

# **THE HISTORY OF MINING IN THE BARBERTON GREENSTONE BELT, SOUTH AFRICA, WITH AN EMPHASIS ON GOLD (1868 – 2012)**

By

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## **Abstract**

Although gold was known in various parts of southern Africa prior to 1868 it was only after the De Kaap Goldfields were discovered around 1882 that South Africa became a significant destination for gold prospectors from around the world. Alluvial gold was first found in streams draining the eastern escarpment regions and this was followed eastwards into the malarial- and sleeping sickness-infested Lowveld. Lode gold discoveries in the Makonjwa Mountains led to the founding of the town of Barberton in 1884 and the recognition of the Barberton Goldfields as an important source of the precious metal. The colourful early history of the gold discoveries in the Archaean volcano-sedimentary successions of the Barberton greenstone belt, which straddles South Africa and northwest Swaziland, is outlined with reference to historic photographs depicting early mining activities in the district. The resourcefulness of the intrepid pioneers who prospected this hostile region and who subsequently set the stage for the discovery and development of the Witwatersrand Goldfields from 1886 onwards is recounted. Despite gold being the principal target of the early pioneers, other mineral discoveries were made that contributed to the Barberton greenstone belt being regarded as a favourable mineral exploration region. These included the discoveries of significant chrysotile asbestos, iron ore, magnesite, talc and barite deposits as well as some occurrences of unusual semi-precious commodities such as verdite and buddstone. Gold mining has continued almost uninterruptedly up to the present day – a period of close on 130 years. New discoveries are still being made and old deposits are being re-investigated as techniques of mining and extraction improve. These developments and the recent discovery of a nickel-sulphide deposit associated with an old talc mine suggest that mining activities in the Barberton greenstone belt are set to continue well into the foreseeable future.

## **Introduction**

The early history of gold prospecting and mining in South Africa has received attention from numerous authors dating back to the early 19<sup>th</sup> century, but many who have written about the early days of adventure and discovery have produced mainly entertaining stories that are at times distorted by hearsay and embellished by fabrication and conjecture. No accounts exists that can be regarded as entirely factually reliable. The first mining of gold was undertaken by the ‘ancients’, but just who these people were can only be speculated upon. There have been suggestions that the early miners came to southern Africa from about the 3rd century A.D., some coming from India and others from biblical or Arab regions with obscure links to the Queen of Sheba and King Solomon (Summers, 1969). By the time the first European explorers arrived in southern Africa during the 19<sup>th</sup> century many ancient gold workings had been abandoned and largely forgotten. In 1886, Carl Mauch, a German geologist, confirmed that the old diggings seen a year earlier by the elephant hunter Henry Hartley, were indeed ancient gold workings. Between 1868 and 1870 further gold discoveries were made by Mauch and Messrs. Button, Pigg and Sutherland in the Olifants River area, as well as in the Murchison greenstone belt, and in the Pietersburg greenstone (schist) belt at Eersteling and Marabastad.

Other reports of gold in South Africa, principally in alluvial geological settings, had been made prior to the exploits of Mauch and his contemporaries, but none of these resulted in any serious mining activities. Gold discoveries dating back as early as 1834 are listed by Handley (2004), many of them being in the vicinity of the Witwatersrand Goldfield, which was reputedly discovered in 1886 by George Harrison and George Walker who found the Main Reef on the farm Langlaagte. The Witwatersrand discovery has also been the topic of much debate as there are those who vehemently support the discoverer as being Fred Struben in 1884 (see “Pretorius’s list” of gold discoveries in South Africa - in Handley, 2004).

### **The Pietersburg and Pilgrim’s Rest Goldfields and Other Early Discoveries Along the Transvaal Drakensberg Escarpment**

The first gold mined in the then northern Transvaal (now the Limpopo Province) came from Eersteling in 1871 (Baines, 1877; Hall, 1908; Willemse, 1938). Saager and Muff (1986) described the gold ore as consisting of (1) quartz veins with disseminated gold or enrichments at the contacts between veins and wall rocks; (2) impregnated gold-bearing schists in extensive shear zones within the mafic lavas; (3) gold occurring in sulphidic banded iron formations and as supergene enrichments in the weathered zones of these rock types; (4) gold associated with thin quartz stringers and veinlets in structurally deformed banded iron formation (as at Marabastad); and (5) alluvial diggings that yielded gold nuggets, one reportedly weighing 2.4 kg. At first the gold ore was crushed by a 500 kg boulder (later exhibited at the Geological Museum in Pretoria, Figure 1). A steam-powered stamp mill was introduced later, which resulted in a 16 m-high smoke stack being erected on the site that is today a National Monument (Byron and Barton, 1990; Norman and Whitfield, 2006, Figure 2).



**Figure 1.** (left) Painting thought to be by Thomas Baines (1820-1875) of a scene in South Africa depicting the crushing and panning of gold-bearing ore.

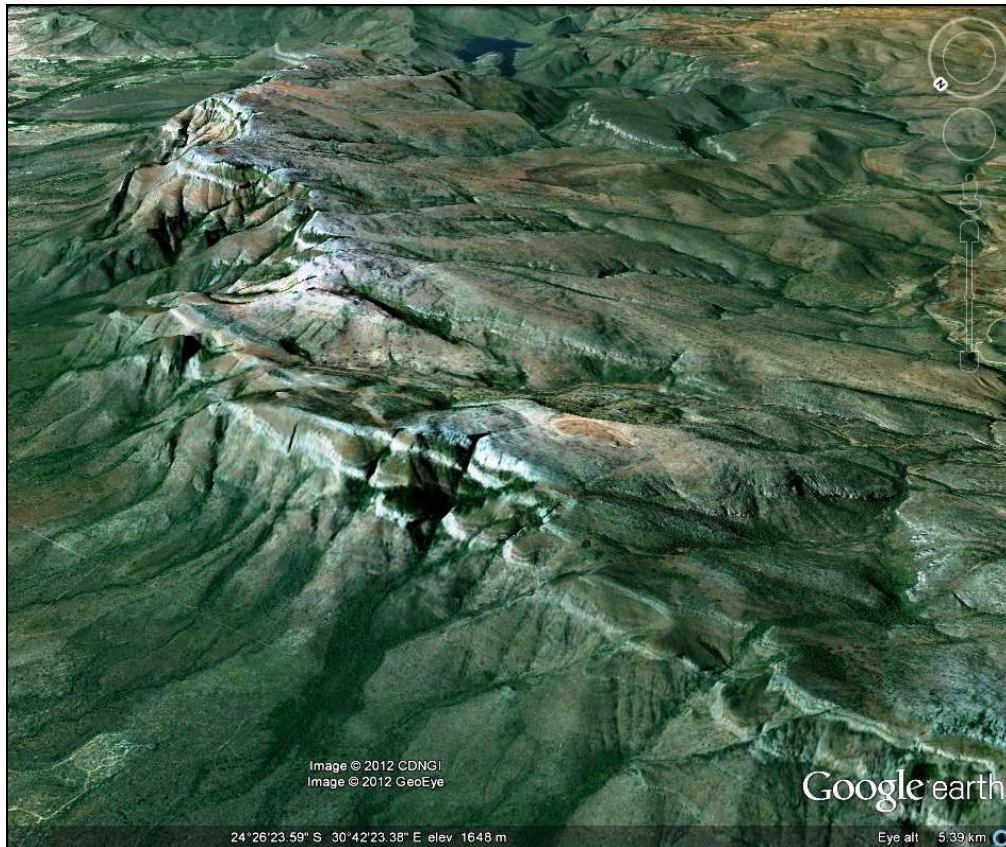
**Figure 2.** (below) Smoke stack built in about 1872 at Eersteling – the site of the first gold mining in the then northern Transvaal.



Records of early gold production for the Eersteling Goldfield were never very extensive or reliable. Byron and Barton (1990) reported 320 kg of gold having been produced between 1906 and 1937. The activity in the area in the early 1870s soon waned and prospectors began searching for gold in the rivers along the Great Escarpment to the east of Eersteling (Figure 3). The first discoveries of alluvial gold were made in 1872 by Messrs Parsons, McLachlan and Valentine and led to the first gold rush in the Transvaal attracting diggers from Australia, America and elsewhere (Ward and Wilson, 1998). Gold was found in



the upper reaches of the Blyde River in September 1873 by Alec “wheelbarrow” Patterson, near what was to become the centre of the Pilgrim’s Rest gold mining district (Hall, 1910). The early discoveries were of gold nuggets in alluvium, including the 3.6 kg Nellmapius nugget, the 3.7 kg Lilley nugget and the 6.6 kg Breda nugget (Cartwright, 1961). The alluvial diggings soon gave way to the primary sources of the gold and ore bodies or “reefs” were mined from stratiform gold-quartz-carbonate sulphide veins in dolomitic rocks of an early Proterozoic succession of rocks that came to be termed the Transvaal Supergroup. An estimated production of about 200 t of gold are believed to have been recovered from the Pilgrim’s Rest Goldfield making it the third largest gold-producing area in South Africa after the Witwatersrand and Barberton Goldfields (Ward and Wilson, 1998).



**Figure 3.** Google Earth image, looking south, of part of the Great Escarpment (Transvaal Drakensberg Escarpment) between the Blyde River and the Sabie-Pilgrim’s Rest area, where early prospectors discovered gold in the rivers draining the area in about 1873.

