CAPE GEOSITES

BRANDVLEI

Hot Springs

Condensation above the shallow Brandvlei Hot Spring, viewed southwestward.

Council for Geoscience

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THE CAPE GEOSITES SERIES

Brandvlei is just one of the many geologically interesting sites in the Cape. This brochure forms part of an educational series that was compiled by the Geoheritage Subcommittee of the Western Cape Branch of the Geological Society of South Africa and is downloadable free of charge from the Branch website (https://www.gssawc.org.za). Bilingual descriptive plaques were placed at the sites during a programme sponsored by Sanlam in the 1990s.

Figure 1: Location map of Brandvlei hot springs. See Figure 4 for more details and GPS coordinates.

INTRODUCTION

Early reference to the hot springs at Brandvlei and Goudini appeared in 1719 in a book by P. Kolben describing the Dutch settlement at the Cape. His information was probably obtained from farmers in the "Land van Waveren" (Tulbagh), who had been exploring the Breede River Valley from the beginning of the 18th century.

The botanist-traveller P. Thunberg visited Brandvlei in 1772 and reported that the hot water issued from seven springs, the lowermost of which produced by far the largest flow. The owner of the farm, Pieter de Wet, had built two bath-houses and a few huts along a wooden canal about 300 m from the source, where the stream could be further cooled by adding water from a nearby cold spring. In 1797, John Barrow described the sandstone range bordering the Breede River, noting particularly the absence of volcanic rocks. He observed that the springs discharged water mixed with quantities of white sand containing minute crystals of quartz. The water was perfectly clear, tasteless, and deposited no mineral crust. The temperature exceeded 140° F (60° C) the maximum that his thermometer could read.

When W.J. Burchell, the naturalist, visited Brandvlei in 1811, he found the bathing facilities greatly neglected and the dilapidated buildings in disuse. Despite the claims of early doctors and patients regarding the healing powers of the spring water, investigations soon established that it was medicinally no better than ordinary pure, hot water. In 1841, both springs were proclaimed public resorts by Governor George Napier. By the turn of the century, it had officially been reported that two children, a horse, an ox, an ostrich and many dogs had perished through falling into the scalding, then 21 m deep, pool.

Figure 2: The Brandvlei Hot Spring *circa* 1899 (du Plessis, 2007).

Systematic mapping of formations by the Cape Geological Commission towards the end of the 19th century and publication of Sheet 1 in 1906, revealed comparable structural settings of the thermal springs at Brandvlei and Goudini. In 1916, M. Rindl reported his chemical analyses of medicinal spring waters. He referred to the location of Brandvlei at the foot of a high range of eastward-dipping "Table Mountain Sandstone" and commented that the geological structure at Goudini was obscured by hill-slope debris.

ACCESS

The Brandvlei hot springs are currently situated on Brandvlei correctional services property and may only be visited for academic purposes with prior written notice. Please contact the area commissioner, Ms Kungune (tel. 021 862 3330) should you need to arrange access under these conditions. The telephone number of Brandvlei Correctional Services is 023 340 8000.

FEATURES OF THE HOT SPRINGS

A thermal classification of natural springs in South Africa was proposed by Kent (1949):

Scalding:	Above 50° C
Hyperthermal:	37 - 50° C
Warm:	25 - 37° C (human body temperature)
Tepid:	17 - 25° C
Cold:	Below average atmospheric temperature (17° C for South Africa)

According to this scheme there are some 30 hyperthermal and scalding springs in South Africa, with Brandvlei at 64° C being by far the hottest and displaying the largest flow-rate (126 litres per second). By comparison, the spring at Goudini Spa, 16 km to the northwest, yields 3 litres per second at a temperature of 40° C. The water of both springs is classified as ''pure'' by virtue of its low content of dissolved mineral matter (total less than 100 milligrams per litre); most of this is silica at 30 to 80 milligrams per litre. The remainder consists of chlorides, sulphates and bicarbonates of magnesium, calcium, sodium and potassium. The bubble gas consists of carbon dioxide with a little methane. Traces of radon cause weak radioactivity of the gas.

Figure 3: Close-up of the shallow bed of the Brandvlei Hot Spring, strewn with sandstone gravel, with light-blue patches in the distance caused by upwelling of spring water on the southern side of the spring.

