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Report: rock sample collection in the Northern Cape

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K Allen and P Gauché

Overview

An exploratory trip to the Northern Cape was organised in order to look for rock samples from areas where it is thought that there is rock that might be suitable for use in thermal storage. Samples of rock were obtained from a large sample area, on a route from Calvinia through Brandvlei, Kenhardt, Keimoes, Kakamas, Augrabies, Pofadder, Springbok, Garies and Bitterfontein.

Introduction

This is part of the research that is being undertaken for the PhD dissertation of K Allen, which is focusing on the feasibility of rock thermal storage, in the context of solar thermal power generation.

A geographical information systems (GIS) survey, in ArcGIS, of a 1: 1 000 000 Council for Geoscience (CGS) map of the rock in South Africa was used as a basis for planning the trip. In regions where it is possible that solar plants might be built, rock considered unsuitable for thermal storage was removed, leaving regions of interest through the central Karoo, along the Orange River, and down the N7 on the West Coast from the border of Namibia through Springbok to Bitterfontein. A route was planned through these areas, in order to obtain representative rock samples, which can be tested for the characteristic properties such as density and specific heat capacity, which need to be known to decide which rock is suitable for thermal storage.

These rock samples represent the available rock types that could be used for thermal storage, in a region of South Africa where solar power plants are likely to be built.

Sample collection – route and location

The total route distance for the return trip to Stellenbosch was approximately 2000 km; the route through the areas of interest is shown in Figure 1, overlaid on the CGS data in ArcGIS:



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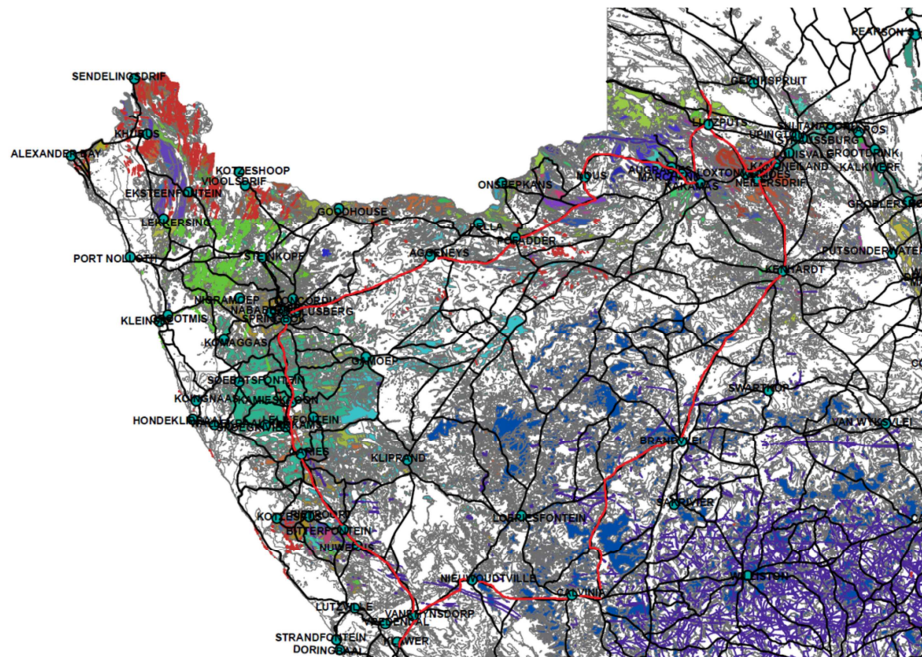


Figure 1: Route followed – overlaid on CGS rock data; produced in ArcGIS

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Findings of interest

Several samples (Figure 2) were collected between Calvinia and Kenhardt. It was noted that where there are rock outcrops, the rock towards the centre appears to have a harder structure, and is in general less weathered/fragmented (or has undergone less exfoliation) than the rock on the periphery (Figure 3). The hard central rocks give a loud ringing noise (almost deafening) when hit with a hammer; the rock on the periphery does not. This may give an indication of the soundness of the rock. As a rule, the harder rock is less weathered and usually found in larger sizes.



Figure 2: Rock from centre of outcrop showing little exfoliation/fracture, Calvinia - Brandvlei



Figure 3: Rock showing high exfoliation or fracture, Calvinia - Brandvlei

There are flat plains in the area (Figure 4) which may be used to construct power plants; however, the land is at least in nominal use by farmers, mostly for sheep farming.



Figure 4: Flat areas suitable for solar power plants

From Kenhardt north to the Orange River, where there is potentially water available for power plants from the river, there are deposits/outcrops of metamorphic rock. They are found along the Orange River from Upington along the border almost to the West Coast; there are also deposits running down through Springbok to Garies and Bitterfontein. The first deposits on this route were in the Kenhardt-Keimoes region near the 'Kokerboom forest' (Figure 5).



Figure 5: Kenhardt rock and plain in the nearby district

The surface rock along the Orange River between Keimoes and Kanoneiland appears to be varied in composition, with deposits of loose rock such as those in Figure 6.



Figure 6: Loose rock along the Orange River region

The terrain along the Orange River is undulating or even mountainous below the Augrabies falls; some examples of this are shown in Figure 7. Where there is flat land directly next to the river, it is often used for agriculture with irrigation, for example vineyards. Since the river is the main water source for the region, proximity to the river needs to be taken into account for solar thermal power plant location.



Figure 7: Hilly land next to the Orange River, west of Augrabies

What looked like a small quarry was observed on the Augrabies road, although the access to this was not obvious.

There are rocky outcrops to the west of Augrabies along the border with Namibia and around Springbok, and from there on down to Bitterfontein. The approach to Springbok on the N14 has large rock outcrops surrounded by plains (Figure 8). According to recent insolation maps, there is a good solar resource around Springbok.



Figure 8: Approach to Springbok on the N14

Springbok itself lies in the midst of rocky hills as seen in Figure 9, and these extend, with some breaks, down to the Bitterfontein area. There are many large rock outcrops in this area, although it would require quarrying to obtain the rock, since it is part of the solid bedrock. This is a difference from the deposits in the central Karoo, which usually have loose boulders lying on the surface, although these are usually large boulders (> 0.2 m).



Figure 9: Springbok and the N7 down to Bitterfontein

Note the extent to which, on a macro-scale, the layers (strata) of rock in this area, seen in a cutting along the N7, are separated (Figure 10 and Figure 11):



Figure 10: Cutting on the N7, showing strata/layer separation



Figure 11: Further detail (N7)

The location and details of the rock samples that were collected on the route were recorded, so that if larger quantities of rock are desired in the future, it is possible to return to the same location.