PITS, SPOTS, UPLIFTS, AND SMALL CHAOS REGIONS ON EUROPA: A SEARCH FOR REGIONAL VARIATIONS. Kelsi N. Singer[1], William B. McKinnon[1], and P.M. Schenk[2]. [1]Department of Earth and Planetary Sciences and McDonnell Center for the Space Sciences, Washington University, St. Louis, MO 63130 (ksinger@levee.wustl.edu, mckinnon@wustl.edu); [2]Lunar and Planetary Institute, Houston, TX 77058 (schenk@lpi.usra.edu).

Introduction: Europa's surface is littered with features that may reveal tantalizing information about its interior and geologic history. This work focuses on features created by subsurface upwellings: pits, uplifts, spots and chaos. Several groups have worked on mapping these features in the past. Greenberg et al. [1] mapped sub-circular features with clear topographic expressions, but explicitly left out chaos regions previously mapped [2, 3]. This work concluded that a continuous range of feature sizes existed, with increasing numbers of small features, down to the resolution limit. They consider this distribution to be in support of a "melt-through" model of feature formation, where localized heating thins the shell exposing water below. Near-equatorial mapping by [4, 5] focused on large and small chaos regions, but also noted pits and other features. This mapping found a peak in size distribution near ~5 km and declining numbers of smaller features. This distribution was interpreted as an indication of a diapiric formation model.

The purpose of this work is to consider all subsurface disruptions but focus on smaller features: pits, spots, uplifts, and small chaos regions. The mapping method is described below. The long-term objective is to obtain data that can be used to investigate regional variation in spatial and size frequency distributions. The sample area presented below illustrates the potential for exploring the distribution of pits, spots, uplifts and chaos on Europa.

Mapping Method: The sample area chosen is at the southern extreme of the eastern regional basemap prepared by one of us (PMS). It extends from 48° to 65° S and 73° to 107° W. This region was chosen because many small subcircular features are immediately apparent and the surface is not dominated by a single large chaos zone. The resolution of the mosaic is 220 m/pixel. The smallest features mapped have equivalent diameters of ~1.5 km which equates to ~7 pixels across. The largest feature is a chaos region with an equivalent diameter of 45 km, but this feature is at the edge of the image and thus this diameter is a lower limit.

Features were identified based on morphology and further classified based on topography and albedo. The basic map units were defined in a similar manner to previous authors [4, 6]:

- Pit – subcircular feature with negative topographic expression and little or no surface disruption – An attempt was made to avoid depressions that appear to be formed only by being bounded by raised ridges and not subsurface activity.
- Uplift – subcircular feature with positive topographic expression and little or no surface disruption – In some cases there is a fine line between an uplift and a chaos region, but uplifts are generally taken to be smaller more circular features formed by a single upwelling or surface disturbance, while chaos is larger and more irregular in shape.
- Spot – low albedo area which is generally smooth and often obscures pre-existing terrain
- Chaos and mini-chaos region – surface area with a hummocky disrupted texture distinct from its ridged or smooth surroundings

This work identified more pits and uplifts than had previously been mapped by [1] in this region and included small subcircular chaos regions as well as a few larger irregular chaos regions.

Observations and Discussion: Figure 1 presents all features mapped. It is useful to consider the distribution of features in terms of both number and area. While individual features are found scattered throughout the image, if the spatial distribution is weighted by the area of each feature, a few areas of higher density emerge (Fig. 2). The chaos regions dominate this visualization due to their large surface areas, but a concentration of smaller pits and uplifts in the center of the image also show a high density.

A size frequency diagram (Fig. 3) is presented in terms of the effective diameter, or the equivalent diameter of a circular feature. This histogram includes complete and (a few) partial features. There is a peak in the size distribution at ~5 km diameter, well above the effective resolution for ~circular feature identification (5 px ~ 1.1 km). Features smaller than 1.5 km diameter can be seen, such as small dark pit-like features 3-5 pixels across, but most appear to be part of larger disturbances. It can not be ruled out that smaller features, plausibly due to subsurface disturbances exist

below the effective resolution limit. In this region, however, the smallest features that did not appear to be part of a larger one are 1.5 km or greater in diameter. The size frequency distribution in this area is similar to that found by [4, 5] in near-equatorial regions.

Future Work: Our mapping will be extended to the rest of the eastern regional map, and ultimately to all high-resolution Galileo imagery. Combined with topographic inferences from stereo, photoclinometry, and shadow measurements, we hope to shed light on the physics of pit, spot, and uplift formation. Mapping in the remaining high resolution Galileo images will allow a search for regional variations that may yield information about crustal history and thickness.

