The quality of the Florisbad spring-water in relation to the quality of the groundwater and the effects of rainfall

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Abstract

The spring-water, groundwater and rainfall were examined as part of a study to determine aspects of the environment in which faunal remains at Florisbad were fossilised. A 1988 analysis of the Florisbad spring and exploration pit-water showed a 27% higher TDS in the pit-water after a high rainfall period, despite the two being located only 22 m apart. An extended qualitative water-sampling programme in 1999 confirmed a difference, but in this instance the TDS of the same exploration pit was 49% lower than that of the spring-water after a low rainfall period. This was contrary to the norm where high recharge usually results in low TDS and low recharge results in high TDS. Results also showed extreme TDS variations of up to 6 times higher between individual pit-waters 54 m apart. The fluctuation in the quality of the pit-water, in relation to the stable spring-water, led to the conclusion that the two should be separate entities. It was further concluded that the mineralisation of the pit-water originated either directly, or indirectly, from a source other than the spring-water. Long-term rainfall appears to have only a slight effect on the quality of the spring-water and possibly no effect on the quality of the pit-water, while short-term rainfall appears to have little effect on the spring-water quality, but has a decided influence on the pit-waters. Aspects relating to water quality and water monitoring at Florisbad are discussed and a comprehensive historic record of the spring-water quality and composition is also given. Investigations on the origin/s of the groundwater mineralisation are continuing. The results clearly indicate that the spring-water does not currently carry sufficient mineralisation for fossilisation.

Introduction

Florisbad spring is located 49 km north-west of Bloemfontein and is located on the eastern boundary of the Western Free State panveld. The topography of the area is slightly undulating with occasionally washes from infrequent runoff. The residence at Florisbad is located on the op of a lunette, which has been formed from aeolian sand deposited by the prevailing north-west wind. Drainage is from south to north with a vlei draining to the north from the third swimming pool. The northern tip of the farm incorporates a part of an extensive salt pan, Soutpan.

The 500 mm isohyet passes slightly to the east of Florisbad with an average 78 year rainfall of 496 mm. Annual rainfall is extremely variable with a maximum of 957 mm in 1988 and a minimum of 271 mm in 1965. The flow rates of the spring, as given in the literature, are possibly not very reliable and vary from 18.8 m^3/h (Grobler and Loock, 1988) to 159.3 m^3/h (Kent, 1948). It has been suggested that seismic activity has played a role in the flow rate of the spring over time, as well as in the migration of spring eyes. During the September 1912 earthquake at Fauresmith, a new spring eye appeared at Florisbad. Water flow was said to have increased and gas, sand, artefacts and fossils were expelled from the new eye (Anon, 1980).

Loock and Grobler (1988) stated that the basement rocks of the area were of the Ventersdorp Supergroup overlying older granite and gneiss. This basement is in turn overlain by a Permian Age Karoo sequence of the Ecca Group into which dolerite dykes and sills have intruded (Brink, 1987; Loock and Grobler, 1988). It is at such a dolerite intrusion that the Florisbad spring has formed. The surface geology is composed of an unconsolidated mantle of red-yellow and pale bleached aeolian sand of varying depth (Brink, 1987; Loock and Grobler, 1988). There is no outcropping of bedrock formations on the farm, while calcrete horizons that have been exposed through erosion, occur in the vlei draining from the spring site.

No specific research has been carried out on the Florisbad spring aquifer and therefore factors such as size, recharge, storage capacity and abstraction are unknown. Grobler and Loock (1988) postulated that the intake of the Florisbad aquifer was located 30 km north of Florisbad at Basberg where permeable Beaufort sandstone occurred at an elevation of 150 m above Florisbad. The possibility that the intake area of the spring may lie equidistant to the south-east of Florisbad, in the hills north of Bloemfontein, was also suggested by Grobler and Loock (1988). It was calculated that if the water intake area was located at Basberg, the water would have to descend to the contact zone between the Karoo and the Upper Ventersdorp basement rock at approximately 500 m, in order to reach a temperature of 32°C to 33°C, and issue at 29°C (Grobler and Loock, 1988). There, however, appears to be some uncertainty as to the travel time that recharge water could take to travel from the intake area, through the aquifer, to the spring eyes. Grobler and Loock (1988) calculated anything from 160 to 16 000 years, with a probable 1 600, years for the water to travel this distance.

With the exception of intermittent spring-water sampling (Rindl, 1915; Fourie, 1970; Mazor and Verhagen, 1983; Douglas, 1992), a study by Grobler and Loock (1988) on the characteristics and genesis of the spring, and some hdydrological data supplied by Fourie (1970), the hydrological environment at Florisbad has been largely ignored. This is perhaps somewhat surprising considering the amount, and diversity, of palaeontological, archaeological, geological, and other research, that has been centred on the spring and its associated fossil remains (Brink, 1987; Douglas, 1992). The association between the spring-water and fossil remains probably originated from reports of fossil finds when the swimming pools

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