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NI 43-101 Technical Report and Mineral Resource Estimate for the Songwe Hill Rare Earth Element (REE) Project, Phalombe District, Republic of Malawi

Prepared by The MSA Group (Pty) Ltd for:

Mkango Resources Ltd

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1 SUMMARY

1.1 Introduction

The MSA Group (Pty) Limited ("MSA") has been commissioned by Mkango Resources Ltd. ("Mkango") to provide a NI 43-101 Technical Report and Mineral Resource estimate (the "2012 ITR") for the Songwe Hill rare earth element ("REE") project, located in the Republic of Malawi, in which Mkango has a 100% interest.

This report has been prepared in accordance with National Instrument 43-101 Standards of Disclosure for Mineral Projects and companion policy 43-101CP, and in accordance with Form 43-101F1, as issued by the Canadian Securities Administrators.

Songwe Hill is an exploration project for REE associated with carbonatite intrusions and related fenite and breccias in what appears to be a ring structure associated with a volcanic vent complex.

1.2 Property, Location and Ownership

The Songwe Hill deposit lies within Exclusive Prospecting License ("EPL") 0284/10 (the "Phalombe License") which is held by Lancaster Exploration Ltd., a wholly owned subsidiary of Mkango Resources. EPL 0284/10 was granted on January 21, 2010 under the Malawi Mines and Minerals Act, 1981, for a period of three years. The expenditure commitment for the initial 3 years of the license has been met and application has been made for the first two year renewal in 2013.

The project area is located approximately 70 km SE of the city of Zomba and approximately 90 km ENE of the city of Blantyre in the Phalombe District of the Southern Region of Malawi. All-weather roads link these centers with the town of Migowi, approximately 15 km from Songwe Hill, and are currently being upgraded to bitumen. Secondary gravel roads provide vehicle access to the exploration camp. Migowi is connected to the national electricity grid.

The Songwe Hill area has a sub-tropical climate. Maximum monthly rainfall is between 125 cm and 218 cm during the rainy season of December to March.

The deposit lies on the north-facing slopes of Songwe Hill, a steep-sided conical hill with a diameter of approximately 800 m that rises to a summit elevation of 990 m. Songwe Hill abuts the slopes of the adjacent and larger Mauze Hill which rises above the alluvial plains south of Lake Chilwa and straddles the border with Mozambique. The slopes of Songwe Hill are densely vegetated with elephant grass following the rainy season but in other times of the year, vegetation does not hinder access.

1.3 Geology and Mineralization

Basement rocks in the Songwe Hill area are Precambrian charnockitic granulites and gneiss. During the Jurassic/Cretaceous period (206 Ma to 65 Ma), these were intruded by a variety of alkalic intrusions referred to as the Chilwa Alkaline Province. In the area of Songwe Hill, there are a number of large alkaline intrusions as well as many small plugs and dykes. The dominant lithologies are alkaline syenitic rocks with locally associated carbonatites.

Songwe Hill is interpreted as a volcanic vent that is expressed as a steep-sided hill approximately 800 m in diameter. The carbonatite is best exposed along the north-eastern slope of Songwe Hill and, together with a somewhat smaller area along its north western edge, is tentatively interpreted to form a ring structure. Information from recent surface mapping and drill core indicates that the vent complex consists of a multi-phase intrusion characterized by diverse carbonatites and breccias exhibiting a range of alteration from potassic fenitisation to low temperature hydrothermal / carbohydrothermal overprinting. The vent complex cuts the western end of the large Mauze nepheline syenite intrusion, but the external contacts on the western and north western sides of the vent are hidden beneath recent surficial eluvial deposits.

The principal lithologies that comprise the Songwe Hill vent complex are carbonatite, fenite and breccia. The carbonatites are dominantly grey calcic carbonatites, although subordinate ferro-carbonatites are present. The fenites comprise dominantly K-feldspar rocks and appear to form an aureole around the carbonatite. They are interpreted to have formed through metasomatism related to the carbonatite intrusion. The breccias range from clearly abraded pebble-sized fragments (pebble dykes) to angular blocks meters in diameter and include significant volumes of breccia in which the fragments appear to have undergone little or no movement. The breccias can essentially be divided into two types: feldspathic-rich breccias and carbonatite-rich breccias and are interpreted to be related to high level explosive processes during the formation of the vent complex.

The principal zone of REE mineralization outcrops along the north eastern slope of Songwe Hill. REE mineralization is present in carbonatites, fenites and breccias, which are exposed intermittently over a surface area of approximately 350 m by 100 m. The REE mineralization is untested to the northeast and southwest beyond the limits of the present drilling and below the deepest vertical intersection of approximately 350 m below the surface of the hill and there is additional regional exploration potential in the Songwe and other carbonatites. The mineralized body is interpreted to be a carbonatite plug with essentially sub-vertical margins. In plan view it is elongate in a NE-SW direction.

For the purposes of mineral resource definition, three geological domains have been identified in the Songwe Hill deposit, a carbonatite domain, a fenite domain, and a 'mixed' domain consisting of breccia and/or finely intermixed carbonatite and fenite. REE mineralization is dominantly within the carbonatites, but locally also occurs within the fenite and mixed domains. The dominant REE-bearing minerals are synchysite and apatite. The apatite is anomalously enriched in the HREO compared to apatites in most carbonatite deposits. The REE mineralization is closely associated with strontianite and baryte and is interpreted to have formed through sub-solidus hydrothermal alteration following the carbonatite intrusion.

1.4 Status of Exploration

Mkango has compiled an extensive exploration database over Songwe Hill, comprising geological, geochemical and geophysical data. The quality of exposure on Songwe Hill has allowed detailed geological mapping and surface sampling which helped identify the outcrop extent of the carbonatite. Surface radiometric surveys have been useful in better defining the areas of carbonatite exposure. Systematic outcrop stripping and channel sampling along the surface trace of the diamond drill lines has helped to characterize the mineralized zone at surface and connect it with mineralization identified by diamond drilling.

A total of 38 inclined and vertical diamond drill holes totaling 6,852.28 m have been drilled in a series of fences spaced approximately 25 m apart to obtain different depth intersections of the mineralization. The outcropping position of the mineralized zone on each drill fence was constrained by channel sampling. The channels and drill core were sampled at a nominal interval of 1 meter and the assay results together with the bulk density measurements were incorporated into the project database.

1.5 Mineral Resources

The following NI 43-101 compliant *in-situ* Mineral Resource Estimate for Total Rare Earth Oxides ("TREO"), Total Heavy Rare Earth Oxides (HREO) and Total Light Rare Earth Oxides ("LREO") have been declared from Songwe Hill and represent 100% of the estimated Mineral Resources defined to date over the project effective September 30, 2012 (Table 1-1and Table 1-2). A cut-off of 1% TREO is currently considered to be appropriate but might change subject to favorable outcomes of the on-going metallurgical test work. All references to rare earths in this report include yttrium as a heavy rare earth.

Table 1-1
***In-situ* Indicated mineral resources for Songwe Hill: All domains at a 1% TREO cut-off** (Hall, 2012)

Domain	Tonnes Million	LREO %	HREO %	TREO %	TREO Tonnes	HREO Proportion
Carbonatite	11.10	1.50	0.12	1.62	179,499	7.3%
Fenite	1.37	1.51	0.10	1.61	22,145	6.5%
Mixed	0.69	1.58	0.07	1.65	11,454	4.5%
Totals	13.16	1.50	0.11	1.62	213,098	7.1%

Table 1-2
***In-situ* Inferred mineral resources for Songwe Hill: All domains at a 1% TREO cut-off** (Hall, 2012)

Domain	Tonnes Million	LREO %	HREO %	TREO %	TREO Tonnes	HREO Proportion
Carbonatite	8.64	1.24	0.11	1.35	116,967	8.2%
Fenite	8.27	1.24	0.10	1.35	111,318	7.5%
Mixed	1.68	1.59	0.06	1.65	27,863	3.8%
Totals	18.59	1.28	0.10	1.38	256,149	7.4%

1.6 Conclusions and Recommendations

Exploration at Songwe Hill has identified a carbonatite vent complex that is mineralized with REE. The principal mineralized lithology is a carbonatite plug and related fenites and breccia which have been drill-tested beneath a surface area of approximately 350 m by 100 m. The mineralized zone appears to be steep-sided and continuous at depth. The carbonatite system is interpreted to have been enriched in REE, which have been redistributed and concentrated by late hydrothermal activity associated with the intrusion. The principal REE-bearing minerals are synchysite and apatite.

The assay results from the channels and drillholes which outline the Songwe Hill deposit have been subjected to industry standard quality control procedures but only the borehole data were used to declare an initial Mineral Resource. The presented categories of the mineral resource and a cut-off grade of 1% TREO are currently regarded as appropriate.

The immediate focus should be on completion of metallurgical scoping work.

Whilst an Indicated resource category is sufficient to support a pre-feasibility study, there is merit in advancing the confidence in the mineralized system with additional drilling to attain Measured and Indicated Mineral Resources. A higher level of confidence in the mineral resource classification will also require a favorable outcome of the on-going metallurgical test work demonstrating reasonable confidence in the viability of economic extraction of the REEs.

A preliminary economic assessment (PEA) study, comprising conceptual mining and geotechnical studies, infrastructure, utility, environmental and socio-economic studies and high level financial studies including risk, sensitivity and market analyses, should be considered pending the outcome of the scoping metallurgical test work.

The proposed budget of CAD$ 1.6 million includes provisions in anticipation of positive outcomes and is adequate to conduct the various tasks (Table 1-3). A successful outcome of the individual components would confirm the advisability for a PEA and then determine the scope for a feasibility study to ultimately advance the project to production.

Table 1-3
Planned Budget for next phase

Task	CAD $
Metallurgical and beneficiation test work	500,000
Geological work including additional drilling and geological modeling	700,000
Environmental survey / social impact assessments	150,000
Scoping baseline PEA data	250,000
Total for next phase	1,600,000

Note: Above expenditures exclude Corporate and Administration costs

2 INTRODUCTION

2.1 Scope of Work

The MSA Group (Pty) Limited (“MSA”) has been commissioned by Mkango Resources Ltd. (“Mkango”) to prepare a NI 43-101 Technical Report and Mineral Resource estimate (the “2012 ITR”) for the Songwe Hill rare earth element (“REE”) Project located in the Republic of Malawi in which Mkango has a 100% interest.

Mkango’s mineral property is considered to represent an “Exploration Project” which is inherently speculative in nature. However, MSA considers that the area covered by the Exclusive Prospecting License (“EPL”) 0284/10, which is large, has sufficient technical merit to justify ongoing exploration programs and associated expenditure. Subject to varying degrees of exploration risk the EPL warrants future exploration and a detailed assessment of the economic potential.

The 2012 ITR has been prepared in compliance with disclosure and reporting requirements set forth in Canadian National Instrument 43-101 Standards of Disclosure for Mineral Projects, Companion Policy 43-101CP, Form 43-101F1, of June 2011 and the CIM Definition Standards for Mineral Resources and Reserves.

All monetary figures expressed in this report are in Canadian dollars (“CAD$”) unless otherwise stated.

2.2 Principal Sources of Information

MSA has based this report on work and information produced by Mkango and Scott Swinden of Swinden Geoscience Consultants Ltd. (“SGC”) of Halifax, Canada, on work conducted by Japanese agencies JICA and MMAJ between 1986 and 1989, Remote Exploration Services (Pty) Ltd (“RES”) of South Africa and other independent parties, on reports commissioned by Mkango and on other relevant published and unpublished data. A listing of the principal sources of information is included at the end of this report.

QP Certificates are included as Appendix 2. We have endeavored, by making all reasonable enquiries, to confirm the authenticity and completeness of the technical data upon which this report is based. A final draft of the report was provided to Mkango along with a written request to identify any material errors or omissions prior to lodgment.

Mkango has completed a comprehensive diamond drilling and channel sampling programme that has satisfied the objectives of delineating a NI 43-101 compliant Mineral Resource. In addition, a limited sampling programme of the drill core has provided representative material for mineralogical and mineral chemical studies and bench scale metallurgical test work.

This 2012 ITR has been prepared on geological information available up to and including September 30, 2012.

2.3 Qualifications, Experience and Independence

MSA is a South African Johannesburg-based exploration and resource consulting and contracting firm, which has been providing services and advice to the international mineral industry and financial institutions since 1983.

This report has been compiled on behalf of MSA by Dr Scott Swinden and Michael Hall who are "Qualified Persons" under the definitions provided in the NI 43-101.

Dr. Scott Swinden is a professional geologist with more than 40 years' experience in mineral deposits geoscience and the exploration and evaluation of mineral properties and is an independent consultant to Mkango. He is a member in good standing with the Association of Professional Geoscientists of Nova Scotia, a Fellow of the Canadian Institute of Mining, Metallurgy and Petroleum, the Geological Association of Canada and the Society of Economic Geologists. He has the appropriate relevant qualifications, experience and competence to be considered a "Qualified Person" under the definitions provided in NI 43-101 and meets the test of independence from Mkango set out in Section 1.5 of NI 43-101. Dr. Swinden completed site visits to the Songwe Hill project during the period April 21 to 25, 2012, and more recently from October 11 to 16, 2012. Dr. Swinden is an independent consulting geologist with Swinden Geoscience Consultants Ltd. and is not employed by MSA.

Mineral Resource estimation and reporting thereof were carried out by Mr. Mike Hall, who is a professional geologist with over 30 years' career experience including 14 years in the field of Mineral Resource estimation and Datamine modeling, as well as surface and underground exploration for a variety of commodities. Mr. Hall is Consulting Geologist - Mineral Resources with MSA. Mr. Hall completed one site visit to the Songwe Hill project from September 1 to 3, 2012.

Neither MSA, nor Messrs. Swinden or Hall, currently have or have had previously, any material interest in Mkango or the mineral properties in which Mkango has an interest. MSA's relationship with Mkango is solely one of professional association between client and independent consultant.

This report is prepared in return for professional fees based upon agreed commercial rates and the payment of these fees is in no way contingent on the results of this report.

3 RELIANCE ON OTHER EXPERTS

Neither Scott Swinden nor MSA has independently verified, nor are they qualified to verify, the legal status of EPL 0284/10, the Phalombe License. The present status of the tenement listed in this report is based on information and copies of documents provided by Mkango and this report has been prepared on the assumption that the tenement will prove lawfully accessible for evaluation.

Neither Scott Swinden nor MSA is qualified to comment on environmental issues associated with the Songwe Hill project. No guarantee, be it express or implied, is made by Scott Swinden or MSA with respect to the completeness or accuracy of the legal or environmental aspects of this document. Neither Scott Swinden nor MSA undertakes or accepts any responsibility or liability in any way whatsoever to any person or entity in respect of these parts of this document, or any errors in or omissions from it, whether arising from negligence or any other basis in law whatsoever.

The historical work outlined in this report is based on published sources, and unpublished reports, maps and data provided by Mkango. The authors have exercised all due care in reviewing the documents provided and attempted to verify the quality and accuracy of the data. MSA has reviewed the data to assess its quality and accuracy and believes that the supplied information and the basic assumptions are factual and correct and that the interpretations are reasonable and has no reason to believe that any material facts were withheld.

Except for the purposes legislated under Canadian provincial securities laws any use of this report by any third party is at that party's sole risk.

4 PROPERTY DESCRIPTION AND LOCATION

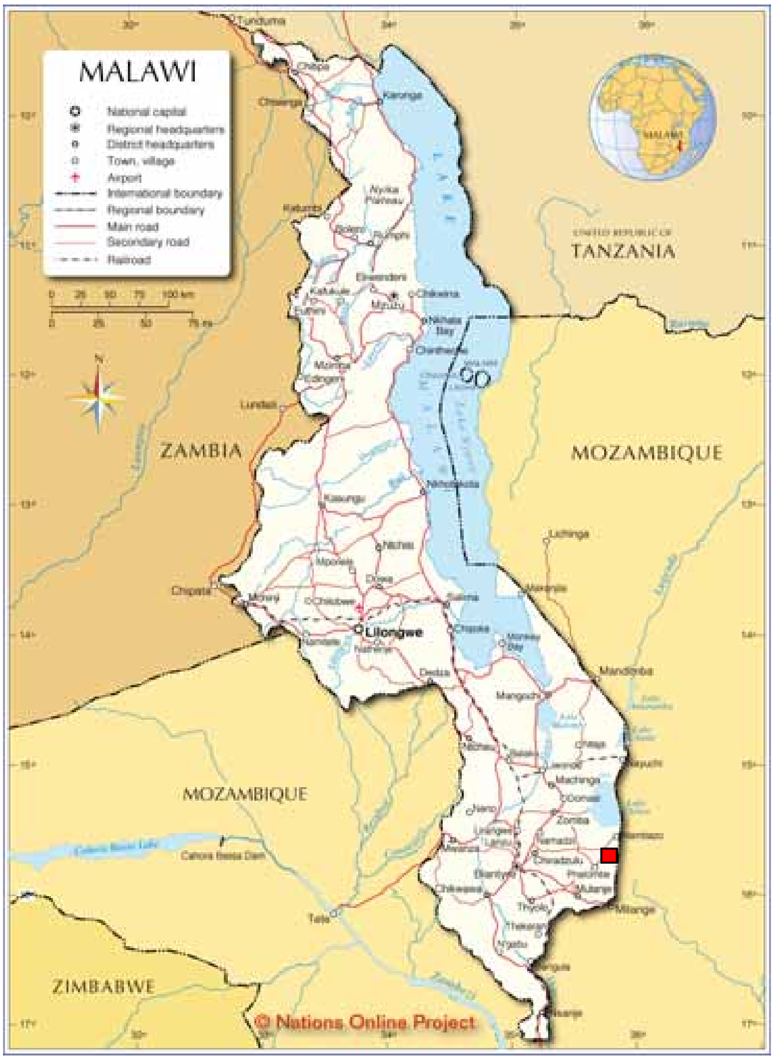
4.1 Property Location

Songwe Hill is located in southeastern Malawi, between Lake Chilwa and the Mulanje Massif and close to the eastern border of Malawi with Mozambique (Figure 4-1). It lies within Exclusive Prospecting License (EPL) 0284/10 which Mkango refers to as the “Phalombe License".

EPL 0284/10 lies entirely within the Southern Region of Malawi and Songwe Hill is within the Phalombe administrative district. It lies approximately 70 km in a straight line SE from the former capital of Zomba and approximately 90 km in a straight line ENE of the commercial centre of Blantyre. Songwe Hill can be reached from these centers via national highways S144 and S145, respectively. The S145 passes within 15 km of Songwe Hill.

Figure 4-1

Location of the Songwe Hill (red square) SE of Zomba (Nations Online, 2012)



4.2 Property Description

4.2.1 Exclusive Prospecting Licenses ("EPL") in Malawi

The search for, mining and disposal of minerals in Malawi is governed by the Mines and Minerals Act (1981). The administration of the Act is the responsibility of the Commissioner for Mines and Minerals in the Ministry of Energy and Mining.

It is the objective of Malawi's mining policy to maximize the economic benefits to the nation by exploiting the nation's mineral resources. The government encourages investors to explore, delineate, evaluate and where viable exploit the country's mineral resources.

The rights to carry out a programme of prospecting operations for specified minerals over a particular area are conveyed by way of an Exclusive Prospecting License. On application for an EPL a detailed programme of exploration and expected expenditures is presented by the applicant together with a proposal for the training and employment of Malawi citizens.

4.2.2 EPL 0284/10 Phalombe

Mkango, through its 100% owned subsidiary Lancaster Exploration Ltd. ("Lancaster"), holds a 100% interest in EPL 0284/10 (the "Phalombe License" or "Permit") which includes the Songwe Hill REE deposit. The EPL covers an area of 1,283 km^2 and was granted to Lancaster on January 21, 2010 by the Minister of Natural Resources, Energy and Environment under the Mines and Minerals Act from 1981 (Cap. 61:01). Mkango is in receipt of a legal opinion from Blantyre's law firm Nampota and Company that Lancaster is the legal holder of 100% interest in EPL 0284/10 which is valid and existing as of the date of the opinion, October 30, 2012. The opinion further states that the EPL is unencumbered and in good standing.

The EPL is valid for a period of three years and may be renewed upon application for two further periods of two years each provided that the terms and conditions of the license have been met (Table 4-1). The EPL allows Mkango to explore for "rare earth metals, strontium, niobium, iron ore, manganese, fluorite, phosphate, uranium, thorium, monazite and associated minerals".

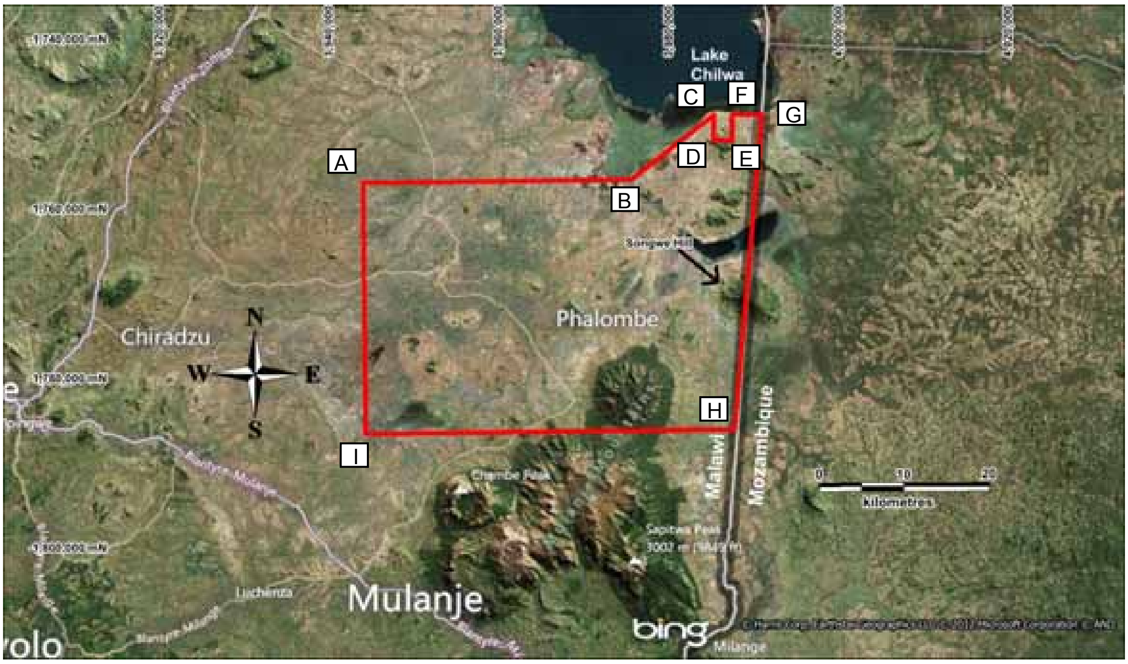
The boundaries of the EPL are determined by reference to the Universal Transverse Mercator (UTM) Grid using the ARC1950 Datum in Zone 36 (Southern Hemisphere). The coordinates of the corner points of the EPL are given in Table 4-2 and its location is shown in Figure 4-2.

An application was filed on October 15, 2012 for the first renewal of the EPL with no reduction in the size of the license area. Mkango has received a stamp on October 26, 2012 from the Ministry of Mines and Energy in Lilongwe confirming that the renewal application has been received. Mkango expects that the renewal of EPL 0284/10 for a further two year period, ending January 20, 2015, will be tabled and approved by the Ministry at the next scheduled license meeting which is expected to occur before the expiry of the license in January, 2013.

Table 4-1 History of tenure of EPL 0284/10 (Phalombe)				
Application	**Applied**	**Granted**	**Validity**	**Comment**
Original	Nov 16, 2009	Jan 21, 2010	Jan 20, 2013	1,283 km^2; work program of prospecting, geochemical, geophysical work and drilling totaling MWK 43,500,000
1st Renewal	Oct 15, 2012	Application accepted on Oct 26, 2012	Jan 20, 2015 to be confirmed	Proposed work program totaling MWK 150,000,000 with no size reduction

Figure 4-2

Location of EPL 0284/10 and access roads (Base map sourced from Microsoft Bing, 2012)



Note: The Songwe carbonatite abuts against Mauze Hill on its northwestern flank and is entirely within the Republic of Malawi. UTM Zone 36S and WGS84 Datum

Table 4-2 Coordinates of the current EPL 0284/10 as valid until January 20, 2013		
Corner Point	**Easting**	**Northing**
A	760000	8275700
B	790500	8275700
C	799900	8282900
D	799900	8280000
E	802000	8280000
F	802000	8282900
G	805400	8282900
H	801800	8247300
I	760000	8247300

Note: The line between points G and H follows the international boundary between Malawi and Mozambique. Co-ordinates based on the Blantyre Map Sheet, 1:250,000. Coordinates in Table 4-2 use ARC1950 Datum

The expenditure commitment for the first three years of the EPL amounted to 43,500,000 Malawian Kwacha (approximately CAD$ 137,500 at November 2012 exchange rate) and this expenditure has already been met by Mkango.

4.2.3 General Provisions

Except for general rights of the local communities to graze livestock or to cultivate the land, which rights may not interfere with the prospecting operations, there are no restrictions on surface access to the area pertaining to the Permit.

Under existing legislation the holder of an EPL may apply for the renewal of the Permit over an area which is not greater in extent than half of the originally granted prospecting area, unless otherwise approved by the Minister. If the application for the renewal of an EPL meets the set criteria, the Minister shall renew the License for a period not exceeding two years. The legislation provides for only two renewals of two years each and any further extension of the License is subject to Ministerial discretion.

The Government of Malawi has no rights or options to acquire any interest in the License save that the Government would be entitled to cancel or suspend the License if the holder of the Permit:

(a) fails to use in good faith the land subject to the Permit for the purpose for which the relevant Permit was granted

(b) uses that land for any purpose other than the purpose for which the Permit was granted

(c) fails to comply with any requirement of the Mines and Minerals Act

(d) fails to comply with a condition of the Permit

(e) fails to comply with a direction lawfully given under the Mines and Minerals Act or with a condition on which any certificate of surrender is issued or on which any exemption or consent is given under the Mines Act

(f) fails to comply with the conditions, relating to the exercise of its rights under the Permit, which are contained in a relevant agreement entered between the Government and the holder of the Permit; and/or

(g) fails to pay any amount payable by it under the Mines and Minerals Act within one month after the amount becomes due

As far as is known, there has been no commercial exploitation of minerals within the License area and thus there are no existing mine workings, tailing ponds or waste dumps. There are no known legal encumbrances to the License area and no environmental liabilities, apart from the obligations of the Permit holder, as outlined in the Terms and Conditions of the EPL.

All necessary permits, approvals, consent, endorsements and permissions have been made in order to permit the company to conduct exploration work of the type contemplated by the Permit, including geochemical sampling, geophysical surveying, diamond drilling and core sampling in the area covered by the EPL.

There are no known significant factors or risks that may affect access, title, or the right or ability to perform work on the property as contemplated by the EPL.

4.3 Overlapping EPLs

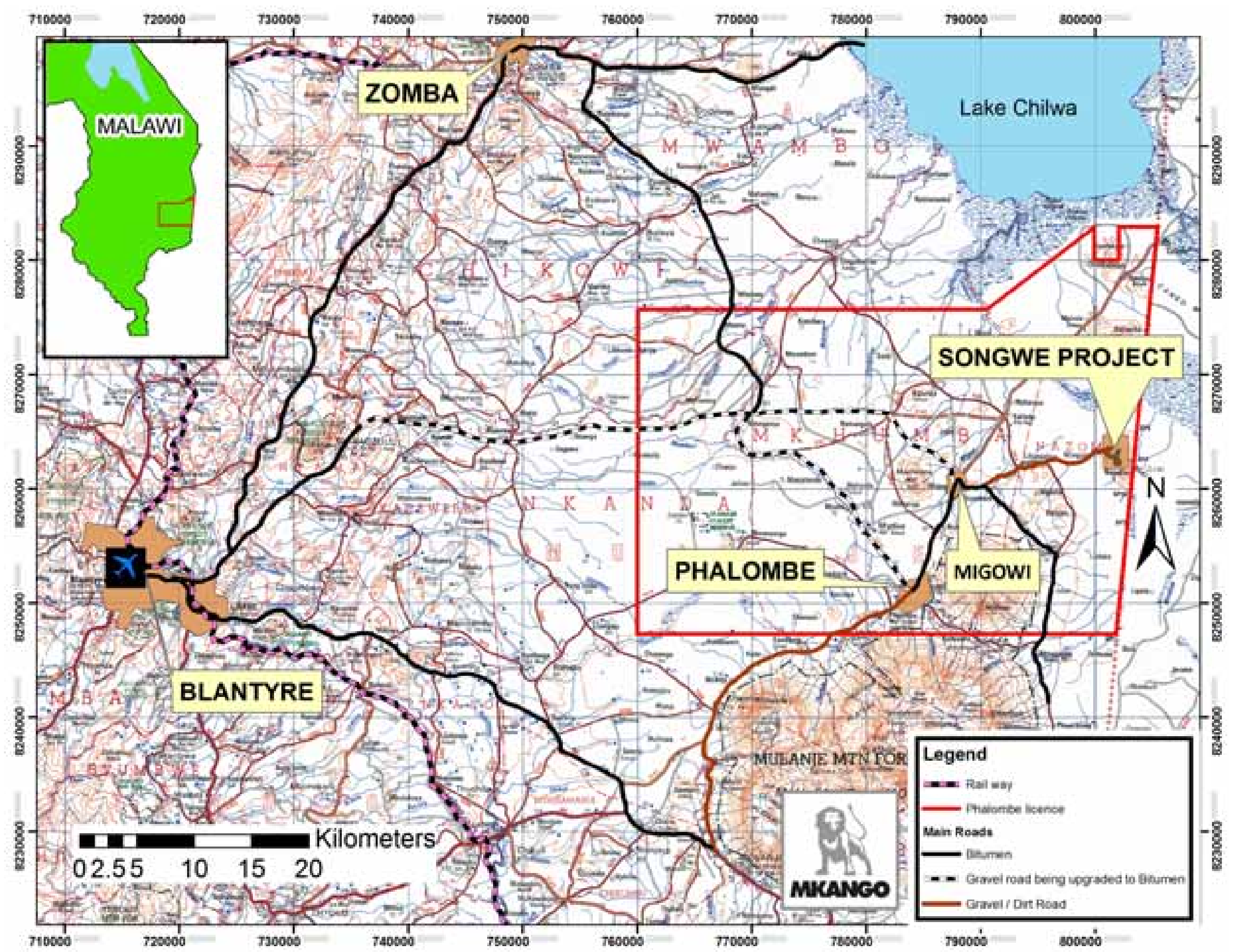
There are no overlapping EPLs, or other factors or risks known to the authors that might affect Mkango's right or ability to perform work on EPL 0284/10.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Access

Migowi, approximately 15 km from Songwe Hill, is the nearest town to the project area (Figure 5-1). Phalombe, the largest nearby town, is located approximately 25 km from Songwe Hill (Figure 5-1). All-weather roads connect Migowi and Phalombe to Zomba, the former capital, and Blantyre, the principal commercial city of Malawi, which are both approximately 55 km from Migowi.

Figure 5-1
Regional geography and road access to the Songwe Hill project area (Mkango, 2012)



Note: The labeled National roads S144 and S145 are currently being upgraded to bitumen

The S144 national road connecting Zomba and Phalombe and the S145 connecting Blantyre with Phalombe via Migowi are currently being upgraded from all-weather gravel to Class 1 bitumen roads with completion planned for 2013 (Figure 5-1). Local gravel roads provide access from Migowi to the exploration camp at the base of Songwe Hill. Total travel time from Zomba is approximately 1.5 hours, which will reduce as the roads continue to be upgraded.

The closest airports to the project area are located at Zomba and Blantyre which are approximately 70 km to the northwest and to the west, respectively. South African Airways (“SAA”) operates regular flights and an air cargo service from Johannesburg to Blantyre.

5.2 Climate

Malawi has a sub-tropical climate which is relatively dry and strongly seasonal but generally suitable for conducting exploration and development all year round. Average temperature, precipitation and humidity data for Malawi are given in Table 5-1. The data are for the capital Lilongwe which is some 280 km to the north but similar to the weather pattern for the Songwe Hill area. The period from November to April constitutes the warm and wet season during which 95 % of the annual precipitation takes place (Malawi Meteorological Services, 2006), occasionally as heavy rains that can disrupt activities.

The cool, dry winter season extends from May to August with day temperatures between 17° C and 27° C and temperatures falling to between 4° C and 10 °C during the night. A hot, dry season lasts from September to October with average daytime temperatures varying between 25° C and 37 °C. The generally dry season from April to December is the most comfortable in terms of temperature and relative humidity and the most conducive to field work.

Table 5-1
Average monthly temperature, rainfall and humidity data for Lilongwe (BBC, 2011)

Month	Temperature (minimum)	Temperature (maximum)	Humidity am	Humidity pm	Average rainfall (mm)	Wet days (>25 mm)
January	17	27	85	64	208	19
February	17	27	89	66	218	18
March	16	27	86	60	125	13
April	14	27	84	50	43	5
May	11	25	82	41	3	1
June	8	23	79	38	0	< 1
July	7	23	77	33	0	< 1
August	8	25	68	31	0	< 1
September	12	27	55	30	0	< 1
October	15	30	50	28	0	< 1
November	17	29	60	42	53	7
December	18	28	76	58	125	15

Surface and ground water are readily available for exploration purposes and sufficient water supply would likewise exist for a mining operation.

5.3 Local Resources and Infrastructure

Exploration activities are conducted from a semi-permanent camp (Figure 5-2) situated at the base of Songwe Hill. Migowi, the nearest town approximately 15 km from the project area, is connected to the national electricity grid. The district administration centre is currently being relocated from Phalombe to Migowi. A large surface water resource is located at Lake Sombani approximately 5 km from the project site. There is an on-site water borehole, constructed in 2011, which currently supplies water for all project operations. Cellular/digital telephone coverage is available at the project site through the telecommunication service providers TNM and Airtel Malawi.

Figure 5-2
View from Songwe Hill onto Mkango's exploration camp (Reichhardt, 2012)

There is a moderately dense population in the project area with the majority of the people living in small villages and relying on subsistence farming for their livelihoods with limited production of cash crops. The residents of the area provide a relatively large but typically unskilled labor force.

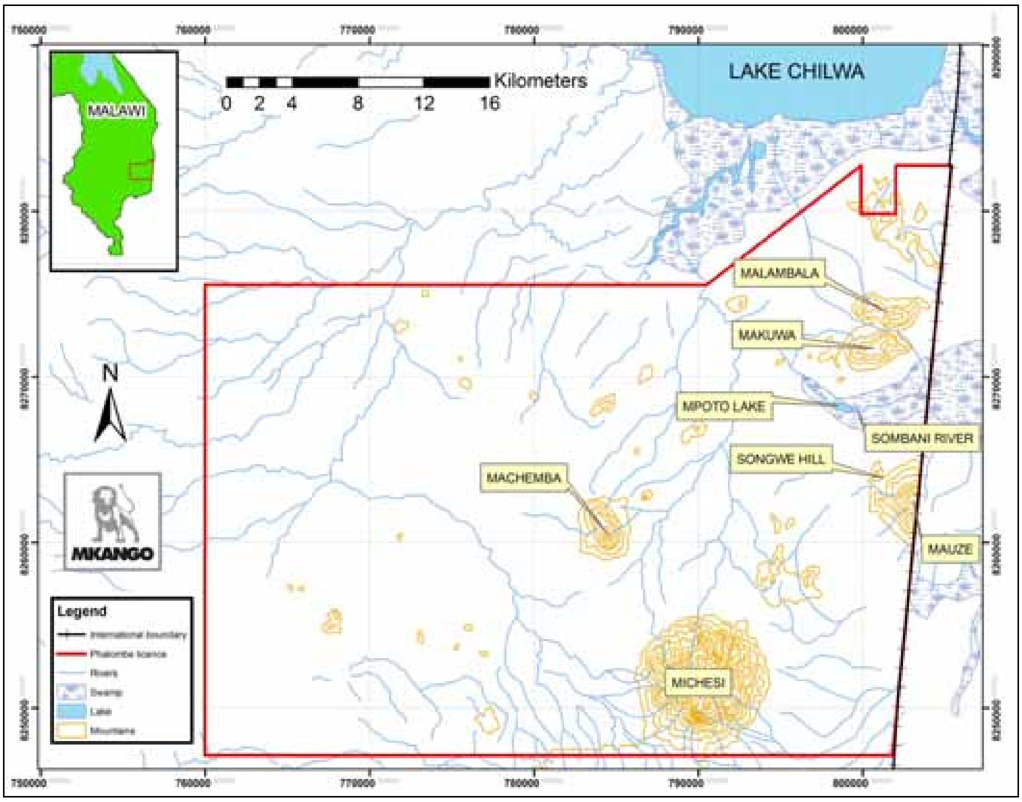
Fuel and some food supplies may be obtained from the nearest town, Phalombe. All other materials and equipment are obtained from the cities of Zomba or Blantyre.

5.4 Topography, Elevation and Vegetation

To the north of Songwe Hill the physiography comprises an alluvial plain immediately south of Lake Chilwa, which passes southwards into a more elevated region characterized by numerous hills and mountains (Figure 5-3). Some mountains are marked by steep cliffs and areas of bare rock, while other hills are completely wooded varying from dense tropical forest to a more open acacia forest.

The vegetation changes significantly between the 'wet' and 'dry' seasons. Following the rainy season the higher ground is covered by a dense growth of elephant grass which can reach three meters in height in open areas. In the dry season the grass cover withers and is commonly burnt back to expose bare ground and rock. The lower lying areas, apart from a zone adjacent to Lake Chilwa, are prone to flooding in the wet season and support occasional villages with the land intensively farmed for tobacco, maize, cassava and sweet potatoes.

Figure 5-3
Physio-geographical map of the Phalombe district (Mkango, 2012)



The Songwe carbonatite forms a moderate- to steep-sided conical hill with a diameter of about 800 m and a summit elevation of 990 m which is approximately 230 m above the plain. On the south-eastern side, Songwe Hill abuts against the higher Mauze Mountain (Figure 5-4) that rises to an elevation of 1592 m.

Figure 5-4
Songwe Hill carbonatite abutting against Mauze Hill (Brady, 2012)

6 HISTORY

6.1 Ownership History

There are no public records documenting the history of mineral tenure in the project area. The Geological Survey Department of Malawi ("GSDM") has no record of any exploration being carried out in the project area since the late1980s.

6.2 Historical Exploration

Historical work referenced below to Dixey (1937), Garson (1962, 1965), Garson and Wooley (1969), and Hunting Geology and Geophysics Limited (1985) was regional in nature and included work outside the boundaries of the current Phalombe license. Work referenced to Lewis (1958) and the Japan International Cooperation Agency and Metal Mining Agency of Japan (1989) was conducted within the boundaries of the current Phalombe license.

6.2.1 Pre-1981 Programmes

The geological sequence in the southern Chilwa Province was originally defined and referred to as 'The Chilwa Series' by Dixey *et al.* (1937) in a monograph which is notably important for identifying and describing carbonatites in Africa for the first time. Dixey *et al.* (1937) recognized 11 occurrences of carbonatite in Malawi which at that time more than doubled the global total of carbonatites. Two localities within the License area, Songwe and Tundulu, were investigated by Dixey *et al.* (1937) who described the Songwe occurrence as a volcanic vent comprising limestone, feldspar rock and agglomerate. The authors produced a simple sketch map along with photographs of hand specimens of agglomerate and feldspathic breccia and concluded that the limestone found at Songwe and other localities in the Chilwa Province is of magmatic origin and comparable to the carbonatites of the Fen complex in Norway.

The Songwe Ring structure was the subject of a brief unpublished report for the Nyasaland Mining Corporation Ltd. in 1953 (Lewis, 1953).

Significant new work on the carbonatites of Malawi was conducted in the early 1950s. Of particular interest is Garson's work with the Nyasaland Geological Survey. Building on earlier descriptions of specific occurrences in the area (e.g. Garson, 1962), he provided a comprehensive account of the carbonatites of Malawi including a detailed description of Songwe (Garson, 1965) with a geological map indicating a volcanic vent filled with feldspathic breccia and agglomerate and cut by arcuate sheets of carbonatite. He showed that rocks of the Precambrian basement are fenitised in the vicinity of the vent and interpreted the calcite-silicate rocks on the eastern margin to be the product of reaction between carbonatite and nepheline syenite. Garson also noted that the agglomeritic rocks at Songwe resemble feldspathic fenites of the Nkalonje vent and the Tundulu carbonatite complex. He provided mineralogical descriptions of the latter occurrences and noted the presence of accessory minerals including apatite, pyrochlore, synchysite, bastnäsite and fluorite.

In a later publication, Garson and Walshaw (1969) outlined the geology of the Mulanje area, including a description of the "Songwe Carbonatite Vent". The authors noted the presence of REE-bearing minerals at Tundulu but did not describe them from Songwe.

6.2.2 Post-1981 Programmes

6.2.2.1 Aeromagnetic Survey

The GSDM compiled and published total field aeromagnetic survey data at 1:250,000, 1:100,000 and 1:50,000 scales. The data were acquired in 1984 by Hunting Geology and Geophysics Ltd ("Hunting") under contract to the United Nations (Project MLW/80/030) covering the whole of Malawi (Hunting Geology & Geophysics Limited, 1985).

The data were obtained, dependent on the terrain, from fixed wing and helicopter aeromagnetic surveys flown with a flight line spacing of 1,000 m at mean sensor elevations of 120 m and 50 m, respectively. The data were corrected for diurnal variations and gridded at a cell size of 250 m prior to contouring for the paper-based maps. Topographic information was reproduced from the 1:50,000 scale map series published by the Government of Malawi using a Universal Transverse Mercator ("UTM") coordinate grid.

6.2.2.2 Gravity Survey

Gravity data were acquired during 1984 together with the aeromagnetic data. The gravity survey covered the entire country and maps with scales of 1:250,000, 1:100,000 and 1:50,000 were compiled and published by the GSDM.

6.2.2.3 Radiometric Survey

Country-wide radiometric data was also acquired during 1984 (Hunting Geology and Geophysics Limited, 1985) and published by the GSDM as a series of 1:250,000, 1:100,000 and 1:50,000 scaled maps. The maps show total counts, uranium, potassium and thorium counts and ternary color plots are available at 1:100,000 and 1:250,000 scales.

6.2.2.4 Airborne Electromagnetic ("EM") Survey

The GSDM compiled 1:100,000 map sheets of the interpreted anomaly coverage from electromagnetic survey data acquired during 1984 and 1985 by Hunting Geology and Geophysics Ltd. The data were obtained using a Geonics EM33-3 helicopter-based EM system with a nominal sensor elevation of 30 m and a flight line spacing of 1,000 m. The anomalies were selected from the analogue profiles in the field and interpreted using either vertical thin dyke or uniform half-space models, as appropriate. The data were presented on 1:100,000 scale base maps with topographic detail reproduced from the 1:50,000 scale topographic maps.

6.2.3 1986-1988 Japan International Cooperation Agency and Metal Mining Agency of Japan

In response to a request from the Government of the Republic of Malawi, the Government of Japan conducted a mineral exploration programme in the Chilwa Alkaline Province from 1986 to 1988. The work was overseen by the Japan

International Cooperation Agency ("JICA") and operated by the Metal Mining Agency of Japan ("MMAJ") working together with the GSDM. JICA and MMAJ completed a detailed investigation of the potential for rare earth element mineralization in southern Malawi included the Songwe Hill deposit. Following the first phase of the programme, which comprised geological and geochemical surveys, JICA and MMAJ concluded that Songwe Hill, as well as other occurrences within and adjacent to the present License area, had 'high potentiality' for a "carbonatite deposit".

The programme was divided into three phases corresponding to the work carried out from 1986 to 1988 and the results have been compiled in "JICA and MMAJ Report on the Cooperative Mineral Exploration in the Chilwa Alkaline Area, Republic of Malawi, Phases I, II and III; Consolidated Report, 1989".

The first Phase involved a "Route Survey" (geological field survey) of 13 km, the collection of 89 geochemical samples (Table 6-1), the completion of a single whole-rock chemical analysis and a single thin section for mineralogical purposes. The sampling programme largely focused on carbonatite and related rocks with analysis for REE comprising lanthanum, cerium, neodymium, samarium, europium, terbium, dysprosium, ytterbium and yttrium as well as strontium, niobium and thorium. The reports contain no information on the method of REE analysis or any QA/QC protocols that may have been implemented.

