-7], leading to new hypotheses about the origin of the observed crustal mineralogical variations. Here, we highlight some results on impact melt deposits based on an integrated analysis of high spectral and spatial resolution data from recent lunar missions.

Impact Melt Mineralogy: Lunar sample analyses of impact melts have highlighted their diverse mineralogical and textural character that ranges from glassy impact melt spherules [e.g. 8], melt-bearing breccia [e.g. 9] to completely crystalline impact melt [10]. The latter observation has led to debates about the possible differentiation of the enormous melt sheets within the impact basins [e.g. 11-13].

Insights from Remote Mineralogical Character of Impact Melt Deposits: Recent availability of high spatial and spectral resolution data has enabled detailed assessment of the mineralogical character of impact melt deposits in different geological settings and comparison of their mineralogical character with the predictions [12,13]. Our work has focused on the mineralogy of impact melt deposits at complex craters, especially in the context of their crystallinity and degree of mixing. We wish to highlight two important findings:

1. Large Scale Mineralogical Heterogeneity in Impact Melt Deposits: Copernicus crater exhibits the presence of a mineralogically distinct, low-calcium-pyroxene-bearing sinuous melt feature juxtaposed next to a high-calcium pyroxene-bearing impact melt on the crater floor [6]. The sinuous melt feature is >30 km long (extending from the northern crater wall onto the floor) and is 0.5 - 5 km wide, highlighting its enormous spatial extent and also the extent of mineralogical heterogeneity. The sinuous melt feature is almost devoid of any topographic expression making it hard to detect in albedo images. It is distinctively detectable only in the spectral data. These properties make the mineralogically distinctive impact melt feature quite unique. We have identified and characterized mineralogically heterogeneous impact melt, at different spatial scales, at other craters including Tycho and Jackson.

2. Multiple Origins of Lithologies with Similar Spectral Character: The well-known olivine-bearing central peaks and the northern wall olivine exposure at Copernicus crater had been proposed [14] to originate from a common source at depth. However, detailed spectral and morphological analysis has suggested an impact melt (modified primary source) origin for the wall exposure, distinct from the primary (subsurface exposure) origin of the central peaks [7].

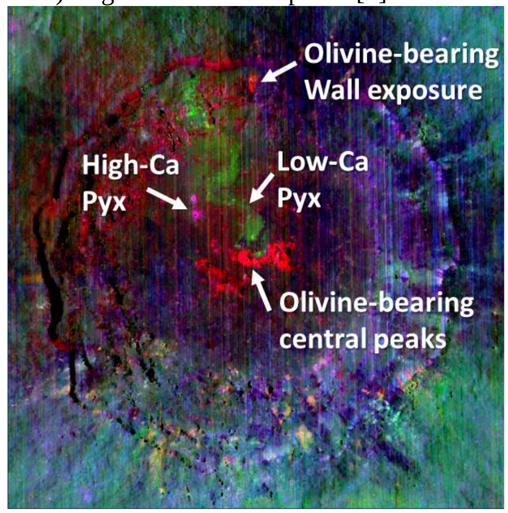

Figure 1 Moon Mineralogy Mapper (M^3) based color composite of Copernicus crater highlights **(a)** The sinuous melt feature (green color, low-calcium pyroxene) in contrast to the floor impact melt nearby (the two fresh craters in magenta color indicate the presence of high-calcium pyroxene) **(b)** Spectrally similar character of olivine-bearing central peaks and the northern wall exposure (shown to be of different origin).

Implications for crustal mineralogical evolution: The prevalence of impact melt in the lunar crust along with its well-defined, diverse spectral signatures at numerous locations, strongly suggests its role in the observed crustal mineralogical diversity (i.e. all is not primary in nature) and its evolution through time. It is also important to note that spectrally similar lithologies within a geological setting may have different origins thereby directly affecting the interpretations (viz. spatial extent of the lithology and its origin).

References: [1] Ryder & Woods (1977) 8th *PLPSC,* 655–668. [2] Pieters (1986) *Rev. Geophys.,* **24**, 557-578. [3] Ohtake et al. (2009) *Nature,* **461**, 236-240. [4] Yamamoto et al. [2010] *Nat. Geosci.*, **3**, 533-536 [5] Pieters et al. (2011) *JGR*, **116**, 10.1029/2010JE003727 [6] Dhingra et al. (2013) *GRL*, **40**, 1043-1048 [7] Dhingra et al. (2015) *EPSL*, **420**, 95-101 [8] Zellner & Delano (2015) *46th LPSC*, Abs#2028 [9] Korotev (1994) *GCA*, **58**, 3931-3969 [10] Daubar et al. (2002) *MAPS*, **37**, 1797-1813 [11] Warren et al. (1996) *GSA Sp. Paper*, **307**, 105-124 [12] Vaughan et al. (2013) *Icarus*, **223**, 749-765 [13] Spudis et al. (2014) *JGR*, **119**, 19-29 [14] Lucey et al. (1991) *GRL*, **18**, 2133-2136