Glaciotectonic evolution of Ven, Sweden: insights from the first comprehensive structural and geomorphological analysis

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Introduktion

Ven, an island in the Öresund strait (Fig.1), is entirely composed of Quaternary deposits overlying bedrock. These sediments, part of the Alnarp valley fill, offer insights into regional geological history. While previous studies have provided a foundation, gaps remain in our understanding, particularly regarding glacial deformation on the island caused by the late Weichselian advances of the Scandinavian Ice Sheet (SIS). Ven has been referenced as a potential example of cupola hills, which are irregular hills formed from glaciotectonised sediments. but this assertion lacks rigorous scientific support and thus either needs to be verified or disproven.

This Study aimed to:

- Improve our current understanding of the glaciotectonic evolution of Ven.
- To investigate the validity of previous statements regarding the Cupola hill statement, and geomorphologically map the any surface features accross the island

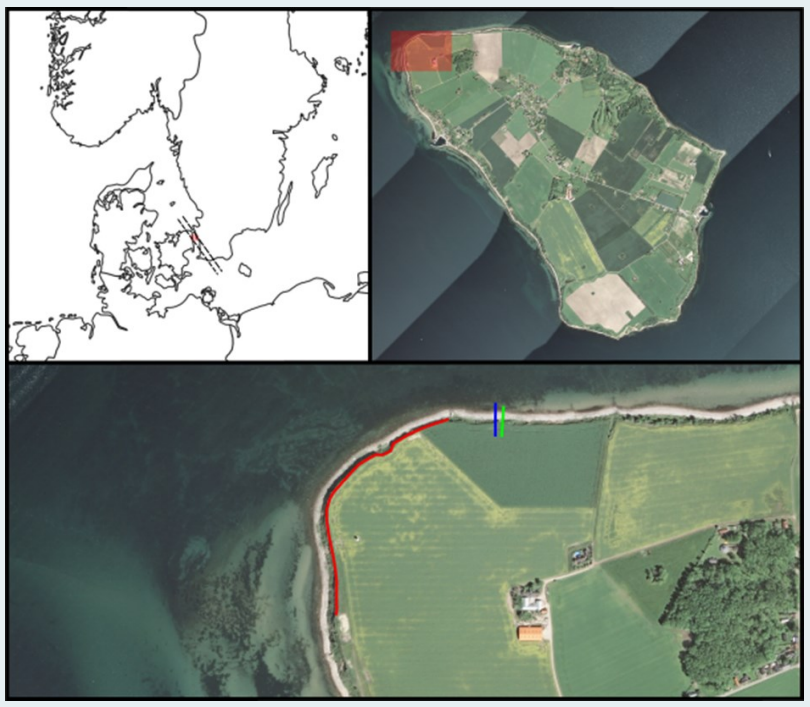

Figure. 1 Overview map of the investigated area. The coloured lines shows the examined cliffsections

Metods:

Geomorphological mapping on Ven involved analyzing LiDAR-based digital elevation models (DEM) and aerial photographs using QGIS. Surface features such as ridges, lineations, and scars related to mass movements were traced on the DEM.

Fresh cliff exposures were manually excavated and cleaned (Fig.1)), followed by systematic logging to scale. Lithofacies units were identified based on properties like grain size and internal structure, and assigned lithofacies codes for visual clarity. Quantitative data, including clast microfabric and measurements of deformational structures, were collected for reconstructing the island's glacitectonic evolution.

Geomorphological mapping:

The geomorphological mapping unveiled various features across the island, including landslide scars concentrated along the southern and western coastlines, small depressions filled with water, and long irregular depressions sloping toward the sea in the southwest. Linear depressions, likely artificial drainage ditches, were observed in agricultural fields in the southwest and east. Ten subtle ridges were identified, exhibiting gentle slopes and varying lengths, predominantly oriented southwest to northeast. While the ridges could be attributed to agricultural activity, uncertainties remain regarding their origin, necessitating further investigation.

Sedimentological findings

Fifteen lithofacies were distinguished in the northern cliff exposure, primarily comprising three subglacial till beds. Intervening these till beds are discontinuous layers of outwash and glaciolacustrine deposits.

Glaciotectonic Evolution of Ven

The examination of deformation structures revealed significant effects from the last two glacial advances, leading to the proposal of two conceptual models to explain the development of glaciotectonic features and sedimentary observations in the northern cliff exposures of the Alnarp valley. These models differ mainly in their interpretation of a specific till bed (LF12) found within the stratigraphy.

