

## AFRICAN GOLD: POTENTIAL, PROBLEMS AND OPPORTUNITIES

Camillo Premoli  
*Suite 16, St Neot Ave, Sydney, 2011*

**Keywords:** Gold, Sub-Saharan Africa, exploration techniques, potential, artisanal mining, environment, corruption, political risk, geological models, Precambrian, mining targets, armed conflicts.

### Foreword

It had to come. Pierpont has always rightly insisted, tongue firmly planted in cheek, that after "this high-grade deposit" (where no size is given) and "this very large deposit" (where no grade is given), the next best thing was "this large, high-grade deposit in the Central African Republic" (Sykes, 1996, p. 63). That time has eventually arrived — Africa is now the flavour of the month.

A quick computer search on the ASX shows there are at least 32 Australian companies involved in gold and metalliferous exploration in Africa in mid-1997. There are probably many more. New African floats seem to be almost a weekly event, often very much along the lines anticipated by Pierpont.

This paper uses in part material previously presented under the title "Africa, New Light on the Dark Continent" in Dubai at the invitation of the local Chamber of Commerce (Premoli, 1997a). Dubai is a very small country that nevertheless trades approximately 400 tonnes of gold each year, so when they are talking of gold the people of Dubai are deadly serious.

### ABSTRACT

The focus of this paper is sub-Saharan Africa and its potential as a future major gold producer.

Sub-Saharan Africa was the traditional source of gold for the Mediterranean and Middle East civilisations. The discovery of America and then of Australia changed all that. So did the development of the colossal gold deposits in the Witwatersrand in South Africa a century ago.

Now sub-Saharan Africa is stirring again. The still formidable gold mines of South Africa are producing less and less but the rest of Africa, despite its enormous problems, is producing more every year. Gold explorers and investors are flocking to Africa, and not just to the well-established producing countries — such as Zimbabwe and Ghana.

This current fascination with Africa is geologically sound but there is a number of constraints specific to that continent. Some of these constraints are examined, including limited record of geological information, limited numbers of suitable personnel. Some areas of perceived, but still underestimated, gold potential are outlined, such as level of gold endowment, major deposits, .....

### INTRODUCTION

This paper on gold in Africa omits South Africa, still the world's largest producer but with very serious problems in these times of depressed gold prices. Also omitted are the five African countries on the Mediterranean seaboard (Morocco, Algeria, Tunisia, Libya and Egypt), as they are unlikely to become major gold producers in the near future (cf. Figures 1 and 2). That still leaves a formidable land mass, including nearly all sub-Saharan Africa (Figure 1), which covers more than 23 m km<sup>2</sup>. It is an area larger than Australia and larger than North America yet, unlike those continents, is still very poorly explored. The geological and mineral knowledge of that part of Africa is approximately at the same level as that of Australia some 30 years ago. Africa has largely missed the latest geological and exploration developments and, above all, was left behind in the gold rush of the past 20 years.

The writer has worked in all the African countries mentioned in this paper.

### Historical review

Gold has been produced in Africa for thousands of years. The Egyptian pharaohs of the Fourth Dynasty actively encouraged gold mining in Nubia and Ethiopia, and it is noteworthy that traditionally an African king is recorded as having brought gold to Bethlehem.

West African gold was actively traded in the Arab world from at least the 7th century AD, and contributed to the power of the African empires of Ghana, Mali, Songhai and Ashanti. It is said that in 1324 the famous Mali emperor, Mansa Mousa, went on a pilgrimage to Mecca bringing along eight tonnes of gold as a gift, a quantity large enough to seriously depress the gold prices in Cairo for years (Utter, 1993).

In the late 19th century the fabulous gold riches of the Witwatersrand were discovered, and Africa was never

to be the same. South African gold flooded the markets, and has stayed in the premier market position for almost a century.

The rest of Africa was less fortunate. Paradoxically, a century of furious colonialism did little for gold exploration in Africa. Almost as soon as the new colonial boundaries were put on the maps gold prices became depressed, and remained that way for several decades. Nor were there any indications anywhere in Africa of a new Witwatersrand. The incredible riches of the Congo–North Rhodesian (Zimbabwean) copper belts were where the mining investments really went.

