

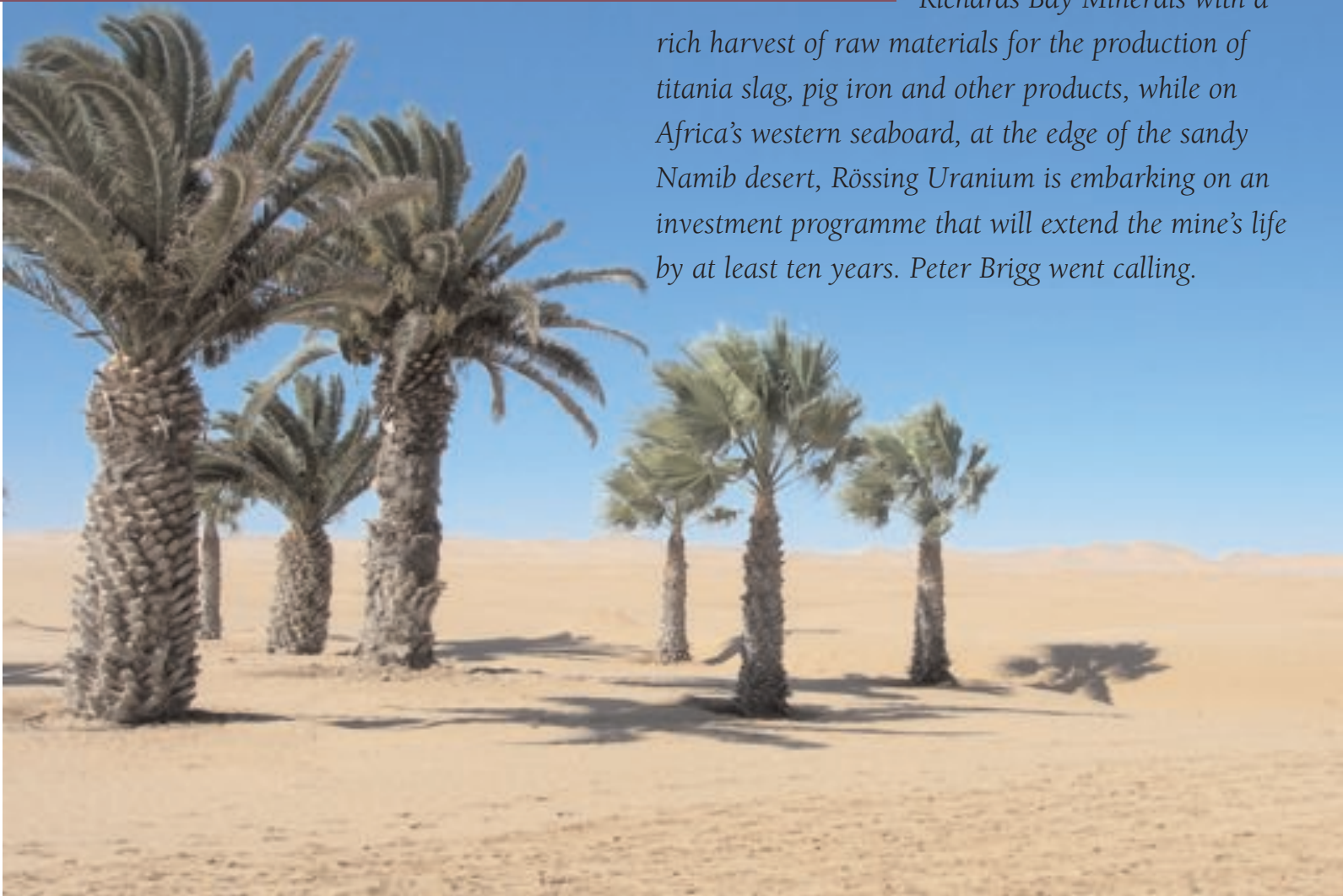


## THE TWIN PEARLS OF AFRICA

*Two Rio Tinto companies in Africa are this year celebrating their Pearl anniversaries – 30 years of successful operation. And just as sand is the seed for the pearl in an oyster, so too it is at the heart of two stories from the continent’s east and west coasts.*

