EFFECT OF TARGET LITHOLOGY ON THE SIMPLE TO COMPLEX TRANSITION DIAMETER FOR LUNAR IMPACT CRATERS.

J. C. Clayton[1], G. R. Osinski[1], L. L. Tornabene[1, 2], J. D. Kalynn[3], and C. L. Johnson[3,4], [1]Centre for Planetary Science and Exploration/Dept. Earth Sciences, University of Western Ontario, London, ON, Canada, [2]SETI Institute, Mountain View, CA, USA, [3]Dept. of Earth, Ocean and Atmospheric Sciences, University of British Columbia, BC V6T 1Z4, Canada, [4]Planetary Science Institute, Tucson, AZ, USA (jclayto6@uwo.ca).

Introduction: Impact craters are divided into two subgroups, based on morphology: simple and complex. The progression from simple to complex morphology is not abrupt and is represented by a "transitional" crater morphology. Due to target effects, the transition diameter, D_t, is best represented as the geometric mean of several crater diameter values that characterize this simple-to-complex morphologic transition [1]. For lunar impact craters, the average D_t has previously been estimated to be ~19 km [1], with D_t for maria and highlands occuring at 16 km and 21 km, respectively [1]. In this study, we revisit the simple-to-complex transition diameter and the characteristics of transitional craters with modern datasets with an emphasis on the effects of target lithology. Here we compare the number of terraces and crater depth for transitional and complex craters formed in different target types to gauge the possible effects of the target lithology on crater diameter and morphology.

Methodology: We constructed a database emphasizing transitional craters, but including some complex craters, based on a database of 111 'fresh' craters of Eratosthenian (3.2-1.1 Ga) age or younger [2, 3]. We define a transitional crater as a flat-floored crater that does not display the bowl-shaped form of a simple crater, has formed terraces or slumps, but lacks a central uplift. Lunar Reconnaissance Orbiter Camera (LROC) images, visualized within the Java Mission and Remote Sensing (JMARS) for Earth's Moon program [4], were used to map out the number of terraces for craters in Mare, Highlands or "Border" (i.e. in or near a Mare-Highland contact) targets. In addition, this mapping was also done for selected fresh, complex craters with well-defined central uplifts, to observe trends well into the complex crater diameter range.

Results and Discussions: *Target Effect on Terracing:* When comparing the number of terraces present to the diameter of the crater (Fig. 1), there is an evident trend in both target types where terracing generally increases with crater diameter. However, Figure 1 shows that the formation of terraces occurs at lower diameters in mare targets, rather than the highlands. It is hypothesized that this could be due to the layered nature of the mare target, not present in highlands, which aids in crater collapse. This is consistent with interpretations for terrestrial craters, whereby layering in sedimentary target results in a lower transition diameter compared to crystalline rock [5]. Thus, layering appears to be one of the most important properties in controlling the simple-to-complex transition.

Target Effect on Depth: Figure 2 shows that the depth of mare craters, both transitional and complex, plot consistently lower than the values for those of the highlands. This trend may be a result of the increased amount of terracing or slumping within the mare target, as explained above, further supporting the idea of collapse being enhanced in the mare basalt targets.

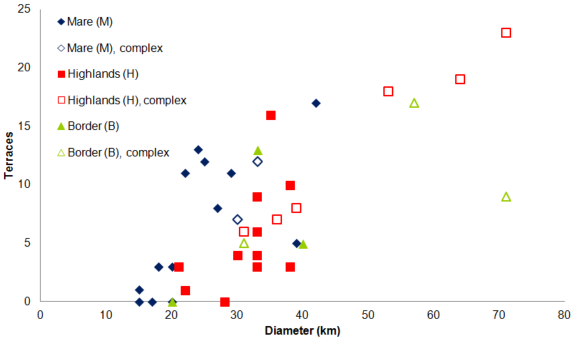

Figure 1: Plot of number of terraces versus diameter (km) for transitional and complex craters in mare, highlands and border target.

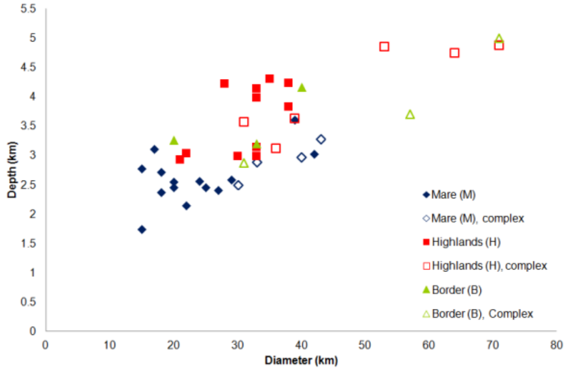

Figure 2: Depth-Diameter relationship for transitional and complex craters in various targets.

Conclusions: This work provides new and important insights into the nature of transitional impact craters on the Moon with evidence that target lithology plays an important role in changes in morphology, depth and transition diameter.

References: [1] Pike R. J. (1980) Proc. Lunar Planet. Sci. Conf. 11th, 2159-2189. [2] Kalynn J. et al. (2013) Geophys. Res. Lett., 40, 38–42. [3] Kalynn J. et al. (2013) LPS XLIV. [4] Christensen P.R. et al. (2009) AGU Fall, Abstract #IN22A-06. [5] Dence M.R. (1972) Int. Geol. Cong. Proc. 24th:77-89.