PROSPECTING FOR KIMBERLITES IN THE SEMI-ARID TROPICS: A CASE STUDY FROM THE AREDOR CONCESSION, REPUBLIC OF GUINEA

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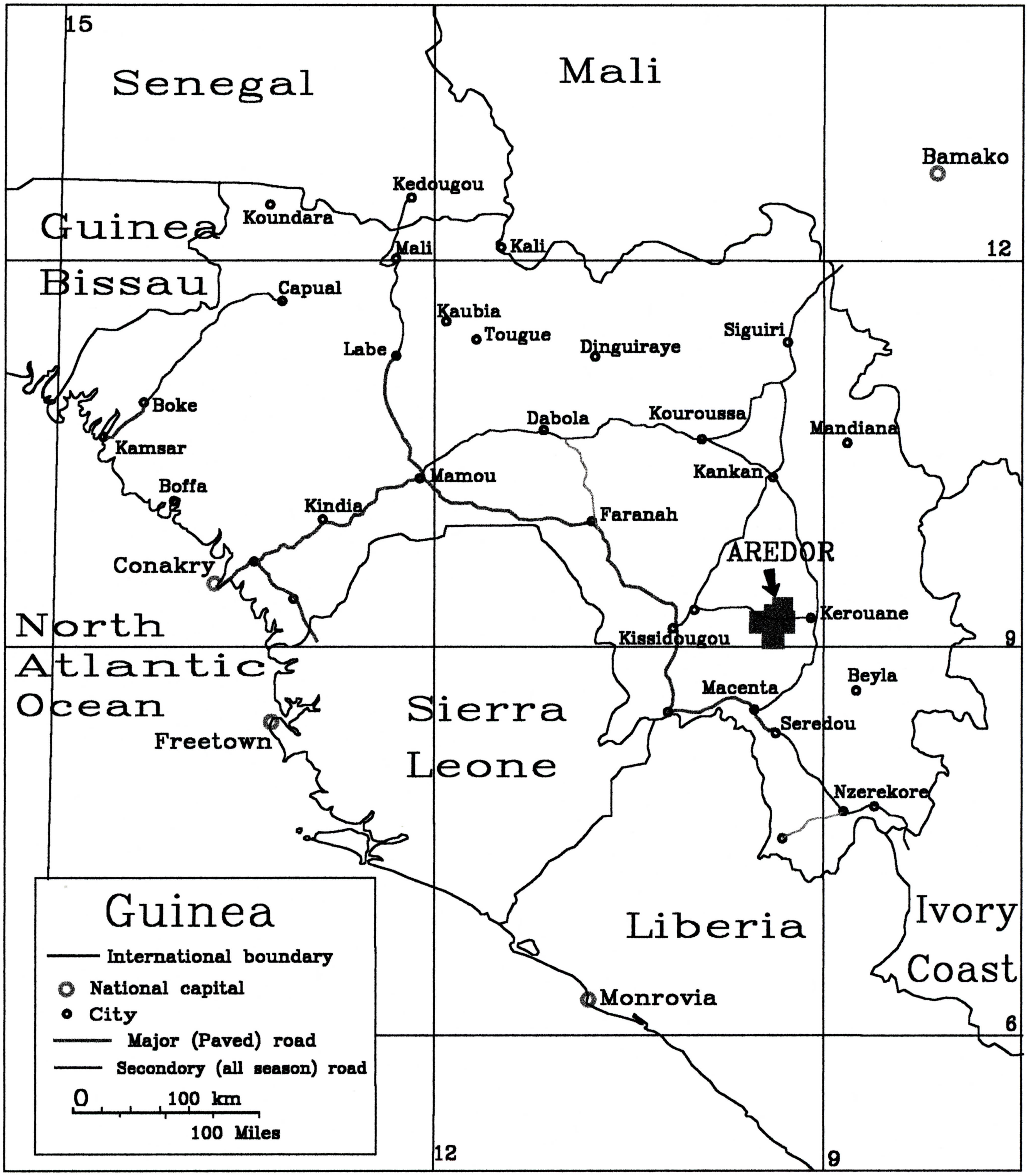
1. INTRODUCTION

