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Magnitude-frequency distribution of hummocks and its geomorphological significance

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Hummocks are conically-shaped mounds formed on debris avalanche deposits after catastrophic sector collapse of mountain (often volcanic) body. The present study investigates the cumulative frequency distribution of hummocks, and discusses its geomorphological significance. Total of 17 debris avalanches are examined in this study. And the result shows a clear relationship between magnitude and cumulative frequency distribution given by (Yoshida, 2015),

$\log_{10}N(x)=a-b\,x$ (1)

where $N(x)$ is cumulative number of hummocks larger than and equal to x, x is the magnitude expressed by $\log_{10}A$, A is the area of a hummock, and a and b are constants. The constant b is peculiar to each avalanche, with a range of 1-2. When a volcanic mass collapses, it breaks up into numerous rock blocks during movement as a debris avalanche. Hummocks are basically composed from such rock masses, and generally become smaller with distance from the source. Previous studies have proposed simple models involving such progressive breaking up of hummocks (volcanic masses or debris avalanche blocks) due to avalanche spreading. From the above, therefore, the constant b becomes a significant value geomorphologically, reflecting the debris avalanche processes directly, because the values of b imply the rate of increases in frequency of hummocks (or debris avalanche blocks as core(s) of hummocks) with the decrease of magnitude, due to the succession of debris avalanche processes. The difference in the value of b may be controlled by the mobility of the debris avalanches. This is because when the debris avalanche is more mobile, the collapsed/sliding masses and the debris avalanches are more shattered and breaked up during movement till emplacement, resulting in more frequent fragments of debris avalanche blocks (i.e. hummocks). A strong correlation between values of H/L (equivalent coefficient of friction as a representative of mobility of debris avalanches) and b supports the above speculation, which the higher H/L (less mobile) of avalanches yields the lower b value.

(Refereneces) Yoshida, H. (2015) AJG Meeting; Yoshida et al. (2012) *Geomorphology*, 136, 76-87.