D. DURICRUSTS

Desk Note D1. Pedocretes - Overview

Pedocrete (here calcrete) on a dune.

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1. *Introduction*

There are three types of pedocretes in the Study Area: calcrete, silcrete and ferricrete. Together they cover large expanses of land.

Some geologists see a pedocrete as 'geological rubbish', which only interferes with the study of the underlying formations.

Perhaps this is why there is so little literature on the pedocretes in the Study Area. Some types (such as non-pedogenic silcretes and ferricretes) were never discussed before. This, the lack of references and inaccurate geology maps, made the study of pedocretes by the author quite difficult, and could be described as a walk in the darkness.

Pedocretes are sediments, which were formed in situ via chemical processes, not fully understood. The formation of silcrete, for example, is regarded 'enigmatic' by the very scientists who study them. The pedocretes have a great variety of habits (appearances) and textures, which may be reported here for the first time.

This study made observations and geomorphological analyses of the various outcrops and drew conclusions which do not corroborate some previous observations, such as the southward (seawards) inclination of the surface on which pedogenic silcretes were formed.

The Desk and Field Notes in this chapter give the reader a comprehensive picture of the landscape, which is shaped by the perdocretes.

The following definitions are from separate sources; they explain the formation of each pedocrete.

2. *Calcrete*

Calcrete, also called Hardpan, calcium-rich duricrust, a hardened layer in or on a soil. It is formed on calcareous materials, as a result of climatic fluctuations in arid and semiarid regions. Calcite is dissolved in groundwater and, under drying conditions, is precipitated as the water evaporates at the surface. Rainwater saturated with carbon dioxide acts as an acid; it dissolves calcite and then redeposits it as a precipitate on the surfaces of the soil particles; as the interstitial soil spaces are filled, an impermeable crust is formed.

Calcrete is a limestone formed by the cementation of soil, sand, gravel, shells, by calcium carbonate deposited by evaporation, or by the escape of carbon dioxide from ground water. It is also called caliche.

Calcrete is a crust or layer of hard mineral or subsoil encrusted with calcium-carbonate occurring in arid or semiarid regions.

Calcrete is a sedimentary rock, a hardened deposit of calcium carbonate. This calcium carbonate cements together other materials, including gravel, sand, clay, and silt. It is found in aridisols (desert soils) and mollisols (grassland soils and dark fertile surface horizons).

3. *Silcrete*

Silcrete is an indurated (resists crumbling or powdering) soil duricrust formed when surface sand and gravel are cemented by dissolved silica. The formation of silcrete is similar to that of calcrete, formed by calcium carbonate, and ferricrete, formed by iron oxide.

Silcrete is a surface or near-surface deposit of soil, saprolite, or sediment that has been cemented by secondary silica, to form an indurated mass.

Silcrete, silica-rich duricrust, an indurated, or hardened, layer in or on a soil. It generally occurs in a hot, arid climate where infrequent waterlogging causes silica to dissolve and be redeposited to cement soil grains together. Silcrete is extremely hard and resistant to weathering and erosion but eventually integrates and weathers down to boulders and angular blocks.

4. *Ferricrete*

Ferricrete is a hard, erosion-resistant layer of sedimentary rock, usually conglomerate or breccia, that has been cemented into a duricrust by iron oxides. The iron oxide cements are derived from the oxidation of percolating solutions of iron salts. (Afrikaans-speaking farmers call this crust “Koffieklip”).

Ferricrete is a ferruginous duricrust, cemented by iron oxides occurring as indurated continuous crusts and soil horizons in the landscape. Fundamental to the formation of ferricrete and laterite is the formation and accumulation of insoluble ferric iron in soils and regolith (regolith: unconsolidated, loose, heterogeneous superficial deposits which cover the bedrock).

Ferricrete is an iron-rich duricrust, an indurated, or hardened, layer in or on a soil. Soil particles are cemented together by iron oxides (such as Fe_2O_3) precipitated from the groundwater to form an erosion-resistant layer. Often the soil covering is eroded from the surface of the ferricrete layer, which is exposed as a rock surface; parts of old ferricrete layers may remain as remnants of old erosion surfaces.

The pedocretes of the Study Area are not considered ‘formations’, although *‘high-level silcretes and ferricretes’* are assigned to the Grahamstown Formation. Not all the silcretes and ferricretes are on ‘high level’, and there are several pedogenic silcrete and ferricrete outcrops which do not constitute parts of this formation.

There are also the intergrade outcrops of calcrete-silcrete and silcrete-ferricrete, where they have been formed synchronously, or replaced each other to a certain extent or even wholly.

Ferrugination of other formations such as shale and sandstones took place in the Study Area. Also, large swathes of land are covered with ferricrete nodules of all sizes and colours. These areas are not part of the Grahamstown Formation.

Non-pedogenic silcrete and ferricretes are also present in the area, along drainage lines, streams and rivers as well as around pans and lakes.

This study of the pedocretes is on-going, and more observations are needed for a full picture.

This chapter describes in detail the many types, appearances and tectures of the pedocretes in a series of Field Notes and field guides as follows:

1. Pedocretes - Overview

2. Calcretes - Overview
   a. Calcrete on the Bokkeveld Formations
   b. Calcrete on the Enon Formation
   c. Calcrete on the Bredasdorp Group Formations
   d. Calcrete on the Bredasdorp Plain
   e. Calcrete in the Ou Werf Valley
   f. Calcrete around roots
   g. Calcrete as conglomerate cement
   h. Calcrete dissolution features
   i. Calcrete spatial distribution

3. Silcretes and ferricretes – Overview

4. Silcretes
   a. Pedogenic silcretes – A. Hilltops
   b. Pedogenic silcretes – B. Hill slopes
   c. Hilltop silcretes spatial distribution
   d. Use of silcretes in prehistoric time
   e. Non pedogenic silcretes – A. Ground water
   f. Non pedogenic silcretes – B. Drainage-lines and rivers
   g. Non pedogenic silcretes – C. Lakes and pans

5. Ferricretes
   a. Pedogenic and non-pedogenic ferricretes
   b. Ferruginised silcretes
   c. Ferruginised shales and sandstones
   d. Heavily ferruginised shales - hilltops
   e. Heavily ferruginised shales – hillslopes
   f. Fault zone ferruginised shales
   g. Manganese in ferruginised shales
   h. Ferricrete spatial distribution

6. Adjacent areas
   a. Elim silcretes and ferricretes
   b. Napier silcretes and ferricretes
   c. Breede River gravel terraces ferricretes

7. Pedocretes landscape - field guides
   a. Calcretised landscape – a field guide
   b. Silicretised and ferricretised landscape – a field guide