Patterned ground near Gobabeb, Central Namib Desert

by

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Two major types of patterned ground and one minor type are found in the interdune valleys south of the Kuiseb River at Gobabeb and are particularly distinct after good rains (e.g. 1976 with 125 mm). The patterns are polygons bounded by straight lines with little regularity. The average distance across a polygon is approximately 5 m although some reach 20 m. The polygons have been briefly described by Goudie (1972), who does not distinguish two types and proffers no explanation. The patterned ground described here is quite distinct from the simple mud cracks figured by Scholz (1972). Besler (1972) described polygons near Gobabeb and Swartbank and relates their formation to the past or present gypsum content of the soil.

The three types are distinguished by the vegetation growing on them: in one kind (Type A) the grass (*Stipagrostis gonatostachys*) grows inside the polygon but not along the bounding lines; in the second kind (Type B) some grass species grow along the lines but not within the polygon. A third type (Type C) supports a slight growth of *Stipagrostis gonatostachys* within the polygon and a more dense growth along the lines. Vegetative growth requires optimum water conditions, so the three types can be re-defined in terms of available soil moisture as:

Type A. Patches within the polygon have available soil water but the lines are too dry for plant growth.

Type B. Patches within the polygon are too dry but soil water is available in the lines.

The three types are shown in Figs. 1, 2, 3, 4 & 5.

Type A: Within the patches there is shallow soil over calcrete which occurs at a depth of about 10 cm. The lines are joint cracks about 20 cm wide, penetrating the calcrete and filled with soft soil. It would seem that the calcrete is a barrier to percolation so any water that falls on the patch is held in the soil above. On the cracks there is no limit to percolation so water goes below the depth of root penetration.

The difference between patch and line can even be detected by firmness of the surface: the patches afford firm ground while the lines are soft.

The lines are utilized by burrowing animals which may exaggerate and perpetuate the difference between line and patch, but the animals are not the original cause of the polygons.

These cracks are essentially joints in limestone (calcrete). The joints cannot have a tectonic origin in this stable area, and are therefore, a local phenomenon, most probably resulting from shrinkage of the calcrete upon drying. This suggests that the polygons are fossil. The patterned ground is not the result of active process continuing at the present time but it was created at a specific time when the calcrete dried out. This particular calcrete is therefore of a specific age, and possibly dates to the last onset of true aridity.

Type B: The patches in this type occur on bare rock, an indurated pebble-free, red sandstone, which may or may not have a slight calcrete development at the surface. The sandstone is probably of Tertiary age and has been called the Tsondab Sandstone (Ollier 1977). These lines are joint cracks up to 20 cm wide filled with sand, pebbles and calcrete fragments.

The bare rock cannot hold enough moisture for plant growth, but the infilled joints full of varied debris can sometimes support growth (though even at the best the growth is sparser than in the patches of Type A). Burrowing animals do not seem to live in the cracks of Type B.

The joints were formed during the lithification of the original sand into sandstone by drying, consolidation and chemical

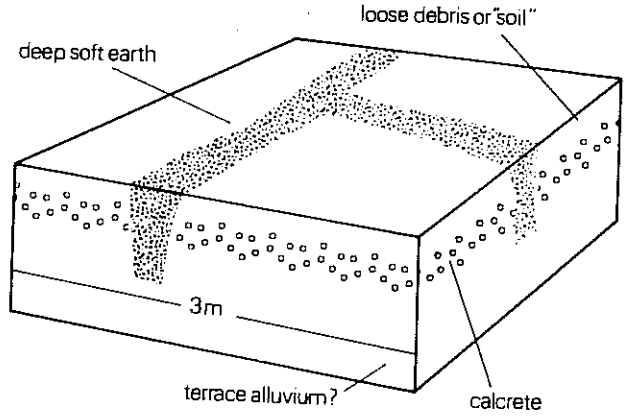

Figure 1: Diagram of type A patterned ground.

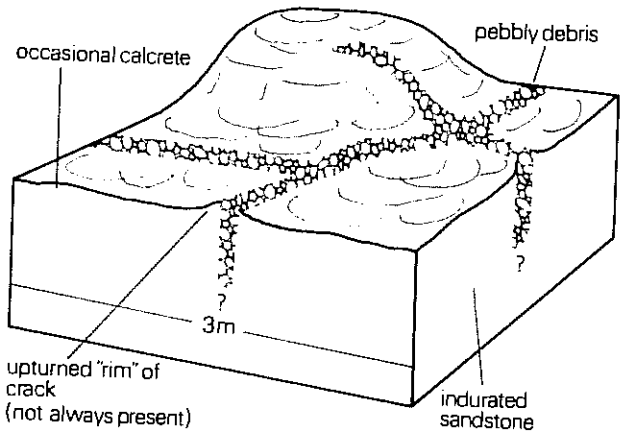

Figure 2: Diagram of type B patterned ground.

cementation. Jointing in sandstone is more complex than simple desiccation cracking and there may be migration of iron or of carbonate cement. The slightly raised rim which often occurs at the edge of the cracks probably indicates such a process.

This sandstone is exposed on a river terrace. The rock was almost certainly consolidated and jointed before fluvial erosion carved the rock-cut terrace. Minor erosion at the time of terrace cutting widened the joints. The terrace was probably covered in alluvium, some of which filled the widened joints. Much later erosion has stripped the alluvium from most of the sandstone, but it has remained in the cracks. Where deep alluvium is preserved on a terrace it may have developed a calcrete pan and could eventually give rise to Type A patterned ground.

The two types of patterned ground thus seem to be related to the nature of river terrace. Where the terrace is rock-cut and bare sandstone is exposed at the ground surface type B patterns appear; where sufficient depth of alluvial fill is preserved on a terrace Type A pattern may be present.

Type C: The third type of patterned ground occurs below the terrace remnants, within the dry interdune valleys south of Gobabeb. On the surface the pattern is similar to Type B, with grass growth more developed in the lines and only slight vegetative growth within the polygons. The soil is about 20 cm deep under both line and patch, and preliminary investigations failed to find any cause for the vegetation pattern. The age and origin of this type is unknown.

REFERENCES

BESLER, H.
1972: Klimaverhältnisse und Klimageomorphologische Zonierung der Zentralen Namib (Südwestafrika). *Stuttgarter Geogr. Stud.* 83: 209 p., Stuttgart.

GOUDIE, A.
1972: Climate, weathering, crust formation, dunes, and fluvial features of the Central Namib Desert, near Gobabeb, South West Africa. *Madoqua* II 1: 15–31.

OLLIER, C.D.
1977: Outline geological and geomorphic history of The Central Namib Desert *Madoqua*. in press.

SCHOLZ, H.
1972: The soils of the Central Namib Desert with special consideration of the soils in the vicinity of Gobabeb. *Madoqua* II 1: 33–51.