Grasmoor

[NY 175 205]

J. Boardman

Introduction

Patterned ground of the type generally associated with periglacial conditions can be found on the high flat summits of the Lake District, such as Grasmoor, Helvellyn and Skiddaw.

Patterned ground, forming under contemporary conditions, was reported from the Lake District by Hollingworth (1934). The features consist of small sorted stripes, nets or polygons and isolated sorted circles (Warburton, 1985). They generally occur above 610 m where vegetation is sparse, and on all the main lithologies, although there is a tighter clustering and denser distribution of sites on Skiddaw Slate than on Borrowdale Volcanic Group rocks (Caine, 1972).

In 1960 Caine surveyed 1500 km^2 over 500 m OD in the central Lake District and recorded the distribution of sorted patterned ground comprising sorted polygons and stripes (Caine, 1972). The Grasmoor massif contained one of the major concentrations of sites of patterned ground (Figure 7.27). Remapping of the Grasmoor sites by Warburton in 1982 and 1994 indicated some changes in the distribution (Figure 7.28).

The most common form of patterned ground is the sorted stripe (Figure 7.29) forming under contemporary climatic conditions of high rainfall and mean annual winter temperatures of between 4° and −3°C. Based on data from the winter of 1961–1962, Caine (1963a) suggested that periods of intense freezing (3–4 days) have the greatest significance in terms of mechanical sorting and occur three to six times in any year. These freezing events give rise to the development of segregated ice and needle ice growth to depths of 30 cm. A model has been proposed for the development of sorted stripes in the Lake District ((Figure 7.30); Caine, 1963b).

Warburton (1985) listed general characteristics of areas of striping in the Lake District:

1. Stripe fields tend to be unvegetated scree slopes surrounded by turf.
2. A zone of ill-defined sorting occurs at the margin of the sorted stripe field; this is most noticeable at the head of the slope.
3. The lower limit of the sorted stripe field has a lobate form that appears to be advancing ((Figure 7.31), section D–d).
4. The upper limit of the sorted stripe field has a cut-bank form possibly maintained by wind action and erosion by sheep ((Figure 7.31), section B–b).
5. Well-developed striping is confined to the central area of the scree ((Figure 7.31), section C–c). Stripes are initiated at some point downslope from the cut bank and die out at a position just behind the frontal lobe, at which point crudely developed sorted nets may be evident. This development may be the result of locally reduced slope gradient.
6. Striping does not normally extend beyond the area of the scree (Figure 7.31), although turf remnants are sometimes observed along fine-stripe crests.
7. Sorted horizons comprise a coarse-stripe gutter with many clasts orientated vertically and some downslope and fine-stripe ridges with few clasts orientated vertically.
8. The basal layer is relatively undeformed and unsorted.
9. Bedrock is usually at a depth of 60–100 cm.

The Grasmoor sites are important in that they were the focus of work done in the 1960s by Caine (1963a, b, 1972). They have been revisited and remapped more recently by Warburton (1985, 1997) and therefore form the basis of some conclusions about changing areal distribution of patterned ground. Early work on patterned ,ground tended to be descriptive (e.g. Caine, 1972), although a model for patterned ground formation was also proposed (Caine, 1963b).

Recently, Warburton, as well as remapping, has begun detailed recording of ground temperatures on High Pike (Warburton, 1997). The focus therefore has shifted to an attempt to understand the processes of patterned ground formation.

Description

Caine (1963b) described the low-angle scree slopes on the summit area of Grasmoor as consisting of 'a generally fine soil up to 60 cm thick covered by a layer of gravel and small scree the constituents of which are rarely more than 15 cm long. This surface layer is frequently sorted into coarse and fine stripes over a ridge and hollow topography in the underlying fine material.' Caine (1963b) measured the movement of marked stones in a downslope direction during the winter 1961–1962 and found it to be between 15 and 20 cm on unvegetated slopes of about 15°. Thus the areas of patterned ground are active under contemporary conditions, with frost heave and downslope movement of clasts occurring.