1A - HISTORY

Diamonds were first discovered in Guinea in 1932 in the Upper Makona River, near the town of Macenta and commercial production on alluvial deposits began in 1935. All economic alluvial deposits occur in the southeastern part of Guinea (Haute Guineé), between the towns of Kissidoudou, Kerouane and Macenta (Figure 1) (Ellis, 1987; Rombouts, 1987, 1988). The Aredor Concession, which occurs in the northern part of the diamond area, near the town of Kerouane, is now and has historically been the main diamond producer in Guinea. Between 1983 and March of 1994, the previous operators of this property, Aredor Guinea, SA, recovered 1,273,754 carats of diamonds, of which over 93% were gem quality, from alluvial deposits. These diamonds sold for nearly $US 378 million, or averaged over $US 300 per carat. Included within this were 7 gemstones in excess of 100 carats each, the three largest of which weighed 284.96, 255.61 and 181.77 carats. Despite the presence of valuable diamonds on the property, Aredor Guinea, SA, ceased operations in 1994 for a number of compelling economic reasons, including the high cost of operating a large DMS recovery plant and an onerous 50-50 partnership with the Guinean Government. In 1996, Trivalence Mining Corp. took over the Aredor Concession. It controls 85% of the project, the remaining 15% being held by the government of the Republic of Guinea. The company is currently mining the alluvials and processing the gravels using 3 mobile pan plants.

Kimberlites were first discovered on the current Aredor Concession in the early 1950's and in the 1960's a Soviet team located 12 pipes or blows and numerous dykes on the property (Figure 2). In the course of recent exploration, additional dykes and a body

Figure 1
Location Map of Aredor Concession, Guinea



of, as yet, undefined form, have been found. Since their discovery, there have been periodic attempts at evaluating the diamond potential of these kimberlites; however, the main focus of exploration on the property has always been the alluvial deposits.

