

Highland Aeolian Deposits in the Faroe Islands

Hálendisvindborin setløg í Føroyum

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Úrtak

Eitt, sum eyðkennir føroyska landslagið, er, at har eru hálendisvindborin setløg og nærum eingir strandsandheggjar. Fleiri fjallatindar eru lutvíst huldur av hálendisvindbornum setløgum. Av tí at tað er vindhart í Føroyum, er tað sjálvsagt, at hálendisborin setløg eru har. Eyðkenni teirra hava kortini ikki verið lýst fyrr, meðan tað er rakt við tey nærhendis í lfknanði hálendisþokjum í útnyrðingspartinum av Skotlandi. Henda greinin er ein fyribilslýsing av jarðformfrøðini hjá teimum hálendisvindbornu setløgum í Føroyum, og hon víðger framhaldandi nýtslu av hesum setløgum til endurskipanir av frumumhvørvinum.

Abstract

One of the characteristics of the Faroese landscape is the existence of highland aeolian deposits and the relative absence of coastal dunes. Several mountain tops are partly mantled by sheets of aeolian deposits. As the modern Faroese climate is dominated by strong winds, the presence of highland aeolian deposits is obvious. Their characteristics have, however, not been described earlier, whereas they are recognised in similar, neighbouring highland areas of NW Scotland. This paper preliminarily describes the geomorphology of the Faroese highland aeolian deposits, and discusses the further use of these deposits in palaeoenvironmental reconstructions.

Introduction

One of the most significant features of the Faroese highland climate is the strength of the wind and the extreme exposure. The average annual wind speed close to sea level at Akraberg in southern Suðuroy is 7.2 m/s for the period 1962-1994 (Data from the Danish Meteorological Institute). The present day dominating wind direction is from W, SW and S (Søgaard, 1996). The strong winds can cause erosion in exposed areas, particularly in those without a vegetation cover, and then lead to deposition in sheltered lee slopes.

Highland aeolian deposits are only sparingly described from the European area, but have particularly been investigated in neighbouring areas in NW Scotland (Pye and Paine, 1983; Ballantyne and Harris, 1994; Ballantyne, 1998). In the Faroe Islands the accumulations of highland aeolian deposits were not even mentioned by Geikie (1883) in his otherwise rather detailed description of the surface sediments. This might be because he primarily travelled by boat, and seldom reached the mountain top areas. The existence of aeolian