GEOLOGICAL EXPLANATION

The high temperature of the springs is not related to volcanism, as originally surmised by some of the writers of the 18th and 19th centuries, but can be attributed to deep subterranean circulation of groundwater, followed by its rapid rise to the spring orifice at the surface. The geothermal gradient of the earth's crust averages about 25° C per kilometre of depth. Accepting a gradient of 20° C per km, the rock temperature at a depth of 2.5 km would be about 65° C. Such conditions provide a satisfactory explanation for the presence of the thermal springs at Brandvlei and Goudini (De Villiers *et al.*, 1964). However, allowance should be made for a cooling of the water during its ascent and a higher temperature at source implies depths in excess of 2.5 km. The Stettynsberge Range, rising to some 700 m above the valley floor at Brandvlei, consists of sandstone of the Peninsula Formation, glacial deposits of the Pakhuis Formation, marine shale of the Cedarberg Formation and sandstone of the Nardouw Subgroup (see geological map and cross-section). The basement rocks underneath the Peninsula Formation comprise phyllite of the Malmesbury Group and the intrusive Cape Granite Suite, as exposed along the upper reaches of the Holsloot River. The predominantly shaley Bokkeveld Group following above the Nardouw Subgroup, is entirely covered by alluvium in the broad valley stretching from the Brandvlei and Kwaggaskloof dams westwards beyond Rawsonville. The geological map shows arcuate outcrops of formations marking the position of a NE-plunging anticline (arch), with its eastern limb dipping steeply eastward and its western limb dipping moderately towards the northwest at the northern end of the Stettynsberge Range. This structure is also expressed prominently by the sandstone ridges of the succeeding Witteberg Group, which swings abruptly from N-S to E-W near the wall of the Brandvlei Dam.

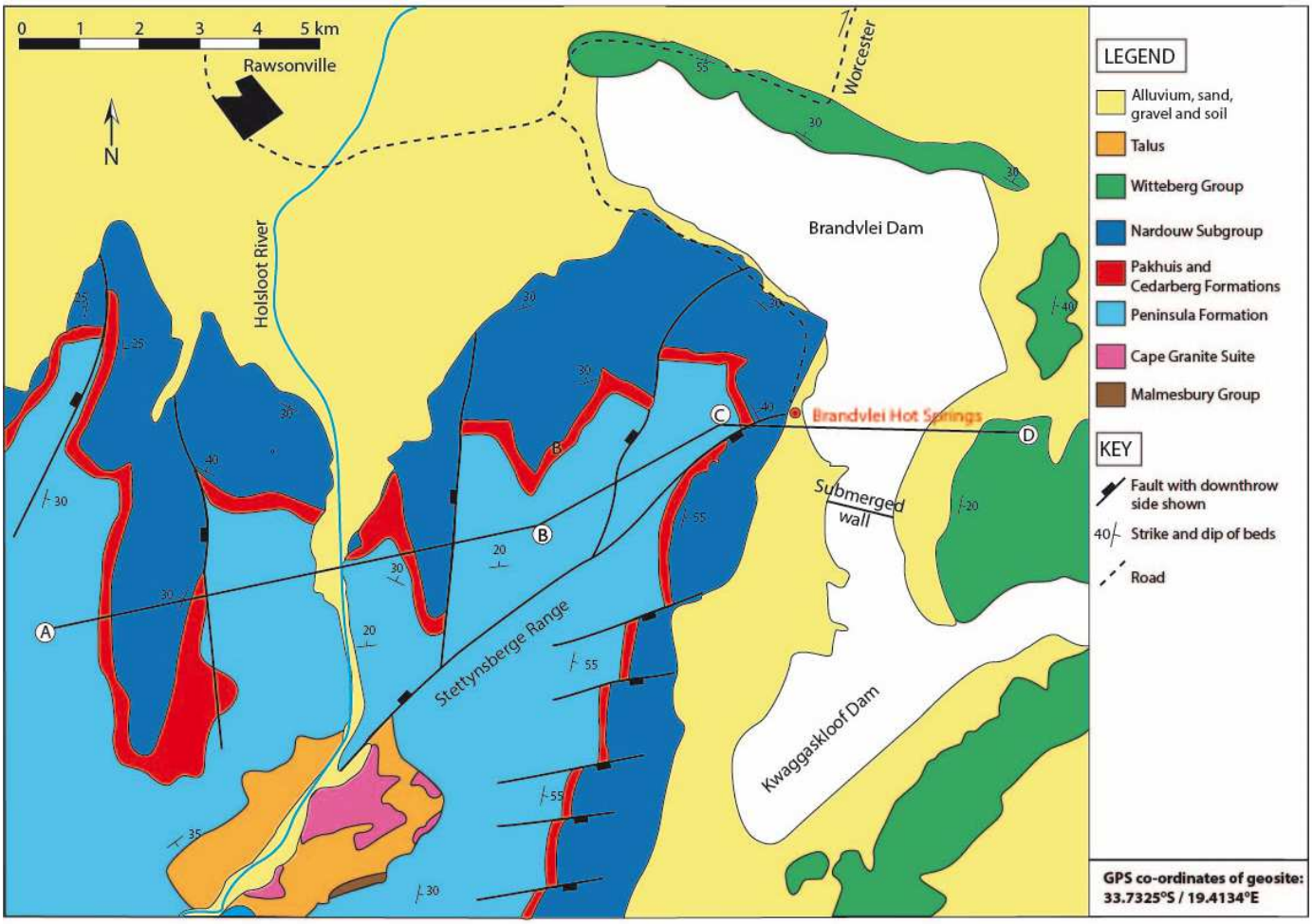

Figure 3: Geological Map of the area surrounding the Brandvlei Hot Springs adapted from various 1:125 000 scale Geological Maps compiled by the Council for Geoscience (see references). The Bokkeveld Group is not exposed at the surface, but is known to underlie alluvium between the Nardouw Subgroup and sandstone ridges of the Witteberg Group (see section in Figure 5).

