MICROFEATURE CLUSTERING ON EUROPA: A POTENTIAL CLUE TO THE SUBSURFACE STRUCTURE. J. L. Noviello[1], Z.A. Torrano[1], A. R. Rhoden[1], and M. Manga[2] [1]School of Earth and Space Exploration, Arizona State University, ISTB4 Room 795, 781 E. Terrace Mall, Tempe, AZ 85287-6004. [2]Department of Earth and Planetary Science, University of California, Berkeley, Berkeley, CA. jlnoviel@asu.edu

Introduction: Europa's surface is marked with a variety of microfeatures, also called lenticulae, including pits, domes, spots, and microchaos (chaos features that are less than 150 km^2). The relationship, if any, between these features is unknown. Previous models [1, 2] have struggled to explain the formation of all of these lenticulae via the same process because of the range of sizes, shapes, and topographic profiles of these features. One idea that often appears in chaos and lenticulae formation models is the mandatory presence of liquid water somewhere within Europa's ice shell.

The locations and morphologies of these lenticulae have been studied extensively [3–5] to identify any patterns that could lead to more information regarding the formation mechanisms and determine whether liquid water was present at or near the surface. A recent model [6] attributes lenticulae to various stages in the thermo-mechanical evolution of liquid water intrusions (i.e. sills) within the ice shell, from sill emplacement to surface breaching (in the case of microchaos) to freezing of the sill. Pits hold particular interest because they appear only when liquid water is still present. Another key feature of the model is that the size of a microfeature at the surface is controlled by the depth of the sill. Hence, we can apply this model to regions of Europa that contain microfeatures to infer the size, depth, and spatial distribution of liquid water within the ice shell.

Methods: We are creating a database of microfeatures that includes digitized, collated data from three previous mapping efforts [3–5] along with our own mapping study. We focus on images with ~220 m/pix resolution, which includes the regional mapping data sets, specifically E15RegMap01 and E15RegMap02. We apply a statistical method using the distribution of nearest neighbor distances [7, 8] to quantify the degree of clustering of different microfeatures. These tests are conducted in ArcGIS, though future work will involve tools [8] for direct comparison to other bodies. Thus, we determine the typical spatial separation among and between microfeature types and create density maps of microfeatures in several regions of Europa.

Preliminary results: The relationship between the size of a feature and the sill that created it is d≈R/2.4, where d is the sill depth and R is the radial size of the feature [6]. Local mechanical properties then control the topographic expression of the feature. According to the model, this relationship holds true for pits, domes, and chaos. Based on this equation, preliminary results indicate that sills that form pits and domes are typically located at depths of 2 km or less from the surface (Figure 1). Sills that form chaos are located at depths ranging from 0.5–4 km. Our preliminary analysis also shows that pits are clustered in some regions, consistent with previous results [5], although individual pits are also observed. Additionally, the majority (>90%) of lenticulae in the two regions studied had another lenticulae feature within 30 km.

Modeling the ice shell structure: Once we have determined the locations and densities of these features and estimated the depths of the sills, we will produce a preliminary, 3D graphic of the subsurface structure of Europa's ice shell. This will allow for future studies to estimate physical parameters of the ice shell, including seismic parameters to generate sample seismographs, in order to better understand Europa's evolution and assesss its present potential for habitability.

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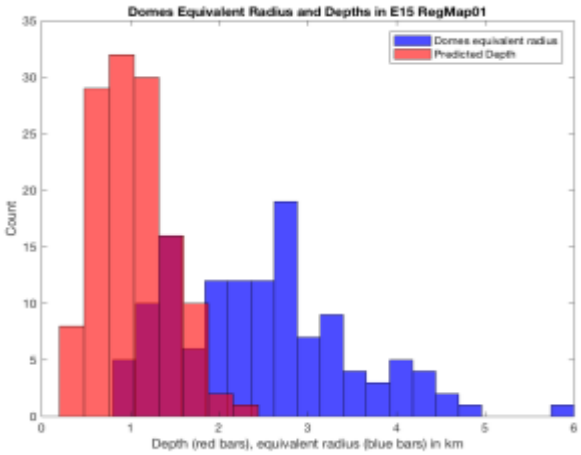

Figure 1: The estimated depths of sills underneath domes in the E15RegMap01region on Europa. Blue bars represent the size of a feature, and red represents the depth of a sill.