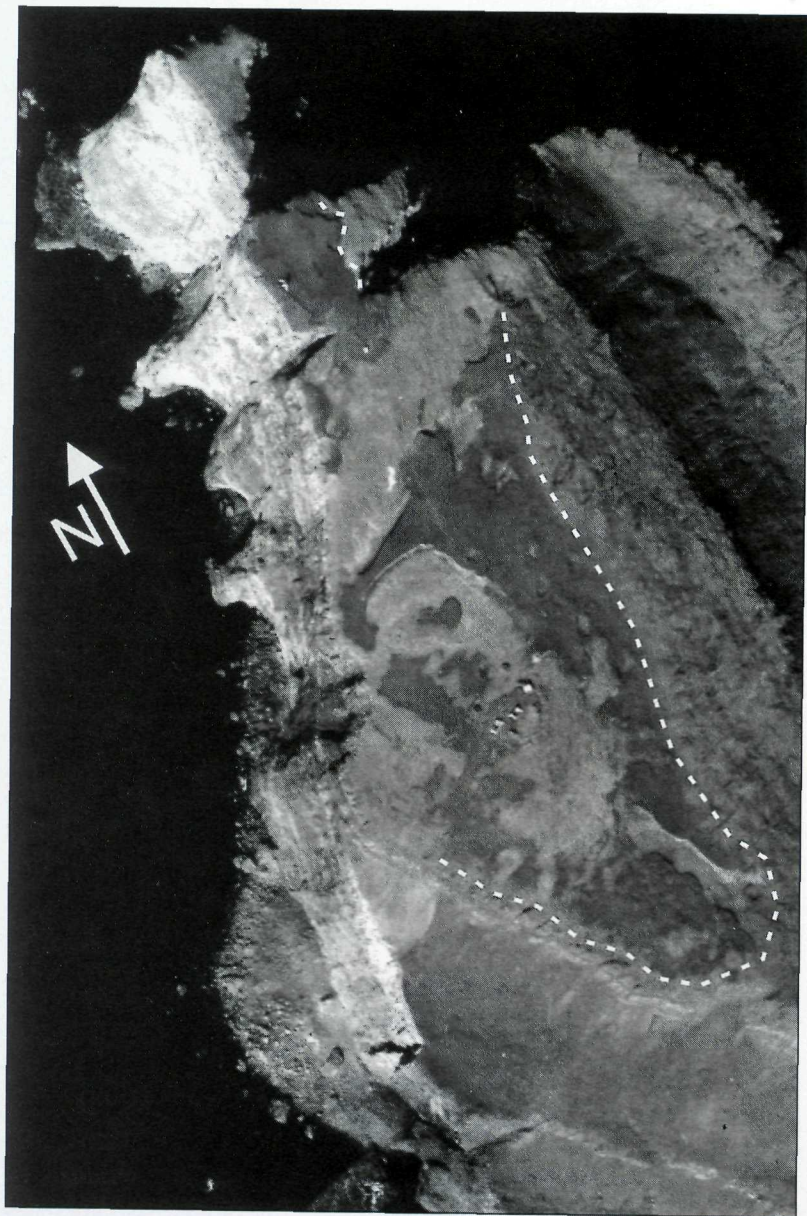


Fig. 1. Remnants of an aeolian sheet covering primarily the top of the peninsula Eiðiskollur, 338 m a.s.l., on Eysturoy. The deposit is accumulating above a coastal free face, at the NW side of the peninsula, which is assumed to be a primary sediment source. This is stressed by the thickness of the sheet being maximally more than 2 m, closest to the free face top. Blow-outs delimited by erosion scarps are seen in several parts of the aeolian sheet. The area shown is about 1×1.5 km in size. The aerial photograph is from 1958.

Mynd. 1. Leivdir av einum setlagi, sum fjalir tað ovasta av Eiðiskolli (338 m). Setlagið rúgvast upp á fløtuni uppi yvir berginum á útnyrdingssíðuni á Eiðiskolli, sum verður hildið at vera ein høvuðsáløgukelda, serliga tí at lagið er so tjúkt, upp í 2 m næst eggini. Nógva staðni hava veður og vindur matað burtur av setlagnum. Økið á myndini er um $1 \times 1,5$ km til støddar. Loftmynd frá 1958.

lian deposits has been briefly mentioned (Humlum and Christiansen, in press) to form part of the periglacial landforms of the Faroe Islands.

In the following a short description of the present knowledge of the morphology, location, sedimentology and age of the Faroese highland aeolian sheets is given. Some indications as to the future use of these deposits in reconstructing palaeowind directions and periods of activity are implied.

Morphology and location of aeolian deposits

The aeolian deposits occur in more or less undulating sheets and have smooth continuous surfaces devoid of boulders and cobbles. There is thus a significant visual difference between the diamict covered hillslopes or bedrock outcrops that dominate the surface of the Faroese highlands and the aeolian deposits. Another characteristic of the aeolian sheets is that they are completely covered only by grass vegetation, opposed to the more mixed vegetation of the rest of the landscape. This gives the wind-blown deposits a very homogeneous appearance in a landscape otherwise dominated by an uneven surface with boulders and bedrock protruding in several areas. It also shows that these aeolian deposits to some degree can have accumulated during former more extensive periods of wind activity than at the present.

Aeolian sediments are often deposited immediately downslope pass areas, such as at Neytaskarð north of Norðradalur on Streymoy. They are also accumulating

above free faces that reach almost vertically down to sea level, such as at Eiðiskollur on Eysturoy (Fig. 1) or are associated with inland free faces or mountain slopes as at Tindur SE of Vestmanna on Streymoy (Fig. 2). Finally some have simply accumulated on gently sloping mountain sides; an example is seen south of Høgareyn, south of Vestmanna. Primarily, the inland aeolian deposits are located on southfacing slopes, but the deposits associated with free faces reaching sea level can occur on slopes with all directions and even on almost horizontal mountain top surfaces. Aeolian deposits occur both below, but mainly above the modern lower limit for periglacial activity at the Faroe Islands at about 250 – 450 m a.s.l. as determined by Humlum and Christiansen (1998; in press).