Warburton (1985) listed seven sites on Grasmoor where active patterned ground existed in 1982, which are grouped in an area to the north and one to the east of the summit (852 m) (Figure 7.28). The sites on Grasmoor are developed on a subdivision of the Skiddaw Group, the Mosser–Kirkstile Slates. Warburton (1985) discussed the characteristics of the Grasmoor sites in association with the lithologically similar sites on Skiddaw, and in contrast to the Helvellyn sites developed on Borrowdale Volcanic Group lithologies. Sorted stripes on Grasmoor and Skiddaw tend to be more extensive than on the Borrowdale Volcanic rocks and occur in a series of stepped benches separated by lobe fronts or turf bands. Stripe widths and depths tend to be less on Grasmoor than those at Skiddaw and Helvellyn sites. Silt and clay contents are similar to the Helvellyn sites. There is less variability in grain size and more segregation between fine and coarse stripes at Grasmoor and Skiddaw sites compared with Helvellyn. Clast size is smaller and clasts are more platy than on the volcanic lithologies (Warburton, 1985). Width–depth ratios of sorted stripes at Grasmoor, as at other sites, tend to give a relatively constant ratio of about 4:1 (Warburton, 1997).

Interpretation

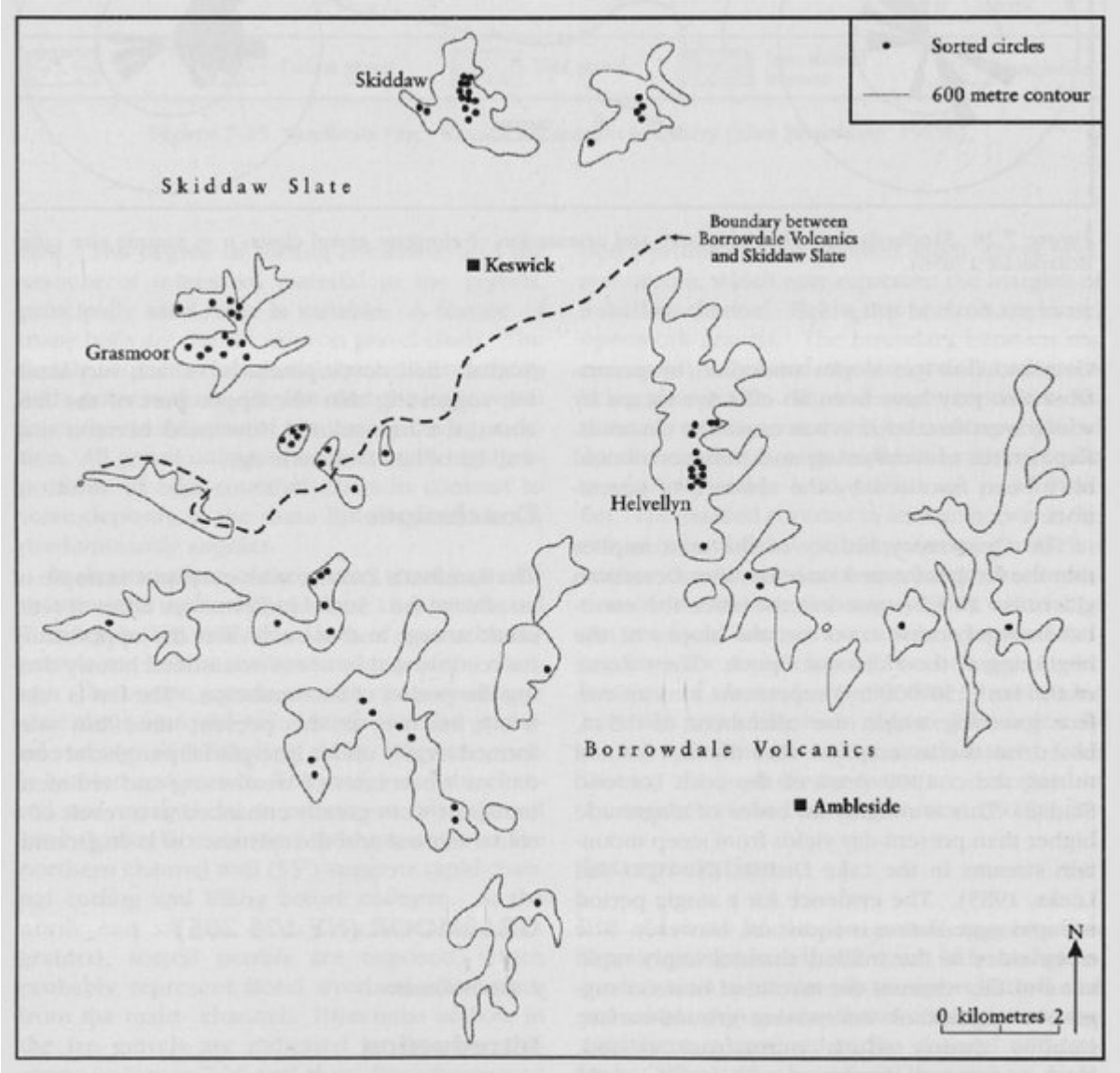
Caine (1972) shows that the distribution of patterned ground in the Lake District has a strong preference for Skiddaw Slate lithologies, presumably because they are more frost susceptible than the Borrowdale Volcanics. Warburton (1997) shows a tendency for sites at higher ele vations to have deeper sorting. He hypothesizes that this is because deeper sorting might be expected at higher altitudes as a result of more frost days and therefore greater frost-heave potential. However, this simple relationship also is affected by the presence of frost-susceptible material at the site. The Grasmoor sites are at relatively low altitude and show low sorting depths.

