

Morphometric extraction of the passage zone: Broad scale analysis of subglacial edifices in Iceland

Gro B. M. Pedersen¹, Pablo Grosse²

¹Nordic Volcanological Center, Iceland, ²CONICET (Consejo Nacional de Investigaciones Cientificas y Tecnicas), Argentina

E-mail: grobirkefeldt@gmail.com

Glaciovolcanic landforms and sequences can be used as a proxy for paleo ice caps. The passage zone, marking the junction between the lava cap and breccia, is of particular interest. It records the englacial water level coeval with the delta formation and thereby provides important paleoenvironmental parameters regarding ice thickness, paleo ice surface and the paleo eruption environment.

Since the very beginning of investigation of subglacial edifices, tuyas have been known for their morphometric characteristics being roughly equidimensional, steep-sided, flat topped mountains. In particular, the passage zone is morphometrically diagnostic and already in 1969 Jones [1] described that the passage zone for the tuya Skrida, Iceland, was noticeable by a conspicuous break in slope marking the transition from steep scree flanks to low sloping lava cap.

Strangely, these morphometric characteristics have never been exploited for broad scale analysis of subglacial edifices based on geomorphometry. Therefore, we initiated a pilot study on Reykjanes Peninsula, Iceland to make a purely morphometric characterization of subglacial landforms based on IS 50V digital elevation model (20 m/pixel). The edifice boundaries were delimited by concave breaks in slope around their bases and morphometric parameters such as volume, slope, base area, base width, edifice height, ellipticity and irregularity were calculated for each edifice [2,3]. Further analysis of topographic profiles correlated with geologic maps and aerial photographs, showed that it is possible to resolve individual land elements based on slope discontinuity. The passage zone is especially clearly defined by a convex break in slope.

This study utilizes the fact that volume, edifice height and the passage zone for tuyas can be extracted to make geomorphometric broad scale investigation of tuyas from the Icelandic neovolcanic zone. Furthermore, aerial photographs will be used to investigate if lavas drained down the tuya edifice providing information on the stability of the englacial lake during the eruption. The correlation of the passage zone heights, volumes and information regarding englacial lake stability allows us to investigate several aspects of tuya formation. This includes examination of; (1) spatial distribution of tuya sizes in rift and plume dominated volcanic systems (2) approximate estimate of paleo ice surface height based on passage zone elevation and (3) relationship between eruption size, approximate paleo ice surface height and meltwater drainage.

[1] J.G. Jones (1969) Quarterly Journal of the Geological Society 124, 197-211. [2] Grosse et al. (2009) Geology 37, 651-654. [3] Grosse et al. (2012) Geomorphology 136, 114-131.