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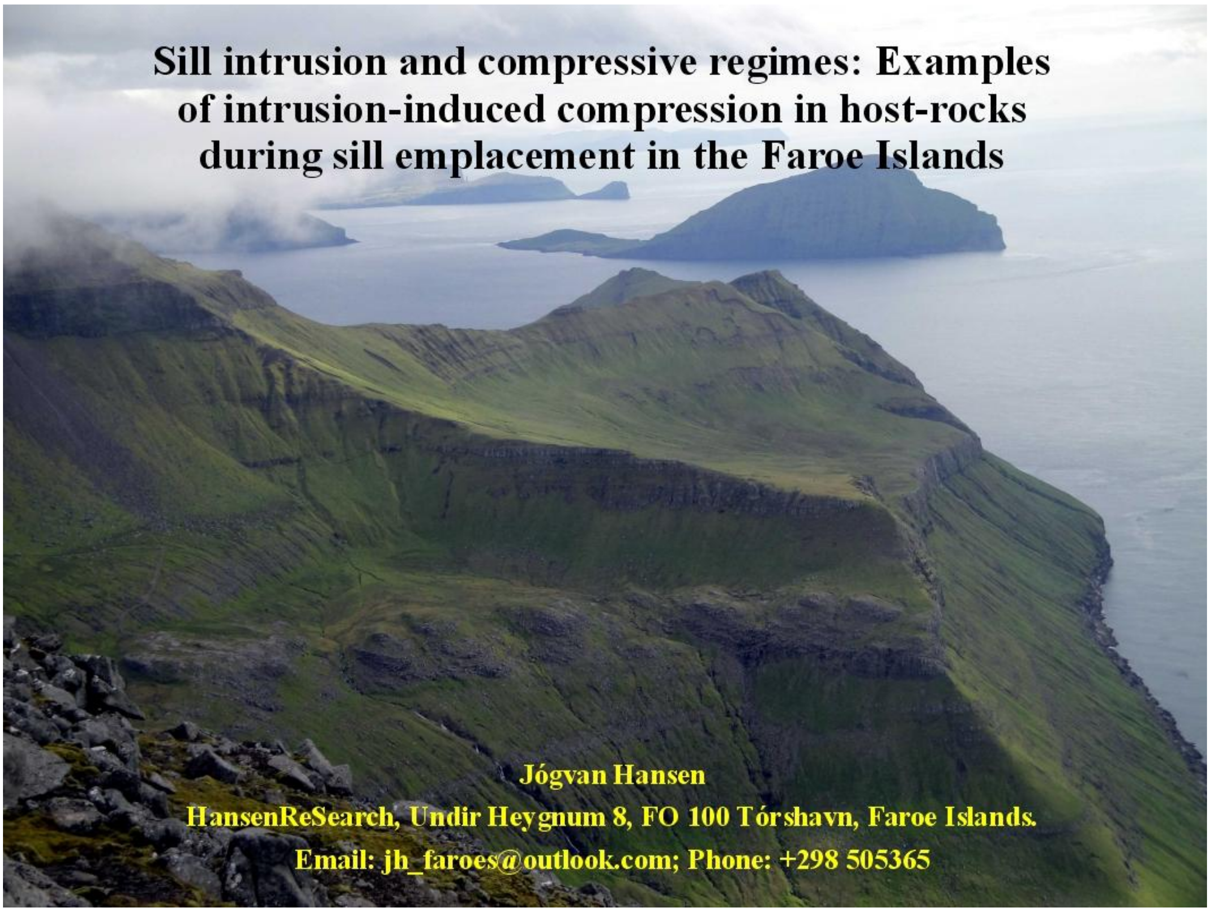

Abstract

Sills of predominantly mafic compositions are ubiquitous in many onshore and offshore extension-related sedimentary basins worldwide and do in some instances also appear in extension-related volcanic settings such as those in North Atlantic islands like NW Britain, Iceland and the Faroe Islands. Both of these settings are typically composed of sub-horizontal layered strata, in which individual layers may possess variable mechanical properties and strengths. Previous models on sill intrusion have commonly invoked sill development, where intruding melts advance sub-horizontally through relatively weak layers and cut upwards through stronger ones at relatively steep angles (ramp-flat geometries), while other models point to gradual and continuous sill climbing irrespective of mechanical properties in layered host-rocks.

Precursor melts to most known mafic sills worldwide stem from extension-related melting within the upper mantle. As long as extensional environments are maintained within the upper crust, ascending melts will advance to the Earth's surface via sub-vertical dykes. Once extension cease to affect areas of intrusion, ascending melts may pool in various magma chambers, or they may be intruded as sills within the uppermost crust. Various researchers have previously attributed intrusion of inclined and/or saucer-shaped sills to regional far-field shortening/compression within actual intrusion areas, while others point to sill emplacement in more neutral environments, when it comes to principal stress axes.

The model presented in this contribution strongly suggests that emplacement of saucer-shaped sills of the Faroe Islands not only caused uplifts of their overburdens following ultimate inflation, but did also impose compression/shortening on surrounding host rocks so as to trigger faulting and displacement within some of these. In turn, compression/stresses built up in surrounding host-rocks in response to ultimate sill inflation did not un-commonly trigger post-magmatic faulting within the actual solidified sills themselves.

Keywords: Faroe Islands, basaltic rocks, sill intrusion, thrust faults, overburden uplift

Introduction

Sills of mostly basaltic compositions occur in widespread areas around the Globe, preferably in settings exposed to previous extensional events such as sedimentary basins onshore and offshore as well as in some onshore igneous environments, which are related to previous extensional/rifting events too. Onshore examples of such intrusions in sedimentary basins include sills from some southern parts of Africa (Chevallier and Woodford, 1999; Polteau et al., 2008), while offshore equivalents can be found in widespread areas off NW European and W African margins for instance (Hansen et al., 2004; Cartwright and Hansen, 2006; Rocchi et al., 2007). When it comes to basaltic sills cropping out in onshore igneous settings such as volcanic lava piles, such intrusions have been reported previously for NW Britain, Iceland and the Faroe Islands (Hansen et al., 2011; Hansen, 2015; Gudmundsson et al., 2014; Fyfe et al., 2021; Hansen 2024). In general, sills may display a wide array of geometries and may occur in a wide array of mutual configurations, from individual intrusions to widespread and intricate sill complexes (Cartwright and Hansen, 2006; Rocchi et al., 2007: Hansen et al., 2011).

It is universally accepted amongst researchers in geology that orientations of principal stress axes in areas experiencing sub-lateral extension, be it in the upper mantle and/or in the uppermost crust, will result in melt transport to the Earth’s surface via sub-vertical dykes. When it comes to magma propagation, an absence of sub-lateral extension in the uppermost crust would mean that other options than sub-vertical magma transports are relevant too. Ascending magmas generally transform from feeder dykes to sill intrusions in settings, where the least principal stress axis (σ_3) display sub-vertical orientation, while the other two principal stress axes (σ_2 and σ_1) are of roughly similar sizes and oriented in sub-horizontal directions. Most current models on intrusion of saucer-shaped sills in such settings favour a propagation mechanism, where the sills grow and climb in response to interaction between advancing melts and overlaying free surfaces, where melts in layered host-rocks of various mechanical properties supposedly propagate sub-horizontally along mechanically weak layers and cut/climb across stronger ones at relatively steep angles at intervals (Eg. Thomson and Schofield, 2008; Walker, 2016). Other models suggest intrusion of saucer-shaped sills during periods of regional sub-horizontal compressive stress/shortening within the uppermost crust (Stephens et al., 2017).

With respect to the Early Paleogene saucer-shaped sills intruded into the upper parts of the lava successions of the Faroe Islands, two opposing models have been proposed in previous studies. One model propose sill emplacement in response to regional sub-horizontal shortening/compression (Geoffroy et al., 1994, Walker, 2016), while the other model invoke local sill intrusion in host-rocks displaying an absence or a near-absence of sub-horizontal compression or extension (Hansen et al., 2011, Hansen, 2015, Hansen, 2024).

In this contribution, physical characteristics at selected margin sections of the Streymoy Sill, Faroe Islands, and adjacent host-rocks are examined in order to determine, whether any traceable potential interactions occurred between/within these during and subsequent to sill emplacement and solidification.

Geological framework

Situated in the north Atlantic at the NW European margin, the Faroe Islands forms a central part of the North Atlantic Igneous Province (NAIP), which also include areas in W Greenland, E Greenland, NW British Isles, Rockall Plateau and the Vøring/Møre Margins, offshore W Norway (Saunders at al., 1997). The exposed parts of the Faroe Islands are in their entirety made up of various volcanic, intrusive and sedimentary basaltic rock suites, mostly arranged in sub-horizontal layers. Initially, these basaltic successions measured an estimated maximum 6.6 km in thickness and covered an area of several tens of thousands of square kilometres, all resting on a ~30 km thick stretched basement, being the remnants of a sunken ancient micro-continent (Richardson et al., 1998; Sammarco et al., 2017).