1B - GENERAL GEOLOGY

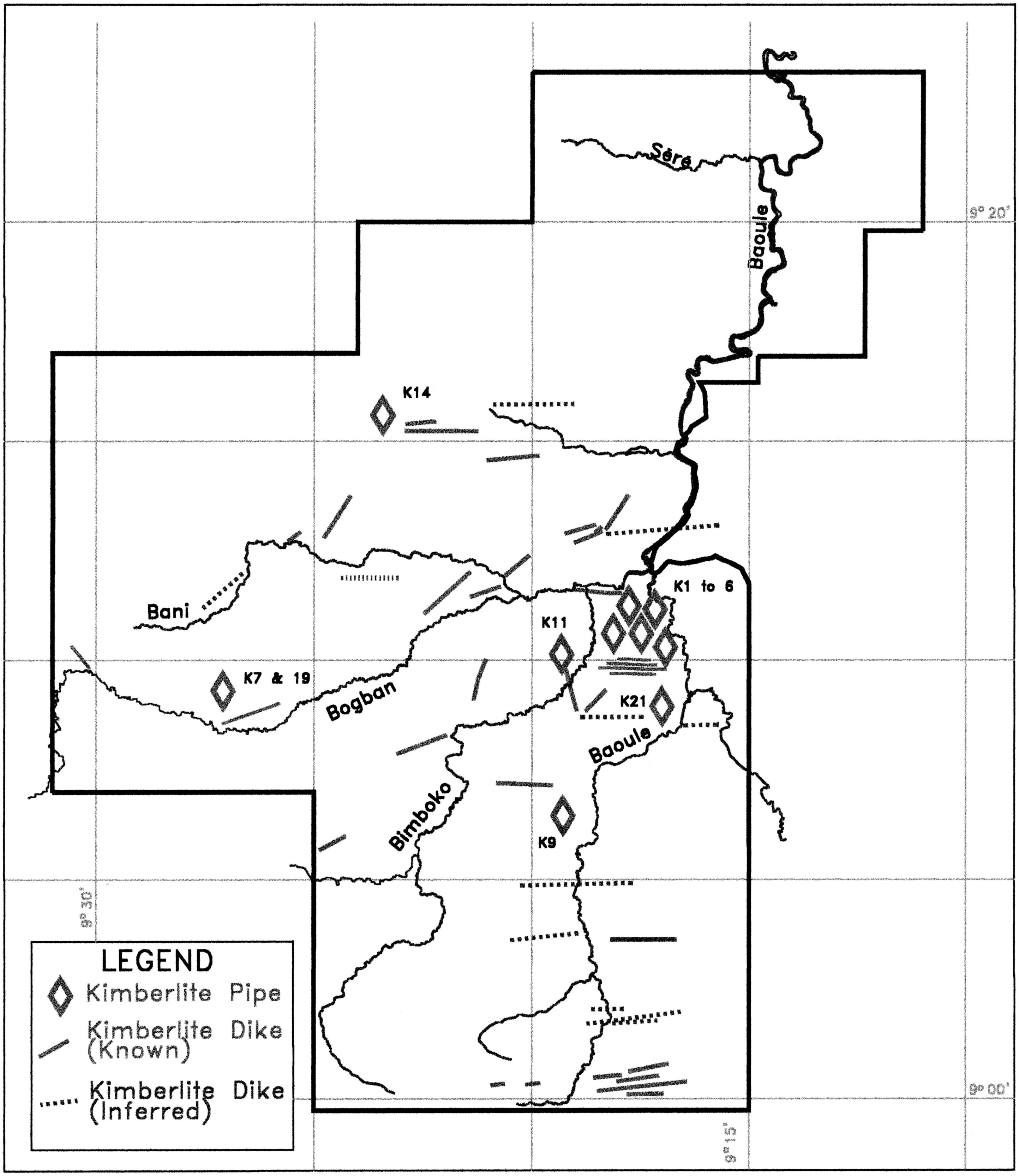
Archean rocks of the West African (or Liberian) Craton, predominantly granites and granitic gneisses with relict supracrustal belts containing schists, amphibolites and quartzites, underlie the region and are locally intruded by multiple, superposed Meosozoic tholeitic dolerite sills and dykes. Correlative dolerites in Liberia have been dated at 185 m.y. or Triassic to Lower Jurassic. Kimberlites cut the dolerites and are considered to be of Upper Cretaceous age, circa 95 m.y. Kimberlites of similar age also occur in the Ivory Coast at Seguela, in Mali around Kenieba, in Sierra Leone at Koidu and in Liberia. Their emplacement appears to be related to a major phase of extentional fracturing that occurred in Mesozoic times, associated with the break-up of Gondwana and the opening of the Atlantic Ocean. Dykes commonly parallel major regional structural lineaments and the pipes or blows are often located at the intersection of lineaments (Rombouts, 1987, 1988). Uplift and erosion since the Cretaceous is estimated to be on the order of 1000 metres and, not surprisingly, all kimberlites discovered to date are hypabyssal facies (Rombouts, 1988), characteristic of the root zones of the typical South African kimberlite pipe model.

1C - CLIMATIC GEOMORPHOLOGY

