Tinto Hill

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Highlights

Tinto Hill is important for studies of periglacial processes, illustrating the best examples of active stone stripes in Scotland.

Introduction

Tinto Hill [NS 953 343] is a broad, rounded hill, elongated in an east–west direction. It is composed of felsite intruded into Old Red Sandstone and, rising to 707 m OD, dominates the middle Clyde Valley. Its lower slopes are covered by drift, and along the northern flank, generally at an altitude of less 300 m OD, there is an impressive sequence of meltwater channels (Sissons, 1961b). However, Tinto Hill is most important for periglacial geomorphology, demonstrating an assemblage of active stone stripes (Miller *et al.,* 1954*;* Galloway, 1958; Ballantyne, 1981, 1987a).

Description

The upper parts of Tinto Hill are apparently bare of glacial deposits and, where the vegetation cover is broken, are covered by frost-shattered debris consisting of angular felsite clasts set in a peaty, sandy matrix. On vegetation-free areas this debris is being arranged at the surface into outstanding examples of active stone stripes (Figure 16.6), the first and possibly finest examples of their kind reported in Scotland (Miller *et al.,* 1954; Galloway, 1958).

Miller *et al.* (1954) reported patterned ground occurring in three main areas: to the south of the summit of Tinto, south-east of there in the gully known as the Dimple, and on the northern side of the hill in Maurice's Cleugh. On the south side of the hill the features were found down to an altitude of 580 m OD and on the north they were reported as low as 400 m OD. At present, the best-developed area of stripes lies south of the summit where they descend to 570 m OD.

On vegetation-free debris slopes, with a gradient of approximately 20°, and where the coarse fraction consists of material generally less than 0.15 m in length, the regolith is being frost-sorted into well-developed 'gutters' between lines of slightly updomed fine-grained material. The stripes are aligned directly downslope and the long axes of pebbles tend to be oriented downslope. Both coarse and fine stripes range in width from about 0.1 m to 0.3 m, and sorting extends to a depth of between 0.08 m and 0.15 m. Below the sorted surface layer, coarse and fine material is intermingled amongst black peaty humus.

In the Dimple, Miller *et al.* (1954) also found a form of sorted circle that they termed 'inverted garlands'. These consisted of convex-upslope, arcuate arrangements of flat or flat-lying clasts, 0.15–0.3 m across. The long axes of the clasts were arranged along the arc with the clasts lying on edge. Excavations to a depth of 0.5–0.6 m revealed a preponderance of similar clasts to those at the surface but with little development of the matrix found under the areas of stripe development.

Miller *et al.* (1954) reported that stripes had started to reform on artificially disturbed ground after two winters. Ballantyne (1981, 1987a) found that a single winter was sufficient for perfect regeneration of stripes on ground dug over to a depth of 0.3 m, and recorded downslope movement of surface clasts averaging 0.25 m (maximum 0.63 m) over a six month period covering the winter of 1977–78. Such experiments prove conclusively the present-day activity of these features. By comparing different editions of Ordnance Survey 1:10,560 maps, Miller *et al.* (1954) observed that the extent of bare ground on the surface of Tinto Hill had increased greatly since 1862. The present extent of development of the patterned ground seems likely therefore to be due to increased grazing pressure on the hill over the last 100 ye4rs (see Ballantyne, 1991a).

Interpretation

The processes responsible for the formation of the stripes are not fully understood. Frost heave resulting from the development of needle ice is important, but Miller *et al.* (1954) considered that the stripes also played a role in the drainage of the hill, noting that there was no gullying of the areas where stripes were developed. Ballantyne (1987a) also suggested a possible role for running water, speculating that the development of rill networks on a bare ground surface may have been an initial condition for the development of lateral sorting. He also suggested that surface wash may have been in part responsible for the high rates of movement he observed for surface clasts. To explain the origin of similar features in the Lake District, Warburton (1987) invoked density-driven convection of soil water, upfreezing of clasts, and downslope movement of debris resulting from creep and rillwash.

Scottish mountains carry a wide range of relict and active periglacial features (Ballantyne, 1984, 1987a). In southern Scotland, the summits and slopes of the main hill groups are mantled by frost-weathered detritus that has been extensively soliflucted (Galloway, 1961a; Tivy 1962; Ragg and Bibby, 1966). On Tinto Hill, where the vegetation has been stripped clear, the surface of this material displays the most outstanding development hitherto reported of active stone stripes in Scotland. Although active stone stripes are known from a number of mountains in the Highlands and Islands (see the Cairngorms and Western Hills of Rum; Godard, 1959; Ballantyne, 1987a; Carter *et al.,* 1987), the examples on Tinto Hill are exceptional for their size, clarity and degree of development. Tinto Hill is also the first locality in Scotland at which such features were described in detail.

Conclusion

Tinto Hill is an important component of the network of sites for periglacial geomorphology, that is for features formed under extremely cold, but non-glacial conditions. The results are evident in intense weathering of bedrock by frost action and other related processes and in frost disturbance of the soil, producing surface arrangements of stones and finer material in the form of stripes and circles, known as patterned ground. Tinto Hill is particularly notable for active-process studies of the formation of stone stripes.

References

(Figure 16.6) Stone stripes are particularly well developed on Tinto Hill. (Photo: J E. Gordon.)