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# Influences of Topography and Strain on the Segmented Nature of the 2014 Bárðarbunga Dyke

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The 2014 dyke intrusion in the Bárðarbunga volcanic system grew laterally for more than 45 kilometres at a variable rate. The dyke propagation was characterized by significant changes in strike, with an initial SE propagation direction away from the Bárðarbunga caldera before turning to a NE direction and continuing northwards with significant variations along its path. Relative locations of hypocenters revealed that the dyke propagation occurred in segments each with different strike. To explain these variations in strike we used the segments, identified through relative locations, and calculated the total potential energy of the crust, the sum of its gravitational and strain potential energy, as a function of the strike. We estimated other parameters of the dyke segments from the seismic data and results of geodetic modelling. The results showed good correlation between the observed strike of the dyke and the minimum of inferred combined gravitational and strain potential.
Topography was a dominating factor in the strike changes close to the Bárðarbunga caldera. However when the dyke had reached more leveled topography the strain potential became the governing term. This was both due to less variability in the topography as well as the dyke having propagated into a rift zone of high strain concentration.

To estimate the strain potential we assumed that the tectonic stress due to plate spreading could be approximated by an infinitely long and wide tensile dislocation below 10 km depth in an elastic half-space. It was located so that it would be under the Askja central volcano as geodetic measurements have indicated that the central axis of plate spreading passes through there. The strike of this dislocation was set to N12°E, to be about perpendicular to direction of plate movements predicted by global plate motion models.
We calculated the gravitational potential energy change, for each dyke segment, by integrating the predicted vertical displacements associated with the dyking, multiplied by the local topographic load density (ice and crust) above an arbitrary reference surface and the acceleration of gravity.

The dyke propagation was segmented with highly variable velocity. At one point the dyke propagation stopped for about four days. We found this location coincided with a minimum in pressure for any given depth. This suggests that the dyke propagated downhill at a level of neutral buoyancy until this point before having to propagate uphill, which required significant pressure build up. Our results suggest that models which consider the influence of topography, gravity and strain may lead to better understanding of dyke propagation and could be applied to mitigate volcanic hazards.