The aeolian deposits located above free faces reaching sea level are presumably the largest. They tend to occur at free faces that have a northerly or westerly exposure, and seem to be thickest closest to the free face top, becoming thinner away from it. At the small peninsula Slættanes on Vágur a large continuous aeolian cover is deposited immediately above a free face only about 150 m high, with a northwesterly aspect. This locality shows very clearly that aeolian sediment accumulation must primarily have taken place during storms from the north, as there is no other sediment source area than the coastal free face which is large enough to yield such a sediment cover.

The aeolian covers associated with inland free faces also seem to be associated with dominating northerly wind directions. An example is the cover of aeolian sedi-



Fig. 2. Aeolian cover, up to 2 m thick, on the southern side of the mountain Tindur, 530 m a.s.l, on Streymoy. The basaltic bedrock can be seen cropping out on the north, upwind side. April 1998.

Mynd. 2. Vindborið lag, upp í 2 m tjúkt, á suðursíðuni á Tindi (530 m) í Streymoy. Basaltheðllan sæst koma undan á norðursíðuni. Apríl 1998.

ments particularly on the NW shoulder of the mountain top Eggjarklettur at about 350 m a.s.l. on Nólsoy, and the very distinct, but small deposit on the south side of Tindur on Streymoy (Fig. 2).

The location of aeolian deposits in the pass areas is on the other hand probably more controlled by local winds. These are canalised through the passes reaching very high wind speeds that enable large-scale aeolian sediment transport to the closest lee sites just downwind the passes.

Generally the aeolian deposits are relatively continuous, but in some areas they

appear as remnants of former more coherent sheets. In such areas deflation surfaces with gravel lag deposits exist in the blow-outs of the aeolian deposits. An example of this is seen on Eiðiskollur (Fig. 1). This indicates that some erosion or reworking has occurred and still continues in the aeolian sheets. However, the large-scale configuration of the windblown sediment covers does not seem to have changed much since 1958, when detailed aerial photographs were taken of large parts of the country. This shows that modern aeolian erosion is presumably only small-scale. Until now no



Fig. 3. Windpolished boulder with a more or less well-developed facet running along the upper edge of the boulder. The dominating wind direction is from the right side, and it therefore primarily abrades this side of the boulder, which appears light coloured and almost without lichens. From the Slættaratindur area, Eysturoy. May 1996.

Mynd. 3. Klettur, ið er brýndur av vindi, við einum lítlum slætta omaná. Har ið ættin stendur mest á, er hann ljósur á liti og hevur næstan onga skón. Nærhendis Slættaratindi í Eysturoy. Mai 1996.

detailed measurements have taken place, quantifying the modern erosion and deposition rate of the aeolian deposits.

Another evidence of wind erosion is the existence of wind abraded surfaces on large boulders. Windpolished facets (Christiansen and Svensson, 1998) do presently develop on large basaltic boulders (Fig. 3), but presumably due to relatively high weathering rates, fossil windpolish does not seem to have been preserved to any

large extent in the Faroese landscape. Living lichens have well-developed windpolished surfaces with the characteristic windabraded microforms that reflect modern wind abrasion (Humlum and Christiansen, in press). Most modern wind abrasion is found to be developed by drifting snow, rather than sand or silt (Humlum and Christiansen, in press).

