



Small scale mining – a balance between men and mechanisation

by Hans Gustafsson

For almost 50 years Uis mine, one of the world's largest open cast, hard rock tin producers, has been in operation in the desert of western Namibia. In the early 1990s the mine closed down and the community in Uis faced severe problems. Legal, safe and economically sustainable small scale tin mining might be one alternative for the future of Uis. The following articles, originally presented at a November 1996 seminar held in Windhoek, describe the Uis pilot project and also give a summary of the South African small scale mining situation.

Mining of tin has taken place in and around Uis in the Namib desert over the whole 20th century. Cassiterite (SnO_2) is found in pegmatite intrusives over vast areas. However most of the pegmatites are narrow and the tin content is fairly low. Some areas of wide pegmatites are concentrated in Uis making it possible to open large scale mining.

Before the 1950s mining took place in small scale operations run by prospectors who employed local black workers. When price on tin rose after 1950 investments could be made in some mechanisation. Remnants of these old plants are found on many sites around Uis.

After the second world war the tin price was varying between 8–10 000 USD/ton. The South African steel company Iscor (in Namibia named Imcor) at that time made the decision to invest in a large scale mining operation in Uis to supply tin to the South African steel industry. The investment appeared to be well timed as the tin price continued to rise steadily for about 30 years.

However in the 1980s the price collapsed. The price fell from more than 18 000 USD/ton in 1980 to about 6 000 USD/ton in 1986. Imcor tried to survive by increasing the capacity but in 1990 the operations closed and about 450 workers lost their jobs in an area where no other industry was at hand.

When the production closed the Imcor mining equipment and concentration plant were of good international standard. Mining was carried out in large open pits with modern equipment for drilling, loading and hauling. The concentration plant included large and modern equipment of its kind. However the tin price was evidently too low to make the operation viable. Imcor decided to close the mine.

The average ore production the last three years of operation 1987–1989 was 950 000 t/yr.

The average grade of the ore mined was 0.135 per cent Sn.

The average production of tin concentrate in 1987–1989 was about 1 600 t/yr. Additional 100 t/yr was produced by some 800 micro scale miners.

The productivity of the Imcor operations with 450 employees was 3 800 kg of concentrate/year and employee equal to 14 kg concentrate/day and employee.

The international price on tin averaged 6 000 USD/t in 1987–1989 or about 3 500 USD/t concentrate (67 per cent Sn) including reductions for smelting costs and transport. This corresponds to 15 ZAR/kg of concentrate on the exchange rate of 4.3 ZAR = 1 USD.

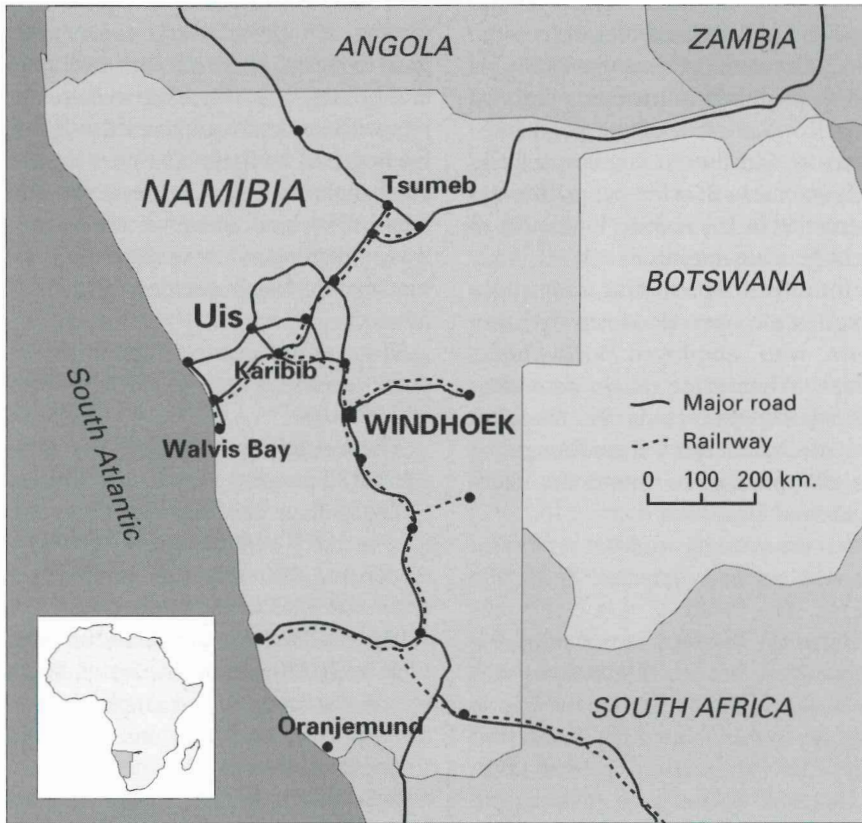
Imcor encouraged artisanal miners during many years to supply concentrate to Imcor by servicing them with free drilling and blasting. In the peak years of

