

ASSESSMENT OF THE GEOLOGY AND MINERAL  
POTENTIAL OF THE DIAMOND PRIMARY MINING  
LICENCES (PML) AT MAGANZO, MWADUI,  
SHINYANGA REGION -TANZANIA

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## EXECUTIVE SUMMARY

Bibi Fedilia L Khalfan of PO BOX 174 TABORA own two diamond licences covering some 20 hectares in the vicinity of one of the world's largest kimberlite pipe at Mwadui, Tanzania. In this area the Mwadui pipe covers some 142 hectares of kimberlite and has very densely distributed kimberlite pipes and numerous paleodrainage channels originating from the main pipe and from other pipes in the area. Diamonds are thus found in the gravels, calcrete sand kimberlite. The gravels have diamonds and the kimberlite pipes are diamondiferous. The usual average grade of the kimberlite is 5 carats per hundred tons but the grade is usually higher in the gravels and other superficial deposits.

The New Alamasi Mine is one of the mines in the gravels and superficial deposits; here the average grade is around 6.7 carats per hundred tones (c.p.h.t). Higher grades are usually found around several dykes, the dykes acted as traps during the transport of the placer material. The area around the claims are characterized by paleo-drainage channels which usually trend north -south as shown on the satellite images and as shown by the sampling carried out by Williamson diamonds Limited around New Alamasi . The thickness of the diamondiferous material varies according to the depth of the bedrock but is generally between 0.5m to 20m. The average is 5m. The 100 hectares of diamondiferous material in the ten Licence thus host substantial diamond reserves worth detailed evaluation and mining. It is recommended that diamond sampling and the search for more kimberlites be undertaken for the Mining to be planned.

## GENERAL INTRODUCTION

### **Location and accessibility**

The Licence area is located near Mwadui mine which is some twenty five kilometers from Shinyanga the regional town of Shinyanga town. Shinyanga is one of the most populous and rich region in Tanzania .The town is served by a tarmac road to the Lake zone city of Mwanza . A rail line connects Mwanza and Shinyanga and a branch of the railway goes to Mwadui and thus passes through the Licence area. There is modern telephone connection and electricity is available in the vicinity of the Licences .The Cordinates of the Licence lie between Lat 3 deg 35 min 54.60 sec to Lat 3 deg 36 min 07.56 sec bound by Longitude 33 degrees 38 min 32.42 sec to 33 degrees 38 minutes 48.62 sec

## **History of Diamond Mining in Tanzania**

Diamond locally known as “almasi” in Kiswahili, the national language of Tanzania reported to have been discovered at Mabuki, a small township south of Lake Victoria before the First World War (1910-1912).

Mining was interrupted by war and reports say that serious activities started in 1921. A South African named Blignault was the first to undertake exploration and mining. Unfortunately Blignault died shortly after starting the work and was buried in one of his pits. Officially, about 106,082 carats are reported to have been mined from gravel's and conglomerates overlying a kimberlite pipe. It is interesting to note that the most recent discovery of a kimberlite pipe is at Mabuki just a few metres from the old pipe.

## **Regional Geology**

The success at Mabuki attracted many prospectors to Tanzania. In 1926 Samuel Birkby discovered diamonds in Shinyanga at Kizumbi. C.F. Boshff made kimberlite discovery on the Iramba plateau in the year 1930. The Usongo deposits in Nzega south of Shinyanga were discovered in the year 1934. A discovery of a 92.5 metric carat diamond at Kizumbi brought prospects from the south back to Shinyanga in 1937. New small mines were discovered at Shiloleli and

Uduhe. By the end of 1939, an extensive diamond belt covering almost 500-km north south had been discovered.

### **Geology of Kimberlites**

A major diamond discovery was that by Dr. J.T. Williamson who in 1941 together with his Tanzania assistant Mr. Bundala discovered the Williamson Diamond Mine at Mwadui, Shinyanga (Peter Keller – Gemstones of East Africa Monograph). The mine was opened up on one of the world's largest kimberlite pipe. To date Williamson Diamonds Mines is still operating. Over 20 million carats of diamonds have already been mined. A country wide exploration project was conducted in the period 1959 – 1976 by Williamson Diamonds LTD. The programme never discovered large mines but several small mines were opened up at Kahama, Nzega, Loya and Mabuki south.

### **Geotectonic Setting of Tanzania Diamond Field**

Airborne geophysical survey covering the whole of Tanzania on a scale of 1:100,000 was conducted on behalf of the United Republic by Geosurvey International Limited. The work forms an important basis for planning mineral exploration for many minerals including nickel, gold, and diamonds. In the year 1979 detailed exploration on a scale of 1:25,000 was commissioned to cover a large area around the Williamson mine, Mabuki, Uchunga plateau and Nzega.

## **Relationship between major shield structures and known Kimberlites**

Ground follow-up of the airborne (magnetic, electromagnetic, radiometry) lead to discovery of new diamond deposits at Mabuki, Galamba, Mwadui, Kishapu, Nyamigunga and other localities. The kimberlite pipes are now under evaluation by mining companies.

Reconnaissance and prospecting licences have been issued recently to many international companies including De Beers registered as Tanex, Reunion Mining of UK, Rio Tinto Zinc and others. De Beers has already discovered six new kimberlite pipes, which await evaluation.

## **REGIONAL GEOLOGY – AN OUTLINE OF THE GEOLOGY OF TANZANIA**

### **(a) The Archean Province(3.2Ga-2.0Ga)**

The oldest rocks in Tanzania are those comprising the Archean craton in which the principal assemblages are granitic complexes with remnants of east-west trending "Greenstone Belts", mainly in the north and northeast, which have been subjected to low-grade, green schist facies metamorphism. These latter include:

#### **i) The Nyanzian Supergroup (2.0-2.9Ga )**

The greenstone comprises a lower, volcanic sequence of intermediate to acid (Andesite-dacite-rhyolite) lavas and

the SEBAKWIAN SYSTEM (Zimbabwe) and LOWER OVERWACHT SERIES (South Africa).

(d) **The Ubendian Paleoproterozoic Terrane (2.2-1.7Ga)**

In the south-west the craton is bounded by the Paleoproterozoic Ubendian metamorphic belt which follows a northwesterly trend. The rocks in this belt extend for 1,000km in a NW-SE direction and has an average width of around 200km. It is characterised by widespread shear zones and migmatization which are developed parallel to the margins of the belt. The rocks of the Ubendian are largely amphibolite or granulite grade gneiss. The high grade eclogites and granulites are oriented E-W and are found within the main Ubendian shear belt (Daily et al 1980)

(e) **The Usagaran Paleoproterozoic**

The Archean craton is bounded in the east by the rocks of the Usagaran. The Usagaran is divided into a lower member, comprising mainly granulites, hornblende and biotite-gneisses, and an upper member characterized by schists, amphibolites, quartzites, granulites and gneisses. The rocks are similar to tectono the Ubendian Paleoproterozoic belt with the exception of the younger Pan African thermal in print.

Sedimentation of Usagaran rocks probably took place in geosynclinal troughs which were marginal to, and derived sediments from, the cratonic foreland in the west. The rocks of the Usagaran extend all along the eastern part of Tanzania from Kenya in the north to Malawi/Mozambique in the south.

The Usagaran is typical of early Proterozoic mobile belts which consist largely of now highly metamorphosed metasediments originally derived from adjacent Archean cratonic massifs.