Contemporary activity of the patterned-ground area of Grasmoor was demonstrated by Caine (1963b). At other sites, formation of stripes on mining waste, and stratigraphical relations between unbroken turf cover, patterned and unpatterned soils also attest to contemporary activity (Warburton, 1997). The Grasmoor sites are particularly important as a result of their remapping. Between 1960 and 1982 there was little change in the distribution of patterned ground, but by 1994 some of the former occurrences at lower sites were missing. Warburton (1997) commented that it is tempting to relate these changes to climatic amelioration but urged caution owing to the absence of a systematic regional survey. Other factors such as grazing intensity could well have influenced patterned-ground distribution.

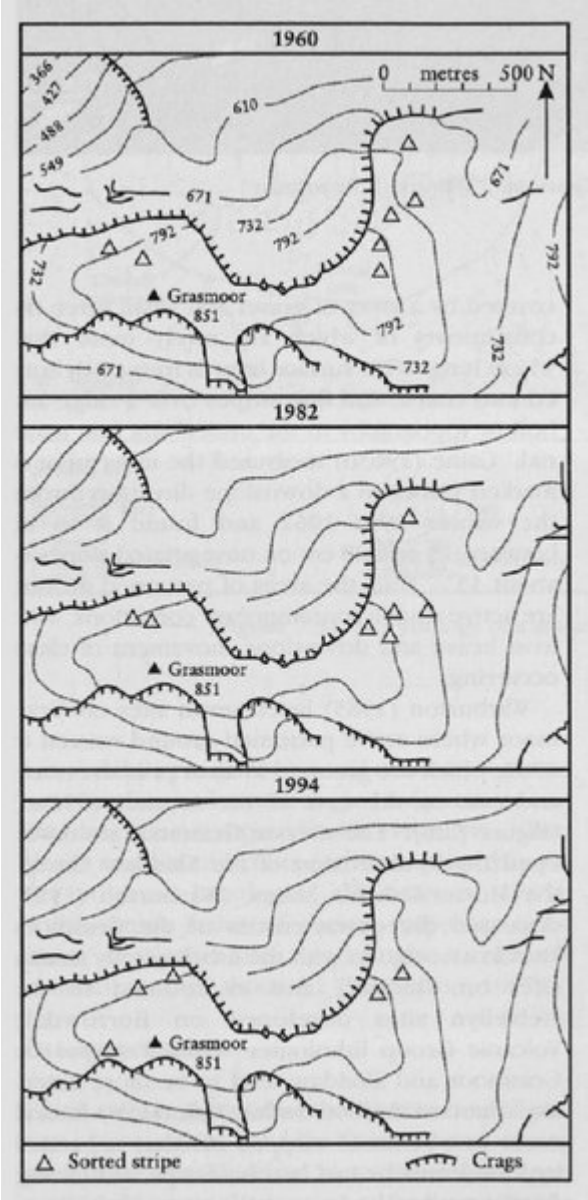
Conclusions

Patterned ground is a feature of upland summit areas in Britain. It appears to develop even under the contemporary mild frost climate and does not require what are generally regarded as 'true' periglacial climates. The existence of patterning seems to be related to frost-susceptible lithologies and periods of ground freezing in the winter. These produce frost heave and a separation of coarse- and fine-grained materials is achieved. The process is then self-organizing.