Haute Guineé lies within the peritropical zone, ie. the seasonal wet-dry savanna region. The project area is located at an elevation of about 700m above sea level and, due to the elevation, the humidity is considerably less than in the capital, Conakry, which is on the coastal plain. Temperature generally varies from a maximum of 43°C during the day to 12°C at night. Rainfall is between 1800 and 2500 mm/year and is generally confined to the period between June and September. The area is characterized by the development of a true lateritic weathering profile (as described below), which has been incised by recent watercourses.

Figure 2

KIMBERLITES ON THE AREDOR CONCESSION



2. KIMBERLITE WEATHERING IN SAVANNA REGIONS

2A - LATERITIC PROFILES – GENERAL DESCRIPTION

True lateritic profiles (Figure3a) are characterized by a dark brown to red-brown upper duricrust (hard pan) layer consisting of coarse iron pisolites. This horizon generally is 0 to 10 metres thick and may outcrop or be covered by a thin layer of soil. The uppermost part generally comprises pebbly, unconsolidated iron pisolites which grade down into an indurated layer of pisolites cemented with ferruginous material.

The duricrust horizon is underlain by a mottled zone, 1 to 15 metres in thickness, consisting of kaolinite clays and ferruginous spots and nodules. The pre-existing macrostructure of the parent rock has been completely destroyed by water percolating down through it and creating a series of voids and channels, which become filled with secondary kaolinite and iron minerals. The ferruginous material decreases in abundance downsection away from the laterite duricrust. The base of the mottled zone commonly corresponds with the water table.

