



Exploration strategy and application at Ashanti's Obuasi operations

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Synopsis

The Ashanti mine is located within the Lower Proterozoic Birimian of Ghana, and covers a concession of 474 square kilometres at its Obuasi operations which comprise large scale underground, surface and tailings treatment facilities. The mine had operated for a century at the end of 1997 and had produced nearly 25 million ounces of gold, a significant proportion of which came from the underground operations.

This paper covers the strategy under which exploration for both surface and underground mineral resources was instrumental in enabling the expansion programme to go ahead together with the methodologies and results that have developed in the exploration area over the last five years.

Within capital expenditure constraints, the objective on surface is to replace oxide depletion with a secondary objective of discovering new sulphides in areas other than the main trend.

In the underground, the exploration strategy is directed at replacement of both underground and surface sulphide depletion, minimising finding costs and assisting the development of long lead time infrastructure.

The exploration application describes the methodologies in use for both surface and underground exploration that have been developed in recent years in conjunction with a description of a major review conducted in 1995/96 of the exploration database, using an integrated approach, geochemistry, geophysics, remote sensing and structural geology.

A revisit of soil geochemical data in particular, and modification of exploration methodology led to the success in finding relatively significant new oxides in 1997.

Introduction

The Ashanti mine, located at Obuasi in the Ashanti Region of south-western Ghana is the largest single gold producer in West Africa. On the African continent, it is second to South Africa (Figures 1, 2 and 3) with future production forecasts of at least 850,000 ounces per annum for the next five years.

For 90 of the 100 years that Ashanti has been mining in Obuasi it would be classed as a small to medium sized high grade underground mine with the quartz-rich ore being extracted from steeply dipping shear structures. The underground operations were labour intensive using cut-and-fill as the



Figure 1—Location map of Ghana and the Ashanti Concession at Obuasi

predominant mining method with hoisting and processing capacity being the main limitations to production levels. In 1946, Goldfields of South Africa constructed the Pompora Treatment Plant (PTP), employing Edwards Roasters to treat the highly refractory arsenopyrite sulphides which in those days constituted some 20 per cent of the feed. This plant has since gone through a number of upgrades with the latest in 1997, increasing throughput to 150,000 tonnes per month comprising 80 per cent sulphide material.

Following the implementation of the 1986 Minerals and Mining Law, designed to encourage foreign investment, Ashanti was able to embark on a series of projects that have enabled it to grow to the group operation it is today, with 6 operating mines, producing 1.3 million ounces per annum. The first

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project, in 1986, with funding of \$80 million from the International Finance Corporation (overall \$160 million), was called the Rehabilitation and Expansion Project. It was essentially designed to rehabilitate, as far as possible, the infrastructure, plant and equipment that had been run down in the previous two decades and included construction of a tailings treatment plant.

Considerable prospecting, largely on the Obuasi Fissure and associated spurs, was undertaken by the Ashanti Goldfields Territories, the then exploration wing of Ashanti, between 1910 and 1913 (Figure 4).

Extensive trenching was undertaken along the Obuasi trend between 1953 and 1962. Trenching was reactivated in the mid-70s, although systematic surface exploration involving soil geochemistry and follow-up trenching covering the then entire 334 square kilometre concession commenced only in 1988/89. Overall trenching and follow-up reverse circulation and surface diamond drilling along the 8 kilometre strike on the Obuasi trend, resulted in the delineation of 11 million tonnes of oxide ore at an average grade of 3.6g/t Au, and the associated surface sulphides of some 14 million tonnes at 5.4g/t Au respectively (Figures 5, 6 and 9). These led to the approval of the \$90 million Sansu Project incorporating a \$60 million injection from the IFC to purchase the

surface mining equipment and construct a 100,000 tonnes per month Heap Leach Plant in 1990 and a 180,000 tonnes per month Oxide Treatment Plant in 1991, respectively.

Encouraged by the quick financial return from this Project—processing high grade oxides at low cost, Ashanti commenced the studies in 1990, for the third major project of expansion called the Ashanti Mine Expansion Project (AMEP). The cornerstone of this project was the re-evaluation of its underground mineral resource and ore reserves. The underground cut-off grade at that time was 11.3 grams per tonne (6.5 dwts) in the underground operations. At a revised cut-off grade of 3.4 grams per tonne based on potential mining and cost parameters, the general orebody configuration and without any further physical underground exploration work, the mineral resource was increased by a factor of 4 to 31 million tonnes and the gold content, nearly 2½ times to 10.4 million ounces. On the surface, the successful follow-up on anomalies delineated by soil geochemistry on parallel trends lying to the east and west respectively, of the main Obuasi trend resulted in the addition of 14.4 million tonnes of oxide ore at 2.3g/t Au.

The Ashanti Mine Expansion Project included constructing an additional Sulphide Treatment Plant (STP) of 180,000 tonnes per month capacity, to treat the surface