*The sand dunes of the KwaZulu-Natal shoreline in South Africa have for three decades been providing Richards Bay Minerals with a*

*rich harvest of raw materials for the production of titania slag, pig iron and other products, while on Africa’s western seaboard, at the edge of the sandy Namib desert, Rössing Uranium is embarking on an investment programme that will extend the mine’s life by at least ten years. Peter Brigg went calling.*





## SHIFTING SANDS

**Most mines** go downward from the surface, either as an underground operation or as an ever deepening, and widening, open pit. But Richards Bay Minerals (Rio Tinto: 50 per cent) in South Africa is different. It is a mine on the move.

Over the last 30 years the mine has been gradually edging its way northwards along the sand dunes on the KwaZulu-Natal coast, and in the process it has yielded vast quantities of ilmenite (a rich source of titanium dioxide and iron), rutile and zircon.

Although the mining operation at Richards Bay Minerals (RBM) uses sophisticated technology, in concept it is quite simple.

A huge dredger floating in its own artificially created freshwater “pond” (there are currently five such ponds) burrows into the sand at the base of the dune wall. This causes part of the dune to flow into the pond, and the sand-water slurry is hoovered up by the dredger, working as a massive floating vacuum cleaner.

If necessary, the dredger operator, sitting atop in his control centre, directs two powerful water cannons at the dune to help loosen the sand. Depending on the height of the dune, the dredger advances two or three metres a day – slow, stately progress, perhaps, but in the course of a single year’s operation that can mean the mine moves as much as one kilometre.

From the clay floor of the pond, the mineral rich sand is transferred to a concentrator via a thick floating pipeline, which also serves as a walkway to the dredger. The concentrator is a vast floating processing plant, the height of a 12 storey building. Here, heavy mineral concentrate consisting of ilmenite, rutile and zircon, the heavy minerals which constitute about five per cent of the sand’s volume, is separated from the slurry using a gravity process.

The demineralized sand is then spewed back onto the dry land at the back of the pond, where it is carefully reshaped into dunes, covered with topsoil and replanted, roughly one third with the original indigenous vegetation and two thirds with commercial casuarina tree plantations.

The heavy mineral concentrate is transferred by road to RBM’s nearby central processing plant. There, in the feed preparation unit, it is mixed (slurried) with water and passed over powerful electromagnets to separate out the iron-bearing ilmenite.

This is roasted before being combined with charred anthracite and fed into one of four electric arc furnaces, where the carbon from the anthracite reduces the iron oxides to metallic iron, which normally undergoes further upgrading before being sold to RBM’s customers worldwide. The furnace’s most important output, however, is titania slag, which is about 85 per cent titanium dioxide.

Meanwhile, the non magnetic materials emerging from the feed preparation unit, mainly rutile and zircon, are dried and separated using an electrostatic process. They are then ready to be sold in their raw form as mineral sands.

Nearly two million tonnes of product leave RBM’s plant every year, 95 per cent of this output being exported, with the result that the company today enjoys a 25 per cent share of the world market for titania slag, rutile, high purity pig iron and zircon. But this massive modern operation is a far cry from the days, nearly 40 years ago, when the notion of trying to extract minerals from the wild and remote dunes on the KwaZulu coast was first being taken seriously.

Although it had been known since the 1920s that minerals containing titanium, iron and zirconium were present in the dunes, it was not until 1967, when a decision was made to build a harbour in the sleepy seaside town of Richards Bay, that things really began to happen. An exploration programme, funded initially by South Africa’s Industrial Development Corporation (IDC) and subsequently in partnership

### Products for the world

RBM’s products find their way into a host of materials essential to modern life. Titanium dioxide’s special properties impart brilliance and opacity to paints, plastics and paper, and, because it is non toxic and biologically inert, it is also used in sweets, cosmetics and toothpaste. Rutile (95 per cent titanium dioxide) is used to make pure titanium metal, which is used extensively in the aerospace and aviation industries as well as in many other applications such as artificial hip joints and spectacle frames. The high purity pig iron coming out of RBM’s furnaces goes to foundries producing ductile iron castings, which are then used in the manufacture of safety critical automobile parts such as brake callipers. Among the many applications for RBM’s zircon is the production of ceramic tiles and sanitary ware as well as TV and computer screens.

with Kings Resources, was put in hand and a thorough study of the prospect was made. In due course a small pilot plant was set up to evaluate possible mining and processing methods. At about this time, Quebec Iron and Titanium (QIT), today a wholly owned Rio Tinto subsidiary, was looking for additional ilmenite reserves and it succeeded in acquiring a stake in the fledgling venture.