Alluvial gold mining in the Pilgrim’s Rest-Sabie-Bourke’s Luck area began declining and underground operations took over as prospectors started moving away in search of greener pastures. This eventually led to the diggers making their way southwards to the Elands and Ngodwana river valleys, and reaching the plateau on the Drakensberg escarpment where the village of Duiwels Kantoor (Devil’s Office) was established. Alluvial gold was discovered at Duiwels Kantoor in 1882 and the village was renamed Kaapsche Hoop (High Dutch). Today the village is known as Kaapsehoop. The gold along the escarpment was initially recovered from the basal conglomerate of the Black Reef Quartzite Formation, an ancient placer deposit at the base of the Transvaal Supergroup, but some gold also occurred in quartz veins associated with a prominent dyke in the area known as the Barrett’s Berlin Dyke. A nugget weighing 175 oz was found at Kaapsehoop in 1912 (Curror, 1967).



## The Barberton Goldfield

As with the earlier-mentioned gold discoveries, the gold at Kaapsehoop soon declined and people again began moving on in search of new places to seek their fortunes. Early in 1882, alluvial gold was discovered in the valley below the escarpment by Jim Murray and Ingram James. These diggers and a few others, including Harry Culverwell and Auguste Robert (French Bob) pegged claims in the area along the Noordkaap river valley and a diggers town with tents and shacks, known as Jamestown (named after Ingram James and James Murray), was established after a rush of diggers into the area (Figure 4). This was the first European settlement in the Lowveld. James Murray's partners were Bob Watson and Tom Elsie, whose wife was the first white woman on what became known as the De Kaap Goldfields. Their daughter, Nugget, was the first white child to be born in the De Kaap Valley (Curror and Borman, 2002). A gold nugget reportedly weighing 58 oz was found by Tom Meikle (who subsequently became famous and wealthy in Rhodesia - later named Zimbabwe).

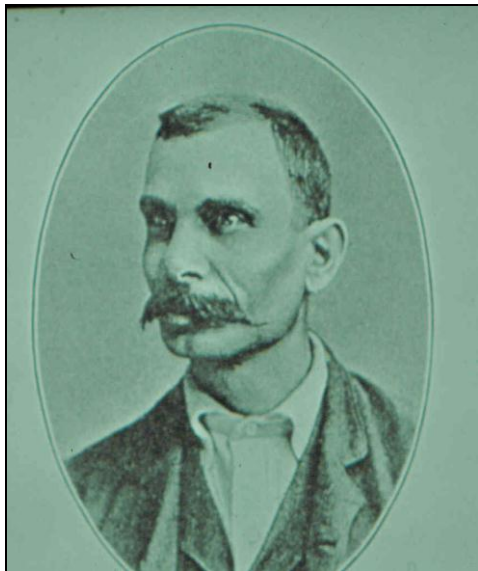


**Figure 4.** Alluvial gold mining in the Jamestown Schist Belt near the Noordkaap River (ca 1873).

Other prospectors, including Augustus Lindley in 1868, Tom McLachlan in 1874 and some Australian diggers in 1875, ventured across the Barberton (Makonjwa) mountains to northwestern Swaziland, but were unsuccessful in finding gold. In 1881 Tom McLachlan eventually found alluvial gold between Popinyana Creek and Pigg's Peak, a town in northwest Swaziland that was established following the discovery of a mine in the area by William Pigg in 1884. Later, in the same year, Alex Forbes and C.J. Swears found the Forbes Reef deposits south of Pigg's Peak.

Following the gold rush to the De Kaap Valley conditions deteriorated in the Jamestown area (malarial fever and sleeping sickness claimed many victims) and this led to French Bob, James Ingram and Jim Murray moving across the valley to higher ground where they continued prospecting on Moodies Estates. French Bob first found alluvial gold in

Concession Creek in May 1883, and on 3<sup>rd</sup> June of the same year discovered the Pioneer Reef, on the farm Oorschot (part of Moodies Estates) - the first payable reef gold in the mountain land (Figures 5 and 6). Once again a large number of prospectors were attracted to the Moodies area and Curror and Bornman (2002) describe some of the phrenetic activity that took place in the area as new deposits were located. A small mining settlement grew in the area known as Blandtown, after Benjamin Adam Bland (this settlement was later absorbed into Barberton as the township expanded westwards).



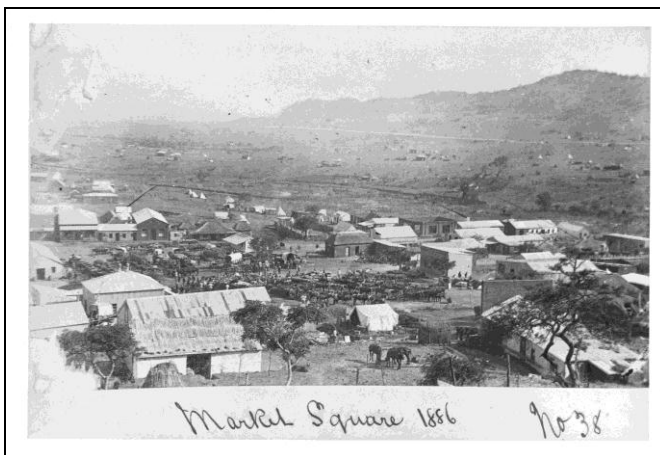
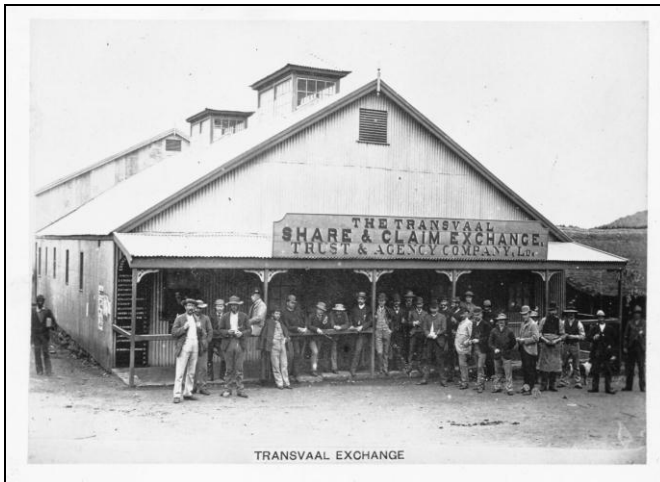
**Figure 5.** (left). The Frenchman, Auguste Robert, better known as French Bob, the discoverer, in June 1883, of the first payable lode gold in the Moodies Hills southwest of the present-day town of Barberton.

**Figure 6.** (below). View of the Moodies Hills southwest of Barberton showing the mine workings of the Pioneer Reef, the first lode gold discovered in the Barberton Mountain Land in June 1883.



Further to the east prospectors, including the Barber and Rimer brothers found reef gold in creeks leading out of the mountains to the south and their discoveries led ultimately to the proclamation of the town named Barberton in June 1884 (the name derives from the brothers Fred and Harry Barber and their cousin Graham). The colourful early history of the town is recorded in several publications, principally those of Curror (1967), Meiring (1976), Curror and Bornman (2002) and the Staff of the Barberton Museum and Hans Bornman (1984). Some old photographs of the town are shown in Figure 7.





**Figure 7.** (top) View of Pilgrim Street ca. 1885.

In the background is Rimer's Creek in which gold was discovered by James Rimer and the brothers Fred and Harry Barber and their cousin Graham, after whom the town of Barberton was named. On the far left is the first double story building in the Transvaal, known as the Lewis and Marks building, which is still standing today.

(centre) The Transvaal Share & Claim Exchange, the first stock exchange in the Transvaal. This was destroyed by fire in 1887 and was replaced with a new building the façade of which is preserved as a National Monument in Barberton.

(below left) A view of early Barberton (1886) looking northeast and showing the Market Square in the foreground.

Prospectors roamed the hills around the town of Barberton and many new discoveries were made. In May 1885 Edwin Bray's discovery of the Golden Quarry (Figure 8) changed matters dramatically and the Barberton Goldfield became known worldwide, attracting fortune hunters from North America, Europe, Australia and elsewhere.



**Figure 8.** View east down Sheba Creek. Edwin Bray's Golden Quarry (below trees in centre of photograph) is situated on the slopes of the southern limb of the Eureka Syncline. The Sheba 'Bar' (Sheba Fault) forms the steeply dipping feature to the right of the quarry. Eureka City developed as a mining township on the hills to the left (top left where trees mark the locality).