Table 6-1
Ranges and averages of REE, Sr, Nb and Th for 89 geochemical samples from Songwe collected during Phase 1 (JICA / MMAJ, 1989)

Element	Range of concentration	Average concentration
La_2O_3 (ppm)	87 – 8,102	3,036
Ce_2O_3 (ppm)	330 – 14,688	5,774
Nd_2O_3 (ppm)	412 – 4,609	2,162
Sm_2O_3 (ppm)	75 – 4,664	325
Eu_2O_3 (ppm)	7 – 931	80
Tb_2O_3 (ppm)	0 – 64	26
Dy_2O_3 (ppm)	2 – 261	88
Yb_2O_3 (ppm)	2 – 82	33
Y_2O_3 (ppm)	55 – 1,411	508
Sr (ppm)	516 – 21,207	7,467
Nb (ppm)	21 – 1,307	381
Th (ppm)	0 – 813	257
TREO (%)	**0.3 % - 2.9 %**	**1.2 %**

Note: TREO includes oxides of lanthanum, cerium, neodymium, samarium, europium, terbium, dysprosium, ytterbium and yttrium

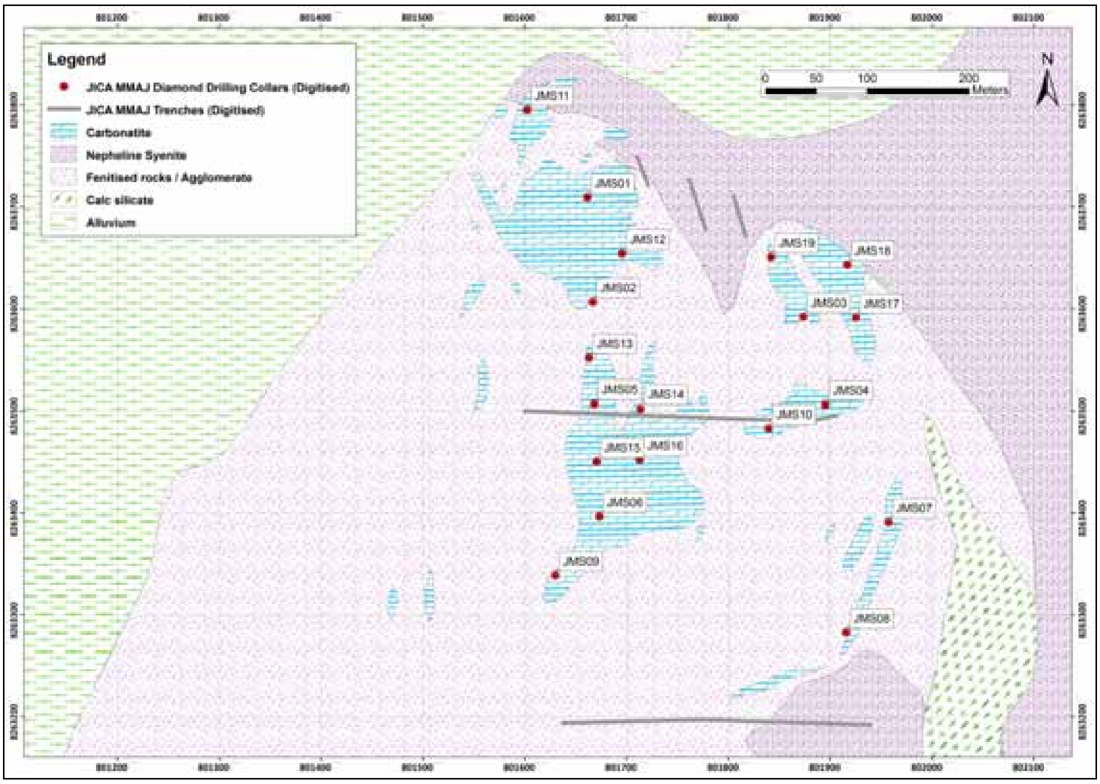
Following the positive Phase 1 results, the work programme proceeded to Phases 2 and 3 in 1987 and 1988, respectively. As outlined in Table 6-2, Phases 2 and 3 were much more comprehensive and included the drawing of a detailed geological map (Figure 6-1), further collection of surface geochemical samples (Figure 6-2) and two drilling programmes.

The geological map distinguishes carbonatite and agglomerate/feldspathic breccia and in this respect does not differ from Garson's 1965 map. However, it does show a much more complex distribution for the carbonatite and notably indicates the presence of two large, continuous areas of carbonatite on the northern slope and a somewhat smaller occurrence on the lower north-eastern side of the hill. The location of the 19 drill holes completed during Phases 2 and 3 and some of the trenches are also shown superimposed on the geological map (Figure 6.1) which was digitized by Mkango from the original map by JICA and MMAJ.

Table 6-2
Phase 2 and 3 investigations on Songwe Hill (JICA / MMAJ, 1989)

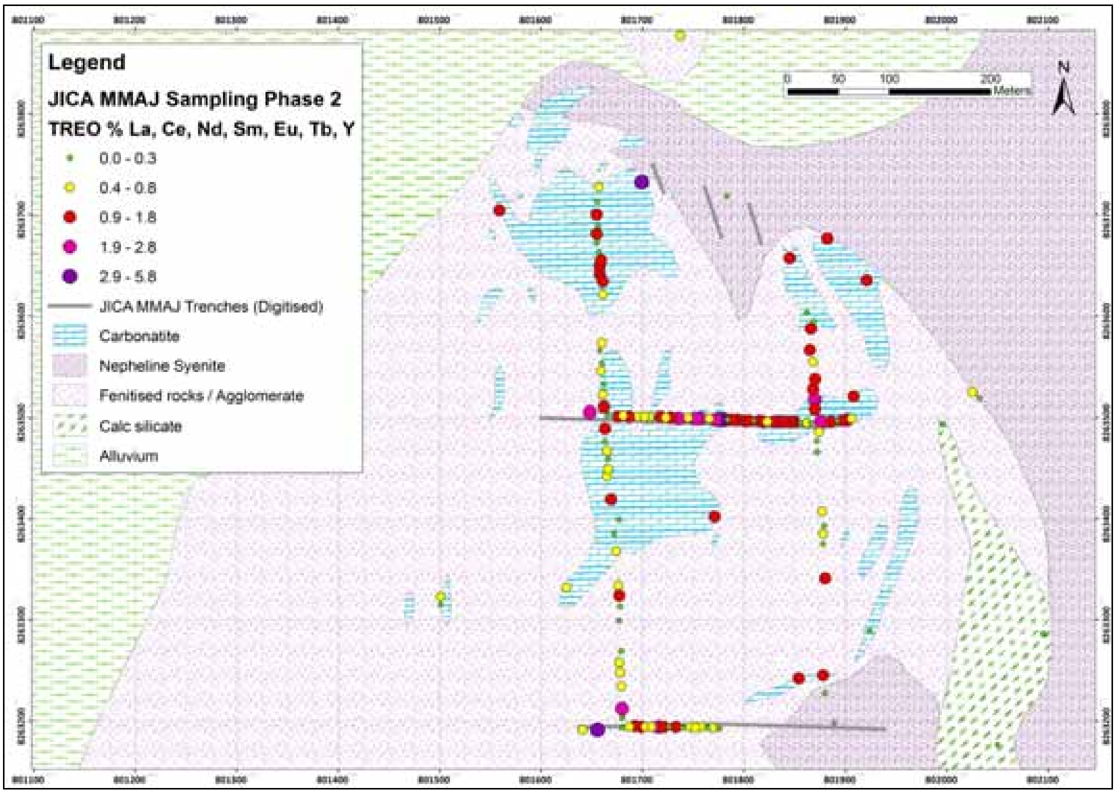
Type of survey	Unit	Drilling	Unit
Area mapped	3.2 km^2	Number of drill holes	19
Route survey	9 km	Total length of drill holes	960.15 m
Trench survey	600 m	Inclination	Vertical
Rock samples collected and assayed	151	Drillcore samples assayed	191
Microscope thin sections	13	Elements assayed for	La, Ce, Nd, Sm, Eu, Tb, Y, Nb, Sr, P
Microscope polished sections	20		
X-ray diffraction analyses	14		
EPMA	1		

Figure 6-1
Geological map with borehole and trench locations (Mkango after JICA / MMAJ, 1989)



Note: UTM Zone 36S and WGS84 Datum

Figure 6-2
Geological map with geochemical sample locations (Mkango after JICA / MMAJ, 1989)



Note: UTM Zone 36S and WGS84 Datum

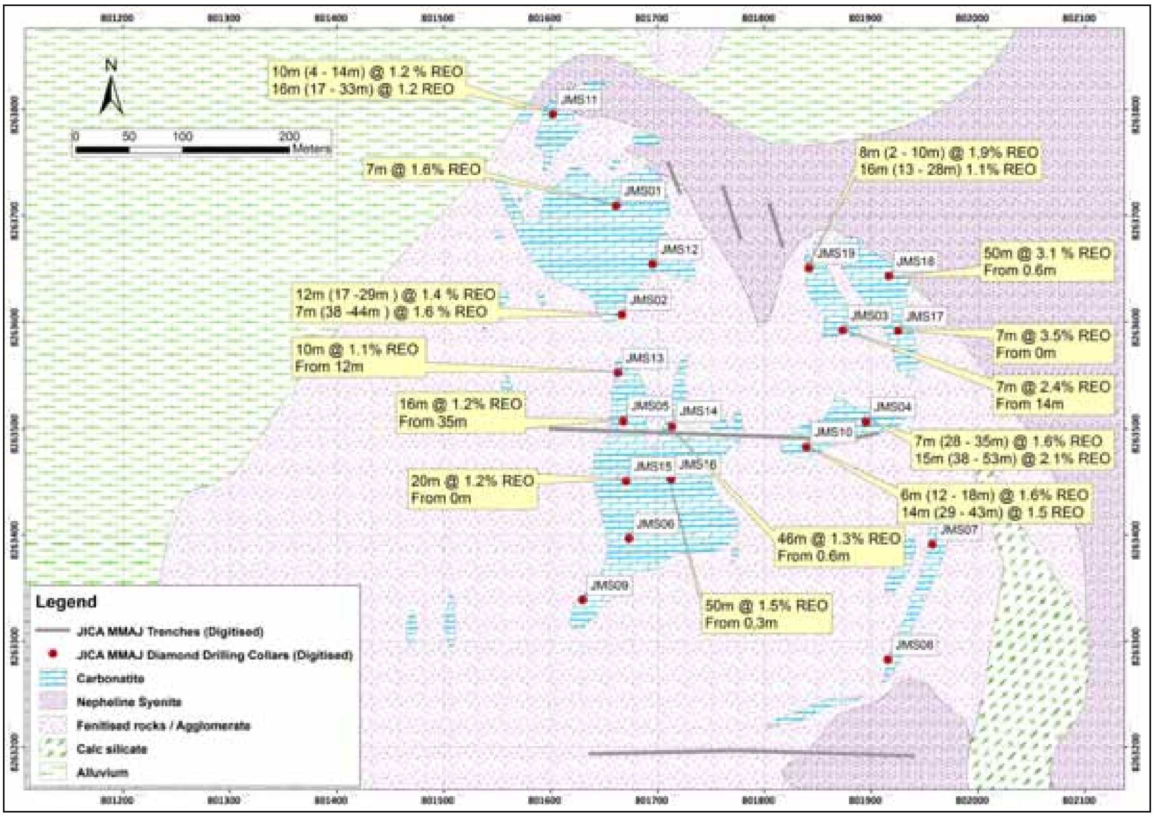
The 1987 Phase 2 drilling programme comprised 11 diamond drill holes totaling 558 m and defined a number of mineralized zones (Figure 6-3). Drilling was performed with a YBM-05DA drill rig using a 73 mm diameter drill bit and BW casing through unconsolidated surface material followed by a 56 mm diameter diamond bit to the bottom of the hole. Average core recovery, excluding the unconsolidated soils, was 94%.

The subsequent Phase 3 drilling programme in 1988 was aimed to better define the extent and grade of the mineralized zone on the northern side of Songwe Hill which was intersected during Phase 2. Two rigs were used to drill 8 holes totaling 401.2 m with a maximum vertical borehole depth of 55 m. The drilling followed the same procedures as in Phase 2 and the average core recovery (excluding soils) was 95 % during Phase 3.

There is no information on the sampling methods used in the JICA / MMAJ drilling programmes, other than that the drillcore was halved prior to chemical analyses of 191 core samples. A total of 109 core samples with an average length of 2.3 m were analysed from the first phase of drilling, while the samples from the second phase had an average length of 4.6 m. The reports do not detail the analytical methods or any QA/QC protocols that JICA and MMAJ may have adopted for the sample preparation or chemical analyses. It has not proved possible to identify the locations of any of these drill collars in the field.

Figure 6-3

Drill holes with drill intersections exceeding 1% REO (Mkango after JICA / MMAJ, 1989)



Note: UTM Zone 36S and WGS84 Datum; REO includes the oxides of La, Ce, Nd, Sm, Eu, Tb and Y

The Phase 2 and 3 drill core samples were assayed for seven rare earth elements namely lanthanum, cerium, neodymium, samarium, europium, terbium and yttrium as well as strontium, niobium and phosphorous. The geological logs of the drillcore indicate broad intersections of carbonatite in a number of boreholes, including JMS 14 (46 m at 1.3% REO), JMS 16 (50 m at 1.5% REO) and JMS 18 (50 m at 3.1% REO) and were used to assess the three-dimensional distribution of the individual carbonatite bodies to a vertical borehole depth of 50 m. The holes were drilled with a nominal length of 50 m but the collars were positioned at various elevations near the top of Songwe Hill and northwards down the slope with the result that only the outer “shell” of the deposit was drill-tested.

The principal REE-bearing minerals identified by JICA and MMAJ, using thin section, polished section, XRF and EMPA analysis, included synchysite, bastnäsite, parisite, strontianite, monazite, pyrochlore and apatite.

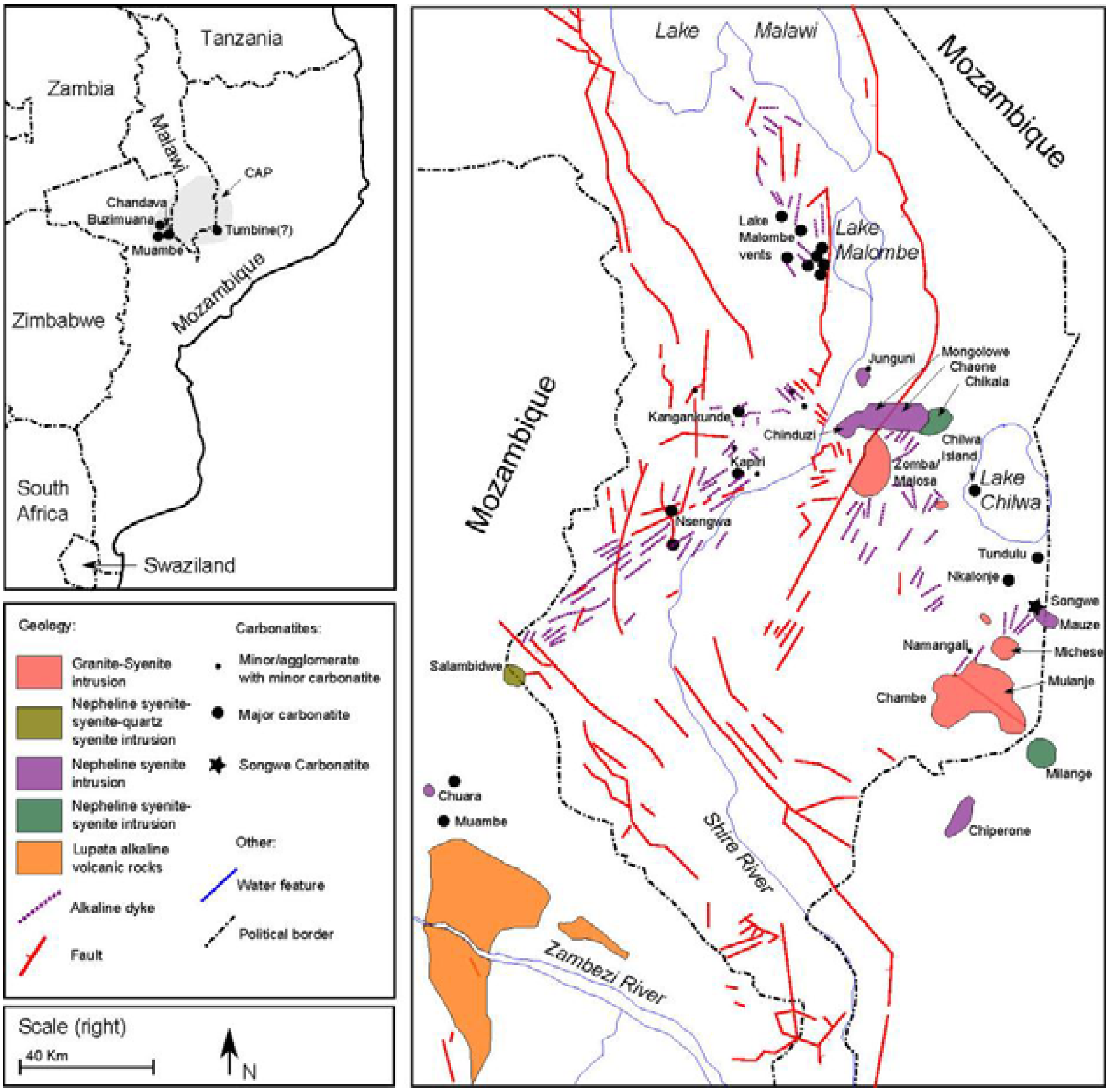
JICA and MMAJ noted (Phase 3 Report, page 53) that “samples from Songwe sector are more enriched in medium REE than those from Tundulu, Kangankunde and Chilwa Island sectors [in Malawi]”. JICA and MMAJ defined the medium rare earth elements as samarium, europium and terbium.

7 GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The Songwe Hill property is located within the Chilwa Alkaline Province, which is centered on southern Malawi and extends into adjacent areas of Mozambique (Figure 7-1).

Figure 7-1
Distribution of Chilwa Province alkaline intrusions in southern Malawi and Mozambique (after Woolley, 2001)



Rocks in southern Malawi range in age from Precambrian to Cretaceous and are in many areas covered by Tertiary to Recent lacustrine sediments. A comprehensive description of all rock units can be found in Garson and Walshaw (1969). The oldest rocks in the area are assigned to a Precambrian basement complex that consists of charnockitic granulites and gneiss. The gneiss around the Songwe Hill area is typically paragneiss but orthogneiss is found elsewhere in the region. The basement complex was intruded during the Jurassic by a dolerite dyke swarm of the Stormberg Series. The latter are genetically linked to the basaltic lavas of the Karroo Supergroup which occur throughout southern Africa.

The geological units of significance with respect to REE mineralization in the Songwe Hill area are intrusions and lavas of the Jurassic/Cretaceous Chilwa Alkaline Province. The Chilwa Alkaline Province is comprised of large alkaline intrusions ranging from Mulanje, which is a massif that covers approximately 640 km^2 and rises some 3,000 m above the Phalombe Plain (750 m), to the Michese intrusion with a diameter of 8 km, to the smaller Machemba intrusions and minor plugs and dykes measuring only a few tens of meters in length. These intrusive centers, mainly early Jurassic in age, comprise a variety of alkaline silica-saturated and silica under-saturated lithologies locally associated with carbonatites and are unrelated to the modern rift system. A general account of the tectonic setting has been given by Woolley & Garson (1970).

Although the Chilwa Province is dominantly intrusive at the present level of exposure, there are locally minor remnants of extrusive rocks. A comparison with alkaline provinces along the East African Rift to the north suggests that volcanic rocks at Chilwa Island may have originally been very extensive. The Chilwa Province is remarkable for the diversity of rock types which include granites, quartz syenites, syenites and trachytes, nepheline syenites and phonolites, ijolites and nephelinites, and a plethora of dykes and carbonatites with associated fenites. Three principal lithological associations have been identified on the basis of field relationships (Woolley, 1987), geochemistry (Woolley & Jones, 1987) and K-Ar age dating (Eby et al., 1995):

1. Nephelinitic lavas and nepheline syenite coeval with carbonatite (133 Ma)
2. Nepheline syenite and syenite (126 Ma)
3. Syenite and peralkaline granite (123 Ma)

Carbonatites are widely present throughout the Chilwa Alkaline Province. There are 17 documented carbonatites in southern Malawi and adjacent Mozambique at the junction of the north-south-trending fault system of the East African Rift and east-west-trending fault system of the Zambezi Rift (Garson, 1965, 1966). In addition to the large carbonatitic vent at Songwe Hill, there are three other substantial carbonatite complexes within the Province: Chilwa Island, Kangankunde and Tundulu. Numerous smaller carbonatites occur throughout the Province and include dykes, sheets, small plugs and a carbonatitic volcanic vent at Nkalonje. Igneous silicate rocks comprise only a few small dykes and sheets of nephelinite, ijolite, trachyte and alnöite at the Chilwa Island carbonatite centre whilst there are no igneous silicate rocks associated with the Kangankunde carbonatites. However, there are significant intrusions of nepheline syenite, ijolite and feldspathoid-bearing carbonate-silicate rocks associated with the carbonatite at Tundulu. The four large carbonatite complexes have metasomatic aureoles characterized by the presence of fenites, which extend up to 2 km from the margins of the carbonatite. The fenites are mostly sodium-rich and comprised essentially of sodic pyroxenes and amphiboles. In addition, there are domains of potassic fenite which are intimately associated with the carbonatite, consisting mainly of K-feldspar reflecting a potassium rather than sodium metasomatism.

The largest intrusions of the Chilwa Province in Malawi, notably Mulanje and Zomba, are comprised of peralkaline granite and quartz syenite similar to the large intrusion of Michese which occurs immediately north of Mulanje. Some of the nepheline syenite and syenite intrusions have a considerable size. For instance the four overlapping nepheline syenites north of Zomba extend nearly 40 km in an east-west line. Most of the igneous centers include swarms of dykes and there are a number of volcanic vents including the six that make up the Malombe vents in the north of the Chilwa Province (Figure 7-1). In the Phalombe license area, the vent in the Nkalonje complex is filled with breccia and agglomerate while the Namangale occurrence contains feldspathic and phonolitic breccias. The Songwe center comprises a large volcanic vent choked with fragmental rocks.

Intrusions in the northern part of the Chilwa Province span ages from about 98 Ma to 137 Ma, making it the oldest igneous province associated with the eastern branch of the East African Rift. This relatively old age, in terms of the general rift volcanism, explains the typically intrusive nature of the province and paucity of extrusive rocks. Reviews of the general geology are provided by Woolley and Garson (1970) and Woolley (1991), while Woolley (2001) presents brief accounts of all the individual carbonatite occurrences.

7.2 Geology of the Songwe Carbonatite Vent

Songwe Hill is interpreted as a volcanic vent that is expressed as a steep-sided hill (see Figure 5-4) with a diameter of approximately 800 m. Information from recent surface mapping and drill core indicates that the vent complex consists of a multi-phase intrusion characterized by diverse carbonatites and breccias exhibiting a range of alteration from potassic fenitisation to low temperature hydrothermal/ carbohydrothermal overprinting. The vent abuts against the western slope of the large Mauze nepheline syenite intrusion, but the outer contacts on the western and north-western sides of the vent are hidden beneath recent surficial deposits. It is possible that the carbonatite complex is in contact with Precambrian gneisses in this area because Chenga Hill, which is located less than 200 m west of the probable western margin of the Songwe vent, includes fenitised gneisses and breccias. A nearby remnant of Precambrian gneiss north and northwest of the vent complex is also fenitised, although a screen of nepheline syenite intervenes between the gneiss and the vent lithologies. The fenitisation is interpreted to be the result of carbonatite intrusion in the Songwe vent, although it is also possible that the Mauze nepheline syenite had some role in the fenitisation process. The occurrence of carbonate-silicate rocks along the eastern margin of the vent was interpreted by Garson (1965) to be the product of metamorphism of the nepheline syenite by the Songwe carbonatite.

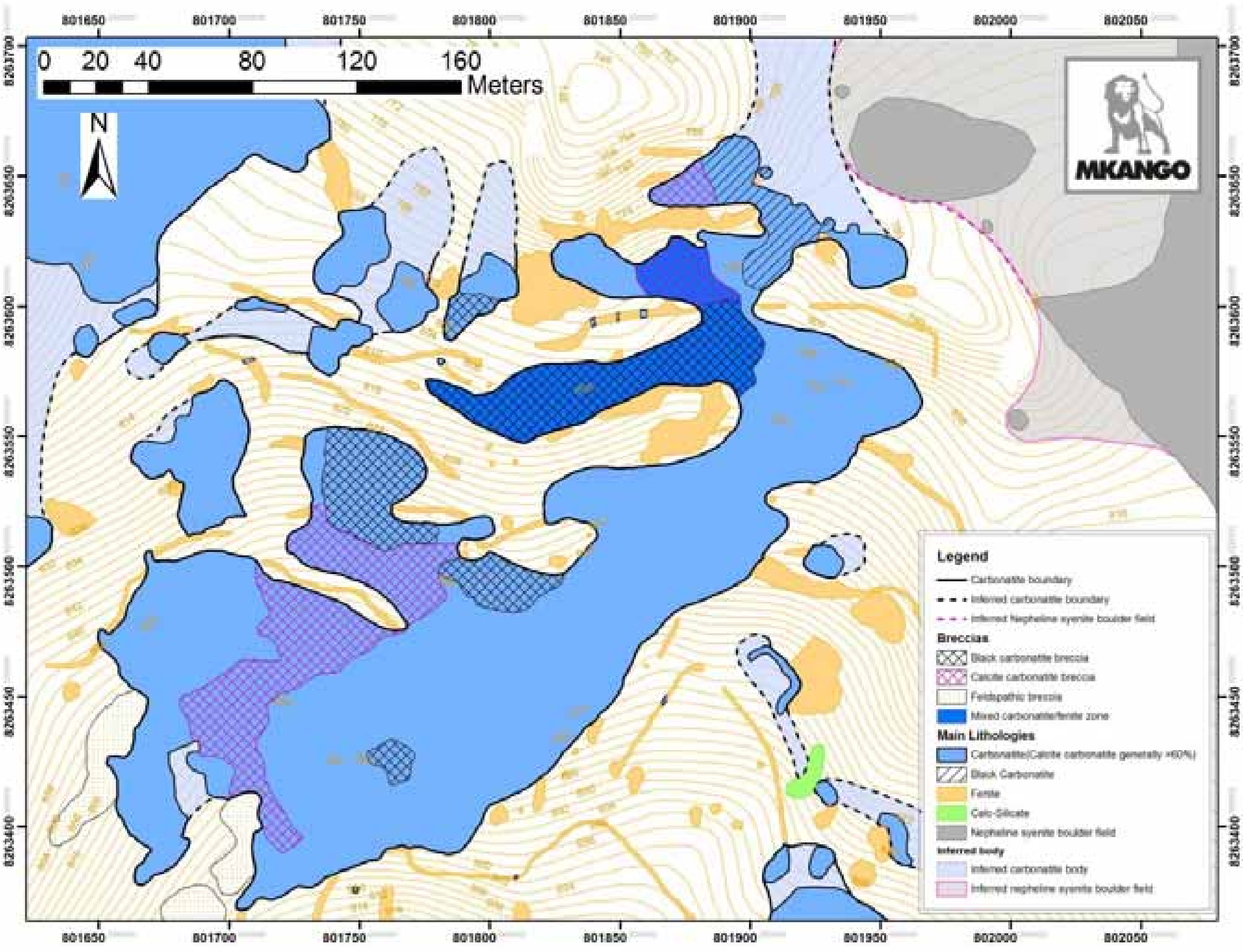
7.2.1 Carbonatite

The carbonatite is best exposed along the north-eastern slope of Songwe Hill and, together with a somewhat smaller area along its north western edge, is tentatively interpreted to form a ring structure (Figure 7-2). There are essentially two REE-mineralized carbonatite end members, namely a light-grey, fine-grained, relatively homogenous calcite carbonatite and a darker, fine-grained, heterogeneous Fe-rich carbonatite.

7.2.1.1 Calcite carbonatite

The calcite carbonatite (Figure 7-3) constitutes by far the largest proportion of exposed carbonatite and forms irregular, massive bodies that appear to have been emplaced in several phases. The grey carbonatite probably represents the closest composition to the primary carbonatite liquid. Petrographic studies have shown that calcite carbonatite consists predominantly of Fe- and Mn-rich calcite, with varying proportions of Mn-bearing ankerite, apatite, Fe-Mn-oxides, pyrite, fluorite and alkali (K-) feldspar.

Figure 7-2
Surface Geological Map of Songwe Hill (Mkango, 2012)



Note: UTM Zone 36S and WGS84 Datum; Contour lines at 2 m intervals

Figure 7-3
Examples of the 3 major rock types at Songwe Hill (Brady, 2012)

7.2.1.2 Fe-rich carbonatite

The Fe-rich carbonatite is dominated by Fe- and Mn-rich carbonates and Fe- and Mn-oxides with apatite and minor amounts of alkali (K-) feldspar. Typically, carbonatites are multi-phase intrusions evolving from early magmatic calcite compositions to late magmatic and/or metasomatic Fe-rich compositions, and petrographic and field evidence at Songwe suggest that the more Fe-rich carbonatite varieties may have intruded and partially replaced/overprinted some of the earlier calcite carbonatite.

Subordinate ferrocarbonatite, ranging from late-stage breccias and thin dykes to pervasive, cross-cutting veins, represents the final stages of carbonatite activity at Songwe Hill. Examination of drill core reveals that veining is extensive throughout the carbonatite, cross-cutting all lithologies including fenite and breccias. The veining can broadly be divided into two types: Fe-rich carbonatite veins and black Fe- Mn-rich ‘wad’ veins which are porous, highly weathered, poorly consolidated intrusions that have undergone extensive alteration (supergene?) and replacement by a range of Mn and Fe oxides. The two types are easily distinguished in the field: the carbonate bearing veins react with HCL, while there is no reaction with the ‘wad’ type veins.

7.2.2 Fenite

Fenites appear to form an aureole around the carbonatite intrusion and in plan view surround the carbonatite outcrop area on Songwe Hill. The fenites are characteristically light red in color (Figure 7-3) and mineralogical work has shown that they are composed essentially of alkali (K-) feldspar. Surface mapping and drill core assays show that the fenites in the immediate area of Songwe Hill are potassic (up to 14.99 wt. % K_2O) confirming Garson’s (1965) observation that the feldspar is potassic and that these rocks resemble feldspathic fenites elsewhere in Malawi. Breccias in the more easterly parts of the vent commonly contain pseudomorphs after large prismatic feldspars which would seem to substantiate a nepheline syenite parentage. However, textures observed elsewhere on surface outcrops and particularly in drill core suggest that at least some of the potassic fenites were formed by metasomatism of earlier phonolitic intrusions and Precambrian basement rocks.

No vertical zonation of fenitisation has been observed in the drill core at Songwe with potassic fenites extending from surface to deeper levels. However, the fenites that occur on Chenga Hill, north of Songwe Hill, are sodic in nature. Garson (1965) described them as containing aegirine, aegirine-augite, a blue sodic amphibole and albite. This is consistent with the fenitisation pattern at other carbonatite complexes in Malawi (see Section 7.1), where potassic fenites are intimately associated with carbonatite while sodic fenites occur at some distance from the carbonatite margin.

The fenite on Songwe Hill appears to be generally in situ, although some blocks and small fragments are highly abraded and indicate some degree of movement during the emplacement history. On the upper reaches of the hill fenite appears to roof the carbonatite with black Fe- and Mn-rich carbonate veins, that appear to originate in the carbonatite, penetrating upwards through the fenite. The Songwe vent complex is interpreted to represent the preserved roof zone of the intrusion and many of the fenite blocks seem to have been stoped into the former magma chamber. This model is further supported by the pervasive occurrence of highly mixed carbonatite and fenite material.

7.2.3 Breccia

The Songwe vent complex includes a considerable variety of breccias that range from clearly abraded pebble-sized fragments (pebble dykes) to meter-sized angular blocks as well as significant volumes of breccias in which the fragments appear to have undergone little or no movement. The breccias can essentially be divided into two types: feldspathic-rich breccias and carbonatite-rich breccias.

7.2.3.1 Feldspar-rich breccia

The feldspathic-rich breccias consist mainly of light red alkali-feldspar rich (orthoclase or sanidine; Garson, 1965) fenite clasts and fragments, partially fenitised nepheline syenite and minor clasts of calcite carbonatite. The matrix is fine-grained, carbonatitic in nature and composed of abundant Fe- and Mn-oxides, Fe-rich carbonates and alkali feldspar with occasional pyrochlore. In some cases the matrix can have a relatively high silica content reflecting the comminution of fenite during formation of the breccias.

7.2.3.2 Carbonatite-rich breccia

Carbonatite-rich breccias contain an abundance of light grey, fine-grained calcite carbonatite clasts, with subordinate fenite clasts in a similarly fine-grained carbonate-rich matrix. Gradational relationships can be observed from one variety of breccia into another indicating a complex process of intrusion, fragmentation and continuous movement of a carbonatite-breccia mixture. The breccias, regardless of type are invariably cross cut by numerous late-stage black Fe- and Mn-rich carbonate veins.

7.2.4 Silicate-rich dykes

Late-stage silicate-rich dykes have been identified in drillcore but rarely outcrop at surface. The dykes are mainly phonolitic in composition, aphanitic or porphyritic in texture and exhibit a wide degree of alteration ranging from minimal modification to extensive alteration and fenitisation. Syn-intrusion and post-intrusion faulting is evident across Songwe Hill although displacements appear to be relatively small.

7.3 Mineralization

7.3.1 Geological Domains

The principal zone of REE mineralization outcrops along the north eastern slope of Songwe Hill. REE mineralization is present in carbonatite, fenite and breccias, which are exposed intermittently over a surface area of approximately 350 m by 100 m. The REE mineralization is untested to the northeast and southwest beyond the limits of the present drilling and below the deepest vertical intersection of approximately 350 m below the surface of the hill.

The mineralized body at Songwe Hill is dominantly a carbonatite intrusion that has incorporated variable amounts of potassic fenite and diverse vent breccias. Lithology appears to be the main control on the REE mineralization which occurs dominantly in the carbonatite but is also found in both fenites and breccias. Carbonatite and fenite form separate geological domains and are easily distinguished visually in core and geochemically. However in some areas, carbonatite and fenite occur together in breccias, or are intimately mixed which complicates the spatial correlation on maps and cross sections.

For the purposes of resource definition, three geological domains have been identified namely a carbonatite domain, a fenite domain, and a 'mixed' domain consisting of breccia and/or finely intermixed carbonatite and fenite. In their respective domains, carbonatite and fenite form the dominant rock type and usually contain small and variable proportions of the other rock types. Each domain has specific geological characteristics which are described in the following Sections.

7.3.1.1 Carbonatite Domain

Calcite carbonatite is the most abundant carbonatite type by volume and surface area and is the principal host of REE mineralization.

Carbonatite contacts with the adjacent fenite are typically sharp and are characterized geochemically by an abrupt increase in potassium, silica and aluminum and a coinciding decrease in calcium. Calcite carbonatite outcrops at various elevations of Songwe Hill and has been traced in drill holes to depths of approximately 350 m below the surface of the hill (Figure 7-4 a). The carbonatite can generally be correlated from section to section particularly in the south of the complex (Figure 7-4 a and b).

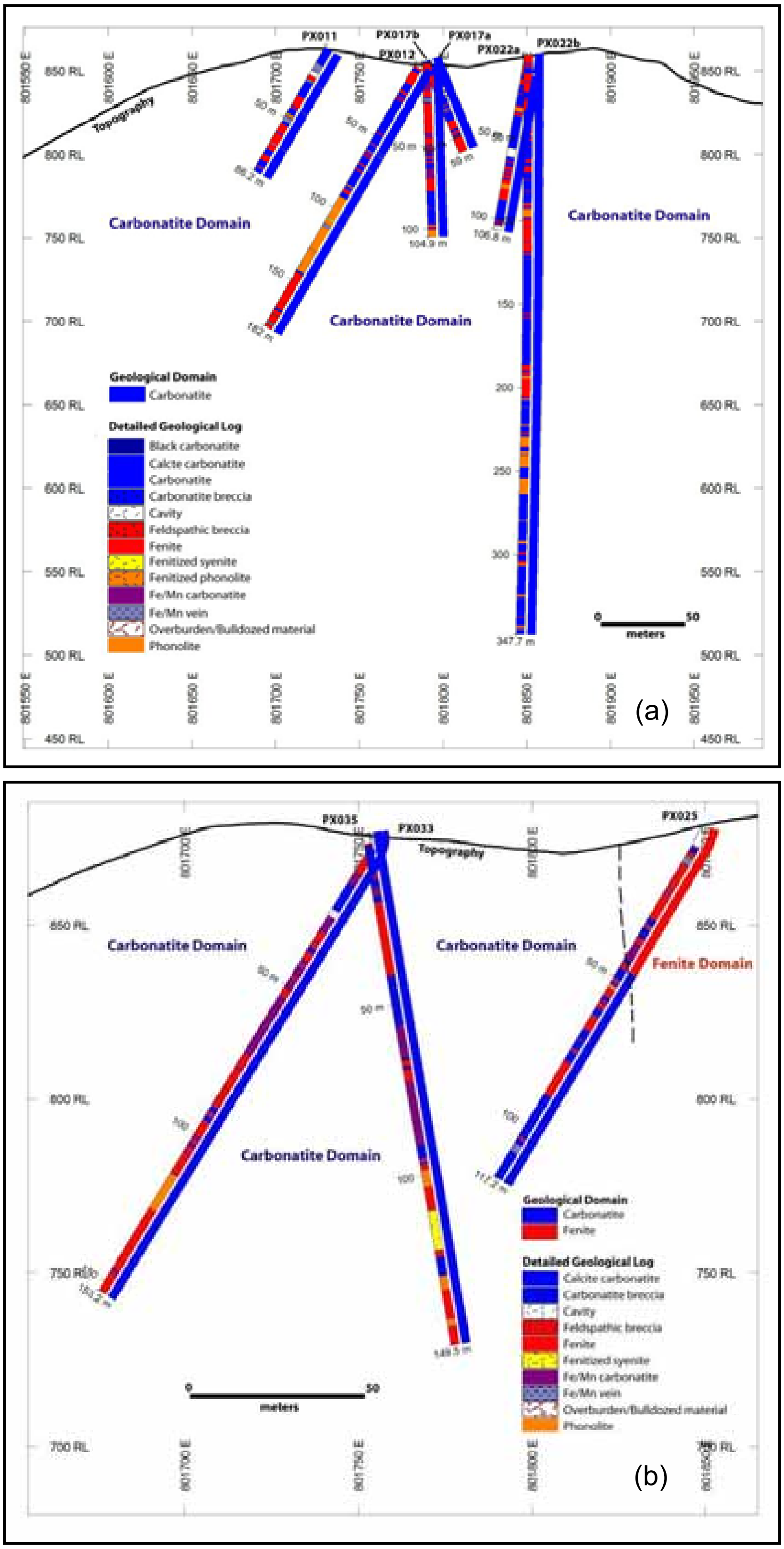
Carbonatite is typically fine-grained and light grey to pinkish white in color (Figure 7-5 a and b). Sulphides, mainly pyrite, are abundant and occur as disseminations, patches and veins. Fluorite is present as locally abundant patches or blebs and can impart a purple hue to the rock. REE mineralization in the calcite carbonatite is not readily identifiable by texture and the similarities in color of carbonatite and mineralization. Several phases of narrow ferro-carbonatite veins are common along with occasional late-stage calcite veining.

The calcite carbonatite unit includes zones of Fe- and Mn-rich carbonatite (Mn/Fe carbonatite in Figure 7-4 a and b). The contact between the two types of carbonatite is typically irregular and can range from sharp to gradational. This Fe- and Mn-rich carbonatite is typically dark brown-black in color and visibly oxidized. It is often vuggy in nature and characterized by a range of late-stage low temperature (supergene?) patchy or brown striped textures. Mineralization is easily recognized in the dark Fe-Mn-rich carbonatite by the pervasive streaks of orange pink to white rare earth fluorocarbonate minerals and apatite.

Black carbonatite contains the highest REE grades (average 3.8 % TREO) and occurs as a distinct zone located in the north eastern part of Songwe Hill (Figure 7-2). It can be traced at surface for approximately 50 m in a N-S direction and to a depth of approximately 40 m beneath the surface of the hill (Figure 7-6 a & b). The black carbonatite is texturally more complex than the calcite carbonatite. The rocks are heterogeneous on the local scale ranging in color from black to light grey with a highly variable fabric comprising various late-stage cross-cutting Fe-carbonatite veins. The carbonatite is characterized at surface and at depth by a distinctive white to orange and pink-colored, streaky mineralization which comprises fluorocarbonates, apatite and carbonates (Figure 7-5 c). The higher TREO content in the black carbonatite does not reflect differences in REE mineralogy compared to the calcite carbonatite but a greater abundance of the REE-bearing minerals.

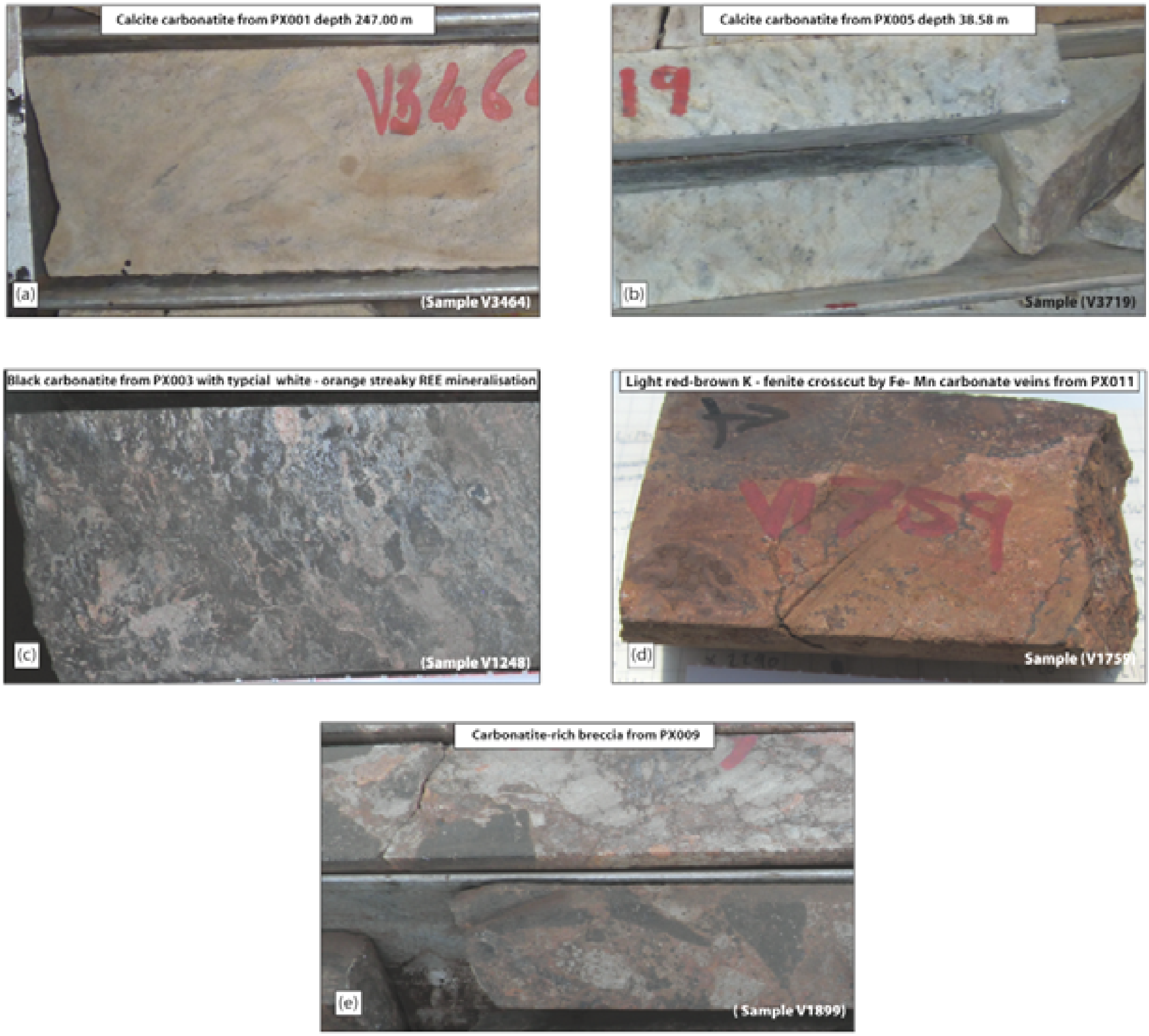
Figure 7-4

Examples of geological domains in two southern cross section (Brady, 2012)



Note: (a) illustrates the continuity of carbonatite to depth at Songwe Hill in Section 8263457 (b) illustrates the geometry of carbonatite and fenite domains in Section 8263423N. Detailed geological logs are illustrated in the center color bar together with geological domains in the color bar on the right

Figure 7-5
Examples of mineralized rock types (Brady, 2012)



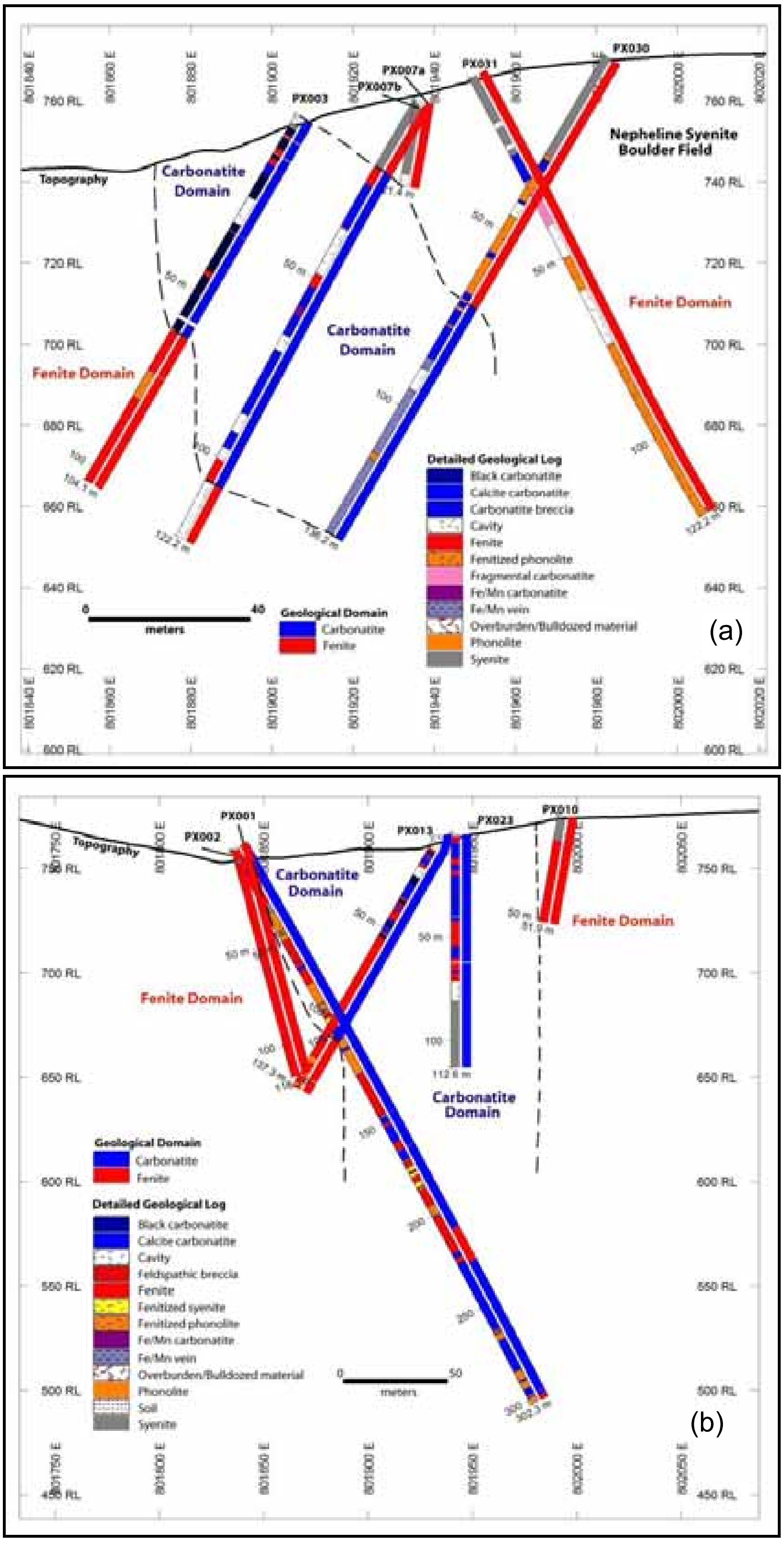
7.3.1.2 Fenite Domain

Potassium fenite, comprising variably carbonatized potassium feldspars which are visible in the core, surrounds the mineralized carbonatite body in plan view and is present in virtually all drill holes. Fenite is typically light orange to red in color (Figure 7-5 d) and is interpreted to roof and partially surround the carbonatite at the present level of erosion. In drill holes fenite occupies the areas marginal to the carbonatite and also occurs as discrete bodies within the carbonatite that are presently interpreted as stoped blocks.