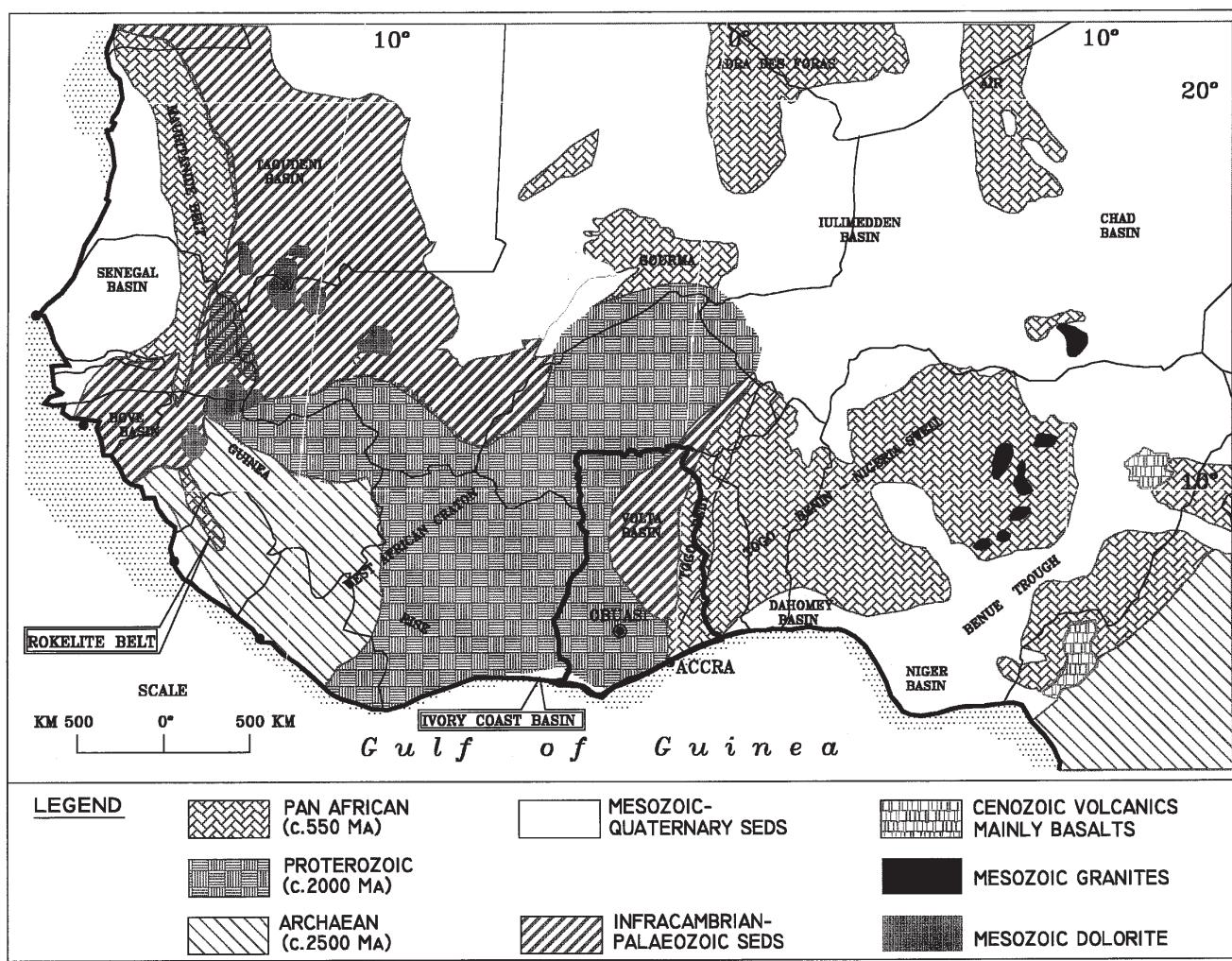


Figure 2—Location of Ghana in West Africa Craton

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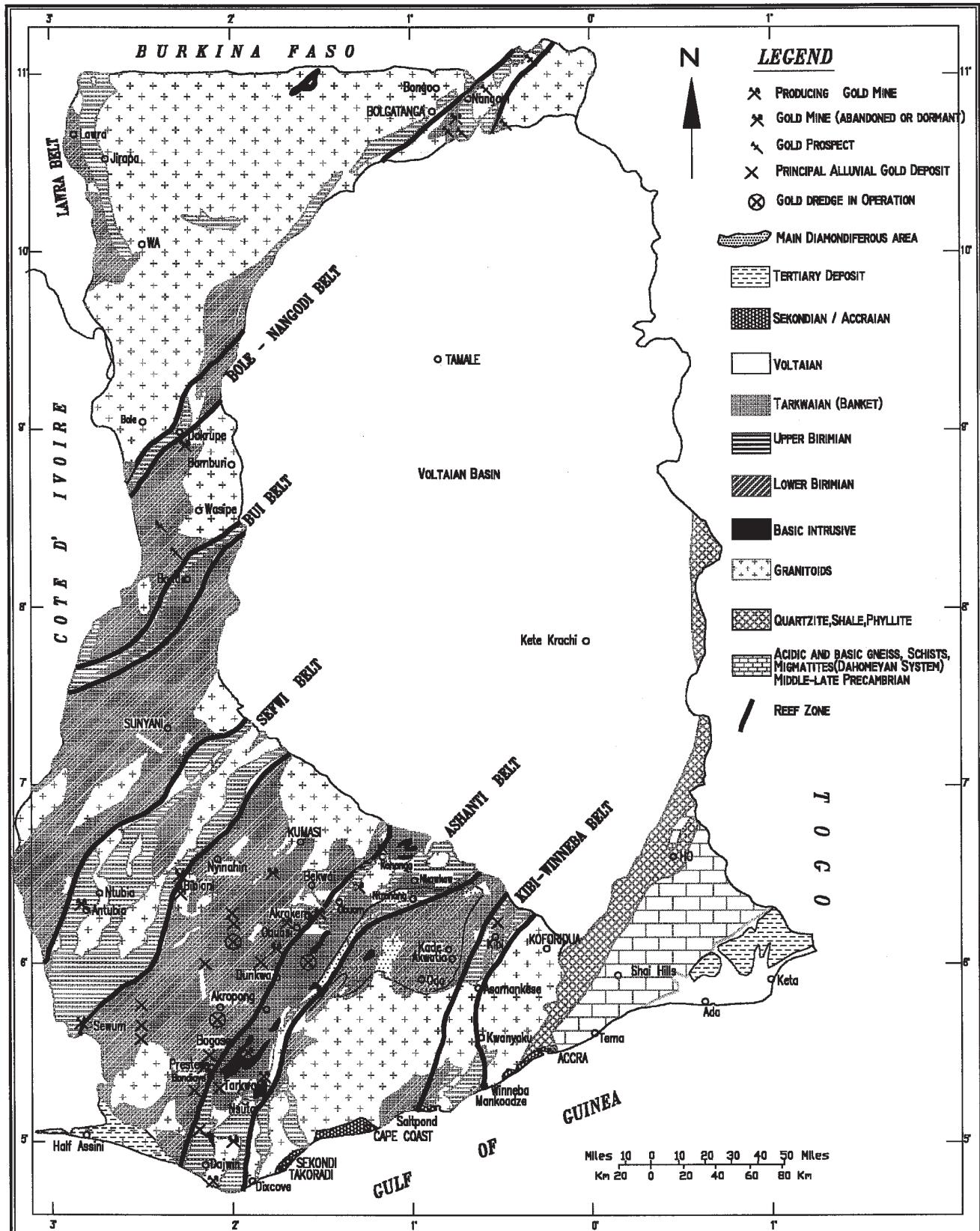


Figure 3—Geological map of Ghana showing the main gold mineralized zones

sulphides initially, while the underground infrastructure was being modernized to cater for the underground expansion. The project was approved in 1992 with IFC funding of \$90

million in the overall package over a 5-year period of some \$300 million.

The surface mining, processing and infrastructure

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sections of the multi-faceted project were all completed ahead of time and within budget. The underground expansion has taken some 3 years longer due to the underestimation of the difficulties of building a new mine within an old mine, together with the inevitable changes arising from an expanding ore reserve base owing to continued exploration successes.

The success of the three projects at Obuasi allowed the

company, in 1993, essentially, a private company, with Lonrho owning 45 per cent and the Government 55 per cent, to launch the flotation internationally in April 1994 on various stock markets. Prior to the flotation, however, an additional 140 square kilometres of mineral rights was obtained to make up a total concession of 474 square kilometres. The \$1.6 billion flotation of 83 million shares included the government holding reducing to 20 per cent and

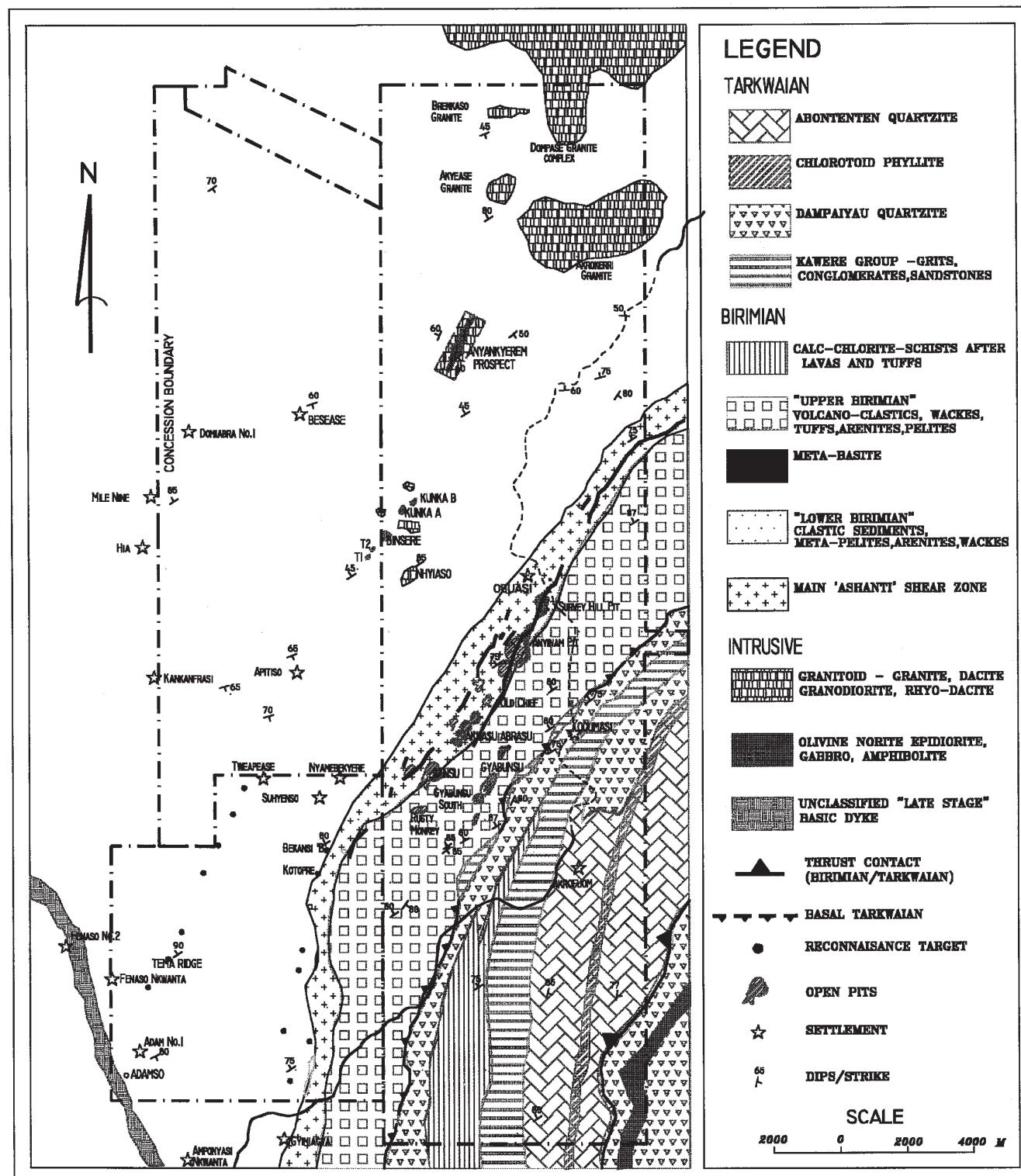


Figure 4—Geological map of the Obuasi Concession

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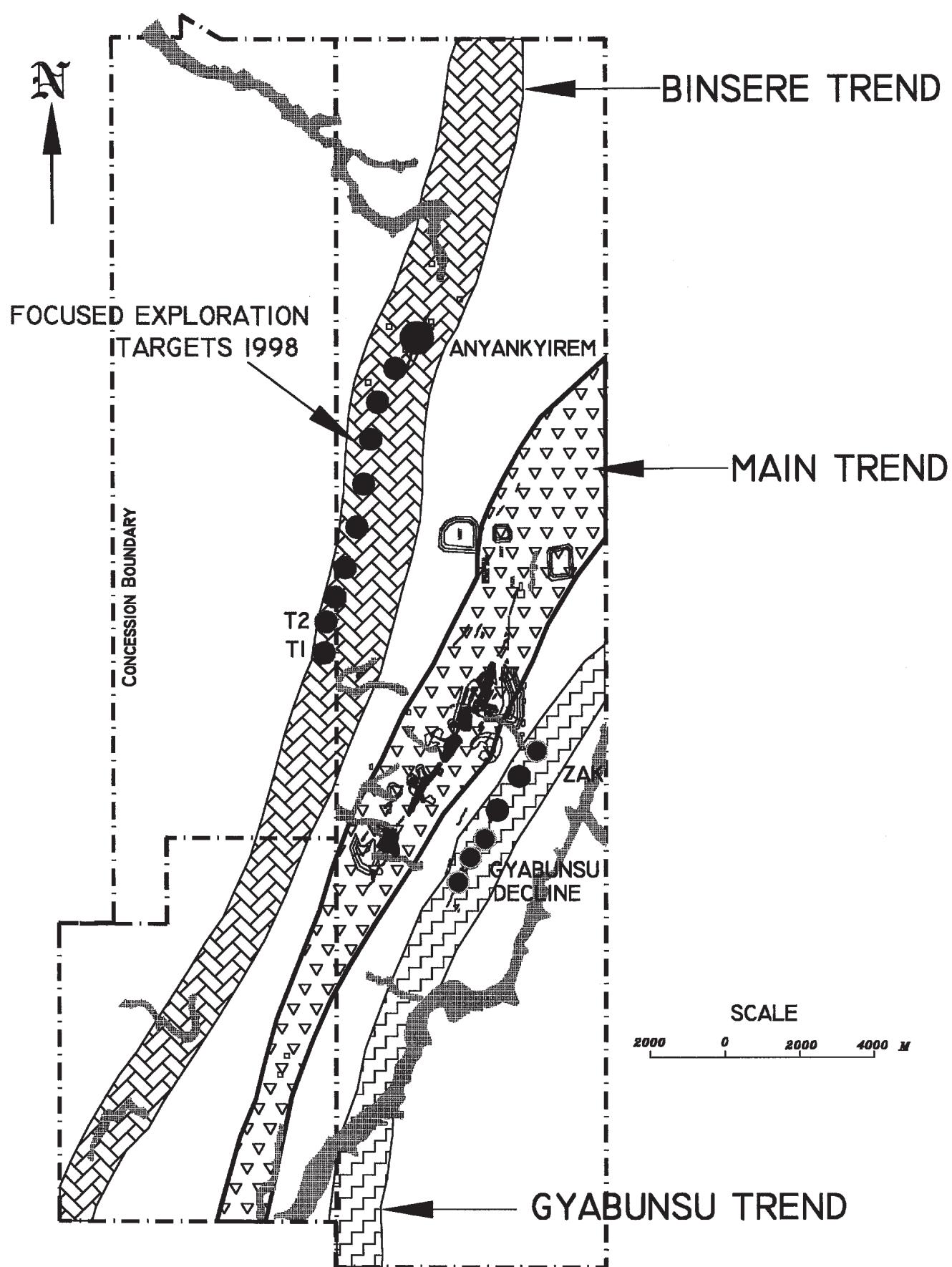


