RELATIVE GRAVITY PROFILES OF LUNAR IMPACTS IN DIVERSE GEOCHEMICAL TERRANES: IMPLICATIONS FOR DENSITY AND POROSITY. Carol B. Hundal[1], Alex J. Evans[1], John F. Mustard[1], Janette N. Levin[1]. [1]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI, 02912. (carol_hundal@brown.edu).

Introduction: The study of lunar subsurface architecture via the Gravity Recovery and Interior Laboratory (GRAIL) mission [1] has provided vital insight into the physical characteristics and dominant processes of the lunar interior. Much recent work has focused on how impact craters and basins have influenced the Moon's crustal porosity [e.g., 2-4]. Impact-generated porosity has been shown to be related to crater size [e.g., 2]; however, it is less certain how terrain-specific quantities like age, geochemistry, and pre-impact porosity affect this process.

Here, we use GRAIL data to assess radially averaged gravity profiles of individual, broadly representative craters (D ~ 100 km) in three geochemically distinct provinces: the Procellarum KREEP Terrane (PKT), the Feldspathic Highlands Terrane (FHT), and the South Pole Aitken Terrane (SPAT), as defined by [5].

Each of these terranes are distinguished by their unique thermal and igneous histories as well as their geochemical/geophysical expressions. The PKT is a mafic, thorium and FeO-rich province that is coextensive with the near-side mare. Its origin may be linked to early differentiation of the Moon [5] and the antipodal formation of the SPA impact basin [6]. Large quantities of heat producing elements in this region may have additionally led to more intensive, prolonged near-side volcanism [7]. The SPAT is a mafic-rich region of intermediate FeO abundance coinciding with the Moon's largest impact basin. Due to the basin's great depth of excavation, this region is rich in upper-mantle materials [5]. Lastly, the FHT, the largest and most anorthositic of the three provinces, covers the lunar farside north of SPAT and is of low FeO and thorium abundance. Like the PKT, the FHT is hypothesized to be a product of the solidification of the Lunar Magma Ocean [5].

Radial Gravity Profiles: We use a 720 x 1440 (7 km/px at the equator) Bouguer Anomaly (BA) map calculated with degree and order 5 through 700 to minimize the influence of long-wavelength features. We assess relative density changes in the subsurface by assuming the local region surrounding each crater is relatively compositionally homogeneous. Thus, variations in the bouguer gravity anomaly would indicate variations in relative porosity. With increasing gravity, density would broadly be expected to increase and porosity decrease.

We measured radially averaged profiles from the center of each type-crater out to four crater radii to consider terrain inside the crater, and both inside and outside its ejecta blanket. Density values were sorted into 100 bins of constant distance from the center of the crater. Each bin was averaged, with weights corresponding to the pixel area of each measurement.

Results: Across terranes, the gravity profiles of each type-crater broadly exhibit two main characteristics: a gravitational minimum within the crater interior and an upward trend with distance thereafter. The gravity profiles for the FHT and SPAT type-craters exhibit a relatively sharp increase in gravity after their respective gravitational minima and a shallowing of slope at ~1.25R. The gravitational profile of the PKT type-crater is notably different. After a gravitational minimum at its rim, gravity steadily increases with distance.

The gravity profile for the PKT type-crater may be different from those in the FHT and SPAT for several reasons beyond geochemical or age considerations. The PKT is denser than most of the Moon; thus, the density correction applied to create the BA map used here may have been ill-suited for this region. This type-crater is also relatively shallow. It is only 750 m deep versus the 5-12 km depths of the type-craters in the FHT and SPAT terranes.

Conclusions and Future Work: Given the significant geochemical and geophysical differences between each terrane, these preliminary results may indicate that the intrinsic properties of the surface do not greatly affect impact-generated gravity profiles, and by extension, density/porosity generation (assuming uniform composition). Future work will focus on building a larger database of craters in each terrane which could be used to create more robust, averaged porosity profiles. While large craters (~100 km) seem to be unaffected by their terrains, future work is needed to confirm this and to see if this is also true for smaller-sized impacts.

