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Hekla volcano the last 1000 years: Integrating remote sensing data, soil and vegetation data

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Hekla volcano is one of the most active volcanic systems in Iceland and has erupted ∼23 times since the settlement of Iceland in AD 874 and five times in the 20th century (1947-1948; 1970, 1980-1981, 1991, 2000). Based on seven photogrammetric surveys before and after each of the last five eruptions (1945, 1946, 1960, 1979, 1984, 1987, 1992) historical DEMs and orthophotos were constructed using digital photogrammetric techniques. Together with radar-based DEMs (1998 and 2012-2013) and a lidar-based DEM (2015) these data sets were used to create thickness maps for the last five eruptions (Pedersen et al. 2018a). Furthermore, they were combined with field observation of stratigraphy and soil-, tephra- and vegetation data to create new maps of the historical lava flows at Hekla in a digital format which can be accessed from https://emmirs.svarmi.is/map (Pedersen et al. 2018b).

The historical lava fields from Hekla cover 233 km2 and the lavas reach up to 16 km from Hekla volcano. Flow lengths up to 20 km are known, though lava flows only travelled up to 8–9 km from Hekla in the last 250 years. Identified historical vents are distributed between 0 and 16 km from Hekla volcano. Vents are known to have migrated up to 5 km away from Hekla during eruptions. Repeated eruptions outside of Hekla are mostly confined to two areas. One area lies 4–8 km SSW of Hekla and another area is 2–5 km NNE of Hekla. Lava flow fields from 16 eruptions have been identified and another 60 unidentified lava units, which may be of historical age, have been mapped. It is expected that some of these units are from known historical Hekla eruptions such as the 1222, 1341, 1510, 1597, 1636 and potentially even from previously excluded eruptions such as 1436/1439.

Hekla's high frequency of lava flow formation and tephra deposition, well defined age constraints and delineation of lava flows provide ideal settings to study the impact of volcanism on the dynamics of ecosystem development in sub-Arctic environments. The plant succession on the Hekla lavas features similarities to other volcanic regions, with the biggest resemblance to lava flows in the Kamchatka peninsula where similar succession stages have been described (Vilmundardóttir et al., 2018). The soils were tephra rich, yet carbon concentrations increased with age and have a continued potential of accumulating soil carbon via natural plant succession, continued events of tephra fall and soil thickening. The C stocks on the Hekla lavas were comparable to estimated stocks in organic soils in Hawaii and Japan, indicating high potential for C accumulation and sequestration, given the soil cover is not eroded.

Pedersen et al. (2018a) Hekla volcano, Iceland, in the 20th century: Lava volumes, magma supply and effusion rates, GRL, doi: 10.1002/2017GL076887.

Pedersen et al. (2018b) Historical lava flow fields at Hekla volcano, South Iceland. Jökull.

Vilmundardóttir et al. (2018). Of mosses and men- Plant succession, soil development and soil carbon accretion in the sub-Arctic volcanic landscape of Hekla, Iceland. Progress in Physical Geography, https://doi.org/10.1177/0309133318798754.