(f) **The Karagwe Ankolean Supergroup (1.2 – 0.90Ga)**

In the northwest of Tanzania the rocks of the NNE-SSW trending Karagwe-Ankolean lie in a crustal downwarp in the NW-SE trending Ubendian belt. The Karagwe-Ankolean is part of the Kibaran fold belt which extends for 1,500 km from Uganda to Zambia and includes rocks which are low grade metamorphites predominantly phyllites, quartzites and pelites. The sedimentary aspect of these late-proterozoic age Karagwe-Ankolean rocks, particularly in the north, is one of nearby cratonic foreland. There is scant evidence of geosynclinal turbidite deposition. Late-tectonic granites, probably derived from remobilised basement, intrude the Karagwe-Ankolean metasediments. Numerous ultramafic bodies also intrude the Karagwe-Ankolean rocks in the West Lake region.

(g) **The Bukoban Group (0.9 – 0.78Ga)**

The Bukoban Group comprises a basal series of coarse sandstones and shales followed by amygdaloidal lavas,

dolomitic limestones and red beds. These rocks are mainly developed in northwest Tanzania and are generally flat lying or gently folded and relatively unmetamorphosed.

During the late-Proterozoic, there was a widespread fracturing of the crust. This resulted in the extrusion of plateau lavas basic intrusions. A swarm of basic dykes immediately to the southwest of Lake Victoria are also thought to be of Bukoban age.

(h) **The Pan-African orogeny**

In palaeozoic times the proterozoic rocks of the Usagaran were subject to a Pan-African thermo-tectonic event. The Mozambique Belt. There are no sedimentary or volcanic rocks of Pan-African age known in the Mozambique Belt in Tanzania. The western limit of this remobilisation of the Usagaran rocks.

(i) **The Karoo Supergroup (0.3-0.2Ga)**

Prior to the break-up of the palaeocontinent of Gondwana land in late Palaeozoic times, rift troughs were developed in Tanzania. The orientation of these rifts generally followed the trends of the Ubendian and Usagaran belts encircling the Archean craton. The rifts were filled with thick deposits of continental sediments belonging to the Karoo and consist predominantly of sandstone, shales and siltstones which

transgress and lie unconformably on the deeply eroded and uneven palaeo-landsurface of Usagaran rocks.

(j) **Jurassic-cretaceous Group**

Along the present coastal margin of Tanzania and in parts of the rift troughs, Jurassic and Cretaceous marine and continental sediments were deposited mostly on the fringes of the new continent of Africa. These rocks comprised mainly of limestones, sandstones and shales and are within the Jurassic sequence of thick evaporate series.

(k) **Jurassic and Cretaceous Intrusives**

In Jurassic times, the structurally consolidated Tanzania block was extensively fractured during the break-up of the palaeocontinent of Gondwana land. Associated with this continental fragmentation in slightly later Cretaceous times there was a widespread intrusion of kimberlites and carbonatites along pre-existing lines of weakness.

The majority of the kimberlites occur in the central part of Archean craton. Most of the carbonatite intrusion in southern and central Tanzania were emplaced at this time, although some may be older. The carbonatites in the northeast of the country were intruded in the Neogene Period.

(l) **Neogene Volcanic Province**

In Tertiary and Recent times, calc-alkaline volcanism accompanied continued rifting to the north of Lake Malawi and in northeast Tanzania where spectacular volcanoes occur. Further carbonatite intrusions are intimately associated with this Neogene volcanic activity in Miocene and Plio-Pleistocene times.

## **GEOLOGY OF THE TANZANIA DIAMOND BELT**

### **REGIONAL GEOLOGY AND GEOMOPHOLOGY**

#### **(a) General**

The Tanzania Diamond Field lies within the ancient cratonic platform of the Tanzanian Shield. The region is generally one of low relief with isolated inselbergs of granite rising up from an eroded Tertiary peneplain which has been termed the "African Surface" (King, 1948). The general level of the surface is 1200m.

Much of the regional geological mapping of the area was carried out before World War II. The results of these early investigations were incorporated by G.J. Williams and N.W. Eades into the geological map of Degree Sheet 18 (Shinyanga) and the accompanying Bulletin No. 13 (1939). Later geological work

in the areas mainly concentrated on the search for diamondiferous kimberlite

pipes. This work is discussed further in the following sections of this report.

The rock of the shield largely consist of high grade quartzo-feldspathic gneisses, synorogenic granites and intrusive

granites. These rocks were consolidated by 2,700 m.y. (Cahen and Snelling, 1966). Remnants of low grade metamorphic supracrustal Nyanzian rocks are widespread in the region and mainly appear as areas of low topographic relief.

(b) **Nyanzian Supracrustal Suite**

These rocks comprises metavolcanics, schists and phyllites with some quartzites and banded ironstones. The latter are represented by alternations of jasperoid and cherty rocks which contain abundant iron oxide (Williams and Eades, 1939). They sometimes form resistant hill ranges readily detectable on Landsat images. The strike of the Nyanzian rocks is generally ENE/WSW and the strike of later dolerite dykes follows this trend.

(c) **Granitic Rocks**

There are two distinct types of granite in the region – an older gneissose granite which is intruded by later more widespread porphyritic variety. Granite of the first type outcrop extensively in the northeast of the region and forms a WNW/ESE range of hills which reach a height of 1375m on Nungu hill. The hill range shows up clearly on the Landsat colour image due to its darker colour, which is related to a denser vegetation cover than the surrounding country. The Tinde hills south-west of Shinyanga have similar appearance on the landsat and may be of like composition. Detrital material, loosely bound by a

calcareous cement, forms wide pedimental aprons around the granitic hills.

(d) **Minor Intrusives**

The area is affected by minor intrusives of Archean age which include porphyry dykes, aplogranites and dolerites. The aplogranites have invaded much of the main granite and in some cases have been partly responsible for preserving the outcrop.

There are at least two, probably three series of dolerite dykes in the area. The earliest are metamorphosed and easily distinguishable from the younger dykes in thin section. However, in the field they are not always easy to distinguish, and they commonly have the same ENE/WSW strike direction. Hepworth (1972) indicated K/Ar dates for Shield dolerite dykes ranging in age from 2,645 ± 72 m.y. Younger dykes of Bukoban age (ca. 810 m.y.) are also known to be present in the area.

(e) **Kimberlites**

The most recent and economically important magmatic event in the area was the intrusion of a large number of kimberlite dykes and pipes. The age of these intrusions is now known to span the Proterozoic to Tertiary periods (Davis, 1977, Kashabano J.B., 1989). The majority of the kimberlites of the Mwadui Diamond Field appear to be located on a tilted block forming

the Uchunga plateau. This is bounded on the south by a low scarp and tilts gently to the north, although drainage across the block is all to the south.

(f) **Tertiary to Recent Deposits**

Lacustrine deposits are widespread in the eastern part of the region and are related to the Wembere-Manonga basin, a former lake site (Handley, 1954). This basin was formed during a period of late Tertiary crustal instability. The lake deposits are of Plio-Pleistocene age and their extent can be very readily ascertained from the Landsat colour composite image used for interpretation. These deposits cover an area of over 6,000 km<sup>2</sup>. Drainage of the Wembere-Manonga basin is now eastwards into the Eyasi-Wembere depression, following tectonic adjustments of the landscape in the early Pleistocene.

Residual and transported soil cover affects large parts of the region and has in many cases made the location of kimberlite pipes a difficult task.