In brief, the original Faroese basaltic successions can be sub-divided into seven formations termed from below: The Lopra Formation (~1075 m); the Beinisvørð Formation (~3250 m);

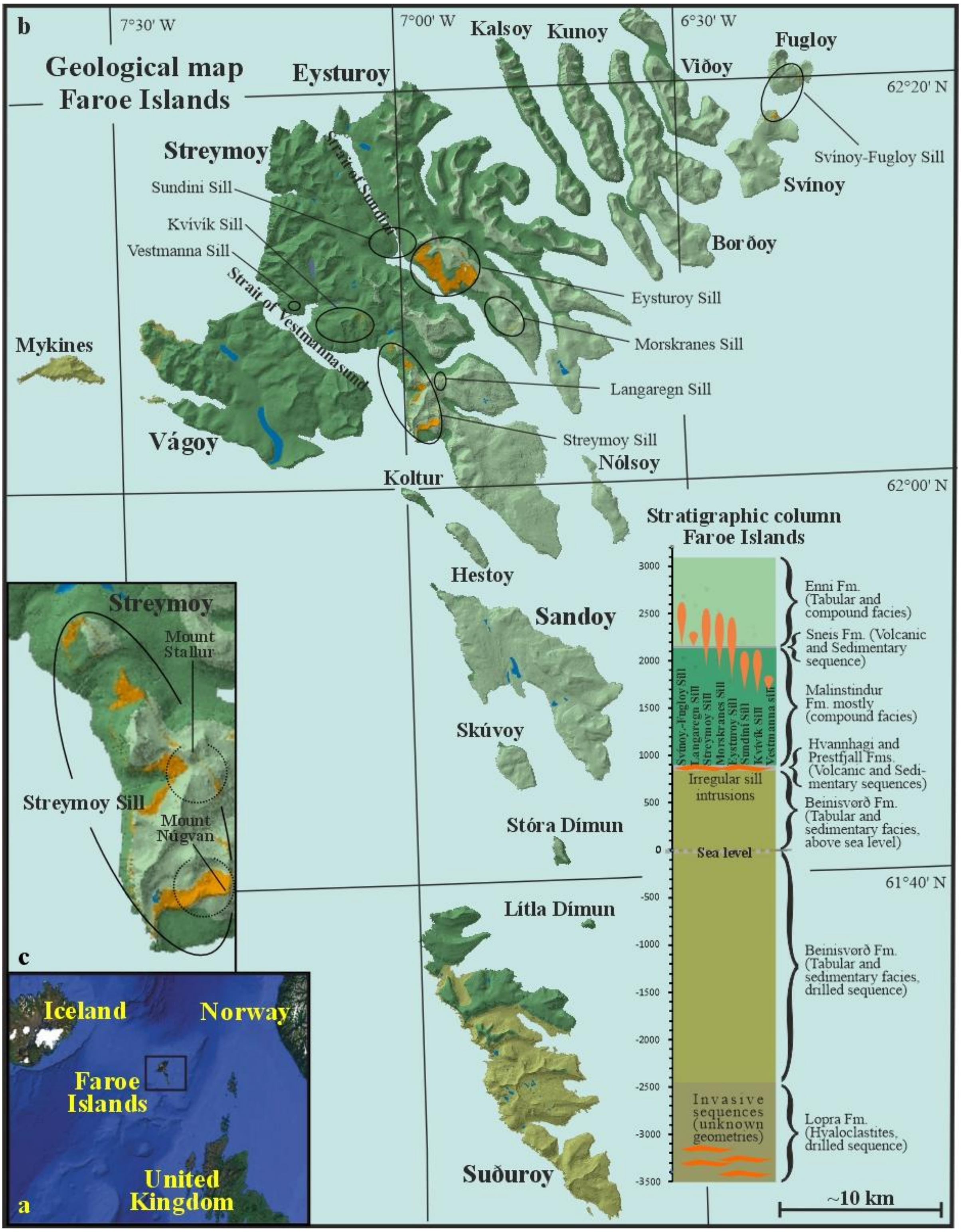

Figure 1. Map views of the Faroe Islands (Modified from Hansen and Ganerød, 2023). **a**. Geographical location of the Faroe Islands in the North Atlantic. **b**. Geological composition of the Faroe Islands. **c**. The black dotted circles indicate geographical locations within the Streymoy Sill, SE segment, focused upon in this contribution.

the Prestfjall Formation (~9 m); the Hvannhagi Formation (40 – 50 m); the Malinstindur Formation (1250 – 1350 m); the Sneis Formation (≤ 30 m) and the Enni Formation (~900 m)

(Fig. 1). Measured ages for these formations range from ~61 Ma to ~55.8 Ma (Compilation in Wilkinson et al., 2016). All parts of the Faroese lava successions host sub-vertical dyke systems of various lengths and thicknesses, while the uppermost Malinstindur, Sneis and Enni formations are also intruded by a number of sill intrusions of various sizes (Hansen et al., 2011, Hansen, 2015, Hansen, 2024). These latter intrusions range in ages from ~55.5 Ma for the largest to ~50.5 Ma for the smallest (Hansen and Ganerød, 2023).

Characteristics of Faroese sills and adjacent host-rocks

Low-angle faults are commonly observed in exposed parts of Faroese sills and are occasionally encountered in adjacent host-rocks too.

Faults occurring in basaltic host-rocks adjacent to Faroese sills are generally exposed in sub-vertical cliff faces in relatively close proximity of actual sill margins. These do not uncommonly occur as sets of conjugated low-angle faults with strikes tending to be oriented roughly parallel to the adjacent sill margins (Fig. 2a).

When it comes to sill-hosted faults in e.g. the Faroese Streymoy Sill, these commonly occur as low-angle irregular sort of en-echelon faults with strikes sub-parallel to those of the inclined outer sill sections, in which they are hosted, and/or as oppositely directed (conjugated) low-angle faults in sub-horizontal sill sections (Fig. 2b; Fig. 2c; Fig. 2d). When the actual sill-hosted conjugate low-angle faults are compared/measured against one another over somewhat wider areas within the SE segment of the Streymoy Sill for instance, it is evident that general fault orientations, and hence orientations of initial principal stress axes, commonly differ between various locations and are in accordance with general orientations of local strikes/dips, displayed by actual sill sections (Fig. 3).

While emplacement of the thinnest sections of Faroese sills apparently did not affect their overburdens or other adjacent host-rocks to degrees being clearly detectable in the current surrounding landscapes, their much thicker local counterparts did of course act/interact intensively on/with surrounding host-rock layers, which in places have been noticeably deformed or displaced where initial layering have been variously interrupted. Interesting examples include a thick light-coloured lava horizon seen in cliff faces in the vicinity of Mount Stallur (seen from the NW), part of which appear atop the upper NE margin of the SE segment of the Streymoy Sill in the Mount Stallur area, while other parts of the same horizon at lower stratigraphic levels, cropping out farther to the NE of the same sill margin, are discontinuous and crop out at various stratigraphic levels (Fig. 4).

