# Meeting the sustainability challenge: rends and Developments in Biological Treatment of mine drainage in South Africa

**Peter Rose**

Environmental Biotechnology Research Unit
Rhodes University .Grahamstown, South Africa

**ABSTRACT**

The discovery of the Witwatersrand gold reef on Langlaagte Farm in 1886 by the Australian gold digger George Harrison and an Englishman, George Walker, set in play the development of the most intensive gold mining enterprise in world history. When it peaked in 1970 it was generating 1million kg fine gold/year (79% of Western world gold production) and, in nearly 120 years of operations, over 6 billion metric tons of ore has been milled and treated to produce some 37 million kg fine gold. Much of the mining and associated industrial activity was made possible by the discovery, around the same time, of extensive coal fields to the east of Johannesburg around Witbank in northern Natal.

While some of the larger Witwatersrand gold mines had been in operation for a century or more, most of these are now either closed or in the process of wind-down and closure. The intensive mining activities over this long period of time has left a legacy of environmental impacts of considerable importance, and particularly for the hydrological systems of the landlocked Gauteng region, served, as it is, by the single and relatively minor Vaal River.

Deep mining has been required to exploit the gold reef and, at depths of over 4 km in some cases, most mines have had to introduce substantial dewatering and pumping operations, generating up to 130 ML/day to sustain activities. With the high pyritic content of the gold-bearing conglomerate, much of this has been acidic, metal contaminated and high TDS water, with sulphate levels up to 7000mg/l.

Although the requirement ultimately for some form of long-term post-closure water plan was acknowledged early in the last century, the accepted wisdom was that, following closure of the mines, water would rise to a steady head and that the problem would be mainly contained within the various basins involved. In a hydrological modelling of the East Rand Basin, Scott (1995) showed that this would not apply, and that somewhat less than 10 years following closure of Grootvlei Mine (the last of some 26 mines in this area alone), decants of over 60ML/day of contaminated water could be expected at the lowest point, close to the town of Nigel. He furthermore warned that the decant of acidic water into the overlying dolomites would create serious problems of karst formation in now heavily built up areas.

More recently, reports have appeared of rising mine waters on the West Rand decanting into dolomitic zones and threatening the Sterkfontein limestone caves, the world heritage “Cradle of Mankind” site where early finds of *Australopithecus* and *Homo habilis* are located. Similar decant problems now also face the Central Rand basin.

In the Witbank and Natal coal fields, the older coal mines have also closed and many are now actively decanting and generating acid mine drainage wastewaters. An additional feature here is the high concentration of chlorides derived from the marine beds of the Karroo geological system associated with the coal deposits.

It is clear that the extensive gold and coal mining activities of the past period in South Africa have left a legacy of mine drainage that will require a long-term investment in treatment that may well extend from decades to centuries. The situation has thus focussed attention, in particular, on the sustainability of particular solutions to the problems involved. This paper deals with current trends and developments in biological approaches to mine drainage wastewater treatment in South Africa, and the application of these at industrial scale of operation.

**REFERENCE**

Scott R. 1995. Flooding of Central and East Rand gold mines: an investigation into controls over the inflow rate, water quality and the predicted impacts of flooded mines. WRC Report No. 486/1/95, Water Research Commission, Pretoria.