Colonial slumber settled in and the achievement of independence of most African states by the 1960s changed matters little, as an even more dreadful socialist slumber took over. By the time gold prices picked up again in the late 1970s, Africa could not have been a worse place for would-be explorers. Most of Africa's geological information was by then obsolete, infrastructure was decaying; and much of the bureaucracy was bloated. Foreign capital stayed away. It was only in the late 1980s, with the rather spectacular changes in the world geopolitics, that the outlook started to change.

In the past 10 years most African countries have passed new mining legislation, and international gold explorers have started to move away from the mature regions of Australia and North America and into Africa.

Africa is now very much the darling of international companies, and is absorbing 11.9% of global exploration expenditure — a significant increase on only a few years ago. This places Africa behind Latin America, Australia and Canada but ahead of the Pacific/South East Asia, the United States of America and the rest of the world (Chadwick, 1997).

## POTENTIAL

An assessment of the gold potential of Africa is still largely speculative — more so than any other continent except Antarctica. However, the following arguments are in Africa's favour (cf. Table 1).

- Sub-Saharan Africa's enormous geographical extension and its Precambrian geology. This is prime exploration ground, and there is a lot of it.
- Africa's (other than South Africa) known gold endowment of only 5 oz/km<sup>2</sup> as compared with 30 oz/km<sup>2</sup> for the far better-explored land in North

America and Australia (Table 1). It seems reasonable to assume that, with more exploration, Africa's known gold endowment will increase dramatically.

- Sub-Saharan gold production experienced a healthy increase of 160% between 1980 and 1990. It is not as spectacular as Australia (which increased its production by 1320% over the same period), but is certainly more than South Africa. Moreover, gold production in sub-Saharan Africa, unlike Australia, is just now resuming significant growth.

Historically there has always been a broad correlation between money spent on mineral exploration and the quantity of resources discovered. Considering its favourable geology, there is every reason to expect a vigorous increase in gold production in sub-Saharan Africa. Mali is already showing the way.

Africa has been a late starter in this century's gold mining but, if its exploration momentum is sustained, production will follow. Present trends (Table 2) point to a respectable 200 tonnes/year by the turn of the century. By then South Africa's production will have slumped to 400 tonnes/year (writer's own projections). Thus the overall pattern of African gold production will have materially changed.

**TABLE 1. CUMULATIVE GOLD PRODUCTION OUTSIDE THE PACIFIC RIM**

REGION	AREA km <sup>2</sup>	GOLD PRODUCED 1850–1990 tonnes	PRODUCTION CHANGES 1980–1990	KNOWN GOLD ENDOWMENT oz/km <sup>2</sup>
South Africa	1 185 000	43 307	-10%	1117.2
Rest of Africa	23 381 000	3 500	160%	4.83
United States of America	9 369 000	11 197	877%	37.7
Canada	9 971 000	7 474	226%	23.6
Australia	7 682 000	6 971	1320%	28.6
Brazil	8 513 000	1 242	117%	4.6

Note: Traditional units have been used for gold production information: 1 ounce (oz) Troy = 31.103477 gm (or g).

**TABLE 2. AFRICAN GOLD PRODUCTION**

Year	1970	1980	1990	1991	1992	1993	1994	1995	2000
<b>All values in tonnes of gold per year*</b>									
South Africa (SA)	1000	675	605	601	614	619	584	522	400
Other Africa (OA)	44	35	70	90	101	111	118	130	200
Ratio SA/OA	23	19	8.6	6.7	6.1	5.6	4.9	4.0	2

Sources: Historical data (1970–1995) are from Consolidated Goldfields (1996)  
The projection for 2000 is from International Mineral Research (1997)

## MODERN EXPLORATION TECHNIQUES

Sub-Saharan Africa is in a perfect position to benefit from the tremendous wealth of exploration expertise expensively acquired by other countries — particularly Australia, which has arid conditions and geology very similar to Africa.

This new expertise can benefit Africa in two ways.