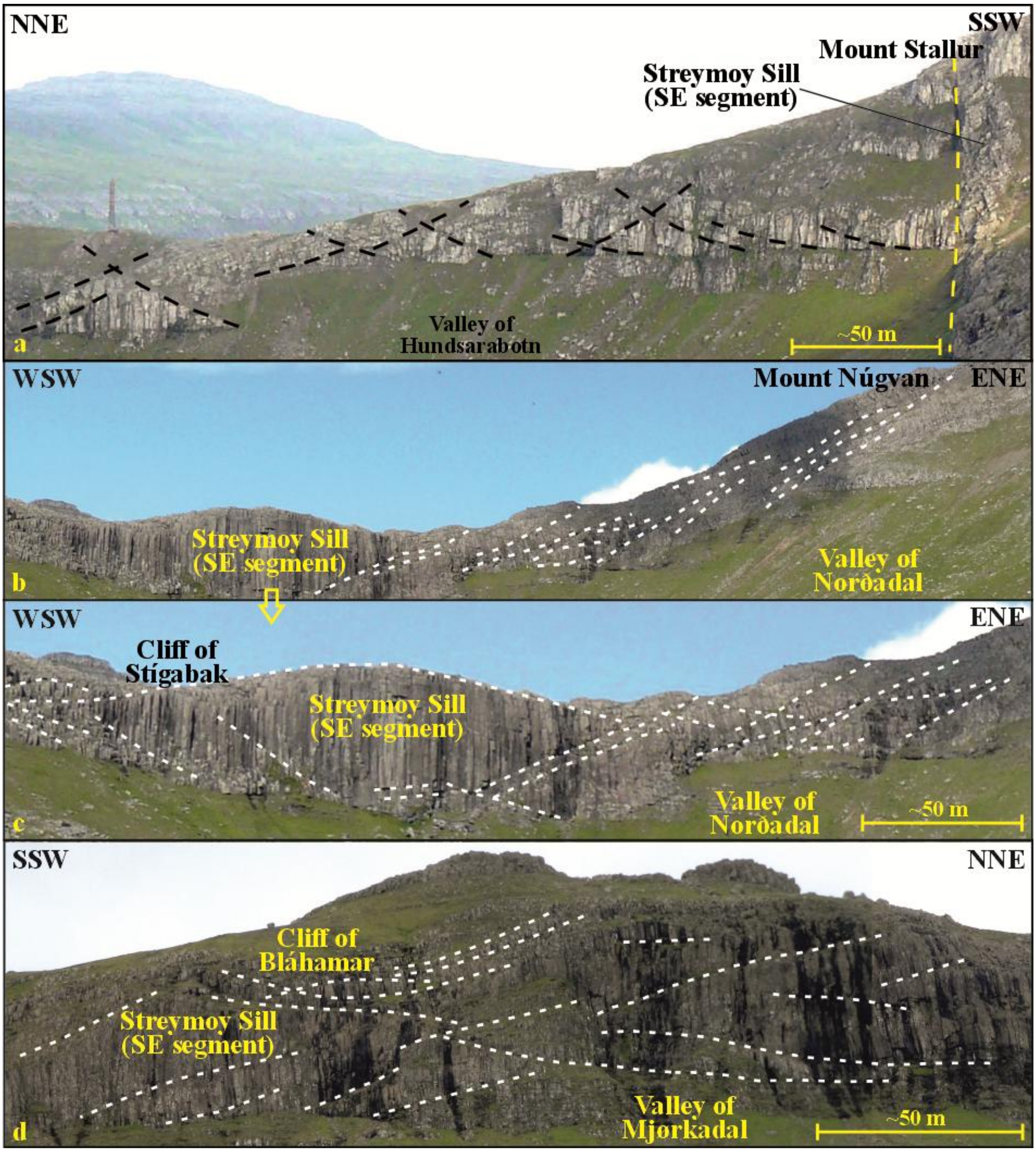

Figure 2. Low-angle faulting in basaltic rocks of the Faroe Islands. **a**. Individual and conjugated sets of low-angle faults (black dashed lines) in host-rocks in close proximity of sub-vertical sill margin (yellow dashed line) in the area of Mount Stallur. **b**. and **c**. Individual and conjugated large-scale low-angle faults (white dashed lines) in the Streymoy Sill, SE segment in the area of Mount Núgvan and the Valley of Norðadal. **d**. Individual and conjugated large-scale low-angle faults (white dashed lines) in the Streymoy Sill, SE segment in the area of the Cliff of Bláhamar and the Valley of Mjørkadal.

This same discontinuous lava horizon dominate the landscape on the opposite and gently sloping side of Mount Stallur, where it occurs as three distinct relatively low cliffs (Labelled 1., 2. and 3.) cropping out at different altitudes (Fig. 5; Fig. 6).

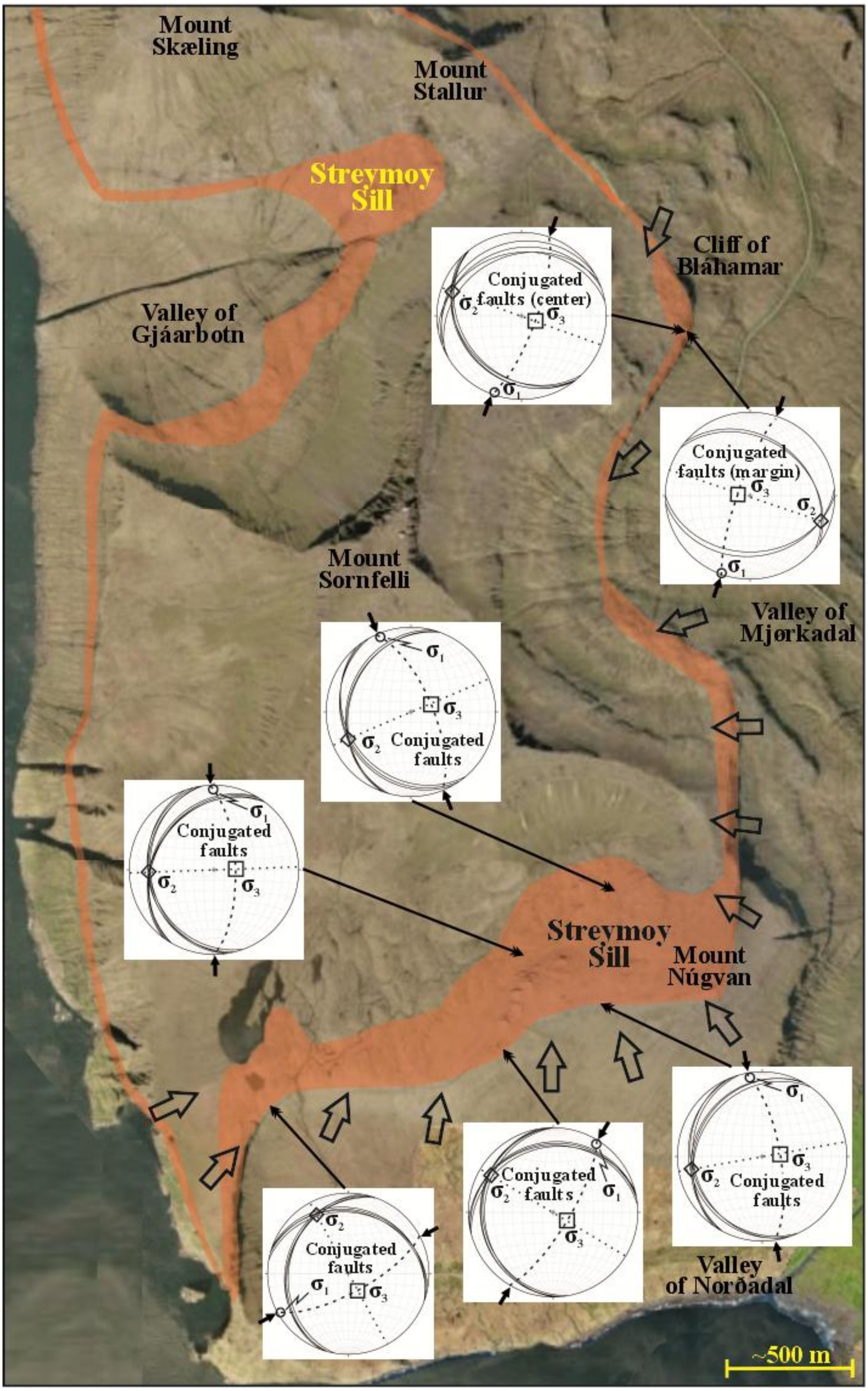

Figure 3. Map view of exposed parts of the Streymoy Sill, SE segment. Open black arrows indicate systematic variations in dip orientations for the various sill sections. Small inset figures represent stereoplots based on local conjugated low-angle fault sets. Tiny black arrows associated with the stereoplots indicate orientations of largest principal stress axis σ_1, while longer black arrows point to geographical locations of measurements.