References

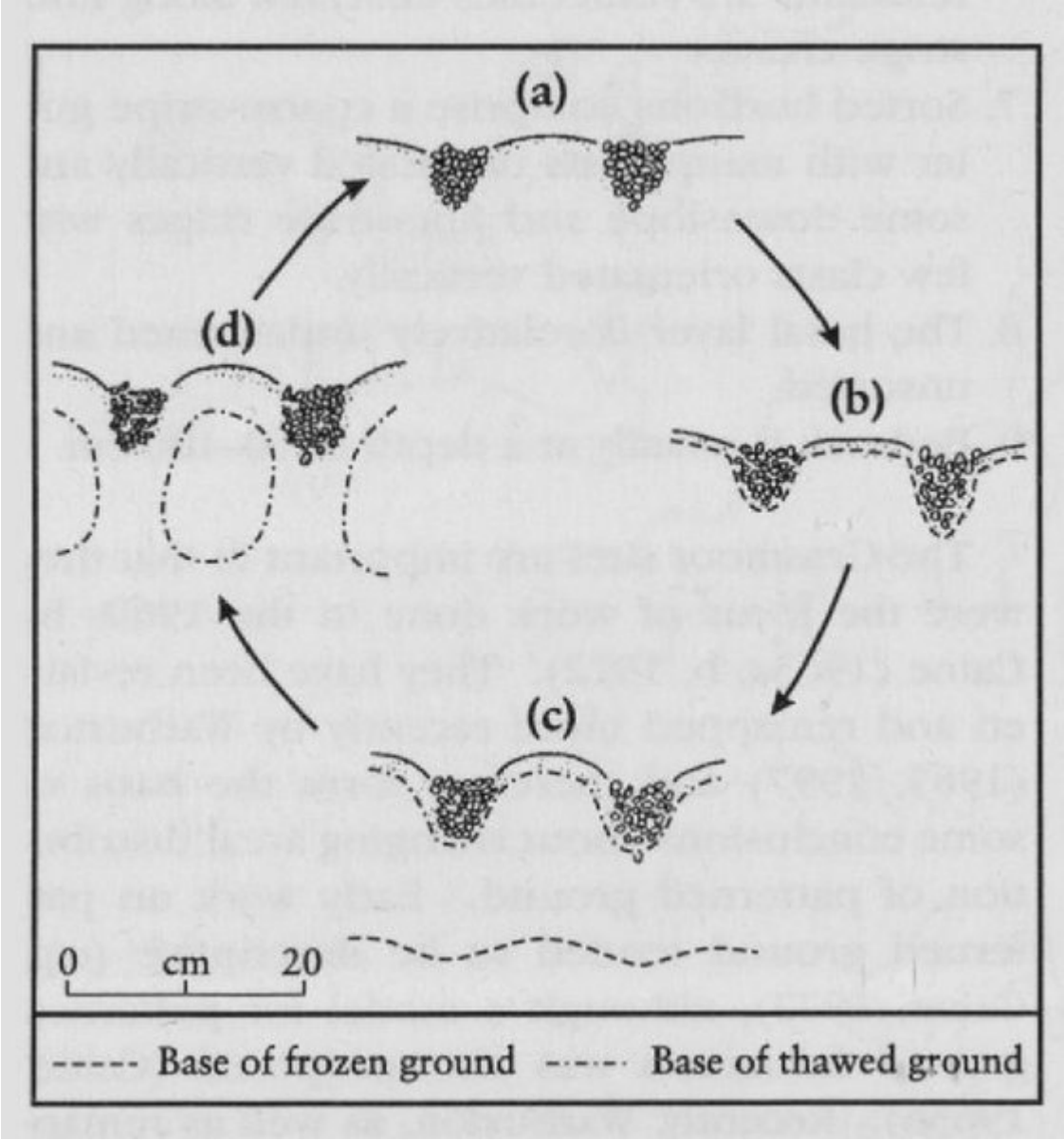


(Figure 7.27) The spatial distribution of sorted patterns in the Lake District. Contour is at 600 m. The broken line shows boundary between Borrowdale Volcanics (to the south-east) and Skiddaw Slate (to the north-west). (After Caine, 1972.)

