

THERMAL SPRINGS generate heated interest

A new multi-faceted research project funded by the Water Research Commission (WRC) is shedding light on one of South Africa's most under-utilised resources.

Article by Petro Kotzé.

For many South Africans, the only reference to a thermal spring is childhood memories of a splash in a heated Aventura pool. Indeed, a number of hot springs have been developed for recreational and tourism purposes and at some, water is bottled and sold for therapeutic purposes. Yet, elsewhere in the world, in addition to the increasing popularity of spas and the growing natural health industry, thermal spring waters are increasingly being used for power generation, industrial processing, agriculture, aquaculture, bottled water and the extraction of rare elements. In 2005, 72 countries reported

on the direct use of geothermal energy. The plethora of new uses for this resource has resulted in an unprecedented resurgence of interest.

Locally, thermal springs remain some of our natural resources that have been researched the least, and are mostly under-utilised. While the potential uses of thermal springs in South Africa are varied, decision-making is hampered by the lack of information available. A recently-completed multi-faceted research project is aiming to change this. It has resulted in some interesting findings, and researchers hope it will result a number of the springs

being put to good use – some of which can result in high-income generating developments.

The topic lies close to the heart of project leader, Prof Jana Olivier (University of Pretoria professor extraordinaire, University of South Africa (UNISA) emeritus professor), who first became interested in the topic in the 1980s. When she joined UNISA in 2001 and was asked to suggest a project in which all members of the geography department could participate, her obvious choice was thermal springs, “a hitherto under-researched natural resource.”



The research team currently studying thermal springs in South Africa are Peter Nyabeze, Prof Jana Olivier, Dr Isaac Rampedi, Dr Ernest Tshibalo, Jaco Venter, Tshupo Motlakeng and Nelia Jonker

This work has been continued under the current WRC research project, under the auspices of UNISA and in collaboration with the Council for Geoscience. This time, it focused more on the scientific aspects. This WRC-funded study was completed earlier this year, and the report is being finalised.

The principal aim of the project was to determine the optimal uses of thermal springs in South Africa. In order to accomplish this, researchers investigated a number of issues. Firstly, they determined the physical and chemical characteristics of local thermal springs, since there is little or no current knowledge on these properties. Secondly, they looked at their current uses and whether these comply with existing water use regulations. Then, what alternative types of development could be instituted at the springs and what novel uses, products and knowledge can be generated from the research.

“What was great about this project is that it was truly multidisciplinary and inter-institutional,” says Prof Olivier. She adds that it involved subject fields such as geology (including geophysics, geochemistry, structural geology and isotope studies), microbiology, geography, environmental sciences and more. “Although we could have submitted separate smaller projects, it was felt that a single, large, multidisciplinary project was the most exciting. It allowed us the opportunity to view this resource in a holistic manner and to share information generated amongst many participants.”

THERMAL SPRINGS IN SOUTH AFRICA

Defined as a naturally occurring spring with temperature exceeding 25°C, almost 80 thermal springs have been identified in South Africa by the time that the project started. Since there is no evidence of recent volcanic activity, it is generally

assumed that all thermal springs in South Africa are of a meteoric origin. Geological studies have also shown conclusively that the origin of each individual thermal spring can be attributed to the local presence of deep geological structures such as folds, fractures, faults and dykes that provide a means for the circulation to depth and the return of the heated waters to the surface.

For the purpose of the project, researchers visited most of the identified thermal springs in South Africa. “We conducted numerous field trips to collect water samples,” says Prof Olivier, “and drove thousands and thousands of kilometres during the three-year project.” She says that some of these trips were “hair-raising,” taking them down deserted roads and often following vague directions. “The project has really been a voyage of discovery,” she says. Often relying on locals to provide them with directions and stories of the springs, Prof Olivier says every single person that helped with information deserved to be thanked for contributing to the success of the project.

Finally, they were also able to conduct research on six as of yet unrecorded thermal springs. Four are in the Kruger National Park and two in Limpopo, at Siloam and Minwamadi. At the thermal spring in Siloam, near the Siloam hospital, the water temperatures measured 71°C; one of the two hottest in the country. The other is at Brandvlei, located in the Brandvlei Correctional Centre grounds in the Western Cape. This one flows at a tremendous rate of 126 l/s, and the scalding water creates a thick layer of steam over the pool in winter months – “an awesome sight.”

RESEARCH FINDINGS

According to Prof Olivier, the project has resulted in a huge amount of knowledge in a number of areas that were previously unfamiliar. It was, among others, the first

time that research has been conducted on the bacterial microbiology of South Africa’s thermal springs.

Some of the results have been surprising. For example, some of the springs contain thermophilic bacteria (a thermophilic organism is one that can survive at high temperatures) that have previously only been found in other countries and ecological settings. One of these, Zavarzinella, has only been found in Siberian peat bogs. “Our springs might thus be rich in novel species,” notes Prof Olivier. Furthermore, enzymes extracted from thermophiles have considerable industrial potential.