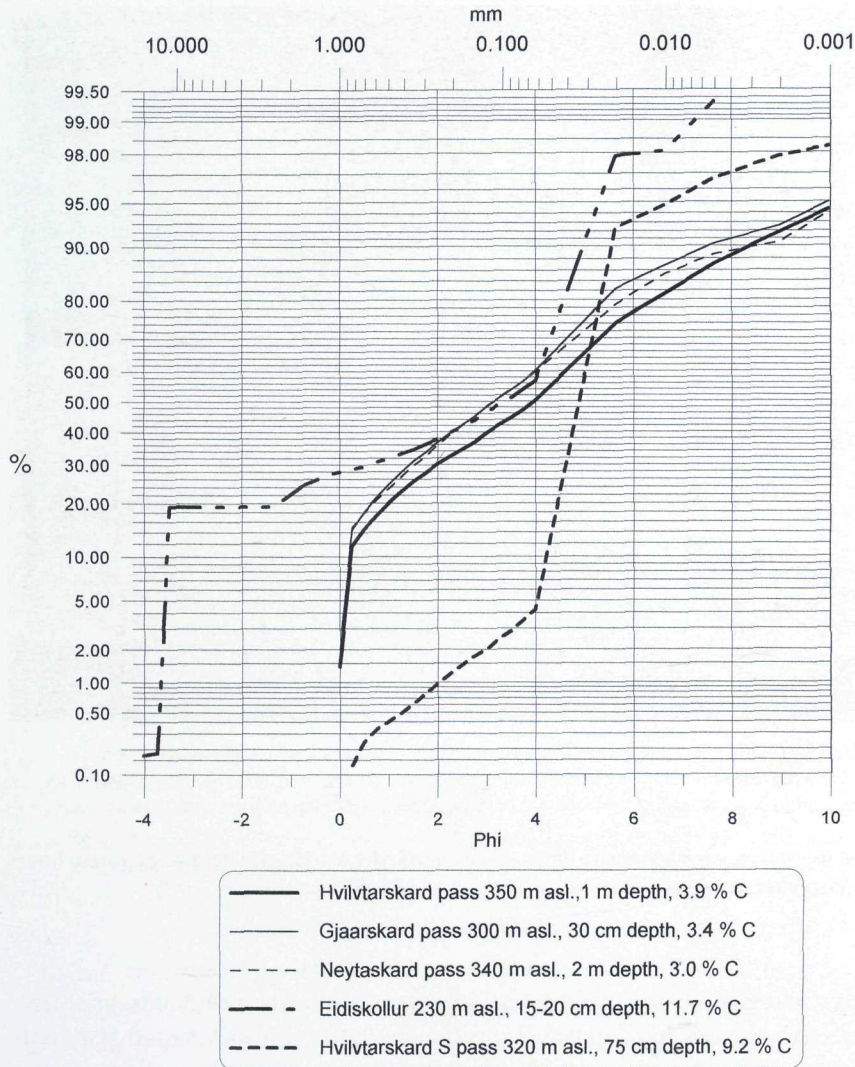


Fig. 4. Grain size distribution of aeolian sediments. The content of carbon is given following the description of each sample location.

Mynd. 4. Býti í kornstödd av vindbornum setløgum. Innihald-ið av kolevni sæst, eftir at staðfestingin av hvørji roynd er lýst.

Sedimentology

The deposits of windblown sediments are up to about 4 m thick. They can be massive, structureless and homogenous, but can also have a distinctive stratigraphy. Grain size distributions from a few large aeolian sheets (Fig. 4) show that both sorted and

poorly-sorted sediments occur. Sorting seems to be most pronounced for deposits rich in silt and with a high content of carbon. The poorly-sorted sediments clearly have less carbon. Aeolian deposits are in some places underlain by peat layers, and layers rich in organic material can be seen



Fig. 5. Snowpatch with a considerable cover of niveo-aeolian primarily organic material that is successively lowered down onto the ground as the snowpatch melts. The niveo-aeolian organic material is seen to form small cylinders about 0.5 to 1 cm in diameter that tend to form lines. From the Neytaskarð area, Streymoy, May 1995.

Mynd. 5. Kavi við einum reiðiliga tjúkkum lag av niveo-vindbornum, mest lívrunnum tilfari, sum legst á jørðina, tá ið kavin bráðnar, sum smáar sylindrar um 0,5 til 1 cm í tvørmál, sum síggjast sum smáir ryggir. Nærhendis Neytaskarði í Streymoy. Mai 1995.

to form part of some aeolian covers.