Fenite is variably mineralized and the degree of mineralization is a function of the degree of carbonatization of the fenite. Along the north-western and eastern side of Songwe Hill, the fenite is relatively uncarbonatized, geochemically characterized by consistently low CaO (~ 7 wt. %) and high SiO_2 and K_2O concentrations (averages of 17 wt. % and 7 wt. %, respectively), and can be traced in drill holes from surface to depth with consistent values of less than 0.5 % TREO (see Figure 7-6 a & b).

Figure 7-6

Examples of geological domains in two northern cross section (Brady, 2012)



Note: Section 8263667N (a) and Section 8263646N (b) illustrate the sharp contact between fenite and carbonatite domains in the north east (PX003 and PX013) and intersections of carbonatite (PX031 and PX001) dipping towards and underneath the boulder field

Well-defined lithological and geochemical contacts are observed between the fenite and carbonatite at the north-western side of Songwe Hill (see Figure 7-6 a and b). Further south the fenite becomes more intimately associated with the carbonatite and is variably carbonatized and cross-cut by multiple generations of late-stage ferro-carbonatite. In these areas, the fenite contains lower concentrations of SiO_2 and K_2O but higher concentrations of CaO and consequently REE concentrations exceed 1 % TREO (Figure 7-7 a and b).

7.3.1.3 Mixed Domain

The geologically mixed domain in drill core consists of intimately intermixed carbonatite and fenite, often on a centimeter scale, such that the lithologies cannot be easily separated or correlated across sections. In many areas, this intimate intermixing reflects the presence of vent breccias with variable proportions of carbonatite and fenite clasts on centimeter and meter scale in a predominantly carbonate matrix. In other areas, the mixed domain may include small stoped blocks of fenite occasionally intruded by carbonatite. The domain is characterized by highly variable concentrations of CaO, SiO_2 and K_2O reflecting the high level of intermixing between carbonatite and fenite. The mixed domain is variably mineralized and the degree of mineralization is a function of the proportion of carbonatite.

Broad zones of mineralized breccias have been recognized in several drill holes interspersed with the carbonatite. Locally the breccia and carbonatite appear to grade in and out of each other in drill core. The breccias are widely exposed at surface along the western side of Songwe Hill but are highly irregular in shape and difficult to correlate in drill holes. The surface breccia exposures are represented in drill core by zones of highly mixed carbonatite and fenite (e.g. PX008 and PX016) (Figure 7-7 a and b). The calcite carbonatite breccias are light grey to orange-red in color depending on the proportions of calcite carbonatite and fenite fragments. Typically, carbonatite breccias contain abundant angular to sub-angular calcite carbonatite fragments in a fine-grained grey carbonatitic to feldspathic matrix (Figure 7-5 e). Similar to the main calcite carbonatite lithology, fluorite and sulphides are abundant and occur as disseminations, patches and veins.

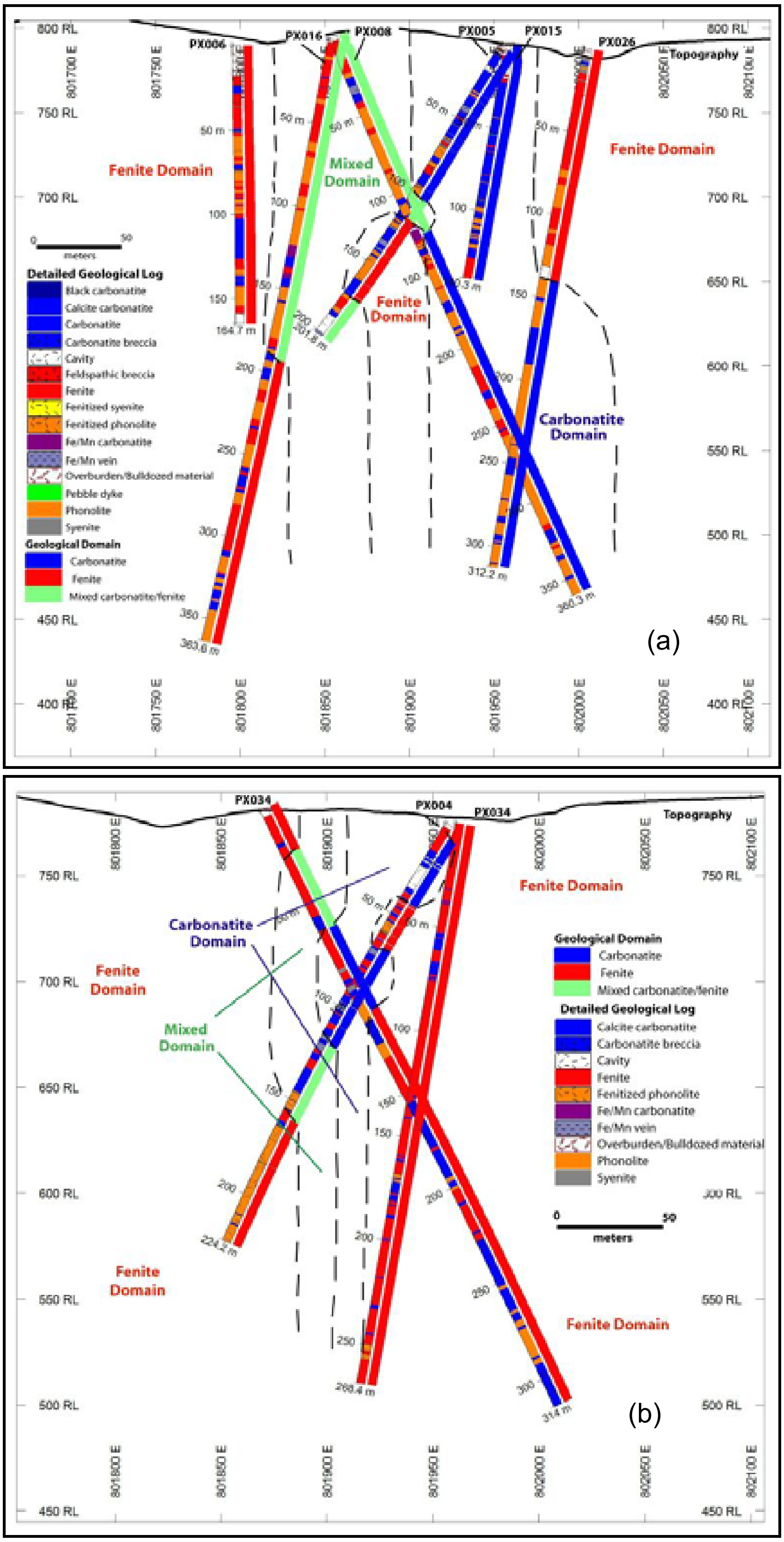
Black carbonatite breccias consist of a mixture of fenite and carbonatite fragments with varying shapes from rounded to angular and typically have spotted, striped and patchy late-stage low temperature (supergene?) textures. The level of rare earth mineralization in the breccias is more variable than in the carbonatites and directly related to the proportion of carbonatite to fenite fragments and the amount of carbonatitic matrix.

7.3.2 Geometry of the Mineralization

The orientation of the mineralized body within the Songwe carbonatite vent system is not well constrained due to the fact that only a few drill holes have penetrated the intrusive contacts of the carbonatite which appears to extend beyond the limits of drilling to the northeast, southwest, and at depth.

Figure 7-7

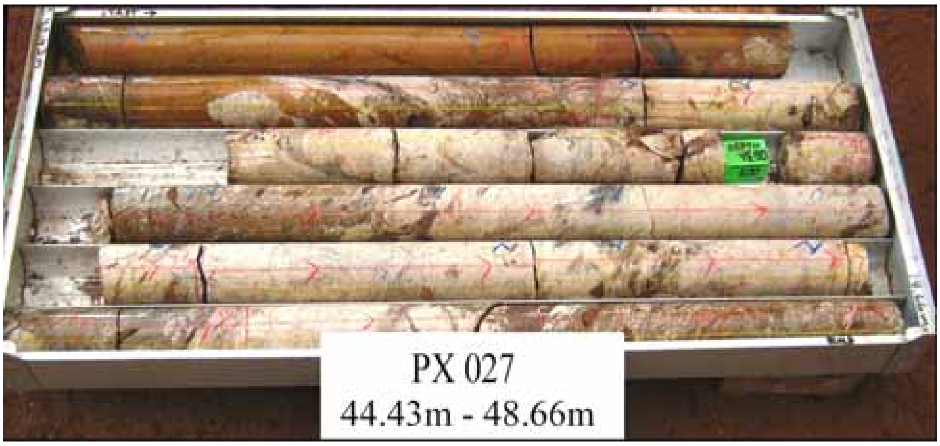
Examples of the various domains in two cross section (Brady, 2012)



Note: Section 8263568N (a) and 8263600N (b) highlight the mixed domains of Songwe Hill and the complex relationships between the three domains

Lithological contacts and structural features are generally at shallow angles to the core axis (Figure 7-8) and suggest that the intrusion has sub-vertical to vertical margins and flow patterns. However, the body as a whole has an irregular shape which can be expected from an intrusive plug. In plan view, the body has an elongate shape in a northeast-southwest direction and borehole evidence from the eastern portion is interpreted to suggest an overall dip to the east. Along the eastern side of Songwe Hill, the calcite carbonatite appears to dip steeply underneath the fenite and nepheline syenite boulder field. Intersections of mineralized calcite carbonatite have been encountered in drillholes which extended to depths below the boulder field (e.g. PX001; Figure 7-6 b) and also in drill-holes collared in the boulder field (e.g. PX031; Figure 7-6 a). To date no major off-setting structures have been identified within the main carbonatite bodies.

Figure 7-8
Example of contact between fenite and calcite carbonatite (Brady, 2012)



The internal geometric relationships of the different mineralized geological domains are not yet well defined. While the carbonatite domains can typically be correlated between drillhole sections, the fenite and mixed domains occur as isolated blocks within the carbonatite and cannot readily be correlated between sections. The boundaries between the carbonatite and fenite domains are relatively sharp but contacts with the mixed domains tend to be gradational (see PX016; Figure 7-7) and not well defined.

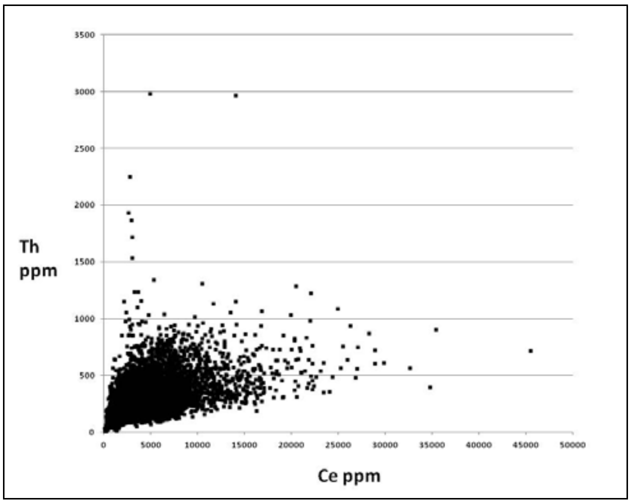
7.3.3 Thorium

The occurrence of thorium can be problematic for some carbonatite-associated REE deposits. Songwe Hill carbonatite is marked by a radiometric anomaly in thorium and this feature provided an important prospecting tool. The concentration levels in individual REE minerals have not been fully quantified and will be addressed as part of the metallurgical test work.

Examination of the assay data from drillcore samples reveals that thorium concentrations in the Songwe Hill deposit are typically relatively low (Figure 7-9). Almost 90% of the samples contained less than 500 ppm Th. The overall values calculated for the mineral resource at various cut-off grades typically range between 240 ppm and 430 ppm (Table 14-7 to Table 14-12).

Electron microprobe analyses carried out by SGS Lakefield, Canada indicate that between 84% and 97% of the Th is carried by REE-bearing fluorocarbonates. The remaining 3% to 16% is hosted by monazite. As illustrated in Figure 7-9 there is a diffuse positive geochemical relationship between Ce and Th that probably reflects the presence of Th in synchysite.

Figure 7-9
Thorium versus Cerium from 2011-2012 drill programme samples (Swinden, 2012)



7.3.4 Mineralogy

Mineralogical studies were initially carried out on six rock samples from the 2010 field sampling campaign using x-ray diffraction ("XRD"), Quantitative Evaluation of Minerals by Scanning Electron Microscopy ("QEMSCAN") and electron microprobe ("EMP") analyses at the mineralogy department of SGS Inc. in Lakefield, Canada ("SGS"), previously described in detail by Scott and Wells (2010).

All samples are dominated by calcite with minor to trace amounts of iron and manganese oxides and carbonates, K-feldspar, strontianite and barite. REE-bearing phases are dominated by synchysite and apatite, with minor to trace amounts of parisite, monazite and ancylite. The abundance of the principal minerals in the 6 rock samples from QEMSCAN whole rock analysis for sub-samples (80% powderized to less than150 micron) is given in Table 7-1.

Table 7-1
Mineral abundances of 6 samples by QEMSCAN (SGS Canada, 2010)

Mineral	Range of abundance (%)
Calcite ($CaCO_3$)	32.6 - 81.6
Ankerite ($CaFe(CO_3)_2$)	3.9 - 41.9
Strontianite ($SrCO_3$)	0.1 - 5.9
Barite ($BaSO_4$)	1.1 - 5.2
Apatite ($Ca_5(PO_4)_3(F,Cl,OH)$)	0 - 8.3
Parisite ($CaCe_{1.1}La0._9(CO_3)_3F_2$)[1]	2.5 - 6.7

[1] = parisite, for the purposes of QEMSCAN analyses, includes bastnaesite, synchysite, and parisite

A comprehensive mineralogical study of REE-enriched lithologies was carried out on core material from the 2011-2012 drill campaign by Dr. Aoife Brady, Mkango senior geologist, using scanning electron microscopy ("SEM"), EMP and laser ablation inductively coupled mass spectrometry ("LA-ICP-MS"). For this purpose a total of 33 samples were selected from drillcore material of nine boreholes and different depths from the three main carbonatite lithologies, namely calcite carbonatite, black carbonatite and carbonatite breccia (Table 7-2).

Table 7-2

Summary of samples for mineralogical studies (Mkango, 2012)

Borehole	Depth (m)	Sample ID	Lab ID	Lithological description
PX001	191.00 - 192.00	V3383	P17593	Calcite carbonatite/fenite mixture
PX001	239.00 - 240.00	V3452	P17835	Calcite carbonatite
PX001	247.00 - 248.00	V3464	P17836	Calcite carbonatite
PX001	255.00 - 256.00	V3474	P17837	Calcite carbonatite
PX001	257.00 - 257.49	V3476	P17592	Calcite carbonatite
PX001	294.26 - 295.00	V3532	P17595	Calcite carbonatite
PX003	3.49 - 4.00	V1206	P17598	Stripy black carbonatite
PX003	8.00 - 9.00	V1212	P17586	Very dark carbonatite
PX003	16.39 - 17.00	V1226	P17585	Mixed stripy black-to-grey carbonatite
PX003	31.00 - 32.00	V1237	P17584	Brown/grey/black stripy carbonatite
PX003	34.00 - 35.00	V1240	P17826	Black carbonatite
PX003	37.00 - 38.00	V1246	P17583	Calcite carbonatite
PX003	39.00 - 40.00	V1248	P17827	Black carbonatite
PX004	53.00 - 53.9	V3984	P17600	Calcite carbonatite
PX004	81.00 - 82.00	V1025	P17601	Calcite carbonatite crosscut by black carbonatite veining
PX004	163.24 - 164.00	V1138	P17602	Black carbonatitic vein? with late-stage brown stripy/spotted textures
PX005	7.00 - 8.00	V3682	P17599	Calcite carbonatite crosscut by black carbonatitic veins
PX005	27.00 - 27.72	V3702	P17834	Calcite carbonatite
PX005	38.58 - 39.00	V3719	P17833	Calcite carbonatite
PX005	59.00 - 60.00	V3747	P17596	Calcite carbonatite
PX005	64.0 - 65.00	V3753	P17597	Weathered black carbonatite
PX009	40.00 - 41.00	V1825	P17828	Carbonatite breccia
PX009	98.00 - 99.00	V1889	P17829	Carbonatite breccia
PX011	4.00 - 5 .00	V1673	P17589	Mixed carbonatite and fenite
PX011	51.00 - 52.00	V1729	P17587	Mn- Fe-rich black carbonatitic vein
PX011	23.00 - 24.00	V1692	P17588	Mn- Fe-rich carbonatitic vein containing fine-grained light red fenite
PX012	37.72 - 38.00	V1465	P17830	Calcite carbonatite
PX012	61.00 - 62.00	V1501	P17831	Mn/Fe carbonatite
PX012	81.70 - 82.00	V1532	P17832	Calcite carbonatite
PX018	190.36 - 191.00	X3982	P18140	Carbonatite
PX018	308.00 - 308.56	Y4139	P18139	Carbonatite
PX020	313.00 - 314.00	Y2189	P17990	Calcite-rich breccia
PX020	313.00 - 314.00	Y2189	P17991	Calcite-rich breccia

REE analyses and imaging of the samples were performed using a Cameca SX100 electron microprobe and a JEOL 5900LV scanning electron microscope, equipped with an Oxford Instruments INCA energy dispersive X-ray microanalysis system and a Gatan cathodoluminescence detector at the Natural History Museum ("NHM") London, England. Quantitative analyses of apatite were carried out on selected samples at the Institute of Geography and Earth Sciences, Aberystwyth University ("AU"), Wales, using a Laser Ablation Inductively Coupled Plasma Mass Spectrometer ("LA-ICP-MS").

The SEM, EMP and LA-ICP-MS analytical work shows that the REE mineral assemblage at Songwe, regardless of lithology, is dominated by fluorocarbonates, principally synchysite with very minor parisite, apatite and occasional florencite. Average rare earth oxide ("REO") concentrations in synchysites from several drillholes are presented in Table 7-3. The synchysite crystals are homogeneous, typically occurring as randomly oriented laths or tabular crystals and/or fibro-radial to plumose aggregates (Figure 7-10 a and b). Crystal size varies but laths typically range in length from 10 µm to 60 µm and crystal aggregates can reach up to 400 µm.

Synchysite is invariably associated with strontianite and/or baryte either as inclusions and/or intergrowths and together they form distinctive vein-like aggregates or segregations (Figure 7-10 and Figure 7-11). In addition to these two phases, synchysite is locally associated with calcite, fluorite, alkali (K) feldspar, pyrochlore and titanite. The mineral association of synchysite with strontianite and baryte in the Songwe carbonatites and their textural relationships is typical of sub-solidus hydrothermal REE mineralisation and has been reported from other carbonatites e.g. Amba Dongar Carbonatite Complex, India (Doroshkevich et al., 2009).

Apatite in the Songwe carbonatites is anomalously enriched in yttrium and heavy rare earth oxides ("HREO"). The HREO enrichment factor of Songwe apatite, defined here as the sum of all HREO from Eu_2O_3 to Lu_2O_3 and Y_2O_3/TREO (Table 7-4), ranges from 40% to 85% compared to 2% to 11% in apatite from other carbonatites (Hornig-Kjarsgaard, 1998). It is rare for apatite in carbonatite deposits to display heavy rare earth enrichment. At Songwe however, apatite formed at a late stage and does not have the characteristic 'lozenge' shape which is typical of early crystallized apatite in carbonatites.

Apatite in the Songwe carbonatite lithologies is often visibly recrystallized and occurs as stringers and groundmass anhedral crystals, or as large bands (Figure 7-11 a) and veins which frequently contain entrained groundmass material, typically carbonate. In samples from the black carbonatite apatite invariably forms large bands and veins (PX003 sample V1206; Figure 7-11 b) and is closely associated with the Fe carbonate.

Chondrite normalized REE patterns for apatite (Figure 7-12) illustrate the anomalous enrichment of HREE+Y. Figure 7-13 compares representative analyses of the Songwe late-stage apatite to typical LREE-enriched unaltered magmatic carbonatite from other carbonatite complexes, Oka in Canada and Jacupiranga in Brazil (Hornig-Kjarsgaard, 1998).

Florencite is particularly abundant in the groundmass of the carbonatite breccias forming narrow acicular crystals (< 20 µm in width) and is associated with various Fe- and Mn-bearing oxides (Figure 7-14). Occasionally, florencite is also found as small anhedral crystals along the edges of entrained carbonate crystals in apatite veins and most likely formed as a replacement/alteration product of apatite.

Xenotime in association with apatite was identified in a calcite- and apatite-rich breccia in bore hole PX020 but this is to date the only xenotime occurrence at Songwe Hill.

Table 7-3

Average REO distribution of Synchysite, analysed by EMP, in Songwe carbonatites (excluding outliers) (NHM and Brady)

Borehole	La_2O_3 wt. %	Ce_2O_3 wt. %	Pr_2O_3 wt. %	Nd_2O_3 wt. %	Sm_2O_3 wt. %	Eu_2O_3 wt. %	Gd_2O_3 wt. %	Dy_2O_3 wt. %	Y_2O_3 wt. %	REO[1] wt. %
PX001										
Median	14.50	23.39	2.16	7.45	1.04	0.26	0.63	0.21	0.54	50.18
Average	14.39	23.11	2.13	7.38	1.03	0.25	0.60	0.22	0.55	49.66
PX003										
Median	15.84	26.52	2.39	7.45	0.58	0.04	0.00	0.06	0.24	53.12
Average	16.13	26.78	2.40	7.17	0.55	0.05	0.01	0.07	0.27	53.43
PX005										
Median	11.42	24.70	2.72	9.42	0.99	0.10	0.17	0.14	0.50	50.16
Average	10.98	24.19	2.55	8.94	0.98	0.12	0.20	0.14	0.61	48.71
PX011										
Median	13.65	24.43	2.38	6.63	0.65	0.11	0.16	0.21	0.84	49.06
Average	13.73	23.99	2.31	6.57	0.64	0.11	0.17	0.24	0.92	48.68
Borehole	**La_2O_3 %**	**Ce_2O_3 %**	**Pr_2O_3 %**	**Nd_2O_3 %**	**Sm_2O_3 %**	**Eu_2O_3 %**	**Gd_2O_3 %**	**Dy_2O_3 %**	**Y_2O_3 %**	**REO[1] %**
PX001										
Median	28.92%	46.44%	4.32%	15.10%	2.11%	0.51%	1.23%	0.43%	1.07%	100.0%
Average	28.97%	46.53%	4.29%	14.86%	2.08%	0.50%	1.21%	0.44%	1.12%	100.0%
PX003										
Median	29.88%	49.65%	4.58%	13.81%	1.09%	0.08%	0.00%	0.11%	0.45%	100.0%
Average	30.23%	50.12%	4.50%	13.39%	1.02%	0.09%	0.01%	0.13%	0.51%	100.0%
PX005										
Median	22.75%	49.21%	5.36%	18.65%	1.93%	0.24%	0.38%	0.28%	1.17%	100.0%
Average	22.45%	49.80%	5.21%	18.33%	2.00%	0.25%	0.41%	0.29%	1.26%	100.0%
PX011										
Median	28.66%	49.09%	4.78%	13.55%	1.30%	0.23%	0.32%	0.45%	1.78%	100.0%
Average	28.20%	49.30%	4.75%	13.50%	1.31%	0.23%	0.33%	0.48%	1.87%	100.0%

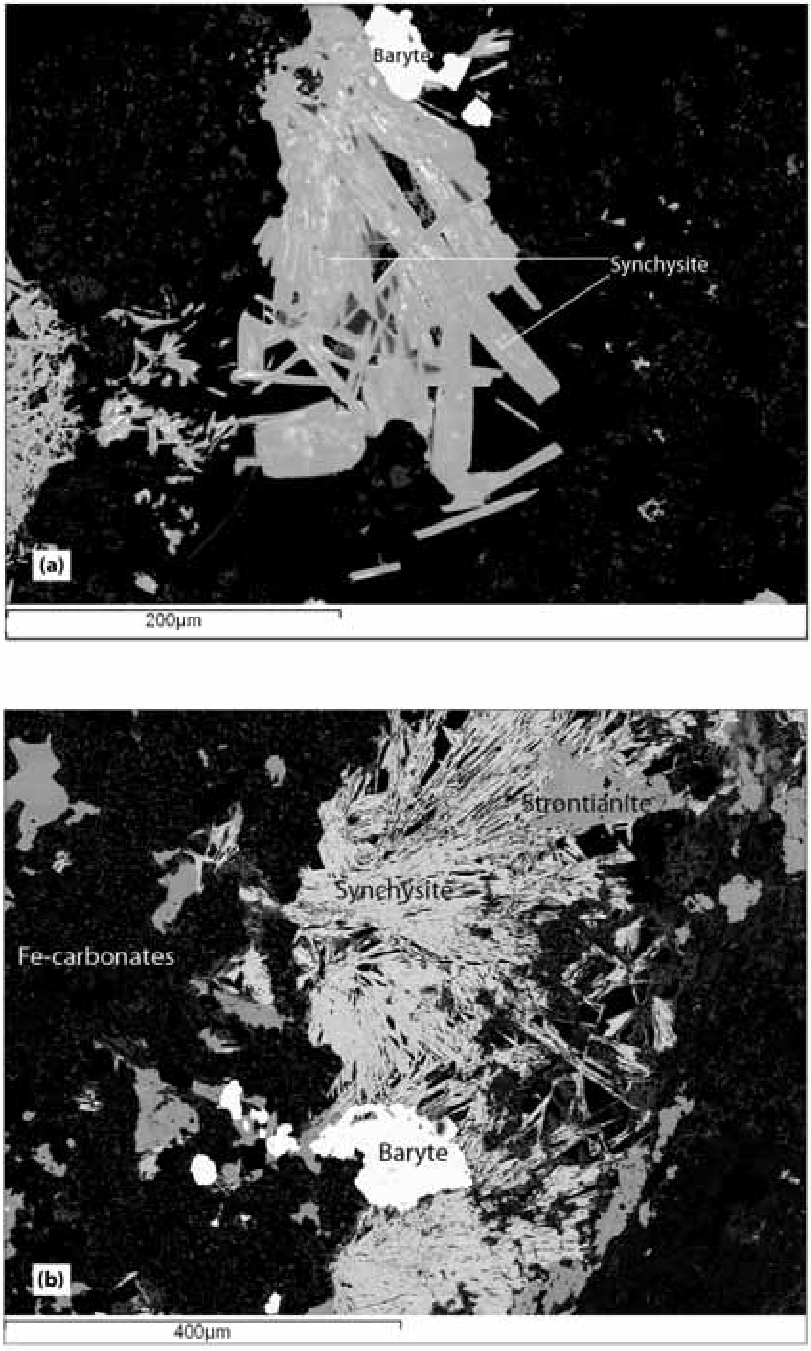
[1]REO = La_2O_3, Ce_2O_3, Pr_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3, Gd_2O_3, Dy_2O_3 and Y_2O_3

Table 7-4
Average REO distribution of Apatite, analysed by LA-ICP-MS, in Songwe carbonatites (excluding outliers) (AU and Brady)

Borehole	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Ho_2O_3 ppm	Er_2O_3 ppm	Tm_2O_3 ppm	Yb_2O_3 ppm	Lu_2O_3 ppm	Y_2O_3 ppm	TREO ppm	HREO $+Y_2O_3$/TREO %
PX001																	
Median	1,195	3,521	555	2,809	859	303	991	161	1,034	185	465	60	314	37	5,304	17,793	49.76
Average	1,124	3,242	513	2,695	799	284	917	150	944	168	420	55	291	33	4,792	16,427	49.03
PX003																	
Median	1,419	3,956	688	3,233	1,006	359	1,157	194	1,237	211	482	48	211	21	5,680	19,902	48.24
Average	1,638	5,700	631	3,058	914	325	1,071	183	1,151	203	458	47	201	20	5,276	20,876	42.80
PX005																	
Median	270	922	170	949	429	199	806	177	1,323	259	619	66	305	28	8,101	14,623	81.26
Average	258	929	168	950	420	199	843	187	1,407	281	680	71	321	31	8,649	15,394	82.30
PX012																	
Median	423	1,414	275	1,561	668	305	1,214	231	1,601	296	703	76	303	28	9,364	18,462	76.49
Average	479	1,463	263	1,493	650	290	1,106	211	1,443	270	632	67	288	27	8,150	16,832	74.17
Borehole	**La_2O_3 %**	**Ce_2O_3 %**	**Pr_2O_3 %**	**Nd_2O_3 %**	**Sm_2O_3 %**	**Eu_2O_3 %**	**Gd_2O_3 %**	**Tb_2O_3 %**	**Dy_2O_3 %**	**Ho_2O_3 %**	**Er_2O_3 %**	**Tm_2O_3 %**	**Yb_2O_3 %**	**Lu_2O_3 %**	**Y_2O_3 %**	**TREO %**	
PX001																	
Median	6.7%	19.8%	3.1%	15.8%	4.8%	1.7%	5.6%	0.9%	5.8%	1.0%	2.6%	0.3%	1.8%	0.2%	29.8%	100%	
Average	6.8%	19.7%	3.1%	16.4%	4.9%	1.7%	5.6%	0.9%	5.7%	1.0%	2.6%	0.3%	1.8%	0.2%	29.2%	100%	
PX003																	
Median	7.1%	19.9%	3.5%	16.2%	5.1%	1.8%	5.8%	1.0%	6.2%	1.1%	2.4%	0.2%	1.1%	0.1%	28.5%	100%	
Average	7.8%	27.3%	3.0%	14.6%	4.4%	1.6%	5.1%	0.9%	5.5%	1.0%	2.2%	0.2%	1.0%	0.1%	25.3%	100%	
PX005																	
Median	1.8%	6.3%	1.2%	6.5%	2.9%	1.4%	5.5%	1.2%	9.0%	1.8%	4.2%	0.5%	2.1%	0.2%	55.4%	100%	
Average	1.7%	6.0%	1.1%	6.2%	2.7%	1.3%	5.5%	1.2%	9.1%	1.8%	4.4%	0.5%	2.1%	0.2%	56.2%	100%	
PX012																	
Median	2.3%	7.7%	1.5%	8.5%	3.6%	1.6%	6.6%	1.3%	8.7%	1.6%	3.8%	0.4%	1.6%	0.1%	50.7%	100%	
Average	2.8%	8.7%	1.6%	8.9%	3.9%	1.7%	6.6%	1.3%	8.6%	1.6%	3.8%	0.4%	1.7%	0.2%	48.4%	100%	

Figure 7-10

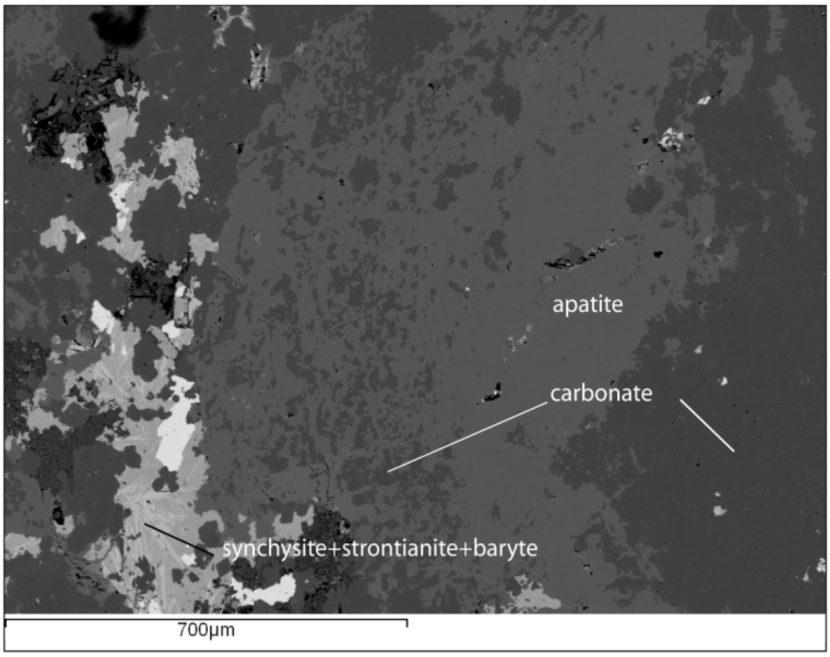
SEM images of synchysite in the Songwe carbonatite (NHM and Brady, 2012)

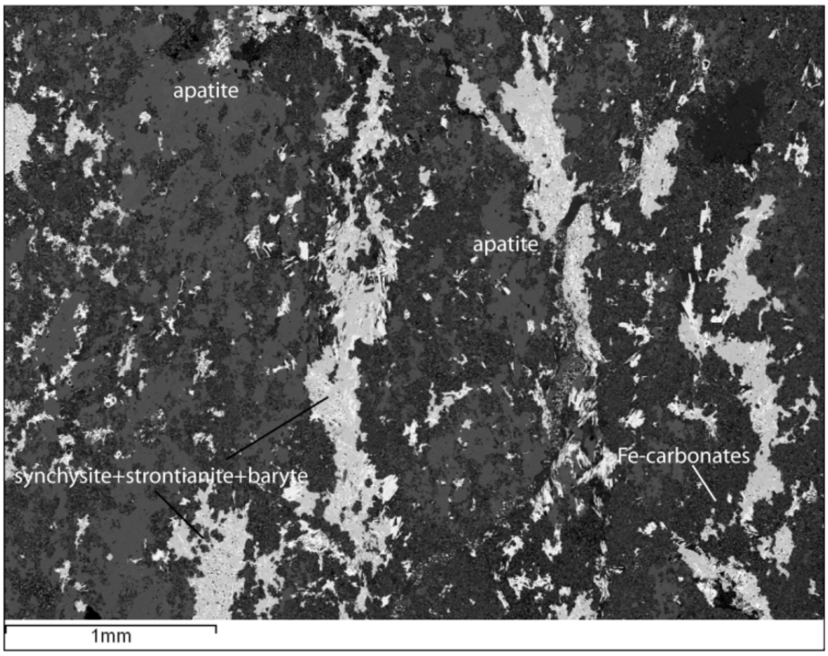


Note: (a): Sample V3702 from borehole PX005 (V3702) with tabular/lath-shaped synchysite crystals;
(b): Sample V3532 from borehole PX001 showing fibro-radial aggregates of synchysite in strontianite

Figure 7-11

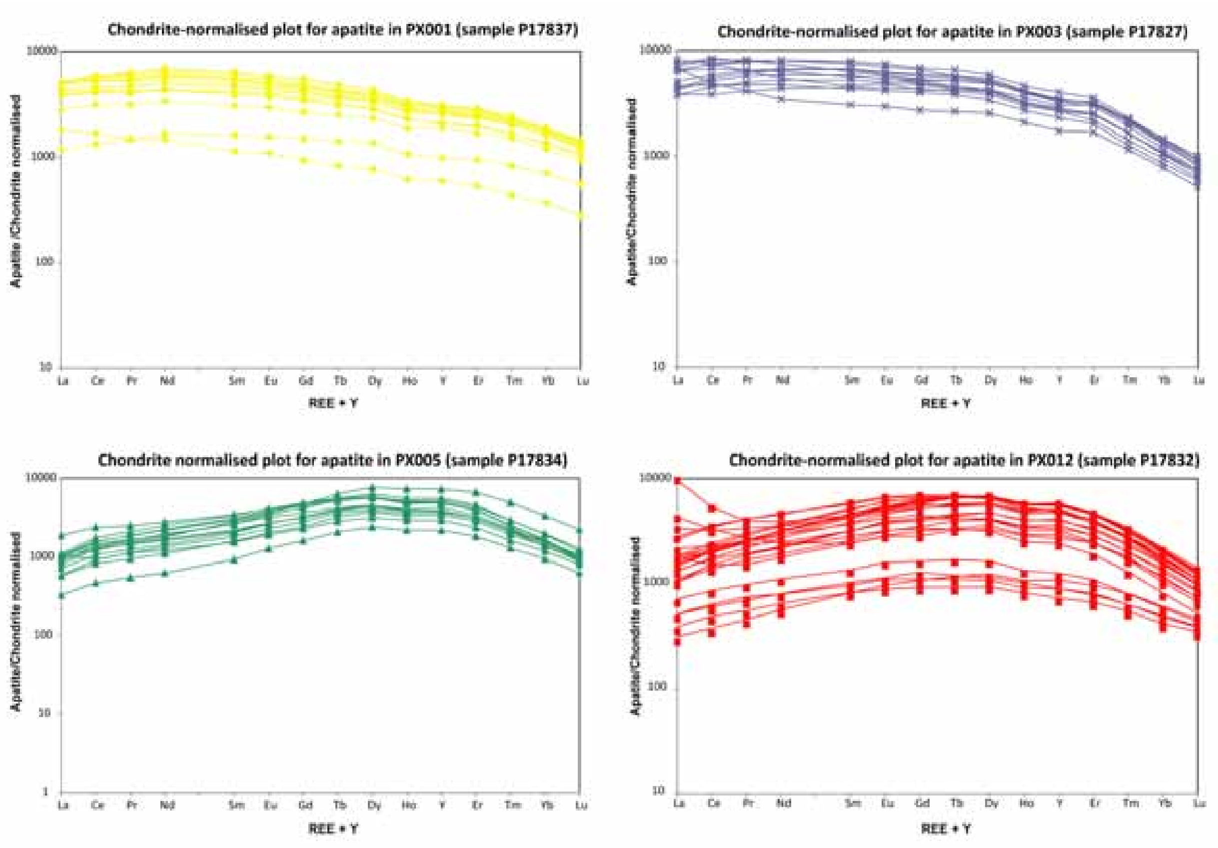
SEM images of apatite in the Songwe carbonatite (NHM and Brady, 2012)





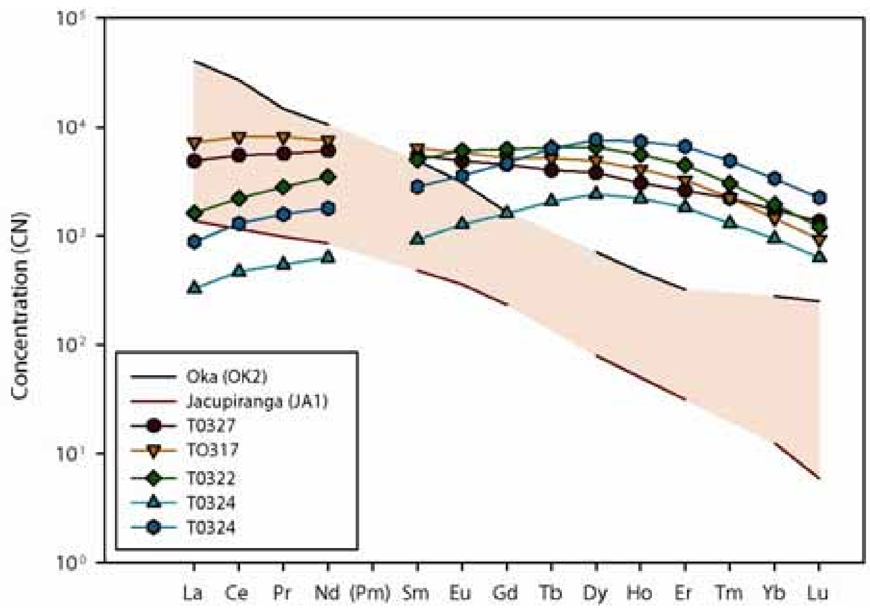
Note: (a): Sample V364 from borehole PX001showing band of apatite containing entrained carbonate with aggregates of synchysite, strontianite and baryte along its edge and (b) Sample V1240 from borehole PX003 with apatite and Fe-rich carbonate bands with large vein-like aggregate of synchysite, strontianite and baryte

Figure 7-12
Chondrite-normalized REE pattern for apatite in Songwe carbonatite (Brady, 2012)



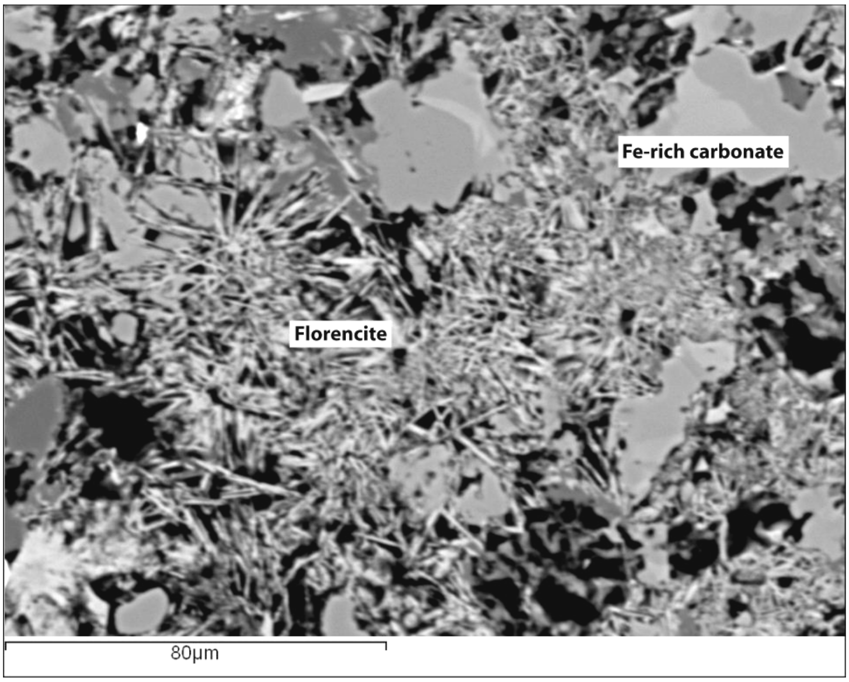
Note: Chondrite normalization after Sun and McDonough (1989)

Figure 7-13
Chondrite-normalized late-stage apatite from Songwe carbonatites (Broom, 2012)



Chondrite-normalized HREE pattern of Songwe apatite compared to typical LREE-enriched unaltered magmatic carbonatite from the Oka and Jacupiranga carbonatites. Chondrite normalization after Sun and McDonough (1989)

Figure 7-14
Florencite-rich groundmass of carbonatite breccia (NHM and Brady, 2012)



7.3.4.1 Genetic Model for REE Mineralization

The mineralogical work to date indicates that the light and heavy rare earth mineralization in the Songwe Hill vent system is late- to post-magmatic hydrothermal in origin and, regardless of lithology, is hosted primarily by fluorocarbonates (principally synchysite) and apatite with minor florencite.