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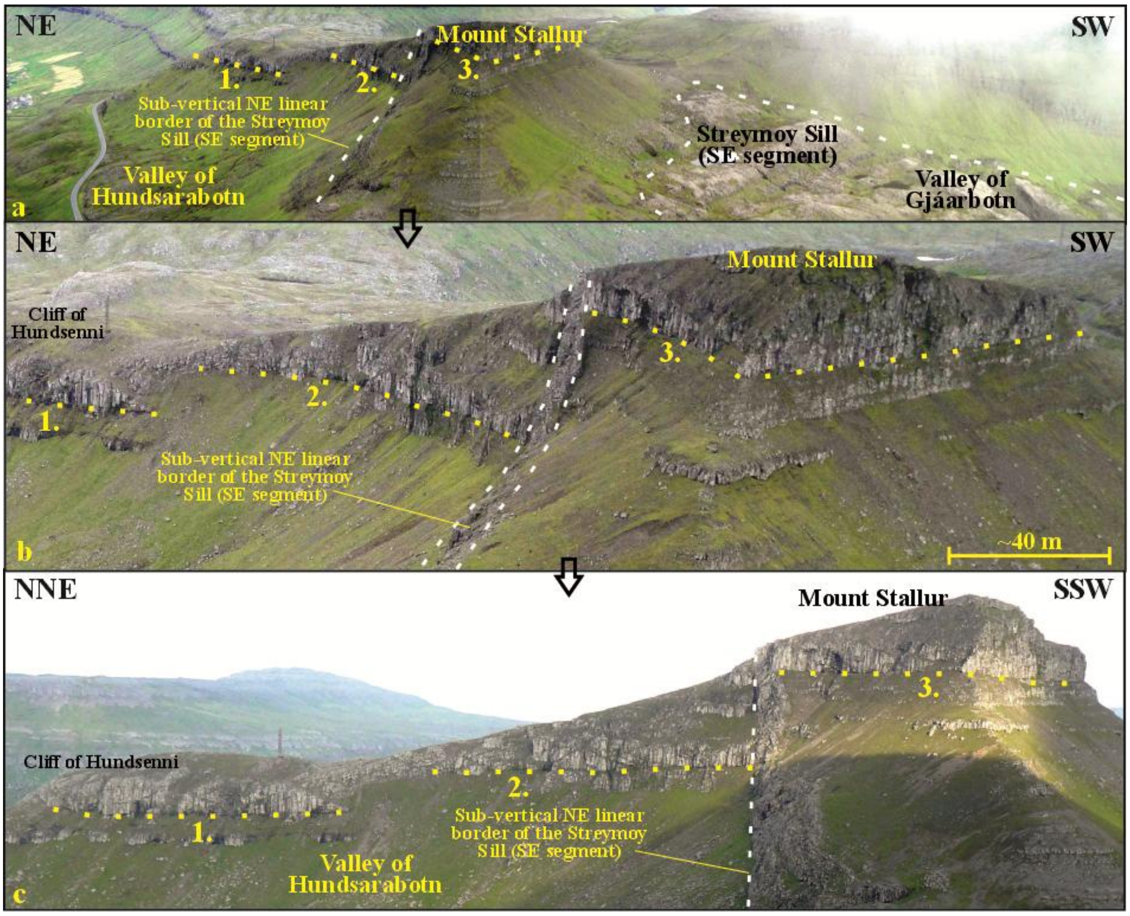

Figure 4. Views from different angles, distances and altitudes of the area around Mount Stallur. **a**. **b**. and **c**. Discontinuous marker host-rock horizon defined by yellow dotted lines, occurs at three different altitudes (1., 2. and 3.) on either side of the NE contact of the Streymoy Sill, SE segment (white dashed line).

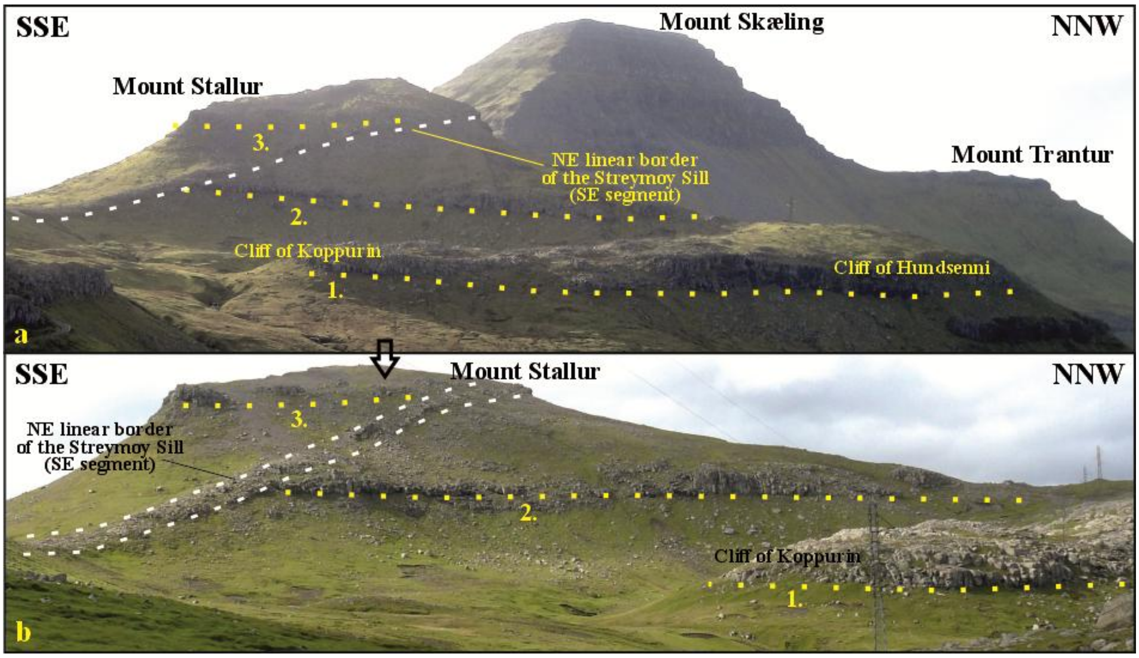

Figure 5. Views from 2 different angles, distances and altitudes of the area around Mount Stallur, as seen from the opposite direction when compared to Fig. 4. Lines are marked as in Fig. 4.

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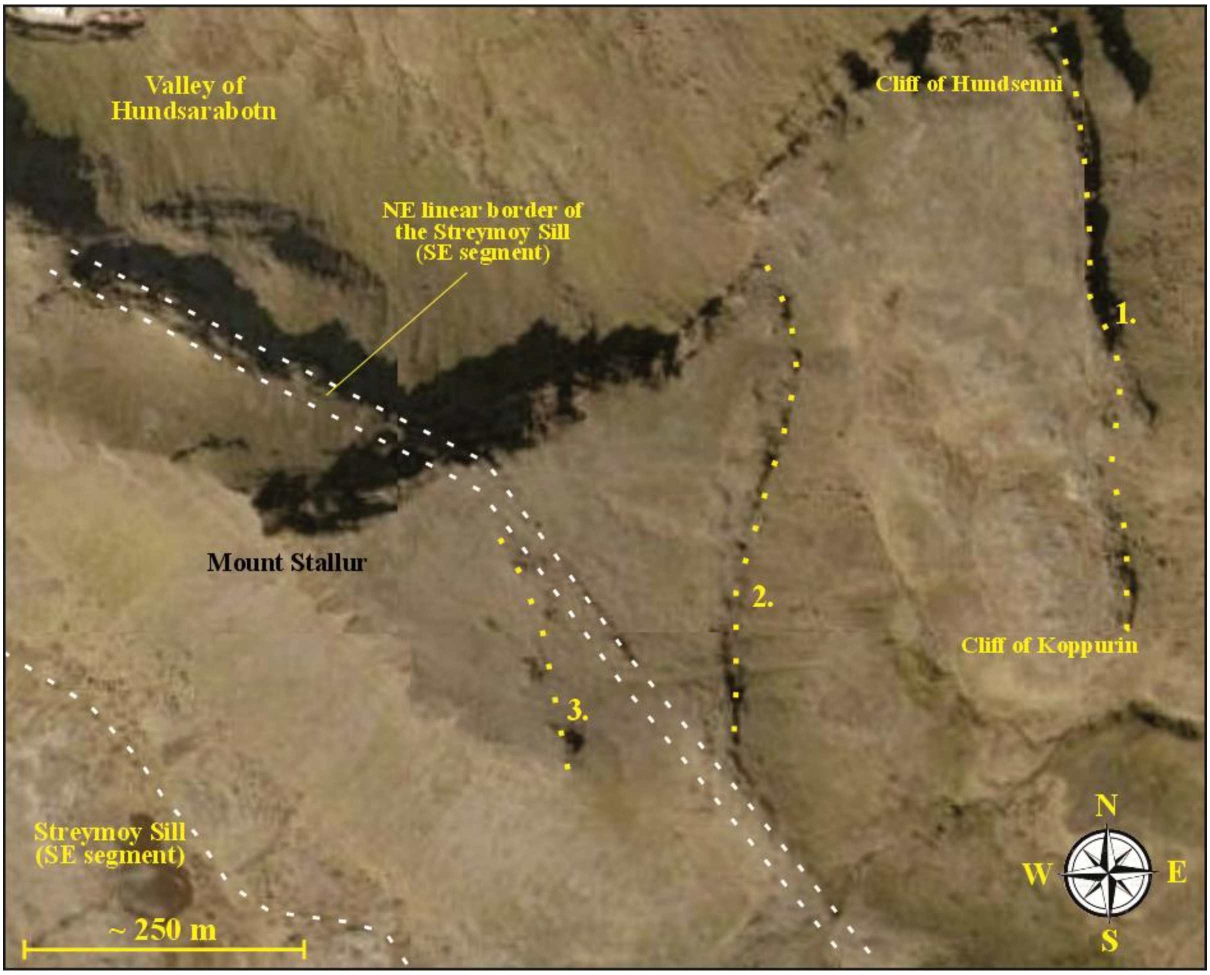

Figure 6. Same as in figures 4. and 5., but seen in map view. Lines are marked as in figures 4. and 5.