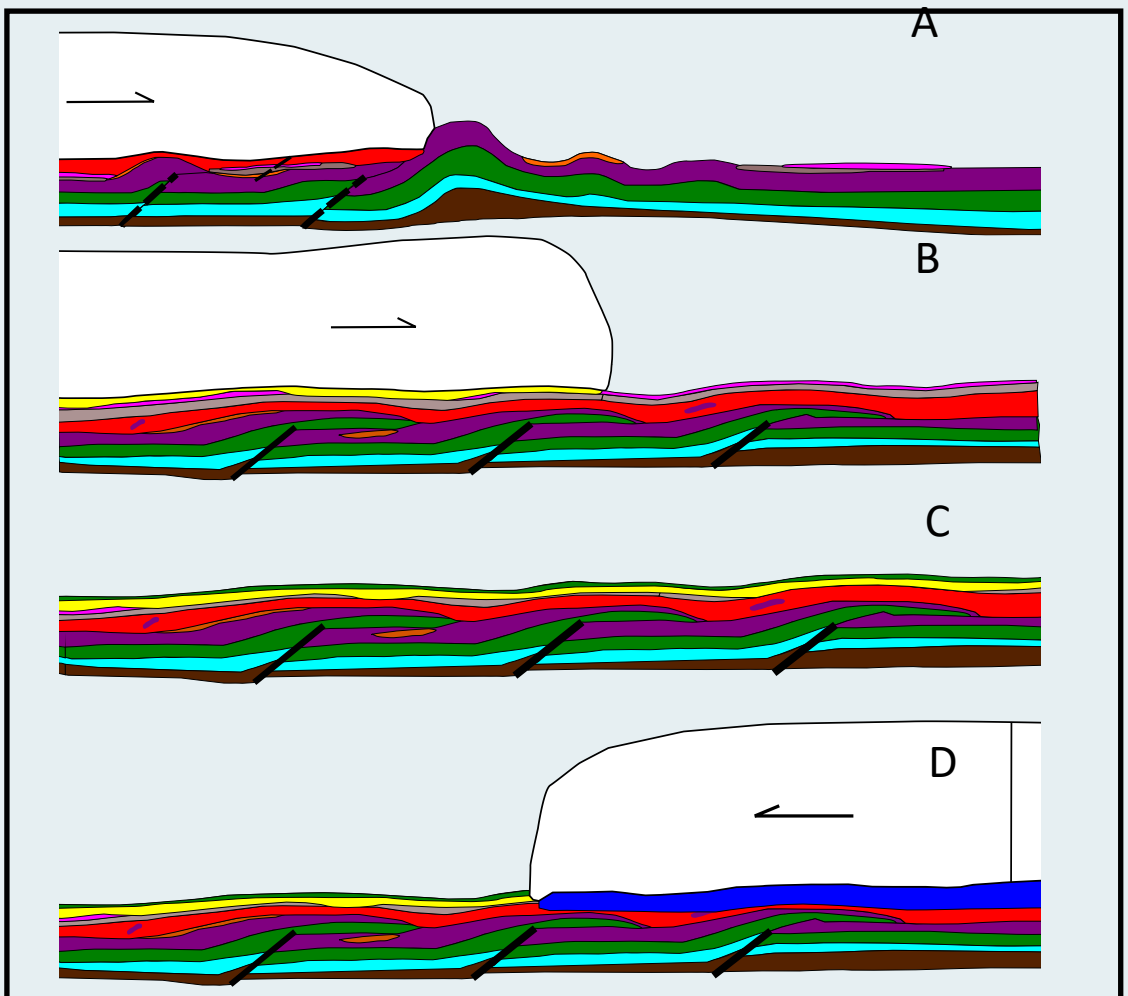

Figure 2. A simplified version of conceptual model number one. The various colored layers represent different lithofacies, with red (LF9), yellow (LF12), and blue (LF15) denoting till beds, while the other lithofacies comprise a blend of glaciolacustrine and glaciofluvial sediments.

The initial model posits a sequence of glacial advances originating from the NE, whereby LF9 was deposited initially, causing considerable deformation of preexisting glaciolacustrine deposits (Fig.2A). Subsequent ice retreat and readvancement led to the deposition of LF12 (Fig. 2B, yellow), followed by a retreat from the area (Fig. 2C). A third glacial advance from the SW partly deformed and eroded the preexisting sediments (Fig.2D), contributing further to the geological complexities observed.

Conversely, the second conceptual model presents an alternative scenario, suggesting that the sedimentary succession and associated glaciotectonic structures can be comprehended through only two glacial advances. According to this model, the ice sheet initially flowed from the NE, inducing deformation of preexisting sediments as seen in figure 2A. Notably, during this phase, the lower till bed (LF9) was purportedly detached through progressive proglacial deformation, resulting in piggybacking and subsequent layering of till, thus forming a nuanced till sequence. This turn of event is later followed by a second glacial advance from the SW partly deforming and eroding the preexisting sediments, in the same manner seen in the first model and in figure 2D.

Key take aways:

- This study shows that our current understanding of the structural evolution of Ven`s northern sedimentary succession is limited and presents a more simplified view of the glaciotectonic evolution.
- This study shows substantial deformation in sediments of the Alnarp valley, contrasting with the absence of deformational structures observed in studies of the same sediments at different points throughout the Alnarp valley.
- Previous statements that Ven is a prime example of a cupola hill complex have been found to be factually incorrect