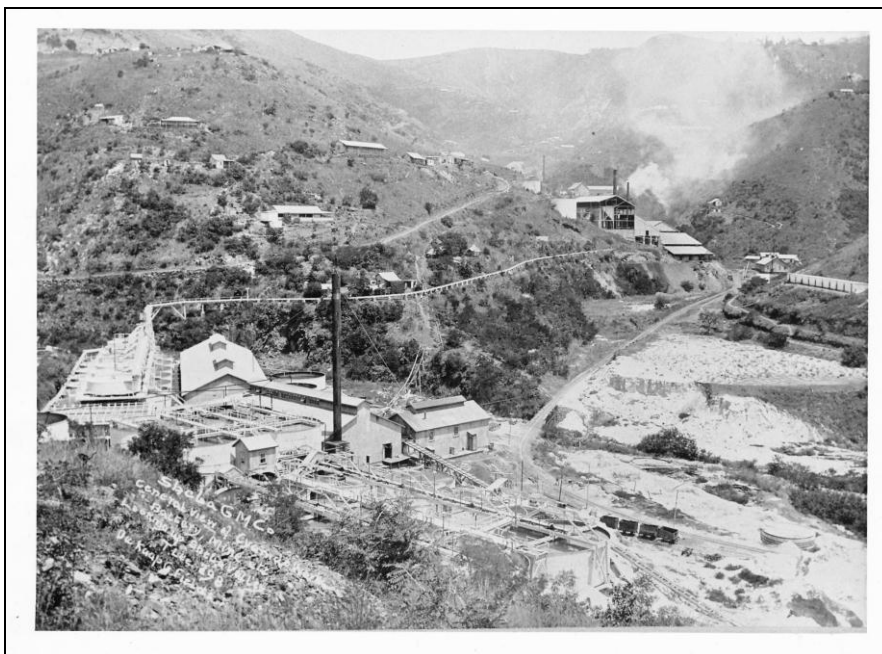
Gold was discovered in a variety of settings and over 350 gold workings or prospects were eventually recorded (Groeneveld, 1975; Anhaeusser, 1986a). Many of the operations were short-lived as the gold occurred as supergene enrichments that in places gave bonanza grades, and where visible gold was a common occurrence (the Lily gold mine provided a good example of this type of occurrence; Anhaeusser, 1986c). These deposit types generally gave way at depth (or below the water table) to ores containing a wide variety of sulphide minerals (De Villiers, 1957) that were not free-milling and which could not be easily extracted at the time. Many prospectors became disillusioned and abandoned their operations or left the goldfield on hearing of the discovery, in 1886, of the Witwatersrand Goldfield, which appeared to offer more sustainable prospects. Those that persevered in the Barberton area were rewarded to some extent by forming syndicates and by amalgamating their claims into larger operations.

The gold discoveries in the Sheba Creek were particularly exciting (Figures 9 and 10) and led to three small settlements in the area. The most colourful of these was Eureka City, established on high ground above the mining activity in the valley below (Figure 11). This camp enabled its inhabitants some respite from the heat and malaria that was rife in the lower-lying countryside.

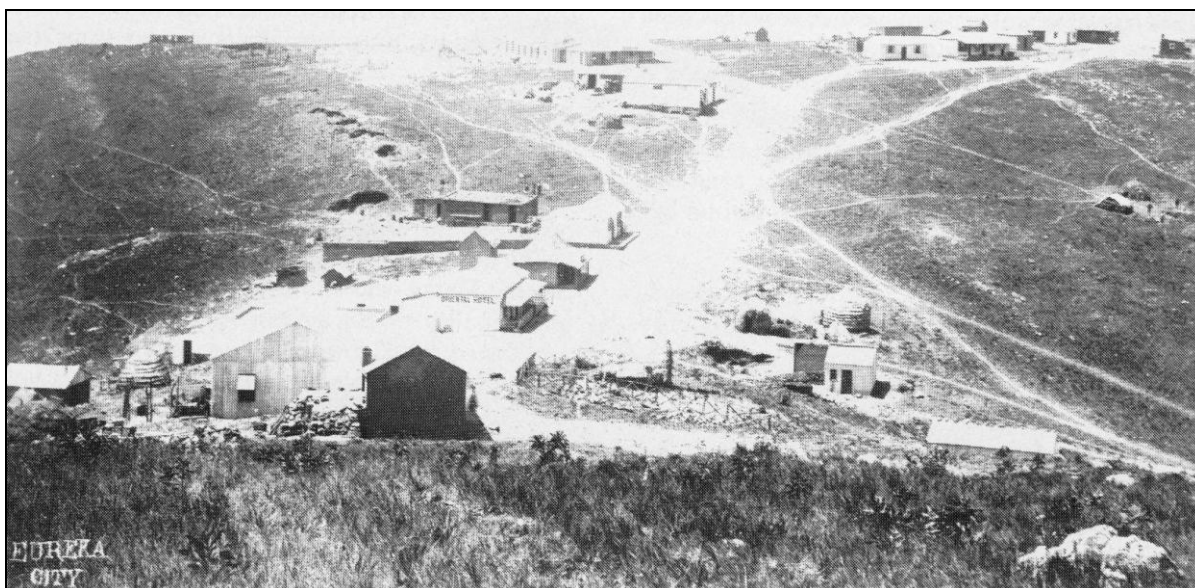




**Figure 9.** View looking east down Sheba Creek showing the intense mining activity associated with the Sheba Gold Mining Company and other properties in the area (ca. 1990). The Golden Quarry is on the hill slope on the top left of the photograph.



**Figure 10.** View looking west up Sheba Valley showing the mining activity and gold recovery plants in the area of the Sheba Gold Mining Company (ca. 1990).



**Figure 11.** View looking northeast towards the early mining camp known as Eureka City, built high on hills of the Eureka Syncline and north of the mines in Sheba Creek. The position of the mining camp high in the mountains offered the inhabitants some relief from the heat and malaria occurring in the lower lying countryside.

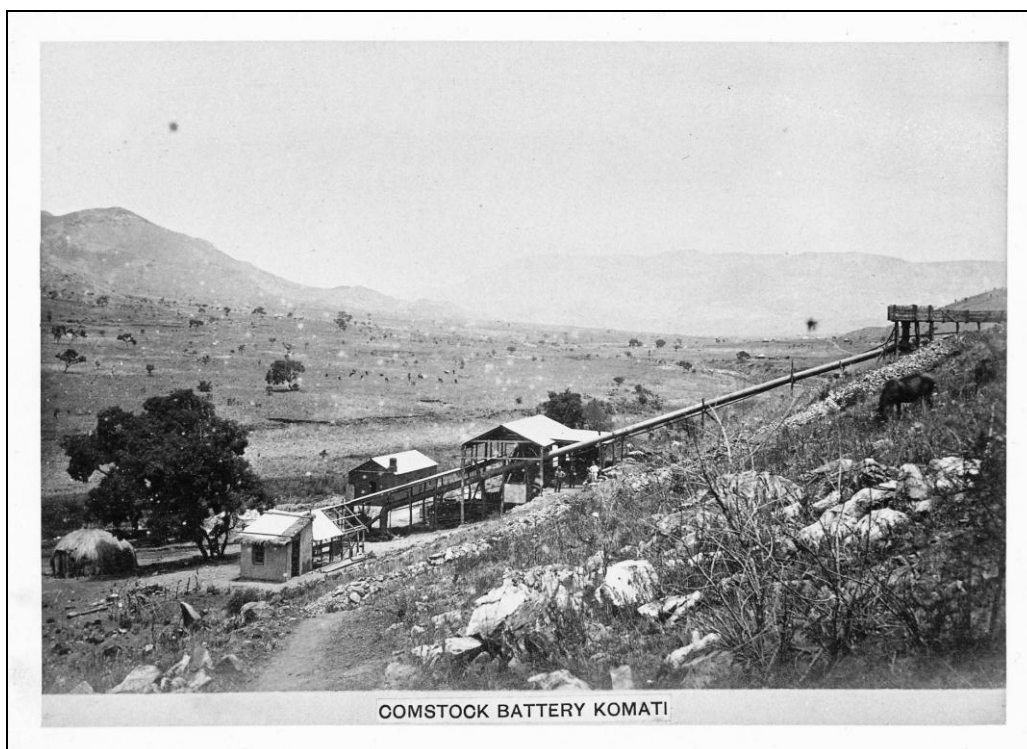
A second small settlement, Charlestown, developed in the area near the confluence of Sheba Creek and Fig Tree Creek. This was also the site of several stamp batteries, but was largely abandoned by 1889 as the increased mining activity in the Sheba area necessitated larger stamp batteries which were established at Avoca (now Eureka) near the junction of Fig Tree Creek and the Kaap River. Here because of the increased availability of water a 60 stamp battery was erected and the ore from the mines in Sheba Creek had to be transported over the mountains by means of an aerial ropeway. This was later succeeded by ore being transported to Avoca by means of a small tramway. Avoca too was short-lived (1887-1892) as companies amalgamated and moved their recovery plants back to their properties in the Sheba Valley (Figure 12). The largest amalgamation took place in 1937 when a number of properties were incorporated into the mining company Eastern Transvaal Consolidated Mines, Limited and included the Agnes, New Consort and Sheba gold mines.



**Figure 12.** A 50 stamp battery erected to crush ore from the mines in the Sheba Valley. Other batteries were built on the Kaap River to the north, where the water supply was more regular.

Gold output on the eastern side of the Barberton greenstone belt, specifically in the northwestern part of Swaziland, was relatively small compared with the rest of the Barberton Goldfield. Of the 33 occurrences recorded in Swaziland (Barton, 1982) less than half declared outputs exceeding 10 kg gold, with a total recorded production of 6798.9 kg (218585 oz). Of this output 95 per cent of the gold was extracted from nine deposits each of which produced over 100 kg of gold. The concentrated nature of the gold in only a few deposits is further exemplified by the fact that the Pigg's Peak Mine produced more than half the total gold for Swaziland as a whole (3709 kg) and 4 mines (Forbes Main Reef, Daisy, Avalanche, Devil's Reef) produced 2221 kg between them (Barton, 1982).