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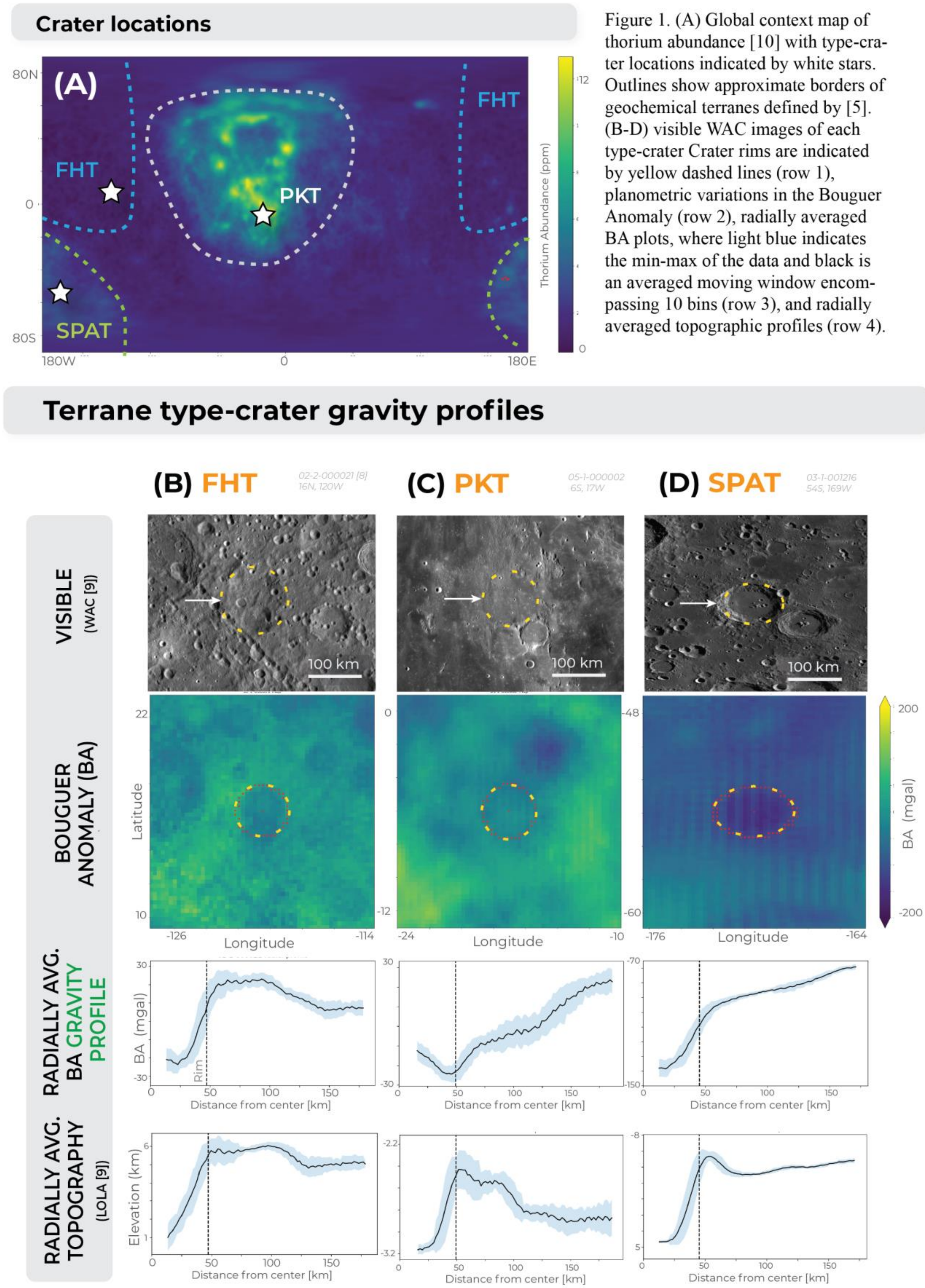

Figure 1. (A) Global context map of thorium abundance [10] with type-crater locations indicated by white stars. Outlines show approximate borders of geochemical terranes defined by [5]. (B-D) visible WAC images of each type-crater Crater rims are indicated by yellow dashed lines (row 1), planometric variations in the Bouguer Anomaly (row 2), radially averaged BA plots, where light blue indicates the min-max of the data and black is an averaged moving window encompassing 10 bins (row 3), and radially averaged topographic profiles (row 4).