Field measurements/observations further demonstrate that the moderately inclined NE rim of the Streymoy Sill in the Mount Stallur area transforms into a thick (~20 m) WNW ←→ ESE and NW ←→ SE directed sub-vertical dyke/chimney that extends several hundred metres farther towards the SE (Fig. 4; Fig. 5; Fig. 6).

Discussion

Relatively recent studies, focused on the saucer-shaped geometries, typical for Faroese sills, came to the conclusion that these initially formed by propagation of thin magma fronts, which generally climbed gently in a mole-like fashion through layered ambient host-rocks irrespective of potential mechanical differences between these. The actual studies concluded that sill climbing through lava successions like that of the Faroe Islands occur chiefly in response to depth dependent variations of Young's Modulus, i.e. to a noticeably degree by uneven small-scale elastic displacement on either side of thin advancing magma fronts (Hansen, 2011, Hansen et al., 2011, Hansen, 2015, Hansen, 2024). Such initial thin magma fronts of developing Faroese sills very probably advanced as lobes or fingers, whilst climbing at the same time, it is not very likely that these interacted with the Earth's free surface to any noticeable degrees prior to their main inflation phases. Parts of slight dilations in host-rocks on either side of such thin developing/embryonic Faroese sills prior to their main inflation phases could well have been taken up by relatively soft/thin inter-basaltic layers of tuff and/or sedimentary material. In any case, it is more than likely that emplacement and ultimate inflation of such voluminous magmatic bodies within the Faroese lava successions ultimately caused a substantial build-up of compressive stresses within these. Similar generation and storage of compressive stresses within competent host-rock layers within basaltic lava successions on either side of intrusive sheets have been reported previously too for thin sub-vertical dyke intrusions in Iceland (Corti et al., 2023).

The physical characteristics displayed by Faroese rock suites such as sills and their ambient host rocks, as presented in the previous section, point to two main issues that require assessments, namely the origin/reason of/for the development of low-angle faults within actual sills and in adjacent host-rocks, as well as origin/reason of/for displacement of thick basaltic horizons within certain host-rock suites.

When it comes to the low-angle faults commonly exposed within the Streymoy Sill, these likely developed in response to sub-horizontal compression/shortening in sub-horizontal sill sections and compression/shortening roughly aligned with local dip orientations in more inclined outer sill sections (Fig. 7a).

However, a closer inspection of e.g. the inclined SE extreme of the Streymoy Sill, SE segment, in the area around Mount Núgvan reveals a somewhat more complex structural development within this geographically restricted part of the actual intrusion. Here, the lower half of the sill has been displaced slightly down-slope relative to the upper half where these are separated by a relatively thick shear zone (~50 cm), which can be traced for a distance of 100 metres or more (Fig. 7b). The formation of such characteristics would be in accordance with a mechanism in which the sill tip at this locality did experience sub-horizontal compressive/shortening forces shortly subsequent to inflation and solidification of the actual sill, which was directed roughly orthogonal to the local strike orientation, being sufficiently strong so as to generate the observed shear movements.

An even closer scrutiny of this particular area reveals that the initial columnar jointing atop the actual shear zone did experience a slight anticlockwise rotation relative to similar jointing below it subsequent to its formation. In turn, these rotated initial columnar jointing are dissected by relatively closely spaced sub-vertical joints/faults that rotate and become

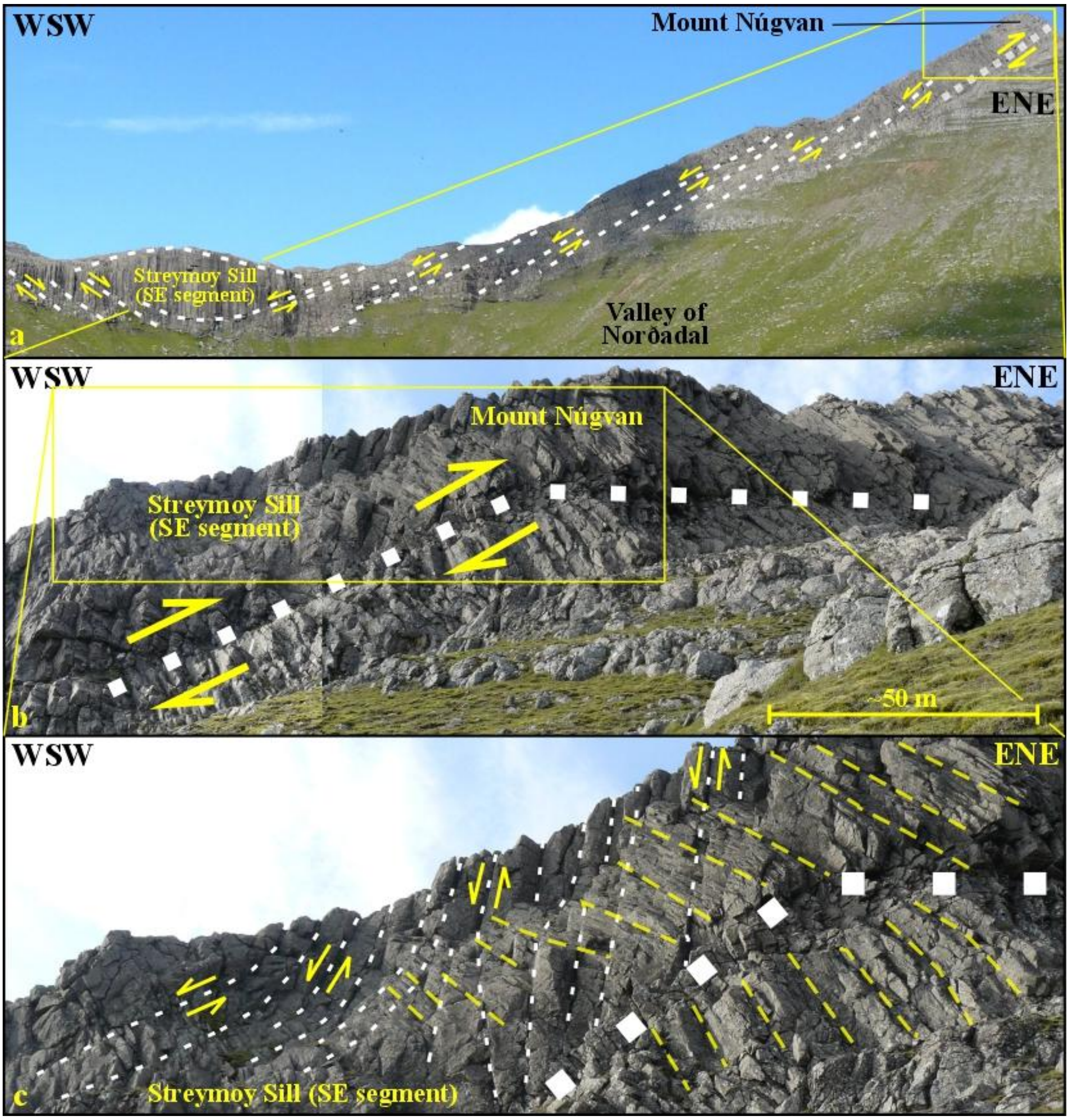

Figure 7. Deformation within the inclined SE extreme of the Streymoy Sill in the Mount Núgvan and Valley of Norðadal area (See also map in Fig. 3). **a**. General overview of the actual area showing large-scale low-angle reverse/compressive faulting within the actual sill (White dashed lines). It is noteworthy that relative shear movement directions (One-sided yellow arrows) differ between top of mountain and rest of mountain slope. **b**. A closer view of the area around Mount Núgvan clearly indicates that the lower half of the actual sill at this geographically restricted locality did move slightly downwards relative to the upper half (I.e. relative dextral movement) at some point subsequent to crystallisation of this intrusion, where upper and lower halves are separated by a ~50 cm shear zone (Thick white dotted line). **c**. An even closer view of the area around Mount Núgvan reveals that the original sill jointing (Thin yellow dashed lines) have been rotated slightly anticlockwise above the thick shear zone relative to those below it. In turn, these rotated initial joints atop the actual shear zone are intersected by later joints (White dashed lines), possessing sub-vertical orientations near the mountain top and then gradually becoming more and more inclined farther down-slope towards left. Relative shear movements within these latter are indicated by small on-sided yellow arrows.

more and more tilted/inclined down-slope thus ultimately transforming to low angle geometries comparable to those of the larger faults occurring farther down the actual mountain slope (Fig. 7a; Fig. 7c). These latter characteristics would be in accordance with a mechanism in which gravity from the overburden and within the sill caused normal faulting to develop at the top of the actual inclined sill section, where the faults gradually transformed to thrust faults, in response to both gravity and stored/latent sub-lateral stress within ambient host-rocks, farther down the relatively steep mountain slope. These latter stress actions do not appear to have affected the sill parts underneath the thick shear zone close to the mountain top, thus suggesting that they (re)acted upon the actual sill at a later point and perhaps also over a wider time span.