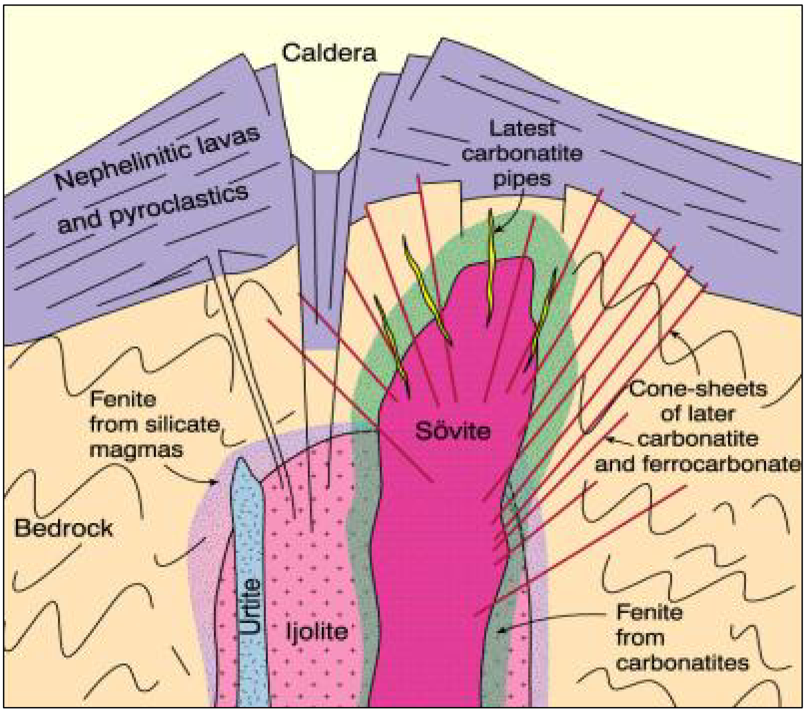
The complex, multi-phase geological evolution of the Songwe carbonatite complex is tentatively interpreted as follows: 1) intrusion of the Mauze nepheline syenites and phonolites, 2) fenitisation of the host nepheline syenites, 3) intrusion(s) of REE-bearing calcite carbonatite in a ring type structure and concomitant incorporation/stoping of fenite blocks, 4) pulses of Fe-bearing carbonatite magma emplacement and replacement of calcite carbonatite, 5) intrusion of thin Fe-rich carbonatite dykes/veins in the calcite and Fe-bearing carbonatites, 6) multiple later stage episodes of brecciation, and finally 7) extensive hydrothermal/carbohydrothermal activity resulting in REE enrichment of the various carbonatite and related lithologies.

The mineral association of REE-rich fluorocarbonates and apatite, with strontianite, baryte, ankerite and fluorite at Songwe strongly suggests that the REE mineralization formed by re-equilibration and recrystallisation of primary (early-crystallized) minerals (e.g. calcite) in the various carbonatite lithologies. REEs are known to concentrate into the late-stage carbonatite-related (deuteric) fluids (e.g. Doroshkevich et al., 2009) and it is therefore most likely that certain elements were introduced and/or re-distributed by hydrothermal/carbohydrothermal solutions. The presence of REE in the fenites demonstrates the mobility of the REE in the hydrothermal/carbohydrothermal fluids at Songwe Hill.

8 DEPOSIT TYPES

The target deposit type at Songwe Hill is a REE-enriched carbonatite. Carbonatites are traditionally defined as intrusive and extrusive igneous rocks that contain in excess of 50% modal carbonate minerals (Woolley & Kempe, 1989). The most recent classification by Mitchell (2005) defines carbonatites as “containing greater than an arbitrary 30 vol. % primary igneous carbonate regardless of silica content”. Carbonatites can be named according to their carbonate mineralogy (e.g. calcite carbonatite, dolomite carbonatite and ankerite carbonatite) and chemically they can be divided into the three main varieties: calcio-, magnesio- and ferro-carbonatite. Figure 8-1 is a generalized and widely accepted schematic illustration of the intrusion of a carbonatite complex.

Figure 8-1
General model for an alkali silicate-carbonate intrusive complex (after Le Bas, 1987)



Carbonatites usually occur as plugs or pipe-like bodies within zoned alkalic intrusive complexes, or as dykes, sills, breccias, and veins, and are almost exclusively associated with continental rift-related tectonic settings. They are characterized by an aureole of metasomatically altered country rocks which are usually referred to as fenites. Carbonatites are typically associated with silicate rocks of which the seven key carbonatite-silicate rock associations are in decreasing order of abundance: 1) nephelinite-ijolite, 2) phonolite-feldspathoidal syenite, 3) trachyte-syenite, 4) melilitite-melilitolite, 5) lamprophyre, 6) kimberlite, and 7) basanite-alkali gabbro (Woolley & Kjarsgaard, 2008). The carbonatite deposit at Songwe Hill is spatially associated with the large nepheline syenite intrusion of Mauze and is therefore interpreted to belong to the phonolite-feldspathoidal syenite association.

Carbonatites can be generated by:

- a low degree of partial melting in the mantle (e.g. Wallace & Green, 1988),
- extreme crystal fractionation (e.g. Watkinson & Wyllie, 1971), or
- liquid immiscibility (e.g. Kjarsgaard & Hamilton, 1989) from carbonated silicate magma

It is possible that all three mechanisms may play a part in carbonate magma evolution. Carbonatites typically consist of multiple phases of intrusions and characteristically evolve, by crystal fractionation within the intrusion, from early magmatic calcite-rich carbonatite to magnesium-rich dolomite carbonatites and finally with decreasing temperature to late-stage iron-rich carbonatite phases. As a result of their petrogenesis, carbonatites tend to be anomalously enriched in the highly incompatible REE and high field strength elements ("HFSE") and such enrichment can lead to economic concentrations of REE (Chakhmouradian and Zaitsev, 2012).

The REE profile of carbonatite-associated mineralization is typically LREE-dominated. Concentrations of REE tend to increase with fractionation from calcic to magnesio to ferro carbonatites and the REE distribution and profile in carbonatites is typically modified by late stage hydrothermal activity (Mariano, 1989; Giere, 1996; Wall & Mariano, 1996; Doroshkevich et. al., 2009). Carbonatite deposits may also contain economic or anomalous concentrations of magnetite, apatite, baryte, sulphides and vermiculite and are characterized by elevated concentrations of some or all of phosphorous, niobium, tantalum, uranium, thorium, copper, iron, titanium, vanadium, barium, fluorine, zirconium, and other rare or incompatible elements.

REE-enriched carbonatite hosted deposits may be divided in to three types: magmatic, hydrothermal, and residual / supergene (Mariano, 1989). Rare earth mineral deposits produced by primary crystallization from carbonatite magma are very rare and at the present time, the Mountain Pass deposit in the USA is the only well documented example. Late-stage rare earth mineralization produced by magmatic hydrothermal fluids is much more common, resulting in the precipitation of rare earth minerals, such as bastnäsite-(Ce), parisite-(Ce), synchysite-(Ce) and monazite-(Ce) in fractures or voids in the host carbonatite rock. Alternatively, hydrothermal mineralization may be present as disseminated, fine grained, polycrystalline aggregates of rare earth minerals overprinting or replacing earlier-formed minerals. Examples of hydrothermal deposits include Bayan Obo in China (Chao et al., 1992; Smith and Henderson, 2000) and Karonge/Gakara in Burundi (Lehmann et al., 1994).

Laterites, overlying deeply weathered carbonatites and alkaline rocks, are also an important source of REE enrichment and examples of supergene mineralization include the Mount Weld deposit in Western Australia. However, the rare earth deposit at Songwe Hill is not a laterite and is best described as a magmatic/hydrothermal REE deposit.

The target at Songwe Hill is a large body of intrusive calcic carbonatite with related breccias and fenites that appears to be part of a ring complex in a high level vent system. The REE mineralization is lithologically-controlled and the highest concentrations and greatest volumes of mineralization occur specifically within the carbonatite bodies. The carbonatites are believed to have been REE-enriched when they were intruded and the REE have apparently been redistributed and enhanced by late-stage hydrothermal/carbohydrothermal activity and are now principally residing in synchysite and apatite.

Vent breccias are also variably mineralized, locally to potentially economic values, and the level of REE concentrations is a function of the relative abundance of carbonatite fragments.

Adjacent fenites are also variably mineralized, although typically at lower volumes and concentrations than carbonatites, and the intensity of mineralisation is related to the degree of carbonate alteration overprinting the fenite suggesting that these rocks have also been mineralized by late-stage hydrothermal activity.

9 EXPLORATION

Mkango has been exploring and evaluating the Songwe Hill rare earth deposit since January 2010. Following confirmation of the enriched zones, previously investigated by JICA and MMAJ (see Item 6), exploration focused on identifying the nature and extent of the REE-mineralized carbonatites and related rocks. Mkango's exploration activities consisted of litho-geochemical sampling, soil sampling, channel sampling, geological mapping, ground magnetic, density and radiometric surveys, and petrographic/ mineralogical analyses and culminated in two diamond drilling campaigns in 2011 and 2012, the results of which are described in Item 10. Geological observations and interpretations and procedures related to exploration methodology were implemented and overseen by the Mkango geological team in Malawi led by Dr. Aoife Brady.

9.1 Litho-geochemical Sampling

Fieldwork undertaken by Mkango on Songwe Hill during March 2010 and May 2010 consisted primarily of litho-geochemical sampling to confirm the nature and extent of the mineralization identified by JICA and MMAJ. Outcrops were systematically scanned with a Thermo-Scientific Niton® XLP handheld X-ray fluorescence analyzer calibrated for the semi-quantitative analysis of rare earth elements. This work indicated that all lithologies on Songwe Hill contain anomalous amounts of REE and that there are variations between the different lithologies. In general, the contents of total REE in the fenites were lower than the carbonatites.

Two principal types of carbonatite were identified: a relatively homogeneous, medium grey rock, which appeared flow banded in places and a much blacker type which was characteristically heterogeneous. The black carbonatite appeared to form zones of various widths that cut or replace the grey homogeneous carbonatite. A total of 88 representative grab samples were taken from outcrop (62 carbonatites, 14 fenites, 11 Fe-rich and related rocks) and assayed for a full suite of rare earth and related elements. The sample locations are shown on Figure 9-1 and the assay results for the various rock types are presented in Table 9-1 and Figure 9-2. The samples were considered to be representative of the outcrop distribution of the mineralization. Care was taken to sample fresh rock and no sample biases were identified beyond the fact that there may have been minor modification of the concentration of REE in some samples by weathering effects.

The new results generally compared well with the data from JICA and MMAJ and confirmed broad zones of carbonatite at surface. The 62 carbonatite grab samples produced total rare earth element oxide ("TREO") concentrations between 0.4% and 5.3% TREO with an average of 1.5% TREO. The proportion of HREO, defined as the sum of oxides of Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu and Y, for these samples averaged 8% of TREO. The average TREO concentration of samples exceeding 1% TREO is 1.84 % TREO.

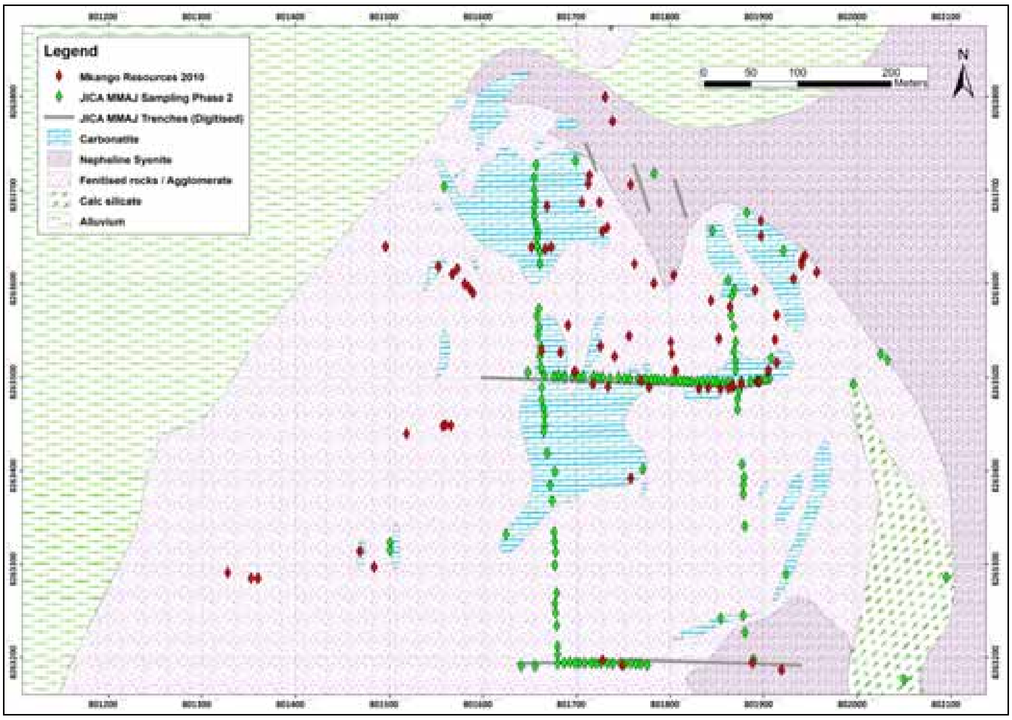
The results of this work confirmed the REE enrichment, initially identified by JICA and MMAJ and suggested that the mineralized carbonatites are more widespread than originally identified. This led to a broadening of the exploration focus to include most of the north-facing slopes of Songwe Hill.

Table 9-1
Representative analyses from the 2010 litho-geochemical sampling programme (Mkango, 2010)

Sample No.	Rock Type	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %
H0101	Carbonatite	8,704	13,232	1,126	3,218	343	85	238	23	102	385	66	2.75
H0102	Carbonatite	2,100	4,661	569	1,866	269	75	183	24	116	547	104	1.05
H0103	Carbonatite	10,135	15,691	1,310	3,626	326	77	228	20	88	370	76	3.19
H0117	Carbonatite	2,721	6,277	715	2,600	364	95	225	24	103	428	112	1.37
H0118	Carbonatite	10,979	16,043	1,369	3,999	448	108	309	30	142	749	155	3.43
H0119	Carbonatite	4,481	9,309	1,013	3,696	592	160	380	41	171	635	128	2.06
H0125	Carbonatite	2,064	4,754	517	1,842	261	68	166	22	118	655	130	1.06
H0126	Carbonatite	2,933	6,663	766	2,775	416	117	292	34	135	466	91	1.47
H0127	Carbonatite	11,343	16,511	1,369	3,731	458	122	326	39	180	720	131	3.49
H0917	Carbonatite	5,396	10,047	1,062	3,964	686	167	395	47	200	711	131	2.28
H0003	Fenite	1,408	3,244	314	1,259	264	68	146	13	46	183	41	0.70
H0004	Fenite	1,021	1,792	185	749	152	38	75	6	22	112	26	0.42
H0901	Fenite	903	1,265	228	1,056	220	62	137	15	63	271	57	0.43
H0902	Fenite	1,325	1,405	298	1,178	182	48	105	12	56	262	57	0.49
H0134	Fenite	745	1,522	199	802	200	61	156	19	88	395	68	0.43
H0909	Fe-rich rock	2,018	4,625	524	2,110	281	63	130	11	35	121	23	0.99
H0911	Fe-rich rock	1,279	2,916	339	1,411	213	52	118	13	49	179	30	0.66
H0913	Fe-rich rock	3,202	7,834	940	3,790	488	103	211	15	51	174	26	1.68
H0109	Fe-rich rock	5,501	8,115	741	1,912	216	66	203	27	119	538	95	1.75
H0002	Fe-rich rock	555	2,764	496	3,090	1,070	299	641	67	228	598	102	0.99

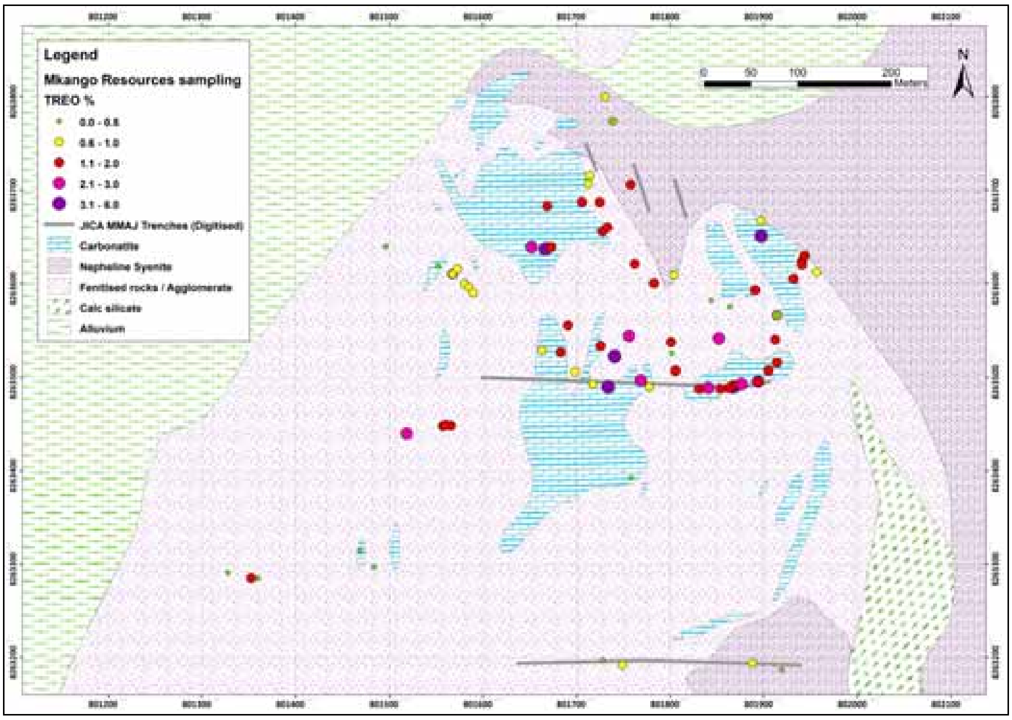
[1] Other comprises Ho_2O_3, Er_2O_3, Tm_2O_3, Yb_2O_3 and Lu_2O_3; [2] TREO = total rare earth oxides including yttrium

Figure 9-1
Geological map of Songwe Hill with sample localities of JICA (1988) and Mkango (2010) samples (Mkango after JICA / MMAJ, 1989)



Note: UTM Zone 36S and WGS84 Datum

Figure 9-2
Geological map of Songwe Hill with assay results for Mkango samples (Mkango, 2010)



Note: Assay results are shown for various rock types sampled; UTM Zone 36S and WGS84 Datum

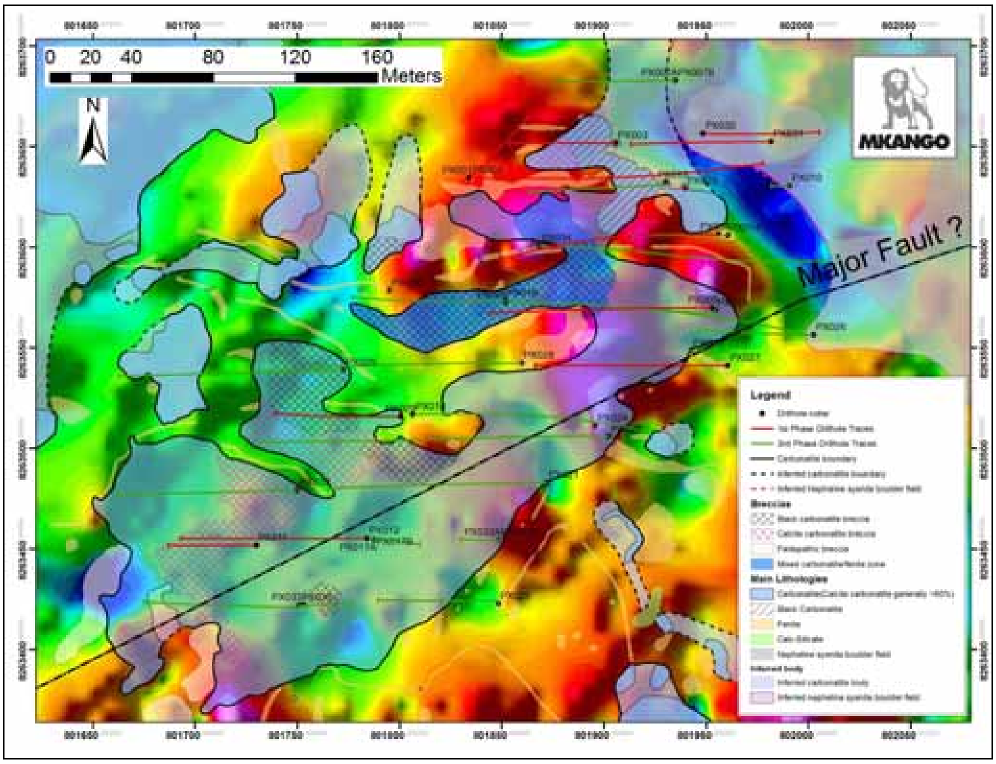
9.2 Ground Geophysical Programme

In October 2010 and January 2011, Remote Exploration Services (Pty) Ltd. ("RES") from South Africa, conducted magnetic, radiometric and gravity surveys over Songwe Hill. The objective of the geophysical programme was to determine the geophysical characteristics of the geological units as an aid to mapping the extent of the carbonatite over Songwe Hill (Remote Exploration Services Ltd., 2010). A digital terrain model (DTM) was prepared as part of the geophysical programme. All data was processed by RES.

9.2.1 Magnetic survey

The ground-magnetic survey was conducted using GEM Overhauser Magnetometers. Magnetic data was collected in "Walk Mode" at one second intervals along 1 km long lines spaced 50 m apart, while a fixed GEM base magnetometer enabled each day's magnetic data to be corrected for diurnal variations by recording magnetic field readings at 10 second intervals. Field data spatial positioning was accomplished with the use of a Garmin handheld GPS. The magnetic data define the vent aureole as a zone of demagnetization around the mapped fenite and depicts the vent as magnetically zoned. A NE-trending major fault cross-cutting the centre of the vent could be the cause for this magnetic zoning. The data showed no clear correlation between magnetic anomalies and the mapped carbonatite outcrops. The magnetic survey also identified several faults/lineaments which could have played an important role in carbonatite emplacement as well as radioelement mobility (Figure 9-3).

Figure 9-3
Modified analytical signal of TMI over Songwe Hill (RES and Mkango, 2011)

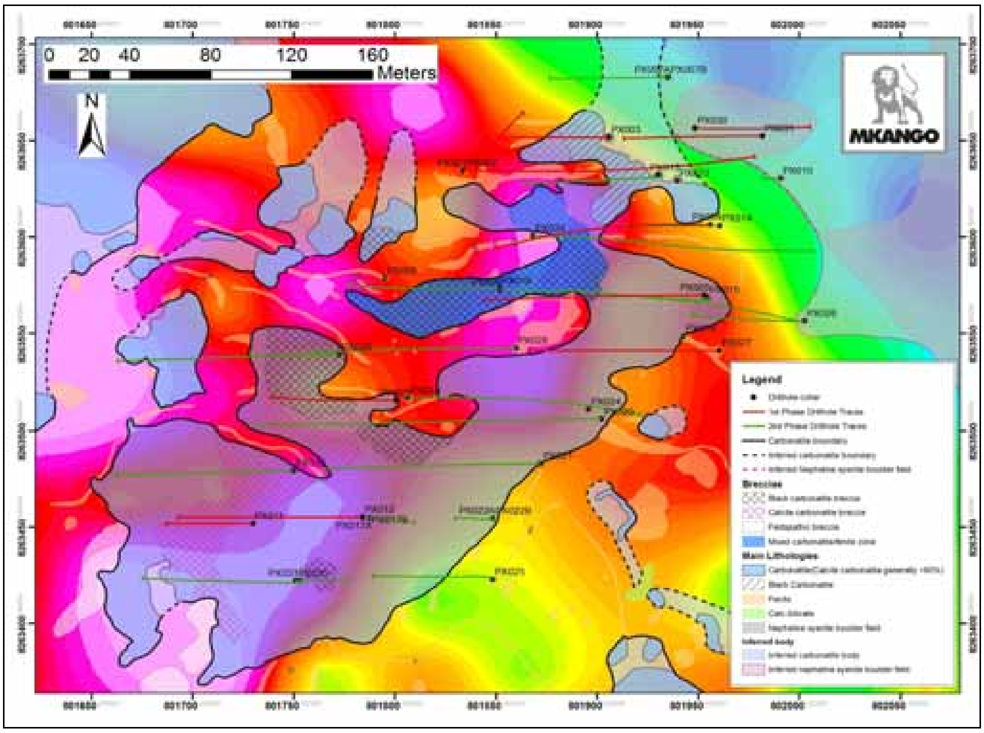


Note: Analytical signal showing magnetic zone and structures; geological map, drill collars and traces superimposed

9.2.2 Radiometric survey

A calibrated 4-channel spectrometer was used for the radiometric survey. Total count, potassium (K), thorium (Th) and uranium (U) counts were recorded for 60 s at 50 m station intervals along 1 km long lines spaced 50 m apart. An additional infill survey was conducted over part of the survey area with a known carbonatite occurrence. The radiometric survey data showed the existence of significant thorium and potassium anomalies and demonstrated a good correlation between the Th response and the mapped carbonatite (Figure 9-4).

Figure 9-4
Thorium radiometric survey over Songwe Hill (RES and Mkango, 2011)



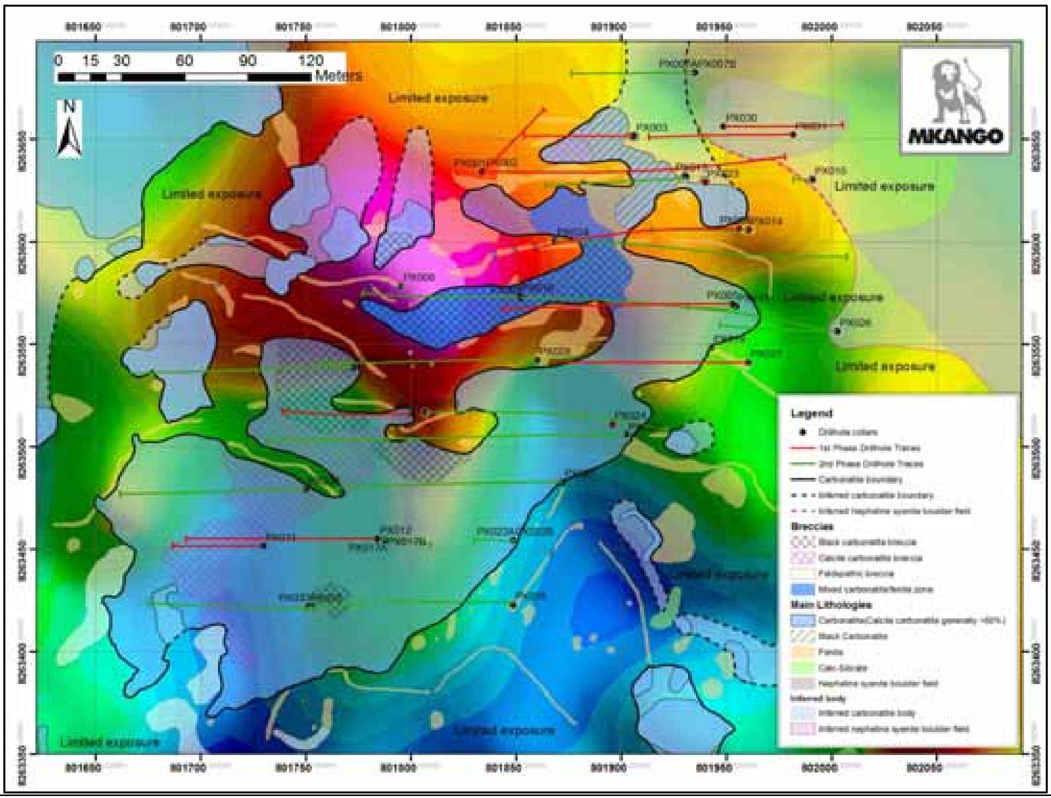
Note: Thorium radiometric survey; geological map, drill collars and borehole traces superimposed

9.2.3 Gravity survey

The ground gravity survey was conducted using a Scintrex CG3 micro-gravimeter, capable of taking readings with an accuracy of +/- 0.001 mGal. Gravimetric measurements were made at 50 m station intervals along 1 km long lines spaced 50 m apart. Readings were stacked for 60 s and averaged at each station so as to minimize random noise and were also kept within a standard deviation of +/- 0.050 mGal. Base readings were taken at the “gravity base” at the beginning and end of each survey day in order to correct field measurements for instrument drift. Elevation and positional control was accomplished initially with the use of a Trimble Differential GPS (DGPS) unit. This had to be abandoned due to a technical fault within the DGPS system and a Garmin 60CSX handheld GPS unit was adopted for the remainder of the survey. The hill was resurveyed in January, 2011 (Remote Exploration Services Ltd., 2011) in order to better constrain the digital terrain model and the gravity survey data was reinterpreted on the basis of the revised DTM. Interpretation of the gravity data, based on in-field observations undertaken on hand specimen grab samples, assumed a high density contrast between the carbonatites and the surrounding rocks.

Figure 9-5

Ground gravity survey over Songwe Hill (RES and Mkango, 2011)



Note: Ground gravity survey over Songwe Hill showing a central gravity high; geological map, drill collars and borehole traces superimposed

Due to inherent errors in the gravity data emanating from imprecise elevation measurements using a handheld GPS as well as the coarse nature of the data, it is likely that an accurate assessment of the density distribution within the vent has not been achieved. A central gravity high was identified (Figure 9-5) but it is inconclusive as to whether it relates to carbonatite or basement geology.

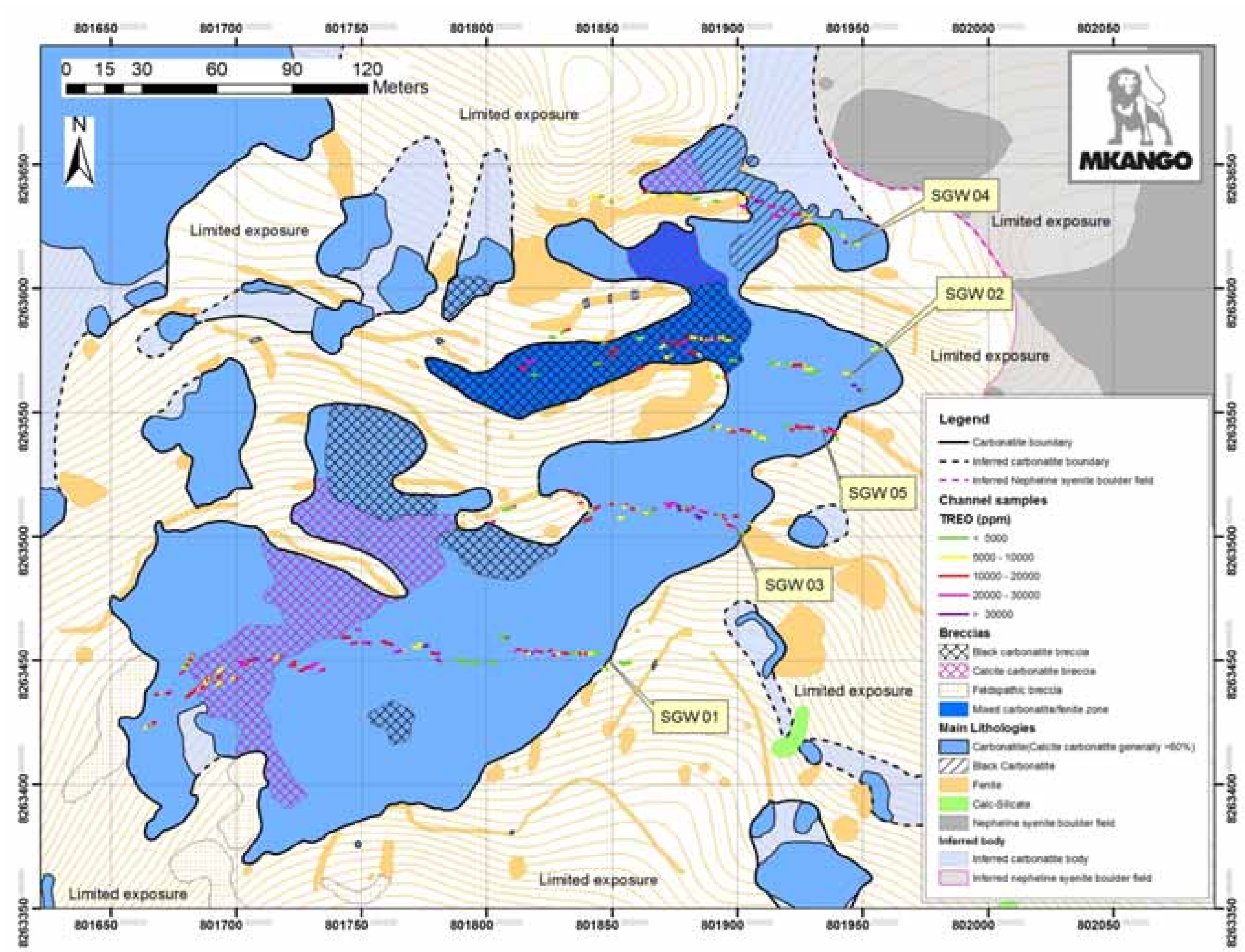
9.3 Geological Mapping

Detailed geological mapping of Songwe Hill was carried out during March, 2010 in conjunction with the surface litho-geochemical sampling program and between May and July, 2011. All outcrops on the north-facing slopes of Songwe Hill were systematically recorded and their locations determined with a handheld GPS (Garmin 60CSX). Mapping was aimed to provide better detail on the distribution of carbonatite, fenite and breccia across Songwe Hill and to delineate the zones of rare earth mineralization (see Figure 7-2). The mapping programme demonstrated that carbonatite outcrops over a significantly larger area than had previously been recognized by JICA and MMAJ. Mapping further achieved a more precise delineation of the distribution of breccia and fenite. The mapping broadened the surface area of known rare earth mineralization significantly beyond the areas identified in previous exploration and identified new areas of rare-earth enriched carbonatite on the western slope of the hill.

9.4 Surface Channel Sampling

A channel sampling programme was undertaken during November and December 2011 following the Stage 1 drill campaign. The objective was to help constrain the geological model and provide continuous surface sampling along the drill section lines in order to constrain the mineral resource estimation. Outcrops were exposed by cleaning off overburden and soil as continuously as possible along 5 lines with an east-west orientation that followed the approximate surface projections of existing and planned boreholes. In detail, the location of the channel sampling lines was dictated by the availability of outcrop along each E-W line. Where outcrop could not be exposed directly on the line, sampling was offset to the outcrop nearest to the line, irrespective of lithology (Figure 9-6). To the extent possible, continuous channel samples were cut along each of these lines.

Figure 9-6
Geological map with location and TREO of the 5 channel sample lines (Mkango, 2012)



Channels were cut in the exposed outcrop using a Stihl TS 700 saw fitted with a diamond saw blade (Figure 9-7) and connected to a Stihl 10L pressurized water tank. All channels were cut to an approximate width of 4 cm to 5 cm and a depth of 10 cm to 12 cm. A single channel was defined by the start and end of a continuous cut. There were many breaks in the cutting due to the uneven topography and distribution of outcrop and overburden. As a result, although the channels follow the planned surface lines as closely as possible, they are not continuous and locally deviate from the line.

Figure 9-7
Example of Channel sampling programme on Songwe Hill (Armitage, 2012)

Note: Left: a single channel cut through carbonatite; Right: Channel cutting with a Stihl TS 700 saw

On completion of cutting, the channels and an area approximately 50 cm to either side of the channels were cleaned of sludge using water and a stiff brush if necessary. When the rock surface had dried after cleaning, meter marks across the channels were painted together with unique sample numbers (sample ticket book number) adjacent to the meter marks on the left side of the channel viewed in the direction of sequential sampling.

Samples were broken and chipped out of the channels using a tapered masonry chisel and a club hammer. As slabs and chips of rock were liberated, they were placed immediately into pre-prepared sampling bags containing sample tickets and marked with sample numbers on the outside. Before sampling each meter, the geologist checked that the sample number of the bag corresponded to the number spray-painted alongside the channel. Channels were sampled at 1 meter intervals and if there was a change of lithology within the sampling interval, then each lithology was sampled separately, using a minimum of 20 cm channel length and a maximum of 130 cm.

On completion of sampling, all channels were photographed, viewed in the direction of sequential sample numbering, and clearly showing the sample numbers.

The channel sampling logging and sampling technique employed during the channel sampling programme followed strict internal quality assurance and quality control

("QA/QC") procedures. Each channel sample line was geologically logged and sampled observing the same procedures used during the drilling programmes. Sample preparation and analytical work was carried out by Intertek-Genalysis Laboratory Services (Johannesburg, South Africa and Perth, Australia) employing ICP-MS analytical procedures and following strict internal QA/QC procedures including the insertion of duplicates, blanks and certified standards. Detailed information on logging, sampling and geochemical analysis is presented in Item 11.

A summary of the channel sampling programme, as illustrated in Figure 9-6, is presented in Table 9-2. The results were broadly consistent with the current geological mapping, litho-geochemical sampling and portable XRF sampling results and further confirm the continuity of rare earth mineralization at surface in carbonatite, carbonatite breccia and fenite on Songwe Hill. Representative assay data for the channel samples are given in Table 9-3.

Table 9-2
Summary of assay results for the 5 channel sample lines (Mkango)

E-W line (approximate length) m	Aggregated length of channel samples m	Aggregated length of carbonatite[1] in channel samples m	Weighted average TREO in carbonatite[1] % TREO[2]	Aggregated length of fenite in channel samples m	Weighted average TREO in fenite % TREO[2]
SGW-01 (200 m)	152	119	1.75%	33	0.73%
SGW-02 (150 m)	106	79	1.44%	27	1.20%
SGW-03 (110 m)	66	53	1.70%	14	0.67%
SGW-04 (120 m)	63	33	2.83%	31	0.94%
SGW-05 (55 m)	37	31	1.37%	6	1.28%

[1] Includes both carbonatite and carbonatite breccia; [2] TREO = total rare earth oxides including yttrium

9.5 Research Programmes

Post-graduate studies on the middle and heavy REE mineralization at Songwe Hill are underway at Camborne School Mines ("CSM"), University of Exeter, UK in conjunction with the British Geological Survey ("BGS"). This project is investigating HREE concentration levels in alkaline and carbonatite complexes which are typically light rare earth dominated.

The research at Songwe is focused on two principle questions: (1) under what conditions are the HREE preferentially removed from a carbonatite and deposited in hydrothermal veins and (2) how does the REE distribution evolve through the carbonatite intrusion phases and into late stage hydrothermal remobilization. This work is being carried out at the mineralogical labs at CSM using cathodoluminescence, electron microscopy and an electron microprobe and at the BGS utilizing laser-ablation inductively coupled plasma mass spectrometry ("LA-ICP-MS") and a fluid inclusion heating and cooling stage.

The study is in progress and the results are expected to aid in targeting and exploring REE-enriched carbonatites elsewhere in the license area.

Table 9-3

Representative assay results for carbonatite, fenite and breccia from the 5 channel sample lines (Mkango)

Profile	Channel No	Sample No	Rock type	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %
SGW-01	5	U4017	Carbonatite	2,851	6,223	726	2,621	397	112	275	32	153	636	117	1.41
SGW-01	5	U4018	Carbonatite	2,389	4,999	576	2,049	292	78	186	21	109	559	98	1.14
SGW-02	6	U4213	Carbonatite	2,456	5,358	621	2,155	315	88	222	29	145	623	115	1.21
SGW-02	6	U4214	Carbonatite	2,308	4,988	568	1,960	294	86	225	32	174	843	150	1.16
SGW-03	8	U4415	Carbonatite	3,784	9,053	1,099	4,346	709	211	528	70	363	1,982	315	2.25
SGW-03	8	U4416	Carbonatite	4,135	9,940	1,179	4,708	924	280	772	98	497	2,212	399	2.51
SGW-04	10	U4521	Carbonatite	10,571	16,306	1,536	5,172	524	134	296	35	170	711	127	3.56
SGW-01	17	U4051	Fenite	1,371	3,029	405	1,599	283	76	183	20	96	497	87	0.76
SGW-01	17	U4052	Fenite	348	670	78	302	68	22	58	8	43	246	45	0.19
SGW-02	31	U4289	Fenite	496	897	119	481	115	34	85	11	52	246	42	0.26
SGW-02	31	U4290	Fenite	762	1,460	193	771	165	45	104	12	58	280	48	0.39
SGW-05	22	U4635	Carbonatite breccia	3,399	5,677	573	1,698	242	66	164	20	101	463	84	1.25
SGW-05	22	U4636	Carbonatite breccia	2,947	5,049	517	1,580	259	82	223	31	155	680	131	1.17
SGW-01	36	U4114	Carbonatite breccia	5,610	8,491	801	2,425	336	96	250	27	128	638	119	1.89
SGW-01	36	U4115	Carbonatite breccia	5,694	8,626	825	2,501	334	91	228	25	114	537	103	1.91

[1] Other comprises Ho_2O_3, Er_2O_3, Tm_2O_3, Yb_2O_3 and Lu_2O_3; [2] TREO: total rare earth oxides including yttrium

10 DRILLING

10.1 Historical Diamond Drilling (1988)

Historic drilling from the JICA and MMAJ programme is described in Item 6 and Figure 6-1 shows the location of the historic drill holes on the property. The historic drilling does not have adequate geodetic or procedural information to be incorporated in the evaluation of the Songwe Hill deposit and does not form part of the database for the current mineral resource estimate.

10.2 Stage 1 and Stage 2 Diamond Drilling (2011 – 2012)

Mkango undertook two diamond drill campaigns totaling 38 drill holes at Songwe Hill during 2011 (Stage 1) and 2012 (Stage 2) to evaluate the REE potential of the Songwe Hill deposit and develop a resource estimate. The drilling programmes were undertaken following strict, industry standard QA/QC protocols which were part of a comprehensive set of standard operating procedures ("SOP"). The implementation of all protocols was independently monitored by MSA.

The Stage 1 drilling programme, from April 2011 to June 2011 was conducted by OX Drilling of Zambia using HQ/NQ (63.55 mm / 47.6 mm) core barrels on a track mounted Boart Longyear drill rig. The objectives were to confirm the extent and tenor of mineralization that had previously been identified during the JICA and MMAJ drill campaigns and to test whether the mineralization extends beyond the boundaries of the previously established mineralized areas.

Figure 10-1
Diamond core drill rig on Songwe Hill (Mkango, 2012)

The programme totaled 13 drill holes, two vertical holes and 11 inclined holes drilled on 90° and 270° azimuths at inclinations of -60° and -70°, and one hole (PX002) drilled at

045° azimuth at -70° inclination. Borehole depths ranged from a minimum of 86 m to a maximum of 302.2 m. Table 10-1 provides the location and attitude information for each drill hole. A total of 1987.38 m were drilled, and 2118 samples were collected for geochemical analyses.

The Stage 2 diamond core drilling programme was carried out between January, 2012 and May, 2012. The drill contractor was Cartwright Drilling Inc. of Goose Bay, Canada, and the core diameter for all boreholes was HQ (63.5 mm) for the upper part and NQ (47.6 mm) to the end of hole. The core diameter of one drillhole (PX22a) was further reduced from NQ to BTW (41.7 mm) size. The track-mounted rig (Figure 10-1) was moved into place on each drill pad using a Caterpillar 329D hydraulic excavator.

The Stage 2 programme focused on infill drilling and expanding the area of known mineralization identified during Stage 1, particularly at depth. A total of 25 holes comprising four vertical holes and 21 inclined holes drilled on 90° and 270° azimuths at inclinations of -60°, -65°, -70°, or -80° (Table 10-1 and Figure 10-2). Borehole depths ranged from a minimum of 21 m to a maximum of 363 m. Table 10-1 shows location and attitude information for each drill hole. A total of 4,864.90 m were drilled and 5,116 samples for assays were collected. Drilling was conducted during day and night shifts.