Figure 5—The Obuasi Concession showing the main mineralized corridors 1997 evaluated deposits, targets for 1998 onwards and prospects on the Gyabunsu Trend

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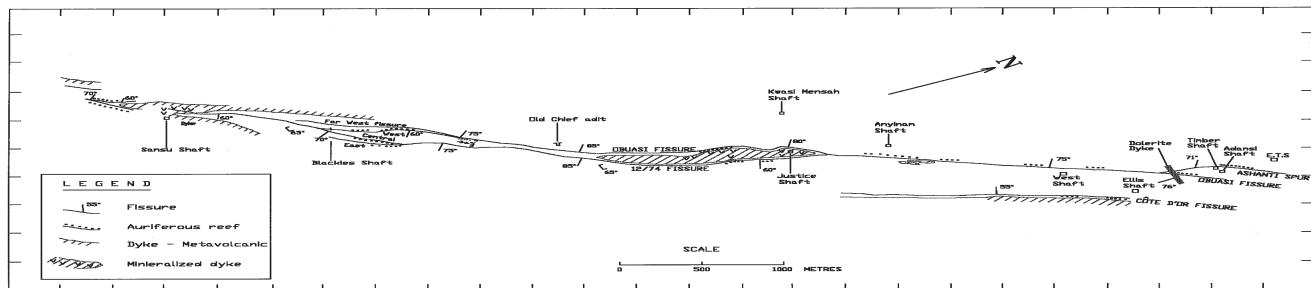


Figure 6—Plan of the main Obuasi Trend on the 244-metre level showing various splays of the Fissure System

Lonrho to 33 per cent. This in turn allowed for further expansion by acquisition and exploration elsewhere in Africa to the position that it is today, 35 projects in 12 African countries.

To do justice to the full Ashanti story would require volumes and this paper will now be confined to the exploration of both surface and underground on the expanded concession of 474 square kilometres and the general mining strategies that have developed from the unfolding geological picture.

Geological setting

Three mineralized corridors have been identified within the Ashanti tenement. These are the main trend—Obuasi Fissure and associated spurs, the Gyabunsu trend, some 2 kilometres to the east, and the Binsere trend, some 5 kilometres to the west of the main Obuasi trend (Figure 5).

The auriferous reef channels on the Main Trend have been examined laterally for 8 kilometres (Figures 6 and 9) to a depth of 1,500 metres below the surface. (Figures 7, 8 and 9). Their plunging geometry and surrounding lithological structures are illustrated in Figures 7 and 9. The plans and sections clearly illustrate a continuous shear striking 042°, and dipping steeply to the north-west (Figures 6, 7 and 8). Secondary shears leave the main shear in an anastomosing pattern, and is clearly illustrated where the more resistant metavolcanics occur as lenses (Figures 6, 7 and 8). The reef channels are persistent and deep seated, forming in shear zones controlled by probable thrust faulting along the 'contact' between the lower Birimian phyllites and upper Birimian metavolcanics.

The Cote d'Or channel, along strike and depth, remains close to the most clearly defined metavolcanic contact, whereas, the Obuasi, Ashanti, Insintsiam, and the 12/74 fissures, branch into the lower Birimian (Figures 6, 7 and 8) with only local metavolcanic control. The Main Reef Fissure at depth shows the broad structural control along the metavolcanic contact. This contact can be traced through the Cote d'Or metavolcanics to the surface Sansu metavolcanics.

Within the mine sequence the original character of the volcanic rock is difficult to determine. Despite fresh samples, pillow structures, amygdules, or volcanic clasts could not be identified. The volcanics have suffered low grade regional metamorphism producing greenstones of the green schist facies (carbonated chlorite-actinolite schists). Variations within the green schists are indicated by hornstones, suggesting contact induration of phyllites by lavas, and

interbedded tightly folded units (Figure 6), probably representing ashes.

The interbedded metasediments to the footwall and hangingwall of the shear zone retain primary bedding structures such as graded bedding, lode casts, scour and fill, and show a remarkable consistency of structure.

The Ashanti deposit comprises four main ore types—the quartz vein type, the disseminated sulphide type, supergene oxides and transition ore, and granitoid stockworks.

The quartz vein type comprises fractured, bluish, grey to greyish black, and laminated quartz which tend to contain specks of visible gold although smears of the metal have been noted in bands within the blue, greyish black and the laminated quartz. Galena, sphalerite, tetrahedrite, chalcopyrite, bournite and pyrite are usually associated with the very rich quartz ores. Bismuth tellurides have been reported from only one area of the mine. Vitreous white quartz is generally low grade.

Disseminated sulphide type comprises arsenopyrite needles, pyrite, pyrrhotite and chalcopyrite.

Supergene oxides and transition comprise relict arsenopyrite, and pyrite.

Granitoid stockworks comprises visible gold in quartz veinlets, arsenopyrite rhombs and pyrite cubes.

Exploration

Surface

Surface exploration is currently concentrated on the three main trends noted with potential for further trends developing to the east and west on the concession.

The methodology is by soil geochemical survey on a 200 m × 20 m grid, with samples collected up to an average depth of 60–70 cm from the B-C and C soil horizons since these horizons constitute the residual soil. Samples are analysed for gold and arsenic.

Anomalous areas based on statistical analysis and geological interpretation are followed up by manual trenching (thresholds 0.1 ppm for Au and 100 ppm for As) respectively. These established thresholds were successful in delineating mineralization in most of the high relief areas where arsenopyrite is a prominent sulphide mineral. With time, the high gold/arsenic anomalies in the high relief areas were becoming exhausted. During that period, an Exploration Strategy Scoping Study Project involving leading explorationists from Western Australia in conjunction with our own exploration teams was initiated.

The study, employing an integrated approach, soil

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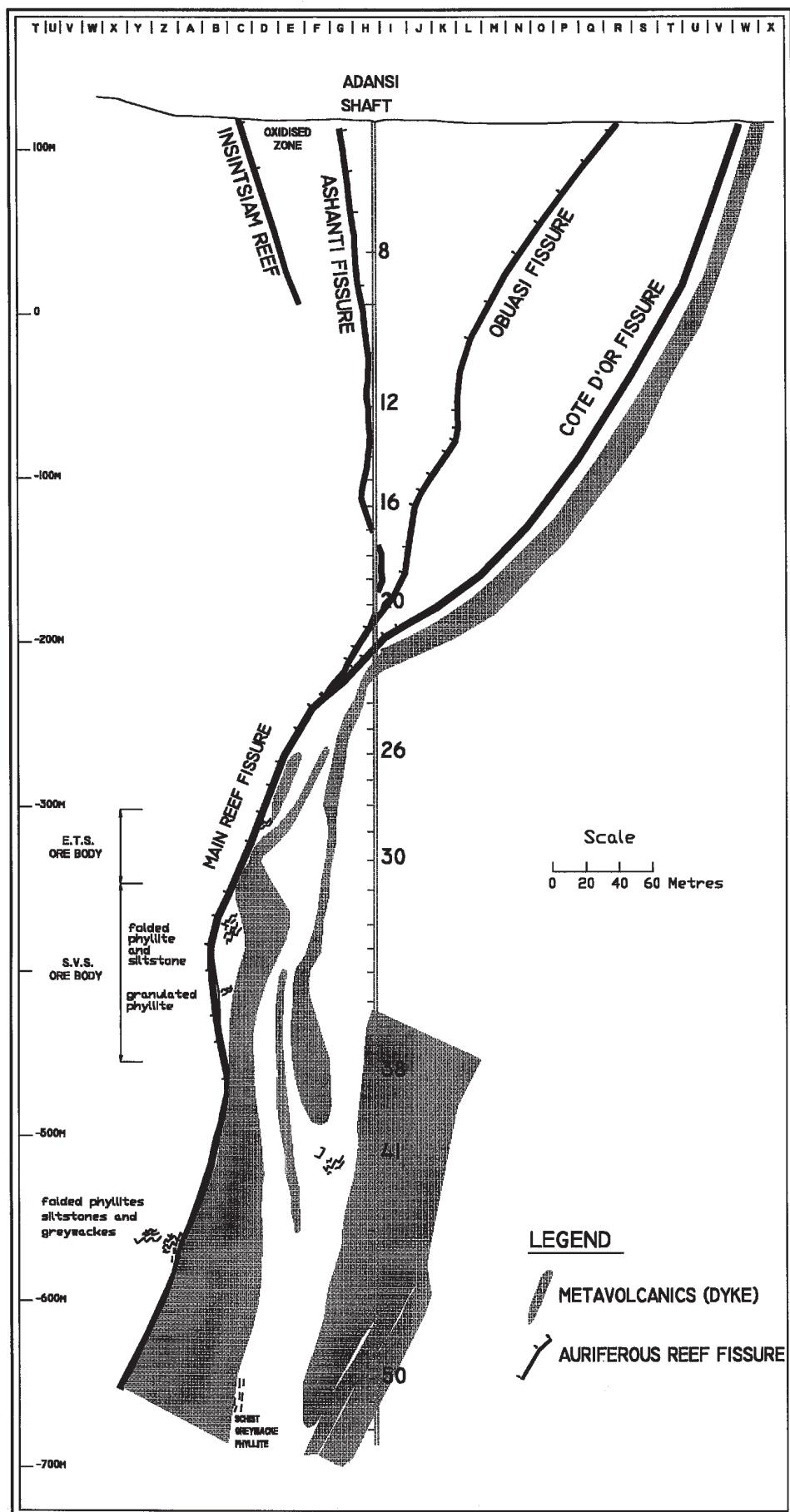