Otherwise, it is worth noticing that actual dip orientations in the various outer inclined parts of e.g the SE segment of the Streymoy Sill vary systematically from SSW oriented dips in the NE parts all the way through SW, W, WNW, NW, NNW, N, NNE, NE to ENE oriented dips in the SW parts of the actual sill segment (Fig. 3). Measurements of principal stress axes (σ_1, σ_2 and σ_3), based on orientations of conjugate low-angle thrust faults within the actual sill segment, point to a relatively close and systematic association between local dip orientations and orientations of local principal stress axes (Fig.3). The results of these measurements render it unlikely that any unidirectional regional stress regime caused all the observed thrust faults. Rather, it appears that the ultimate inflation of the actual sill induced/stored stresses within ambient host-rocks, which became more or less aligned with general dip directions, prevailing for the various sill sections. In turn, the stresses stored in the actual host-rocks most likely reacted upon the actual sill, once its initial magmas had crystallised (and shrunk somewhat), thus generating the observed thrust faults.

It is noteworthy that unevenly oriented sets of conjugate thrust faults of various sizes/extent occasionally occur in relatively close association with one another in basal sill sections in the extreme SE parts of the actual intrusion, i.e. variously oriented stress fields did occasionally overlap within this geographically restricted area in accordance with variations in local dip orientations of adjacent outer sill sections.

Assessments regarding characteristics, displayed by a conspicuous host-rock marker horizon adjacent to the NE border of the Streymoy Sill, SE segment, exposed in the Mount Stallur area, show without much doubt that a part of this horizon (labelled 3.) was sub-vertically uplifted by perhaps 40 to 45 metres relative to the average elevation of its counterparts 1. and 2., cropping out a short distance from the sill contact farther to the NE, in association with ultimate inflation of the inclined sill section in this area (Fig. 4; Fig.5; Fig.

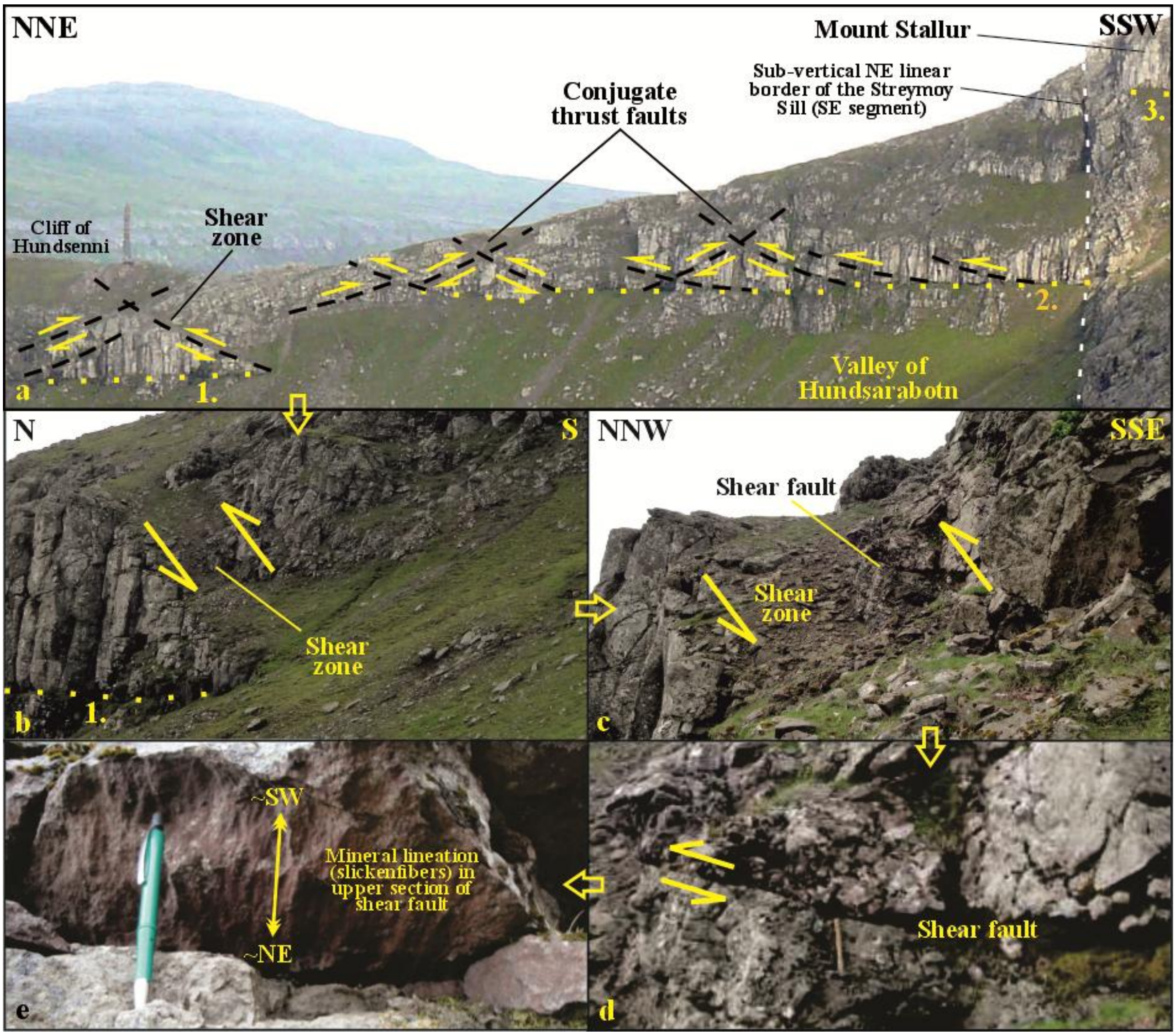

Figure 8. Deformation/displacement of thick host-rock basaltic marker horizon adjacent to NE sill margin. **a**. Individual and conjugated thrust faults (black dashed lines) developed in response to sub-horizontal compression. Dotted yellow lines labelled 1. 2. and 3. indicate base of displaced marker horizon sections. NE sill margin is outlined by white dashed line. **b**. and **c**. Closer view of the shear zone indicated in a. **d**. Closer view of the shear fault indicated in c. **e**. Mineral lineation in the upper part of the shear fault shown in d. Double yellow arrow indicates direction(s) of mineral lineation. One sided yellow arrows in all part-figures indicate relative shear movements. Open yellow arrows point to sequence of part-figures.

8a). Physical mechanisms required to explain the substantial discontinuity between the actual marker horizon parts 1. and 2., in addition to a few much less pronounced discontinuities displayed by the bottom contact of horizon 2., may appear somewhat nebulous at a first glance, as no known sub-horizontal intrusive bodies, which could have caused such discontinuities/uplifts, reside underneath this particular area. However, orientations of the low-angle faults, being hosted by the actual host-rock horizon, in addition to characteristics displayed by a conspicuous shear-zone between horizon parts 1. and 2. seem to indicate a