## THE GEOLOGY OF KIMBERLITES

### (a) Composition

Kimberlite is a hybrid rock of dominantly ultramafic composition often containing xenoliths of country rock. In Tanzania Edwards and Howkins (1966) have described it in the following terms, "Kimberlite is an intrusive, undersaturated, feldspar-deficient igneous rock, usually observed in an altered and brecciated state". It is a type of peridotite where the original abundant olivine has been completely altered to serpentine. Recent research (Dawson, 1980) has shown that kimberlite is certainly composed of "fragments of rocks of upper mantle origin intermixed with the crystallisation products of a highly volatile fluid". Dawson also points out that kimberlite come from depths between 35 km and 300km.

The rock contains essential chrome-rich pyrope-almandine garnet and magnesian ilmenite. Some of the following accessory minerals are found in kimberlite:- chromiferous diopside, phlogopite, zircon, perovskite, diamond, magnetite, celestite, barite and calcite.

(b) **Mode of Occurrence**

The modes of occurrence of kimberlite are as diatremes, commonly referred to as pipes, as dykes and occasionally as sills exploiting the tabular jointing of granite. The latter have been found in the Singida, Ibadakuli and Kimali – Meatu areas of Tanzania.

A pipe is formed by an upward expulsion of magma from dyke, which is accelerated to the surface up a fracture plane. The pipe tapers at depth, expansion having taken place near the surface. The lessening confining pressure near the surface created a high volatile pressure which caused expansion of the magma and fracturing of the surrounding rocks.

According to J.B. Hawthorne (1975) many kimberlite pipes contain large amount of what is known as epiclastic kimberlite. This material is a mixture of primary kimberlite and lacustrine or sedimentary material, and occurs over relatively little eroded pipes. These pipes generally do not have a strong magnetic signature. However, because of their abundant clay content they may be readily distinguished from adjacent granites by an electromagnetic survey. The detection of epiclastic kimberlite is very important for diamond exploration, as several of Africa's most important diamond deposits have been found in this material, e.g. Mwadui, and Orapa in Botswana. The Mwadui

deposit is shown to be a good conductor and exhibits a very weak magnetic anomaly on the airborne survey carried out by BGR-Tanzania exploration team (J.B. Kashabano, J.M. Gobba, 1992).

(c) **Size and Shape of Kimberlite Pipes.**

The size of kimberlite bodies varies greatly but most are less than 150 metres across. Exceptionally large ones, such as the Mwadui pipe, are over 1km across (the surface area of the Mwadui pipe is 1.46km<sup>2</sup>). Their shape is often irregular and frequently more oval than circular, due to strong fracture control.

(d) **Geomorphology of Kimberlite**

The kimberlite of central Tanzania is strongly weathered, and peneplanation and deposition of residual soils means that few kimberlites can be observed directly at the surface. However, Mannard (1968) observed that near a number of Tanzanian pipes there is an increase in the intensity of gulleying, and a tendency for meanders to form in water courses crossing kimberlite bodies. These phenomena are made more obvious by the fact that they appear as anomalies in areas which are dominantly controlled by a rectangular fracture system in the granitic country rock.

(e) **Distribution of Kimberlites within the Tanzanian Diamond Belt**

i) **Ten Kimberlite fields:**

Edwards and Howkins (1966) defined ten recognizable kimberlite fields in Tanzania of which the Mwadui field is by far the most important (see fig. 3). Nine of these fields fall within the main granitoid shield and one occurs in Karoo sediments in the Ruhuhu river area close to Lake Nyasa. A group of alluvial diamond occurrences was found outside the craton during the heavy mineral sampling programme. These are located on the Gregory rift valley near Nyumba ya Mungu dam on the Pangani river, Rufiji river and Muhuwesi river. These represent potential diamond fields and are worthy of further investigation.

ii) **Favourable locations for the discovery of kimberlite pipes**

Kimberlites within the Tanzania Shield are hard to locate, except where Recent uplift has reactivated the drainage and removed superficial material. Such an area is the Uchunga plateau south of Mwadui and more than 25 kimberlites have been discovered. The area formed a morphotectonic unit and similar areas could become prime prospecting targets if geological factors are favourable.

A second factor of importance in the survey region is the close association of kimberlites with the outcrop of Nyanzian rocks.

Nearly all kimberlite areas north of the NW/SE Nzega fault which bound the Nzega greenstone belt lie close to or within greenstone areas. This may be fortuitous, or it could be that the greenstones lie along deep fracture zones which have acted as loci for kimberlite emplacement. Alternatively they are areas eroded to the lowest base level, and as such would expose any kimberlites within these areas.

iii) **Placer diamond deposits**

Diamond prospecting must always take account of the geomorphological and depositional history of a region and these aspects are important in Tanzania. A primary location for placer diamond deposits is in the Tertiary gravels filling palaeo-drainage channels in the Africa surface. These channels are recognized in the field by a capping of a red soil known as "Kikungu", but they also underlie a large part of the Shinyanga area and are in places covered by black "mbuga" soils. These valley gravels were laid down in an aggrading environment on

an eroded peneplain under more humid conditions that exists at present.

Examples of palaeo drainage channels are well seen on the Landsat image to the north of Mwadui. There they are readily recognized as they appear darker toned than the present active channels. The latter are very light toned due to the strong albedo of the sandy valley-floors. An alluvial diamond deposit has been discovered at Maganzo a few kilometres south of Mwadui (J.B. Kashabano, 1995).

A group of kimberlite pipes in the extreme north of the area, the Mabuki group, has provided important placer gravels. The gravels are 11 metres thick. Seven pipes appear to be related to a major NW/SE fault zone. Prior to the discovery of the Mwadui pipe in 1940, by J.T. Williams, these deposits were the most profitable in the country.

In Shinyanga area important economic gravel deposits were located at Kizumbi Hill. According to Williams (1939) these gravels are colluvial deposits formed in arid conditions in hollows in the peneplained surface.

These gravels were termed the "Boshoff gravels" after their original exploiter. The Boshoff gravels provide a good example of a prospective environment for

other placer diamond deposits which could be found within the Tanzanian Shield. Differential weathering of the granite has given rise to an irregular bedrock surface. Gabbros in a calcrete or silcrete matrix tend to accumulate in depressions or against pegmatite dykes. The latter sites could be highly prospective for placer diamonds as these form natural traps for their accumulation. They can be compared with the quartz vein rock gbars across West Africa valleys which have provided some rich pockets of diamonds.

Since the discovery of the Mwadui pipe, prospecting efforts have concentrated mainly on the discovery of more kimberlite pipes. The high grade diamonds of the Mwadui deposits have over shadowed the early importance of the colluvial deposits of Mabuki and Kizumbi. Williams (1939) recorded that diamonds found in such gravels were generally close to a pipes source, so that to day the search for kimberlite pipes is still of prime importance. However, in view of the extensive volumes of Tertiary gravel deposits in the area, they should be considered as potential hosts for large low-grade deposits. Therefore, although one can conclude that the highest grade deposits are likely to occur directly over pipes, there is in addition potential for the discovery of economic colluvial valley deposits. The recently discovered diamond deposit in the Tertiary gravels at Maganzo is the illustration and proof of this argument.

(f) **The Probability of Kimberlites Containing Diamonds**

It has been suggested that some periods of kimberlite intrusions are more likely to be diamondiferous than others. Lampietti and Sutherland (1978) suggest that the periods 1,000-1,100 m.y., 250 m.y., and 80-150 m.y. are economically important for diamonds. This is an observational analysis based on known kimberlite occurrences. At present detailed knowledge of the ultimate controlling factors – the effects of chemistry and pressure/temperature conditions at the time of

diamond formation is not yet available. Green and Ringwood (1967) have ascertained that kimberlites originate in the upper mantle, and the diamondiferous ones come from the depth range 150-300 km.