Small scale mining – experiences from a pilot project in Uis

Some 50 persons representing all stakeholders in the small scale mining sector in Namibia and South Africa attended the international small scale mining seminar held in Windhoek, Namibia November 27th 1996. In his opening address the Namibian Minis-

ter of Mines and Energy A. Toivo ya Toivo thanked the Swedish International Development Cooperation Agency (SIDA) for making funds available to undertake the pilot project in Uis as well as to organise the seminar.

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1987–1989– artisanal miners delivered up to 100 tons of tin concentrate/yr giving employment to several hundreds of miners, men and women.

Micro scale mining, wind panning

A considerable number of people have been involved in micro scale mining in the vicinity of Uis. Informal tin mining has long tradition in Uis and in the early 1980s as many as 800 people worked as micro scale tin miners around the Imcor mine, selling their concentrate to Imcor. It was in the interest of Imcor to add more concentrate to their production.

In 1992 Imcor decided to withdraw completely from Uis which meant that no more services were given to the micro scale miners. Imcor however continued to buy concentrate until 1995 when all installations were dismantled and sold out.

The decision of Imcor to withdraw from Uis gave the result that the production from the micro scale mining in Uis decreased drastically. In 1994 only 2–3 tons of concentrate was sold compared to about 100 tons in the peak years.

This was the reason why in 1992 the remaining micro scale miners, a core of them being women, organised and sent off a request for support from the Ministry of Mines and Energy. At the ministry a strategy to develop the whole small mining sector of Namibia was designed. Swedish funding was se-

cured and the Raw Materials Group (RMG) of Stockholm started a project with the ministry to support micro scale mining. The project was initiated in 1993.

