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Digital multi-model photogrammetric mapping of dyke patterns in the Disko and Nuussuaq region, West Greenland: Methods and results

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Dykes are self-induced magma-filled fractures that act as pathways channelling magma from the source towards the surface. Whether or not dykes make it to the surface to become feeder dykes, or they get arrested below the surface, their spatial distribution and characteristics provide important information about the magmatic system and the state of stress at the time of formation.

In this study we map dyke patterns in three dimensions by using a combination of aerial photographs and oblique photographs taken from a helicopter with handheld cameras set up in a digital multi-model photogrammetric system. The dykes cut the Paleocene volcanic succession in the Disko-Nuussuaq area in West Greenland. The Paleocene volcanic succession of the Nuussuaq Basin consists of two parts, a lower part consisting mainly of picrites and an upper part consisting of basalts. The volcanic products were erupted in both a subaerial and subaqueous environment and later followed by an Eocene volcanic activity. As previous studies have mainly focussed on understanding the volcanic geology and the interplay between subaerial lava flows, hyaloclastites and contemporaneous sediments in the evolving Nuussuaq Basin, we focus our attention here on the subsurface intrusive system. As dykes are mapped in three dimensions, we are able to calculate strike and dip in order to make structural interpretations.

In addition to calculation of strike/dip of whole line segments we have also developed methods that evaluate strike and dip at intervals along the dyke which enables us to make more realistic 3D geometric models of the dyke bodies. The data presented here cover a roughly 120 km long and 30 km wide transect running more or less northeast-southwest from the north coast of Nuussuaq to the Mellemfjord area in the central western part of Disko. The data show that there is a clear change in dyke orientation along this transect. In the southern part around the north coast of Disko, dyke orientations cluster around N150°E. Further to the north, in the southern part of Nuussuaq, the preferred dyke orientation is sligthly shifted to around N135°E and more variation in dyke orientation is observed. Finally in the northern part, dyke orientation varies even more with the main part of the data striking between around N55°E and N125°E and with a mean orientation of N88°E. We interpret the change in dyke orientation to represent changes in the regional stress field during formation.