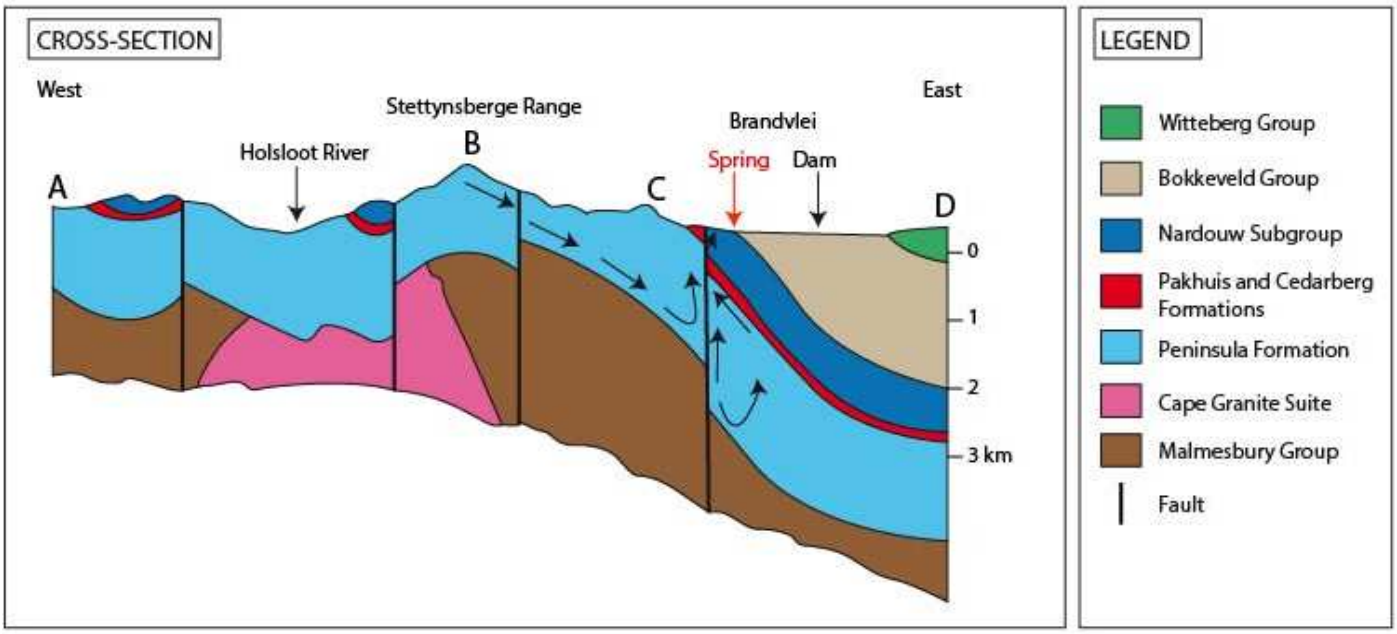

Figure 4: Cross-section of the geology of the area surrounding the Brandvlei Hot Springs along points A –D.

Figure 5: The Brandvlei Hot Spring viewed south towards the Brandvlei Prison.

The hot spring is located on a major north-east-striking fault. The relatively impermeable Cedarberg shale serves to cap water from the lofty Stettynsberge Range as it moves down to great depth through the relatively permeable jointed sandstones. This flow will be aided by the major fault striking northeast and also by numerous cross-fractures. The water will probably reach down into the basement of both Malmesbury Group phyllite and granite of the Cape Granite Suite, which crop out on the southeastern upthrow side of the fault, 10 km southwest of the hot spring. The position of the fault within the closure of the anticline probably facilitated a rapid escape of the heated water, which finally emerges through Nardouw Subgroup sandstone near the contact with Bokkeveld shale. Two trial boreholes located up the slope, some 35 m above the spring, struck warm (40° C) water under artesian pressure.

Figure 6: Most active upwelling of the hot spring occurs above the blue patches, viewed here towards the east from the western perimeter of the spring.

The geological control at Goudini Spa is, in the main, comparable to that of Brandvlei. The much lower temperature and yield at Goudini may be attributed in part to more moderate relief and lower rainfall in the catchment ranges, combined with shallower circulation. Erstwhile speculation that these springs receive their water via deep circulation from more distant sources (like the Worcester fault system) is still open to question.

CONTACT

Western Cape Branch of the Geological Society of SA:
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