Saprolite is generally developed beneath the mottled zone and can be as much as 80 to 100 metres in thickness. In this zone most of the primary, weatherable minerals have been altered to secondary minerals, such as kaolinite, goethite or amorphous iron hydroxides, and only the more resistant minerals such as chromite, quartz and tourmaline remain. Weathering in this horizon is isovolumetric, so that the original rock fabric is preserved and recognizable; however, it becomes obliterated as the contact with the mottled zone is approached and the kaolin content increases.

The transition from saprolite to the underlying bedrock may be sharp or transitional. Where transitional, a zone of "saprock" is developed which consists of slightly weathered rock with easily altered minerals pseudomorphed by weathering products or clasts of slightly weathered rock in a completely weathered saprolitic matrix.

Lateritic profiles were, in most cases, developed during the late Mesozoic to mid-Tertiary and are commonly partially eroded. They may also be modified somewhat if climatic changes have occurred between the time of formation and the present (Butt, 1997; Gleeson, 1994; Soever, 1994).

2B - KIMBERLITE IN THE LATERITIC ENVIRONMENT

Lateritic duricrust formed over kimberlites is virtually indistinguishable from duricrust developed over other mafic rock types. Most primary kimberlite indicator minerals are destroyed; however, minor amounts of ilmenite may survive. In the underlying mottled zone, kimberlites can be mottled red-bown, orange, yellow, white or greenish in colour. Most primary minerals are completely altered, with the exception of ilmenite, diamond and possibly chromite. Commonly, kimberlites may only be distinguished visibly from other weathered rock types by the presence of ilmenite and a paucity of quartz. In the saprolitic horizon primary textures are preserved and, therefore, kimberlites are easy to recognize. Pyrope garnets, as well as ilmenite, chromite, and diamond may be preserved and as the fresh rock interface is approached, chrome diopside, phlogopite and other minerals begin to appear.

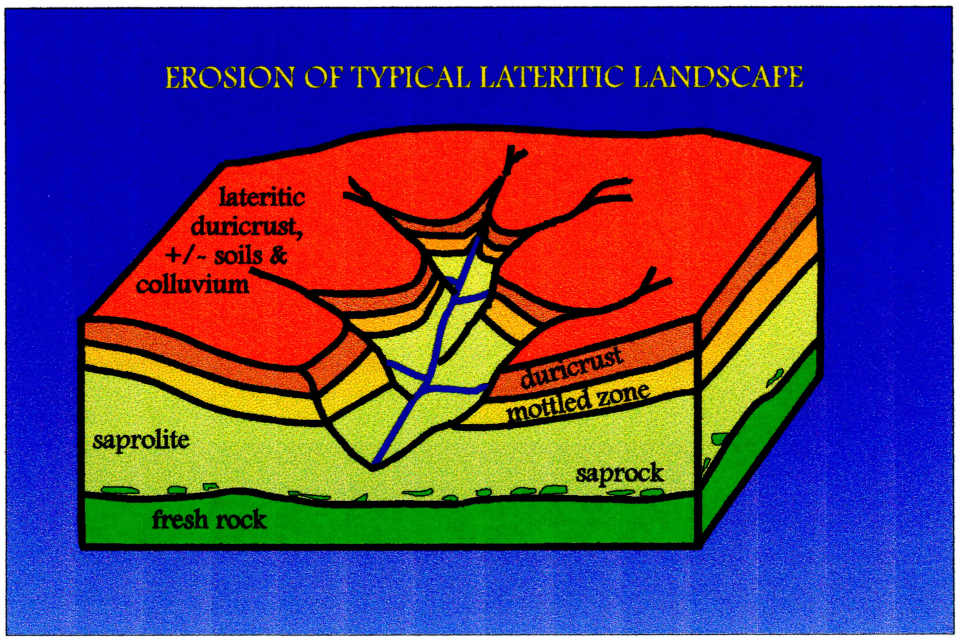
When prospecting for kimberlites one must be aware of the fact that if the lateritic or mottled zones only of the kimberlite are exposed, one is likely only to find an ilmenite (+/- chromite and diamond) signature in loam or stream sediment samples. If the saprolitic or saprock horizons are exposed, other heavy minerals such as pyrope and chrome diopside may appear in samples (Figure 3b). In stream sediment sampling, as distance from source is increased indicators decrease in size and abundance. Chrome diopside and phlogopite are the first to disappear, followed by pyrope, which does not travel more than a few kilometres from source. Ilmenite may survive in stream for tens of kilometres and diamond, of course, may be transported many hundreds of kilometres. However, only crystal forms such as octahedra, dodecahedra and their resorbed products or irregular but equant stones are likely to survive for great distances, macles, cleavage fragments and stones with imperfection will be destroyed.