1. Exploration is likely to entail searching for types of gold deposits that were unknown only two decades ago. In Australia, the major resources at Boddington, Roxby Downs and Ernest Henry are good examples of relatively newly recognised deposit types. These are

large deposits but with practically no surface expression — they are classic "blind" deposits.

Only geologically competent companies could identify such deposits, which would most likely be totally missed by simple prospectors. This would be a welcome and major change for Africa. If such deposits are discovered in Africa (and there is no geological reason why they shouldn't), the gold exploration momentum would then increase dramatically. Large investors feel comfortable with large deposits and regions of proven major potential — "elephant country", to use a classic cliché.

2. Future exploration will make use of very advanced exploration techniques. These modern techniques (notwithstanding that they have been developed from

earlier procedures) have proved very successful in the discovery of gold deposits in deeply weathered or sand-covered areas in Australia (ie, Yilgarn, Gawler and Mt Isa blocks), and they are ideally suited to Africa. But Africa's depth of weathering is considerable and can be greater than over much of Australia — up to more than 100 m for some regions (eg, Guinea, Mali) of west Africa. The age of the weathering profile, and the climate, are also important factors.

The list of such exploration techniques is too long for the scope of this paper, and some are discussed elsewhere in this volume (eg, Farquhar-Smith et al., 1997). Modern airborne geophysics coupled with satellite imagery should give good results (cf. Anderson and Nash, 1997), particularly if used in conjunction with inexpensive satellite positioning systems on the ground (an essential requirement in Africa, where modern maps may often be unavailable). Ultrasensitive geochemical methods (down to one onehundredth part per billion of gold in water, soils or calcretes) should also be useful. Australian geoscientists know how to handle these technologies.

Thus, Africa now has two of the three factors necessary to discover new gold deposits: a favourable geology; and access to modern techniques needed for discovering them. What is still lacking is a sustained and well-financed commitment and a precise appreciation of Africa's problems. Slow learners will be heavily penalised in Africa, more so than in any other continent.

## SOME AFRICAN PROBLEMS

### Political fragmentation

While the largest gold-producing countries (South Africa, United States of America, Australia, Canada) are politically homogeneous landmasses, Africa is not. Sub-Saharan Africa is divided into a number of countries (Table 3) with different gold potential, cultures, languages, mining codes, and attitudes.

This makes a big difference. Regional exploration for gold, particularly in poorly-known regions, must cover large areas. In Africa, this often means dealing with the administrative systems of two or more countries at the same time. Countries with relatively good geological records may border ones where ground exploration has been impossible for decades. Countries with stable political regimes may border nations in full civil war. This tends to worry some large companies committed to innovative exploration work.

The fact that three of Africa's largest and most mineral-rich countries — the former Zaire (now Congo), Angola and Sudan — are locked in very uncertain political situations does not help. This is particularly so because a surprisingly large number of Australians still appear unable to tell which country is which. Decent, orderly Namibia is still mixed up with Angola (McNicolls, 1993); a largely reformed Uganda is still associated with Idi Amin's or Obote's excesses; and so forth.