Some attempts have been made, with a certain degree of success, to test whether a kimberlite pipe is likely to be diamondiferous by a careful chemical analysis of chromites and garnet crystals. This relationship of geochemistry of kimberlite indicator mineral to diamond potential work on most Tanzania kimberlite pipes (Kenstone of Re Union Mining Co. - personal communication)

The kimberlites of the Tanzanian shield have been divided into two groups (Edward, 1970)-an eastern group are Kimali and Iramba/Singida (see Fig. 39. Interpretation of Landsat images over these two fields shows a strong correlation of the kimberlites with NE/SW fractures, a strike direction associated with Archean/Lower pretorozoic dolerite dykes.

The age of the eastern kimberlites is known but they have been linked with those of the Lake Nyasa area which are also related to NE/SW fracruring. These in turn have been related by Edwards (1970) to kimberlites of the Luangwa valley in Zambia. The age of the Lake Nyasa kimberlites is assumed to be post-Karoo as they intrude sediments of that age. The Luangwa kimberlites are now known to have been wrongly termed kimberlites they are in fact Lamproites!

At least three ages of kimberlites have been established in the western group. Davis (1977) has established an age of 189 m.y. for the Mwadui pipe and an age of 53 m.y. for one of the Nzega kimberlites. Both these pipes are apparently related to major WNW/ESE lineaments. If the ages of the eastern group of kimberlites fall within the range of the western kimberlites, as now seems likely,

it is just possible that in the Tanzanian Diamond Belt structural setting and perhaps morphotectonics are more important than age in determining whether a kimberlite is likely to be diamodiferous or not. The oldest kimberlite dated the Bubiki is known to have a mean age of 1100 ma. This kimberlite pipe is located some 25 kilometres north west of Mwadui (J.B. Kashabano, 1989).

(g) **Prospecting Methods**

(i) **Heavy Mineral Sampling.**

Heaving mineral sampling has been the principal prospecting technique for the location of kimberlite pipes. About three quarters of known kimberlites have been discovered by this method (Mannard, 1968). The method relies on the survival in residual and transported soils, of a diagnostic suite of resistant heavy accessory minerals which have been derived from the weathering of kimberlite pipes. In Tanzania this suite essentially includes magnesian ilmenite, chromian pyrope-almandine garnet and chrome diopside and chromite.

It should be emphasised that the most important indicator mineral of all for diamonds is diamond itself. Therefore in the final analysis there is no way of avoiding bulk sampling, pitting or drilling to recover and wash relatively large samples. These samples will normally need to be at least a cubic metre in volume. Ideally sampling should be carried out on a regular

square grid with the grid spacing being reduced as a diamond reserve becomes more clearly defined.

**(ii) An integration of magnetics and electromagnetic geophysical surveys**

An integration of magnetic and electromagnetic geophysical surveys (airborne and ground) has proved successful in locating new kimberlite pipes (J.B. Kashabano, J.M. Gobba, 1992). Ground gravity and resistivity surveys have also proved useful in determining the size and shape of kimberlite.

**(iii) Petrography and Geochemistry**

As it has been proved that diamonds source rocks are lamproites and kimberlites and since the two have been confused macroscopically, a successful prospecting programme requires petrographical studies of fresh kimberlite or lamproite samples.

J.J. Gurney and others have proved the use of studies of mineral chemistry of kimberlite indicator minerals in determining the potential diamondiferous ness of kimberlites and lamproites. Though there are some exceptions the method can be used successfully in prospecting. Reunion Mining Company is applying the study with some degree of success. The author recommends petrographic studies and geochemical studies by microprobe analysis on some of the rocks of kimberlitic affinity on the cratonic margins as some of these might be lamproites.

Use is also being made of micro diamonds to determine the possible grades of some kimberlite pipes. Such a study will not remove the necessity for bulk sampling might be useful in reducing the risk of expensive sampling on otherwise non commercial deposits.

## **GEOTECTONIC SETTING OF THE TANZANIA DIAMOND FIELD.**

### **THE TANZANIA SHIELD**

#### **(a) General**

The Landsat interpretation of the shield by Geosurvey International 1979 has strongly emphasised that the whole area has been dominantly affected by brittle rather than ductile deformation. It shows that this large area is traversed by numerous faults and fractures. Many of the longer and consequently deeper faults will have acted as important controls for the emplacement of kimberlite magma. A knowledge of their distribution is vital to the elucidation of the structural control of kimberlite magmatism, and discovery of new diamond occurrences in the shield. The shield is characterised by a number of major features which include:-

- A variety of intrusive granites
- Greenstone belts with banded ironstones
- Dolerite dyke swarms
- Major faults and fractures
- Tectonised fault zones

- A peripheral gneiss belt

(b) **Granite Composition**

There is a wide range in composition within the shield, which varies from granite to granodiorite. A typical granite is grey, coarse-grained or even porphyritic rock. Remnants of earlier foliated granites occur within this matrix of intrusive granites. In the north several approximately circular granites are surrounded by belts of banded ironstones and suggest the possibility of remobilisation of their central granite cores.

(c) **Greenstone and Banded Ironstone Formations**

The majority of the greenstone belts are found in the northern part of the shield. Further, it can be seen from the Landsat interpretation and the aeromagnetic map that their main development is truncated by a major NW/SE fault bounding the southern margin of the Nzega greenstone belt. This important fault, not shown on existing maps, has been named the Nzega fault.

Where banded ironstone forms a substantial part of the greenstone belts they show up well on both the aeromagnetic and radiometric maps. So far important gold discoveries have been confined to quartz veins and reefs intersecting the banded ironstones. A point of some significance in diamond prospecting

is that many known kimberlites of the northern area appear within or close to greenstone belts.

(d) **Dolerite:**

Dolerites of diverse composition and ages outcrop in swarms across the shield. Their composition is variable and normal dolerites, quartz dolerites and olivine dolerites are found (Williams and Eades, 1939). The age of the dykes varies considerably many being older than 1700 m.y. (Hepworth, 1972). The youngest dykes appear to be olivine dolerites, but even these antedate the Mozambiquian orogeny (600 – 500 m.y.). It is assumed that the majority of the dolerites crossing the shield are of Kibaran (Bukoban) age ca. 810 m.y.

There is little record in Tanzania of basic magmatism, similar to that of southern Africa, marking the disruption of the supercontinent of Gondwana land in the period 190-150 m.y. However, recent radiometric dating of the Mwadui kimberlite at 189 m.y. (Davis, 1977) shows that it belongs to this period. It is also possible that the major N/S magmatic lineaments traversing the shield were related to this event.

(e) **Major Faults and Fractures**

The Tanzania shield is affected by number of major faults and lineaments. The most important of these can be described as geotectonic in scale. As a rough guide, geotectonic faults are those which strike for distance of over 150km (Lloyd-Lawrence, 1977). Examples of such faults are major fault related to the East African rift system and a number of important WNW/ESE shear faults traversing the shield. A second order of faults which are important to diamond exploration are major regional faults or lineaments, which are generally more than 80km and less than 150km. Both geotectonic and major regional faults can be classed as planetary or global fractures. These abyssal faults are assumed to penetrate deeply into the crust and to affect parts of the upper mantle. The most important faults interpreted from the Landsat imagery are shown in figure 5.

(f) **Tectonised Fault Zones**

A number of major WNW/ESE faults run through zones of highly sheared granite within the craton. These zones have been considered by Hepworth (1972) to belong to the "Dodoman" tectonic domain. Interpretation of Landsat imagery suggests that two of these zones which are coincident with the Kilimatinde and Rungwa faults are associated with ductile shearing.