Figure 10-2
Geological map with Stage 1 and Stage 2 drill collars and traces (Brady, 2012)

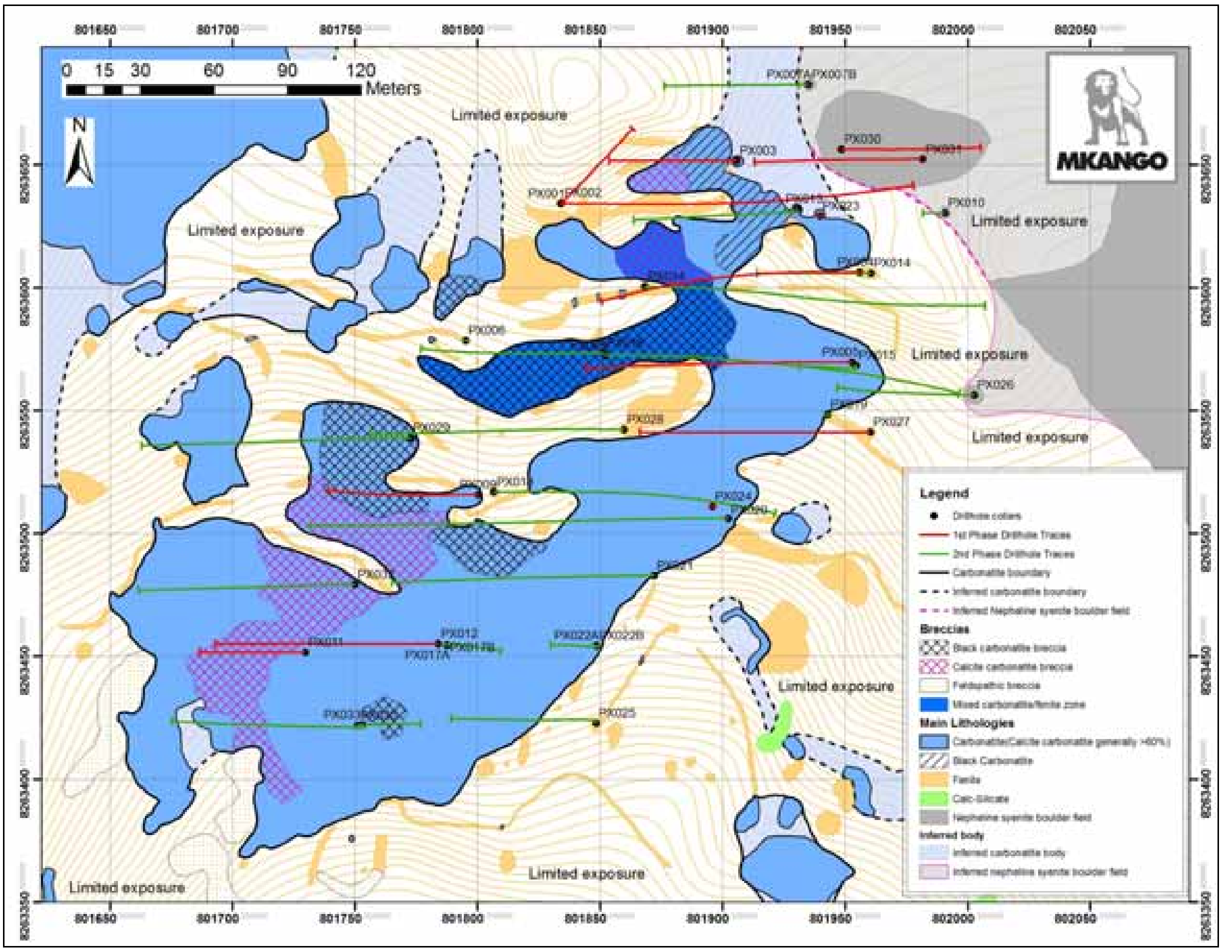


Table 10-1
Details for 38 diamond drillholes on Songwe Hill (Mkango, 2012)

Borehole ID	Easting	Northing	Elevation (m)	Depth (m)	Azimuth (°)	Inclination (°)
PX001	801833.79	8263634.21	773.46	302.35	90	-60
PX002	801834.45	8263634.44	773.44	116.30	45	-70
PX003	801905.75	8263651.56	773.81	104.10	270	-60
PX004	801956.00	8263606.21	792.13	224.20	270	-60
PX005	801952.80	8263569.65	807.51	201.78	270	-60
PX006	801795.09	8263578.51	805.18	164.70	0	-90
PX007a	801934.71	8263682.65	776.31	122.00	270	-60
PX007b	801935.09	8263682.61	776.33	21.35	270	-80
PX008	801852.13	8263572.57	810.02	360.31	90	-70
PX009	801800.18	8263515.75	833.78	122.20	270	-60
PX010	801990.79	8263630.30	792.44	51.85	270	-80
PX011	801729.74	8263451.70	883.05	86.20	270	-60
PX012	801783.93	8263455.08	870.55	182.00	270	-60
PX013	801930.41	8263631.93	782.55	137.25	270	-60
PX014	801960.58	8263605.78	792.28	268.40	270	-80
PX015	801954.53	8263568.45	807.49	140.30	270	-80
PX016	801851.58	8263573.22	809.88	363.58	270	-80
PX017a	801787.50	8263454.54	870.60	57.95	90	-70
PX017b	801787.50	8263454.54	870.60	106.75	0	-90
PX018	801806.66	8263516.77	834.92	341.60	90	-70
PX019	801942.77	8263548.44	817.38	76.25	0	-90
PX020	801902.24	8263506.05	849.49	350.75	270	-60
PX021	801871.97	8263482.77	869.18	216.55	270	-80
PX022a	801848.42	8263454.36	879.78	106.75	270	-80
PX022b	801848.42	8263454.36	879.78	347.70	0	-90
PX023	801939.70	8263629.14	783.53	112.55	0	-90
PX024	801895.77	8263510.96	849.69	91.00	0	-90
PX025	801848.40	8263422.79	899.65	117.00	270	-60
PX026	802002.65	8263556.25	803.43	312.19	270	-80
PX027	801960.36	8263541.10	818.05	188.30	270	-60
PX028	801859.78	8263542.26	828.09	201.30	270	-60
PX029	801772.54	8263538.77	828.65	210.45	270	-60
PX030	801948.48	8263656.25	781.33	122.20	90	-60
PX031	801981.63	8263652.24	788.53	136.20	270	-60
PX032	801749.86	8263479.11	866.41	170.80	270	-60
PX033	801753.10	8263422.12	895.30	153.22	270	-60
PX034	801868.31	8263600.37	795.25	314.45	90	-65
PX035	801751.08	8263421.82	895.55	149.45	90	-80

Note: Coordinates are in UTM Zone 36S and WGS84 Datum; PX018a is excluded from the Table because the hole was terminated after 9.15 m

10.3 Core Recovery

Core recovery was determined prior to logging and sampling and standard core recovery forms, prepared by MSA, were completed for each hole by the geologist at the drill. Core recovery was typically very good, usually > 90% within the carbonatite, carbonatite breccia and fenite lithologies. However, in zones that contained significant void space/cavities, recoveries were locally very poor (< 50%) and in a few cases, very little material (< 10%) was returned to the surface. The cavities/void spaces are the likely result from karst-type dissolution of matrix carbonate in the host carbonatite.

Large cavity/void areas were not included in assay intervals, but were tabulated as voids. Poor recoveries were also encountered close to and within the boulder field on the north eastern side of the hill. This area is a palaeo-drainage system and interaction with flowing water has resulted in the formation of a zone of highly weathered, friable and void-filled fenite and carbonatite that tends to fracture and disaggregate easily during drilling. Consequently, recoveries were poor in this zone.

10.4 Collar Surveys

The 2011 Stage 1 borehole collars were surveyed by Digital Surveying based in South Africa. The 2012 Stage 2 channel sample lines and borehole collars were surveyed by a licensed land surveyor, Land Management Consultants, of Blantyre, Malawi using a Real Time Kinematics ("RTK") Differential GPS system with sub-centimeter accuracy. The Stage 1 drill-collars were also re-surveyed by Land Management Consultants for verification purposes and all collar locations are reported using the Land Management Consultants survey data. The UTM Zone 36 South and WSG84 Datum were used for all survey measurements.

10.5 Downhole Surveys

The 2011 Stage 1 drill-holes were surveyed by Digital Surveying based in South Africa using a Reflex GYRO tool with station readings every 5 m. The surveys were carried out using a winch inside plastic casing placed down the hole to ensure hole integrity.

During the Stage 2 programme 14 holes (PX007a, PX008, PX014, PX015, PX016, PX018, PX020, PX021, PX026, PX028, PX029, PX032, PX034, and PX035) were surveyed using a Reflex GYRO tool, with station readings every 5 m. The Reflex GYRO tool has an integrated Azimuth Pointing System (APS) that indicates True North azimuth, a GPS position and degree of inclination. The APS is not affected by magnetic interference and thus during the Stage 2 programme the surveys were carried out inside the drill rods. The Reflex GYRO was set up and controlled by the site geologist using the Toughbook field PC supplied with the system. Several parameters, including temperature, were continuously recorded in the on-board memory throughout the survey to track the path of the drill-hole. Once the survey was finished and the instrument brought to the surface, the data was transferred from the Reflex GYRO's on-board memory to the field PC.

The remaining 10 holes of the Stage 2 programme were surveyed using a Reflex EZ-AQ instrument with station readings every 5 m. The EZ-AQ surveys were carried out using a hand winch inside plastic casing placed down the hole to ensure hole integrity. The EZ-AQ instrument, which is sensitive to magnetic interference, measured the inclination and direction of the drill-hole, together with magnetic and gravity field components. A handheld device was used to communicate with the instrument which allowed the site geologist to view the orientation of the borehole path immediately. The survey data was transferred from the EZ-AQ instrument via an infra-red data link. Both the Reflex GYRO and the EZ-AQ tools worked effectively.

In general, very minor dip deflections were recorded in both the Stage 1 and Stage 2 drillholes. Azimuth deviation was typically less than 5 degrees for all holes, but for a number of deep holes deviation could range up to 10 degrees over 300 m.

10.6 Drilling Logistics and Procedures

Drill access on Songwe Hill was via a network of roads constructed for that purpose. Water for drilling was supplied from a borehole at the Songwe Hill exploration camp site. Water was pumped from the borehole into a 30,000 liter aqua-dam at the base of Songwe Hill and then pumped through heavy-duty pipes to a second 30,000 liter aqua-dam at the top of the Hill and then gravity fed to the drill rig.

All boreholes were sited by a geologist from Mkango's exploration team with a handheld GARMIN GPS unit using UTM Zone 36S projection and WGS84 Datum. The planned collar positions were marked with wooden pegs and the azimuth outlined using spray paint. Prior to drilling, the alignment of the rig was checked by the site geologist to ensure correct rig setup. The inclination was measured on the derrick using a Brunton compass. Azimuths were checked by the geologist using a compass clinometer corrected for local magnetic declination. After the completion of each drilling programme all holes were re-surveyed using DGPS equipment.

Drilling was monitored on a continuous basis by Mkango geologists to ensure maximum recovery. Core was obtained using wire-line methods and was washed by a member of the drill crew prior to placement in a steel core tray. Core trays were labeled in advance with the borehole name and box number and placed near the drill rig, Drill core was consistently packed left to right, pointing down hole, in each tray. Plastic depth marker blocks were inserted at the end of every run and the actual drill depth, according to the number of rods in the ground, and the length of the recovered core were recorded on the depth blocks. Detailed core recovery measurements were completed by the site geologist before the trays were transferred to the exploration camp.

Filled core trays were removed from the drill site twice a day under the supervision of the site geologist. Trays were covered with blankets and then secured by straps with ratchets in Mkango's pick-up truck and transported to the exploration camp site.

Following completion of the holes, drill collars were capped and marked with a concrete slab with the relevant information recorded on a metal plate (Figure 10-3).

Figure 10-3
Examples of borehole beacon (Swinden and Reichhardt, 2012)

10.7 Results of Drilling

10.7.1 Drill Objectives

The Stage 1 drill programme was successful in confirming the presence of REE mineralization first outlined by the JICA and MMAJ work. Eleven of the thirteen holes intersected significant zones of rare earth mineralization. Having confirmed the presence of the mineralization, the Stage 1 drilling was expanded to areas not previously tested and demonstrated the extension of rare earth mineralization both laterally and vertically.

The Stage 2 drilling focused on expanding the area of known mineralization, infilling between existing holes and testing the mineralization at depth. All boreholes intersected REE mineralization and the maximum depth at which REE mineralization was encountered was 350 m below the surface of the hill.

Table 10-2 and Table 10-3 summarize significant intersections from the Stage 1 and Stage 2 drilling campaigns.

10.7.2 Mineralized Lithologies

The drilling demonstrated that the mineralized body at Songwe Hill is geologically complex. It is best interpreted as a carbonatite plug that has intruded and partially assimilated a carapace of fenite. The explosive nature of the intrusion is demonstrated by the widespread occurrence of carbonatite and fenite breccias. The following 3 lithological domains were used to guide the mineral resource estimate:

10.7.2.1 Carbonatite

Carbonatite is the dominant lithology, ranges from grey to black in color and hosts the bulk of the mineralization. Assay data show that the carbonatite is widely and uniformly mineralized. Mineralogical observations suggest that the mineralization is dominantly hosted by synchysite and apatite. The latter is generally anomalously rich in heavy rare earths compared to apatites in many other carbonatite complexes. This feature is interpreted to be the result of sub-solidus hydrothermal redistribution of the REE during the final stages of the evolution of the carbonatite body.

10.7.2.2 Fenite

Fenite is present throughout the carbonatite body and is intimately intermixed with the carbonatite. The fenites comprise dominantly potassium feldspar and are interpreted to have formed through metasomatism related to the intrusion of the carbonatite, although fenitization related to intrusion of the earlier nepheline syenites cannot be ruled out. At least some of the fenites are interpreted to be blocks stoped into the carbonatite magma. The fenites are variably carbonatized and mineralization in the fenite appears to be related to the degree of carbonatization, In other words, relatively pure fenites typically do not contain significant REE concentrations, while increasingly carbonatized fenites carry anomalous quantities of REE.

10.7.2.3 Mixed Lithologies

The mixed lithologies form a relatively small part of the Songwe Hill mineral resource. They include breccias with carbonatite and fenite components, as well as finely intermixed carbonatite and fenite that cannot be separated into distinct units and correlated at the scale of mapping. The mixed geological domain tends to carry similar amounts of TREO to the carbonatite and fenite, but tends to be lower in overall HREO.

10.7.3 Orientation and Spatial Distribution of Mineralization

The orientation of mineralization at Songwe Hill is not yet well constrained because of the limited understanding of the geometry of the carbonatite intrusion and related lithologies. The mineralized body is a carbonatite plug which is part of a larger volcanic vent system and has incorporated variable amounts of surrounding lithologies. The mineralization appears to be the result of hydrothermal processes that acted within the carbonatite as well as in the related lithologies (fenite, breccia) and produced a relatively uniformly mineralized body. As such, the mineralization does not have a well defined strike or geometric shape although the drilling suggests that in plan view, it is elongate in a NE-SW direction. Mineralization remains untested by drilling beyond the NE and SW extent of the current drill sections (Figure 10-2) as well as at depth (e.g. Figure 7-4). Structural observations in the drill core suggest that contacts and other fabrics are very steep and this supports the interpretation that the overall contacts of the body may be sub-vertical and the carbonatite body may, therefore, extend to considerable depths below the surface. However, the overall geometry is not well enough constrained to allow a determination of the extent to which intersections represent true width.

Table 10-2
Summary of Significant Mineralized Intersections from Stage 1 drilling campaign (Mkango)

Carbonatite Domain

Drill Hole	From m	To m	Interval m	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %	% HREO[3] + Y_2O_3
PX001	2.4	302.2	299.8	2,464	4,539	474	1,593	237	71	172	22	100	460	85	1.0	8.9
including	184.83	302.2	117.4	3,743	7,037	736	2,478	355	102	241	31	143	710	128	1.6	8.6
	225.6	262.1	36.5	4,287	8,515	911	3,145	449	128	298	38	176	893	179	1.9	8.9
	268.0	290.7	22.7	3,481	7,581	849	2,960	452	130	293	41	192	1,066	215	1.7	11.1
PX003	3.5	61.2	57.7(i)	11,773	17,145	1,727	5,179	606	152	357	44	198	844	161	3.8	4.6
including	3.5	23.2	19.7	10,987	16,016	1,607	4,803	543	134	309	38	173	751	145	3.6	4.4
	23.2	30.6	7.4(ii)	20,290	29,449	2,945	8,761	1,058	272	650	82	383	1,717	333	6.6	5.2
	30.6	50.0	19.4	9,735	14,375	1,472	4,475	527	131	303	36	158	645	120	3.2	4.4
	50.0	58.0	8.0(iii)	12,851	17,948	1,751	5,162	606	153	366	46	203	823	156	4.0	4.4
	58.0	61.2	3.2	6,777	10,466	1,115	3,466	428	110	269	35	157	646	119	2.4	5.7
PX004	14.6	42.0	27.2(iv)	4,630	8,988	1,033	3,562	513	149	381	51	249	1,117	324	2.1	10.4
	78.0	117.8	39.8	7,438	10,953	1,065	3,261	389	103	249	30	133	585	122	2.4	5.0
PX005	2.5	102	99.53(v)	2,393	4,399	476	1,609	230	62	157	21	104	484	97	1.0	9.2
including	2.5	30.9	28.5(v)	2,695	5,231	581	2,000	285	78	206	29	163	804	164	1.2	11.8
	34.4	70.0	35.6	2,670	5,069	566	1,953	285	75	192	24	118	522	104	1.2	8.9
PX009	2.3	116.2	113.9(vii)	4,762	8,320	847	2,860	399	108	246	28	125	590	107	1.8	6.5
including	37.0	51.9	14.9	5,881	9,938	982	3,236	417	113	261	31	154	754	134	2.2	6.6
	68.3	110.2	41.9 (viii)	5,775	9,997	1,015	3,380	465	120	254	23	81	246	56	2.1	3.6
PX011	1.32	86.2	84.9(ix)	2,081	4,359	524	1,894	314	89	224	27	130	631	110	1.0	11.7
including	1.3	29.0	27.7 (x)	3,068	6,219	726	2,555	386	106	262	32	151	738	129	1.4	9.9
PX012	2.1	91.8	89.7	3,764	7,273	811	2,771	394	103	245	30	142	697	123	1.6	8.2
including	22.0	79.0	57.0	4,538	8,537	934	3,127	422	110	260	32	153	731	129	1.9	7.5
PX023	2.0	11.0	9.0	2,346	4,632	485	1,660	250	71	180	25	126	604	107	1.0	10.6
	29.0	41.0	12.0	2,058	4,477	493	1,724	249	68	166	21	103	463	85	1.0	9.1
	54.4	60.4	6.0	2,772	5,717	608	2,069	286	78	188	24	120	585	105	1.3	8.8
PX024	2.0	91.0	89.0 (xi)	3,412	6,576	724	2,442	386	103	237	29	141	722	123	1.5	9.1
including	13.0	23.0	10.0	7,381	11,465	1,132	3,516	590	167	390	48	224	1,072	185	2.6	8.0
PX027	43	101.8	58.75	3,397	7,078	784	2,712	374	99	231	28	136	606	112	1.6	7.8
	80.0	98.7	18.7	4,575	9,723	1,090	3,842	516	130	295	34	155	689	125	2.1	6.7
	170.0	188.3	18.3	3,811	6,778	725	2,478	359	92	202	22	95	390	69	1.5	5.8
PX031	68.0	81.0	13.00	2,828	6,009	665	2,414	338	96	230	29	151	705	126	1.4	9.8

Table 10-2 (continued)

Fenite Domain

Drill Hole	From m	To m	Interval m	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %	% HREO[3] + Y2O3
PX004	42.0	66.0	24.0 (xiii)	1,805	3,653	424	1,469	218	64	165	22	112	533	109	0.9	11.7
PX005	116.0	173.0	57.0	4,340	7,553	747	2,335	311	83	185	22	90	426	90	1.6	5.5

(i) Includes 1m cavity not sampled in addition to a cumulative 14.4 m with core returns < 90 %. If the latter is excluded average grade is 3.3 %

(ii) Poor core returns. Peak value 11.5 % TREO

(iii) Poor core returns. Includes 1 m cavity not sampled

(iv) Includes 4.5 m cavity not sampled in addition to a cumulative 13 m with core returns <90 %. If the latter is excluded average grade is 1.6 %

(v) Includes 5m cavity not sampled

(vi) Poor core returns. Borehole ends in solid core grading 3.3 % TREO

(vii) Includes a cumulative 26 m with core returns < 90 %. If this is excluded there is no major impact on the grade

(viii) Includes a cumulative 11 m with core returns < 90 %. If this is excluded there is no major impact on the grade

(ix) Includes 3 m cavity not sampled in addition to a cumulative 9 m with core returns < 90 %. If this is excluded there is no major impact on the grade

(x) Includes 3 m cavity not sampled in addition to a cumulative 8 m with core returns < 90 %

(xi) Includes 0.9m cavity not sampled in addition to a cumulative 18 m with core returns < 90 %. If this is excluded average grade is 1.4 %

(xiii) Includes 0.50 m cavity not sampled

[1] Other comprises Ho_2O_3, Er_2O_3, Tm_2O_3, Yb_2O_3 and Lu_2O_3

[2] TREO: total rare earth oxides including yttrium

[3] HREO defined here as oxides of Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb & Lu

Note: Drill intercepts do not necessarily represent true widths

Table 10-3
Summary of Significant Mineralized Intersections from Stage 2 drilling campaign (Mkango)

Carbonatite Domain

Drill Hole	From m	To m	Interval m	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %	% HREO[3] + Y_2O_3
PX007a	51.9	97.3	45.5(i)	3,615	7,916	930	3,392	475	133	312	39	194	847	163	1.8	9.4
PX008	257.0	291.0	34.0	4,108	8,137	900	3,208	457	108	223	22	93	452	77	1.8	5.5
	318.9	339.0	20.1	6,002	9,220	912	2,944	378	99	230	29	152	807	152	2.1	7.0
PX013	5.7	72.2	66.5(ii)	6,924	10,801	1,005	2,978	319	85	196	24	117	514	93	2.3	4.5
including	21.1	39.2	18.1	9,950	15,126	1,375	3,980	404	106	236	28	133	593	109	3.2	3.8
	44.6	54.8	10.2	12,157	17,333	1,491	4,132	395	102	225	26	114	466	83	3.7	2.8
PX015	20.1	97.8	77.8	2,687	5,048	522	1,793	248	71	183	25	135	652	131	1.1	10.4
including	82.0	92.0	10.0	5,957	8,954	803	2,557	309	88	211	28	136	611	123	2.0	6.1
PX017a	0.00	39.1	39.1	5,353	8,445	846	2,676	373	107	249	32	147	659	134	1.9	7.0
including	0.00	13.5	13.5	11,170	16,233	1,536	4,562	594	165	379	44	190	804	155	3.6	4.8
PX017b	10.4	25.6	15.3	4,825	8,378	903	3,310	507	129	288	29	137	701	129	1.9	7.3
	42.3	100.8	58.4	3,780	6,895	746	2,697	379	97	215	23	110	551	109	1.6	7.1
including	77.3	97.8	20.5	5,213	8,973	927	3,246	424	113	261	31	155	752	149	2.0	7.2
PX018	9.0	56.3	47.3	6,290	10,224	1,028	3,209	420	118	278	31	146	540	98	2.2	5.4
	102.8	116.4	13.6	5,608	9,136	941	3,208	487	141	318	37	160	611	111	2.1	6.6
	125.6	225.4	99.8	2,745	5,378	603	2,137	303	79	169	18	75	328	63	1.2	6.2
including	125.6	164.3	38.7	3,444	6,490	718	2,569	382	105	228	25	106	442	86	1.5	6.8
	236.0	260.2	24.2	2,928	5,421	586	2,032	291	75	163	16	71	343	68	1.2	6.1
PX020	4.2	100.0	95.8	3,918	7,432	795	2,800	409	110	248	28	127	556	107	1.7	7.1
	147.2	195.2	48.0	4,127	6,883	686	2,318	330	89	215	23	101	389	70	1.5	5.8
	215.0	347.0	132.0	2,984	5,845	656	2,327	371	103	245	28	124	575	121	1.3	8.9
PX021	5.7	106.5	100.8	3,742	7,295	804	2,894	436	120	274	35	165	792	149	1.7	9.2
	117.0	171.0	54.0	3,935	7,380	788	2,726	392	104	220	24	116	508	92	1.6	6.5
	184.9	211.5	26.5	2,861	5,817	688	2,551	385	111	254	29	144	703	124	1.4	10.0
PX022a	11.6	73.2	61.7(iii)	2,671	5,933	700	2,700	419	116	258	32	162	774	143	1.4	10.7
including	37.0	68.0	31.0(iii)	3,362	7,274	825	3,068	441	123	281	37	193	930	175	1.7	10.4
	88.0	103.7	15.7	3,576	7,919	904	3,394	514	135	296	34	161	731	142	1.8	8.4
PX022b	15.0	347.7	332.7	3,224	6,190	690	2,510	357	96	219	26	124	590	122	1.4	8.3
including	49.1	89.5	40.4	2,776	6,069	719	2,652	381	109	258	34	172	831	162	1.4	11.1
	112.5	195.0	82.5	3,901	7,133	768	2,745	385	102	223	25	119	566	122	1.6	7.2
	202.0	229.0	27.0	4,363	8,148	856	3,096	414	110	259	32	142	659	135	1.8	7.3
	235.5	347.7	112.2	3,627	6,710	741	2,665	370	100	229	27	124	572	124	1.5	7.7

Table 10-3 (continued)

Drill Hole	From m	To m	Interval m	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %	% HREO[3] + Y_2O_3
PX025	89.4	117.0	27.6	3,724	7,801	895	3,308	455	124	280	33	159	692	127	1.8	8.0
PX026	163.6	190.1	26.5	2,409	4,702	537	1,919	341	101	249	28	132	544	95	1.1	10.4
	243.0	271.9	28.9	3,071	5,753	610	2,140	309	79	171	17	74	316	59	1.3	5.7
PX028	21.35	145.0	123.7	5,191	8,309	823	2,711	365	99	234	27	116	475	86	1.8	5.6
	40.3	108.0	67.7	6,668	10,344	1,018	3,337	437	116	265	30	130	531	94	2.3	5.1
	159.0	188.0	29.0	2,621	5,290	604	2,189	363	106	256	29	138	686	137	1.2	10.9
PX029	4.6	117.3	112.7	4,568	7,728	791	2,621	357	94	212	25	124	548	114	1.7	6.5
including	5.6	30.2	24.6	7,052	10,968	1,054	3,265	398	100	226	26	128	541	114	2.4	4.8
PX032	2.54	167	164.5	2,567	5,021	576	2,024	311	85	205	26	125	630	130	1.2	10.3
including	2.5	48.6	46.1	3,548	6,809	781	2,715	398	108	267	37	188	1,015	217	1.6	11.4
PX033	4.2	101.0	96.8(iv)	4,005	7,004	731	2,539	379	103	247	30	136	596	114	1.6	7.7
including	42.0	84.3	42.3	5,920	9,323	914	2,968	411	110	258	30	132	552	102	2.1	5.7
PX034	89.0	102.2	13.2	9,108	13,724	1,256	3,861	451	120	282	38	192	945	181	3.0	5.8
PX035	0.00	96.3	96.3(v)	3,390	6,589	731	2,570	373	107	254	32	156	741	158	1.5	9.6
including	41.5	66.5	25.0	3,940	7,877	890	3,165	465	130	303	37	176	810	162	1.8	9.0
	72.3	95.0	22.7	4,204	8,368	930	3,222	428	121	285	35	160	611	130	1.8	7.3

Mixed Domain

Drill Hole	From m	To m	Interval m	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %	% HREO[3] + Y_2O_3
PX008	26.13	128.1	102.0	3,708	5,949	591	1,839	240	63	148	17	77	380	77	1.3	5.8
PX034	24.0	64.0	40.0	3,312	5,446	521	1,674	223	63	154	20	96	420	80	1.2	6.9

Fenite Domain

Drill Hole	From m	To m	Interval m	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Y_2O_3 ppm	Other[1] ppm	TREO[2] %	% HREO[3] + Y_2O_3
PX006	100.0	130.4	30.4	3,255	7,318	859	3,096	531	154	382	47	217	883	159	1.7	10.9
PX014	142.0	181.1	39.1	4,481	7,605	770	2,535	336	92	222	27	128	534	103	1.7	6.6
PX019	6.1	76.3	70.2	2,457	4,878	533	1,853	269	81	206	30	162	784	156	1.1	12.4
PX016	322.7	363.6	40.9	3,681	7,705	874	3,125	435	121	281	37	191	1,001	223	1.8	10.5
PX034	13.0	24.0	11	5,603	9,145	880	2,837	373	107	272	36	165	638	117	2.0	6.6
	155.0	199.9	44.9	4,024	6,669	697	2,354	311	85	210	26	132	580	116	1.5	7.6
	241.4	269.0	27.6	2,356	4,603	479	1,663	251	73	186	27	142	663	130	1.1	11.5

(i) Includes two cavities totaling 9.4 m not sampled; (ii) Includes 5.3 m cavity not sampled; (iii) Includes 5.7 m cavity not sampled; (iv) Includes 2.2 m cavity not sampled. (v) Includes 2.6m cavity not sampled. [1] Other comprises Ho2O3, Er2O3, Tm2O3, Yb2O3 and Lu2O3; [2] TREO: total rare earth oxides including yttrium; [3] HREO defined here as oxides of Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb & Lu. Drill intercepts do not necessarily represent true widths

11 SAMPLE PREPARATION, ANALYSES AND SECURITY

Channel sampling and core drilling programmes were carried out in accord with written Standard Operating Procedures (“SOP”) developed by MSA and reviewed during site visits. Logging and sampling procedures described for the drill core were also applied to the channel sampling program. All core cutting, sampling, bagging and dispatch procedures were undertaken at the Songwe exploration camp by Mkango personnel.

SOP for geological and geotechnical logging, core splitting and sampling were compiled by MSA to ensure that the various activities are carried out in a consistent, transparent, auditable and appropriate manner in accordance with industry standards.

11.1 Sample Preparation

11.1.1 Core Handling

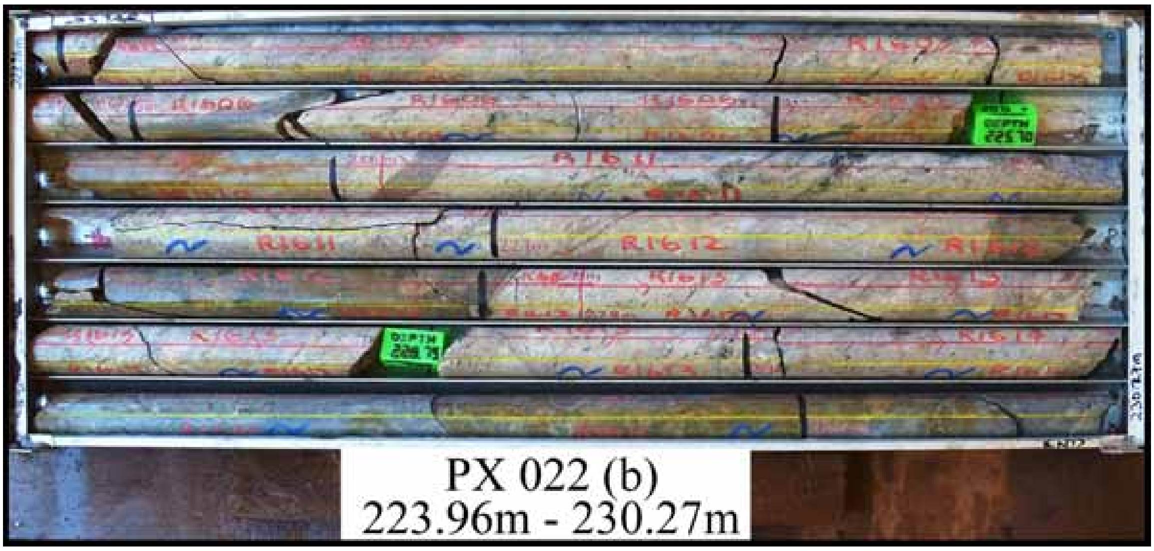
- Drillcore was placed by the drill crew in pre-labeled steel core trays together with plastic depth blocks indicating the start and end of each run. A down hole orientation line was then marked on the core immediately with a red china marker by the site geologist
- Geotechnical logging was carried out at the drill site by a geologist who measured the core from each run to determine the accuracy of the drillers’ recoveries. The core was marked incrementally every meter with a red china marker perpendicular to the core axis
- Core trays were transported twice daily under the supervision of the site geologist to the core logging and sampling facility at the exploration camp
- The core trays were laid out at the camp and the tray labels and the meter markings checked for accuracy by a geologist

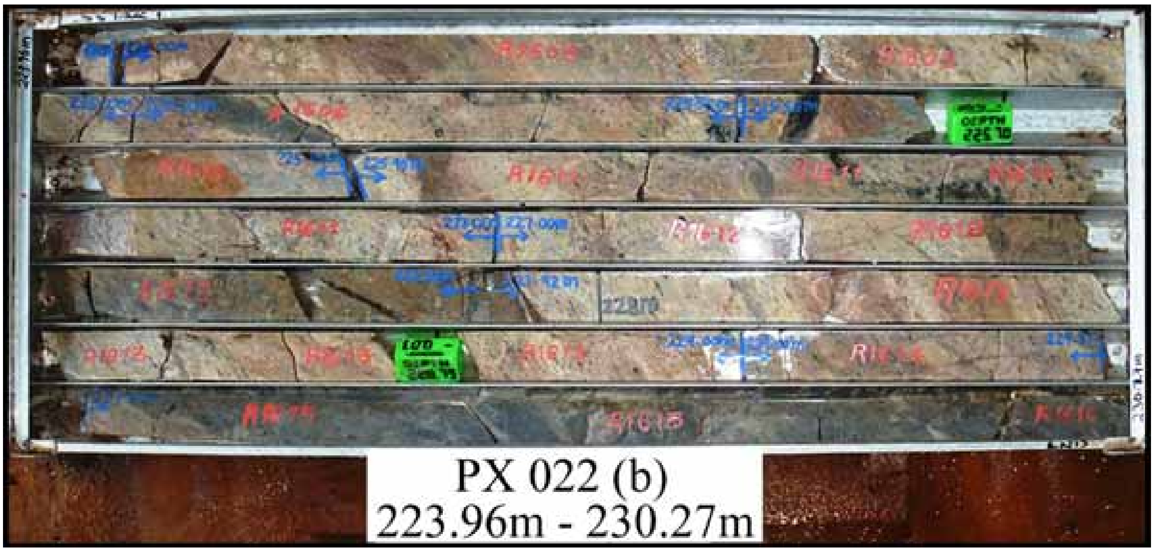
11.1.2 Core Logging

- Geological logging of the core was carried out using customized logging sheets designed by MSA. The logging sheets captured the borehole number, collar position, date drilled, ‘from-to’ data, weathering, grain size, color, dominant rock type, subordinate rock type and quantity, mineralization, reaction with acid, rock type description and lithological codes
- The core was logged on paper forms and the logs were subsequently captured in project specific MS Excel spreadsheets. All original paper drill logs are kept on file
- Semi-quantitative geochemical analyses were undertaken by the logging geologist using a handheld Thermo-Scientific Niton® XLP analyzer. This was used as a guide to areas of mineralization which are not always easily identified visually
- The magnetic susceptibility and gamma radiation (average reading over 30 seconds) for each meter of core were measured using a handheld magnetic susceptibility meter (SM30) and a RadEye Personal Radiation Detector (“PRD”)
- After core observations and measurements were completed, and prior to splitting, the core was photographed wet (Figure 11-1) using a hand-held digital camera. The

borehole number and interval of each core tray are clearly marked and each tray was photographed separately

Figure 11-1
Examples of drillcore marking before and after core splitting (Brady, 2012)





11.1.3 Core Sampling

- The entire length of each borehole was sampled for chemical analyses. Core was generally sampled in 1 meter long intervals. Where a change of lithology occurred within the sampling interval, then each lithology was sampled separately, using a minimum and maximum core length of 20 cm and 130 cm, respectively. A black line marked the start and end of each sample interval
- The sampling interval and a unique, sequential sample number (from sample ticket book) were clearly marked by the logging geologist above the red orientation line and below the core cutting line. The core cutting line (yellow china marker) was marked on the core below and parallel to the red core orientation line. Sample numbers were marked with pink permanent marker on each individual piece of core

- The sample ticket number for each interval was recorded in the sampling sheet prior to sampling. The borehole number and the sampled interval were also recorded on the stub of the sample ticket book
- The core was cut in half using a commercial core cutter with a 2.2 mm wide diamond cutting blade. If any part of the core was friable or difficult to handle it was taped with masking tape prior to cutting. Once sawn, both halves of the core were returned to the core tray. After each sample, the saw blade was cleaned with water. The upper half of the core was used for sampling and the lower half of the core retained in the core tray (Figure 11-1) for future reference or additional test work
- Each sample was double bagged with two sample number tags in extra strength plastic sample bags. The sample and the number tag were first placed in a pre-labeled sample bag and securely sealed a with cable tie. This bag was then placed in a second plastic bag along with the corresponding sample number tag and closed with a stapler
- Core that had been logged, cut and sampled was stored in locked and secure, company-owned, storage containers at the Songwe exploration camp (Figure 11-2)

Figure 11-2
Core logging and core tray storage facilities (Brady and Reichhardt, 2012)

11.1.4 Density measurements

Rock density measurements using the Archimedes principle (dry & wet mass and water displacement) were taken for every sample of core, after splitting and sampling. Each sample is approximately 15 to 20 cm long. The density device comprised a 3 kg electronic scale, below which a water container was placed. Attached to the balance was a core sample holder used to immerse core in water in the container. The density method is as follows:

- The balance is always reset to 0.00 g before each reading
- Place a dry length of core in the core holder and record the mass of the core in air
- Fill the container with water to submerge the sample (If the core was weathered it was wrapped in cling wrap). Mark and maintain the same level of water in the container for each reading
- Determine the mass of the sample under water
- The formula used for calculating the density (specific gravity = SG) is simply:

$$SG = \frac{\text{Mass in Air}}{\text{Mass in Air} - \text{Mass in Water}} = \frac{W}{V}$$

All information was recorded on density measurement sheets for the core samples. No measurements were carried out for the channel samples.

The sampling database was maintained at the camp site and regularly transmitted and backed up at Mkango's office in Zomba and at the head office in the UK.

11.2 Sample Analyses

11.2.1 Primary Laboratory

Intertek-Genalysis Laboratory ("Genalysis") Services Pty Ltd. in Johannesburg, South Africa, and Perth, Australia, was the primary laboratory for the sample preparation and analysis of drill core and channel samples. Genalysis is an independent laboratory that performs geochemical analyses on a commercial basis. Genalysis has no relationship with Mkango other than the provision of analytical services for fee.

Samples were prepared at Genalysis in Johannesburg prior to chemical analyses in Perth, using the following procedures:

- Samples were weighed, checked and job registered on the laboratory information management system (LIMS). Any discrepancies between the samples received and the sample submission sheets were conveyed to Mkango and resolved immediately
- After weighing of the samples, if required, the material was dried in a drying oven at 110°C for 8 hours
- The samples were then crushed in a jaw crusher. If a sample was >3 kg it was split through a riffle splitter to provide a 1.5 kg sub-sample. If the material was <3 kg then the entire sample was used

- The samples were milled and pulverized in a swing mill to 85 % passing 75 micron
- A portion of 150 g was split from the pulp material and submitted to Perth for assays

The samples were analysed in Perth using digestion method FP6 and Inductively Coupled Plasma Mass Spectrometry ("ICP-MS") and Inductively Coupled Plasma Optical Emission Spectrometry ("ICP-OES"). The FP6 fusion digest ensures complete dissolution of the sample including the refractory mineral component. Each sample is weighed at 0.25 g, mixed with an alkaline flux (Na_2O_2) and placed in a nickel crucible. This is fused in a muffle with precautions to retain sulphur and the fusion product is dissolved in hydrogen chloride ("HCl"). Once digestion is accomplished the sample is diluted appropriately and analysed with an ICP-MS, ideally suited to the analysis of trace elements in the ppm or ppb range.

For major element analysis, once digestion is accomplished, the sample is diluted appropriately and read on the ICP-OES. Calibration is effected using standard solutions of known concentration. Corrections are made, where applicable, for emission line overlaps and scattered light and the overall dilution and catch weights used in the digestion process. Internal standards are used to correct for drift, viscosity effects and plasma fluctuations.

Genalysis is accredited by The National Association of Testing Authorities Australia ("NATA") to operate in accordance with ISO/IEC 17025, which includes the management requirements of ISO 9001: 2000. The Perth facility is accredited in the field of Chemical Testing for the tests shown in the Scope of Accreditation issued by NATA (Date of Accreditation: 20 September 1991).

The analytical results were e-mailed to Mkango in MS Excel format followed by the issuing of signed assay certificates in pdf format.

11.2.2 Umpire Laboratory

Activation Laboratories ("Actlabs") in Ancaster, Ontario, Canada was selected as the umpire laboratory. Actlabs is an independent laboratory that performs geochemical analyses on a commercial basis. Actlabs has no relationship with Mkango other than the provision of analytical services for fee.

Pulps split from the original samples were provided to Actlabs directly from Genalysis. Actlabs' digestion involved a lithium metaborate / tetraborate fusion with subsequent analysis by ICP and ICP-MS (Code 8-REE Assay Package Major Elements Fusion ICP (WRA) / Trace Elements Fusion ICP-MS (WRA4B2/OE)). Mass balance was required as an additional quality control technique to ensure elemental totals of the oxides between 98% and 101%. If samples contained > 0.3% Nb_2O_5 then the ICP-MS technique was replaced by fusion XRF for Nb_2O_5 because ICP-MS results tend to be very low as a result of the Nb falling out of solution.

Actlabs quality system is accredited to international quality standards through the International Organization for Standardization / International Electrotechnical Commission (ISO/IEC) 17025, which includes ISO 9001 and ISO 9002 specifications, with CAN-P-1758 (Forensics), CAN-P-1579 (Mineral Analysis) and CAN-P-1585 (Environmental) for specific registered tests by the Standards Council of Canada

(“SCC”). Actlabs is also accredited by the National Environmental Laboratory Accreditation Conference (“NELAC”) program and Health Canada.

The analytical results were e-mailed to Mkango in MS Excel format followed by the issuing of signed assay certificates in pdf format.

11.3 Sample Security and Dispatch

Strict security protocols were employed for the handling of samples. All samples were prepared and transported in such a manner that a secure and auditable chain-of-custody from the field to the laboratory was ensured according to the following procedures:

- Once an entire hole was sampled, the bagged and securely closed samples were placed in woven PVC bags, approximately 10 samples per bag. The drill-hole number and corresponding sample numbers were recorded on the exterior of each bag. The bags were then stored inside locked and secured, company-owned, storage containers at the exploration camp until dispatchment
- All samples submitted for analysis were accompanied by standard sample submission documents carrying sample details and analytical instructions
- The woven bags were transported by road using a contract commercial carrier to the company office in Zomba. Samples were physically accompanied from the exploration camp to Zomba by a senior geologist from Mkango’s exploration team
- Upon receipt at Mkango’s office in Zomba, samples were inspected, weighed and sealed by a senior geologist of the Malawian Geological Survey Department. A certificate of inspection which was signed by the Director of the Malawian Geological Survey or his representative was prepared and issued. The certificate of inspection contains the name of rocks, EPL certificate number, total number and weight of samples inspected, estimated sample value, port of exit and name and address of the consignee
- Samples were then delivered by a senior Mkango geologist to SDV Malawi Ltd. (“SDV”) in Blantyre for shipment by commercial carrier South African Airlines (“SAA”) to Genalysis in Johannesburg, South Africa. Samples were weighed by SDV and compared with the weights supplied by the company. In most cases, sample transport was timed so that samples proceeded directly from camp to Zomba and then to the carrier. In rare instances, where SDV was unable to receive the samples the same day, the bags were stored in a secure, locked room at Mkango’s offices in Zomba until they could be delivered to SDV
- SDV was responsible for the shipment and tracking of the samples from Malawi to Genalysis in Johannesburg, South Africa. All shipping paperwork was sent to Mkango personnel and once shipment was confirmed by SDV, notification along with sample submission sheets were emailed to Genalysis
- When the sample batches were received by Genalysis, the sample numbers were checked, recorded and a job number assigned on the laboratory information

management system (LIMS). Sample receipt verification was then e-mailed to Mkango staff, including the principal geologist. Following sample preparation, the samples were couriered by Genalysis to their analytical facilities in Perth, Australia

11.4 Quality Assurance and Quality Control

Appropriate quality assurance and quality control (“QA/QC”) monitoring is a critical aspect of the sampling and assaying process in any exploration programme. Monitoring the quality of laboratory analyses is fundamental to ensuring the highest degree of confidence in the analytical data and providing the necessary confidence to make informed decisions when interpreting all the available information. Quality assurance (“QA”) may be defined as information collected to demonstrate that the data used further in the project are valid. Quality control (“QC”) comprises procedures designed to maintain a desired level of quality in the assay database. Effectively applied, QC leads to identification and corrections of errors or changes in procedures that improve overall data quality. Appropriate documentation of QC measures and regular scrutiny of quality control data are important as a safeguard for project data and form the basis for the quality assurance program implemented during exploration.

In order to ensure quality standards are met and maintained, planning and implementation of a range of external quality control measures is required. Such measures are essential for minimizing uncertainty and improving the integrity of the assay database and are aimed to provide:

- An integrity check on the reliability of the data
- Quantification of accuracy and precision
- Confidence in the sample and assay database
- The necessary documentation to support database validation

Mkango adopted an industry standard QA/QC program and inserted Certified Reference Material (“CRM”) and blanks each at a frequency of 1 in 20 (5%) into the batches prior to submission to Genalysis. These control samples were inserted as part of a continuous sample number sequence and the QA/QC samples were not obviously different from routine samples after the pulverization process. In order to create the required 5% duplicate samples, Genalysis were requested in the sample submission sheet to split the pulp of predetermined samples (1 in 20) and insert the material into empty and pre-numbered bags, supplied by Mkango together with the other samples. Genalysis in Perth were unaware which samples were QA/QC samples and what their composition was. This allowed for monitoring of the sample preparation procedure as well as monitoring the accuracy and precision of analyses.

An additional 5% of the total samples were couriered by Genalysis to the umpire laboratory Actlabs in Canada. Hence the overall number of control samples constituted approximately 20% of the samples analyzed which is in line with best practice procedures to ensure integrity of data and is independent from the internal QA/QC methods applied by the laboratory.

Gaps in the sample sequence were left for standards, blanks and duplicates in the course of the sampling and bagging process conducted at the Songwe camp. The standards and blanks were only packed after the main sampling process was completed to minimize the possibility that sample numbers are inadvertently swapped between routine and control samples.

11.4.1 Blanks

To monitor inadvertent contamination of samples, a blank sample containing negligible REE concentrations was included in every batch of 20 samples. The blank sample material used during the Stage 1 drill programme was REE-barren Magaliesberg quartzite chips. During the Stage 2 campaign AMIS0305 from African Mineral Standards (“AMIS”) and Magaliesberg quartzite were used. The blanks were inserted into the sample stream with a normal, sequential sample number.

Slightly elevated REE concentrations in 4 blank samples from 4 separate batches were queried with Genalysis which re-analysed the samples with acceptable results. No further action was taken or required and the results of the blank analyses are interpreted to indicate that there was no contamination or systematic analytical issues during the period of sample submission and analyses.

11.4.2 Certified Reference Material (“CRM”)

For independent assessment of the accuracy of laboratory analyses, certified reference materials were inserted using a frequency of 5 % (1 in 20). Each CRM was assigned a sample number within the normal sample sequence. CRMs comprised AMIS0185 and SARM 40 during the Stage 1 programme and AMIS0185 and Geostats GRE-04 during the Stage 2 campaign. The performance of the CRMs during the two Stages is acceptable and occasional values outside the recommended range have no material effect on the overall data quality. Rare earth elements Tb, Dy, Gd and Y show a systematic under-reporting for AMIS185 which is not considered critical due to their very low concentration levels in this light rare earth standard. Representative results from the 2 CRMs are presented in Appendix 3.