TABLE 3. AFRICA'S GOLD POTENTIAL

COUNTRY	AREA km <sup>2</sup>	FORMER COLONIAL POWER	GOLD PRODUCTION tonnes/year Note 1	GOLD POTENTIAL Note 2	RECENT PAPERS ON GOLD Note 3	RECENT ARMED CONFLICT	RECENT MINING PROVISIONS Note 4
Angola	2 382 000	Portugal		Good	0	Yes	Yes
Benin	113 000	France		Mediocre	0		Yes
Botswana	600 000	Britain		Good	2		Yes
Burkina Faso	274 000	France	2.7	Good	4		Yes
Cameroon	475 500	France		Good	0		
Central African Republic	625 000	France		Good	0	Yes	Yes
Chad	1 284 000	France		Good	0	Yes	Yes
Congo	342 000	France		Fair	0	Yes	
Eritrea	118 000	Italy-Ethopia		Good	9	Yes	Yes
Ethiopia	1 222 000	-	2.9	Good	35	Yes	Yes
Gabon	267 000	France		Good	2		
Ghana	238 000	Britain	52.2	Very Good	22		Yes
Guinea	255 000	France	6.5	Good	1		Yes
Guinea- Bissau	36 000	Portugal		Mediocre	0	Yes	
Côte d'Ivoire	322 000	France	3.2	Fair	3		
Kenya	583 000	Britain		Mediocre	1		
Lesotho	30 000	Britain		Mediocre	0		
Liberia	111 000	-		Fair	0	Yes	Yes
Madagascar	594 000	France		Good	0		Yes
Malawi	94 000	Britain		Mediocre	1		
Mali	1 240 000	France	7.8	Very Good	4	Yes	Yes
Mauritania	1 031 000	France	1.3	Good	0		Yes
Mozambique	785 000	Portugal	0.9	Good	5	Yes	Yes
Namibia	824 000	South Africa	2.1	Good	4	Yes	Yes
Niger	1 186 000	France		Good	1		Yes
Nigeria	924 000	Britain		Fair	2		Yes
Senegal	197 000	France		Good	0		Yes
Sierra Leone	72 000	Britain		Fair	0	Yes	Yes
Somalia	630 000	Italy-Britain		Mediocre	1	Yes	Yes
Sudan	2 506 000	Egypt	3.6	Good	2	Yes	
Tanzania	904 000	Britain	5.3	Good	6		Yes
Togo	57 000	France		Mediocre	0		
Uganda	237 000	Britain		Fair	2	Yes	Yes
Western Sahara	266 000	Spain		Fair	0	Yes	
Zaire (now Democratic Republic of Congo)	2 345 000	Belgium	9.5	Good	1	Yes	Yes
Zambia	753 000	Britain		Mediocre	3	Yes	Yes
Zimbabwe	390 000	Britain	26.1	Very Good	28	Yes	Yes
Average	658 068			Total:	139		
Australia	7 682 300			For comparison:	389		

Sources: (1) = Consolidated Goldfields (1996)  
(2) = International Mineral Research (1997)  
(3) = Geo Ref American Geological Institute Disc 4: 1995-1997  
(4) = Otto (1995)

## Corruption

Corruption has frequently been mentioned as a major constraint in Africa. The case is probably overstated.

The worst cases of corruption and plunder in mineral-rich countries (and Zaire or Congo comes inevitably to mind) can be seen as an unfortunate legacy of colonial times. In any case they took place with the open sycophancy of major European interests. The sudden "discovery" of Zaire as being corrupt is quite disturbing.

On the other hand, some newly-independent African countries (for example Eritrea) have exemplary standards, which bode well for future mining investments in Africa.

It has also been noted that, all things being equal, the mining sector, traditionally an area of investment, is less prone to corruption than most. Corruption is simply seen by a long-sighted mining investor as an additional, and unwelcome, investment risk (Premoli, 1997b).

Another argument, increasingly being made by influential African voices (Versi, 1996), is that African corruption is often promoted by the industrial countries themselves. To offer bribes in an overseas project is considered a punishable offence only in the United States of America. The Australian mining industry will have everything to gain in taking steps to criminalise corrupt practices overseas. This need not be an ethical decision, just a practical one — if for no other reason than to fend off competitors with deeper pockets and inferior mining expertise!

But, by and large, the mining scene in Africa is less corrupt than it may appear to outsiders. Africa, being the poorest continent on earth, should be the most corrupt one, but it is not (that distinction goes to South East Asia, Premoli, 1997b). Totally transparent mining businesses are perfectly possible in a surprising number of African countries. The mine manager (and a very old African hand) of the largest gold mine in Guinea offered the writer this valuable piece of advice: "You see ... in the long run ... Africans like consistency ..." (Jacob, 1996).

### **Suitable personnel**

This is an often overlooked constraint. Most major explorers in Africa feel that their greatest problem is a lack of suitable personnel, particularly at a senior level. Gold exploration techniques can be easily transferred

from one continent to another, but people cannot be relocated so readily. A capable Australian manager in a Queensland gold project could turn out to be a costly failure in a similar project in, say, Burkina Faso or Mozambique.