(g) **Dodoman Peripheral Gneiss Belt**

A zone of gneissic granite outcrops in a NW/SE direction south of Tabora and is then deflected eastwards along the line of the

Rungwa fault. The exact age and mode of formation of this belt is uncertain, but it is assumed to be Dodoman in age. The Landsat imagery had shown that the zone is considerably narrower than shown on the Geological Map of Tanzania (Quennell, 1959).

#### (h) **Plio-Pleistocene Structural Depressions**

Faulting of Plio-Pleistocene age (the main period of East African Rift faulting) has created a number of individual basins or troughs infilled with sediments. The most significant of these is the arcuate Eyasi-Wembere trough. Another giant depression named the Ugalla depression has been revealed by the Landsat survey in the area north of the Rungwa fault (see fig. 5). These depressions together with a number of smaller basins or "mbuga" are widespread over the shield and very often are fault-controlled along one or more boundaries. Because of this they have in some cases been identified as the sites of kimberlite pipes which have been related to the boundary faults.

## THE RELATIONSHIP BETWEEN MAJOR SHIELD STRUCTURES AND KNOWN KIMBERLITES

### (a) General

The Landsat and aeromagnetic interpretations of the shield area have shown that in many cases kimberlite intrusion has been controlled by important faults and fractures. However, this situation does not appear to be universal. Further, the common assumption that kimberlites are more likely to occur at the intersection of faults, does not appear to be always true such kimberlites are not easily identified in the field due to strong erosion at such intersections alternatively, they may not have strong magnetic signatures.

A third type of phenomenon has been observed. This is an approximately circular clustering of known kimberlites and dipolar magnetic anomalies (the latter representing presumed kimberlites). Such groupings are harder to identify than obviously fracture controlled targets but may nevertheless be important for locating new pipes. Dawson (1980) in describing kimberlites in the stable craton, reports that they are intruded into areas which have undergone epeirogenic movements prior to intrusion. These kimberlites are sometimes associated with local swell or dome structures.

Many kimberlites in Tanzania have been discovered in areas rejuvenated by Tertiary rift faulting. Areas such as the Uchunga and Iramba plateau form discrete morphotectonic units with many exposed kimberlite pipes. Prime areas for the location of kimberlites have been close to fault scarps on the up throw side of the fault. The aeromagnetic map on the other hand allows one to extend these areas of known kimberlites across faults and provide new targets for ground investigation.

The Landsat investigation of the Tanzanian belt has shown that kimberlites occur in a variety of situations. Those related to specific tectonic features will be discussed in the following paragraphs.

## **GEOLOGY OF MWADUI KIMBERLITE NW/SE**

### **Lineaments**

NW/SE trending structures dominate the structural interpretation of the shield area. In particular a broad zone of fractures about 150 km wide strike across the centre of the shield. Kimberlites obviously related to these faults have been found in the vicinity of the Nyahua River. In this area four known kimberlites lie along a major NNE/SSW fault.

### **Description of Kimberlite Pipes NNW/ESE Wrench Faults**

Oblique to the NW/SE fractures are few very important WNW/ESE wrench faults of which the three longest are Nzega, Kilimatinde and ungwa faults (see fig. 5). The latter two faults

are known to be strongly tectonized zones or zones of ductile shearing and may be in fact closely related to Dodoman diastrophism. The Kilimatinde and Nzega and both closely associated with groups of kimberlites.

### **Geology of Detrital Deposits The Singida Kimberlites**

The numerous kimberlite pipes located to the east of the Eyasi-Wembere depression comprise the Singida/Iramba and Kimali fields. All these pipes have been declared non-diamondiferous. The Landsat interpretation shows that they all lie within a dense swarm of dolerite dykes. This swarm appears to be offset to the northwest across the Nzega fault. Many of the pipes appear to be aligned along the dyke direction ENE/WSW, but not all. It is suggested that this "barren" group of kimberlites may represent eroded stumps, which have undergone erosion due to Tertiary tectonic uplift. If this is the case diamonds which may have been present at the top of the pipes could now be widely dispersed. Microprobe work on the garnets, ilmenites and chromites from the kimberlite rocks of these areas might help understand their true potential diamondiferousness. It might be that the overlying gravels on the pipes that were tested have no relationship with the kimberlites. Microdiamonds were reported (Williamson Diamond Report 1959-1976) from the Kimali pipes and a three carat diamonds are reported from gravels near the Mbalanketi pipe (Singida) – Geological Survey Records Tanzania. The diamondiferousness of these pipes can be decided by carrying out testing of the kimberlite rocks and

carefully studying the microdiamonds and other heavy minerals.  
This kimberlite field represents the highest density of pipes.

### **Size and Quality of Diamond Greenstone Belt Environment**

Formerly it was considered that kimberlite pipes were not commonly found coincident with greenstone belts. However, a study of the location of kimberlites in northern Tanzania shows that many kimberlites do occur in areas of greenstone rocks. Such zones may therefore represent ancient lines of weakness and have acted as natural boundaries to the intrusion and remobilisation of later granitic intrusives. Dawson (1970) reported that kimberlites in the northern Tanzania are sometimes related to lines of weakness such as the contacts between the cratonic granite and Nyanzian greenstone belts. These fracture zones may therefore have acted as the loci for kimberlite emplacement and as such should not be overlooked in future

## **ASSESSMENT OF THE DIAMOND POTENTIAL OF THE PROPERTIES .**

### **DIAMOND POTENTIAL MAPPING:**

**Diamond Recognition criteria that are found in the Properties:**

## **Presence of kimberlite indicator minerals**

The Properties are in a few metres vicinity of the world's largest kimberlite pipe mine. Such important geological criteria like the presence of kimberlitic indicator minerals from diamondiferous sources .

The geochemistry of the indicator minerals does correlate with the indicators in the diamondiferous group. The figure shows the highest densities of the indicators to be centered around Mwadui and Shinyanga.,

### **Cliffords Empirical Rule:**

Clifford's rule states that diamondiferous kimberlites are located in Archean terrains . Mwadui area lies in a typical Archean craton.

### **Thermal gradient:**

To form and preserve diamonds high pressure and low temperature is required .The indicator mineral chemistry indicates the minerals to be from a thermally quite mantle roots and thermal barometry indicates the minerals to originate from a depth of more than 160 km. This is a good depth of origin of the kimberlite indicator minerals (Nixon and Griffith). Paper-Trace elements in indicator minerals:area selection and target evaluation in diamond exploration by **W.L.Griffin, C.G Ryan** attached , the Tanzania part is on pages **316,317,319,320,321.**( Journal Geochemical Exploration 53(1995)pp**311-337**

### **Geotectonic conditions.**

As described earlier the properties are in an area where the NE-SW/NW-SE

AD/C10/3  
X

8/12/90  
MINISTRY OF ENERGY AND MINERALS

CMR (38)

**WILLIAMSON DIAMONDS LIMITED**

RECEIVED 27 MAY 1999

MADINI BOGOMA

**To : Production Manager**

**From : Chief Geologist**

**c.c : MD - WDL , RC - Shinyanga, Commissioner for Minerals**

**Date : 21 / 11 / 1998**

**Sub : GEOLOGICAL REPORT ON NEW ALAMASI - SAMPLING**

**1. INTRODUCTION :**

Pitting and trenching work to confirm the continuation of diamondiferous gravels on the eastern side of the Mwadui Pipe started on 08 / 06 / 1998 to 25 / 09 / 1998.