According to Mike King, who took over as manager of the pilot plant soon after it was commissioned in 1973, the initial results of the geological and metallurgical surveys were not encouraging. “The heavy mineral content of the sand

dunes was low, which meant that only a large scale, and therefore costly, mining operation would make economic sense,” he recalls. “At the time we were looking upon the mine purely as a potential source of rutile and zircon: the ilmenite had too high a chromium content and would have been unsaleable without significant upgrading. But this is where QIT’s extensive knowledge of ilmenite beneficiation proved very helpful.”

The early physical conditions in the area were also far from ideal. “There were snakes everywhere and the water kept seeping out of the man made pond,” King recalls. “In bad weather people found it virtually impossible to get to work on the rough tracks and because haulage trucks experienced the same problem it was sometimes difficult to get them where we needed them on time.”

Despite all these problems, construction of a full scale mining operation, plus all the necessary downstream processing facilities, duly went ahead and now, in 2006, RBM is celebrating the thirtieth anniversary of the company’s official start-up on 1 April 1976.

Of course the company ethos has changed since those early days, says King, who when he retired in 2002 was RBM’s longest serving employee. “Richards Bay was a much smaller place in the mid 1970s. Apart from the aluminium smelter and the coal terminal, RBM was pretty much the only show in town, so we tended to make our friends from within the company – particularly as most of us were new to the area.”

“There was a strong social ‘family’ feeling back then,” agrees Peter Rowland, consultant, Process Training, who has been with RBM for 29 years. “But over the years the company has grown considerably and we have also had to become leaner and meaner in the way we work in order to respond to an increasingly competitive market place.”

All that said, RBM today boasts an enviable record of employee long service. Half of the 1,750 strong labour force has been with the company for ten years or more and one third of employees have given more than 20 years’ service.

One of the most significant developments in RBM’s 30 year history was the “Million Ton Project”, begun in June 1989 and completed in December 1992. “It was that project that really put RBM on the map by making us the largest single producer of titanium products in the world,” says Marketing general manager Pieter Scheepers. “It was by any standard a massive undertaking – we made a large number of improvements in the roasting equipment and processes, added a fourth furnace, increased the handling capacity of the slag plant and expanded our iron processing capacity.”

“But of course things don’t stand still,” adds Bruce Beath, general manager, Finance. “So we are continuously looking at and investing in new projects to enhance our operating efficiency and to



### Bringing the dunes back to life

Ben Mkhize (above) joined RBM in 1983 as a supervisor in the mining ecology department but since 2003, when the replanting and maintenance of the dunes was outsourced, he has been running his own company, Dune Rehabilitation Services

(Pty) Ltd. “We have a five year contract to supply all the labour, plants, weed and animal control operations, netting and other materials needed to reinstate the dunes to their natural state after mining operations are completed,” he says. “Our company is thriving and we now directly employ 75 people.

“It was quite a challenge making the switch from being an employee to running my own company but through its broadly based Black Economic Empowerment programme RBM is actively encouraging and training local entrepreneurs, so that made the transition relatively painless. The work we do restoring the natural environment is satisfying and rewarding and I’m very happy with the way things have worked out.”

help us deliver high quality products to our customers. And we actively involve all employees in our multi-initiative business improvement programme. However, one thing that will always give us the edge is the relatively low cost of our mining operation.”

So, after 30 years of successful operations, what lies ahead for RBM? George Deyzel, RBM’s managing director, sets the agenda. “Creating wealth for all our stakeholders, including our partners in the Black Economic Empowerment programme, in a sustainable way for the long term is key,” he says. “And mining and processing without harm to anybody is our goal.