Long gone are the times when expatriates were enthusiastically staffing the Geological Surveys of half of Africa. Experienced expatriates in Africa are now rare people, and can be both demanding and very expensive, or just uninterested. This adds to overall gold development costs.

Making serious gold discoveries in Africa is not cheap in any case. Only very well managed companies have an advantage in operating in Africa. For companies reduced to "painting by numbers" because of a lack of key personnel, Africa, like any other overseas venture, could turn out to be a suicidally expensive place. Several Australian examples are readily available.

### **Information availability**

This is an issue that worries a lot of Australian geoscientists. They feel that there is simply too little geological information about most countries in Africa to allow them to make sensible exploration decisions. Table 3 tabulates the number of gold papers published in the major sub-Saharan countries. The figures speak for themselves. What is perhaps overlooked is that the gifted and instinctive geologist can turn this lack of information to his or her advantage and hence move ahead of the pack. It is what the French call the "coup d'oeil"; an interesting concept.

### **Small scale mining**

Africa is a continent of small scale gold miners even panners in many cases. In countries where the per capita GDP often does not exceed \$180 a year (and far less so in rural areas), it means that winning as little as half an ounce of gold a year is to do rather well. Hence the considerable number of "artisanal" (another French expression) miners in most of sub-Saharan Africa: there are probably well in excess of two million persons involved in artisanal mining. Recently, photographs of African gold panners have started to grace the prospectuses of several Australian gold floats. Suitably exotic images, but almost meaningless.

Artisanal mining causes considerable damage to the environment and some governments (eg, Guinea, Zimbabwe and Madagascar) have tried to regulate their activities. This, of course, has proved impossible, as

Australians discovered long ago. A policeman, to be effective in a goldfield, has to earn more than a miner.

Sometimes the interests of artisanal gold miners and larger operations clash (as they also have in Papua New Guinea, Brazil and wherever there is a large number of unregulated miners). This does not have to be the case. Serious, major gold miners in Africa are seeking large, primary deposits, which require a lot of drilling and could be exploited only by large-scale, mechanised mining. These activities are well outside the capability of artisanal miners.

Governments tend to favour large and rational gold mining operations which they can tax and control, but they are obviously loath to antagonise small mining interests, which are both numerous and vocal. Direct dialogue between large mining companies and the "small men" is the only solution to these impasses. Quite often both parties can arrive at mutually satisfactory formulas for co-operation.

### **The dogs of war**

Television often shows African soldiers as harmless clowns in camouflaged uniforms. This is a stereotype. More often than not African "soldiers" are barefoot children cradling rusty assault rifles. Besides, African soldiers are not always clowns and are almost never harmless. Two aspects of this military activity affect mining and mineral exploration in some countries.

**Land mines.** This is a painful subject. No other continent is so heavily mined as Africa. Angola alone has 10 million land mines — more than one for each citizen. Land mines also seriously affect at least 10 other sub-Saharan countries, and every year more land mines are deployed in Africa than are cleared away. A typical land mine costs US\$3 to manufacture and about US\$300 to US\$800 to remove. Anti-personnel mines are meant to kill or to maim, but preferably the second, and (statistically) the main victims are women and children. About 99% of these land mines are produced outside Africa, Egypt and South Africa being the only significant African mine manufacturers. Mines have, in effect, "sterilised" some parts of the African continent to agriculture, mineral development, or any other useful purpose. A sordid business.

**Security for mining titles deals.** Trading of mining titles for military expertise is a comparatively recent development but has already affected Australian interests in the Pacific and it is increasingly popular in Africa. It works in this way. Assume that (in this example) an African country cannot any longer protect its national integrity. And assume that the country has

large, underdeveloped mineral resources (particularly ones needing only minimal infrastructure such as gold, diamonds, etc.). Then a deal can be made with legal firms doling out military expertise (from South Africa, United Kingdom, United States of America, Israel, etc.). Some of these firms have their own mining branch.