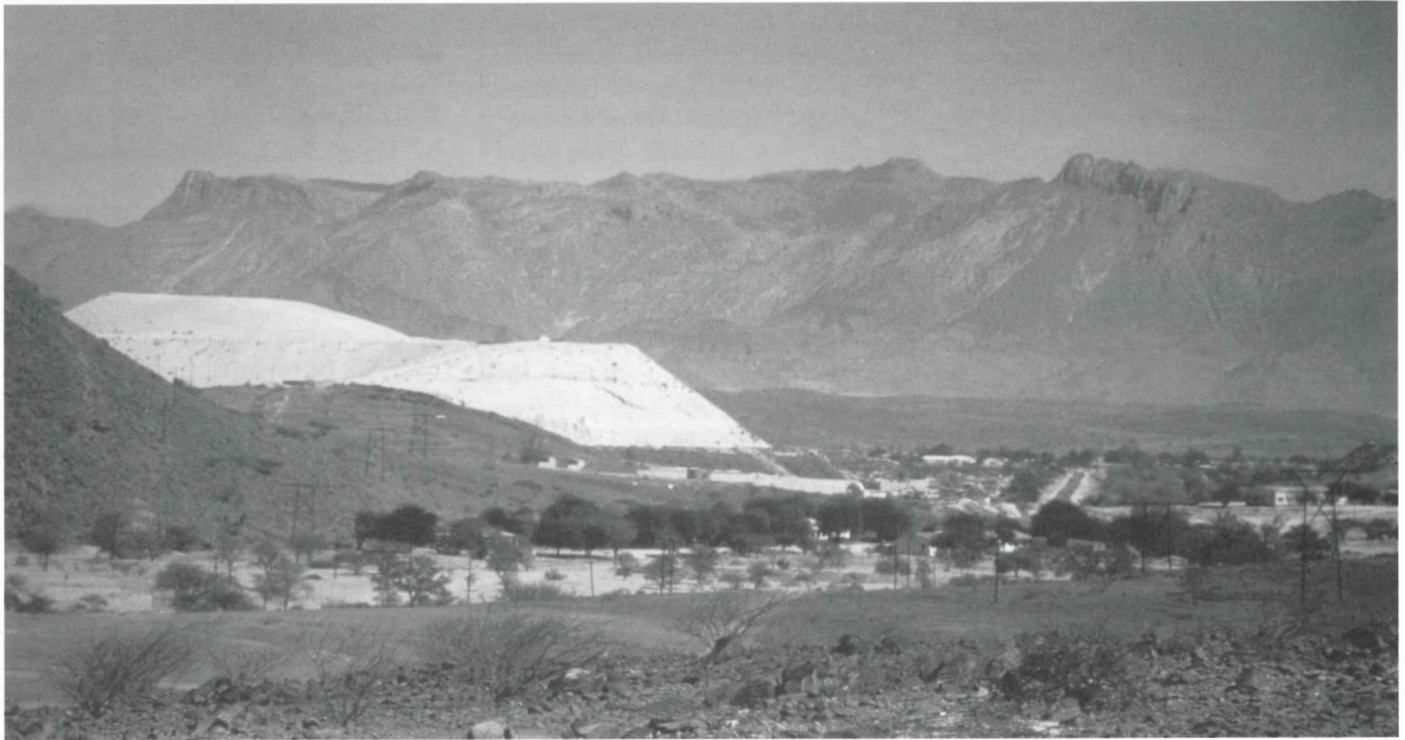
The final set up of the project came after lengthy discussions with the micro miners and with the ministry. Agreements were made on the following points:

- The project should start as a pilot project with 25 micro scale miners, half women half men.
- The micro miners to be selected by the Tinkappers, the local micro scale miners organisation.
- Overseas expertise to be used as sparsely as possible. Local management to take all responsibilities.
- A supervisor with a blasting licence to be recruited knowledgeable of the local Damara language.
- The micro miners know how to be used as much as possible.
- Training of key personnel to be organised.
- Equipment to be acquired locally when possible.
- Prospecting and mining concessions to be owned by the project.
- Environmental impacts to be minimised. The Ministry of Tourism and Environment requested an Environmental Impact Assessment to be carried out.
- The organisation of the project to be some sort of cooperative.
- The project to have a time limit of two years. SIDA (Swedish International Development Cooperation Agency) secured funding for two years.

Small scale tin mining in Uis – key data 1996

- * Number of jobs 100 – 150
- * Investment per job 3000 – 4000 NAD
- * Annual output 15 – 20 ton tin/tantalite concentrates
- * Annual income 1500 – 2000 NAD per miner
- * Total investment 600 000 NAD
- * Job potential 200 – 300 in Uis and surroundings

*Vis tin mine under
the Brandberg silhouette.*



- After two years the project should be sustainable.
- Equipment requested for the first phase was specified by the micro miners and was acquired in late 1994. The equipment included: one compressor, two rockdrills and two breakers, wheelbarrows, shovels, picks and hammers, personal safety equipment, one diesel powered jaw crusher (was donated by Imcor to the project) and one four wheel drive pick-up.

It proved to be difficult to get hold of explosives and the blasting services were supplied by a contractor until an explosives magazine was constructed in early 1996.

Intensive prospecting was carried out by the RMG geologists and a mining area was selected. Mining commission was obtained in late 1994. The initial sampling showed that the average tin content of the mining area was 0.15 per cent Sn. Mining started in early 1995.

The micro miners showed to be good prospectors and very soon took the initiative on where and how to mine. When

mining had been going on for a number of months and had reached a steady state time studies were carried out.

Mining was carried out in the following manner:

1. Loosening the rock by blasting or by braking with pneumatic hammer.
2. Preconcentration by manual cobbing with pick and hammer.
3. Transport by wheelbarrows to jaw crusher.
4. Crushing to pass a sieve of 2–3 mm. Repeated crushing with a second crushing plate in between the jaws.
5. Wind panning for concentration was done by the women. It could start only when the wind picked up around mid-day.