3. KIMBERLITE PROSPECTING ON THE AREDOR CONCESSION

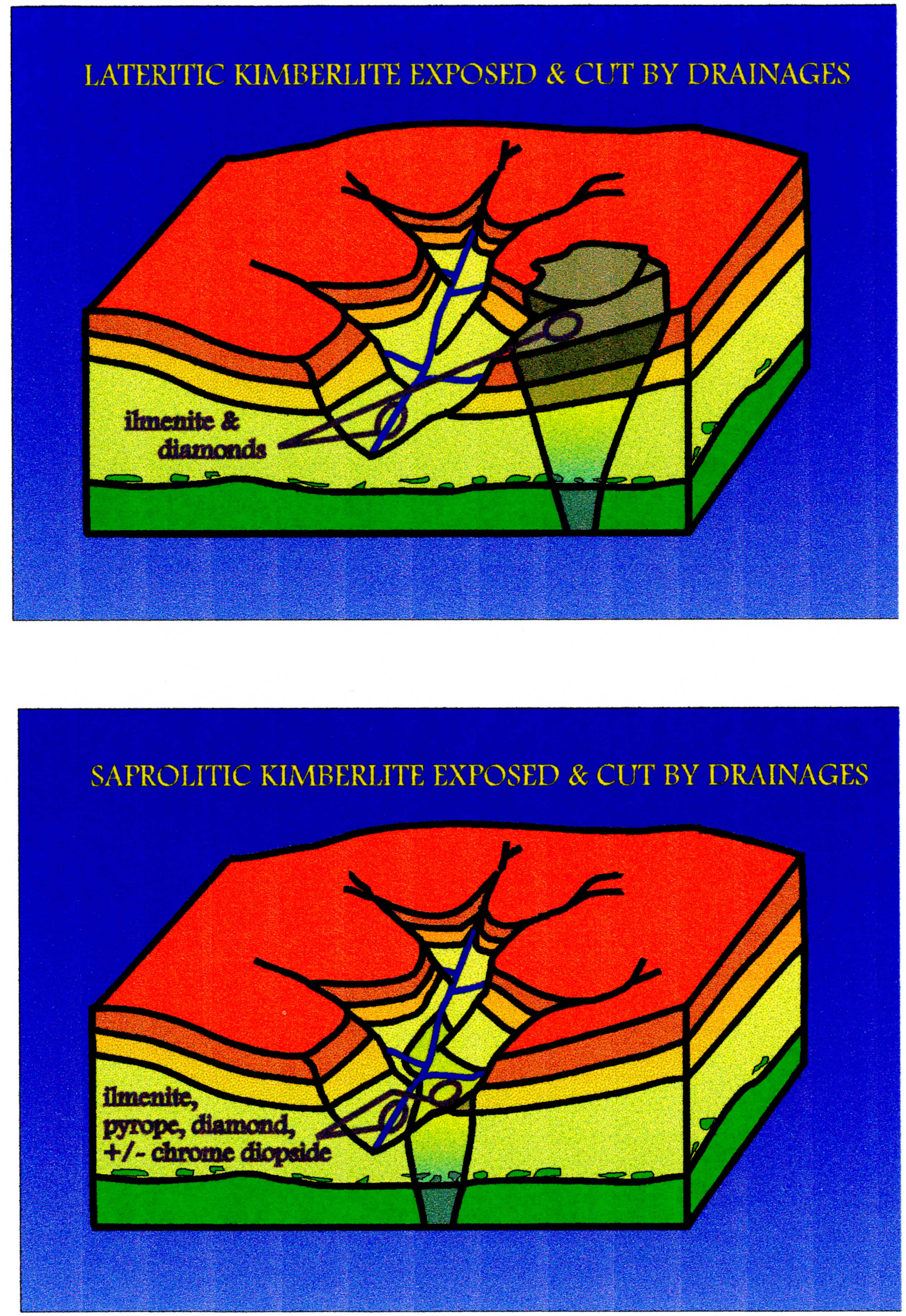
3A - GENERAL OUTLINE

Trivalence began a kimberlite exploration program on the Aredor concession in 1998. Diamonds recovered from the alluvial operations are highly variable in shape and colour. Octahedra and dodecahedra are the most common crystallographic diamond

Figure 3


EROSION OF TYPICAL LATERITIC LANDSCAPE
lateritic duricrust, +/- soils & colluvium
duricrust
mottled zone
saprolite
saprock
fresh rock

A.


LATERITIC KIMBERLITE EXPOSED & CUT BY DRAINAGES
ilmenite & diamonds
SAPROLITIC KIMBERLITE EXPOSED & CUT BY DRAINAGES
ilmenite, pyrope, diamond, +/- chrome diopside

B.

forms in the Aredor deposits; however, macles, flats, aggregates and broken or irregular stones are not uncommon and the relative abundance of these forms and diamond colours differs from mining block to block. These factors, along with the fact that diamond indicator minerals, primarily ilmenite and pyrope, are commonly recovered from alluvial operations suggests a proximal source for the alluvial diamonds. The history of large diamonds suggests that an economically attractive source may be present.

The current exploration program consists of two main tracks: re-evaluating known kimberlites through drilling, trenching, sampling, and indicator mineral chemistry studies and regional prospecting for new bodies, using geophysical surveys and indicator mineral sampling. An airborne magnetometer survey of the entire concession was flown in 1997. It has not proved to be very useful, as only one of the known kimberlite bodies could be picked off this survey. Some work was spent ground-truthing and sampling in the vicinity of anomalies picked from this survey, but nothing of interest was revealed. The focus of the regional program has now changed strictly to indicator mineral sampling. This paper will focus on this aspect of the project.

3B - STREAM SEDIMENT AND LOAM SAMPLING PROGRAM

A regional program of heavy mineral sampling is underway. Work is currently being focused in drainages that previous sampling during alluvial prospecting identified as containing diamonds, pyropes or ilmenites. Samples of both stream sediments from second and third order tributaries and loam are being collected. Samples are generally of a standard volume (20 litres) and are processed in the field by hand jigging and panning. Picking is then done in a small laboratory set up in the office complex. A number of anomalous areas containing abundant coarse ilmenite, plus or minus pyrope and locally chrome diopside have been identified. Indicator minerals are much more abundant in stream sediment samples that in loam samples and, therefore, loam anomalies are subtler. Loam sampling has proven effective in areas of duricrust; however the mineral signatures tend to be very weak and care must be used in interpretation. Follow-up work done in one area resulted in the discovery of a new kimberlite, K21.