11.4.3 Duplicates

Duplicate samples were not used during the Stage 1 drilling programme. However, they were inserted during the channel sampling and Stage 2 drilling programmes at a rate of one in every 20 samples (5 % frequency) to assess the precision of the analyses. Duplicates were placed as an empty numbered bag into the sample stream. Samples were split at the laboratory following pulverization and the pulp of the sub-sample was inserted in the empty sample bag. The instructions on the sample submission sheet to Genalysis specified which samples were to be split for duplicates.

The duplicates indicate a very high level of precision except for 3 duplicate pairs where the problem was traced to a sample number issue at the laboratory. Genalysis re-analysed these samples with acceptable results and no further action was taken or deemed necessary. A summary of duplicate results and representative plots are shown in Appendix 3.

11.4.4 Umpire Laboratory Samples

In order to check the quality of analyses from the primary laboratory, a duplicate of the pulps was sent by Genalysis to Actlabs. Umpire samples were sent at a frequency of approximately 5% (1 in 20). The results of these analyses were plotted graphically against the original analysis. In 2 cases the umpire results differed substantially from the primary data and this problem was subsequently rectified through re-analysis and attributed to a sample mix-up. The vast majority of samples show a discrepancy between the two laboratories of less than 10% and less than 1% of the 405 sample pairs exceeded 20%. Representative plots of the umpire results are presented in Appendix 3.

11.5 Adequacy of Sample Preparation, Security and Analytical Procedures

All aspects of core handling, marking, logging, cutting, bagging, labeling and sample submission to Genalysis preparation facilities at Johannesburg are covered by well-designed protocols to ensure that all routine activities are conducted with maximum consistency and followed industry standards.

Mkango followed an auditable chain-of-custody which ensured greatest security and integrity of the results. MSA believes that there was little or no opportunity for an outside agent to temper with the sample material.

MSA is of the opinion that the sampling and analytical procedures and number of QA/QC samples inserted into the sample stream are appropriate for the current level of the project, the type of the deposit and for the analytical techniques used. The CRMs and blanks show acceptable performance for the elements analyzed over the period of the sampling campaign. The duplicate samples reported acceptable precision for all relevant concentration levels.

The analytical results from the primary and the umpire laboratories show a very good correlation and therefore confirm the element concentrations determined by the primary laboratory. The observed negative bias at generally low concentration levels of certain elements of the CRMs is within acceptable analytical limits and has no effect on the overall adequacy of the data.

The quality control procedures have been effective in demonstrating the quality of the analytical results and any issues that were identified were quickly dealt with and resolved.

Based on these results, it is concluded that the sampling and assay data from the drilling and channel sampling programmes are acceptable for use in a mineral resource estimate.

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12 DATA VERIFICATION

Verification activities were conducted by the Qualified Persons during site visits to the Songwe Project and at the MSA office and included:

- Inspection of the drilling and trenching programs
- Review of core handling and core sampling procedures
- Review of borehole data collection protocols and QA/QC systems
- Checks of the database against the original borehole logs
- Checks of database against original Assay Certificates
- Examination of database used for mineral resource estimation

Data from duplicates, internal standards, CRM's and blanks were examined on a batch by batch basis to check for analytical data confidence. Data was examined numerically and graphically to determine the repeatability of the duplicate analyses, the precision of the standard analyses with respect to the accepted values, and the levels of REE present in the blanks. MSA undertook audits on the database and all identified errors were addressed by Mkango's database manager.

The assay data display industry standard levels of precision and accuracy through the adoption of a stringent QA/QC program. The database has therefore been declared in the opinion of MSA and the authors as an accurate representation of the original data collected and to meet the requirements for use in a mineral resource estimation.

Overall MSA and the authors are of the opinion that all exploration activities have been conducted and recorded in an appropriate manner and that all analytical issues have been identified and suitable remedial action taken. Industry standard practices have been followed and the quality of the project database meets or exceeds NI 43-101 standards and CIM best practice guidelines.

13 MINERAL PROCESSING AND METALLURGICAL TESTING

Work related to mineral processing and metallurgical testing has begun on rare earth bearing samples from Songwe Hill but has not been completed to date. Indicative results are expected in 2013.

Detailed mineralogical studies have been carried out that characterize disposition of REE in the deposit and provide a good basis for the more detailed studies presently underway.

13.1 REE Mineralogy of the Songwe Hill deposit

The Songwe Hill REE mineralization is hosted by carbonatite and has a mineralogy that is characteristic of carbonatite-hosted deposits. The first detailed assessment of the mineralogy of the Songwe Hill carbonatites was by JICA and MMAJ between 1986 and 1989. Using thin and polished section, XRF and EMPA analysis, they were able to identify bastnäsite, synchysite, parisite, strontianite, monazite, pyrochlore and apatite.

In 2010-11, Mkango undertook a mineralogical program at SGS Lakefield utilizing X-ray diffraction (“XRD”) and QEMSCAN supplemented by electron microprobe analysis. Six samples of carbonatite were analysed. The major mineral component in all samples was calcite. Most samples contained minor to trace amounts of iron and manganese oxides and carbonates, apatite, strontianite and barite. REE-bearing phases were dominantly synchysite and apatite with minor florencite and parisite and trace amounts of monazite (Scott and Wells, 2010).

Following this, a comprehensive mineralogical study was undertaken by scanning electron microscope (“SEM”), electron microprobe, and laser ablation - inductively coupled plasma - mass spectrometry (“LA-ICP-MS”) in an attempt to derive a detailed understanding of the REE-hosting minerals, their disposition, and contribution to the total REE budget of the deposit. The study confirmed that the REE mineral assemblage at Songwe Hill is dominated by synchysite (with very minor parisite), apatite, and locally florencite. Details of the analytical results are found in Item 7 of this report.

The synchysite crystals are geochemically homogeneous, occurring as individual crystal laths and crystal aggregates. The laths range in long dimension from 10 µm to 40 µm but aggregates can attain diameters of up to 400 µm (micro millimeter). The synchysite is typically associated with strontianite and baryte as well as calcite, fluorite, potassium feldspar, pyrochlore and titanite.

Apatite is typically recrystallized and occurs as groundmass crystals and in veins. Micro-analysis of the apatite shows that it is geochemically anomalous in that it is enriched in the HREO and Y relative to apatites in carbonatites elsewhere.

Florencite is much less abundant than either synchysite or apatite, and is found mainly in the groundmass of the carbonatite breccias in the mixed domain, and forms narrow acicular crystals less than 20 µm wide associated with Fe- and Mn-oxides.

13.2 Planned Mineral Processing and Metallurgical Testwork

Scoping metallurgical test work has been initiated by Mintek ("Mintek") in South Africa. Mintek is South Africa's national mineral research organization and it is one of the world's leading technology facilities specializing in mineral processing, extractive metallurgy and related areas. The mineralogical studies completed by Mkango to date form the basis for defining the scope of work at Mintek, the objective of which is to concentrate and maximize recovery from the principal rare earth element bearing minerals, synchysite and apatite. Synchysite is a fluorocarbonate mineral in the same mineral group as bastnäsite the principal ore mineral in several REE deposits. Apatite is a phosphate mineral, commonly processed to produce fertilizer.

In order to provide representative samples from the Songwe Hill deposit, five different sets of samples were taken from drill holes PX001, PX003, PX005, PX009 and PX012. These were delivered to Mintek, with the corresponding drill core material weighing 117 kg, 120 kg, 102 kg, 125 kg and 171 kg, respectively. The samples consist of various carbonatite and breccia lithologies and were derived from quarter sections of diamond drill core from intersections considered to be representative of the deposit. Intersections sampled for the purposes of the metallurgical test work are as follows:

Table 13-1
Borehole intersection for metallurgical testwork (Mkango)

Borehole	Sampled Interval (m)	Sampled Length (m)
PX009	0.0 – 116.2	116.2
PX012	2.1 – 91.0	88.9
PX001	218.0 – 300.0	82.0
PX003	2.2 – 59.0	56.8
PX005	2.0 – 64.0	62.0
Total meters		**405.9**

The current scope of work at Mintek mainly comprises flotation tests using reagent regimes and conditions targeting both synchysite and apatite flotation, including similar regimes to those used previously at the Mountain Pass mine and variations that take into consideration the particular mineralogical properties of the Songwe Hill deposit. This work is being conducted on a composite sample comprising equal proportions of material from PX012, PX001, PX003 and PX005 which predominantly comprise carbonatite lithologies. Additionally, leach test work is planned on concentrates produced from the ongoing flotation test work.

It is anticipated that results from the mineral processing and metallurgical test program will be available in 2013.

14 MINERAL RESOURCE ESTIMATES

14.1 Previous Mineral Resource Estimates

JICA and MMAJ conducted a core drilling programme on Songwe Hill in the late 1980s but did not produce a code-compliant mineral resource.

In 2010 Mkango commenced an extensive exploration programme over Songwe Hill and the current exercise represents the maiden mineral resource estimate for the project, covering an up to 200 m wide north-east trending section of Songwe Hill.

The location of the Phalombe license, including Songwe Hill is shown in Figure 5-3. A geological map of the Songwe Hill area is shown in Figure 7-2.

14.2 Current Mineral Resource Estimate

The current mineral resource estimation exercise is based on a Microsoft Access database compiled by MSA containing borehole and surface channel sampling data (Figure 14-1) supplied by Mkango, from two exploration programmes covering Songwe Hill. Drilling and channel sampling were conducted between April 2011 and May 2012. MSA verified all data received from Mkango upon receipt and requested Mkango to rectify errors where these were identified.

This report includes total rare earth oxides ("TREO"), heavy rare earth oxides ("HREO") and light rare earth oxides ("LREO") mineral resource estimates for three domains defined as each of the dominant lithological units identified at Songwe Hill. These are Carbonatite-, Fenite- and a combination roughly of equal proportions of these two, termed the Mixed Domain.

14.3 Known issues that materially affect Mineral Resources

All geological data were acquired in terms of the Standard Operating Procedures ("SOP") as supplied by MSA at the project outset. These SOP were designed to address all aspects of the CIM Exploration Best Practices Guidelines. MSA undertook audits and reviews of the exploration data as and when supplied by Mkango. The project Access database was evaluated for use in mineral resource estimation by the application of an internal checklist for the assessment of data quality and integrity.

MSA exported the Access database into Microsoft Excel spread sheets and applied an internal checklist for the assessment of data quality and integrity. Final data verification was undertaken upon import into Datamine software, this being the selected 3-D modeling software package. Any errors and, or omissions identified at each interrogation stage were communicated to Mkango who then rectified the data accordingly.

No material issues were identified with respect to the finalized Mkango exploration database which would negatively impact on the declaration of code-compliant mineral resources. No material issues were identified by which the mineral resource estimates could be materially affected by environmental, permitting, legal, title, taxation, socio-economic, marketing, political, or other factors.

14.4 Assumptions, Estimation Methods and Parameters

The methodology, assumptions and process for preparation of the mineral resource estimations are discussed under the following sections:

- Input database validation and preparation
- Geological modeling
- Block model creation
- Statistical analysis of the input data
- Variogram modeling and grade continuity
- Estimation parameters
- Grade estimation
- Mineral resource classification parameters

14.4.1 Input Database Validation and Preparation

The input database consisted of borehole sample data including collar, lithology, sampling, assay, density, core recovery, magnetic susceptibility and structural data for boreholes, and lithology and assay data from surface channel samples. These data were derived from the combined 2010-2012 exploration programmes.

Lithology codes were retained as received for the Mkango boreholes. The input data was subjected to checks and validations at MSA and a database error listing was submitted to Mkango for rectification of the identified errors. Original data collection for the Mkango drilling was carried out on site at the time of the drilling by Mkango's appointed geological contractors and was periodically observed by MSA's representatives and associates; Messrs Mike Venter and Pete Siegfried respectively. Additional site inspections and verifications were undertaken by consultant Dr. Scott Swinden and Dr. Frieder Reichhardt and Mike Hall, both of MSA.

Data acquisition during the drilling was undertaken according to the established SOP. The total database consisted of 6,852.28 m of drilling in 38 inclined and vertical diamond boreholes as well as 424.08 m of channel sampling and logging in five channel sampling lines. A sixth channel line was chip sampled across 50 m resulting in 44 composited samples.

The breakdown of the exploration data available for mineral resource estimation is shown in Table 14-1.

Table 14-1
Drilling and Channel input data Songwe Hill: Mineral Resource Estimation

Sample Type	Number[1]	Drill and Channel Meters	Sampled meters
Boreholes	38	6,852.28	6,696.91
Surface Channels	5	424.08	424.08
Surface Chip sampling2	1	50.00	50.00
Total	45	7,326.36	7,170.99

[1] includes two boreholes at each of sites 7, 17 and 22

[2] comprises 50 m of sampled outcrop comprising chips from only 44 samples

14.4.1.1 Collar and Downhole Survey

All borehole collars and all channel sample end points were surveyed using a Differential GPS system by a qualified and certificated Land Surveyor.

Drilling fence lines were aligned in an east to west direction, in order to intersect the depth extension to the mapped carbonatite outcrops. Fence lines were spaced at 25 m apart north to south. The down-dip borehole spacing varies between 50 m and 100 m. All fence lines contain more than one borehole.

All boreholes were surveyed down-the-hole with the exception of eight boreholes (PX-003, 007b 010, 011, 012, 023, 024 and 027). The collared dip and direction readings for these eight were however accepted as the final borehole dip and direction considering both their relatively shallow depths and the minor deviations exhibited by those boreholes that had been surveyed. The coordinates of all channels were surveyed at the start, end and at each of the sample centre points along their length using a Differential GPS system.

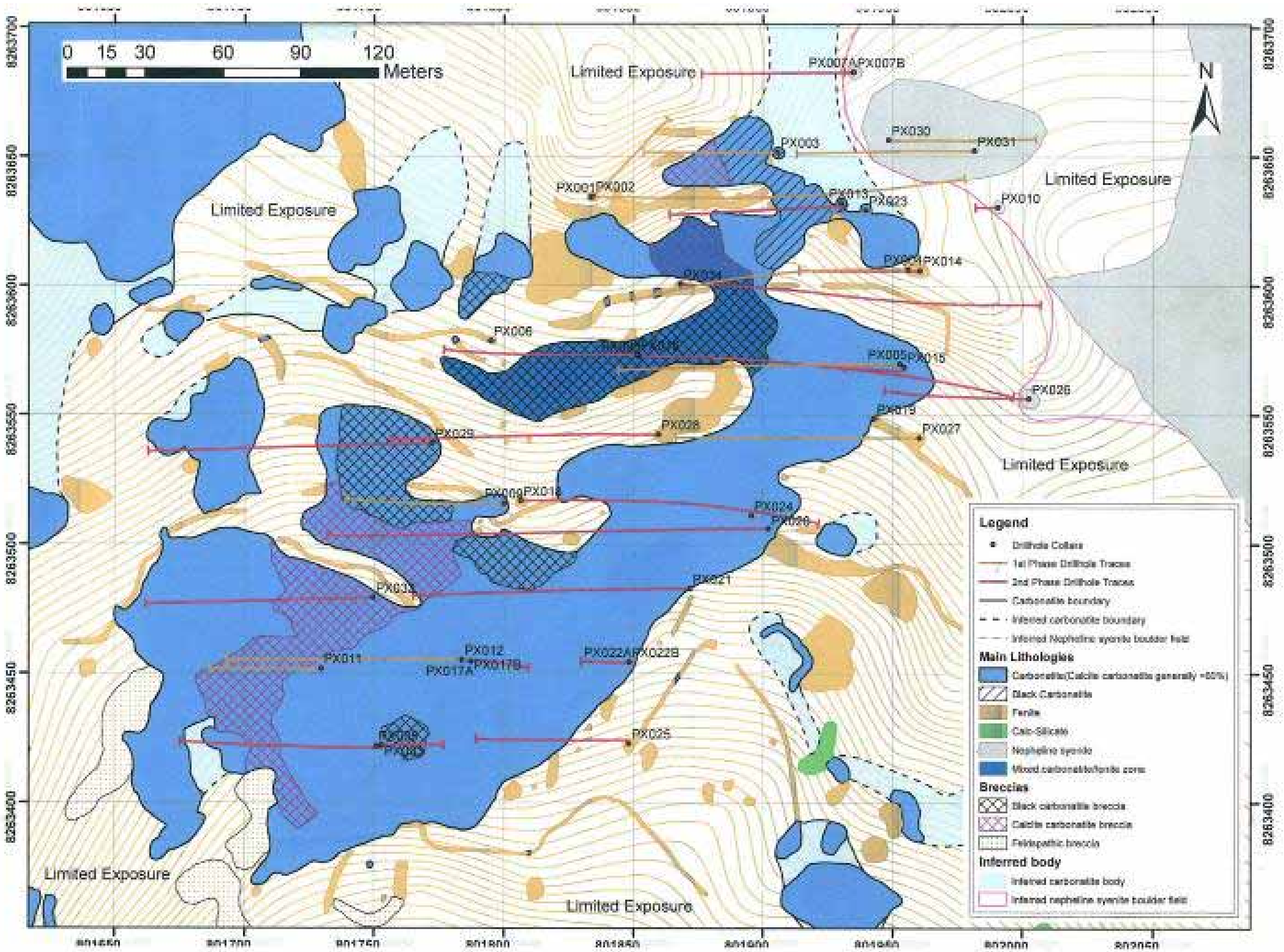
Borehole data is spread evenly across the 400 m strike of the identified Songwe Hill carbonatite mineralisation for which mineral resource estimates were undertaken (Figure 14-1).

A total of 7,230 borehole samples and 454 channel samples are contained in the current database, amounting to 7,164.99 m of sample length. The nominal sample interval was 1 m. Average borehole sample length was 0.93 m and average channel sample length was 1.04 m.

A detailed topographic surface was supplied by Mkango for the project area. The supplied borehole collar elevations were matched to this surface.

Figure 14-1

Drilling plan for Songwe Hill (Hall, 2012)



14.4.1.2 Density

Density measurements were undertaken at site using the Archimedes principle of weight in water versus weight in air. Density readings for 6,420 core samples, representing 5,690 m or approximately 80% of the assayed sample length, were taken. Average core length for density determinations was 17 cm, with a maximum of 21 cm and a minimum of 8 cm, covering all lithologies intersected at Songwe. No density data were determined from the channel samples.

14.4.1.3 Core recoveries

Core recoveries for the Mkango diamond drilling were included in the supplied database. The length-weighted average core recovery is 88.2% in the data set. There is a broad depth-core recovery relationship as shown in Table 14-2, showing increasing core recovery with increasing depth, this being assigned to the decreasing degree of weathering with increasing depth. The average depth of weathering is 20 m below surface at Songwe Hill.

Table 14-2
Core recovery in percent per depth interval below surface (Hall, 2012)

Depth Interval (m)	0-10	0-20	0-30	0-40	0-50	Overall
Songwe Hill	57.5	66.5	72.5	77.4	79.3	88.2%

The core recovery data shown in Table 14-2 reflect the effects of a lower recovery rate during Phase 1 drilling. This was subsequently improved upon as documented in boreholes drilled during Phase 2 at the same collars as phase 1 drilling.

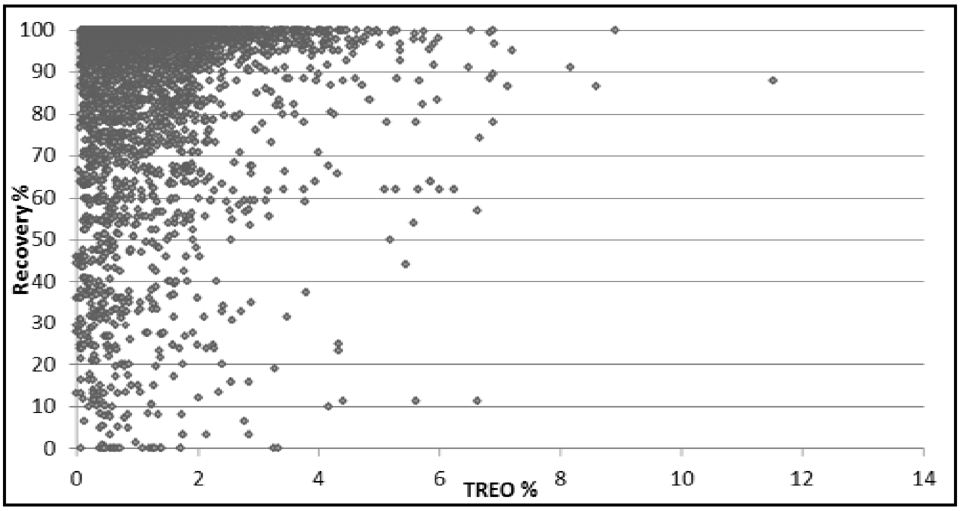
Voids or cavities have been intersected in several boreholes at Songwe Hill. These voids may attain lengths of up to 15 m (in borehole PX007a), as intersected in the drilling database. They occur at varying depths (9.15 m in borehole PX015 to 181.93 m in borehole PX008), mostly within carbonatite or carbonatite-dominant intervals. There is a total of 113.13 m in intervals reported as voids in the drilling database, representing 1.7% of the drilled meters. This figure may be over-stated as it is partially a result of the sub-standard drilling practices in the first phase. An example of a void is shown in Figure 14-2.

Figure 14-3, which represents the complete drillhole database core recovery data, shows that there is no discernible relationship between grade and core recovery. This illustrates that there is no assay bias introduced as a result of core loss or enrichment in the REO concentration associated with cavities, supporting the incorporation of all borehole assay data in the mineral resource estimate. In the disseminated style of mineralisation, such as that found at Songwe Hill it is not expected that any relationship should exist between core recovery and grade.

It is recommended that studies of core recovery versus grade, lithology and depth be continued in future drilling programs. Once suitable information is available it is possible that a slight discount on the tonnages in some lithologies in certain depth intervals may be considered as a result of voids.

Figure 14-2
Void or cavity in carbonatite: void is 20 cm in diameter rimmed with calcite (Hall, 2012)

Figure 14-3
Scattergram of core recoveries versus grade for Songwe Hill (Hall, 2012)



14.4.1.4 Quality Control Quality Assurance

The assay data quality control and quality assurance is described in Item 11. MSA believes the levels of assay precision and assay accuracy are sufficient for use in mineral resource estimations at the current level of confidence.

14.4.1.5 Checklist for mineral resource estimation

Table 14-3 lists the parameters assessed for reporting the Songwe Hill Mineral Resource. These parameters are based on the Canadian Institute for Mining, Metallurgy and Petroleum (CIM) Guidelines for Disclosure of Mineral Resource estimates and are made in accordance with industry standard definitions approved by the CIM, which have been incorporated by reference into NI 43-101.

Table 14-3
Checklist for Mineral Resource Reporting (CIM 2010), (Hall, 2012)

Drilling techniques	Inclined and vertical diamond drilling of both NQ and HQ diameter. Inclined boreholes were drilled at angles between -60 and -80 degrees to the west and east. Channel samples were cut from outcrops using a diamond saw. Two parallel grooves 5cm apart were cut, from which samples were removed using a chisel.
Logging	All boreholes and channels were geologically logged by qualified geologists. The logging was of an appropriate standard for mineral resource estimation
Drill sample recovery	Core recoveries are documented for the Mkango diamond boreholes and are an average of approximately 88%. Channel sample recoveries were not documented.
Sampling methods	Core samples were collected using a nominal sample length of 1 m while making the appropriate adjustments to honour geological variability. Channels were also sampled at 1 m intervals. MSA observed that the routine sampling methods were of a high standard and suitable for mineral resource estimation purposes.
Quality of assay data and laboratory tests	The assay database displays industry standard levels of precision and accuracy and meets the requirements for use in mineral resource estimation.
Verification of sampling and assaying	Internal data verification is carried out as a standard. This incorporated approximately 5% blanks, 5% certified reference materials and 5% duplicates. An external verification of approximately 5% of the assay data was carried out using an umpire laboratory. Assay QAQC was found to be acceptable.
Location of data points	All Mkango borehole collars were surveyed by a qualified surveyor using a differential GPS system. All except eight boreholes were downhole surveyed. Those not downhole surveyed were, with one exception less than 104 m in length and were assumed to have been drilled as collared. One borehole was 182 m in length and was also accepted to have drilled as collared. Channel samples were also surveyed using a differential GPS system, at each sample point and at the channel start and end points.
Tonnage factors (in-situ bulk densities)	Density determinations were made for approximately 80% of the drilling database' samples using the Archimedes method of weight in air versus weight in water.
Data density and distribution	Diamond drilling was carried out along fence lines at 25 m apart north-south and at between 50 m and 100 m east-west along these fences.
Database integrity	Data were supplied to MSA at regular intervals in Excel spreadsheets and were captured into a dedicated Microsoft Access database. These were subsequently exported as separate Microsoft Excel spreadsheets for import into mineral resource modelling software. MSA undertook audits on the database and Mkango addressed all identified inconsistencies and errors. The original Access database and the exported Excel spreadsheets have been declared as an accurate representation of the original data collected.

Checklist for Mineral Resource Reporting (CIM 2010)	
Dimensions	The Mineral Resource at Songwe Hill has been drilled over a length of 250 m in a north easterly direction and across a 100 m width in a westerly direction. The mineral resource occurs from surface and has been constrained by the depths of the boreholes. However, in some cases the resource has been extended an additional 25 m to 30 m below the borehole depth after consideration was given to the depths of adjacent boreholes.
Geological interpretation	The current geological model comprises a vertically dipping intrusive plug. The confidence in this interpretation is considered appropriate for Indicated mineral resource classification where supported by the data.
Domains	The deposit has been sub-divided into domains comprising the two dominant lithologies and a domain comprising a mixture of the two lithologies.
Compositing	Borehole core sample data were composited into 1 m lengths within the modelled domains.
Statistics and variography	Isotropic variograms were used to model the spatial continuity separately for each domain.
Top or bottom cuts for grades	Statistical analysis of the composited data demonstrated that no capping of the data was necessary, there being no isolated outlier values.
Data clustering	Boreholes were drilled on an approximately regular grid across the project area. These holes have been drilled to varying depths in some areas, which has resulted in mineral resource classifications of lower confidence in those areas informed by fewer drillhole data at varying depths.
Block size	A three dimensional block model composed of 50 m E by 50 m N by 5 m RL cells was constructed for each domain
Grade estimation	Metal grades were estimated using ordinary kriging. Grades were interpolated within a search ellipse representing the ranges of the isotropic variograms for each domain.
Mineral Resource Classification	The classification incorporated the confidence in the borehole data, the current geological interpretation, data distribution and variogram ranges. Blocks informed within the first search radius were classified as Indicated. The remainder were classified as Inferred Mineral Resources.
Cut-off grades	A series of cut-off grades have been selected for the purposes of mineral resource reporting on the project. These were selected based on bench-marking of similar deposits. A base cut-off grade of 1% TREO has been selected for the reported Mineral Resource.
Mining Cuts	No mining cuts have been applied
Metallurgical factors or assumptions	No metallurgical test work has been completed at the time of this report. MSA understands that this work is in progress.
Audits and reviews	The following audit and review work was completed by MSA: • a comparison of the database against the original borehole logs and interpreted geological sections • a review of borehole data collection protocols and QA/QC systems • a site based review of the borehole data. • QA/QC audits by Dr S. Swinden, independent consultant to Mkango and by Dr Frieder Reichhardt of MSA

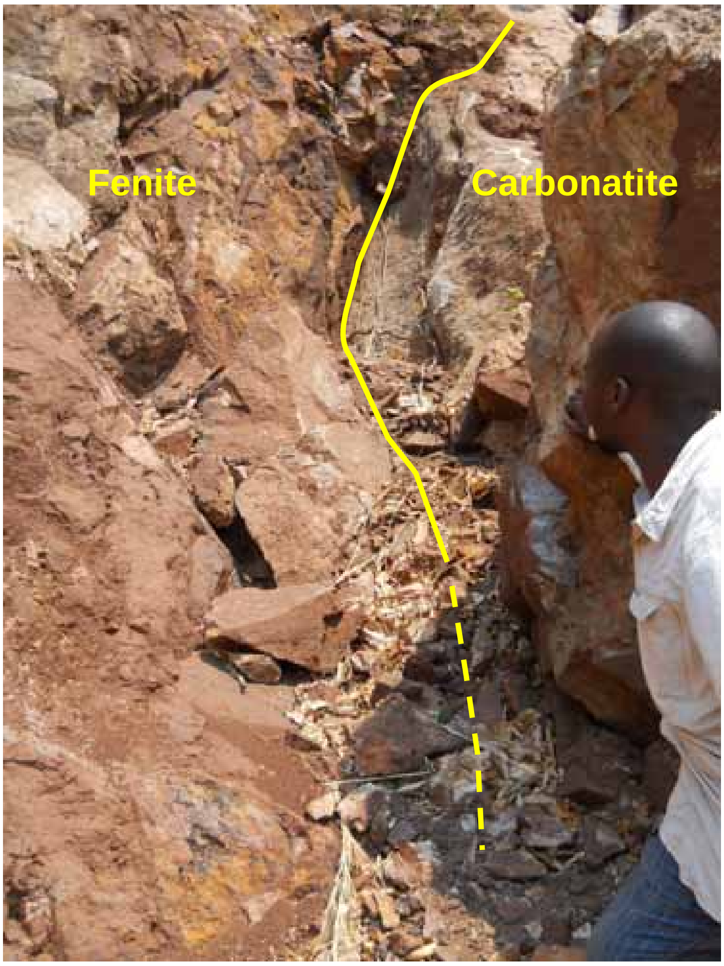
14.4.2 Geological Modeling

Datamine Studio 3 was utilized for the three-dimensional modeling. Snowden Supervisor software was used for the univariate and geostatistical analysis.

REE mineralisation at Songwe Hill deposit occurs within a vertically intruded carbonatite plug. The drilling to date has investigated only the north eastern portion of the plug. Within this portion, surface exposures show that the carbonatite is the dominant domain, which comprises carbonatite breccias and mixtures of carbonatite and fenite, with carbonatite accounting for >60 % of the rock mass.

The relationships of the various lithologies and structural features within the carbonatite plug are difficult to establish. Rarely are contacts observed between the major lithologies. A sub-vertical dip was viewed between fenite and carbonatite at a single locality, shown in Figure 14-4. This single data point may however, not represent the overall orientation of the various lithologies with the plug.

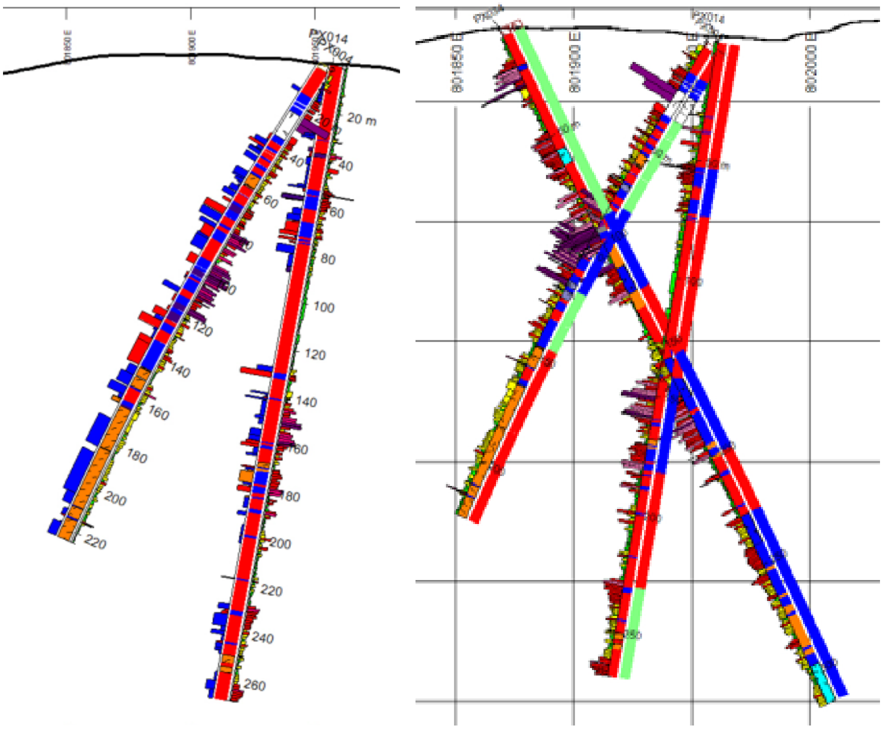
Figure 14-4
Sub-vertical Fenite-Carbonatite contact at Songwe Hill (Hall, 2012)



Mkango supplied detailed logging section views along drill fence lines. These incorporated lithology and TREO data. An example illustrating the high level of logging detail is shown in the left-hand image in Figure 14-5. Lithological logging and associated assay data is highly variable between one sample and the next, often alternating between fenite and carbonatite on a scale of less than one metre. Such complex relationships are depicted in the insert in Figure 14-5.

In order to carry out mineral resource modeling some simplification of the lithological information was required. Upon request by MSA, Mkango provided geological logs that identified zones of carbonatite or fenite dominant lithologies that were correlated with the broad lithological zones mapped in surface exposures. The simplified equivalent of the section through PX004 and PX014 is shown in the right-hand image in Figure 14-5. Criteria used to create broad zones included potassium and silica contents (as indications of fenitisation) and higher grade TREO and $CaCO_3$ as indications of carbonatite dominance. A number of simplified sections were provided by Mkango, which were used in the generation of the rock type envelopes. Furthermore, the simplified lithological intervals were entered into a separate field in the geological database and these were used to enable broad scale geological modeling.

Figure 14-5
Borehole sectional views (after Brady, 2012)



Insert: Fenite (pink) in carbonatite at outcrop

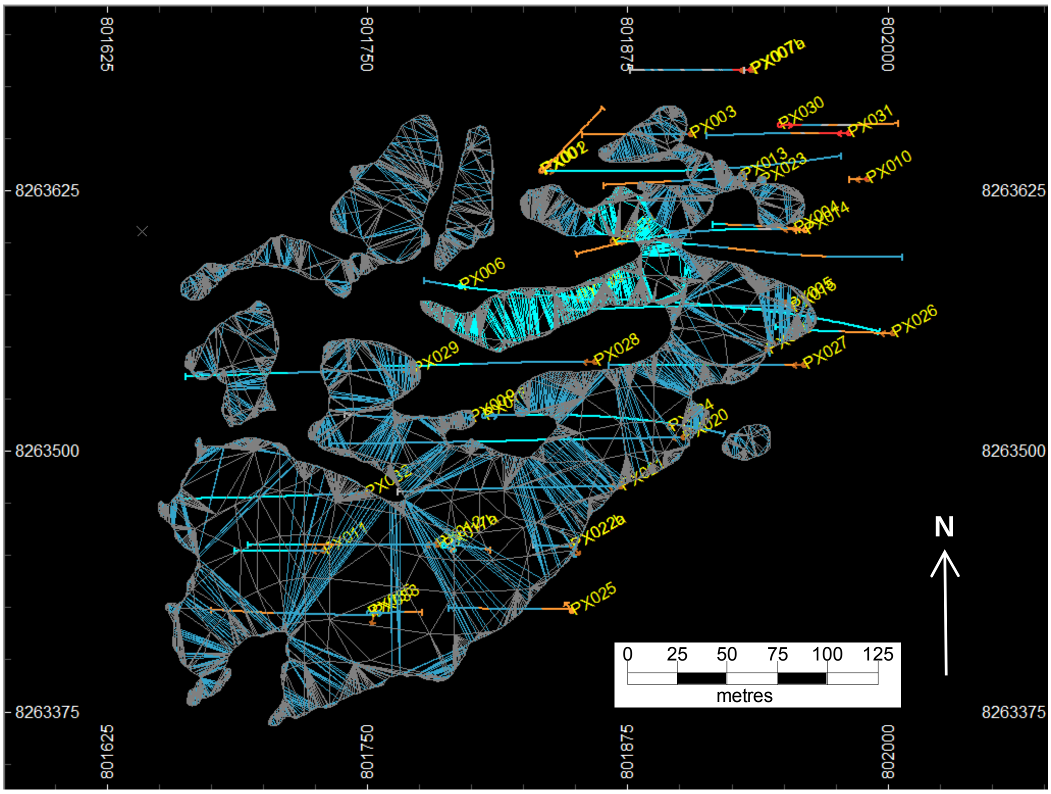
Note: Left hand image: secondary lithology annotated on left hand side of borehole, TREO% on right hand side
Right hand image: TREO% annotated on left hand side of borehole
Red: Fenite; Blue: Carbonatite Light green: Mixed; Orange: Fenitized Phonolite Insert: Fenite (pink) in carbonatite at outcrop (detailed borehole legend is shown in Item 7.3.2)

The surface geological mapping provided the basis for the geological modeling. Consistent with the interpreted emplacement morphology of the plug, the geological contacts from the mapping were translated vertically downwards at 50 m intervals and adjusted with the intersection data in the boreholes. This enabled construction of the Carbonatite and Mixed Domain envelopes. An example of a horizontal sectional view of the wireframes is shown in Figure 14-6.

The modeled envelopes were extended 50 m horizontally away from the extents of the borehole intersections. The entire geological model was extended to 350 m below the topographic surface which resulted in the geological model being approximately 25 m below the deepest borehole intersections.

Figure 14-6

Example of an horizontal sectional interpretation at Songwe Hill: 300 m amsl (Hall, 2012)

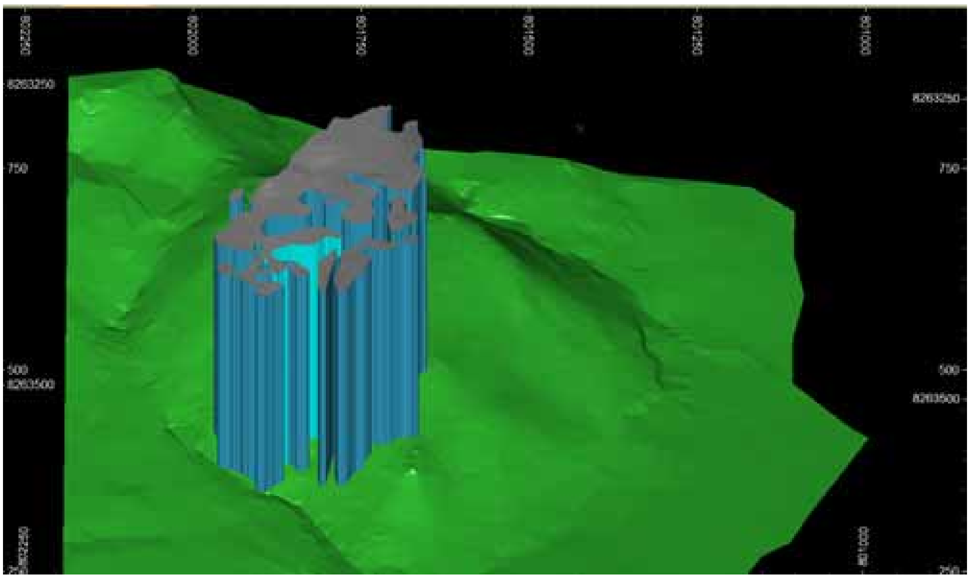


Light blue: Carbonatite envelope and Carbonatite intersections in boreholes
Turquoise: Mixed envelope and Mixed intersections in boreholes
Grey: Planar surface is 300 m above mean sea level (amsl)

14.4.2.1 Topographic surface

A topographic survey including DGPS point data was provided by Mkango and the surveyed borehole collars were matched with this surface to produce a combined topographic surface (Figure 14-7). The channel sample data were draped onto the combined topographic surface. The orebody wireframe extents were constrained by the surface topography model. MSA notes that the acquisition of an updated topographic surface is planned for the next phase of exploration.

Figure 14-7
Oblique view of Songwe Hill Carbonatite and Mixed lithology wireframes cut by topographic surface looking south west (Hall, 2012)



Lithology legend as for Figure 14.5 Grey: topography cut-off of domains; Green surface: 350 m below topography plane

14.4.3 Block Model Creation

Block models were generated within the modeled mineralization wireframes for each domain using 50 m by 50 m blocks in the X (easting) and Y (northing) directions with exact wireframe edge fitting in the Z (elevation) direction. Cell splitting was applied to better fit the modeled wireframes, resulting in sub-cells of a minimum of 5 m x 5 m in the X and Y directions.

The common origin for the un-rotated block models is (UTM Zone 36 South, WGS84):

Easting (X): 801500 m

Northing (Y): 8263000 m

Elevation (Z): 300 m above mean sea level (amsl)

14.4.4 Input Data Exploratory Data Analysis

Snowden Supervisor software was used for univariate and geostatistical analyses. These were carried out by domain. The input data for each domain were separated using the wireframe envelopes and then composited to approximately 1 m ensuring that all of the sample lengths were included in composites and that there were no residual lengths omitted. Statistical analysis was carried out on the 1 m composites.

14.4.4.1 Songwe Hill TREO Statistics

Statistics for TREO for the Carbonatite, Fenite and Mixed Domains are depicted in Figure 14-8 to Figure 14-10. The log histograms of the Carbonatite and Fenite Domains are negatively skewed. The number of inflection points in the log probability plots indicate several distributions with each domain (Figure 14-11 to Figure 14-13), which may be a result of the imperfect nature of creating the generalized lithological zones. The histogram of the mixed domain clearly shows the difference between the fenite data and the carbonatite data within this domain.

The HREO proportion of the TREO is less than 9%. In addition, Th and U contents at Songwe are low. Statistics for other constituents of each domain including HREO, Th, U and density are included in Appendix 4.