All this is perfectly legal under international or national law. True, there was a nebulous "resolution" by the Organisation of African Unity (OAU) condemning the use of mercenaries in Africa. But the OAU cannot possibly have any problems with "instructors", "communication experts", "security consultants", etc. Somebody has to keep order. And that somebody has to be paid. As simple as that. Angola and Sierra Leone are just the beginning: brace yourself for more.

## **OPPORTUNITIES**

### **Why?**

The question is often asked: why should a gold mining company get involved in Africa at all, in preference to other regions?

Paradoxically, some of the problems previously mentioned can be transformed into opportunities for the right player. For example, the confident exploration manager prefers to work in geologically poorly-known countries that daunt most of his peers. The rationale is obvious: talent and adaptability command a far superior premium in Africa than in most other regions.

What is true for individuals is true for companies: high stakes can lead to high gains. This has always been the case for any mining rush. The opportunities for gold exploration in Africa can be said to be now based on three main considerations.

- An exceptional, still unquantified gold potential — that is the single most important consideration. Leave that with the geologist.
- An unique historical window of opportunity where many African governments are providing very constructive investment and mining policies (Otto, 1995). Leave that with the lawyers.
- A time when gold exploration technology is progressing very fast and is most applicable to African conditions. Leave that with the exploration manager.

Still, to put these objective opportunities together is not particularly easy. It requires a good team and a precise

philosophy. The cardinal rules for successful gold projects are deceptively simple:

low exploration costs (say, well below US\$50 per ounce of gold discovered and proved, compared to Australian costs of around US\$65); and

low production costs (say, below US\$220 per ounce) once mining gets under way.

These are intentionally very rough figures.

An important qualification should be noted. While gold production costs vary within a narrow range, exploration costs can vary enormously. Gold deposits have been found for as little as a few dollars an ounce. Hence the tremendous importance of exploration. That is where the real gamble lies.

Often gold deposits are likely to change hands between the discoverer and the miner. Junior explorers feel they are better in breaking new ground (a still unproved point). Large mining houses feel that they can sit back and recognise a good deal when it comes along. Both these attitudes are presently exaggerated in Africa, with literally hundreds of small companies (often individuals) frantically pegging ground, and some major mining houses sitting in the wings and waiting for the best opportunity.

### **The major African players**

A perceptive view of who is best positioned for mining in Africa has been given by Ruffini (1996). The most active explorers in Africa are now the South Africans, the Australians and the Canadians. Each group tends to behave differently.

The Canadians are perhaps the miners with easier access to venture capital, particularly for funding new exploration projects. Also, the escalating costs of gold exploration in Canada make overseas ventures attractive. The speculative nature of the Canadian capital markets is naturally inclined to put a premium on companies operating in exotic places, Africa included. Most of the financing of Canadian junior gold companies is in the vicinity of US\$20 million. But they are also more reckless players than the Australians: according to Foster (1996), Canadian juniors — eg, Timbuktu Gold, Mali — were salting gold prospects in Africa long before the Busang case.

The South African gold miners are spurred on by their urgent need to replace their aging gold mines with new deposits elsewhere on the continent. There are only half a dozen major South African mining houses. They

are all looking for large deposits (over a million ounces gold, as an absolute minimum) and they favour a policy of acquisition rather than "grass roots" exploration. The South Africans stress their superior knowledge of the continent (an attitude some Africans grumble about) and their strong financial and technical expertise. Both points are overstated. Arguably, the South Africans will be the last ones to realise that Africa has changed.

The Australians are still feeling their way, but unquestionably their recently acquired experience in new gold development is relevant to Africa. The cost of discovering an economic gold deposit in Australia has proved to be much lower than Canada or South Africa. Also, the average size of deposits Australians are good at developing is comparatively small — perhaps an attractive factor to a continent by now weary of very large mining projects and their attendant social, economic, and ecological problems.

Australians are also experienced with the problems of finding gold deposits buried under sands or laterite, and Africa can use that expertise. But Australians have limited experience overseas and almost none in Africa. This calls for a lot of learning, an expensive luxury in the fast-moving gold industry. Australian companies are most active in Zimbabwe, eastern Africa and Ghana, the most Anglicised countries in Africa. But their geographical spread is likely to increase, as it should.