Careful evaluations were carried out over the first phase of the project, following up investment costs, running costs and productivity. The costs were compared to the projected tin price. It became evident that the break even point of the project needed a productivity of about 1 kg of concentrate per worker and day. To cover the costs and give the miners an in-

come of about 150 NAD/month the productivity would have to raise to about 2 kg/worker and day. The calculations were based on a tin price of 6.75 NAD/kg concentrate (63 per cent Sn).¹

Time studies were made on the following set up:

One day operation: 6 hours effective working time. Number of workers: 19 (9 women). Equipment: 1 diesel jaw crusher. Pre-concentration by cobbing: 0.15 to 0.25 per cent. Crushing from 100–200 mm to 2–3 mm by repeated crushing 4–5 times. Total crushing time: 4 hrs. Total crushed volume: 0.42 m³ or 0.85 ton. Total panning time (9 women): 4.5 hrs. Total production: 14.0 kg of concentrate (63 per cent Sn). Productivity: 0.74 kg/day and worker or 0.19 ton/yr and worker.

Some notices made during the day of the time studies: the wind was picking up at 11 am and panning started, the air temperature was hot, the sky was blue, the production group was working very efficiently, productivity could not increase much from 0.74 kg/day. On the contrary it

does not seem very likely to have 250 days in a year with such high productivity.

The conclusion was that the project could not become viable with the set up at that time.

Market studies had shown that the minimum volume of tin concentrate that could be sold was 10–20 tons per shipment or 40–80 kg/day production if shipment was to be made once a year. The relative costs per ton concentrate will increase with lower volume. Wind panning with one crusher and 25 micro miners will give maximum 20 kg of concentrate per day.

All in all – some changes had to be introduced. Some mechanisation of the concentration operation was the obvious part to start with as the wind panning operation was the main bottle neck.

Micro scale mining, concentration plant

Erecting a concentration plant does not necessarily mean investments in a conventional plant with crushers, jigs and tables. This would cost 100–200 thousand USD and was financially impossible.

Initially dry concentrators were evaluated: A Belgium company manufactures a dry gravimetric table which appeared interesting. However the price, about 100 000 USD, was too high for the project budget.

From the financial point of view a Dry Washer developed for dry alluvial gold mining in the USA looked more interesting. US Bureau of mines supplied drawings and we were about to have a prototype made in Windhoek when a local contractor of Uis came with an offer.

As has been mentioned previously small plants with jigs and tables for tin concentration had been erected around Uis in the good days before 1980. Water had been supplied by trucks if no water was available. All of these plants were now dismantled or rusty monuments of times passed.

However there are still old prospectors left in Uis who know about small scale tin mining. One of them came with an offer to the project to erect a plant with a capacity of 20–30 tons/day. He claimed to have most of the equipment in his backyard. He came up with an offer that

The newly set up drilling team.

we could not resist even if the calculations appeared very optimistic. It might be the solution. For a total sum of 71 000 NAD (17 000 USD) he offered to supply a turn-key plant including one primary crusher. The project's jaw crusher to be equipped with an electric motor, one secondary hammer mill crusher, one single deck vibrating screen, one duplex jig, one James table, one borehole pump, non corrosive, two Warman pumps, three conveyor belts, switch gears, electric cables and meters, drying floors for the concentrate, security fence, steel constructions and roof for jig and table and lights on poles for the area.

All equipmen was to be supplied with new or rewound electric motors. All equipment and steel constructions were to be sand blasted and anti-rust painted.

The functioning of the plant was guaranteed at an production level of 20 t/day to the primary crusher on two shifts.

A survey at the contractors backyard only confirmed that the equipment was rusty and it merely gave the impression of a scrap yard. The contractor however had a good reputation and was a good craftsman. After some detailed discussions with him it was decided to accept the offer. One contributing factor for the decision was that the project manager at the ministry had long experience of project management and could give close supervision of the construction.

The erection of the plant started late 1995. Operations were planned to start in March 1996.

A number of difficulties came up, the main one was the optimistic calculations as was anticipated and the time schedule could not be kept. However the installations completed were of high professional standards and carried on with compromises on price and time schedule. The plant was finally completed in May 1996 at a costs of 91 000 NAD (21 000 USD).