The individual domain TREO population coefficients of variation are all low indicating low variability overall and therefore it is acceptable to use Ordinary Kriging (OK) as the estimation technique

Figure 14-8
Borehole TREO in the Carbonatite Domain at Songwe Hill (Hall, 2012)

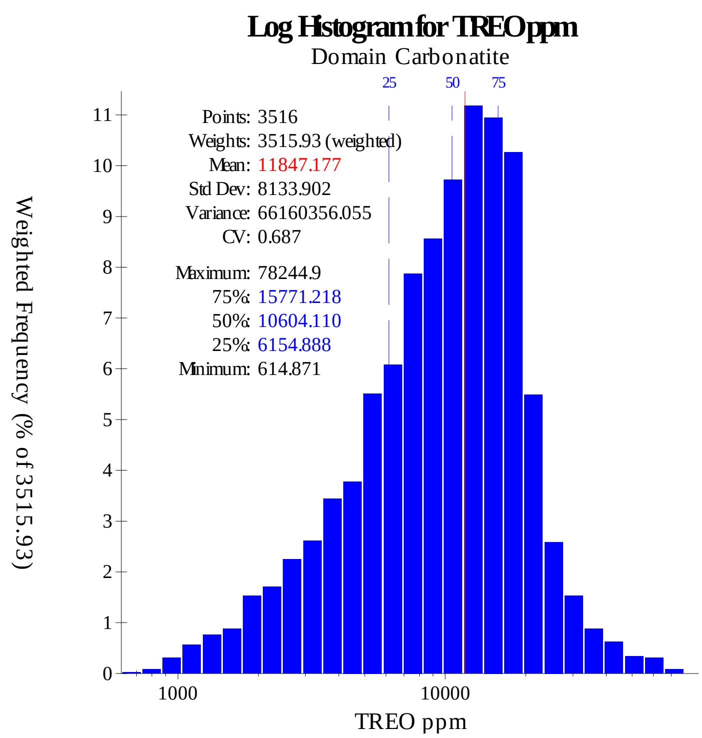


Figure 14-9

Borehole TREO in the Fenite Domain at Songwe Hill (Hall, 2012)

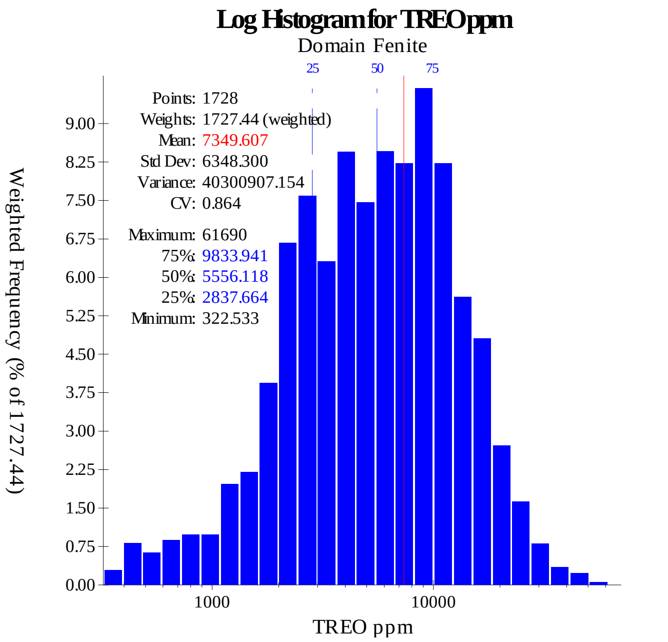


Figure 14-10

Borehole TREO in the Mixed Domain at Songwe Hill (Hall, 2012)

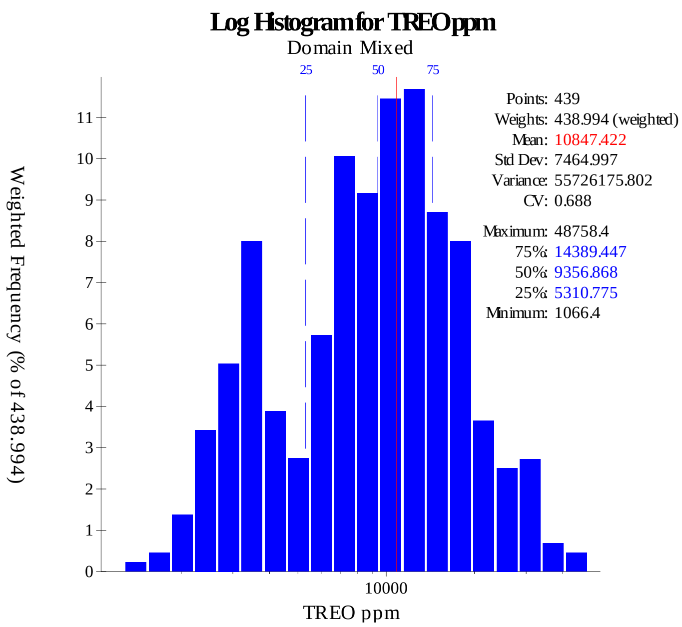


Figure 14-11
Songwe Hill Carbonatite Borehole TREO Log probability plot (Hall, 2012)

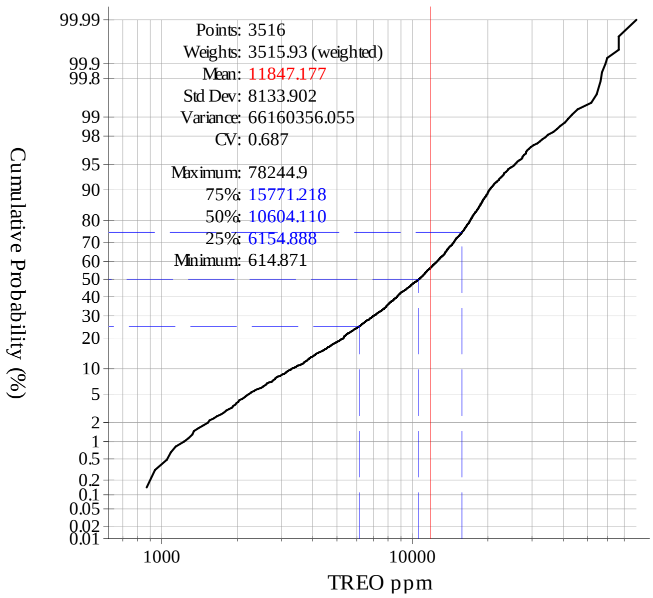


Figure 14-12
Songwe Hill Fenite Borehole TREO Log probability plot (Hall, 2012)

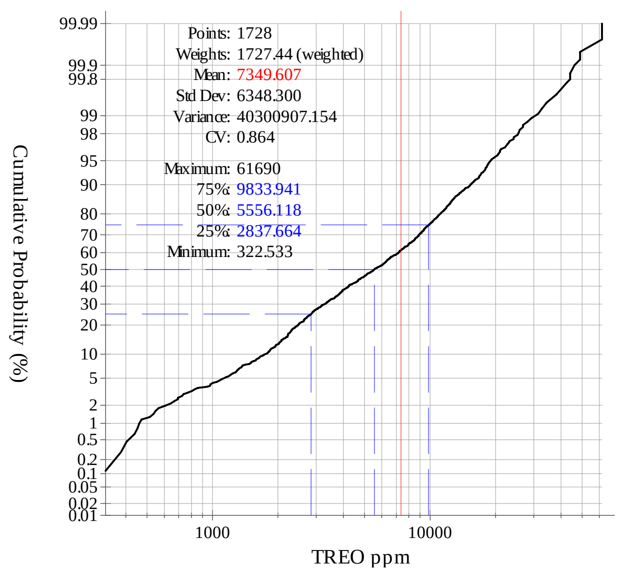
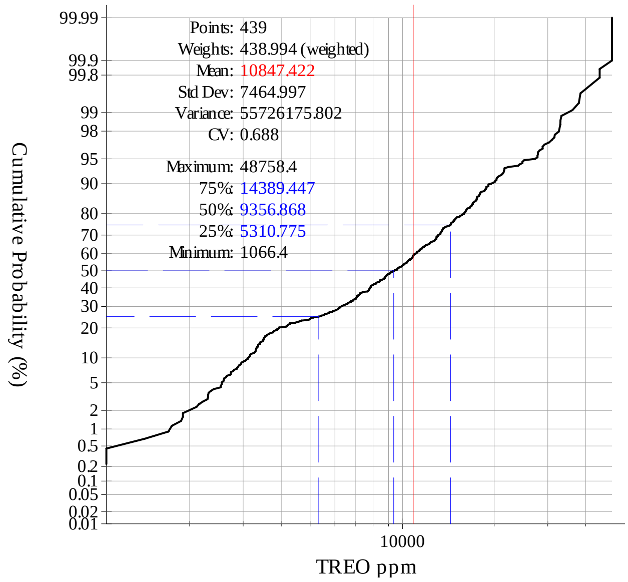


Figure 14-13
Songwe Hill Mixed Borehole TREO Log probability plot (Hall, 2012)



The borehole and channel data were compared for compatibility for use in the mineral resource estimates. Q-Q plots comparing the populations are shown in Figure 14-14 to Figure 14-16. These comparisons show that the channel sample grades for all domains are higher than the boreholes, suggesting they are from a different population, which may be a result of weathering and surface enrichment. As such the channel samples were excluded from the estimation database.

Figure 14-14
Songwe Hill Carbonatite Q-Q Plot: Boreholes versus Channels (Hall, 2012)

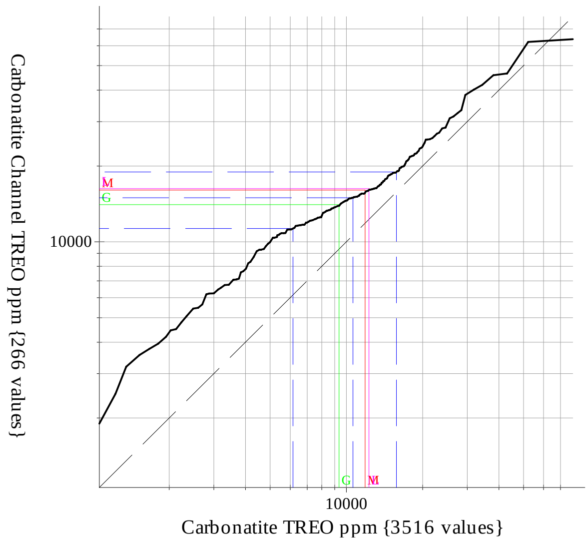


Figure 14-15
Songwe Hill Fenite Q-Q Plot: Boreholes versus Channels (Hall, 2012)

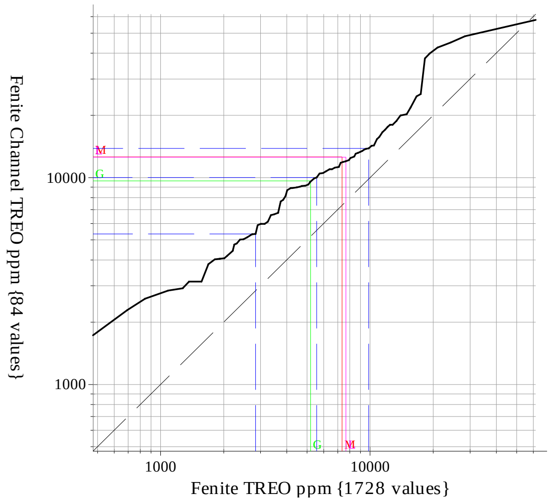
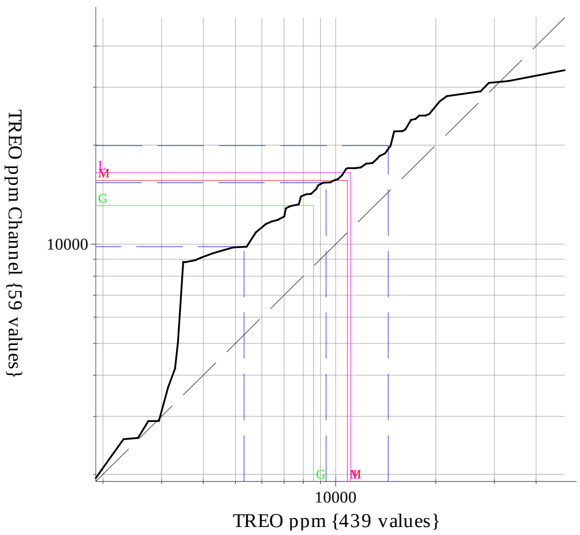


Figure 14-16
Songwe Hill Mixed Q-Q Plot: Boreholes versus Channels (Hall, 2012)



14.4.5 Individual REO Proportions

The drilling database was interrogated to yield proportions of the individual REOs as shown in Table 14-4 which represent the global proportions per domain. These data were subsequently applied per domain to assign proportions at differing cut offs.

Table 14-4
Individual REO proportions at Songwe Hill (Hall, 2012)

REO	Carbonatite %	Fenite %	Mixed %
Light Rare Earth Oxides (LREO)			
La_2O_3	24.23	23.88	26.85
Ce_2O_3	44.21	43.40	45.61
Pr_2O_3	4.75	4.68	4.60
Nd_2O_3	16.41	16.07	14.69
Sm_2O_3	24.23	23.88	26.85
Total LREO	91.97 %	90.45 %	93.74 %
Heavy Rare Earth Oxides (HREO)			
Eu_2O_3	0.65	0.69	0.53
Gd_2O_3	1.52	1.69	1.25
Tb_2O_3	0.18	0.21	0.15
Dy_2O_3	0.86	1.05	0.67
Ho_2O_3	0.14	0.17	0.11
Er_2O_3	0.33	0.42	0.25
Tm_2O_3	0.04	0.05	0.03
Yb_2O_3	0.24	0.29	0.19
Lu_2O_3	0.03	0.04	0.03
Y_2O_3	4.02	4.93	3.06
Total HREO	8.03 %	9.55 %	6.26 %

14.4.6 Density

Density was interpolated into the block models for each domain similarly to a grade variable. Density values exist for 80% of the samples used in the grade estimation. Histograms of density data are contained in Appendix 4.

14.4.7 Variogram modeling and grade continuity

Variograms for TREO and HREO borehole data were modeled for each domain.

14.4.7.1 Songwe Hill variography detail

The omni-directional variograms for each domain are shown in Appendix 5. Heavy rare earths, as defined in Item 7 of this report comprise europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium and yttrium. The poor structure of the variograms models may be a function of the mixed data in the generalized lithological domains.

The omni-directional variogram parameters are tabulated in Table 14-5.

Table 14-5 **Variogram parameters** (Hall, 2012)					
Variable	**Nugget**	**Range structure 1**	**Variance structure 1**	**Range structure 2**	**Variance structure 2**
TREO Carbonatite	0.42	29 m	0.58	-	-
HREO Carbonatite	0.41	35.5 m	0.59	-	-
Th Carbonatite	0.38	30 m	0.62	-	-
U Carbonatite	0.33	8.5 m	0.46	50.5 m	0.21
Density Carbonatite	0.48	73.5 m	0.52	-	-
TREO Fenite	0.23	23.5 m	0.77	-	-
HREO Fenite	0.11	10 m	0.57	52 m	0.32
Th Fenite	0.08	7.5 m	0.92	-	-
U Fenite	0.21	24 m	0.79	-	-
Density Fenite	0.29	24.5 m	0.71	-	-
TREO Mixed	0.36	11 m	0.27	26 m	0.37
HREO Mixed	0.10	6 m	0.77	33 m	0.13
Th Mixed	0.21	20.5 m	0.79	-	-
U Mixed	0.32	6.5 m	0.18	34 m	0.50
Density Mixed	0.30	6 m	0.29	25 m	0.41

Grade interpolation was carried out for TREO, HREO, Th and U. The final LREO estimate was derived by deduction of the HREO estimate from the TREO estimate.

14.4.8 Estimation Parameters and Grade Estimation

Ordinary Kriging was used for the grade and density estimation for TREO and HREO. The estimation search parameters are shown in Table 14-6.

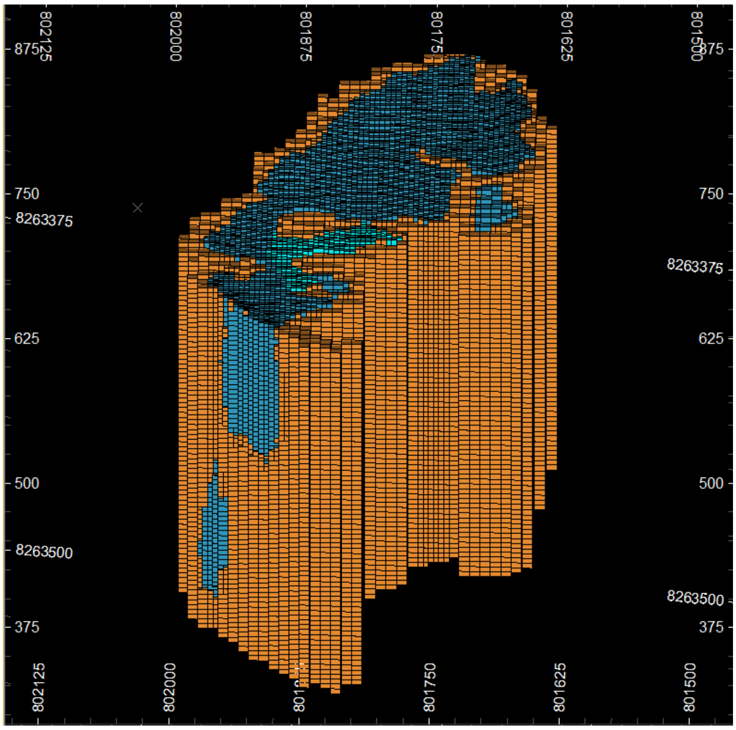
Table 14-6 **Search parameters** (Hall, 2012)		
Variable	**Direction**	**Search Distance**
TREO Carbonatite	omni-directional	29 m
HREO Carbonatite	omni-directional	35.5 m
Th Carbonatite	omni-directional	30 m
U Carbonatite	omni-directional	50.5 m
Density Carbonatite	omni-directional	73.5 m
TREO Fenite	omni-directional	23.5 m
HREO Fenite	omni-directional	52 m
Th Fenite	omni-directional	7.5 m
U Fenite	omni-directional	24 m
Density Fenite	omni-directional	24.5 m
TREO Mixed	omni-directional	26 m
HREO Mixed	omni-directional	33 m
Th Mixed	omni-directional	20.5 m
U Mixed	omni-directional	34 m
Density Mixed	omni-directional	25 m

A minimum of 5 and a maximum of 10 samples were selected by the search ellipse in order to estimate a block. The number of samples selected was limited so that local outliers were limited in influence to adjacent areas. The first search selected samples within the variogram range. The search was expanded by up to nine times the variogram range so that all of the model cells were estimated with grade and density. . Those blocks that were estimated with the expanded search are considered to be low confidence estimates, they being largely confined to the peripheries of the block model. Parent cell estimation was undertaken.

A view of the combined block model, colored by domain is presented in Figure 14-17 and the same view is presented in Figure 14-18 colored by TREO grade.

Figure 14-17

Block model view looking south west: All Domains (Hall, 2012)



Blue: Carbonatite Domain Blocks; Brown: Fenite; Turquoise: Mixed

The surface expressions of TREO, LREO, HREO and Th grades at Songwe Hill are shown in Figure 14-19 to Figure 14-22. Thorium contents at Songwe are low as depicted in Figure 14-22. HREO constitute approximately 8% of the TREO content in carbonatite, 9.5% in the fenite and approximately 6% in the mixed Domain.

Figure 14-18
Block model view looking south west: All domains TREO% (Hall, 2012)

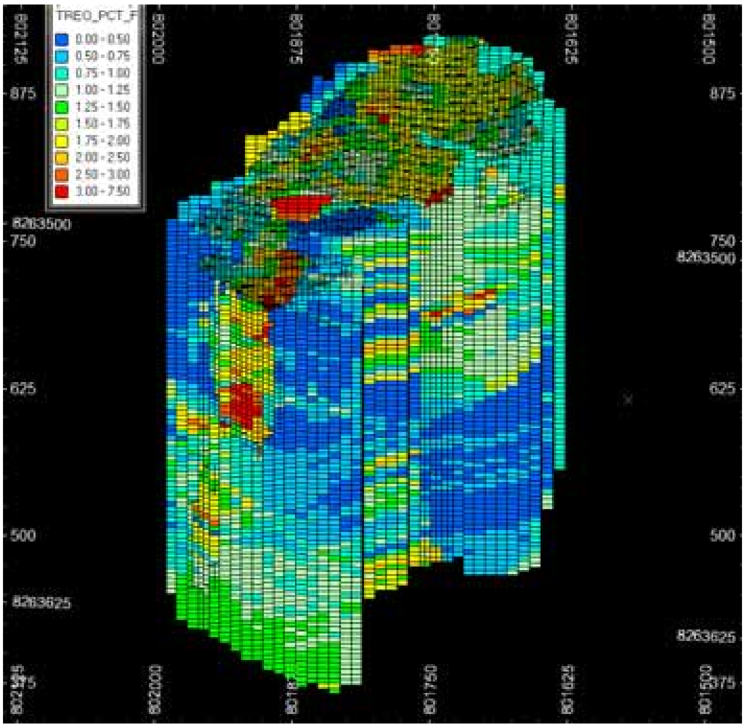


Figure 14-19
Surface expression of TREO grades at Songwe Hill (Hall, 2012)

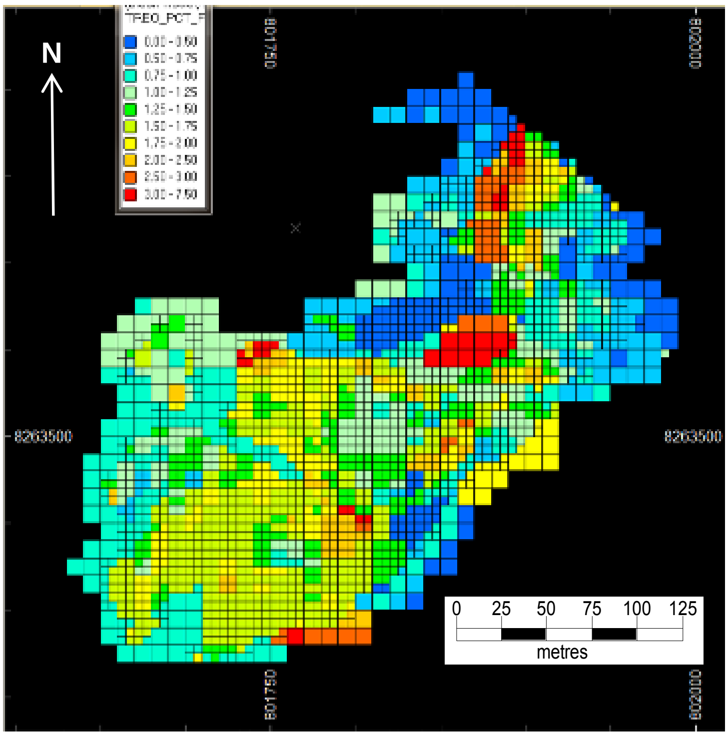


Figure 14-20

Surface expression of LREO grades at Songwe Hill (Hall, 2012)

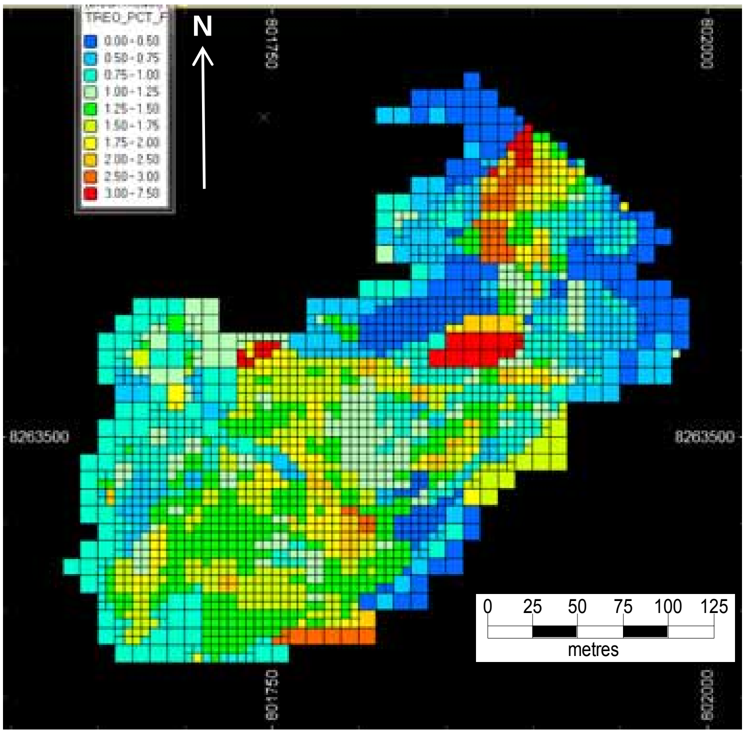


Figure 14-21

Surface expression of HREO grades at Songwe Hill (Hall, 2012)

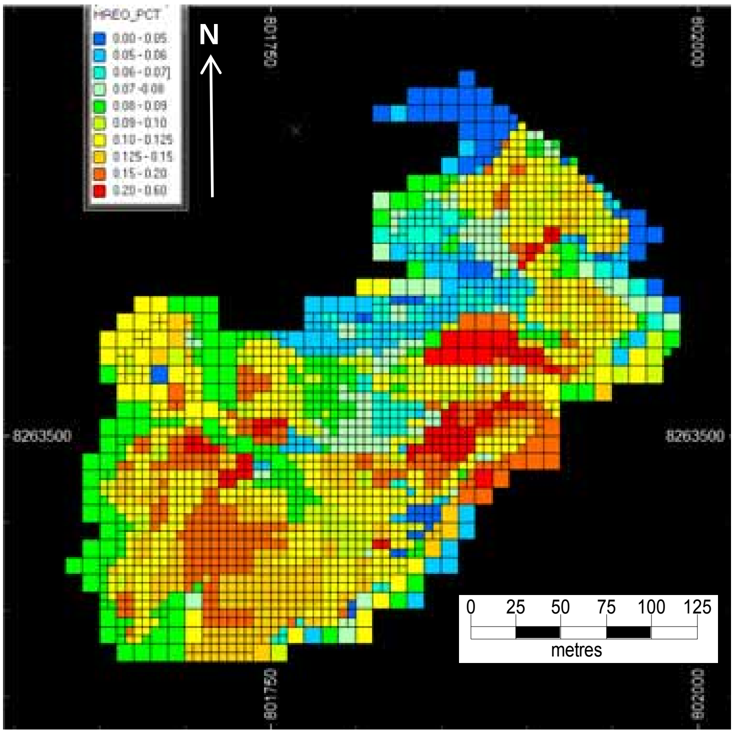
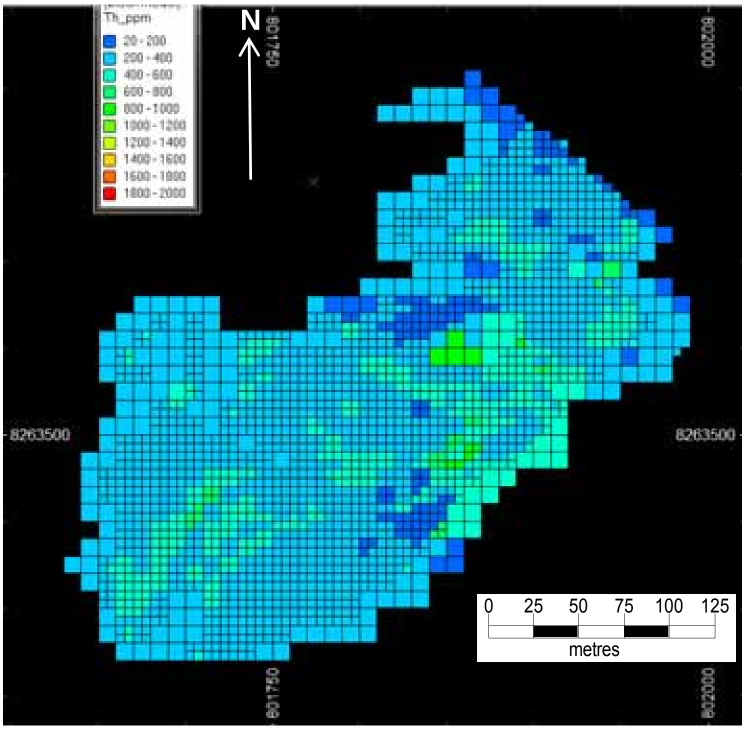


Figure 14-22
Surface expression of Th grades at Songwe Hill (Hall, 2012)



14.4.9 Geological Losses

No geological losses were applied for the current mineral resource estimates. Geological features such as faults and dykes are not known to occur within the mineral resource. The reported voids represent a consideration for discounting the mineral resource by 1.7% but this has not been applied due to a degree of uncertainty regarding the currently documented void data.

14.4.10 Mineral Resource Classification

Blocks that were estimated by samples within the variogram range were classified as Indicated resources and the remainder of the block model estimates were classified as Inferred resources.

The interpreted geological model at Songwe is of a vertically-intruded plug. Dips of the margins and of the internal lithological contacts have been interpreted as vertical in this model but there is limited data to support this.

Drilling data is considered to be of an appropriate level of detail and reliability and is spread evenly across the study area. It is considered that drilling data adequately covers the mineral resource to attain Indicated classification in those areas covered by the regular grid.

The geological breakdown into domains is not currently well enough defined in order to classify the mineral resource with more confidence than Indicated. It is noted that the grade continuity is a function of the lithological domains and that more confidence in the estimates may result from better definitions of the domains.

An overall assessment of the above factors limits the current mineral resource to the Indicated category.

14.5 Mineral Resource Statement

14.5.1 Songwe Hill Mineral Resources

The Songwe Hill Mineral Resource has been classified as Indicated and Inferred for each of the Carbonatite, Fenite and Mixed domains in accordance with CIM guidelines. These are shown in Table 14-7 to Table 14-12. Comparisons are made at a number of cut off grades for TREO in 0.5% increments from 0.5% to 2.0 %, although the base case cut-off grade is 1.0% TREO, which is highlighted in the various tabulations of the mineral resource.

Table 14-7
***In-situ* Indicated mineral resources for Songwe Hill: Carbonatite domain** (Hall, 2012)

TREO % Cut Off	Million Tonnes	DENSITY	TREO %	LREO %	HREO %	Th ppm	U ppm	TREO Tonnes	LREO Tonnes	HREO Tonnes
0.5	16.31	2.79	1.35	1.24	0.11	322	12	219 978	202 724	17 255
1.0	11.10	2.80	1.62	1.50	0.12	351	12	179 499	166 429	13 071
1.5	5.26	2.79	2.03	1.91	0.13	385	12	106 886	100 185	6 699
2.0	1.85	2.78	2.63	2.50	0.13	429	12	48 572	46 193	2 379

Table 14-8
***In-situ* Inferred mineral resources for Songwe Hill: Carbonatite domain** (Hall, 2012)

TREO % Cut Off	Million Tonnes	DENSITY	TREO %	LREO %	HREO %	Th ppm	U ppm	TREO Tonnes	LREO Tonnes	HREO Tonnes
0.5	17.09	2.82	1.07	0.97	0.09	304	12	182 866	166 637	16 226
1.0	8.64	2.87	1.35	1.24	0.11	324	11	116 967	107 335	9 629
1.5	1.90	2.87	1.85	1.72	0.12	349	11	35 045	32 709	2 335
2.0	0.39	2.89	2.50	2.38	0.12	358	11	9 849	9 383	466

Table 14-9
***In-situ* Indicated mineral resources for Songwe Hill: Fenite domain** (Hall, 2012)

TREO % Cut Off	Million Tonnes	DENSITY	TREO %	LREO %	HREO %	Th ppm	U ppm	TREO Tonnes	LREO Tonnes	HREO Tonnes
0.5	2.71	2.81	1.18	1.09	0.09	288	13	31 912	29 504	2 408
1.0	1.37	2.85	1.61	1.51	0.10	301	11	22 145	20 704	1 441
1.5	0.59	2.87	2.11	1.98	0.12	334	10	12 460	11 735	726
2.0	0.24	2.84	2.59	2.45	0.14	378	10	6 313	5 972	341

Table 14-10

***In-situ* Inferred mineral resources for Songwe Hill: Fenite domain** (Hall, 2012)

TREO % Cut Off	Million Tonnes	DENSITY	TREO %	LREO %	HREO %	Th ppm	U ppm	TREO Tonnes	LREO Tonnes	HREO Tonnes
0.5	17.47	2.82	1.06	0.97	0.09	271	13	184 819	169 732	15 086
1.0	8.27	2.86	1.35	1.24	0.10	295	13	111 318	102 935	8 381
1.5	1.73	2.83	1.88	1.75	0.12	331	11	32 477	30 374	2 104
2.0	0.41	2.75	2.41	2.27	0.14	350	11	9 875	9 313	562

Table 14-11

***In-situ* Indicated mineral resources for Songwe Hill: Mixed domain** (Hall, 2012)

TREO % Cut Off	Million Tonnes	DENSITY	TREO %	LREO %	HREO %	Th ppm	U ppm	TREO Tonnes	LREO Tonnes	HREO Tonnes
0.5	1.01	2.79	1.38	1.31	0.07	318	12	13 993	13 266	727
1.0	0.69	2.80	1.65	1.58	0.07	335	12	11 454	10 941	513
1.5	0.31	2.72	2.19	2.11	0.08	387	14	6 719	6 469	250
2.0	0.15	2.65	2.68	2.60	0.08	420	17	3 924	3 806	118

Table 14-12

***In-situ* Inferred mineral resources for Songwe Hill: Mixed domain** (Hall, 2012)

TREO % Cut Off	Million Tonnes	DENSITY	TREO %	LREO %	HREO %	Th ppm	U ppm	TREO Tonnes	LREO Tonnes	HREO Tonnes
0.5	1.90	2.86	1.56	1.50	0.06	251	11	29 614	28 430	1 184
1.0	1.68	2.87	1.65	1.59	0.06	248	11	27 863	26 815	1 049
1.5	1.43	2.87	1.74	1.68	0.06	243	11	24 890	24 005	885
2.0	0.11	2.94	2.36	2.29	0.07	255	11	2 595	2 521	73

The totals per mineral resource category for the combined domains at the base case cut-off grade of 1% TREO are shown in Table 14-13 and Table 14-14.

The total Indicated mineral resource for all domains at Songwe Hill is 13.16 million tonnes at a TREO grade of 1.62% which equates to 213 098 tonnes of TREO at a 1% TREO cut-off.

The total Inferred mineral resource for all domains at Songwe Hill is 18.59 million tonnes at a TREO grade of 1.38%, which equates to 256 149 tonnes of TREO at a 1% TREO cut-off.

Table 14-13
***In-situ* Indicated mineral resources for Songwe Hill: All domains at a 1% TREO cut-off** (Hall, 2012)

Domain	Million Tonnes	LREO %	HREO %	TREO %	TREO Tonnes	HREO Proportion
Carbonatite	11.10	1.50	0.12	1.62	179 499	7.3%
Fenite	1.37	1.51	0.10	1.61	22 145	6.5%
Mixed	0.69	1.58	0.07	1.65	11 454	4.5%
Totals	13.16	1.50	0.11	1.62	213 098	7.1%

Table 14-14
***In-situ* Inferred mineral resources for Songwe Hill: All domains at a 1% TREO cut-off** (Hall, 2012)

Domain	Million Tonnes	LREO %	HREO %	TREO %	TREO Tonnes	HREO Proportion
Carbonatite	8.64	1.24	0.11	1.35	116 967	8.2%
Fenite	8.27	1.24	0.10	1.35	111 318	7.5%
Mixed	1.68	1.59	0.06	1.65	27 863	3.8%
Totals	18.59	1.28	0.10	1.38	256 149	7.4%

The individual REO contents at the 1% TREO cut off are shown in Table 14-15 (Indicated) and Table 14-16 (Inferred).

Table 14-15

***In-situ* Indicated Mineral Resources: Individual REO contents at Songwe Hill at the 1% TREO cut off** (Hall, 2012)

Domain	Tonnes million	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	LREO ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Ho_2O_3 ppm	Er_2O_3 ppm	Tm_2O_3 ppm	Yb_2O_3 ppm	Lu_2O_3 ppm	Y_2O_3 ppm	HREO ppm	TREO ppm	Th ppm	U ppm
Carbonate	11.10	3 951	7 208	775	2 676	387	14 997	95	223	27	127	21	48	6	36	5	590	1 178	16 175	351	12
Fenite	1.37	3 980	7 235	779	2 679	404	15 077	76	186	24	116	19	46	6	32	4	542	1 050	16 127	301	11
Mixed	0.69	4 520	7 678	774	2 473	335	15 780	63	148	17	79	13	29	4	22	3	362	739	16 519	335	12

Table 14-16

***In-situ* Inferred Mineral Resources: Individual REO contents at Songwe Hill at the 1% TREO cut off** (Hall, 2012)

Domain	Tonnes million	La_2O_3 ppm	Ce_2O_3 ppm	Pr_2O_3 ppm	Nd_2O_3 ppm	Sm_2O_3 ppm	LREO ppm	Eu_2O_3 ppm	Gd_2O_3 ppm	Tb_2O_3 ppm	Dy_2O_3 ppm	Ho_2O_3 ppm	Er_2O_3 ppm	Tm_2O_3 ppm	Yb_2O_3 ppm	Lu_2O_3 ppm	Y_2O_3 ppm	HREO ppm	TREO ppm	Th ppm	U ppm
Carbonate	8.64	3 275	5 974	642	2 218	321	12 430	90	211	25	120	19	46	6	34	5	559	1 115	13 545	324	11
Fenite	8.27	3 286	5 973	643	2 212	333	12 448	73	180	23	112	18	44	5	31	4	523	1 014	13 462	295	12
Mixed	1.68	4 559	7 746	781	2 495	338	15 918	53	125	14	66	11	25	3	19	3	304	622	16 541	248	11

The tabulations per cut-off grade and per domain are included in Appendix 6

The proportions of the individual REO's at the 1% TREO cut off are presented in Table 14-17 and Table 14-18.

Table 14-17

In-situ Indicated Mineral resources: Individual REO proportions at Songwe Hill at the 1% TREO cut off (Hall, 2012)

Domain	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
Carbonate	11.10	24.43	44.56	4.79	16.54	2.39	0.59	1.38	0.17	0.78	0.13	0.30	0.04	0.22	0.03	3.65	100
Fenite	1.37	24.68	44.86	4.83	16.61	2.50	0.47	1.15	0.15	0.72	0.12	0.28	0.04	0.20	0.03	3.36	100
Mixed	0.69	27.36	46.48	4.69	14.97	2.03	0.38	0.90	0.10	0.48	0.08	0.18	0.02	0.13	0.02	2.19	100

Table 14-18

In-situ Inferred Mineral resources: Individual REO proportions at Songwe Hill at the 1% TREO cut off (Hall, 2012)

Domain	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
Carbonate	8.64	24.18	44.11	4.74	16.37	2.37	0.67	1.56	0.19	0.89	0.14	0.34	0.04	0.25	0.03	4.12	100
Fenite	8.27	24.41	44.37	4.78	16.43	2.48	0.54	1.33	0.17	0.83	0.14	0.33	0.04	0.23	0.03	3.89	100
Mixed	1.68	27.56	46.83	4.72	15.08	2.04	0.32	0.75	0.09	0.40	0.06	0.15	0.02	0.11	0.02	1.84	100

The individual REO proportions do not vary greatly between the different cut-off grades. The tabulations of individual REO per cut-off grade and per domain are included in Appendix 7.

14.6 Conclusions

This is the maiden NI 43-101 compliant mineral resource reported for Songwe Hill.

The combined domain Indicated mineral resource for Songwe Hill is 13.16 million tonnes at a TREO grade of 1.62% which equates to 213,098 tonnes of TREO at a 1% TREO cut-off.

The combined domain Inferred mineral resource for Songwe Hill is 18.59 million tonnes at a TREO grade of 1.38% equating to 256,149 tonnes of TREO at a 1% TREO cut-off.

The HREO constitute 8.03% of the TREO content in the Carbonatite domain, 9.55% of the TREO in the Fenite and 6.26% of the TREO in the Mixed domain.

The current mineral resource estimate only covers an area in the north eastern portion of Songwe Hill. There is potential to identify additional mineral resources, both immediately to the northeast and southwest of the drilled area as well as at depth.

The remainder of Songwe Hill may also have additional REO mineral resource potential, the testing of which could involve step-out drilling to the north east and south west on a 25 m fence line spacing. In addition, there is potential to extend the mineralization through shallow depth drilling into other carbonatite outcrop areas at Songwe Hill.

The apparent difference between the borehole and channel sample TREO grades should be investigated in order to understand this bias. Following this, inclusion of the channel sample data into the estimation database could be considered.

15 MINERAL RESERVE ESTIMATES

Not required as the Songwe Hill REE deposit is not an advanced project.

16 MINING METHODS

Not required as the Songwe Hill REE deposit is not an advanced project.

17 RECOVERY METHODS

Not required as the Songwe Hill REE deposit is not an advanced project.

18 PROJECT INFRASTRUCTURE

Not required as the Songwe Hill REE deposit is not an advanced project.

19 MARKET STUDIES AND CONTRACTS

Not required as the Songwe Hill REE deposit is not an advanced project.

20 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

Not required as the Songwe Hill REE deposit is not an advanced project.

21 CAPITAL AND OPERATING COSTS

Not required as the Songwe Hill REE deposit is not an advanced project.

22 ECONOMIC ANALYSIS

Not required as the Songwe Hill REE deposit is not an advanced project.

23 ADJACENT PROPERTIES

No information from any adjacent properties is incorporated in this report and no interpretations or results regarding the Songwe Hill property have utilized information from adjoining properties.

24 OTHER RELEVANT DATA AND INFORMATION

No further information or explanation is deemed necessary for this technical report.

25 INTERPRETATION AND CONCLUSIONS

Exploration at Songwe Hill has identified a carbonatite vent system with a ring-type morphology consisting of a central core of carbonatite, capped and partially surrounded by a potassic fenite, and interspersed with a wide variety of vent breccias containing both fenite and carbonatite clasts in variably carbonatitic and silicic matrices. The carbonatite occupies a steep-sided conical hill on the side of the larger Mauze Hill, which is underlain dominantly by related but slightly older nepheline syenite. The Songwe vent complex is part of the Jurassic/Cretaceous Chilwa Alkaline Province, and represents the terminal event of an alkalic intrusive event that includes the earlier nepheline syenite.

The carbonatites in the vent complex are dominantly grey calcic carbonatites, although locally, subordinate iron-rich varieties cut and overprint the earlier carbonatite. Fenites cap and partially surround the central carbonatite intrusion and are believed to have formed by metasomatism related to the carbonatite intrusion, although metasomatism related to the intrusion of the nepheline syenite cannot be ruled out.

The vent complex is mineralized with rare earth elements. Mineralization occurs dominantly within the carbonatite lithologies, but economically interesting grades are also present in the surrounding fenites and in the breccias (where grade is directly related to the proportion of carbonatite clasts). The REE are disposed primarily in synchysite (with minor parisite) and apatite, with relatively minor florencite (mainly in the matrix of the breccias) and trace amounts of monazite, and are associated with strontianite, baryte and iron and manganese oxides and carbonates. The assemblage is interpreted to be hydrothermal in origin, resulting from late, subsolidus processes having redistributed REE that were originally enriched in the carbonatite. This hydrothermal process has resulted in mineralization both within the carbonatite itself and within the associated fenites and breccias.

The mineralized zone appears to have dominantly sub-vertical flow patterns and contacts, and the relative proportion of carbonatite appears to increase with depth. Lithology is the dominant control on the mineralization. For the purposes of mineral resource definition, three geological domains have been identified in the Songwe Hill deposit, a carbonatite domain, a fenite domain, and a 'mixed' domain consisting of breccia and/or finely intermixed carbonatite and fenite. In their respective domains, carbonatite and fenite form the dominant, but not necessarily the sole, rock type. In the mixed domain, they are intimately interspersed with each other and with vent breccias.

The assay results from the trenches and boreholes which targeted the mineralized zone have been subjected to industry standard quality control procedures and were used to declare an initial Mineral Resource. The scientific and technical information used to declare this mineral resource has an effective date of September 30, 2012.

A 1.0% TREO cut-off has been applied for the purpose of calculating a base case mineral resource estimate. The global Indicated mineral resource tonnage for the Songwe Hill deposit using this cut-off grade is 13.2 million tonnes, with a grade of

1.62% TREO, yielding 213,098 tonnes of REO and a HREO/TREO of 7.1%. As TREO grade decreases, relative proportions of heavy rare earths increases (at 0.5% TREO cut-off grade, the HREO proportion is 7.7% and 8.3% for Indicated and Inferred categories, respectively). The reverse is also true: at 1.5% TREO cut-off grade, the HREO proportion is 6.1% and 5.7% for Indicated and Inferred categories, respectively.

The vast majority of the Indicated mineral resource blocks (at a 1% TREO cut-off: 9.1 mt of carbonatite, 0.67 mt of mixed and 1.04 mt of fenite) are at depths of less than 200 m below the surface of the hill. The areas drilled to date are in an elevated position on the northern slopes of Songwe Hill, which rises approximately 230 m above the surrounding plain. The approximate dimensions of the mineral resource estimate are 400 m aligned northeast by 230 m aligned northwest and to a depth of 350 m below and paralleling the topographic surface of the hill and surrounding plain.

The Songwe Hill mineral resource includes Indicated and Inferred resources. The interpreted geological model at Songwe is of a vertically-intruded plug but there is limited data to support this. Drilling data is considered to be of an appropriate level of detail and reliability and is spread evenly across the study area. It adequately covers the mineral resource to attain Indicated classification in those areas covered by the regular grid. The geological breakdown into domains is not currently well enough defined in order to classify the mineral resource with more confidence than Indicated. A higher confidence level in the mineral resource classification will also require a favorable outcome of the on-going metallurgical test work demonstrating reasonable confidence in the viability of economic extraction of the REEs.

It is concluded that the mineral resource defined in this report is supported by appropriate data, procedures and interpretations and that further work to define the nature of the resource and the conditions under which it can be extracted are warranted.

Metallurgical studies are underway to determine the extent to which the REE can be extracted. Mineralogical studies indicate that maximizing recovery of rare earths from synchysite and apatite will be critical to the success of the mineral processing and successful demonstration that this can be accomplished would represent a key milestone for the project going forward. The outcome of metallurgical studies also represents the principal risk for the project going forward.

The Phalombe license has considerable exploration potential, both in the vicinity of the Songwe Hill vent, and in nearby Chilwa Province intrusive centers. This exploration potential presents a further opportunity for the project going forward.

26 RECOMMENDATIONS

The immediate focus should be on completion of metallurgical scoping work. The mineral processing and metallurgical programme that is currently underway at Mintek will provide important information on the extent to which the REE can be extracted and this in turn will allow a more complete assessment of the classification of the resource and provide essential data to advance the project to a Preliminary Economic Assessment (PEA).

Whilst an Indicated resource category is sufficient to support a pre-feasibility study, there is merit in advancing the established mineralized system at Songwe Hill towards both a Measured and Indicated Mineral Resource in order to provide further comfort on the quality of geological controls and the certainty of the resource definition. Advancing the classification of the known resources to a Measured and Indicated status will require additional geological work to produce an optimal (physical) differentiation between the mineralized lithologies and a more definitive mineralization mechanism and morphology. This will involve additional geological investigation and interpretation of field and drill core relationships, perhaps followed by targeted drilling to confirm relationships.

A preliminary economic assessment (PEA) study, comprising conceptual mining and geotechnical studies, infrastructure, utility, environmental and socio-economic studies and high level financial studies including risk, sensitivity and market analyses, should be considered pending the outcome of the scoping metallurgical test work. Collection of baseline data should be considered in the near term to prepare for environmental assessments and social impacts.

The proposed budget of CAD$ 1.6 million includes provisions in anticipation of positive outcomes of studies currently underway and is adequate to conduct the programmes outlined in Table 26-1. A successful outcome of the geological and mineral processing/beneficiation programmes would confirm the advisability for a PEA and then determine the scope for a feasibility study to ultimately advance the project to production.

Table 26-1
Planned Budget for next phase

Task	CAD $
Metallurgical and beneficiation test work	500,000
Geological work including additional drilling and geological modeling	700,000
Environmental survey / social impact assessments	150,000
Scoping baseline PEA data	250,000
Total for next phase	1,600,000

Note: Above expenditures exclude Corporate and Administration costs

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28 DATE AND SIGNATURE PAGE

This report titled "NI 43-101 Technical Report and Mineral Resource Estimate for the Songwe Hill Rare Earth Element (REE) Project, Phalombe District, Republic of Malawi" with an effective date of September 30, 2012, prepared by The MSA Group (Pty) Ltd for Mkango Resources Ltd. dated November 22, 2012 was prepared and signed by the following authors:

Dated at Halifax, Canada	Scott Swinden
November 22, 2012	B.Sc. (Hons); M.Sc.; Ph.D.; P.Geo. Associate Consulting Geologist Swinden Geoscience Consultants Ltd.