Figure 7—Section of the fissure system through Adansi Shaft illustrating the various fissures and their junction zones at depth

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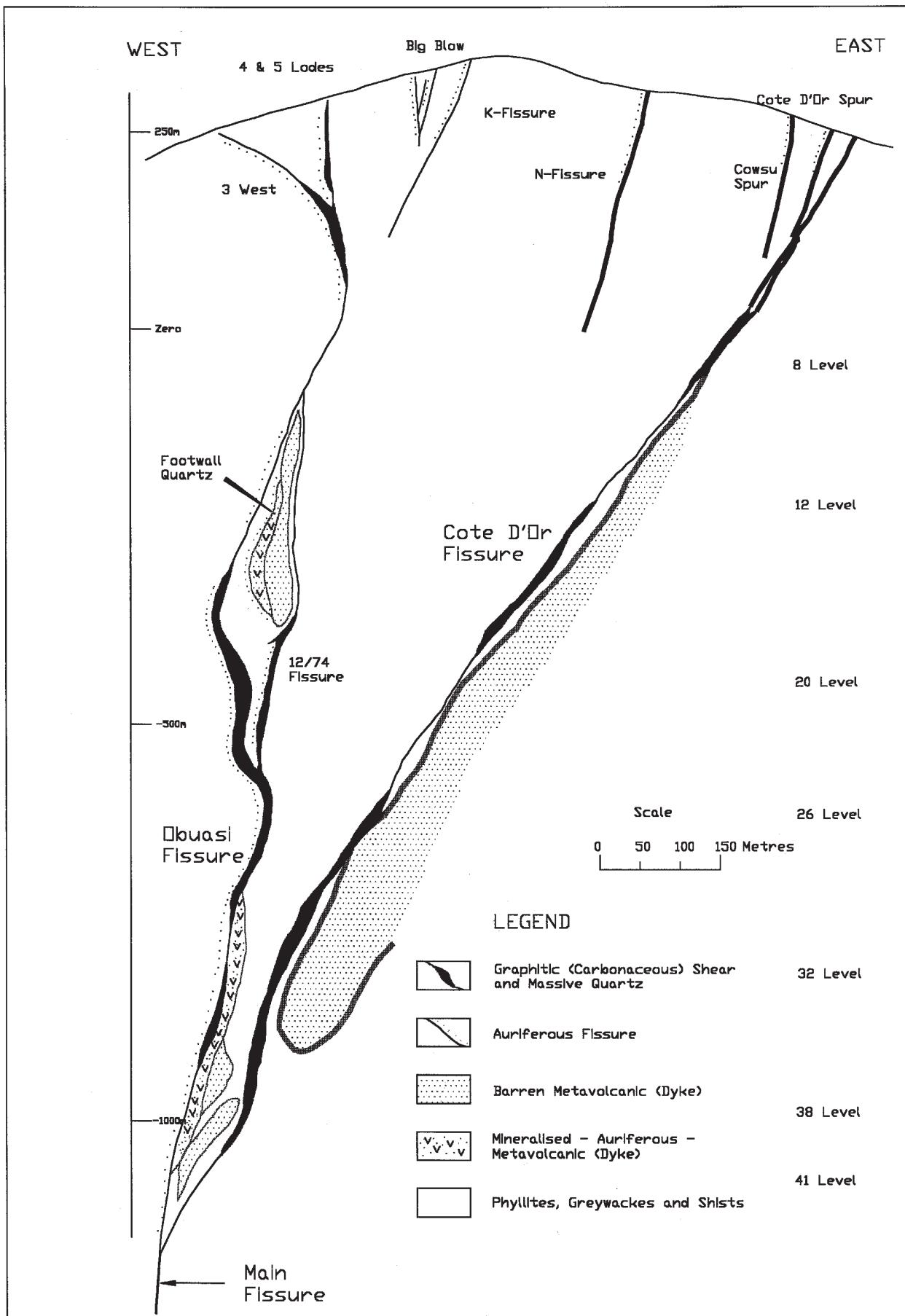


Figure 8—Section through the Fissure System around Kwesi Mensah Shaft area

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geochemistry, aero geophysics (exclusive helicopter electromagnetics, magnetics radiometrics) ground geophysics, aerial photography and structural geology has confirmed various Au and As anomalies.

Prior to the above project, there was the strong belief based on experience in the high relief areas that there was not the likelihood of further oxide resources of significant size to be found on the rest of the property, utilizing the above thresholds. There was, therefore, the need to initiate a programme of revisiting all subtle anomalies. These included anomalies down to 50ppb Au and 50ppm As which were prioritized for follow up. Initial follow-up work was by manual trenching.

Owing to the rather deep weathering profile in these areas, manual trenching was found to be slow, and often unable to reach the sampling horizon of decomposed bedrock. The normal effective trench sampling horizon in our environment in this low relief area is of the order of 6–7 metres.

Mechanical trenching employing a Komatsu PC 300 LC excavator was adopted. This equipment is fast, able to reach the desired depths of sampling with productivity levels of 80 to 100 metres of trenching in a day. The excavator facilitated deepening of trenches which were previously dug by manual means.

This has resulted in the establishment that anomalies as

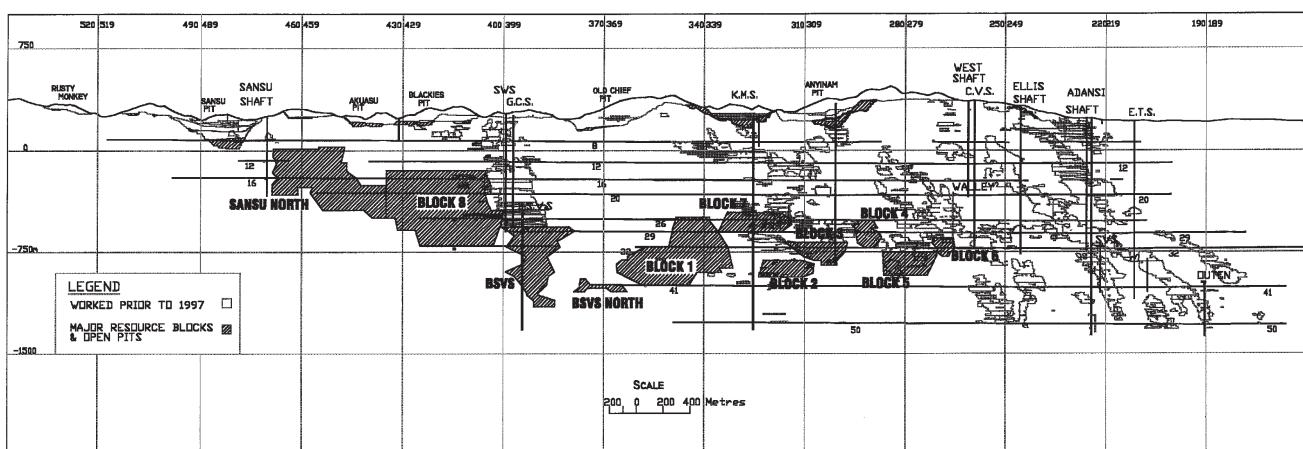


Figure 9—Longitudinal projection of the mine on the main Obuasi Trend illustrating the major resource blocks, and plunging geometry of the oreshoots