A total of 30 sample - pits , each measuring 2.0 m by 1.0 m, were excavated covering an area of about 0.5 square - kilometer. This work outlined a very prominent Old Gulley ( Palaeo - drainage Channel ) with over 1.0 metre gravel - thickness which trends in a North- easterly direction towards New Alamasi Tailings dump ( c.f Map of New Alamasi Gravels ).

Three trenches measuring 325.0 m long were excavated along a Palaeo - Channel from which 895 tonnes of gravels were treated through the Williamson Plant recovering 59.35 metric carats of diamonds at a grade of 6.63 carats per hundred tonnes ( cpht ).

**2. GEOLOGY OF THE AREA :**

Most of the area is covered by black cotton soil which has favoured a growth of thick thorn bush within the area. In several places this top soil has been stripped. The average thickness of overburden is between 0.5 m to 1.0 m , followed by 0.5 m thick sub-angular to sub - rounded quartzitic gravels in reddish brown soil matrix. Underlying this formation is a sub - rounded to rounded quartz gravels in white calcareous matrix. In some areas granitic and pegmatitic rubbles were dominant. Average gravel thickness varied from 0.75 m to 2.80 m . Generally bed - rock is dominated by highly weathered gneissose granite cross - cut by feldspathic and pegmatitic dykes ( c.f Cross Section on a Map ).

Notes  
Kusungu  
L.A.S.

### 3. SAMPLING RESULTS :

Three trenches measuring 325.0 m long were excavated in blocks CD 15 / 16 along a palaeo - channel which trends in a north - easterly direction toward New Alamasi Tailings Dump ( c.f Map of New Alamasi Gravels ). Sample result was as follows:

- a ) Average Ore Thickness : 1.8 m
- b ) Ore Description : Sub - rounded to sub - angular quartz gravels and rubbles in red soil / white calcareous matrix. In some areas granitic rubbles were common and contribute between 5 % to 10 % by total volume.
- c ) Contamination : Bedrock taken was about 15 % and Overburden about 5 % .
- d ) Tonnage Treated : 895
- e ) Tonnes to DMS : 476
- f ) Tonnes of Concetrate : 0.391
- g ) Carats Recovered : 59.35
- h ) Grade ( cpht ) : 6.63
- i ) % - 13 : 64.5
- j ) Stone(s) Greater or Equal to 5.00 Carats : 1  
{ 10.10 carats with a light pink colour, gem }

### 4. NEW ALAMASI ORE RESERVES :

This sampling exercise has added into Williamson Diamonds Limited Ore Reserve as shown below

**TABLE 1 : ADDED GRAVELS**

AREA	BLOCK	TONNES	GRADE	CARATS	% - 13
NEW ALAMASI	CD 15 / 16	180,000	6.63	11,934.00	64.5

**TABLE 2 : THE OVERALL SUMMARY OF SUPERFICIAL GRAVELS  
AS AT 30 / 10 / 1998**

**A : MINEABLE AT PRESENT :**

AREA	TONNES	GRADE	CARATS	% - 13
AIRPORT NORTH	7,000	5.07	354.90	66.8
MATUNDURU	68,000	7.48	5,086.40	67.8
SOUTHERN { GOLF C }	350,000	6.48	22,680.00	67.5
SOUTHERN { DAIRY & NUR }	85,000	6.50	5,525.00	68.5
WESTERN { RED GRAVELS }	130,000	6.59	8,570.25	69.5
NEW ALAMASI	180,000	6.63	11,934.00	64.5
<b>TOTAL MINEABLE :</b>	<b>820,000</b>	<b>6.60</b>	<b>54,150.55</b>	<b>67.3</b>

**B : NOT MINEABLE AT PRESENT :**

AREA	TONNES	GRADE	CARATS	% - 13
WESTERN { Congl & Calcrete }	230,000	7.12	16,375.77	70.0
SOUTHERN { Fire }	200,000	6.00	12,000.00	68.5
NEW ALAMASI { Near Glory Hole }	450,000	7.00	31,500.00	70.0
<b>TOTAL NOT MINEABLE :</b>	<b>880,000</b>	<b>6.80</b>	<b>59,875.77</b>	<b>69.7</b>

**C : OVERALL SUPERFICIAL RESERVES { S.A.P } :**

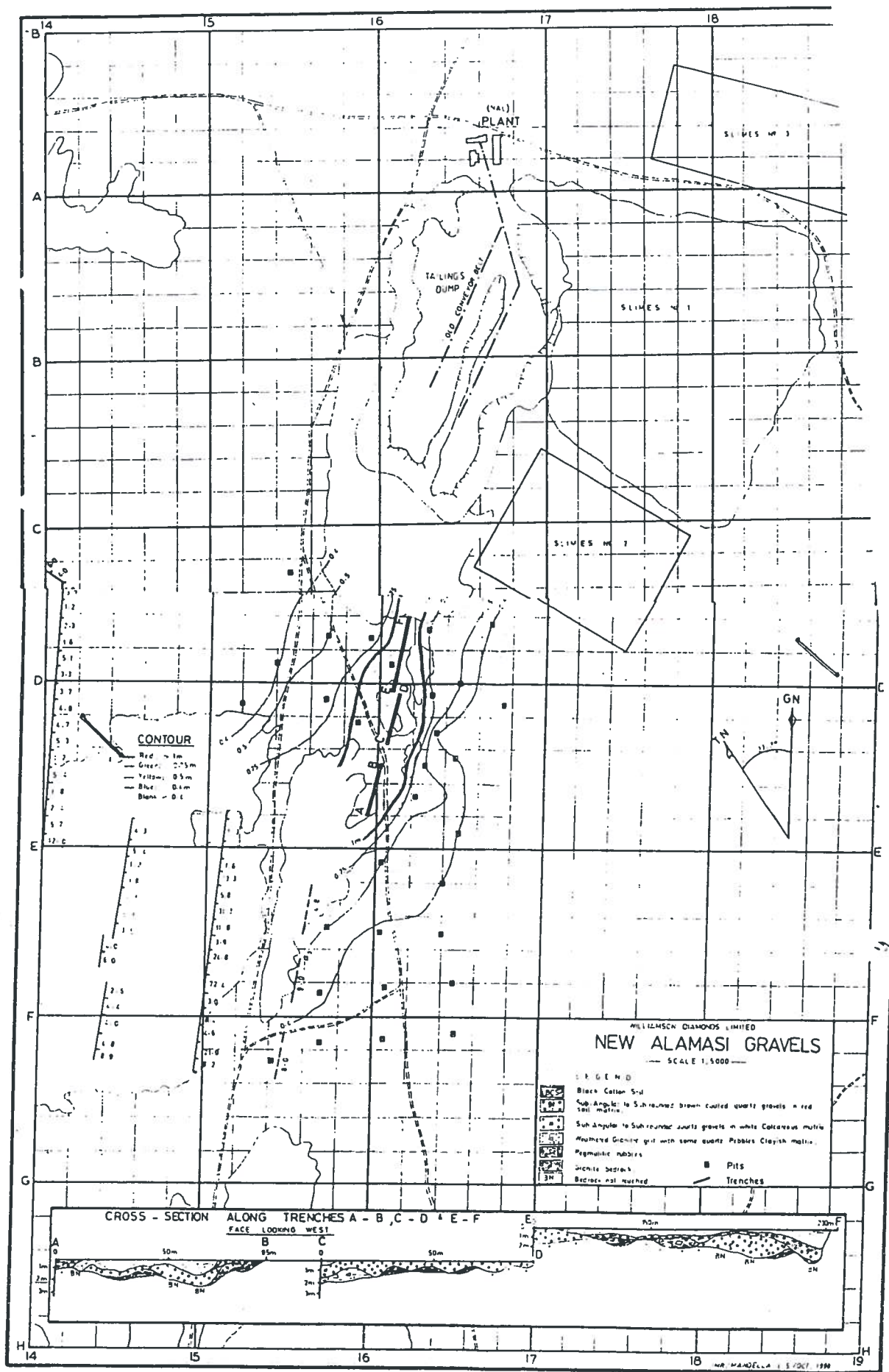
<b>GRAND TOTAL { A + B } :</b>	<b>1,700,000</b>	<b>6.70</b>	<b>114,026.32</b>	<b>68.6</b>
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**5. SUMMARY AND CONCLUSION :**

Sampling work in the vicinity of Mwadui Kimberlite pipe have indicated the continuation of payable diamondiferous gravel channels within New Alamasi Lease. More work is recommended, especially near the famous New Alamasi Glory Hole and surrounding areas.