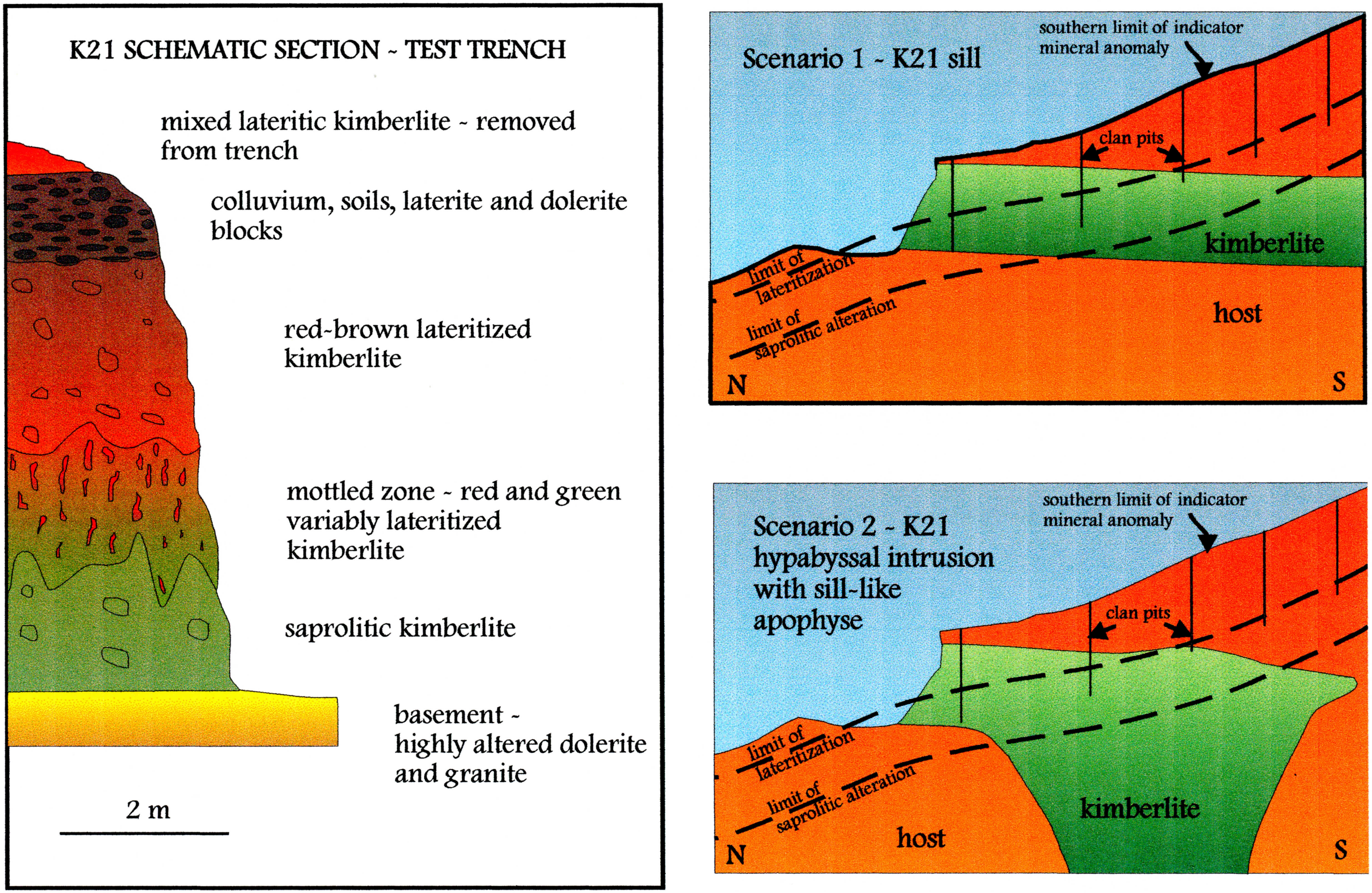
History of the K21 (Torogban Hill) Kimberlite Discovery

The Torogban Hill Kimberlite (K21) is a new discovery made in the third quarter of 1998 on the Aredor FCMC mining property by Trivalence Mining Corp. staff. It is located on a hillside south of Torogban Creek, approximately 1.5 km south of one of the company's current alluvial diamond mining blocks and 2.5 km south of the 14-foot Pan Processing Plant.

Clandestine mining activity on Torogban Hill, in an area of colluvial deposits, well above the level of the highest alluvial terrace initially attracted our attention. An exploration grid was established in February and 95 surface loam samples of a standard 20 litre volume were collected. A mineral picking laboratory was set up on site in July and subsequent to that, the samples were processed. Coarse ilmenite (>0.5mm), was found in nine samples from four different parts of the grid and anomalous concentrations of ilmenite in the fine fraction (<0.5mm) were also found in these four areas of the grid. A fifth region of anomalous fine ilmenite was also outlined as well as a few spot highs identified.

