SECONDARY CRATERS AT THE APOLLO 17 LANDING SITE: NEW APPROACHES FROM MODELING AND OBSERVATIONS. Jordan D. Kendall[1,2], David M.H. Baker[1], Daniel P. Moriarty[1], and Noah E. Petro[1], [1]NASA Goddard Space Flight Center, [2]University of Maryland, Baltimore County (jordan.d.kendall@nasa.gov).

Craters cover the lunar surface due to meteorites striking and creating primary craters. However, ejected materials from these craters form secondary craters, as well as rays of ejecta oriented radially away from the primary crater. Additionally, the concurrent impact of two or more craters within a few impactor diameters leads to the creation of doublet craters and multiple overlapping ejecta patterns, referred to as herringbone patterns. Proper identification of primary and secondary craters is important for determining the provenance of samples, crater counting ages, and identifying source craters.

Previous observations noted secondary crater clusters in and around the Apollo 17 landing site [1]. Near the landing site and on the summit of the South Massif, two sets of secondary clusters (one above and one below) have similar trajectories and may originate from Tycho crater. The orientation of these secondary craters suggests an impact angle of ~20° relative to the horizon based upon the distance and locations relative to the South Massif.

Distinguishing between primary and secondary craters within the Taurus-Littrow Valley has been challenging. Craters such as Camelot appear to be associated with secondary clusters on the valley floor but perplexingly shows signs of being a primary crater. One piece of evidence is the reduction in the abundance of boulders compared with similar craters of its size and age, including other secondary craters of Tycho [2]. Due to the correlation between age and boulder abundance, this suggests that Camelot may be older than Tycho. Alternatively, it may imply some difference in target properties at the Apollo 17 site that inhibits boulder production. An older age for Camelot is consistent with an estimated age of 500+/-150-200 Myr based upon a topographic diffusion analysis [3]; however, this is in contrast with the measured ~100 Myr exposure ages of surface rocks at the crater. Understanding why these discrepancies occur has important implications for the history of events at the Apollo 17 site.

We use iSALE-3D, an impact shock physics hydrocode capable of three-dimensional (3D) simulations of oblique impacts. From our models, we show the development of the secondary craters and the provenance of the ejecta and infer depth to diameter ratios for highly oblique secondary craters as suspected for the Taurus-Littrow valley.

With future work, we intend to answer the above questions by using our models to understand the formation of secondary and primary craters within the valley of Taurus-Littrow and to find if Tycho crater is a probable source for the secondary crater chains and crater clusters.

References: [1] Lucchitta, B.K., 1977. Icarus 30, 80–96. [2] Basilevsky, A.T., et al. 2018. PSS 153, 120–126. [3] Schmitt, H.H., et al. 2017. https://doi.org/10.1016/j.icarus.2016.11.042

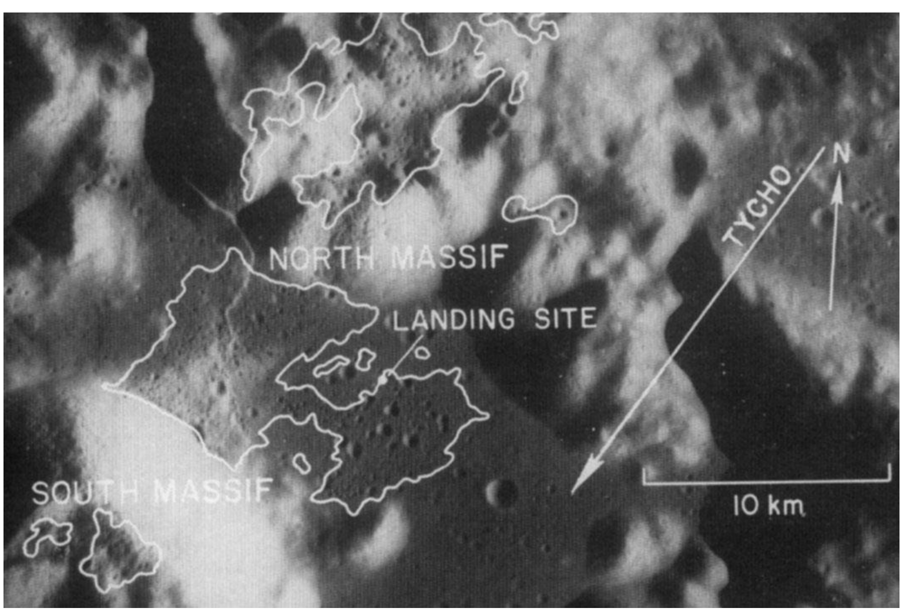

Figure 1: Image from Figure 7 of [1] shows a map of crater clusters (the white outlines) across the Taurus-Littrow area.