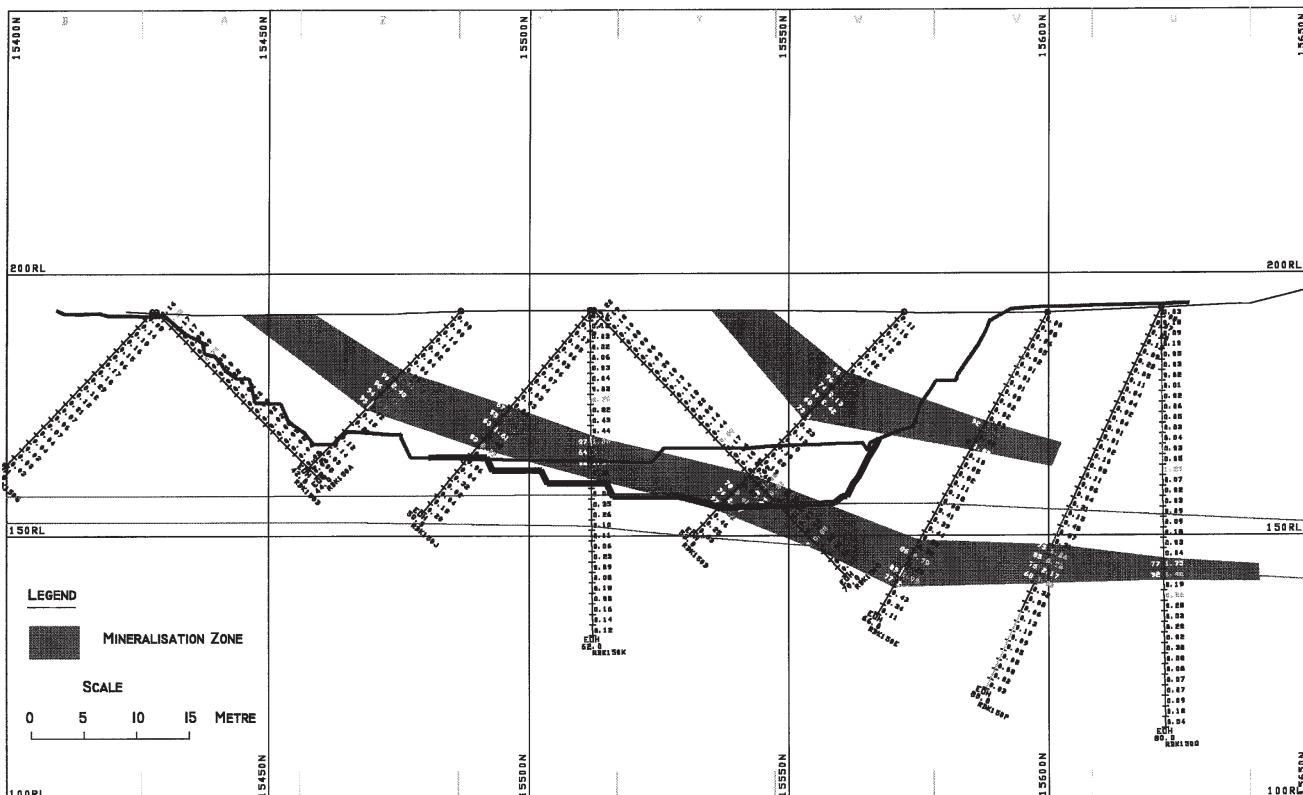


Figure 10—Section of west dipping low angle reversed fault hosting Au mineralization

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low as 50ppb Au/50ppm As were sufficiently significant as one moved away from the ridges that surround the main area of Obuasi further to the west in relatively low relief ground. To date, three oxide deposits have been delineated and evaluated by the above levels of soil anomalies, which is unusual in the Obuasi area.

From the structural point of view, the mineralization in the low relief, deep weathering profile underlying the Binsere concession is associated with west-dipping low angle reversed faults similar to the style in Ballarat, in Australia, usually referred to as the leather-jacket lode (Professor D. Groves—personal communication; Dr D. M. Ramson of D. M. Ramson & Partners, Victoria, Australia; personal communication). Figure 10.

The recognition of these structures and their geochemical responses have led to the delineation of a number of mineralized structures which have been prioritized for follow-up reverse circulation drilling (Figure 5).

The average finding cost for surface oxide is approximately \$15 per ounce.

In our experience, the soil anomalies that have been defined on the three mineralized trends have not exhibited significant down slope dispersion characteristics.

The use of induced polarization and ground penetrating radar (GPR) is being considered for the future.

Quality control is done by taking duplicate samples in every tenth sample for precision and inter-lab assay checks, and the introduction of standards into various batches of samples submitted for assays. Presently, check-assays are carried out in three laboratories.

Underground

The current underground exploration strategy is to replace both the surface and underground sulphide depletions by new underground resources.

Prior to the 1990s, the traditional exploration operating mode in the underground mine was to develop ahead of the mining face with footwall or hangingwall drives and locating the economic zones by either cross cutting or short hole diamond drilling, using compressed air rigs. At the production rate of 60,000 to 70,000 tonnes per month upwards of 140 stopes were in production at mining rates of 200 to 500 tonnes per month using scrapers in the cut-and-

fill stopes and 1 yard electric scoops in sub-level caving areas. In the steeply dipping quartz predominant structures a stope would take several years to complete the vertical distances of 30 or 60 metres and mining widths of 2 to 5 metres. The ore reserve was maintained at some 7.0 to 8.0 million tonnes at approximately 17 grams per tonne.

Figure 9 shows the vertical projection of the mine. The lateral extent from north to south is 8 km and has been worked to depths up to 1,600 metres over the past 100 years.

The oreshoots are structurally controlled. This is illustrated by their plunging geometry.

Structural work carried out with Etheridge Henley Williams led to the following interpretation for the controls on mineralization:

- Shears or fissures follow/reactivate major thrust and its splays.
- The relatively flat plunging oreshoots are controlled by cross-folds that plunge at about 40° to the north-east.
- East-west and NW-SE cross-faults control the steeply plunging shoots.

The company now has a fleet of 9 electrohydrostatic drills, 5 Longyear rigs (two LM75, one LM55 and two LM45) and four Diamec 252, together with ten compressed air rigs.

Underground diamond drilling is carried out by in-house facilities (NQ core size for exploratory drilling and BQ size for infill drilling). During the 1997 calendar year, 85,000 metres of drilling was completed. 53,000 metres of this metreage was for exploratory drilling.

The planned metreage for 1998 is 66,000 metres of drilling. This comprises 36,000 metres of exploratory drilling to delineate 1.5 million ounces of resource and 30,000 metres of infill drilling, respectively.

The finding cost per ounce of resource is approximately \$3.00

Presently, some 90 per cent of underground resource lies above the 41 haulage (1,200 metre level) and there is considerable scope for further finds under the current exploration programme between the 1,200 metre and 1,500 metre levels.

Present exploratory drilling has also indicated structure and value continuity to 1800-metre level. Drill results and our knowledge of the deposit point to an open ended set of oreshoots at depth.

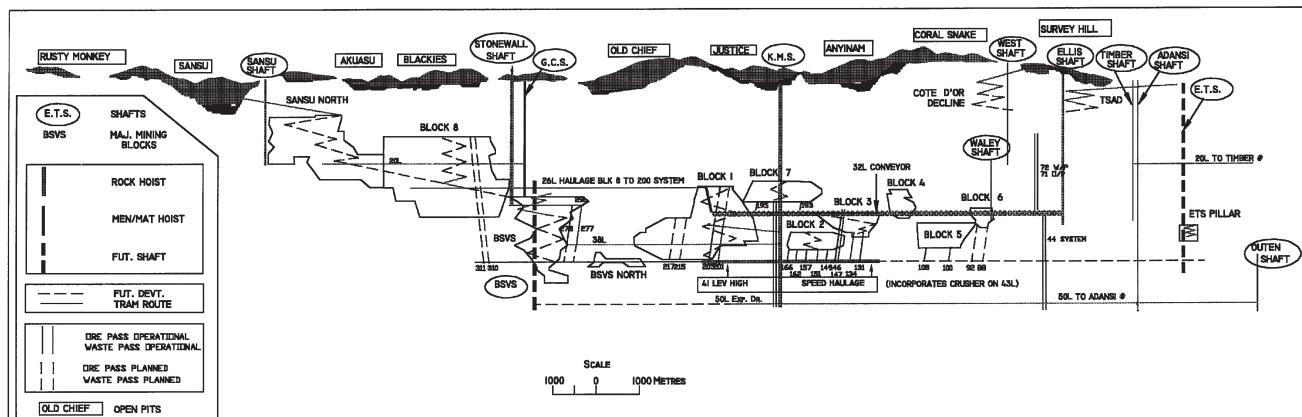


Figure 11—Longitudinal projection illustrating infrastructural development (a new mine within an old mine)

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A development programme to cater for the next phase of exploration down to 75 level, 2,300 metres below the surface, is under way with the first long crosscut into the footwall on 50 (1,500-metre) level for diamond drilling at depth in progress.

Diamond drilling during the last four to five years had delineated large resource blocks to the south, namely, Block 8, Sansu North, BSVS, and BSVS North resource blocks (Figure 9).

Block 8, comprising broad multiple zones of mineralization, sometimes up to six zones has equally significant mining widths which favour the application of bulk mining methods (Figures 9, 12 and 13). It currently stands at 15.6 million tonnes containing 4.9 million ounces.

The trend in the configuration of mineralized zones continues south to the Sansu North ore shoot, which was first intersected in the middle of 1995, and now has a resource of 7.3 million tonnes containing 2.2 million ounces (Figures 9, 14 and 15).

Suffice to round off on large resource blocks by stating that the Brown Subvertical Shaft North (BSVS North) ore shoot intersected in August last year now has a resource

of 3.8 million tonnes containing 1.1 million ounces, and it is open ended to the south and at depth.

It is also worth noting that all mineral resources quoted in this document include only measured and indicated resource and that the delineation and evaluation has been carried out by adopting the Australasian Code of Reporting of Identified Mineral Resources and Ore Reserves.

Resource evaluation is by the Datamine software in all the major resource blocks with the polygonal method being used in the old resource areas largely in the north of the mine. To date, about 65 per cent of the underground resource largely in the central and south of the mine has been block modelled.

In terms of overall resource, there are three major sources at Ashanti Obuasi; underground, surface and tailings.

As at 31st December, 1997, the overall mineral resource stood as follows:

Underground	—58 million tonnes @ 10.5g/t Au
Surface	—20 million tonnes @ 2.9g/t Au
Tailings	—9 million tonnes @ 2.6g/t Au
Total	—87 million tonnes @ 7.9g/t Au.