Only a few gold showings were ever located in the southern part of the Barberton greenstone belt, most of the gold being located in the Steynsdorp-Komati valley areas. In July 1885, Jim Painter and his partner Frank Austen first panned gold in the Mlondosi River, a tributary of the Komati River. By October 1886 the population of diggers had grown to about 600 and the settlement, first known as Painter's Camp, was renamed Steynsdorp, and the field (known as the Komati Goldfield) was proclaimed a public digging on 21 February 1887 (Pretorius, 1965; Currer and Bornman, 2002). Alluvial gold was mined in several areas and two other camps sprang up northeast and northwest of Steynsdorp (Ladysmith and Violet Camps). The most productive alluvial diggings were located in Fullerton Creek near Steynsdorp where the population peaked at over 1000 by April 1887. Other vein-quartz – hosted gold deposits were also mined at several localities, including the Comstock (Figure 13), the Nevada and Gypsy Queen mines near Steynsdorp - Viljoen et al., 1969) and the Sheba Queen and Von Brandis mines in the Komati River area (Groeneveld, 1975; Anhaeusser, 1986a). The production records for these mines and the alluvial diggings in the Komati Goldfield (also referred to more recently as the Steynsdorp Goldfield) is incomplete, but indications suggest that the output was small and by 1897 the goldfield was completely deserted (Pretorius, 1965).

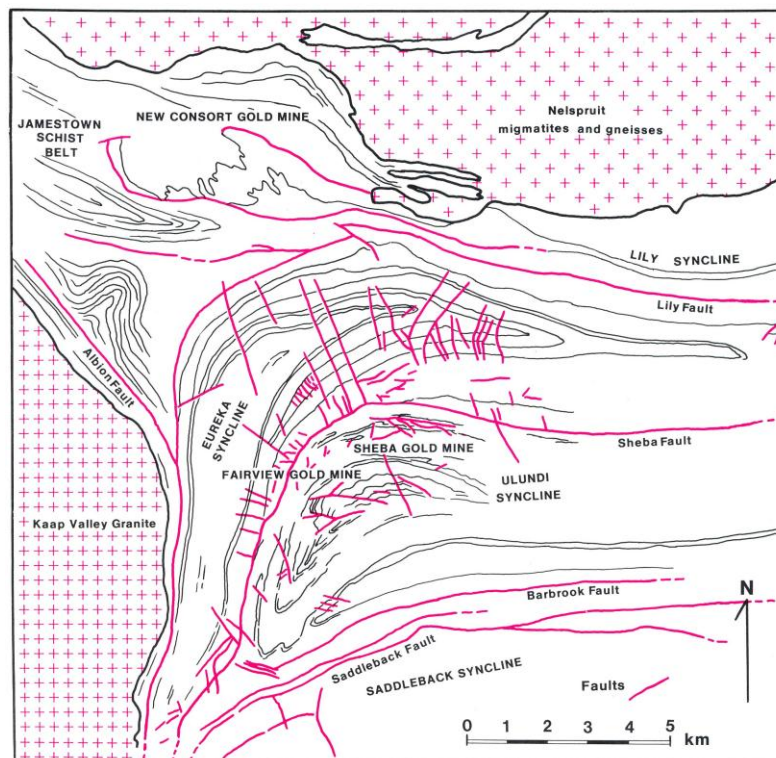


**Figure 13.** The old workings of the Comstock gold mine in the Mlondosi River valley north of Steynsdorp. This was one of several mines in the area that worked quartz -vein gold deposits. The rest were alluvial workings.



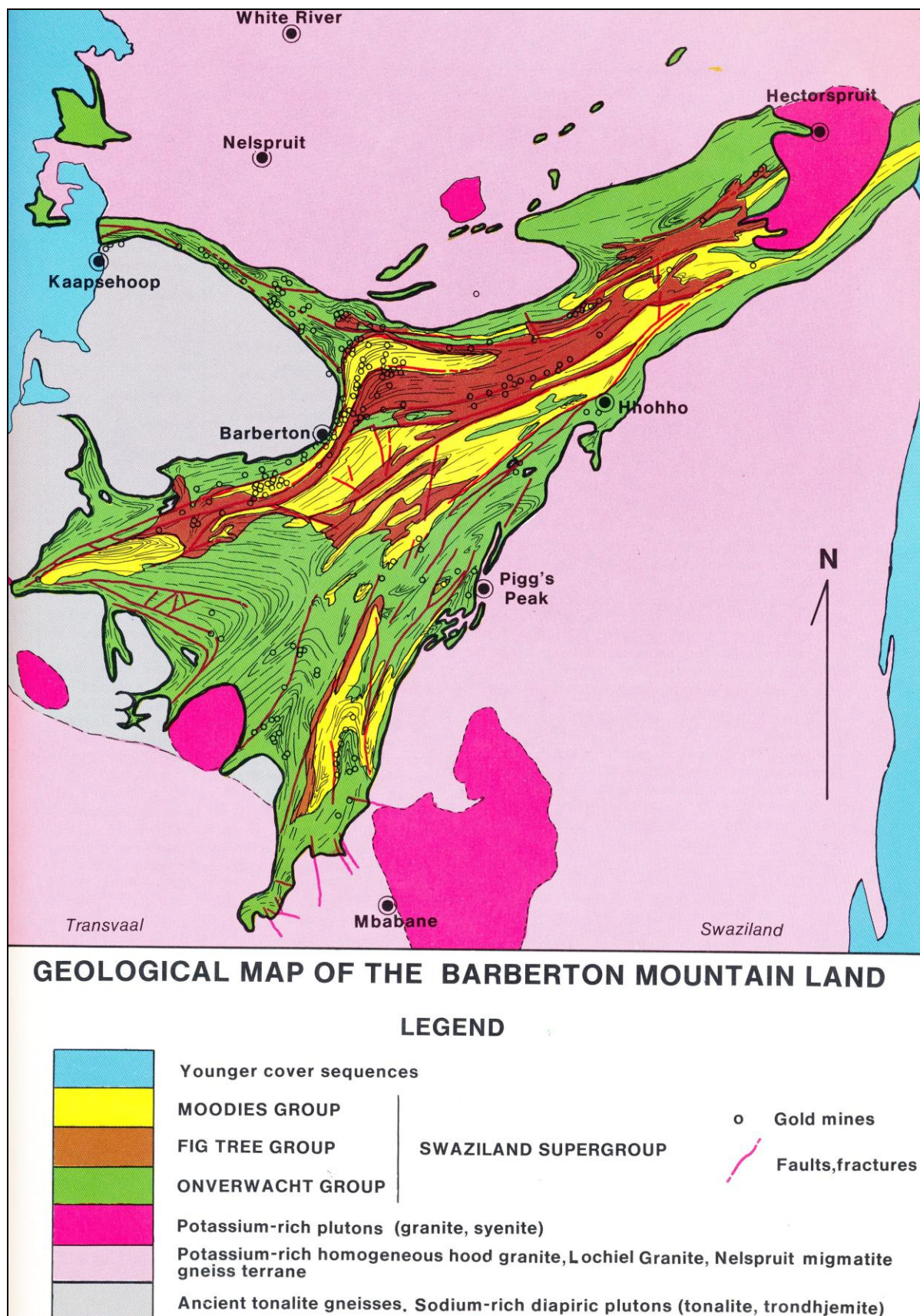
Of the approximately 350 small mining operations recorded in the Barberton Goldfield only about 44 mines each produced in excess of 311 kg (10 000 oz), with over 70 per cent of the gold coming from four main producers (Sheba, Fairview, New Consort and Agnes). Anhaeusser (1986a) listed available production data for the Barberton gold mines for the period 1884-1983 which amounted to 23 560 kg (7 582 894 oz). These figures are now almost 30 years out of date, but it is estimated by Ward and Wilson (1998) that total production by about 1998 exceeded 320 t of gold (11 287 667.873 oz). To this can be added a further 14 years production at approximately 100 000 oz per annum (i.e., 40 000 kg or 1 400 000 oz). A total estimate for the gold produced in the Barberton Goldfield since its inception is 360 t gold (12 698 626 oz). Most of the production in recent years has come from only five mines (Sheba, New Consort, Fairview, Agnes, and Lily, in approximate order of output). Gold grades varied considerably from ounces to the ton to more conservative values as low as 5 g/t. The main gold producers have average grades ranging from 7-14g/t with grades in some places being as high as 30g/t.

The gold deposits of the Barberton area are almost without exception linked to structural influences that have affected the rocks of the greenstone belt on more than one occasion (Anhaeusser, 1976a, 1984). This structural influence was augmented by heat related to episodic stages of granite emplacement, the latter causing greenschist-to-amphibolite grade metamorphism and being accompanied by auriferous fluid migration into brittle-to-ductile fractures and shear zones, best developed along the northwestern flank of the Barberton greenstone belt in deformed sediments of the Fig Tree and Moodies successions (Eureka and Ulundi synclines). Most of the gold prospects and mines are located on the northwest side of the Barberton greenstone belt and are strung out in close proximity to major regional faults (Sheba, Lily, Barbrook faults - Anhaeusser, 1986a, Figures 14, 15).



**Figure 14.** Simplified structural map of the Jamestown and Sheba Hills area of the Barberton greenstone belt showing the more important folds, faults and fractures and the locations of the three main gold producing mines (Sheba, Fairview and New Consort gold mines). More than 80 per cent of the gold produced in the Barberton Mountain Land has come from deposits in this region (see also Figure 15).