When comparing the Faroese highland aeolian sediments with similar deposits in the neighbouring Scottish highlands (Ballantyne and Whittington 1987; Ballantyne and Harris, 1994; Ballantyne, 1998) it is obvious that the grain size distribution and stratigraphy are almost identical.

In Scotland, the existence of the generally poorly-sorted windblown sediments on the exposed mountain tops and sides has been attributed to the accumulation being

of a primarily niveo-aeolian origin (Ballantyne and Whittington, 1987; Ballantyne and Harris, 1994). Accumulation this way takes place at lee slopes, where sediment is blown into snowpatches during snowdrifting in winter, and then lowered onto the vegetation covered ground surface during snowpatch ablation in summer (Ballantyne and Whittington, 1987). It is indicated that a vegetation cover must persist during the period of accumulation to enable the thick deposits to form, as it traps the accumulat-

ed aeolian material (Ballantyne and Whittington, 1987).

In the Faroe Islands sediments and organic materials are seen on ablating snow-patches in spring and summer (Fig. 5). Therefore it is very possible that some of the poorly-sorted aeolian deposits are niveo-aeolian in origin also here. As the wind speed in general is strongest in the winter (Søgaard, 1996), a niveo-aeolian origin for some of the high-lying wind-blown deposits is very likely. In the highlands most precipitation falls as snow in winter, enabling snowdrift particularly in these areas.

Sediment sources

Obviously the sediments of the aeolian deposits are the result of weathering of bedrock and erosion of the glacial sediments that otherwise cover the landscape. Since vegetation was first established in the Faroese landscape in the early Holocene (Johansen, 1985), primarily free faces and other high-lying exposed bedrock surfaces must have been the main sediment source areas. This could explain the largest occurrence of aeolian sheets above coastal free faces, as these are presumably most productive in terms of weathering. Inland free faces are generally lower and not so steep as the near vertical coastal cliffs. In vegetation free areas with active periglacial landforms, such as e.g. small-scale sorted polygons and sorted stripes, presumably some sediment is blown away and therefore enable aeolian accumulation in local topographical lee sites.

Age

As the windblown deposits occur in former glaciated areas and below periglacial trimlines, these are younger than the last glaciation. Some aeolian sheets, however, occur above trimlines, indicating that they can be of Weichselian age. The existence of peat layers below some of the windblown deposits indicates a mid to late Holocene age, as peat layers on the Faroe Islands are primarily known to have accumulated since the early to mid Holocene (Humlum *et al.*, 1996).

Luminescence dating of sand grains from some aeolian deposits has been attempted, despite that the sediments are devoid of quartz, but does contain feldspars. So far the luminescence technique has, however, not been successful because the luminescence property of the feldspar grains seems to be too small to be measured. Presumably ash layers found in parts of the aeolian deposits, and ^{14}C AMS dating of macrofossil plant remnants from organic rich layers in the aeolian deposits could date parts of the aeolian deposits, just as pollen stratigraphical investigations might lead to a closer determination of the flora at the time of deposition.

Conclusions

For the first time the geomorphology of the extensive highland aeolian deposits of the Faroe Islands has been described. They have been found to be primarily located on south facing slopes, indicating predominantly northerly wind directions during time of deposition. Texturally and morphologically they resemble similar deposits in

Scotland, and thus they may also partly be niveo-aeolian in origin. The ages of the aeolian deposits are not yet determined in detail, but the existence of early to mid Holocene peat layers below some of the sheets of these windblown sediments indicates that some of them are of mid to late Holocene age. Probably they might to a large extent be accumulated due to late Holocene climatic deterioration, such as occurred e.g. in the Little Ice Age, but also due to the general cooling following the early to mid Holocene climatic optimum.

Implications and perspectives

Further detailed studies of the aeolian deposits are expected to significantly increase knowledge of environmental changes in the Faroe Islands. More detailed reconstructions of the dominating palaeo-wind directions, and periods of high wind activity will be possible, just as information on Holocene flora presumably will be available from pollen analyses. Likewise studies of these deposits should be able to contribute to determine the effect of human settlement on landscape development and thus on the ecological balance. This is because the aeolian deposits occur both in areas of the landscape that can have been influenced by man, but also in remote parts most likely not affected very much by settlement.

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