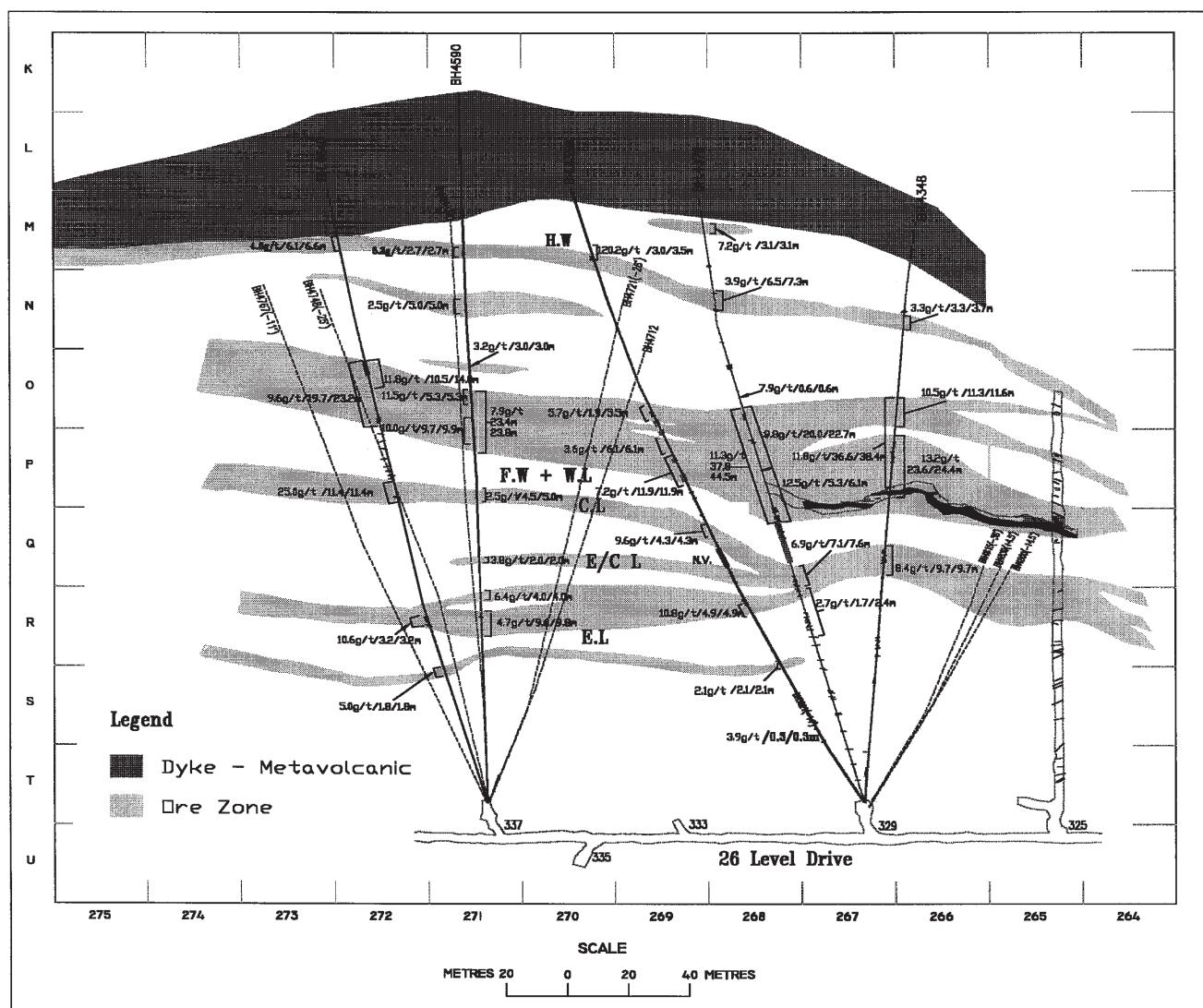


Figure 12—Plan of 26, Level Block 8, illustrating multiplicity of ore zones and significant mining widths

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Indications from exploration to the end of June this year are that resource replacement targets for 1998 will be met.

To summarize, a number of subtle soil geochemical anomalies have been identified on the surface which we are continuing to follow up.

On the underground side, the intercepts from the BSVS North ore shoot where exploratory drilling has been intensified have indicated continuity of mineralization to significant depths.

Mining strategies

As stated above, the overall mining and development strategy at Obuasi with depleting surface sulphides and large underground resources, with considerable potential dictated the strategy to expand the underground resource base while continuing to explore on the surface for new bodies. With limitations of capital in the current low gold price climate, the exploration objectives are currently confined to replacing both the underground and surface annual depletions by new underground resources and replacing oxide depletions on surface. In the wider group context, the company's objectives are to grow its other operations to reduce the level of reliance on Obuasi, which by virtue of its massive reserves and

potential, will continue to provide a strong foundation for the long term.

The infrastructure strategy for the underground mine incorporates replacing the several small shafts and trammimg levels every 60 metres to a limited number of gathering haulages feeding a few larger capacity shafts. The expansion which includes conversion of the mining methods from conventional to varying degrees of mechanization in the wider orebodies involves the move away from an all-rail transport system to a combination of short haul rubber-tyred diesel transport in conjunction with rail transport for the high-volume long-distance trammimg in gathering haulages to the shafts. In the current 10-to 20-year framework, the two main haulage systems will be the 26 Haulage on the 800 metre level in the south, feeding the new Kwesi Renner Shaft and the 41 Haulage on the 1,200 metre level that covers 6 kilometres of strike length to haul ore and waste from all the main mining blocks to the two-shaft system of Kwesi Mensah Shaft (KMS) in the Central Section and Eaton Turner Shaft (ETS) in the North, see Figure 11—a vertical projection of the underground infrastructure.

Some 90 per cent of the current resource lies above the 41 haulage and although there is still considerable scope for further finds above this level, the long-term exploration to

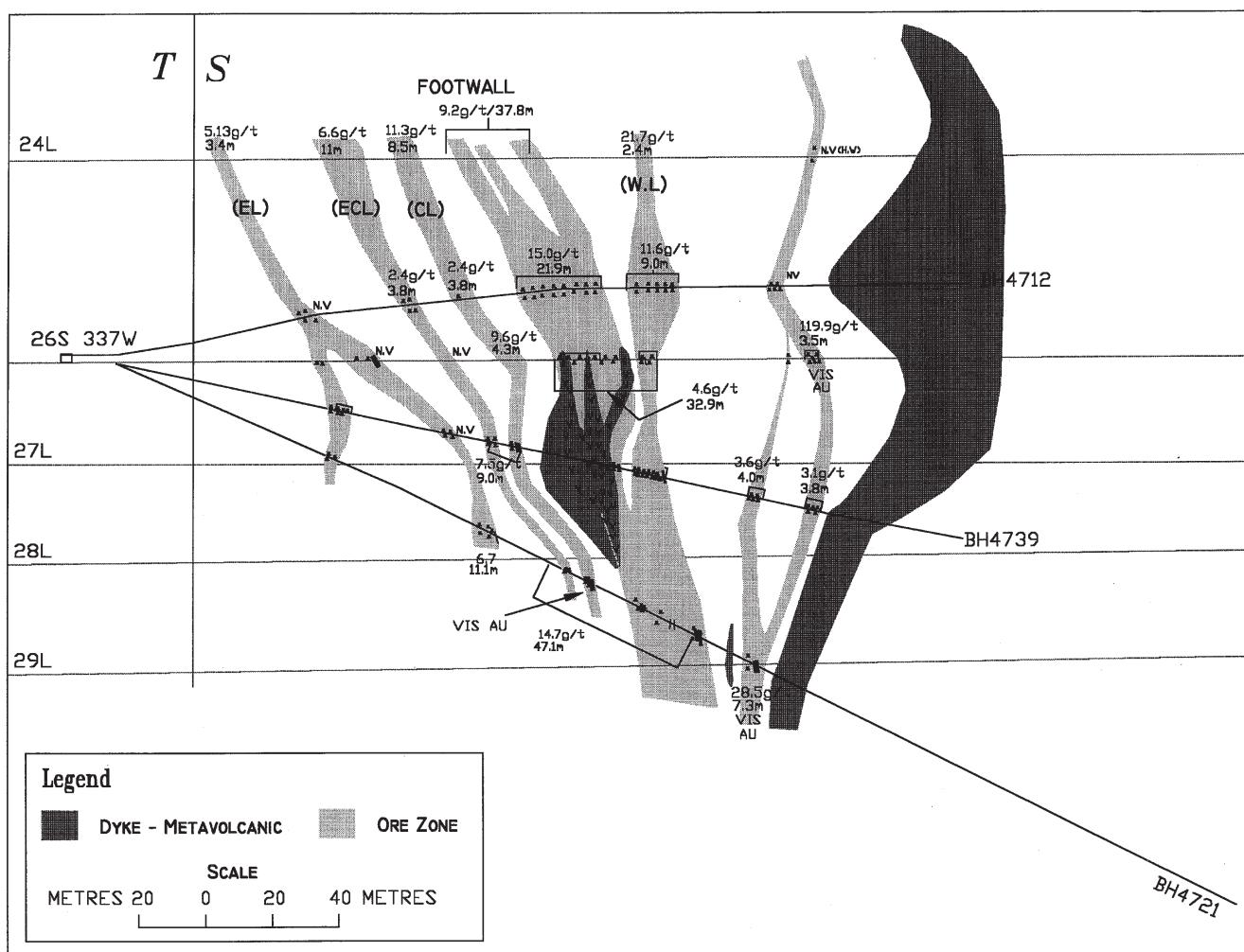


Figure 13—Section through Block 8, 730-metre level to 950-metre level

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cater for infrastructure lead times, is now concentrating on the 41 (1,200 metre) to 50 level (1,500 metre) and 50 to 75 level (2,300 metre) horizons respectively.

Following the re-evaluation of the ore resource to 31 million tonnes at a 3.4 grams per tonne cut-off, essentially including the lower grade sulphides lying in the foot and hangingwall of the quartz structures respectively, mining widths increased to an average of 10 to 15 metres with some areas up to 50 metres in width. The bulk of this additional tonnage was located in several discrete areas in the central and southern sections as shown in Figures 9 and 11. In the central section particularly, the grouping of these wide bodies allowed for the design and the development of an efficient infrastructure for both the vertical and horizontal transport systems.