Researchers also looked at the algae found in the springs. “We found weird and wonderful algae in thermal spring waters,” says Prof Olivier. Some might be used as indicator species for specific minerals while others might be archaic (typical of a previously dominant evolutionary stage) in origin.

A database containing the physical and chemical properties of most thermal springs was also compiled. Researchers could then use this information to determine whether current uses are appropriate for human and animal use.

They found that many thermal springs in South Africa have high levels of fluorine and bromine, which may have health impacts if the

“It was found that all springs in South Africa are suitable for one or more alternative uses.”

(From left) Two local youths show the original project team the way to Minwamadi. They are Dr Ernest Tshibalo, Prof Memory Tekere, Elna van Niekerk, Prof Jana Olivier, Jaco Venter and Peter Nyabeze.



Neila Jonker

Studying springs can be dangerous work especially when it takes you into the heart of the Kruger National Park.



water is consumed. Some also show unacceptably high concentrations of potentially hazardous minerals such as mercury, notes Prof Olivier. The exact source, whether it is from the spring itself or pipes and other infrastructure, is not known. However, owners of some of the resorts should take cognisance of these findings.

The highlight of the research project was identifying potential uses for thermal spring waters based on their thermal capacity of the actual minerals in the water. “It was found that all springs in South Africa are suitable for one or more alternative uses,” she says.

Researchers investigated a

number of alternative uses. These include its suitability for bottling, aquaculture (particularly Tilapia, spirulina and oysters), the extraction of minerals, generating electricity, cosmetics or health treatments such as balneotherapy.

A perfect example of where a thermal spring can be used to create an industry is at Sagole, a small dilapidated thermal resort in Venda. According to Prof Olivier, there is the potential to generate a gross income of more than R70 000 per month if all the boron, strontium and titanium could be extracted. These elements can be used in the production of a plethora of uses, such as glass and, ceramics, cleaning product, insecticide, neurotransmitter, toothpaste, gemstones and many more.

Developing a new industry from the thermal spring could stimulate small businesses and improve the living conditions of the surrounding community. At some springs, more than one potential use has



A researcher testing the water of one of the thermal springs in the Kruger National Park.

been identified, which could lead to a cascade of uses with money potentially being generated at each tier of development.

The project has already led to umpteen scientific publications and presentation at conferences, while four post-grad students have obtained their masters or PhD degrees during the course of the project. Yet, they have just managed to scrape the surface of discovery of this natural resource. Prof Olivier says much more research is required and more people must come on-board in order to develop these resources to the benefit of entrepreneurs, existing businesses and local communities.

While the project has highlighted opportunities that are there to be grasped, Prof Olivier says that it has forced them to think out of the box in terms of how these natural resources can be used. It is hoped that, following the completion of the final report, a symposium workshop can be organised to present the findings to stakeholders that could potentially fund developments.

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THE STORIES THAT FLOW FROM THE SPRINGS

Every thermal spring has a story. During the course of the WRC project, the research team learnt of many. These often related to how the springs were found, what they were used for and the reasons why some have disappeared from the scene while others are flourishing. As a result, Prof Jana Olivier and her team have obtained funding from the National Heritage Council through the Kara Heritage Institute to research the rich indigenous knowledge (IK) of some of the springs.

There is no lack of interesting material to support such a project. The fountain at Montagu was apparently discovered when a Boer-trekker injured his hand, and it began to fester. He stuck his injured hand into water that was bubbling from a rock, after following a stream to its source. The water was piping hot and after bathing his hand in the water for the next couple of days, it soon healed. Word of this miracle quick spread and instantly made the Montagu fountain famous.

The Bath at Cistrusdal, on the other hand, was accidentally discovered in the 1930s when an ox stepped in a hole. When the herder tried to rescue the trapped animal, they discovered the hot water, which led them to the spring.

Originally established as a military post under the auspices of the Dutch East India Company, it has undergone numerous changes of ownership until 1903 when the spring was sold to James McGregor, the great grandfather of the current owner.

Dr Ernest Tshibalo (a UNISA team member who obtained his PhD on alternative uses of the thermal spring at Sagole) tells that the local community at Warmbaths (Bela Bela) used the hot spring for the cleansing of evil spirits, invoking charms and during initiation ceremonies.

At others, ancient practices are still in use today, like the extraction of salt. Baleni Camp is situated on the banks of the Klein Letaba River, on land belonging to the Mahumani Traditional Authority. The economy here is dependent on traditional salt mining. The 42°C thermal spring, the main salt source, is also a sacred site for the Tsonga community and visitors can wash away their bad luck in it. During winter months guests can watch locals making salt from the crystals that are deposited from the Soutini spring.

Prof Olivier cautions that many of the springs have considerable customary and spiritual significance, which could support an argument to rather keep them in their pristine state in some instances.

Rotorua in Zealand is famous for its spectacular geysers and thermal activity. It has been used to build a thriving industry, and an extensive range of rejuvenating spa therapies are offered by the area's numerous wellness centres.