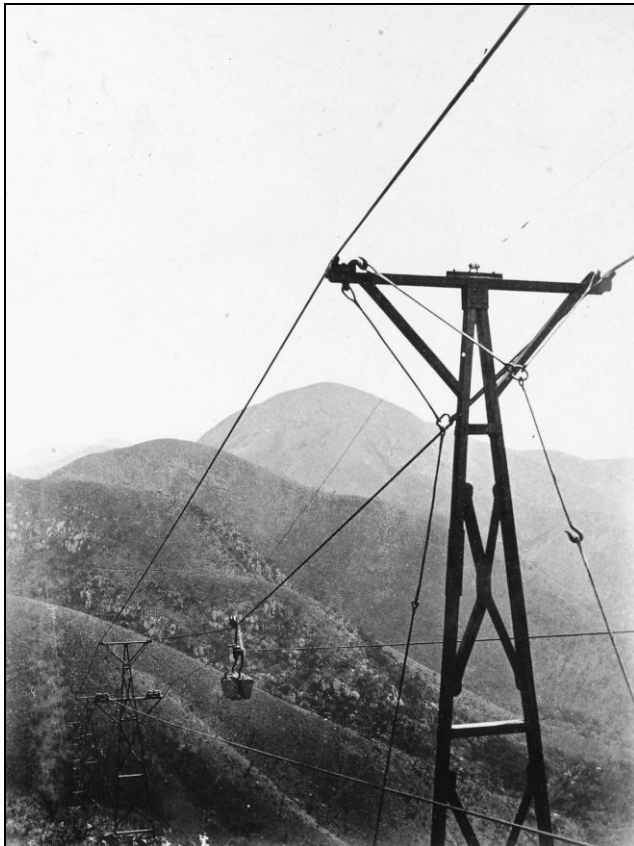


**Figure 15.** Major faults and folds affecting the rocks of the Barberton greenstone belt. Most of the gold mines (circles) occur on the northwest flank of the belt, or near contacts with the surrounding granites (see Anhaeusser, 1976b).

In the Sheba-Fairview mine areas isoclinally folded brittle chert layers in rocks of the upper part of the Onverwacht Group of rocks (Swartkoppie Formation) were also deformed to produce favourable host structures for gold and sulphide mineralization. The central parts of the Barberton greenstone belt, on the other hand, whilst experiencing similar deformation histories to those in the northwest have no known gold deposits of note suggesting that the gold mineralization in the district as a whole was spatially and temporally linked to the episodic emplacement of granitic rocks into the region between approximately 3500 to 2750 million years ago.

The Barberton gold ores are sub-divisible into three main ore types: (1) unoxidized, complex sulphide ore that is the main ore type mined thus far in the district and which has produced the most gold; (2) gold-bearing quartz veins and shears containing only negligible amounts of sulphide minerals, but which are common throughout the area; and (3) weathered ore, occurring in oxidized zones that represents the main gold source in the historical past (De Villiers, 1957; Schweigart and Liebenberg, 1966; Anhaeusser, 1986a).

The sulphide ores have presented particular recovery problems as this ore-type is refractory and contains mostly pyrite, pyrrhotite or arsenopyrite in various combinations. A wide range of other sulphide minerals occur in the Barberton gold ores, including mainly sphalerite, chalcopyrite, galena, tetrahedrite and stibnite (De Villiers, 1957). In the early stages of treatment of refractory ores recoveries were as low as 27 per cent with conventional cyanide treatment. This was increased to 80-85 per cent if the ores were roasted. A roasting plant was first built at the New Consort gold mine to treat ore from this mine as well as ore from the Sheba gold mine. In the early years the ore from Sheba Mine had to be transported over the mountains by an aerial cableway to the roaster (Figure 16).



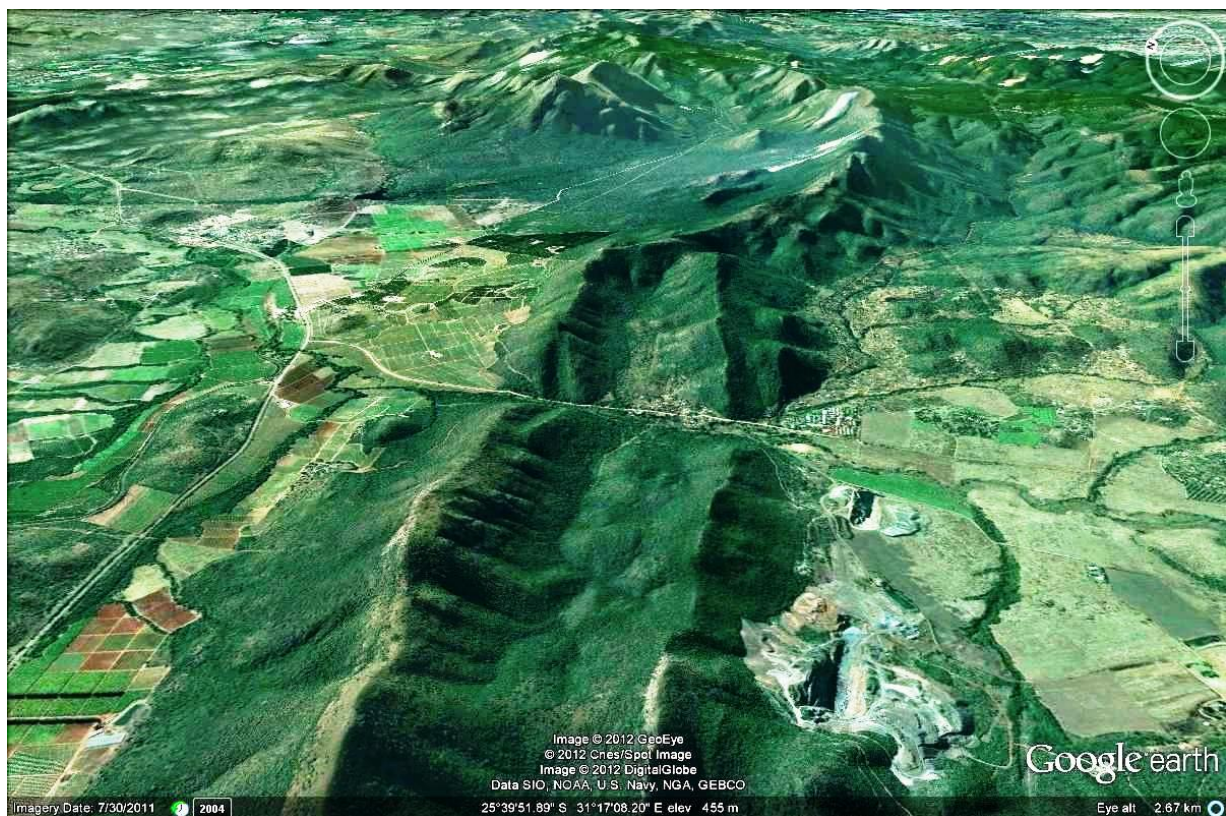
**Figure 16.** Aerial cableway used to transport sulphide-rich gold ore from the Sheba gold mine across the mountainous region of the Eureka Syncline to the roasting plant at the New Consort gold mine, a distance of approximately 8 km, with one angle station.

The ropeway crosses rocks of the Moodies Group. The prominent peak in the far distance is part of the Baviaanskop ridge consisting of conglomerates and quartzites of the Baviaanskop Formation. For details of the geology of this area see Anhaeusser (1976a).



Later a second roasting plant was established to treat the refractory ores of the Fairview gold mine. In more recent times a BIOX® process, which has been in existence since the late 1970s, pre-treats refractory sulphide gold ores such as those containing pyrite, arsenopyrite and pyrrhotite. The BIOX® process, involves bacterial action which destroys the sulphide minerals and exposes the gold for leaching (the process was pioneered at the Fairview Mine by Gencor Process Research - now Billiton Process Research). The gold in the sulphide ores is encapsulated in sulphide minerals, which prevent the gold from being leached by cyanide. The bacterial process results in accelerated oxidation. The process is noted for its robustness, simplicity of operation, environmental friendliness and cost-effectiveness, and offers real advantages over conventional refractory processes such as roasting and pressure oxidation (Van Aswegen et al., 2007).

Gold has been mined in the Barberton-Swaziland areas for close on 130 years and the predictions are that it will still be a viable goldfield for many years to come. Gold deposits in Archaean greenstone belts are notoriously difficult to locate and evaluate as the gold is patchy and variable in grade. Factors such as the price of gold and a good understanding of the geological controls of mineralization will play a significant role in determining whether exploration will continue into the future. Re-investigation of some of the old deposits and prospects may be warranted as these localities at least indicated the presence of gold. Modern exploration techniques and improvements in the gold price might herald a resurgence of interest, particularly in areas to the northeast of Barberton in the Lily mine area (Figure 17) and along the Barbrook Line to the south.



**Figure 17.** Google Earth image of the Lily Syncline extending east towards Three Sisters peaks in the far distance. Renewed interest has resulted in the Lily gold mine and extensions to the east (Roses Fortune and Kimberly Imperial mines being potential targets for future exploration. The Lily Mine, which initially operated as a supergene enriched oxide-facies iron formation with bonanza visible gold (Anhaeusser, 1963; 1986c), is now a sulphide-rich ore body with a medium to long life. Visible gold from the Lily Mine is shown in Figure 18.