The Ashanti Mine Expansion Project design incorporated expanding the underground production from the 0.8 million tonnes per annum level to 2.2 million tonnes per annum from the ore resource of some 30 millions tonnes. This has since been extended to 3.5 million tonnes per annum from the increased ore resource base of 58 million tonnes. This level of expansion has been partly driven by the economics of the scale of operations and the need to replace the surface sulphide feed to the two sulphide plants. With the original Pompora Treatment Plant at the northern end of the mine upgraded to 150,000 tonnes per month or 1.8 million tonnes per annum and with the Sulphide Treatment Plant at 2.6

million tonnes per annum, the total sulphide capacity is now 4.2 million tonnes per annum. Confidence in being able to achieve these levels of expansion, stem from the extraordinary level of mineralization over the 8 kilometre strike length of the Main Trend. In South African terms, mining is still confined to relatively shallow depths.

The exploration strategy has, therefore, been largely dictated by the mining requirement to continue operations at high production rates. This includes maintaining the ore resource base at least at the 60 million tonne, 20 million ounces level. Although finds are being made in parallel structures to the main trend—a million tonne resource has been identified some 2 km to the east. The current underground exploration objective on the Main Trend is to replace both the surface and underground mining annual depletions. To allow for a reserve-to-resource factor of some 70 to 80 per cent, mining efficiencies and plant recovery of the refractory ore at just over 80 per cent, the target is currently 1.5 million ounces per annum.

Target areas for exploration are dictated by both proximity to existing infrastructure and advanced information in areas where long lead time infrastructure is required. With current operations confined to above the 50 level horizon (1,500 metres), consideration is now being given to the next mining horizon between 50 and 75 level—1,500 to 2,300 metres. Although mining does not need to take place in this horizon within a 12 to 15 year period, long

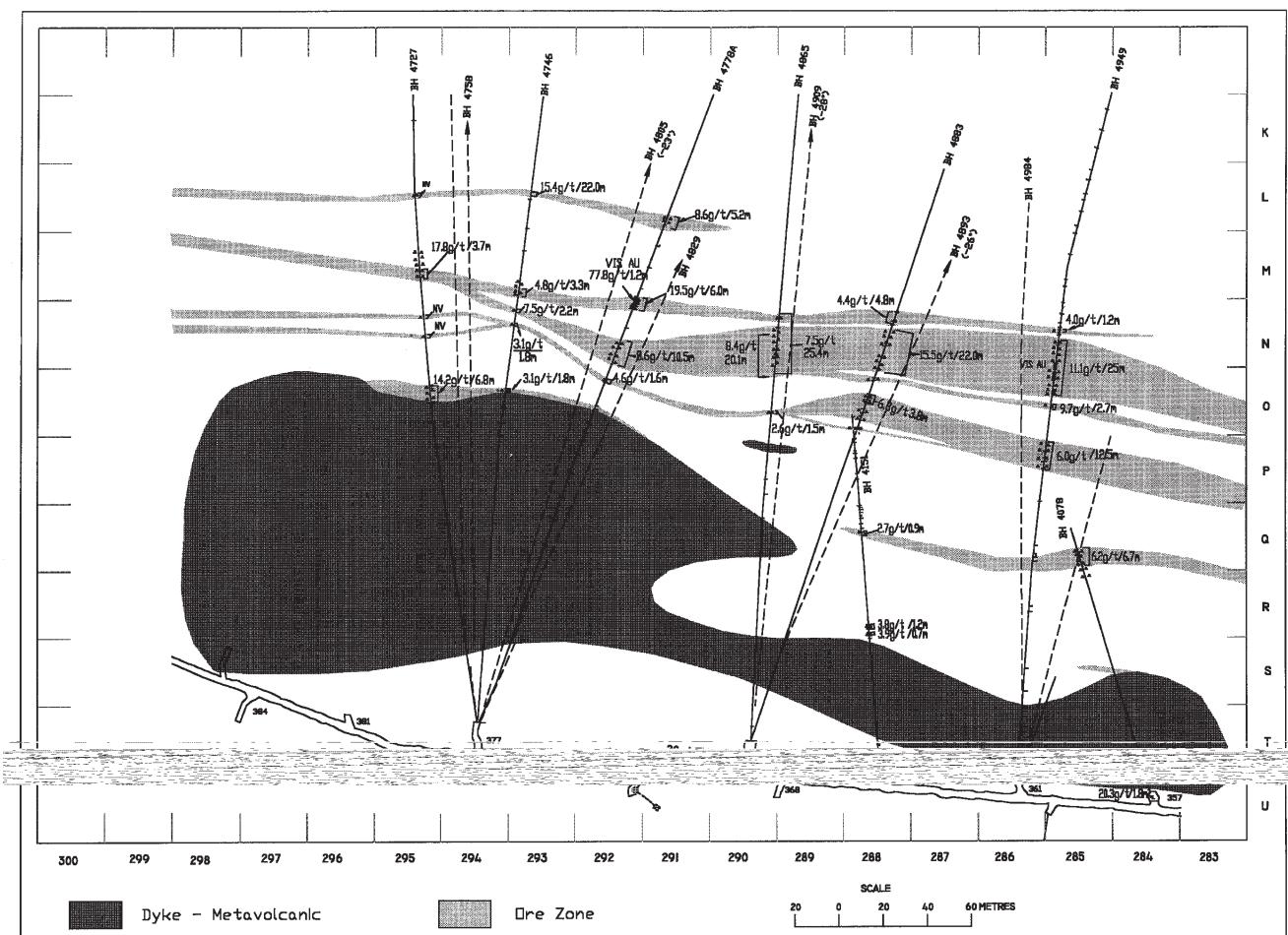


Figure 14—Plan of Sansu North Oreshoot illustrating various mineralized zones and similarity to Block 8

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lead times will be required for accessing the lower levels and in particular, as an example, the developing Brown Sub-Vertical Shaft (BSVS) North ore zone, as described above, is close to a new sub-vertical shaft of the same name that is about to be equipped. The decision on the final configuration for the shaft could be influenced by the results of exploration below 50 level in the area. If the find below 50 level is substantial as indicated by the junction zone of the major structural features, the shaft could be re-configured for later deepening to 60 level.

It is projected that mining below the 1,500 metre level will be required to expand rapidly in the 15–30 year time horizon, initial probing and infrastructure development within the 5–15 year period and exploration in the coming five years.

In South African mining depth terms Ashanti is indeed in a fortunate position particularly when reflecting that it had its 100th birthday in 1997.

Finally, the future of Ashanti in terms of mineral resource potential is great and we are confident that it will remain in production for a long time to come notwithstanding the volatile gold price.

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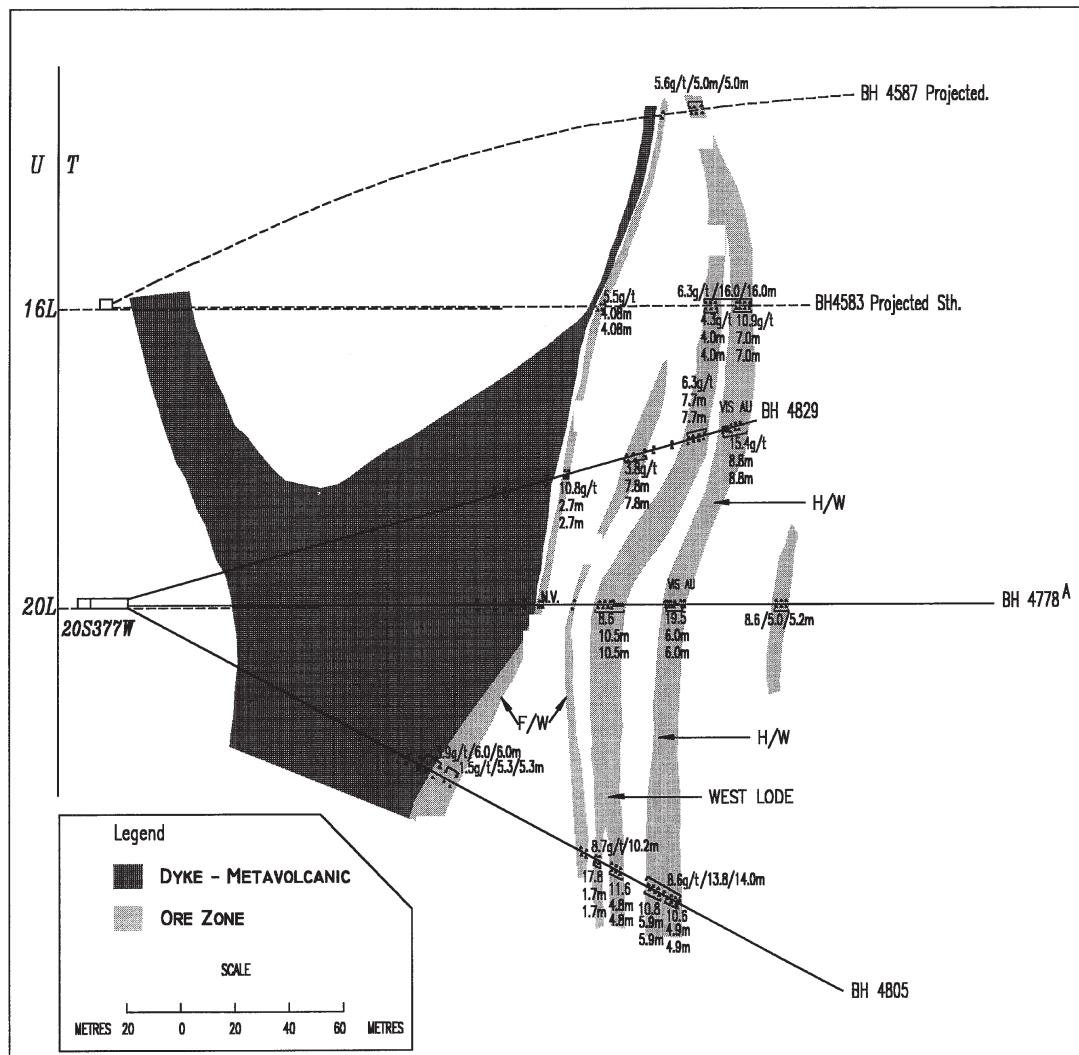


