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# HILL OF LONGHAVEN QUARRY

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OS Grid Reference: NK083424

## Highlights

The disused quarry at Hill of Longhaven shows an exposure of granitic bedrock that has been heavily decomposed through granular disaggregation and limited chemical weathering. It is a particularly good example of this type of phenomenon which is widespread in north-east Scotland.

## Introduction

Hill of Longhaven Quarry (NK 083424) is excavated at an altitude of 110 m OD, near to the summit of a broad west–east ridge which extends almost to the North Sea coast. It provides good exposures of weathered granite typical of the granular disintegration to gress accompanied by a relatively low degree of chemical alteration that is found at many locations in north-east Scotland (Hall, 1985; Hall *et al.*, 1989a). The nature of the weathering contrasts with that, for example, at Pittodrie (see above), where the alteration to clay minerals has been much greater. The only account of the Longhaven site is by Hall (1983), who gave data on granulometry, geochemistry and clay mineralogy (see also Hall, 1985; Hall *et al.*, 1989a).

## Description

The lithological succession at the site is simple and continuous along 100 m of quarry face. Extending down from the surface and through a thin humic soil is a layer of cryoturbated till up to 0.3 m thick and containing abundant flint clasts. Beneath this lies up to 5 m of weathered granite, which is locally incorporated into the overlying deposit. The parent rock is typical pink, coarse-grained Peterhead granite, which has disintegrated to a uniform gravelly sand in which original rock structures, such as joint systems and thin quartz veins, are perfectly preserved (see Chorley *et al.*, 1984, plate 8). Corestones up to 1.5 m in diameter are found on the quarry floor, but no fresh rock, apart from occasional aplite veins, occurs in the quarry faces. The basal surface of weathering is locally exposed at the quarry floor by several whaleback-shaped rock 'risers'.

Weathering elsewhere in the Peterhead granite is described by Edmond and Graham (1977) and Moore and Gribble (1980). In an engineering study for Boddam power station, Edmond and Graham (1977) note that weathering in the Peterhead granite:

1. reaches a depth of 56 m in a fault zone;
2. decreases in intensity with depth, thereby indicating that subaerial, rather than hydrothermal alteration is the main cause of weathering;
3. includes thin seams of white and red clay along vertical joint planes, which may reflect minor hydrothermal activity.

Moore and Gribble (1980) gave geochemical data for a 10 m deep weathering profile in Stirling Hill Quarry (NK 123415), approximately 4 km east of the Longhaven site. Kaolinite and illite are the main clay minerals present and the amount of geochemical change is shown to decrease with depth, again supporting the idea of subaerial weathering.

At Hill of Longhaven, the content of fines is unusually low (<6%) and the granite has disintegrated to a gravelly sand (Hall, 1983). Average losses of CaO, Na<sub>2</sub>O and MgO are also low (5.9%). Samples relatively enriched in clay, taken from joint planes, are dominated by illite with kaolinite and halloysite. Chlorite is present as a green coating on certain joint surfaces and may reflect slight alteration by hydrothermal solutions. Hall noted that the incorporation of previously weathered granite into the overlying cryoturbated till demonstrates that the period

of rock weathering pre-dates at least one glaciation.

## Interpretation

A puzzling feature of this site is that an apparently very low degree of chemical alteration has produced such deep and thorough disintegration of the rock. Hall (1983) suggested that some form of mechanical disintegration in response to buttressed expansion (Folk and Patton, 1982), or even ice-sheet loading and unloading (Carlsson and Olsson, 1982), may have been involved. The site has considerable research potential in this respect.

Hill of Longhaven Quarry provides a large exposure in weathered granite showing many features typical of weathering in coarse-grained granites in north-east Scotland. The site also has potential for research into the causes of rock breakdown in the initial stages of chemical alteration.

Other good exposures in similar weathered granites in north-east Scotland are found at Mill Maud (NJ 566067), Glen Cat (NJ 574949) and East Den (NK 082443). The degree of weathering at these sites is slightly greater than at Hill of Longhaven, but other features are broadly similar. Deep weathering in finer-grained granites is well-exposed at Redhouse (NJ 577203), Cairnlea (NJ 901537) and Cairngall (NK 053471).

Deep weathering of granite and other rocks is widespread in north-east Scotland and its geomorphological significance is outlined above (see Pittodrie). The weathering is widely regarded as pre-glacial or interglacial in origin (FitzPatrick, 1963; Basham, 1974; Wilson and Tait, 1977; Hall, 1983, 1985; Hall *et al.*, 1989a). In view of the low degree of alteration at the Longhaven site it is likely that this profile is of interglacial origin (see Hall, 1985; Hall *et al.*, 1989a). Its survival beneath a relatively exposed hilltop site is evidence of the inefficiency of glacial erosion in the Peterhead area, a characteristic feature of the geomorphology of this part of Scotland (Hall, 1983, 1985; Hall and Sugden, 1987; Sugden, 1989). It is also interesting to note that stripping of the weathered bedrock would reveal a hummocky bedrock topography resembling certain types of ice-moulded terrain. The site may thus have further research potential in elucidating the origins of certain classic landforms of glacial erosion, such as roches moutonnées and "knock-and-lochan" topography (areal scouring) (Linton, 1959).

## Conclusions

Hill of Longhaven Quarry demonstrates a particularly good example of weathered granite. It is representative of a type of weathering that shows granular disaggregation of the rock and a relatively low degree of chemical modification. In contrast to the more intense (?Tertiary age) chemical alteration seen at Pittodrie, the weathering at Hill of Longhaven Quarry may have occurred during one or more interglacial climatic phases in Pleistocene times. It is important for interpreting the geomorphological processes that have shaped the landscape of north-east Scotland.

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