“Our existing mines still have many years of life





left and we also have a lease on Zulti South, a site with considerable potential to the south of Richards Bay harbour. A pre-feasibility study is under way on that. Still further ahead, we have sole exploration rights on an extensive undersea tract close to the shoreline, where further mineral deposits exist.”

It seems, therefore, that although RBM's business is built on shifting sands, its foundations and its future are securely rooted.

**Colourful concentrator: spiral channels separate the heavy minerals from the sand by gravity.**

## DESERT SANDS

**The Rössing Uranium** mine in Namibia, supplier of nearly eight per cent of the world's uranium, sits at the edge of an arid desert of sand and rocks and owes its discovery to the curiosity and dogged perseverance of one man, South Africa born Peter Louw.

Back in the late 1920s, Louw would pack his wife and three young sons into the family jalopy and drive from their home in the coastal town of Swakopmund across the flat, sandy plain to the Rössing hills some 65km to the east.

“There were no roads in those days,” recalls Peter Louw's son, Graham, now a sprightly 80 year old, who with his brother, John, is still a director of the mine their father helped start. “We often had to get out and push when we got stuck in the sand.

“We used to spend hours fossicking around the hills and dry river beds, and although my father had no geological training he had a keen eye for minerals. One day, about five kilometres from where the mine is today, he came across some curious looking rocks with blackish nodules that he suspected might be pitchblende (a form of the mineral uraninite).

“We didn't have a Geiger counter but my mother, who was English and who had trained as a radiographer at Guy's Hospital in London, put the samples on a photographic plate and, sure enough, we could see the telltale discolouration caused by the radiation.

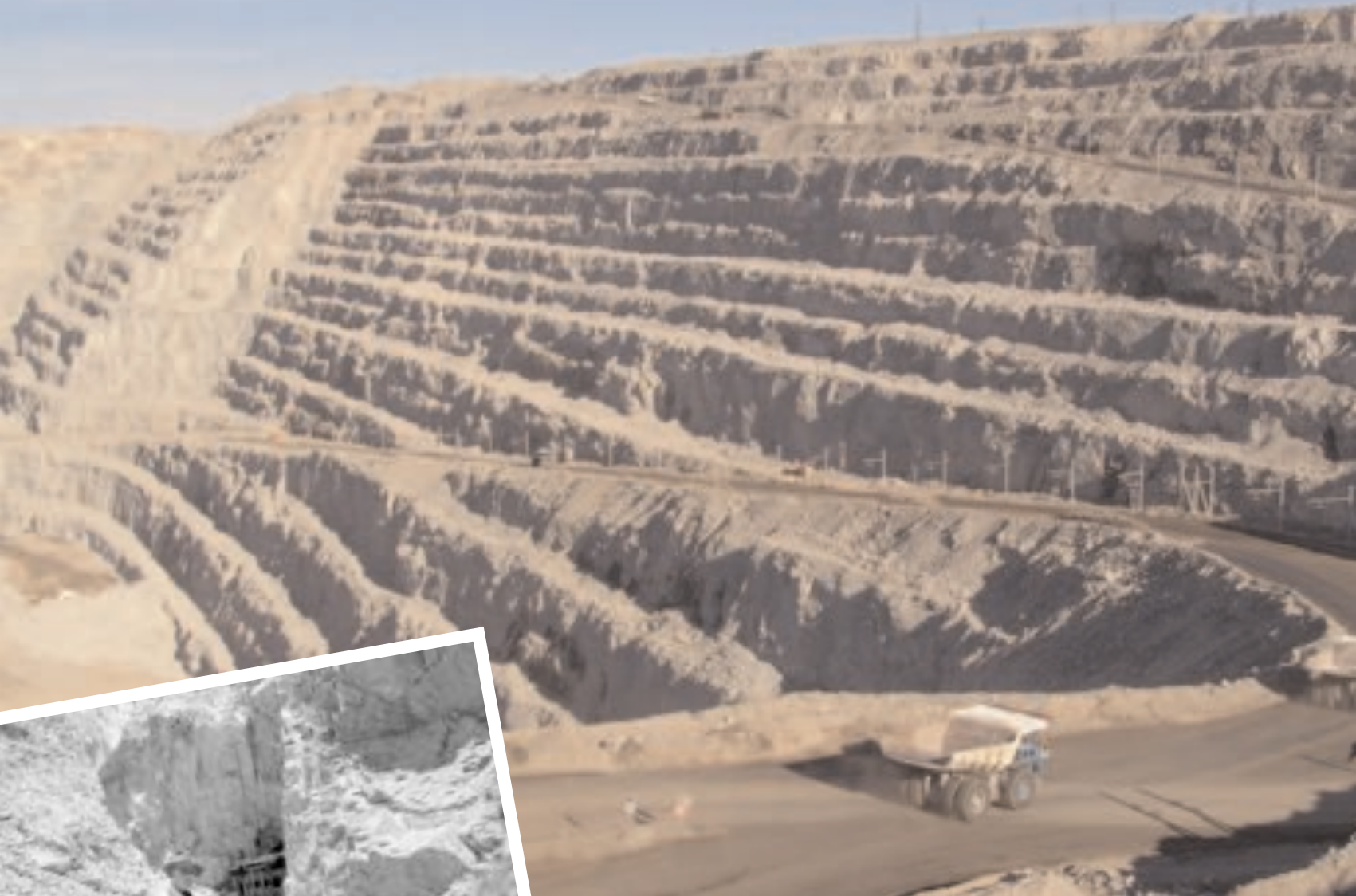
“Over the course of about a year we returned many times to the dry Khan River bed where the rocks lay, and collected the uraninite in a bag – to the point where we had virtually denuded the area of any remaining samples.”