Figure 15—Section through Sansu North ore shoot levels

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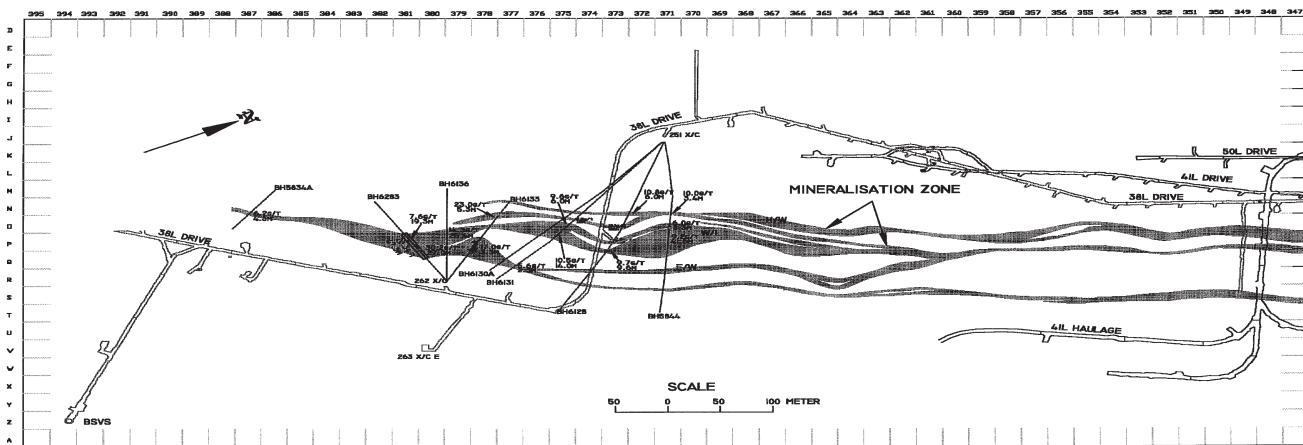


Figure 16—Plan of BSVS North orebody on the 1200-metre level

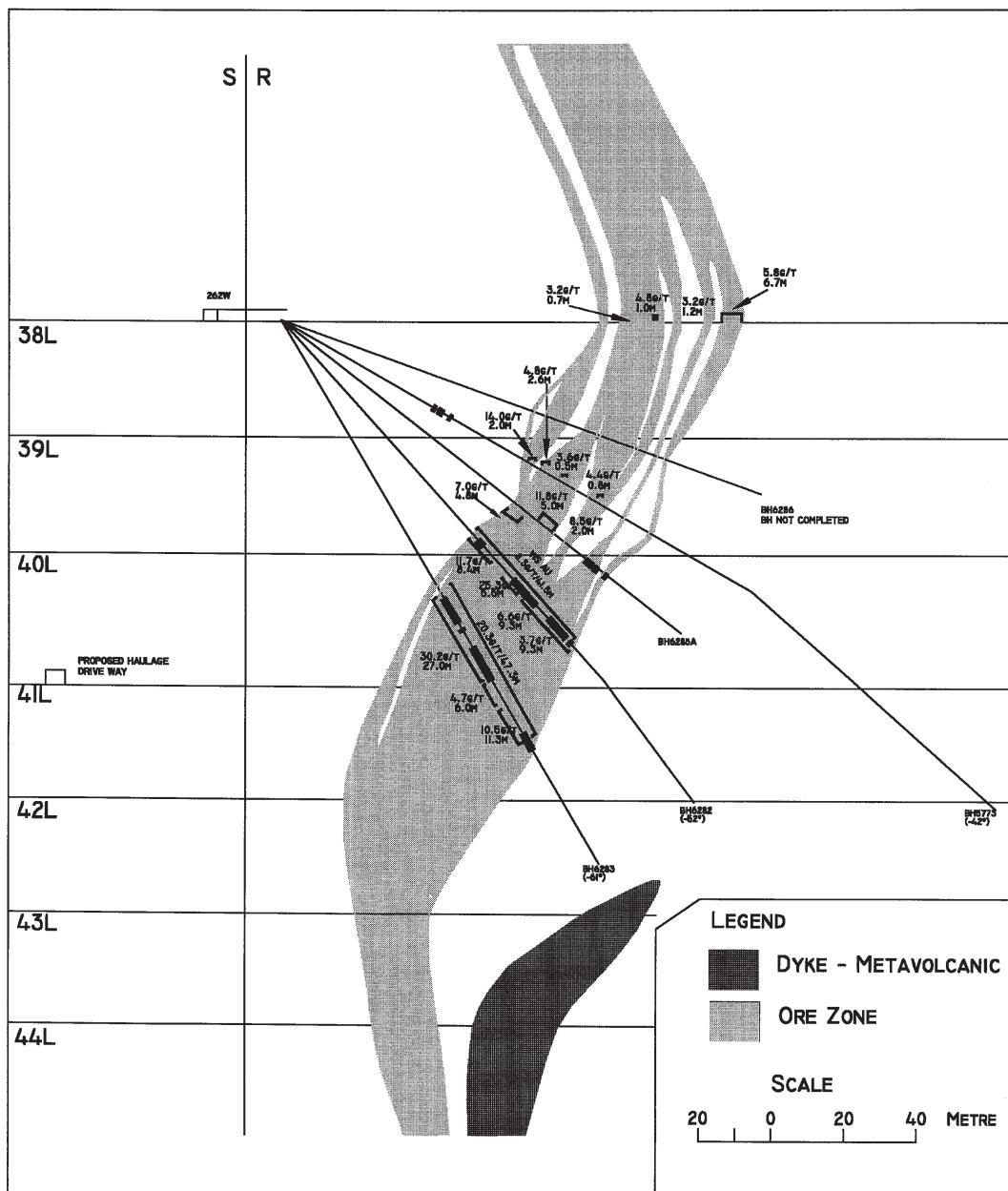


Figure 17—Section of BSVS North oreshoot

International flotation pilot plant launched at Karee Platinum Mine

A joint research initiative between the University of Cape Town (UCT) and the Julius Kruttschnitt Mineral Research Centre (JKMRC) in Brisbane, Australia, promises to break new ground in the local mineral processing industry. In 1996 the UCT Mineral Processing Research Unit was subcontracted by the JKMRC to co-ordinate the South African component of the Australian Mineral Industries Research Association (AMIRA) P9 project.

The AMIRA P9 project is an extensive research programme in the field of mineral processing aimed at understanding and ultimately simulating entire industrial mineral processing operations. The project has been running for over 30 years and is currently funded by 38 industrial sponsors, including some of the largest mining companies in the world.

Flotation forms a major component of the P9 project and, in order to further their understanding of this field, engineers on the project have designed and built a flotation pilot plant. The pilot plant is termed a Floatability Characterization Test Rig (FCTR) and will be used to characterize and optimize flotation circuits. The (FCTR) has been commissioned at the Karee Mine of the Lonrho Platinum Division and was officially launched on 13 April 1999. The launching function was attended by an international

gathering from Australia, the USA and almost all the groups working on the practical and research aspects of flotation in South Africa.

The FCTR is a highly flexible, portable flotation plant consisting of six 145 litre Wemco Smartcells™ in a rougher-scavenger duty and six 45 litre Wemco Smartcells in a cleaner-recleaner duty. The unit is fitted with the Mintek Floatstar® flotation level control system which was developed by Mintek South Africa.

It is a carbon copy of an industrial-sized unit and is constructed on a collapsible frame that fits into a 12-metre container. The plant controls and electrics are contained within the same enclosure to minimize set-up time at each test site.

The FCTR was constructed by Baker Process SA and funded by its parent organization in the United States. The FCTR was jointly donated to the research project by Dr Mike Nelson, product research manager of the US company and Mark Craddock, marketing director of the local company.

The FCTR forms an integral part of the AMIRA P9 project and will be used extensively on industrial flotation circuits in South Africa and Australia over the next five years.

Euromin 99*

European Industrial Minerals and Markets

6–8 June 1999, Athenaeum Inter-Continental, Athens, Greece

Supported by IGME, The Institute of Geology and Minerals Exploration in Greece

Euromin 99 will discuss important topics pertaining to the European industrial minerals industry. Attracting delegates on an international scale, this event will be an exciting opportunity to discuss new and growing markets of Europe and its neighbouring countries.

What are the current trends in European mineral consumption? Which markets are showing the most growth? What opportunities are there for exporting into Europe? How will the Euro affect mineral trade?

Many eminent speakers including an international panel of 13 key speakers will present wide-ranging topics, such as:

- Kaolin—meeting the needs of the European ceramics industry
- Mineral flame retardants: overview and future trends
- Industrial minerals of Greece
- Arab mineral wealth—an overview
- Industrial minerals of the Eastern Rhodopes, Bulgaria
- The role of modern logistic services on European industrial minerals

- Challenges in the sanitaryware industry, the feldspar case
- The influence of the US cement industry on European cement producers
- Markets for Turkish feldspar
- The role of IMA in the European industrial minerals industry
- Status of the European Foundry Industry
- Silicon carbide—a market review
- The future of magnesite.

A field trip is also planned to visit the Aegean island of Milos where over a quarter of Greek industrial minerals are produced. The visit will take place at the bentonite and perlite mines and processing plants of the Greek mining giant, Silver and Baryte Ores Mining Co. Companies wishing to display their products and services contact Sharon Thomas: Tel +44 (0) 171 827 9977, Fax +44 (0) 181 337 8943 or e-mail: sthomas@metalbulletin.plc.uk