The discussion above represents only the largest groups exploring for gold in Africa. But Americans, French, Ghanians, Irish, Brazilians and other nationalities are also active in the continent.

### **Where to explore**

Having put together an efficient exploration team (the "sine qua non" condition for success), the next thing to decide is where to conduct gold exploration in Africa. It has been said that the first and most important element in overseas mineral development is the political stability and investment climate of a particular country, rather than its geological potential (Ainsworth, 1995). This is an outright fallacy. If a country has no gold potential, an explorer looking for gold has no business to be there in the first place. The excellent political stability of Singapore or Switzerland is immaterial when it comes to mining. The resource is just not there. Conversely, major mineral resources have been developed in countries racked by bitter civil wars. A good example is the oil industry in Angola.



The first duty of a gold explorer is to evaluate the objective potential of a region and only afterwards to critically evaluate the risk involved in proceeding with exploration and development. This is a hugely subjective exercise. There are no universal rules. Some companies are at their best in moving first and securing valuable ground in untested conditions. Others are better in cutting deals, bringing in finance and running mines. Both approaches are valid. But a mining company must make up its mind on its intended policies well before spending its first exploration dollar.

Whether using the acquisition strategy or the grass roots approach, a gold developer in Africa must decide on targets, both in terms of grade and tonnage. This is another indispensable step.

### The target

The argument that Africa can support lower grade gold deposits because of cheaper labour costs is a dangerous one. The type of deposit the Australian investors should want to develop in Africa is essentially one of the same, or higher, grade as those in their own country. If anything, the main difference is that the deposit must be above a certain critical size. In Australia there are literally hundreds of gold mines with resources of less than 300 000 ounces of gold. A resource of that size might look a bit modest in Africa. With the possible exception of Zimbabwe and Ghana, Africa has not yet developed a "medium-sized" gold industry, although this is certainly possible, and indeed highly desirable,.

Once again, the overseas mining investor must know what he wants and have a perfect grasp of the situation. In certain African countries, that investor must realise that to get involved with gold resources which are too small could spell disaster.

### African potential areas

Figure 3 gives a very simplified view of the (Precambrian) geology of Africa. In a way, African geology is made easier because the continent is essentially a cratonic landmass. The small Palaeozoic orogenies of southern and northern Africa are largely irrelevant to its gold potential.

In Figure 3 the Archaean and younger Precambrian terranes are represented jointly, although the first is unquestionably more favourable to gold deposits. This has been done for two reasons: in Africa the distinction between the two terranes is not well known, as too little geochronological work has been done; and

(outside South Africa, Zimbabwe and Ghana) relatively little is known about gold metallogeny.

For the purpose of this discussion, five areas in Africa are indicated as having an uncommon potential. The criteria for this selection are based on a combination of geological inferences and a number of other factors, including the relevance of Australian-developed major gold deposit models applied to African terranes. These areas are far less explored than the obvious target countries of Zimbabwe or Ghana. The areas are:

- 1) around the Kalahari basin;
- 2) the Madagascar–northern Mozambique area;
- 3) the region in and around the West Nile craton;
- 4) the Eritrea–Ethiopia–Sudan region; and
- 5) the Mauritania–Senegal area

## CONCLUSIONS

At present Africa is among the most exciting places to carry out gold exploration. Many are trying their luck — 223 companies by Chadwick's (1997) count. Obviously, only a fraction of them will be successful; probably no more than 10% at best.

Gold development in Africa demands contrasting talents: a sure technical expertise; an acceptance of risk; a love and respect for the African people; and an uncommon adaptability and persistence. Some African countries are overcrowded with gold developers (Zimbabwe and Ghana), while others have barely been scanned.

Several African countries have exceptional gold potential but in conditions rather different to the rest of the established gold-producing countries. Depending on the abilities of gold developers, sub-Saharan Africa will probably enter the new century as a significant gold producer (200 tonnes per year or more). However, the game will be tougher than in the Australian gold rush of the last two decades, and many failures are to be expected.

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