**Figure 18.** Gold in dark vein quartz from the supergene-enriched oxidized zone of the Lily gold mine. Approximately 60 oz gold are shown in the photograph. The gold was recovered in 1963 from an ore shoot that contained several other bonanza ore pockets. The gold shown was found at a depth of approximately 30 m below surface. The coin used for scale measures about 30mm in diameter.

Geologically, the Barberton greenstone belt has probably received more attention than any other region in South Africa since it was first mapped by Hall (1918). Later, another Geological Survey of South Africa publication provided an explanation of a 1:50 000 scale map of the area (Visser, compiler, 1956). In the period that followed, the Barberton region became world renowned as a classical Archaean geological terrane in which to study virtually all aspects of the evolution of the early Earth. Hundreds of papers have been published in local and international journals and books describing the ancient volcano-sedimentary stratigraphy, the komatiitic and other volcanic rocks, the plutonic layered ultramafic complexes, the wide variety and ages of granites, gneisses and migmatites surrounding and intruding the greenstone belt, the structural and metamorphic history, evidence for primitive life organisms and the chemistry of the early atmosphere and oceans, and the various types of mineralization to be found in the area. Summaries of these findings appear in various review articles (including those of Anhaeusser, 1976b,c, 1981, 1986a,b, 1999, 2006; Anhaeusser and Viljoen, 1986; Barton, 1982; Brandl et al., 2006; Cairncross and Anhaeusser, 1992; Groeneveld, 1975; Lowe and Byerly, 1999; Robb et al., 2006; Ward, 1999).

### **Other Mineral Occurrences in the Barberton Greenstone Belt**

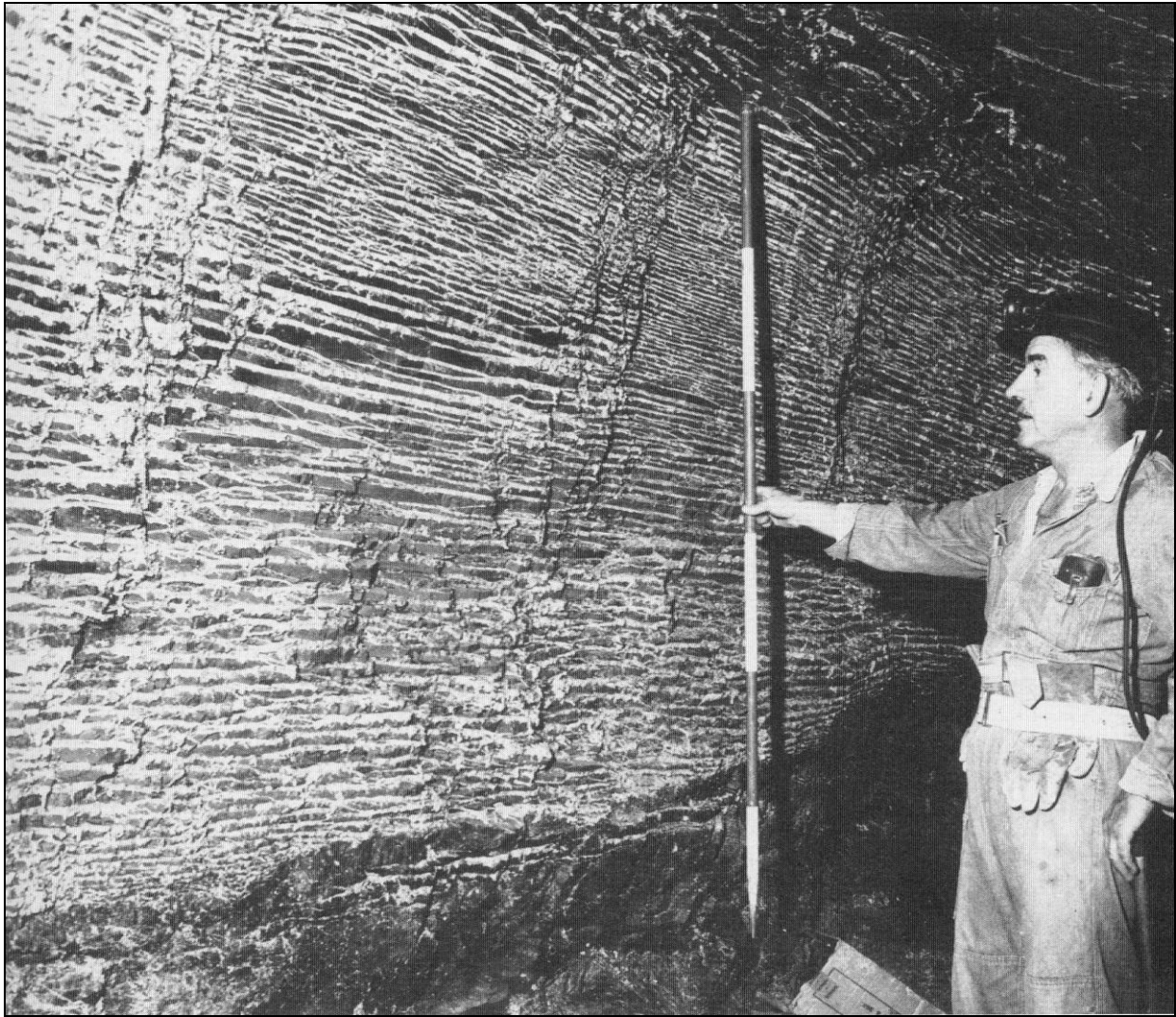
Although gold was the main attraction in the Barberton greenstone belt for many years the early prospectors who combed the hills also drew attention to the presence of other mineralization types in the region. These included occurrences of chrysotile asbestos, iron, barite, magnesite, talc, tin, antimony, mercury, nickel-copper, zinc, and verdite-buddstone. In later years some of these commodities yielded important deposits and were significant producers particularly of chrysotile asbestos, magnesite, talc, barite and iron ore. Minor occurrences of stibnite, cinnabar, cassiterite and verdite were mined in places and the presence of nickel-copper and zinc-silver-lead was noted, but never exploited.

#### **Chrysotile Asbestos**

Chrysotile asbestos was first noted in the Kaapsehoop area in 1905, but was only exploited from 1915 onwards (Hall, 1921, 1930). Four deposits were mined in the western extension of



the Jamestown Schist Belt in what Anhaeusser (1976b, 1986b) described as the Kaapsehoop Ultramafic Complex. Four mines were developed in the layered intrusion (New Amianthus or Kaapsehoop Asbestos Mine, Munnik-Myburgh, Stella, Sunnyside). The so-called “Ribbon Line” in the New Amianthus Mine, a spectacular 2.13 metre-wide fibre zone, displayed 165 seams with fibre lengths varying between 1.6-12 mm (Hall, 1930, Laubscher, 1986 – Figure 19). Fibre lengths in these mines are among the longest recorded in the world and ranged in places from 50-152 mm. Cross-fibre measuring 218 mm was found in places and was sought after as museum specimens. The mines in the Kaapsehoop area have all ceased production yielding in excess of 222 348 t of high-grade fibre (Ward, 1999).



**Figure 19.** Chrysotile asbestos fibre seams of the ‘Ribbon Line’ in the New Amianthus Mine near Kaapsehoop (photograph after Laubscher, 1986).

Two of the largest chrysotile asbestos deposits in the Barberton area were located in the Msauli-Havelock Ultramafic Complexes straddling the border between South Africa and Swaziland. Although gold and asbestos was discovered in 1887 on the Havelock Concession (named after Sir Arthur Havelock, then Governor of Natal), it was only in 1918 when Izaak Holtzhausen ‘rediscovered’ the asbestos occurrence that renewed interest was shown in the deposit (Barton, 1982, 1986). Exploration followed, but it was only in 1939 that the first fibre was processed by the mill. The mine commenced as an open pit operation, but later changed



to underground mining. Being in mountainous country it was decided to connect the mine to the railhead at Barberton and this resulted in the construction, by Bleichert and Company of Leipzig, Germany, of a 20.36 km-long aerial ropeway across the mountains. Construction of the aerial ropeway commenced in mid-1937 and was completed in June 1939. It had a carrying capacity of 13.5 t per hour in both directions and transported all the asbestos and mine materials, but not any passengers. The ropeway operated successfully until the Havelock Mine ceased production in 2001. The mine produced over 2 Mt of chrysotile fibre (Ward, 1999) and was at one stage the second largest Archaean greenstone belt asbestos deposit in the southern hemisphere, after the Shabani Mine in Zimbabwe and, at the time, was the principal contributor to the economy of Swaziland (Figure 20 ).