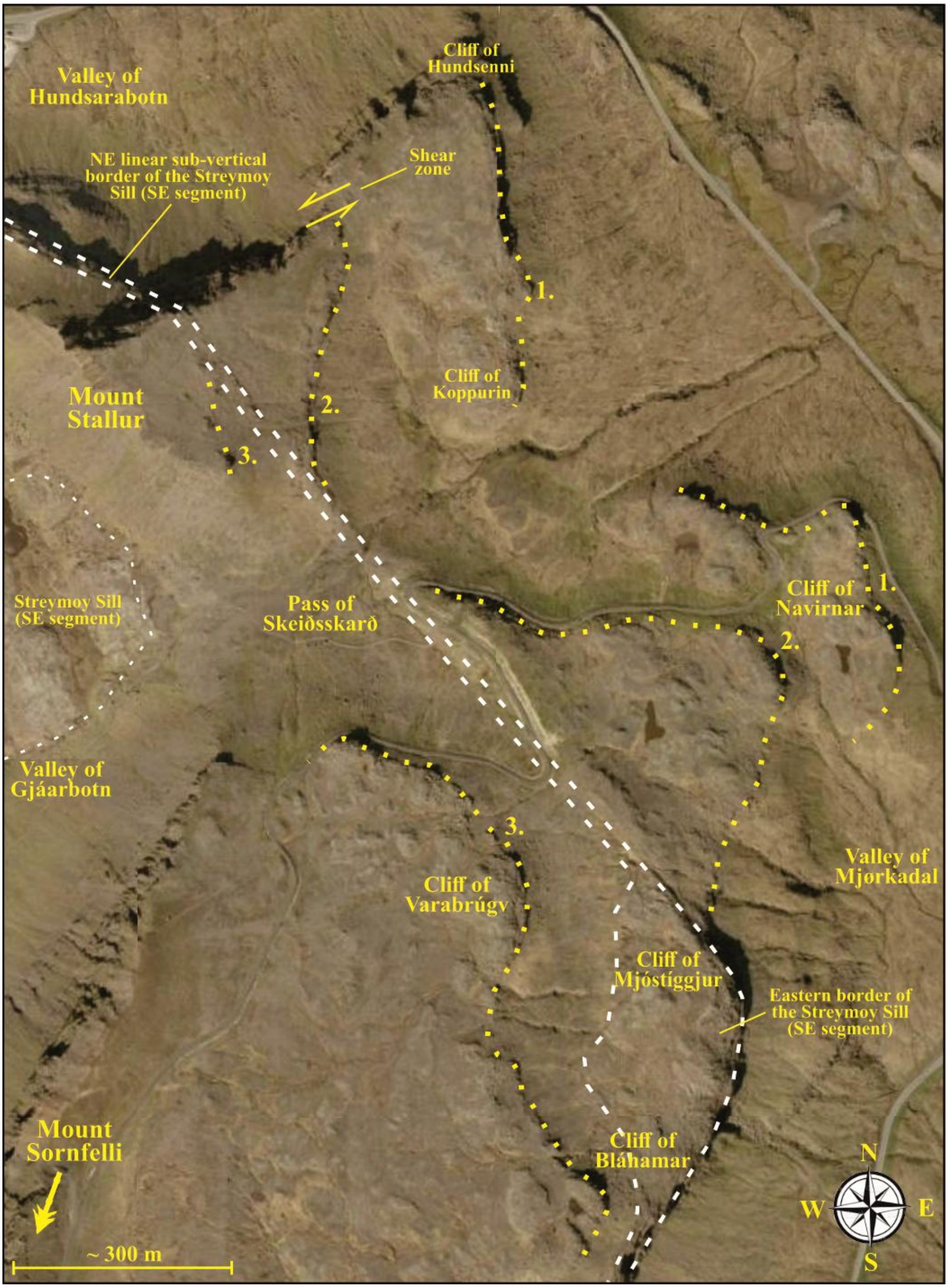

Figure 9. The area around the NE margin of the Streymoy Sill in map view. The extent of the area affected by the displacement of a single host-rock marker horizon into 3 distinct levels (yellow dotted lines labelled 1., 2. and 3.), as already shown for the area around Mount Stallur, can be extrapolated towards the SE for the length of the actual thick sub-vertical dyke, i.e. for around a kilometre towards the area around the Cliff of Bláhamar at the Valley of Mjørkadal. White dashed lines indicate outlines of the NE margin of the Streymoy Sill at these locations.

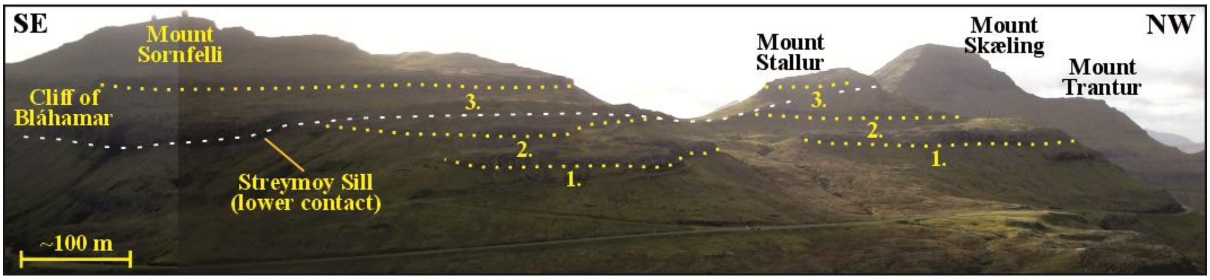

Figure 10. Same as in Fig. 9, but in panorama view towards the SW.

compression-related origin (Fig. 8a; Fig. 8b; Fig 8c). In these instances, dips displayed by individual and conjugate faults are universally oriented roughly in NE or in SW directions, i.e. they display strikes that generally point in directions NW-SE. Also, mineral lineation (slickenfibers) within a shear-fault cropping out in the shear-zone between horizon parts 1. and 2. (Fig. 8c; Fig. 8d; Fig. 8e) are oriented in roughly NE-SW directions, where the upper part of the actual fault has moved towards the NE relative to the lower part. Interestingly, orientations of local fault dips and mineral lineations are also roughly orthogonal to the sub-vertical NW-SE trending contact of the Streymoy Sill, SE segment, as seen on NE slope of Mount Stallur (Fig. 5; Fig. 6).

It is not straightforward to accurately assess the depth to which the thick sub-vertical NW-SE trending dyke/chimney, emanating from the NE rim of the Streymoy Sill in the Mount Stallur area and towards areas farther to the SE, extends, but field evidences suggest that its base must reach a stratigraphic depth at least down to (or slightly below) the base of the local marker horizon labelled 1. (Fig. 4; Fig. 5; Fig. 6; Fig. 8). During inflation from a near-zero thickness to ~20 m, the approximate thickness, which can be observed in the actual dyke/chimney today, the initial melts of this intrusion must have displaced surrounding host-rocks with a similar distance in sub-horizontal directions. Parts of such expansion may have been accommodated by elastic compression of surrounding host-rocks at roughly similar stratigraphic levels over relatively wide areas, but a certain amount of permanent failure and faulting within ambient host-rocks must have accompanied the actual inflation of ~20 m. Accordingly, the faults and discontinuities observed in and between marker horizons 1. and 2. in the cliff face just to the NE of Mount Stallur and the sub-vertical NE margin of the SE segment of the Streymoy Sill (Fig. 2a), most likely developed in response to inflation of the actual sub-vertical dyke/chimney. The notion that the displacement between marker horizon 1. and 2. and deformation/displacement(s) within horizon 2. are likely to have developed in response to inflation of the sub-vertical dyke/chimney, emanating from the NE margin of the

Streymoy Sill, and not so much so in response to any potential contemporaneous regional unidirectional stress actions, is strengthened by the evident variations in principal stress axes that are measured for other parts of the actual sill (Fig. 3).

Discontinuities similar to those displayed by the thick marker horizon, cropping out in the Mount Stallur area, are also clearly visible/detectable in the mountain range farther towards the SSE and S (Fig. 9; Fig. 10). Hence, the intrusion and subsequent inflation of the Streymoy Sill, SE segment, had a profound effect on the local landscape from the area around Mount Stallur to the area around Mount Sornfelli and the Cliff of Bláhamar.

It might be envisaged that sub-horizontal and/or sub-vertical displacement of basaltic lava horizons, as can be observed locally within basaltic successions elsewhere in the Faroese archipelago, might well reflect actions of unknown intrusive bodies in actual areas.

Summary and concluding remarks

Based on the observations/measurements presented above and associated assessments, interpretations and results from previous studies on Faroese sills, focusing upon characteristics displayed by two distinct areas of the SE segment of the Streymoy Sill together with selected host-rocks, the conclusions reached in this contribution are briefly summarised below.

1) Initial basaltic melts, which gave rise to Faroese sills in general, likely ascended through most parts of the uppermost crust via sub-vertical feeders, which ultimately deflected to become moderately inclined for several or a few tens of metres immediately below their transformations to sill intrusions, in response to rotations of local principal stress axes (σ_1, σ_2 and σ_3). The basic saucer-shaped geometry, displayed by all Faroese sills, likely developed in response to initial propagation of thin magma fronts, where depth-dependent variations of Young's Modulus within ambient host-rocks resulted in gentle climbing of advancing melts in a mole-like manner, which didn't affect overlaying free surfaces noticeably prior to the main inflation phases (Stage 1 and 2; Fig. 11a; Fig. 12a).
2) Subsequent partial sill inflation, initiated at outer inclined sections of the Streymoy Sill, resulted in breach and asymmetric uplift/tilt of overburdens, which included parts of host-rock marker horizon 1. exposed in the Mount Stallur area (Stage 3; Fig. 11b; Fig. 12b).
3) In association with full/ultimate sill inflation of the Streymoy Sill, the stress effects from the inflating and the fully inflated intrusion on ambient host-rocks, which did reflect contemporaneous local magmatic pressures, resulted in storage of stress in ambient host-