  
**CHIEF MINE GEOLOGIST**

12 / RJJ / SAMP2NAL  
21 / 11 / 1998.



**CONTOUR**

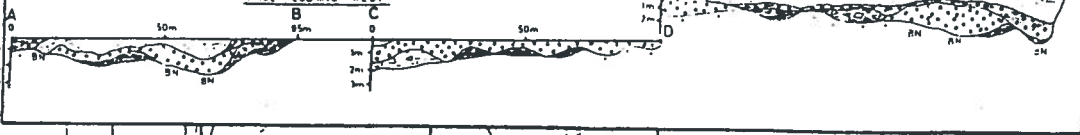
- Red - 1m
- Green - 0.75m
- Yellow - 0.5m
- Blue - 0.25m
- Black - 0.1

WILLMSON DIAMONDS LIMITED  
**NEW ALAMASI GRAVELS**  
 SCALE 1:5000

**LEGEND**

- Black Cotton Soil
- Sub-Angular to Sub-rounded quartz gravel in red soil matrix
- Sub-Angular to Sub-rounded quartz gravel in white Colerian matrix
- Angular to sub-angular quartz gravel in some quartz pebbles clayish matrix
- Pegmatite nodules
- Dolomite bedrock
- Bedrock not reached
- Pits
- Trenches

**CROSS-SECTION ALONG TRENCHES A-B, C-D & E-F**  
 FACE LOOKING WEST



/E-W faults intersect. These are global faults and may be related to mantle or deep crustal terrains.

## PRESENCE OF NUMEROUS PALEODRAINAGE CHANNELS

Landsat Image around Mwadui and HEAVY MINERAL DISTRIBUTION PATTERN AND LOCATION OF KNOWN KIMBERLITE PIPES AND KIMBERLITE TARGETS

## FIELD EXPLORATION WORK

PREVIOUS EXPLORATION WORK (DIAMOND SAMPLING RESULTS) BY WILLIAMSON DIAMONDS LIMITED

Report by Chief Geologist, Mwadui dated 21/11/1998

### SUMMARY

Pitting and trenching work to confirm the continuation of diamondiferous gravels on the eastern side of the Mwadui kimberlite pipe started on 08/06/1998 to 25/09/1998. A total of 30 sample pits each measuring 2.0 m by 1.0 m, were excavated covering an area of about 0.5 square-kilometres. This work outlined a very prominent Old Gulley (Paleodrainage Channel) with over 1.0m gravel –thickness which trends in a North –easterly direction towards the New alamsi Tailings dump. Three trenches measuring 325 m long were excavated along a Paleodrainage channel from which 895 tonnes of gravel were treated through the Williamson mine Plant recovering 59.35 metric carats of diamonds at an average grade of 6.63 carats per hundred tones (cpht). Of the stones recovered Stones greater or equal to 5.0 Carats :1(10.10 carats with a light pink colour ,gem. Such stones are exceptionaly good and are highly prices. A stone called the Williamson was worn from the Mwadui Mine and stands as one of the best rose stones in the world. The 53 carat stone was presented to her Majesty the Queen Elizabeth for her wedding the cut stone of this special diamond weighed some 23 carats . A copy of the detailed sampling is attached to this report

## **PLANNED SYSTEMATIC SAMPLING WORK**

To achieve the best results the entire area of the claims must be systematically pitted to the bed rock. In areas where paleodrainage channels are identified trenches must be dug along the channels in order to estimate the diamond grade. Ground magnetic/gravity and selected EM profiles must be run in order to outline diamondiferous kimberlite and in order to determine the depth to the bedrock and hence help in the determination of the diamond grades in the gravels.

## **DIAMOND RESOURCE FORECAST**

### **Presence of placer diamonds.**

The area around Maganzo and that around the Songwa dam where alluvial diamonds have been won, and estimates put the deposit at the grade of the New Alamasí mine to the east. Geophysical data indicate a likelihood of discovering new pipes in the concession. It is widely believed that the diamonds are from two different sources some are from Mwadui while some are from other kimberlites to be discovered after exploration. The ore resource is calculated at 100x100x10x2x2tonnes .The ore grade in the enriched gravels is 10cpht on average , so  $100 \times 100 \times 10 \times 2 \times 2 \times 10 / 100 = 40,000$  metric carats are estimated without taking into account the potential of the kimberlites

## **CONCLUSION:**

The Properties are good targets for diamond exploration/mining .As the area lies in a greenstone terrain one does not rule out the presence of an economical gold/ base metal prospect. It is recommended that sampling for gold and base metal be conducted in order to add value to the concessions A map of the soil sampling at a sample spacing of one kilometer is attached . The map shows gold

and base metal potential in the area. Detailed property evaluation is recommended.

### **KEY SOURCES OF INFORMATION (REFERENCES)**

1. Diamond Exploration Reports of Tanganyika Territory by  
Williamson  
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2. E.O. Teale, Shinyanga Diamond Fields, Geological Survey  
of Tanganyika  
Short Paper N<sup>o</sup>. 9 – 1931.
3. Geosurvey International. Detailed airborne survey around  
Mwadui 1981
4. G.J. Williams - The kimberlite Province and Associated  
Diamond Deposits  
of Tanganyika Territory Bulletin N<sup>o</sup>. 12 – 1931

### **MAPS ATTACHED**

1. Heavy Mineral Distribution map of QDS 65/1
2. Location map of the property



## Landsat Interpretation of the Tanzanian Diamond Belt

Scale 1:1,000,000

Topographic base is the 1:500,000 scale operational air-photograph charts published by the US Defense Mapping Agency and US Landsat imagery.

### LEGEND

#### PHANEROZOIC

- Residual soils from granite
- Red lateritic soils weathered from Neoproterozoic and Paleoproterozoic
- Calcareous fill
- Age Sate of the Mananga-Esoi-Jombe depression

#### PRECAMBRIAN

- Neoproterozoic metasediments, mainly quartzites and quartz-feldspathic gneiss
- Bukoma sediments, undifferentiated
- Dodoma metasediments, mainly quartzites
- Avanian metasediments undifferentiated, mainly quartzites and metaconglomerates
- Tanzanian banded ironstone formation

#### IGNEOUS ROCKS

- Granite
- Granite
- Sheared granite and granite strongly resistant to weathering
- Undifferentiated granite (metamorphogenic)
- Regolite surface

#### STRUCTURAL FEATURES

- Major fault with slicken sense
- Transcurrent fault with direction of movement
- Lineament
- Lineament inferred
- Geological boundary
- Circular feature
- Trace of strike ridge
- Volcanic centre

#### TOPOGRAPHICAL FEATURES

- Railway
- Main Road
- River
- Scarp edge
- Important town

#### IMPORTANT MINERALS AND KIMBERLITE PIPES

- Kimberlite pipe
- Diamondiferous kimberlite pipe
- Asbestos diamonds
- Gold
- Copper
- Lead
- Iron
- Nickel
- Chromium
- Active mine
- Inactive mine



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**THE UNITED REPUBLIC OF TANZANIA  
MINISTRY OF ENERGY AND MINERALS**

**ACKNOWLEDGEMENT AND RECORDING IN THE CENTRAL  
WESTERN ZONE REGISTER THE TRANSFER OF PRIMARY  
MINING LICENCE 0009459**

I, The Zonal Mines Officer for the Central Western Zone, pursuant to section 106-(1) of the Mining Act, No.14 of 2010 hereby confirm recording in the Central Western Zone Register the transfer of 100% shares of 1 Primary Mining Licence No. **PML0009459** from **Fedilia L. Khalfan** (100%) to **Omary Hussein Mkongo** of **P.O. Box 41279, Dar-es-Salaam.**

The foregoing transfer is hereby recorded on terms and conditions contained in the said Primary Mining Licenses.