Although Peter Louw always believed his discovery held great potential, he was not able to pursue its development for another 25 years or so. Then, in 1954, along with son Graham and two family friends, Major Archie MacLaren and a Mr Beecroft, he formed a four man syndicate which acquired the sole rights to prospect for “prescribed materials” (uranium prospecting and mining has always been strictly regulated) in a 3,100 square kilometre area which included the Rössing site.

“After all those years it took some time to pinpoint the exact location of my father's original discovery,” says Graham Louw, “but the area was eventually found with the help of a Geiger counter.”

The next step was to try to interest one of the big mining houses in the prospect. In due course the syndicate granted an option to Anglo-American, which carried out a two year investigation of the Rössing site, drilling 11 bore holes and several sample tunnels. In the end, however, the company walked away, saying that the deposit was too small and of too low a quality to make a mine economic.

The Louws and their partners were deeply



**Above: Rössing operations today and (inset) Peter Louw on the site of his original discovery.**

disappointed but they never lost heart. Over the course of the next ten years the syndicate pursued other mining houses but the word had got round that Anglo-American had given the prospect the thumbs down and this was sufficient to deter others. Eventually, though, at the third time of asking, Rio Tinto Management Services agreed to send its chief geologist, John Berning, to have a look at the site. “I think in the end they agreed to come just to shut us up!” Graham Louw admits.

Happily, Berning’s evaluation of the deposit’s potential proved to be a good deal more favourable than Anglo-American’s. “Within two weeks Rio Tinto had come back to us saying they wanted to carry out a more detailed appraisal,” Louw says. “This they did. In fact, they drilled the orebody like a pin cushion. They found that the deposit, although of low quality, was a good deal larger than the earlier survey had revealed. This made it an ideal candidate for a large scale open pit mining operation – in which Rio Tinto had a lot of experience.”

The story is taken up by John Kirkpatrick, chairman of Rössing Uranium between 1990 and 1995 and a board member since 1978, two years after the

mine opened. A lawyer by profession, Kirkpatrick has acted for Rio Tinto in southern Africa since the 1950s and recalls the excitement of the mine’s early days.

