Geophysical Research Abstracts
Vol. 17, EGU2015-7891, 2015
EGU General Assembly 2015

Shape of lenticulae on Europa and their interaction with lineaments.

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The surface of Europa contains many elliptical features that have been grouped into three classes: (a) positive relief (domes), (b) negative relief (pits), or (c) complex terrain (small chaos). Collectively, these three classes of features are often called “lenticulae”. The internal processes that form lenticulae are unknown. However, given that the diameters of all these features are similar, it is parsimonious to ascribe each class of feature to a different stage in the evolution of some process occurring within the ice shell. Proposed models for these features including diapirs (Sotin et al., 2002; Rathbun et al., 1998); melting above diapirs (Schmidt et al., 2011); and sills of water (Michaut and Manga, 2014). The objective of the present study is to first characterize the shape of lecticulae, and then look at the interaction of lenticulae with lineaments, in order to test lenticulae formation mechanisms. Lenticulae and lineaments are mapped and annotated on ArcGIS. We mapped a total of 57 pits and 86 domes. Both pits and domes have similar aspect ratios and orientations. The elliptical similarities of domes and pits suggest that domes and pits are surface expressions of different stages of a common process within the ice shell.

The cross cutting relationships between lineaments reveal relative age. Lineaments either lie over or under the lenticulae. All of the lineament segments that appear within pits also appear topographically lower than the rest of the surface. Domes lie over and under lineaments, but unlike pits there are lineaments that lie over domes that do not vary in topography. This suggests that the lineaments that lie above lenticulae and match the lenticulae’s topography are older than the lenticulae. Domes have more crossing lineaments. Therefore, on average, they appear to be older than pits. Lineaments also appear on the sides of lenticulae. There are two different ways in which adjacent lineaments appear: 1. they disrupt the shape of the lenticulae; 2. they are tangent to the edge of the lenticulae. These observations suggest that lineaments that interrupt the shape of lenticulae are younger than the lenticulae, and the lineaments tangent to lenticulae are older than the lenticulae. The shape of the disrupted lenticulae, which has lost its elliptical shape due to the lineament, implies that the ice behaves rigidly on either side of the lineament. Furthermore, lenticulae do not perturb lineaments during lineament formation. Last, pits that have lineaments tangent to them appear sheared or compressed, suggesting that pits could be influenced by the stresses that form lineaments.

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