STRATIGRAPHY OF THE SCHICKARD CRATER AREA: INVESTIGATIONS USING STATISTICAL CRATER MODELING. I. Antonenko and J. Prinos, PIT, 50 Hillsboro Ave. #2107, Toronto ON M5R 1S8, Canada, irene.antonenko@utoronto.ca.

Introduction: Cryptomaria are lunar volcanic deposits, whose low albedo signature has been obscured by high-albedo ejecta [1]. These hidden maria are important to lunar studies because they provide evidence of ancient volcanism [2], and give clues to the thermal history of the Moon [3]. The geometry of cryptomare deposits can be studied using craters that penetrate into the subsurface mare layer [4]. In previous work, the stratigraphy of the Schickard crater area was studied using Clementine UVVIS data. Spectra of young craters were obtained and classified as indicative of basalt or highland materials. From these data, a detailed stratigraphy was constructed [4].

One of the most interesting and controversial findings of this stratigraphic analysis, was the implication that more than one cryptomare layer may be present in some regions of the study area [4]. In an effort to test this possibility further, we performed statistical crater modeling to consider how a random crater population would interact with different possible stratigraphies.

Crater Population Modeling: In order to compare our model with the results of [4], we produced a crater population with the same size range as those in the Schickard study, namely craters with diameters of 1-25 km. Using the cumulative crater frequency equation of [5], we simulated a random population of craters within this size range and having the appropriate distribution (Figure 1). We found that for an area roughly equal to the Schickard study area, a total number of 850 craters in the range of 1-25 km were required to fit the theoretical curves of [5].

However, plotting the craters from the Schickard study shows that these craters represent a population that is older than the normalized age of the theoretical curve [5] (~3.7 b.y. [6]). "Aging" of our modeled population was, therefore, simulated by increasing the total number of random craters in the appropriate size range to 5000 (Figure 1).

It should be noted that the craters from the Schickard study in no way represent a proper dating crater count. They were selected for completely different purposes, using spectral distinctiveness as a criteria [4]. Therefore, they are not representative and are highly biased towards larger craters (as can be seen from the turn over of the curve in Figure 1). Furthermore, these craters probably represent several episodes of resurfacing and crater obliteration. Never the less, the relative age suggested for these craters in Figure 1 is consistent with other, more rigorous findings [7, 4].

Stratigraphic Modeling: The "older" generated crater population of Figure 1 was applied to three different stratigraphic models (Figure 2), which simulate the stratigraphic types proposed for Schickard. These models are very simplistic, assuming flat, even layers. In reality, the boundary between cryptomare and ejecta layers is thought to be highly irregular [4].

Diameters of the modeled craters were converted to depths of excavation [4]. The craters were then assigned ratings of either highland or basalt for each stratigraphy, depending on whether the deepest layer they excavated was highland or basalt material. This method assumes that, for real craters, the deepest layer being excavated will be observable using spectral techniques. Clearly, this will not always be the case.

Results: Modeled craters were randomly plotted on an xy grid, corresponding to the Schickard study area.
Comparison between the two shows the distribution of large model craters to be consistent with both the study craters and observed populations.

Note that the spatial distribution of highland-excavating craters in Figure 3, though randomly generated, appears clustered in the upper left corner. This result should serve as a caution when interpreting cryptomare materials this way, since such a distribution could lead to false assumptions about the variability of layer thicknesses. Clearly, crater size and distribution need to be considered together in such studies.

Figure 3. Left: Spectral results of the Schickard study. Right: Model crater population, plotted for Stratigraphy 2. Green dots represent mare, blue dots highland. Dot size on the right represents modeled crater size.

Crater histograms were plotted, using their basalt or highland assignments, for the 3 stratigraphies and Schickard craters (Figure 4). Plots were truncated at 10 to highlight subtle variations at larger crater sizes, where penetration of layer boundaries takes place.

For the model stratigraphies, the histograms are "clean" and clearly show where layer transitions occur. In comparison, the Schickard histogram shows great variation. This is likely due to a) variation in layer thicknesses and b) the presence of several different stratigraphic column types in the Schickard area. Regardless, the Schickard histogram agrees best with that of Stratigraphy 2, supporting earlier interpretations of multiple cryptomare layers in parts of this region [4].

A problem with the multi-layer cryptomare theory is that few craters tap the deep mare layer. This study finds only one model crater registering the deep basalt layer of Stratigraphy 2. Therefore, we should expect to find very few craters in the correct size range to recognize deep cryptomare layers when they are present.

Conclusions: Craters from a previous study in the Schickard area suggest an age >3.7 b.y.. When compared to a model population, Schickard craters are consistent with a stratigraphic model having two cryptomare layers. This study also finds that, statistically, very few craters are expected to tap deep mare layers.

Figure 4. Crater histograms, plotted as a function of the deepest layer excavated, for each of the model stratigraphies and for the Schickard study craters.