“I became friendly with John Berning and he invited me to visit the site long before the mine went into production,” he says. “To tell the truth, although the place was a hive of activity there wasn’t much to see at that stage, just bare desert and a couple of drilling rigs. John and his colleagues were living in caravans on the bank of the dry Khan River – though on one occasion all the caravans were washed away by flash floods.”

Eventually all the necessary geological mapping, radiometric surveying, laboratory metallurgical tests, underground sampling and pilot plant test work were completed and the mine – designed to produce 5,000 tonnes of uranium oxide a year – began operating in March 1976 with the first output of uranium oxide following that June.

But it was not all plain sailing, says Kirkpatrick. The abrasive properties of the granite rock containing the uranium minerals caused unforeseen wear and tear on the machinery and this, coupled with some other design problems, impaired the plant’s overall extraction efficiency. An ambitious modification programme was put in hand to remedy these problems but worse was to come.



In 1978, just as the modifications were being completed, a fire caused by a spark in a motor destroyed one of the two solvent extraction plants. “This was a very serious setback,” Kirkpatrick says. “It meant that we had to declare *force majeure* and cut contractual deliveries to our customers. But it was not too long before the plant was rebuilt and we were up and running again.”

The first sales of uranium oxide were to electricity utility companies in France, Germany and Japan. At the time, world uranium prices were buoyant, consistently running at over US\$40 a pound.

Over the years, the world market price of uranium oxide has had its inexorable impact on the mine’s fortunes. But as Mike Leech – the first Namibian national to become managing director of Rössing Uranium – explains, that has never been more true than in the past couple of years.

“Prior to 2002, spot prices had been bumping along at a dismal US\$10 a pound or less for more than a decade. Although they strengthened in 2003 and 2004, we still turned in an operating loss in those years and in 2005 we made only a very small profit. The weakness of the US dollar, the currency in which all our sales are made, was another factor contributing to our disappointing results.

“So, for a long period we were basically operating in survival mode,” Leech admits. “What’s more, at the beginning of 2005 we’d actually announced plans to close down the mine in 2009. Then, in the nick of



**Peter Louw’s son Graham, now aged 80 – still a director of the mine today.**

time so to speak, the market improvement gathered pace and today we’re seeing spot prices in the region of US\$45.”

According to Rehabeam Hoveka, general manager, Commercial, who has worked at Rössing Uranium for 20 years and so has seen two thirds of the mine’s life, there are two main reasons for this recent surge in prices. “First, there has been a reduction in the amount of secondary, that is to say reprocessed, uranium coming onto the market from Russia and other parts of the former Soviet bloc. Second, a renewal of interest in nuclear energy in a number of countries has given the market a fresh impetus, and many power utilities are buying primary supplies under long term contracts, well into the future.

“Unfortunately, there’s nothing we can do about the low quality of our orebody,” Hoveka points out. “We have to work with raw material that would be regarded as disposable waste by many of our international competitors. But what we can do is produce high volumes and so benefit from economies of scale, and we can also make sure we operate as efficiently as possible.”

The big improvement in market dynamics in 2005 prompted a fundamental reappraisal of the mine’s future and led to a decision that has put a smile on the faces of Rössing’s 900 employees. Rio Tinto approved the investment of US\$112m in new facilities that will extend the mine’s life to 2016 and possibly beyond.

About half of this sum is being spent on mining equipment – two huge mechanical shovels, 11 haul trucks plus other support equipment. Along with the mine’s existing fleet, this will be used to extend the main pit in order to give access to ore beyond the western rim. “Substantial waste removal is needed to uncover this ore,” says Leech, “and to handle this task we’re investing in what is essentially a second mining fleet.”

The other half of the new funds will be used to refurbish the processing plant, whose originally planned lifespan was 20 years rather than the 30 years it has already served.

After several lean years, a mood of optimism now pervades Rössing Uranium. “If survival was the name of the game in recent times, our watchword today is growth,” says Mike Leech.

“We can celebrate our 30 years of operation with a sense of pride and accomplishment rather than with one of foreboding. The market outlook remains good and I’m confident that the difficult years at Rössing are now behind us.”

So, the story begun when Peter Louw first stumbled on radioactive rocks on a family outing way back in the 1920s looks set to run and run.

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