**Figure 20.** View of the Havelock Chrysotile Asbestos Mine in northwestern Swaziland taken in 1961.

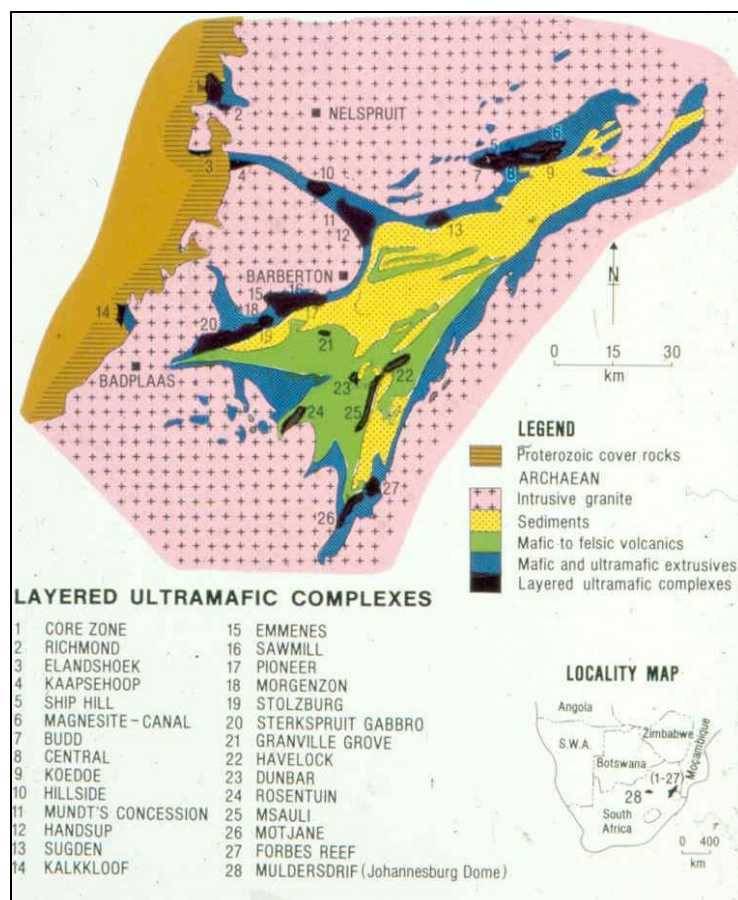
Across the border and located in serpentinized ultramafic rocks of the Msauli Complex (believed to be an extension of the Havelock Complex, Anhaeusser, 1986b), was the African Chrysotile Asbestos Mine. The mine, in the Diepgezet valley, was also known as the Msauli Asbestos Mine, and was first worked in 1942 when C. J. Yssel and J. F. Cronje produced 148 t of fibre. As there was no bridge across the Komati River at this time an aerial ropeway was constructed across the river and the fibre from there had to be transported initially by road to the railhead at Breyton, a distance of approximately 130 km. Later the milled and blended asbestos fibre was transported over the mountains to Barberton, a distance by road of 40 km. The mine changed hands on numerous occasions (Ward, 1999) and initially consisted of four quarry operations. Later underground mining commenced during the period when the mine was operated by Gencor and a total of approximately 2.5 Mt of fibre was produced prior to the mine closing in September 2001. The mine is now abandoned with the mill and mine dumps having been demolished and rehabilitated and the village abandoned as a ghost town.

A number of other chrysotile asbestos deposits were discovered in the Barberton greenstone belt, including three mines in the Stolzberg Complex (Sterkspruit, Stolzberg, Doyershoek) in the southwest near Badplaas. The Stolzberg Mine, the largest of the three, operated from 1942 until 1959 and produced 38 877 t of asbestos fibre (Ehlers and Vorster,

1998). The Sterkspruit Mine produced 10 769 t of quality asbestos fibre from 1951 to 1963. Mining continued for a number of years afterwards, but eventually closed, and was abandoned and rehabilitated. The production in the later years is not known. The Doyershoek Mine operated from 1943-1946 and again later from 1950-1955 and produced 4 190 t of fibre.

The Kalkkloof Mine, north of Badplaas, is located in the Kalkkloof layered ultramafic complex and commenced mining in 1928 and worked sporadically until 1970 when the mine closed. It produced more than 45 000 t of asbestos fibre (Ehlers and Vorster, 1998). A number of other chrysotile asbestos deposits were exploited in the Barberton greenstone belt at various times, but were relatively small and production data is not known.

Anhaeusser (1976c, 1986b) and Ward (1999) described the geological setting and controls of most of the chrysotile asbestos deposits in the area. It was concluded that all the deposits were associated with layered ultramafic complexes (Figure 21) with the principal host rocks being serpentinized dunites, harzburgites and orthopyroxenites.



**Figure 21.** Geological map of the Barberton greenstone belt showing the location of the layered ultramafic complexes (black) that are the main host rocks of the chrysotile asbestos deposits in the region (after Anhaeusser, 1986b).

The mineralization is, without exception, structurally controlled, with folding and faulting creating the open spaces in which the chrysotile asbestos cross fibre developed as a result of serpentinous fluid migrating into tensional openings created during deformation. A complete list of chrysotile asbestos mines and details of the geology of the deposits can be viewed in Groeneveld (1975).



## Iron

The earliest records of iron being mined in the Barberton greenstone belt date back thousands of years. The first record of ancient mining anywhere on Earth occurred in northwestern Swaziland. Deposits at Ngwenya were worked at least 42 000 years BP (Before Present) for the extraction of red haematite and specularite (sparkling ores). The peoples concerned belonged to the Middle Stone Age, which flourished in southern Africa for about 100 000 years, until almost 20 000 years ago. The red ochre was also used by later peoples as a pigment and as an early cosmetic product. The ancestors of the present San (Bushman) peoples used the pigments for their rock paintings, of which there are many in the southeast part of the Mountain Land and in Swaziland (Figure 22).



**Figure 22.** San or Bushman painting in the Steynsdorp Valley, southeastern Barberton Mountain Land.

Charcoal from the Lion Cavern of the Ngwenya Iron Ore Mine (Bomvu Ridge) gave an age of 41 250 BC (Dart and Beaumont, 1971) – seven times older than the oldest known Neolithic (5 500-1 500 BC) flint mines of Western Europe. Later Carbon 14 dating of the Ngwenya material suggests that the true age of the onset of mining at Bomvu Ridge may have been as early as 70-80 000 BC. Initially mining was for haematite (iron oxide) used as a red pigment in ornamentation and as an early cosmetic product, and later for the smelting of iron. Numerous stone mining tools and tens of thousands of implements belonging to the Middle Stone Age have also been found in the area, the latter overlain by Iron Age shards dated at 7 690 BC.

Iron ore occurrences in the Barberton greenstone belt are generally associated with ferruginous banded iron formations and jaspilites. Algoma-type iron formations (so named after examples of this type in the Canadian Archaean – Goodwin, 1973) are distributed widely throughout the Barberton greenstone belt and occur mainly as thin horizons associated with ferruginous shales of the Fig Tree Group of rocks. In addition, jaspilitic iron formations and magnetic shale horizons occur in several layers within the overlying Moodies Group of sediments (Barton, 1982; Groeneveld, 1975; Ward, 1999). Local folding and faulting of the thin stratiform horizons have, in places, resulted in duplication and thickening of the layers and alteration by supergene processes of enrichment have produced some iron deposits that have been mined.

The most important iron deposit was that occurring along the Ingwenya Range along the Swaziland border, south of the Havelock asbestos mine. Known as Bomvu Ridge or Ngwenya Mine the deposit was ‘rediscovered’ in 1946 by A. T. M. Mehliiss of the Swaziland



Geological Survey. Small by world standards, the deposit was evaluated and subsequently mined by open pit from 1964-1979 and produced 28 Mt of ore grading approximately 60 per cent Fe (Figure 23). The mine made a significant contribution to the economy of Swaziland and also resulted in the construction of a 210 km railway across Swaziland to the port at



**Figure 23.** View of the Ngwenya iron mine open pit in northwestern Swaziland taken in 1965. The deposit, also known as the Bomvu Ridge Mine, produced high-grade supergene-enriched haematite ore.

Maputo (then Lourenço Marques) in Mozambique. The mine ceased production in mid-1980 when the last of the stockpiled ore was shipped to Japan. Additional extensive reserves of iron are known in several other parts of northwest Swaziland. It is estimated that almost 1 billion tonnes of low grade (30-45 per cent Fe) iron formation are present north of Ngwenya, but are not likely to be mined in the foreseeable future (Barton, 1982).

On the South African side of the Barberton greenstone belt only a small deposit of high grade iron was mined at the Spago Mine southwest of Malelane. Here ore was mined from a 100 m-thick, supergene-enriched banded iron formation on either side of a transgressive dyke-filled fault. Only 28 000 t of ore was mined between 1954 and 1962 (Groeneveld, 1975).

## Magnesite

Important deposits of magnesite were first recorded in the northeastern sector of the Barberton greenstone belt in the Kaapmuiden-Hectorspruit magnesite field where the first mining took place in 1906 (Hall, 1907; 1918; Strydom, 1998). Initially the magnesite was required for the manufacture of cement, but subsequently it was used for refractory products, especially bricks in the steel industry, as well as a range of other products, including additives in fertilizer and animal feeds, and as magnesium sulphate ( $\text{MgSO}_4$ ) in paper production and  $\text{MgO}$  in the chemical industry.

Geologically the magnesite occurrences, like those of the chrysotile asbestos deposits, are all located in rocks associated with layered ultramafic complexes. A number of deposits, (including Strathmore, Bald Hill, and Budd) are located in what was termed 'ore zone' serpentinite (Viljoen and Viljoen, 1970). The ore zone serpentinites are the result of alteration of dunites and provide the primary source of magnesium and a suitable environment for the development of stockwork fractures wherein the magnesite occurs as veins (Figure 24). The age of magnesite formation has been determined as being 2 990 Ma (Toulkeridis et al., 1993) suggesting that the magnesite post-dated the structural and metamorphic events that affected rocks in this sector of the Barberton greenstone belt between 3 230-3 107 Ma.