**IN WITNESS WHEREOF,** this transfer has been duly recorded

this ..... **13<sup>th</sup>** ..... day of **MARCH** ..... **2015** .....

.....  
**Humphrey E. Mimbando  
ZONAL MINES OFFICER  
CENTRAL WESTERN ZONE**

0010345



**THE UNITED REPUBLIC OF TANZANIA  
MINISTRY OF ENERGY AND MINERALS**

**ACKNOWLEDGEMENT AND RECORDING IN THE CENTRAL  
WESTERN ZONE REGISTER THE TRANSFER OF PRIMARY  
MINING LICENCE 0009458**

I, The Zonal Mines Officer for the Central Western Zone, pursuant to section 106-(1) of the Mining Act, No.14 of 2010 hereby confirm recording in the Central Western Zone Register the transfer of 100% shares of 1 Primary Mining Licence No. **PML0009458** from **Fedilia L. Khalfan** (100%) to **Omary Hussein Mkongo** of **P.O. Box 41279, Dar-es-Salaam.**

The foregoing transfer is hereby recorded on terms and conditions contained in the said Primary Mining Licenses.

**IN WITNESS WHEREOF**, this transfer has been duly recorded

this ..... 13<sup>th</sup> ..... day of MARCH ..... 2015 .....

.....  
Humphrey E. Mmbando  
**ZONAL MINES OFFICER  
CENTRAL WESTERN ZONE**

## Geological Legend



Garnets

Size of Circle is proportional to the number of grains  
Colour split in circle represents the relative  
percentages of Garnets and Ilmenites in the sample.



Ilmenites



Magnetic Targets



Kimberlites - Geophysics Plotting



Kimberlites - Laboratory Plotting

## Topographical Legend



Major Roads



Major Rivers



Minor Rivers

33°40'E

Residual granite soils

N

Residual granite soils

Gt

Gt

Nyazian Quartzite

Plio-Pleistocene Lake Beds

Finger R.

Mvabur Mine

Nyazian Schists

Residual granite soils

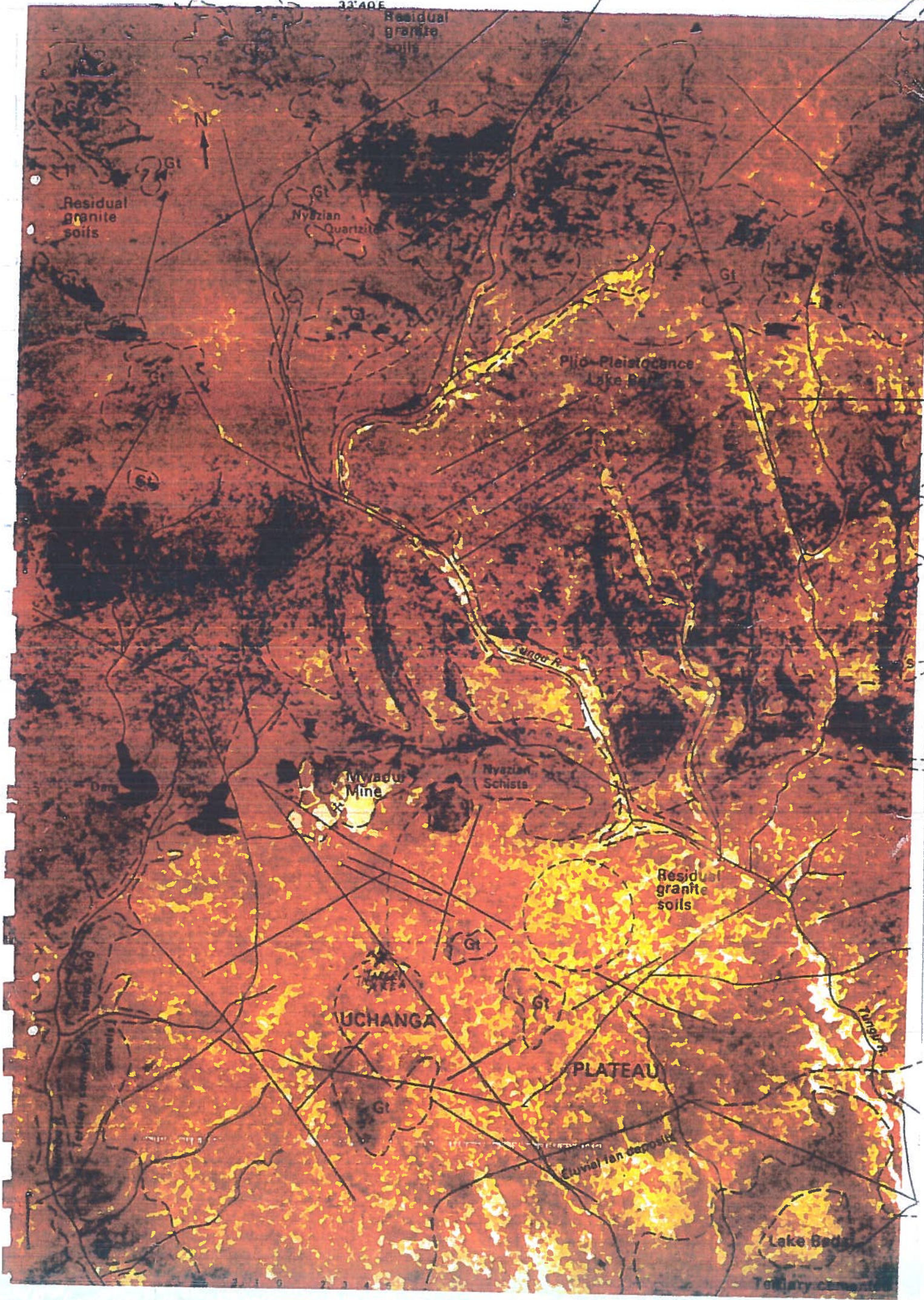
UCHANGA

PLATEAU

Eluvial fan deposits

Lake Beds

Tertiary conglomerate



33°40'E  
Residual  
granite  
soils



Gneissose granite

Residual  
granite  
soils

Nyazian  
Quartzite

Plio-Pleistocene  
Lake Beds

Yurigu R.

Dani

U m

Mwadui  
Mine

Nyazian  
Schist

Residual  
granite  
soils

Whumbu R.  
Tertiary cemented  
sands and  
gravels

TARGET  
AREA

UCHANGA

PLATEAU

Yurigu R.

Eluvial fan deposits

Lake Beds

Tertiary cemented

2 1 0 . 2 3 4 0

23400