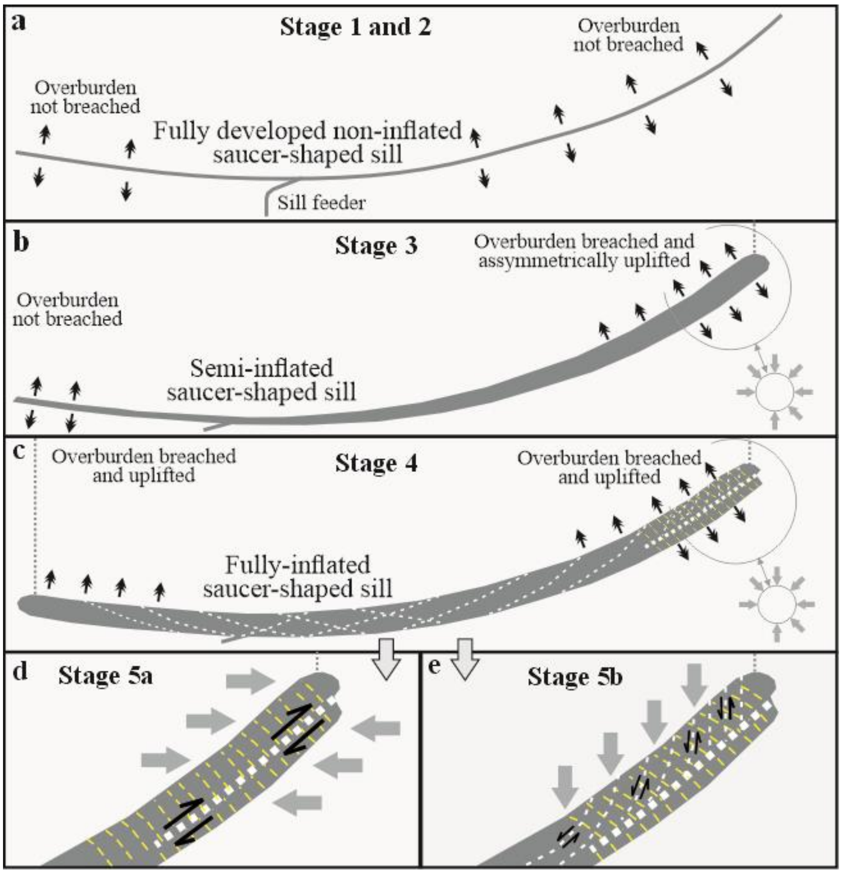

Figure 11. Simplified profiles depicting magmatic and structural evolution at the relatively steeply inclined SE extreme of the Streymoy Sill, SE segment, (Along longest axis) in the Mount Núgvan area. **a**. Precursor magmas to the Streymoy Sill initially ascended sub-vertically through the upper crust before being deflected to moderately inclined orientations, due to rotation of local principal stress axes slightly below the base of the future sill. Following transformation from inclined feeder dyke to sill intrusion melts propagated as thin magma fronts whilst climbing gradually during development of the ultimate sill geometry. **b**. The most inclined parts of the sill inflated partially, whilst exerting compression on ambient host-rocks thus initiating reactive stresses within these. Overburden breached and moderately uplifted in asymmetrical fashion. **c**. The rest of the sill was subsequently inflated and overburden was breached atop the entire intrusion, which in turn was exposed to reactive stresses from ambient host-rocks. **d**. The highest and most inclined part of the sill experienced sub-lateral components of reactive compression, which caused the lower half to move/slide slightly down-slope relative to the upper half (Dextral movement) thus resulting in a relatively wide (≤ 0.5 m), but short (~100 m), shear zone. **e**. Gravitational and reactive stresses subsequently generated normal faults close to sill tip and compressive faults farther down-slope. Black arrows in all part-figures indicate magmatically generated stresses, grey arrows indicate reactional and gravitational stresses within ambient host-rocks, thin yellow dashed lines indicate original columnar jointing, thick white dotted lines indicate shear-zones, white dashed lines indicate gravitational and compressive faults/joints and one-sided black arrows indicate directions of relative shear movements.

rocks and breach/uplift of entire sill overburden(s), including the host-rock marker horizon 3. in the mount Stallur area (Stage 4; Fig. 11c; Fig. 12c).

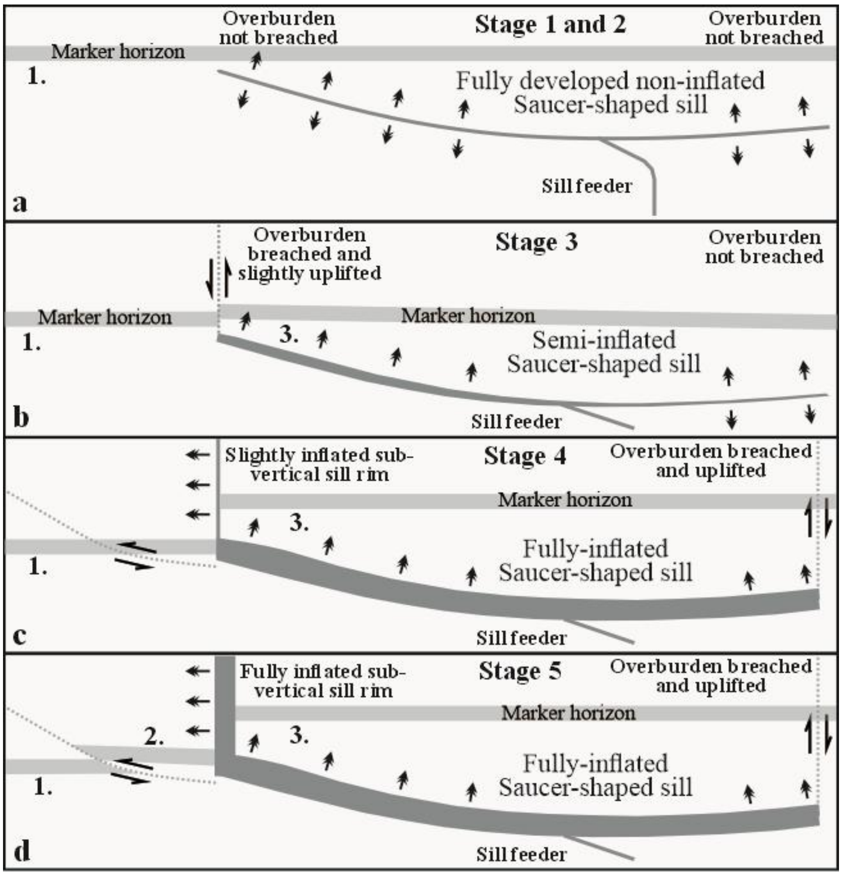

Figure 12. Simplified profiles depicting magmatic and structural evolution at the gently inclined NE margin of the Streymoy Sill, SE segment, (Along shortest axis) in the Mount Stallur area. **a**. Same as in Fig. 11a. **b**. The most inclined parts of the sill inflated partially, whilst inducing slight breach/shear and moderately uplifting/tilting of overburden including host-rock marker horizon. **c**. All sub-horizontal and inclined parts of the sill became fully inflated thus inducing breach/shear and uplifting of their overburden including the host-rock marker horizon. At this point a thin sub-vertical dyke/chimney started to develop at the sill tip, which initiated sub-horizontal compression resulting in a slightly inclined shear zone within adjacent host rocks. **d**. Continued inflation of the sub-vertical dyke/chimney at the NE sill tip generated sub-horizontal compressive stresses/shear that ultimately displaced adjacent host-rocks, including the marker horizon, so as to cause it to become displaced/uplifted relative to less affected materials below the shear zone from c. Black arrows in all part figures indicate magmatic pressures while one-sided black arrows indicate shear movements. Black arrows in all part figures indicate magmatic pressurs.stress, while one-sided black arrows indicate relative directions of shear movements. Numbers 1., 2. and 3. in all part figures refer to host-rock marker horizon, as indicated in other figures/photos from the Mount Stallur area.

4) Following ultimate inflation and solidification of the Streymoy Sill, SE segment, sub-horizontal re-active forces, stored in surrounding host-rocks during earlier sill inflation events, affected the top of the inclined sill rim in the Mount Núgvan area so as to cause a ~100 m long dextral shear zone, sub-parallel to local sill dip and strike orientations, to develop (Stage 5a; Fig. 11d). At some later point, a combination of gravity and re-active

forces, stored within ambient host-rocks in the Mount Núgvan area, resulted in the generation of relatively closely spaced sub-vertical faults, within the actual sill above the dextral shear zone near the mountain top, which gradually evolved to more low-angle faults down-slope (Stage 5b; Fig. 11e).

5) Subsequent to ultimate inflation of lateral and inclined sill sections, compressive forces related to ultimate inflation of a dyke/chimney emanating from the NE margin of the Streymoy Sill, SE segment, caused host-rock marker horizon 2. to be up-thrusted on top of initial marker horizon 1. in the Mount Stallur area (Stage 5; Fig. 12d).

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