References: [1] Greenberg R. et al. (2003) *Icarus 161*, 102–126. [2] Riley et al. (2000) *JGR 105*, 22,559–22,578. [3] Greenberg R. et al. (1999) *Icarus 141*, 263286. [4] Spaun N. (2002) Ph.D Thesis, Brown Univ. [5] Spaun N. et al. (2004) *LPSC XXXV*, abs. #1409. [6] Greeley R. et al (2000) *JGR 105*, 22,559-22,578.

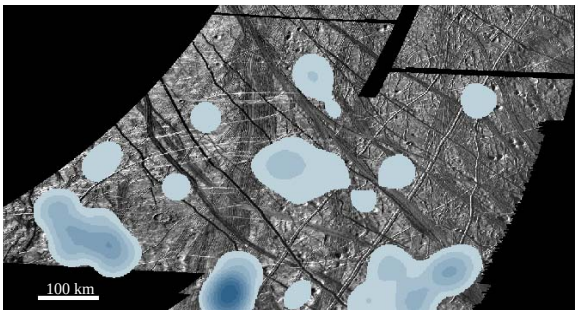

Figure 2. Density map of sample region. ArcMap weights each occurrence of a feature by its area and fits a quadratic kernel function for each. These functions add when they overlap spatially, to create the map of relative high density (darker blue) vs. relative low density (lighter blue). See text for discussion.

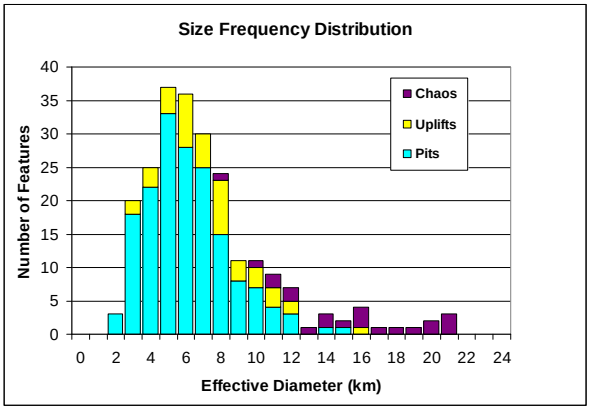

Figure 3. Size frequency distribution by feature type. To display more detail, nine chaos regions larger than 24 km in diameter were excluded. A peak in frequency occurs for features ~5 km in diameter.

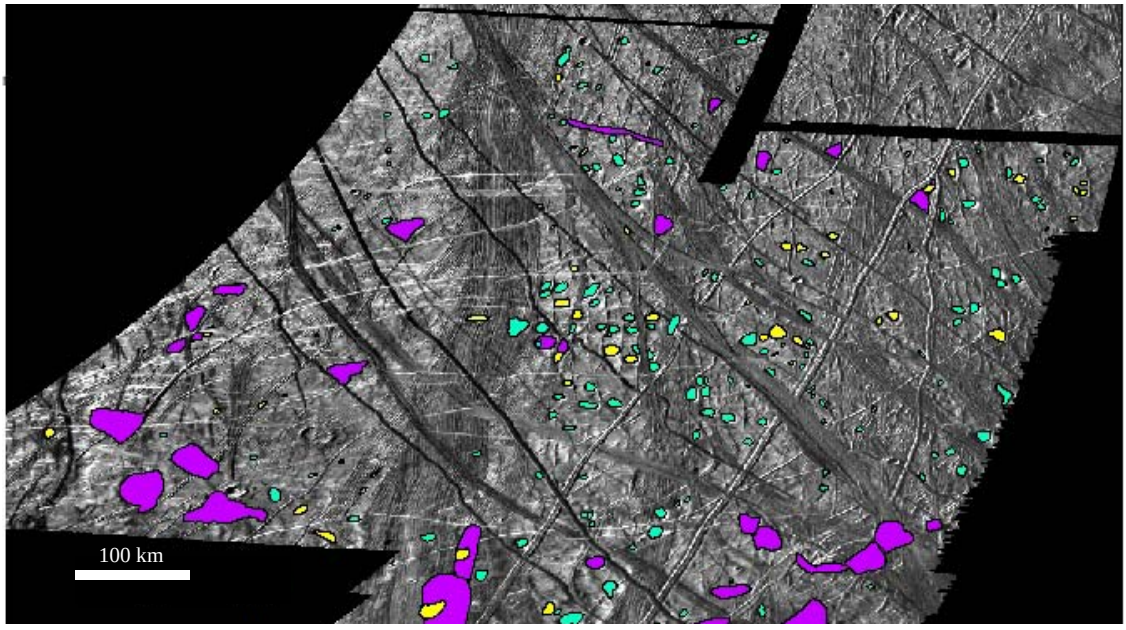

Figure 1. Map of all features. Purple indicates chaos, blue denote pits and yellow represents uplifts. Region is centered on 90° W 57° S. Sarpedon linea crosses the image from approximately the NW corner to the SE corner.