A detailed grid was established in the main anomalous zone and 92 samples of altered bedrock from pits between 2 and 4 meters in depth were collected and processed for heavy minerals. An anomaly up to 75m wide and in excess of 200 metres in length, elongated in a NW-SE direction was outlined. However, it is much better defined than the original anomaly as the samples on the detailed grid are from weathered bedrock and not overlying soils. Subsequent work has exposed kimberlite in a trench over 100 metres in length, within the indicator mineral anomaly.

Exposed in the trench is 1 to 2 m of overburden (mixed soil, colluvium and laterite), which overlies 2 to 4 metres of red-brown lateritic kimberlite above 2 to 3 metres of mottled red & green altered (partially lateritized) kimberlite, overlying 1 to 2 metres of green saprolitic kimberlite (Figure 4a). In the current trench, the kimberlite is underlain by highly altered granitic and dolerite bedrock. Dykelets of kimberlite, a few centimetres to a few tens of centimetres thick, were observed to cut the country rock in a number of places. As exposed in the trench, the kimberlite appears to have a sill-like form with a thickness in the order of 10 to 11 metres, which is sub-horizontal or dipping slightly into the hillside. Its extent to the south (into the hill) is not defined. It may well



A.

B. Hypotheses on the shape of K21

FIGURE 4

continue to the south, beyond the indicator mineral anomaly, the limit of which might simply reflect where the kimberlite was too deep for the illegal miners to reach from surface. As well, without drill information, it is impossible to define the true shape and extent of the body – it might be simply a kimberlite sill; alternatively, what is exposed in the trench might represent a sill-like branch off a hypabyssal kimberlite pipe (Figure 4b).

When the detailed grid work was being done, 3 tonnes of weathered kimberlitic material was collected from pits piles and washed by hand, from which over 3.5 carats of diamonds were recovered. These extremely favorable results prompted additional testing; however, the early grade was not reproduced. Approximately 92 tonnes of lateritic and saprolitic kimberlite were processed by hand, yielding 15.01 carats (16.3 carats per 100 tonnes). As well, around 4000 tonnes of mixed kimberlitic material and overburden were processed at the 14-foot Commercial Plant to see if it was weathered enough to be used as direct plant feed without crushing. This does not appear to be viable.

Stones recovered from the testing have been evaluated on site to give a preliminary estimate of their worth. Twenty gems over 1 carat in size were recovered (Table 1). The total salable parcel (gems and "Indian" goods) has an estimated average value of approximately $113/carat based on the in-house evaluation. When a larger parcel of stones is obtained, they will be evaluated externally.

In the upcoming months K21 will be drilled in order to obtain a sample of fresh rock to allow indicator mineral and microdiamond studies and to define it's form.

CONCLUSIONS

Approximately ten kimberlite pipes are known to occur on the Aredor Concession, Republic of Guinea. All are diamondiferous. A number of dykes are also present on the property. Work is currently underway to evaluate these kimberlites as well as to explore for others. This area has a history of large diamonds in alluvial deposits and it is probable that the source of these stones occurs on the concession. Standard indicator mineral sampling appears to be the most successful technique to be employed in the initial phase of prospecting for kimberlites in this environment.

TABLE 1. STONES GREATER THAN 1 CARAT RECOVERED FROM TESTING K21

GEMS Cts	ESTIMATED VALUE $/ct	INDIAN Cts	ESTIMATED VALUE $/ct	BOART cts	ESTIMATED VALUE $/ct
6.96	800-950	9.13	28-30	1.86	0.5-1
5.85	85	8.08	28-30	1.42	0.5-1
5.79	140-155	7.56	28-30		
3.79	125-135	6.70	28-30		
3.59	78	4.22	28-30		
3.56	75-78	3.79	28-30		
3.37	400-450	3.78	28-30		
3.16	400-450	3.44	28-30		
2.33	83-85	3.39	28-30		
2.20	120-130	3.13	28-30		
2.06	95-100	2.87	28-30		
1.97	125-130	2.42	28-30		
1.69	85-88	2.13	28-30		
1.64	68-72	2.02	28-30		
1.53	78-80	1.50	28-30		
1.39	145-150	1.47	28-30		
1.35	185-200	1.35	28-30		
1.10	35	1.20	28-30		
1.07	115-118				
1.00	78-80				

Note: theses are preliminary price estimates done by an in-house diamond evaluator and do not represent an official external evaluation.

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