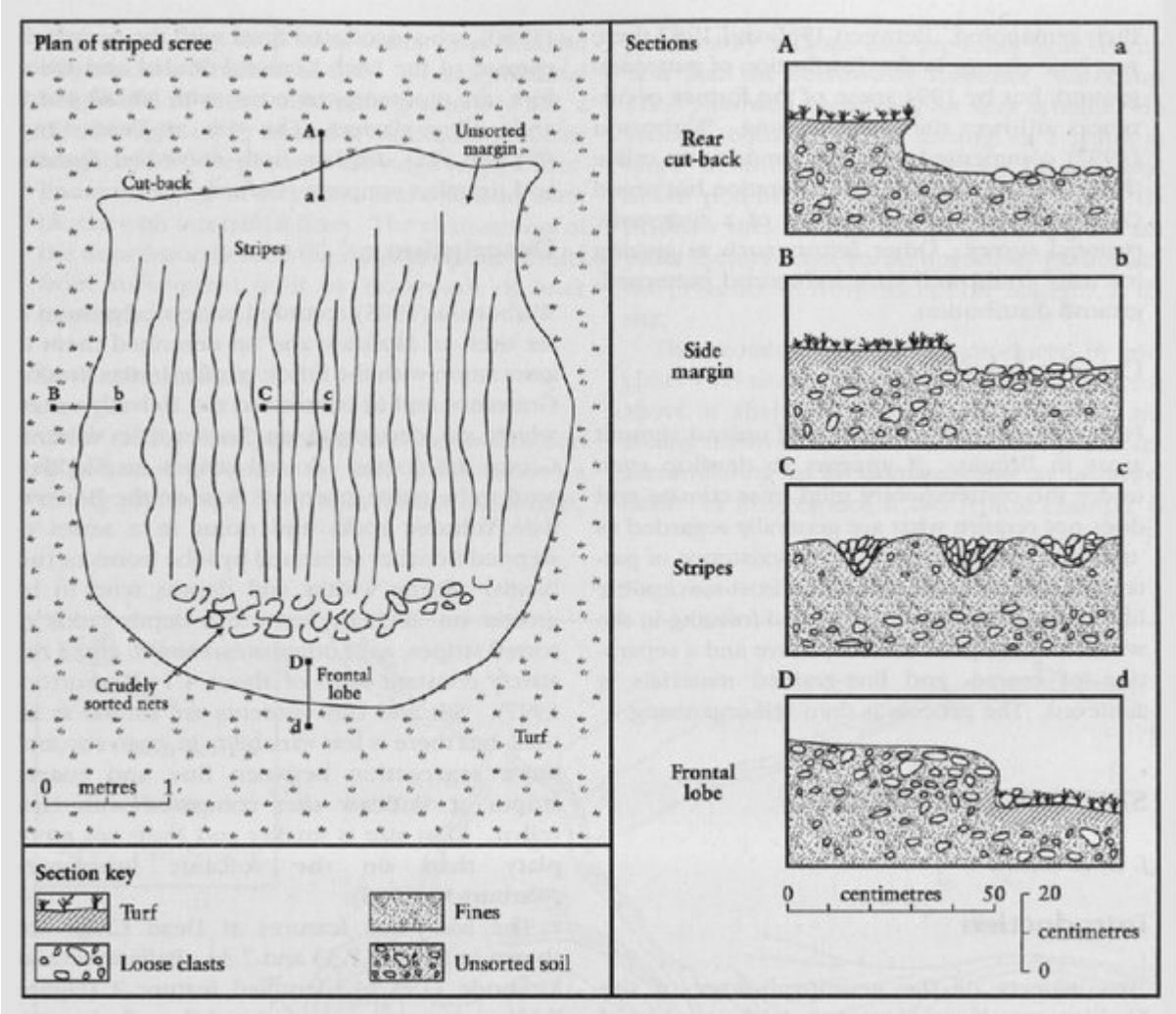


(Figure 7.28) Sequential mapping of sorted stripes sites on Grasmoor between 1960 and 1994 (after Warburton, 1997).

(Figure 7.29) Stone stripes on Grasmoor. (Photo: J. Boardman.)



(Figure 7.30) Model for the development of stone stripes (after Caine, 1963b). (a) completely thawed; (b) freezing extends downwards faster under coarse stripes than under fine; (c) thawing occurs faster under coarse stripes than under fine; (d) frozen areas remain only under fine ridges.



(Figure 7.31) Morphology of a stone stripe field (after Warburton, 1985).