The plant is functioning well besides dust from the secondary crusher and process water supply. Shortage of water



was caused by the lack of a recirculation circuit and the plant therefore could run only about 4 hours per day. Recirculation of process water would solve the water issue and is presently taken care of. The plant is scheduled to be ready for two shift operation in February 1997. The total costs of the plant will be 110 000 NAD (27 000 USD).

The plant has been running from May til December 1996 without major stops besides water shortage. It has been in operation 3–4 hours per day, 5 days a week. Besides the problems mentioned only regular exchange of hammers to the hammer mill have caused production stops.

Training of the crew was going on during the erection and the plant has been run by the local Damara crew from the start in May. Also maintenance and most of the repairs are taken care of by the crew. Welding and electrical maintenance is still carried out by the contractor.

Production statistics from November gave the following average results: precobbed ore through the primary crusher 3.2 t/hour production of tin concentrate 6.6 kg/hour concentrate recovered per ton precobbed ore 2.1 kg/t

A planned production on two shifts, estimating 12 effective hours on 16 hours operating time: ore through the primary crusher 38 t/day production of tin concentrate 80 kg/day

The turn-key plant was guaranteed to produce 20 tons on two shifts per day.

It is estimated that the present crew of 25 micro miners for mining and cobbing will produce 10–15 tons of cobbed material per day. To produce 40 t/day there is a need of 65–100 micro miners.

Five workers are required for one shift plant operation. For two shift another 5 workers are required.

Say a total of 80 micro miners could produce 80 kg of concentrate per day.

Cost calculations made give a positive cash flow at a production of 50 kg of concentrate per day and a tin price of 10 NAD/kg (63 per cent Sn). Price offers on

this level has been obtained from smelters if regular deliveries will be made with 10–20 tons per shipment.

Summary and discussions Big scale tin mining in Uis with a production of 950 000 ton/year, 3 800 ton/day and a productivity of 14 kg/day and employee did not give a positive cash flow in 1990 when production was stopped. The tin price at that time was about 6 000 USD/ton or 15 NAD/kg concentrate at site.

Micro scale mining in Uis with wind panning for concentration was calculated to give a positive cash flow at a productivity of 2 kg of concentrate per micro miner and day at a calculated price on tin concentrate of 6,75 NB/kg.

The productivity obtained was maximum 0,75 kg/day and micro miner. With this productivity a positive cash flow will be reached only at a minimum price on tin concentrate of about 18 NAD/kg.

With the only portable crusher available the maximum production was estimated at 3–4 tons per year.

Micro scale mining in Uis with a concentration plant for concentration is calculated to give a positive cash flow at a production of 50 kg/day of tin concentrate at a price of 10 NAD/kg. The tin price in 1996 was average 6 000 USD/ton.

Production statistics of the operation with a calculated crew of 80 micro miners give an estimated production of 10 000 tons/year of cobbed ore and 80 kg/day or 20 ton/year of tin concentrate. The production is thus calculated to be viable with the assumptions given.

The results show that investments in big scale equipment is not always the way to get a mining operation viable. The main reasons are the ever increasing costs for modern equipment and skilled personnel. The difference in salary between skilled personnel and local unskilled workers in Uis is at least 1 to 20. The difference in cost between new and second hand equipment in Uis is 1 to 10 for a turn key plant. Therefore a minimum use of skilled personnel and no in-

vestments in sophisticated new equipment might give new life to old mining areas like Uis in Namibia.

Devaluation of the Namibian dollar also favour local second hand equipment and local employments. In 1988 1 USD = 2 ZAR. In 1996 1 USD = 4.3 NAD = 4.3 ZAR

The low price on tin normally gives no room for new investments in Namibia. However besides tin also tantalum and niobium occur in varying degree in the pegmatites around Uis. Especially tantalum is interesting with a price of 10–20 times that of tin. The project has negotiated with one smelter to pay also for tantalite in the tin concentrate which will improve the cash flow. Some tantalite rich pegmatites have been surveyed and the project is currently planning to start test mining one site in the near future.

Note

1. 1 Namibian Dollar (NAD) = 1 South African Rand (ZAR). 1 NAD = 4,3 USD ■