The only other magnesite deposit to have been mined occurs in the Sugden Ultramafic Complex also on the northern flank of the Barberton greenstone belt (Anhaeusser, 1963). The

occurrence of all the magnesite deposits in the northern and northeastern parts of the greenstone belt has led to the suggestion that climatic influences may have played a role in their development. The deposits are generally near-surface occurrences, seldom deeper than



**Figure 24.** White veins of magnesite in altered olivine-rich dunite of the Budd layered ultramafic complex. The magnesite is exposed in a road cutting through Pettigrew's Nek, about 3 km south of Kaapmuiden.

about 30 m and as a consequence of the hot and humid climatic conditions in this part of the belt the magnesium-rich olivine of the dunites was altered in the zone of weathering by meteoric waters containing CO<sub>2</sub> (Viljoen and Viljoen, 1969)

## **Barite**

Barite was first discovered when the road from Barberton to Bulembu (Havelock) was constructed in 1939. Commercial exploitation of the barite commenced in 1942. In subsequent years the bulk of the production (44 473 t) was mined between 1942-1961 from stratiform deposits occurring in the middle Fig Tree Group along a strike length of 12 km in the so-called Barite Valley in the south-central part of the Barberton Mountain Land (Groeneveld, 1975, Reimer, 1980; Ward, 1999). Although numerous other showings of barite occur in different parts of the Barberton greenstone belt only the Londosi deposit in the Londosi valley in northwest Swaziland and the Stentor deposit in the northeastern part of the belt recorded any production. The Londosi deposit adjacent to the South African border north of Oshoek was mined between 1942 and 1976 and produced 10 766 t of crude barite (Barton, 1982), while the Stentor deposit yielded a mere 1 358 t when it was mined between 1941-1942 (Groeneveld, 1975; Ward, 1999). No further interest was shown in the barite occurrences of the Barberton greenstone belt from 1976 onwards.

## Nickel-Copper

Signs of ancient mining activity, in this case for copper and/or nickel, in the Nelshoogte Schist Belt, northeast of Badplaas were first noted in 1971 by the writer while undertaking regional geological mapping of the Stolzberg-Nelshoogte area. A gossan containing malachite and azurite led to the area being prospected by African Selection Trust Exploration (Pty) Limited who recorded, in 1976, sporadic, disseminated and low-grade copper-nickel mineralization (Ward, 1999). Other early reports of nickel mineralization in the Barberton greenstone belt were made by Hall (1924) who described nickel sulphide (millerite) associated with chrysotile asbestos in the New Aminathus chrysotile asbestos mine near Kaapsehoop. An occurrence of nickeliferous magnetite (trevorite) was discovered in serpentinites on the farm Bon Accord near Sheba Siding, which occurred in a small lens where about 25 t of ore grading 36 per cent nickel were mined (Trevor, 1920). The unusual occurrence was described later by De Waal (1986), who also recognized several new and rare nickel minerals in the deposit. He offered two suggestions as to the origin of the trevorite body, the one speculating that it was an oxidized and subsequently metamorphosed nickel-rich meteorite or, secondly, that it was an oxidized and subsequently metamorphosed segregation of nickel-rich sulphide. The origin of the trevorite occurrence still remains unanswered.

In the 1970s Eland Exploration (Pty) Limited investigated a nickel-sulphide prospect in the vicinity of the Scotia Talc Mine, also at Bon Accord, and this later led to the discovery of massive and disseminated pyrite-pyrrhotite-pentlandite-gersdorffite mineralization (Keenan, 1986). Recent exploration by African Nickel Limited has led to the development of a possible new mine in the area (Hornsey and Chunnet, 2009). Despite numerous other nickel showings in ultramafic rocks found throughout the Barberton greenstone belt no nickel mine has yet been established (Barton, 1982; Ward, 1999).

## Talc

Talc was first mined in the Barberton greenstone belt in 1915 and from then until about 1942 annual production never exceeded 1 000 t. Output rose rapidly and peaked in 1953 dropping off again in the years that followed. The most important deposits are situated along the northern margin of the greenstone belt and are associated with ultramafic rocks found between Malelane in the northeast and the Jamestown Schist Belt in the west. The first talc mine in this area was the Verdite Mine, which originally began as a gold mine. More than 8000 t of talc were produced from 1915 to 1944. Talc was also mined from underground workings in the New Albion Mine, which was also a gold mine, between 1945 and 1954. Other talc workings in the Jamestown Schist Belt were mostly small pits and quarries from which about 16 000 t of talc were recovered between 1948 and 1963. Details of these operations and those further to the east in the Kaapmuiden-Malelane area are outlined in various publications (Hall, 1918; Anhaeusser, 1969, 1972; Groeneveld, 1975; Ward, 1999). The largest deposit, the Scotia Talc Mine north of Sheba Siding, has operated since 1918 and has produced more than 100 000 t of industrial grade talc from altered serpentinites in which, recently, nickel mineralization has also been located in the underground workings. Some 2000 t of pharmaceutical-grade talc and about 5 000 t of industrial-grade talc was also produced from deposits in steatized serpentinite in dunites of the layered ultramafic complexes in the Kaapmuiden area.



## Verdite and Buddstone

Verdite, an attractive green ornamental stone, has been quarried from isolated pods, mainly in the Jamestown Schist Belt north and northwest of Barberton and in the ultramafic rocks found southwest of Barberton town. Most deposits occur associated with layered ultramafic complexes (Mundt's Concession, Handsup, Hillside, Pioneer - Hall, 1918; Anhaeusser, 1969, 1972; Groeneveld, 1975; Antenen, 1991; Ward, 1999). The deposits are small and hence the uses are limited. The verdite owes its emerald-green coloration to the microcrystalline chromian mica, fuchsite, and is mostly a soft rock that is used for carving figurines. It has also been used to adorn a tombstone in the Barberton cemetery (Figure 25).



**Figure 25.** Emerald-green verdite, a semi-precious ornamental stone found mainly in the Barberton area, used to decorate a tombstone in the old Barberton cemetery.

Buddstone is a somewhat harder, greenish-white, ornamental stone found in places associated with verdite. It occurs commonly as a banded and contorted fuchsitic-cherty rock, and like the verdite is only found in relatively small pods and hence its uses have been limited.

## Antimony

Antimony occurs in only a few localities in the Barberton greenstone belt - mainly in the far northeastern sector on the farm Amo, 13 km south-southwest of Malelane and in the area west of the Msauli asbestos mine in the far south of the greenstone belt, referred to as the Mali antimony mine (Hall, 1918, Groeneveld, 1975; Ward, 1999). The Amo deposit was first recorded by Hall (1918) and initially only 15 t of stibnite ore were mined in 1935. The deposit was 'rediscovered' in 1960 during road building operations. According to Viljoen et al. (1986) the mineralization is associated with a pelitic schist zone along the Scotsman Fault, which also hosts the Three Sisters gold mine a few kilometers to the west of Amo. The Mali deposit produced 17 t of stibnite in 1916. Most of the antimony in the region occurs as minor accessory minerals in the refractory sulphide gold ores of the Barberton Goldfield (De Villiers, 1957; Ward, 1999).

## **Mercury**

Very few mercury deposits are found in the Barberton greenstone belt. Those that do occur are mainly in northwestern Swaziland and in the far northeastern part of the belt in the Kaalrug area. This latter deposit occurs along a brecciated fault zone along the Inyoka Fault and consisted of cinnabar, together with pyrite, native sulphur and tourmaline. About 50 t of cinnabar were recovered in 1906. Cinnabar has also been reported from five separate localities in northwestern Swaziland, but the showings are very erratic and little ore has been produced (Barton, 1982). All the occurrences are thought to be of epigenetic origin formed at shallow depth and relatively low temperature (Ward, 1999).

## **Tin-Tungsten**

Small alluvial and eluvial tin occurrences occur only in the Oshoek-Forbes Reef areas of northwestern Swaziland. Primary tin mineralization occurs in talc-carbonate schist near the contact with the Mpuluzi batholith. The hosts to most of the alluvial and eluvial deposits are pegmatite veins carrying disseminated cassiterite (Barton, 1982; Ward, 1999). A small tungsten deposit (scheelite) associated with lode gold occurs in the same area near Forbes Reef.

## **Zinc**

Despite the presence of abundant felsic volcanic and plutonic rocks, which in other greenstone belts, like those in Canada, are hosts to important copper-zinc ores, these rocks in the Barberton greenstone belt are largely devoid of this type of mineralization. Only one deposit showing some potential occurs in the Three Sisters area approximately 35 km northeast of Barberton. Referred to as the Bien Venue zinc deposit this pyritic zinc-silver-gold-copper-lead-arsenic-barium-antimony occurrence was investigated by Anglo American Prospecting Services during the period 1978-1986 and again later by Gencor in 1990-1991. A drill indicated resource of 1.6 million tonnes grading 3.88 per cent zinc was reported with minor accessory mineralization (Ward, 1999). No mining of the deposit has taken place.

## **SUMMARY**

The Barberton greenstone belt, an early Archaean granite-greenstone terrane extending from South Africa across the border into northwestern Swaziland, has had a colourful mining history largely centred around gold mineralization. Additional mines of significance that came on stream in later years included mainly the large deposits of chrysotile asbestos, iron and magnesite. The remaining mineralization types described earlier were of small scale and more of curiosity value than economically important producers. They nevertheless contributed to the development of the region as a whole, but the deposits are now largely worked out. Gold clearly provided the main impetus for the sustained development of the region and may continue to contribute into the foreseeable future.

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