Dated at Johannesburg, South Africa	Mike Hall
November 22, 2012	BSc (Hons); MBA; MAusIMM Mineral Resource Consultant The MSA Group (Pty) Ltd

APPENDIX 1:

Glossary of Technical Terms

Glossary of Technical Terms

Airborne magnetic surveys	Surveys flown by helicopter or fixed wing aircraft to measure the magnetic susceptibility of rocks at or near the earth's surface
Alkaline rocks	Rocks containing an excess of sodium and/or potassium
Amphibolite	A metamorphic rock comprised mainly of amphibole
amsl	Elevation above mean sea level
Apatite	A mineral $Ca_5(F,Cl)(PO4)_3$ found in igneous rocks which is a source of phosphate and locally contains significant amounts of rare earth elements
Archean	The third oldest of four geological eons in the history of the earth. It extends from 2,500 million years back to approximately 3,800 million years
Baryte	A mineral consisting of barium sulphate $BaSO_4$
Basement	The igneous and metamorphic crust of the earth, underlying sedimentary deposits
Bastnäsite	A family of rare-earth carbonate-fluoride minerals
Brecciated	A body of rock that has been intensely fractured
Calcite	A mineral consisting of calcium carbonate $CaCO_3$
Carbonate	A rock, usually of sedimentary origin, composed primarily of calcium, magnesium or iron and CO_3 or a mineral characterized by presence of the carbonate ion (CO_3^{2-})
Carbonatite	An igneous intrusive or extrusive rock that consists of more than 50% carbonate minerals. Calcitic carbonatite is dominantly calcium carbonate, dolomitic carbonatite is dominantly magnesium carbonate, ankeritic carbonatite is dominantly iron carbonate
Ce	Cerium, a LREE
Channel sample	A sample taken by cutting a shallow "channel' across an outcrop surface permitting a continuous sampling of the outcrop and providing assay results that are representative of a specified width across the outcrop
Chondrite	Stony meteorites that have not been modified due to melting or differentiation of the parent body, and are considered to have very primitive compositions
Craton	Large, ancient mass of the earth's crust comprised of various crustal blocks amalgamated by tectonic processes
Diamond Drilling	Method of obtaining a cylindrical core of rock by drilling with a diamond impregnated bit
Dolomite	A carbonate mineral composed of calcium and magnesium carbonate, $CaMg(CO_3)_2$; a rock predominantly comprised of this mineral is also referred to as dolomite or dolostone
Dy	Dysprosium, a HREE
Dyke	A tabular body of intrusive igneous rock, crosscutting the host strata at an oblique angle
Eluvial	geological deposits and soils that are derived by in situ weathering or weathering plus gravitational movement
EPL (Exclusive Prospecting License)	A mineral right granted by the Government of Malawi that allows the holder to carry on prospecting operations related to the mineral or group of minerals specified in the prospecting license

Er	Erbium, a HREE
Fabric	The orientation in space of the elements of which a rock is composed
Fault	A fracture or fracture zone in the earth's crust, along which displacement of opposing sides has occurred
Fenitisation	A distinctive alkali metasomatic alteration of host rocks surrounding a carbonatite intrusion
Fluorite	A mineral composted of calcium fluoride (CaF_2); a.k.a. fluorspar
Fold	A planar sequence of rocks or a feature bent about an axis
Ga	Billion years
Gd	Gadolinium, a HREE
GPS (global positioning system)	A satellite-based navigation system that provides reliable location information anywhere on Earth when there is an unobstructed line of sight to four or more GPS satellites
Gneiss	A foliated metamorphic rock that has a banded appearance
Grab samples	Rock samples taken from outcrop in non-systematic manner
Ho	Holmium, a HREE
HREE	Heavy Rare Earth Elements – Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu
Hydrothermal	Processes that involve heated water
ICP-OES	Inductively Coupled Plasma Optical Emission Spectroscopy, an analytical method used for elemental analyses
ICP-MS	Inductively Coupled Plasma Masss Spectrometry, an analytical method used for elemental analyses, particularly trace elements including the rare earth elements
La	Lanthanum, a LREE
Lacustrine	formed at the bottom or along the shore of lakes, as geological strata
Lithogeochemical	Study involving the chemical composition of rocks
LOI	Loss on ignition. The amount of volatile substances that are driven out of a sample by heating, reported as part of an elemental or oxide analyses of a rock or mineral
LREE	Light Rare Earths – La, Ce, Pr, Nd and Sm
Lu	Lutetium, a HREE
Ma	Million years
Magnetometer	An instrument for measuring the intensity of the earth's magnetic field
Magnetic susceptibility	The degree of magnetization of a material in response to an applied magnetic field
Magnetite	An important iron oxide mineral Fe_3O_4
Mafic	Pertaining to or composed dominantly of magnesium and iron rock-forming silicates. Typically synonymous with "dark minerals"
Metamorphism	Changes to rocks and minerals generally as a result of changes in pressure and/or temperature
Metasomatic	A metamorphic change in the rock which involves the introduction of material from another source
Monazite	A rare earth and thorium phosphate mineral found as an

	accessory mineral in felsic igneous rocks, pegmatite dykes and heavy mineral sands
mt	Million metric tonnes
Muscovite	A potassium-bearing white mica
Nd	Neodymium, a LREE
Nepheline	A rock-forming feldspathoid mineral with composition $Na_3KAl_4Si_4O_{16}$, that occurs in low-silica intrusive and volcanic rocks
Orogen	A belt of rocks characterized by folding, faulting, metamorphism and intrusion recording active ancient tectonic regimes that culminated in mountain-building
Orogeny	A deformation and/or magmatic event in the earth's crust, usually caused by collision between tectonic plates
Paragneiss	Banded metamorphic rock derived from sedimentary rocks
Parisite	A rare earth-bearing fluor-carbonate mineral
Phonolite	Fine-grained to porphyritic igneous rocks that are rich in nepheline and potash feldspar
Plug	A near vertical, more or less cylindrical, intrusion that appears more or less circular in plan
Porphyritic	Igneous rock containing larger crystals of one or more minerals in a dominantly fine grained groundmass
Pm	Promethium, a LREE
Pr	Praseodymium, a LREE
Precambrian	Informal name for the geological time periods that predate the Paleozoic (older than ca. 545 million years)
Radiometrics	A measure of the natural radiation in the earth's surface (sometimes referred to as Gamma-Ray Spectrometry)
Rare Earth Elements	15 elements of the Lanthanide Series ranging from atomic number 57 (Lanthanum) to atomic number 71 (Lutetium)
REO	Rare Earth Oxides
Shear zone	A tabular to sheet-like, planar or curvi-planar zone composed of rocks that are more highly strained than rocks adjacent to the zone, typically zones of much more intense foliation, deformation, and folding
THREE	Total Heavy Rare Earth Elements (includes yttrium)
TREE	Total Rare Earth Elements
TREO	Total Rare Earth Oxides
Schist	A crystalline metamorphic rock having a foliated or parallel fabric resulting from the alignment of platy (micaceous) minerals
Scintillometer	An instrument that measures the intensity of ionizing radiation
SEM (scanning electron microscope)	A type of electron microscope that images a sample by scanning it with a high-energy beam of electrons
Sill	A tabular intrusion that is parallel to the layering in the host rocks
Sm	Samarium, a LREE
Spectrometer (gamma ray)	An instrument capable of detecting and analyzing the spectrum of the intensity of gamma radiation. Specifically, it can measure the relative intensity of radiation resulting from uranium, thorium and potassium
Sövite	The coarse-grained variety or facies of a carbonatite intrusive. Sövite is often a medium to coarse grained

	calcite carbonatite with variable accessory amphibole, biotite, pyrite, pyrochlore and fluorite
Strontianite	A mineral consisting of strontium carbonatite $SrCO_3$
Subsolidus	Refers to chemical reactions in rocks that take place under pressures and temperatures at which the magmatic liquids have completely solidified
Supergene	Process involving circulation of surface waters throughout an orebody, which can result in remobilization and enrichment of metals and minerals
Strike	Horizontal direction or trend of a geological structure, defined as the intersection of a horizontal plane with the plane of the structure
Syenite	An intrusive igneous rock composed dominantly of alkali feldspar, with little or no quartz and ferromagnesian minerals
Synchysite	*A* rare earth-bearing fluor-carbonate mineral
Tb	Terbium, a HREE
Tectonic	Pertaining to the forces involved in, or the resulting structures of, movement in the earth's crust
Thorite	An accessory mineral of composition $(Th,U)SiO_4$, the most common mineral of thorium
Tm	Thulium, a HREE
Trenching	The process of digging shallow linear pits in the shallow overburden to provide access to a more or less continuous section of bedrock
Xenotime	A rare earth-bearing phosphate mineral of composition YPO_4 in which the heavy rare earths are expressive secondary components
XRF (X-Ray Fluorescence)	A routine non-destructive analytical method to determine major and trace element concentrations in geological materials
Y	Yttrium. An element with atomic number 39, which behaves chemically in a similar fashion to the HREE and is typically included with the HREE for purposes of economic valuation
Yb	Ytterbium, a HREE
Zircon	A mineral consisting of zirconium silicate $(ZrSiO_4)$

APPENDIX 2:

Certificates of Qualified Persons

CERTIFICATE of QUALIFIED PERSON

I, H. Scott Swinden, Ph.D, P.Geo. do hereby certify that:

1. I am the Principal Consulting Geologist for :

   Swinden Geoscience Consultants Ltd.,
   3 Crest Road,
   Halifax, Nova Scotia B3M 2W1
   CANADA

2. I have the following academic qualifications:

Ph.D. (Earth Sciences), 1988	Memorial University of Newfoundland
M.Sc. (Geology), 1976	Memorial University of Newfoundland
B.Sc. (Honours in Geology), 1970	Dalhousie University

3. I am a member in good standing of the Association of Professional Geoscientists of Nova Scotia (No. 085), Fellow of the Geological Association of Canada, the Canadian Institute of Mining, Metallurgy and Petroleum, and the Society of Economic Geologists and Adjunct Professor of Earth Sciences at Dalhousie University.
4. I have worked as a geologist for more than 40 years since graduation from University with my first degree.
5. I have read the definition of "qualified person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am responsible for the preparation of all sections of the technical report (except Items 12 and 14) titled "NI 43-101 Technical Report and Mineral Resource Estimate for Songwe Hilll Rare Earth Element (REE) Project, Phalombe District, Republic of Malawi" which has an effective date of September 30, 2012 and is dated November 22, 2012 (the "Technical Report").
7. I have conducted 2 visits to the Songwe Hill Project, from April 21 to April 25, 2012 and from October 11 to October 16, 2012.
8. I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement is as an independent consultant to Mkango Resources Ltd since March, 2012.
9. To the best of my knowledge, as of 30 September, 2012, the Technical Report contains all the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
10. I am independent of the issuer applying all of the tests in Section 1.4 of National Instrument 43-101.
11. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that Instrument and Form.
12. I consent to the filing of the Technical Report with any stock exchange and other regulatory authority and any publication by them for regulatory purposes, including electronic publication in the public company files on their websites accessible by the public, of the Technical Report.

Dated this 22nd day of November, 2012

H. Scott Swinden Ph.D., P.Geo.

CERTIFICATE of QUALIFIED PERSON

I, Michael Robert Hall; Pr.Sci.Nat. do hereby certify that:

1. I am a Mineral Resource Consultant for:

   The MSA Group (Pty) Ltd,

   20B Rothesay Avenue,

   Craighall Park,

   2196

   Johannesburg

   SOUTH AFRICA

2. I graduated with a degree in BSc Eng (Mining Geology) from the University of the Leicester, England in 1980. In addition, I obtained an MBA from the Business School at the University of the Witwatersrand in 2003.
3. I am a member in good standing with the South African Council of Natural and Scientific Professions (SACNASP) the Geological Society of South Africa (GSSA).
4. I have worked as a geologist for a total of 31 years since my graduation from University.
5. I have read the definition of "qualified person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.
6. I am responsible for the preparation of Sections 12 and 14 of the technical report "NI 43-101 Technical Report and Mineral Resource Estimate for Songwe Hilll Rare Earth Element (REE) Project, Phalombe District, Republic of Malawi" which has an effective data of September 30, 2012 and is dated November 22, 2012 (the "Technical Report") relating to the Songwe Hill Prospecting Right property.
7. I visited the Songwe Project on September 1 to 3, 2012.
8. I have not had prior involvement with the property that is the subject of this Technical Report.
9. To the best of my knowledge, as of 30 September, 2012, the Technical Report contains all the scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
10. I am independent of the issuer applying all of the tests in Section 1.4 of National Instrument 43-101.
11. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that Instrument and Form.
12. I consent to the filing of the Technical Report with any stock exchange and other regulatory authority and any publication by them for regulatory purposes, including electronic publication in the public company files on their websites accessible by the public, of the Technical Report.

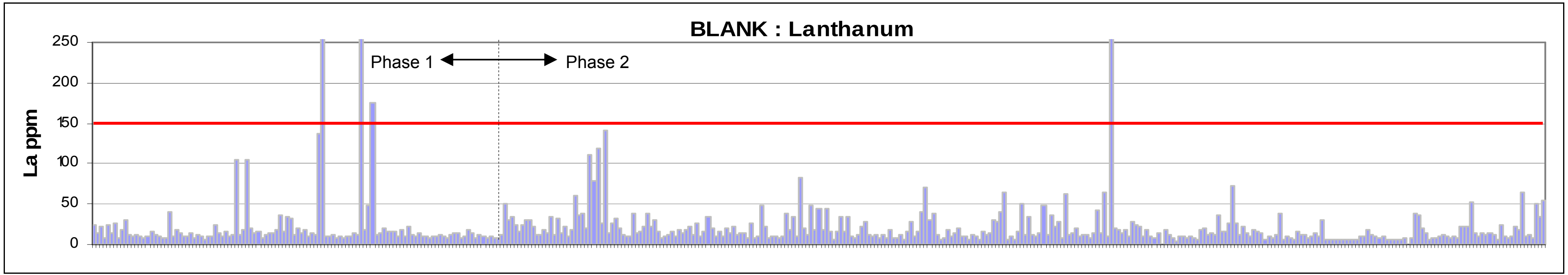
Dated this 22nd day of November, 2012

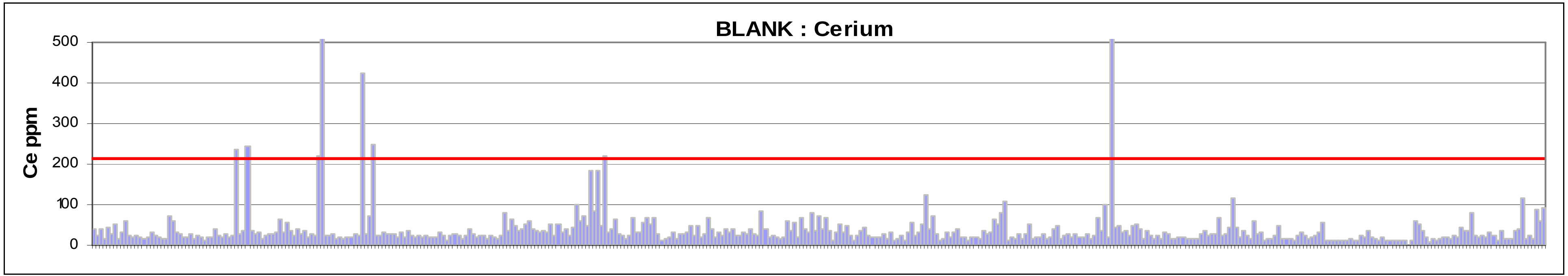
Michael Robert Hall MBA

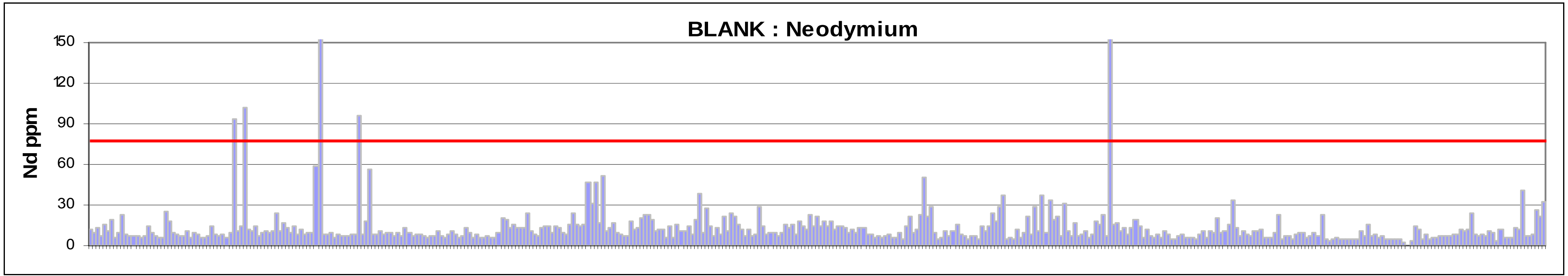
APPENDIX 3:

QA/QC Summaries

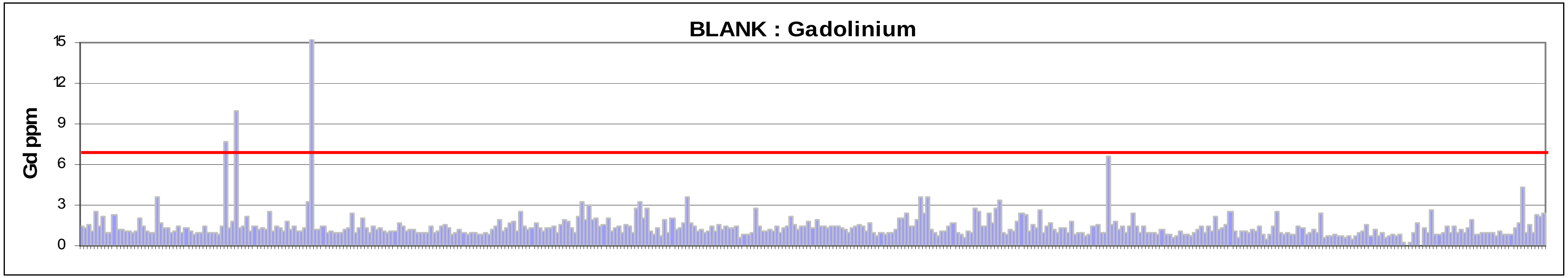
Performance of selected light rare earth elements in 407 Blank samples:

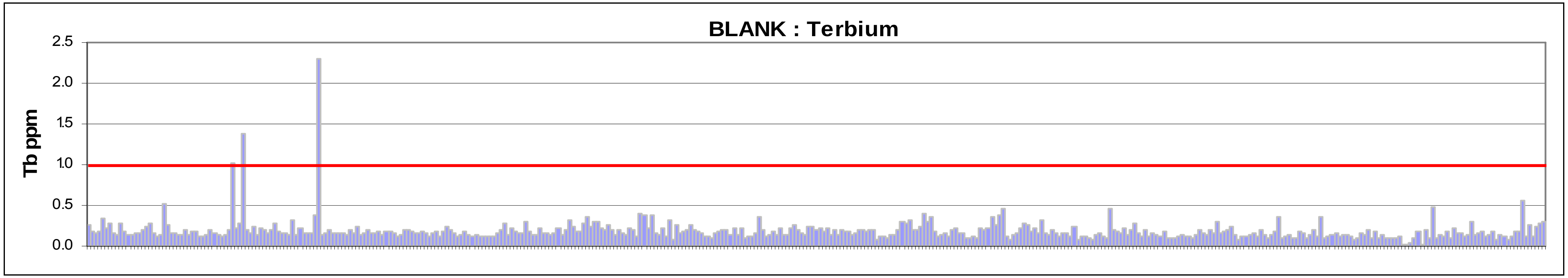


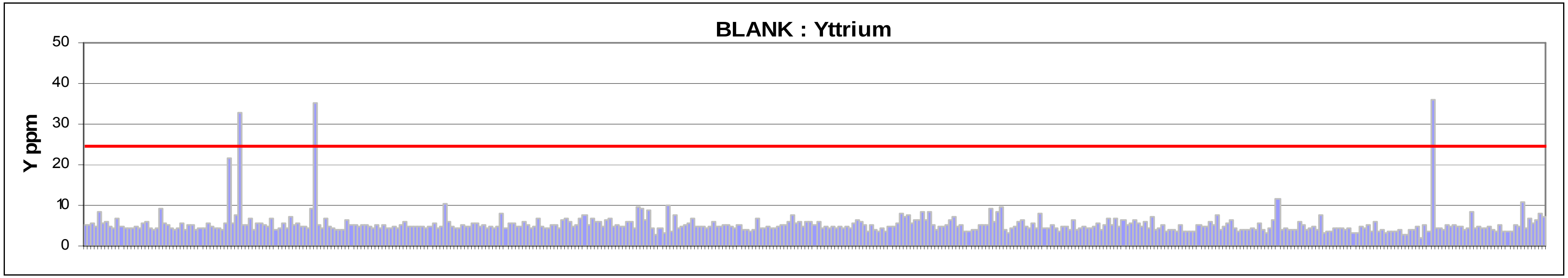




Performance of selected heavy rare earth elements in 407 Blank samples:

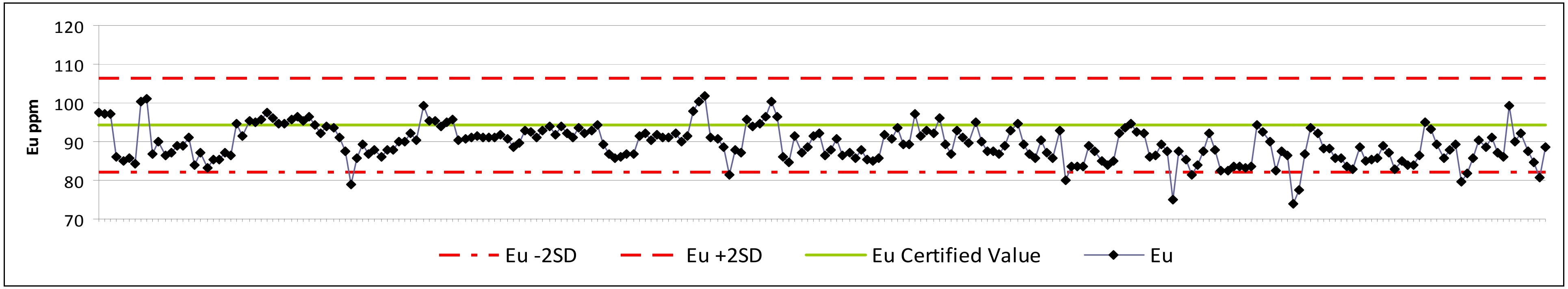


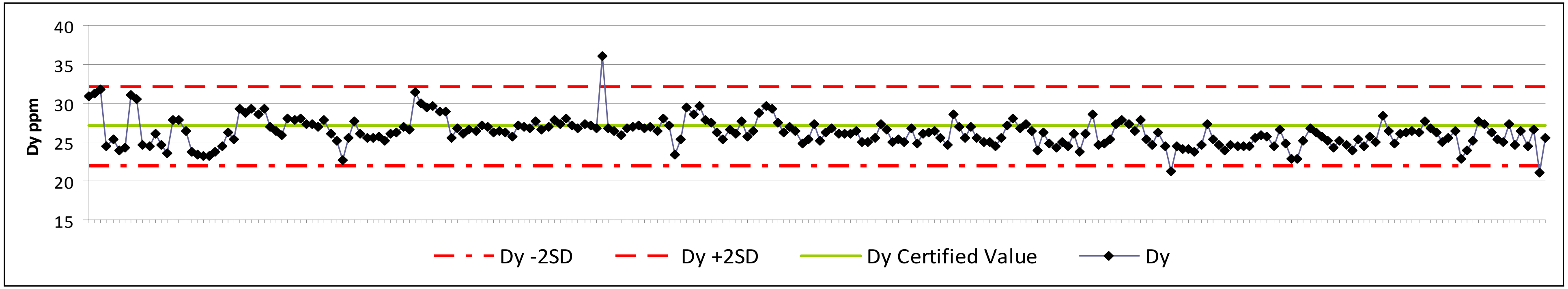


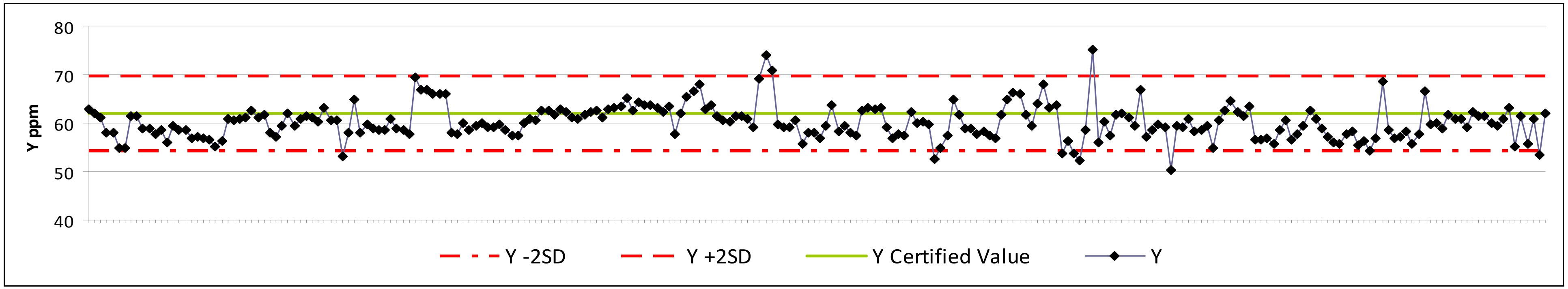


Accuracy of selected light rare earth elements in 242 samples of CRM AMIS185:

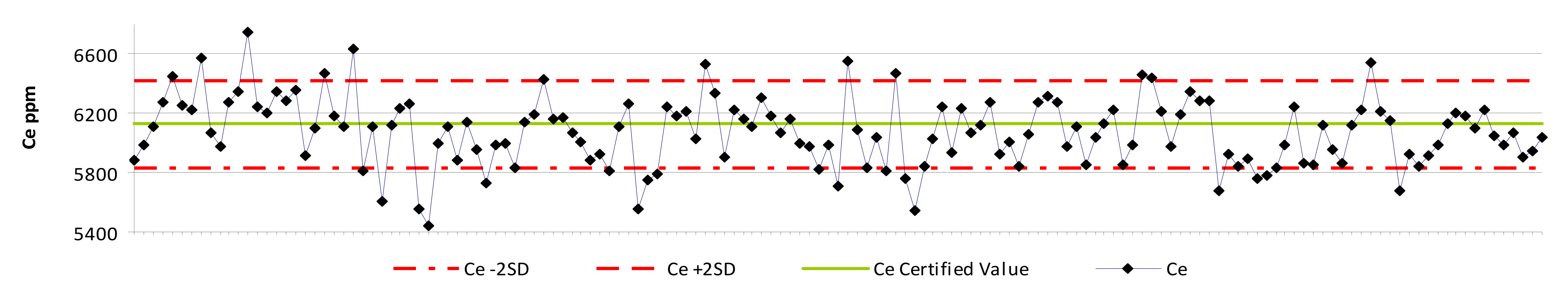
Accuracy of selected heavy rare earth elements in 242 samples of CRM AMIS185:

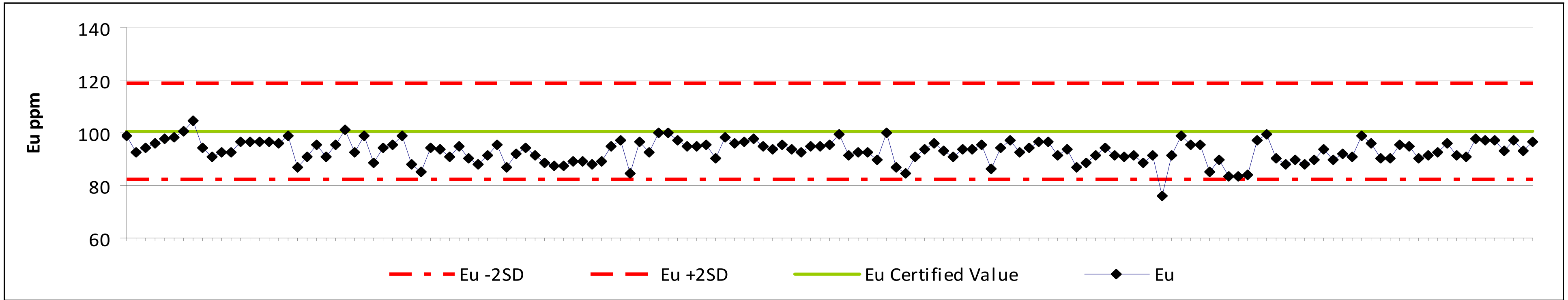


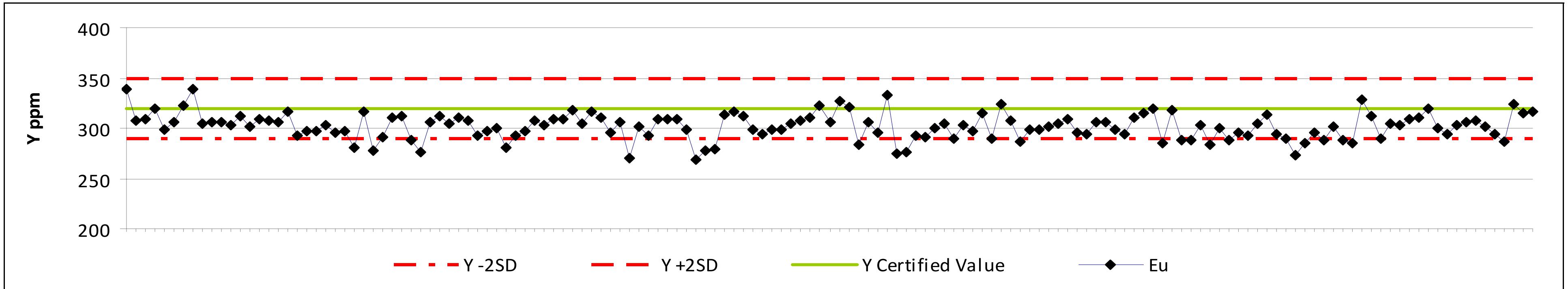




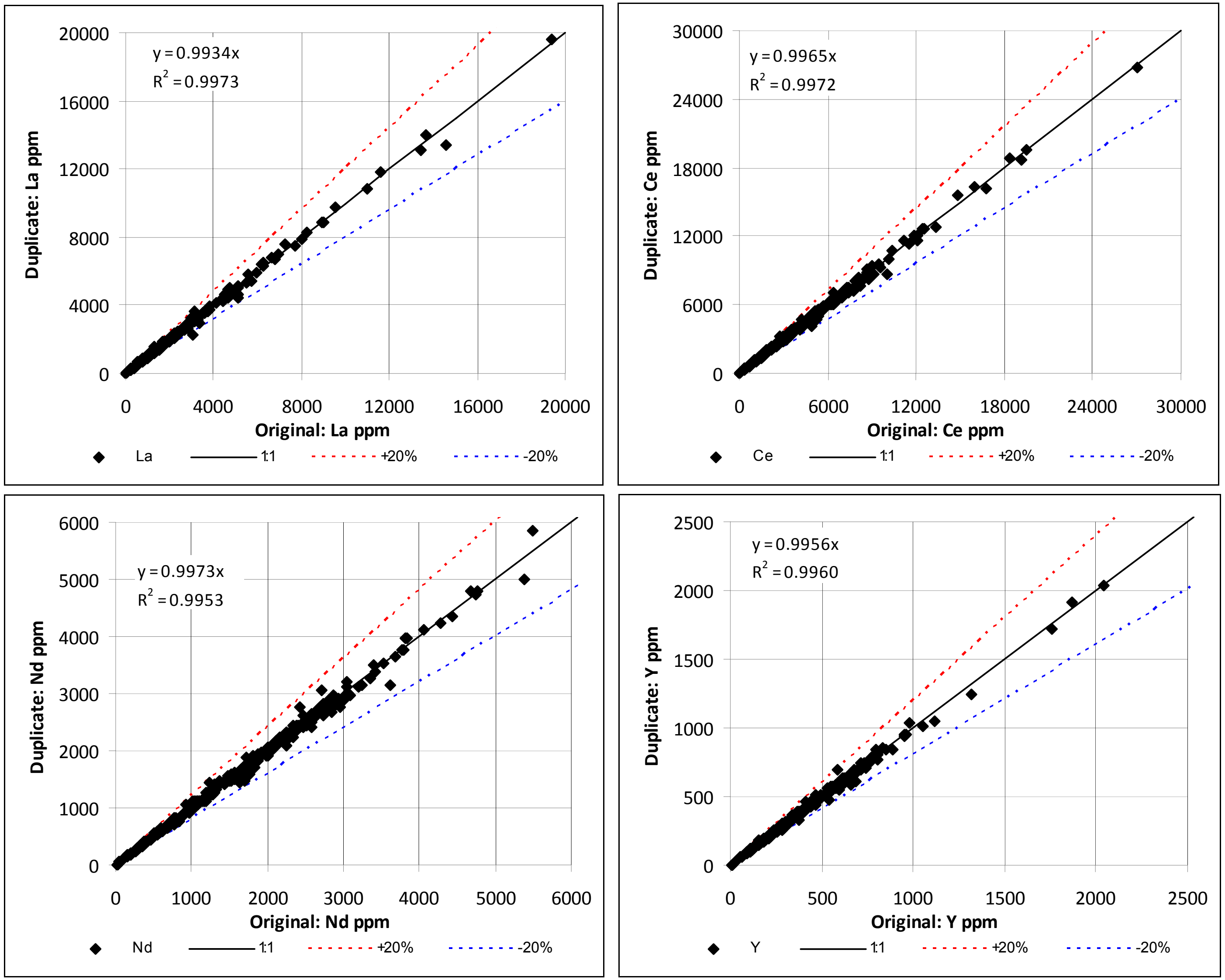
Accuracy of selected light and heavy rare earth elements in 149 samples of CRM GRE-04:



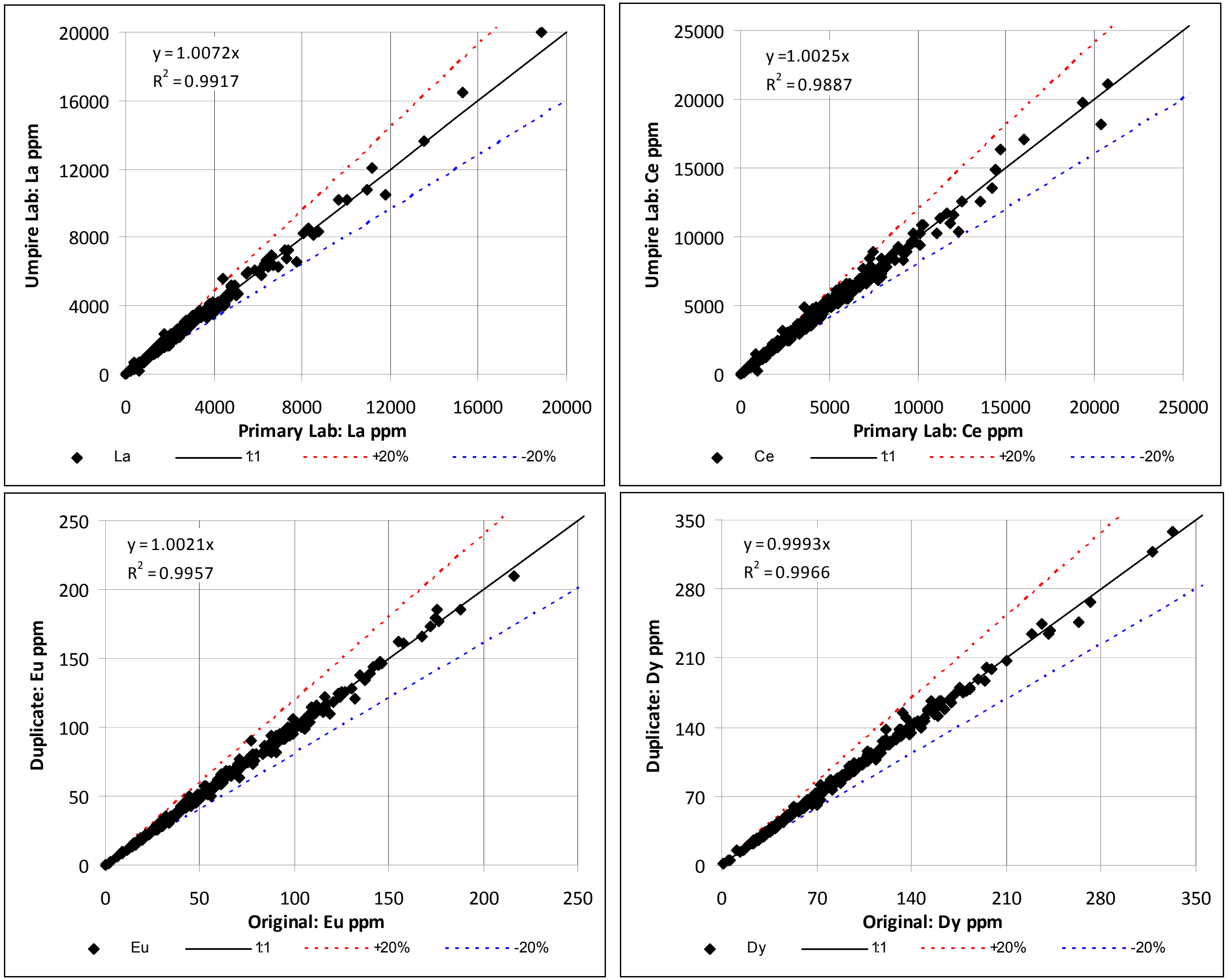




Repeatability of selected light and heavy rare earth elements in 297 duplicate sample pairs



Repeatability of selected light and heavy rare earth elements in 405 umpire laboratory sample pairs

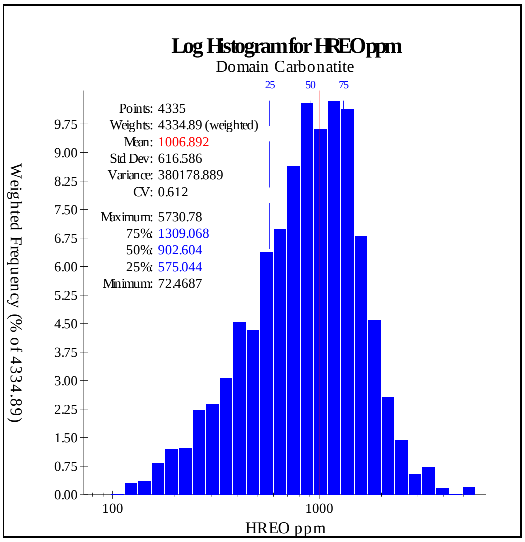


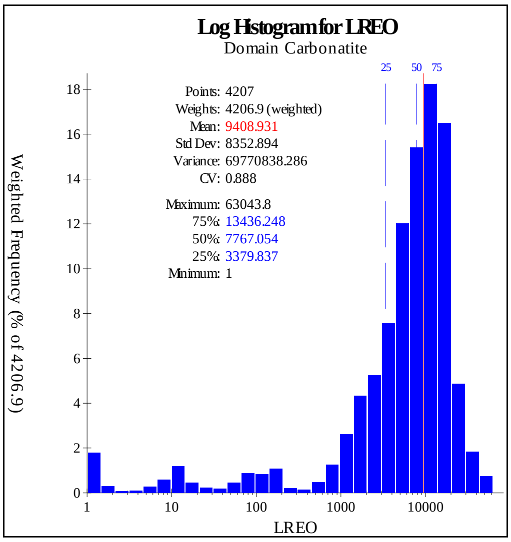
APPENDIX 4:

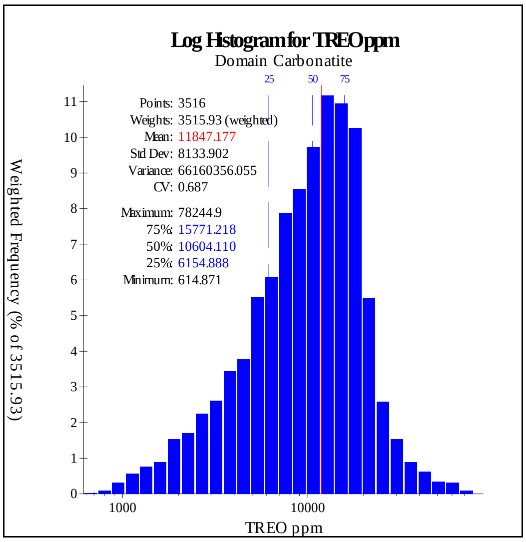
Domain Histograms

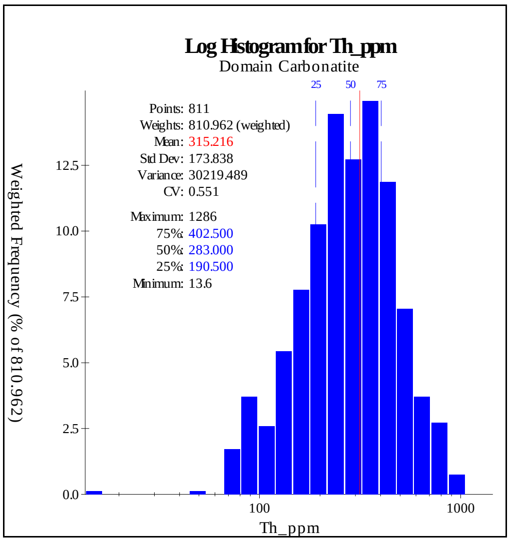
Boreholes vs Channel samples

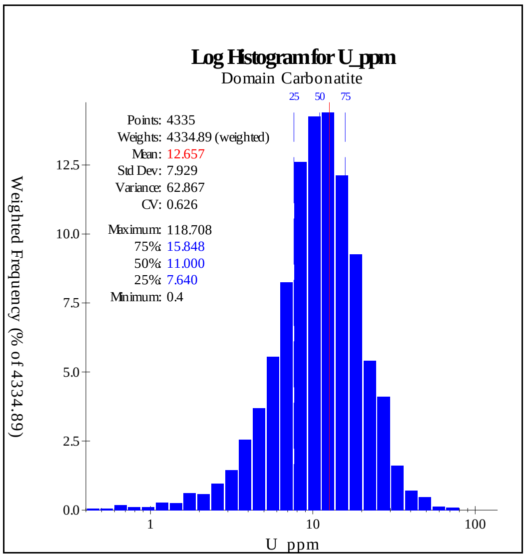
Carbonatite: Borehole samples

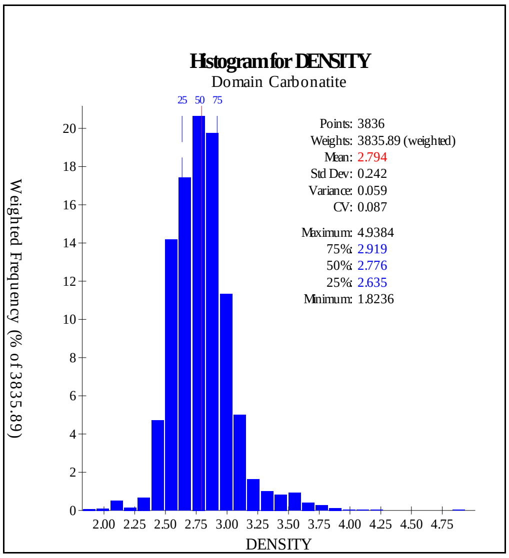




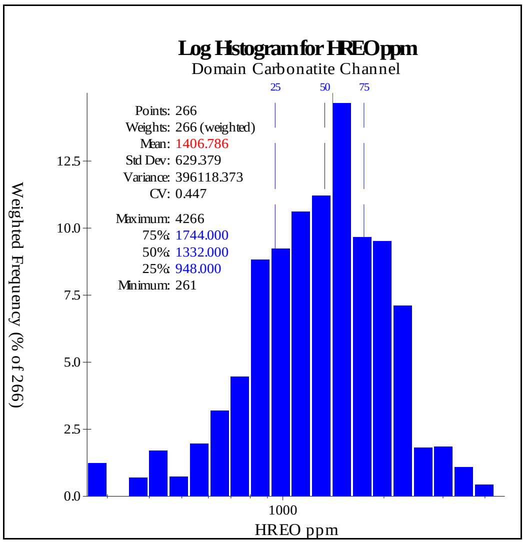


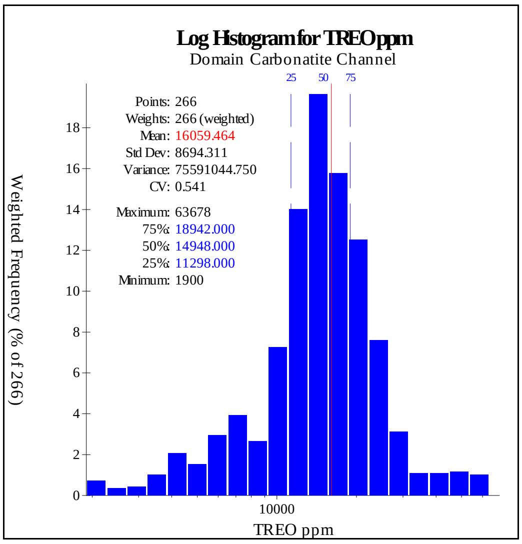


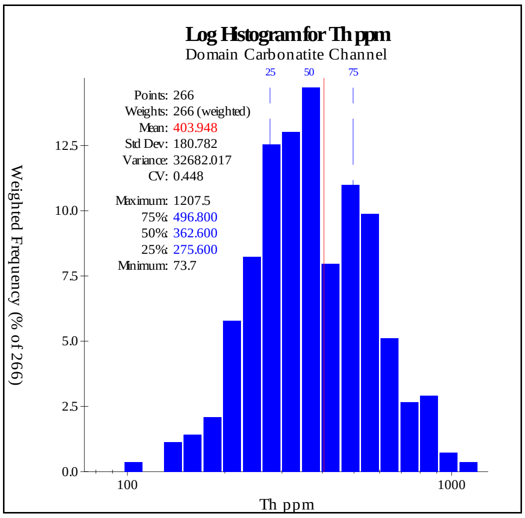


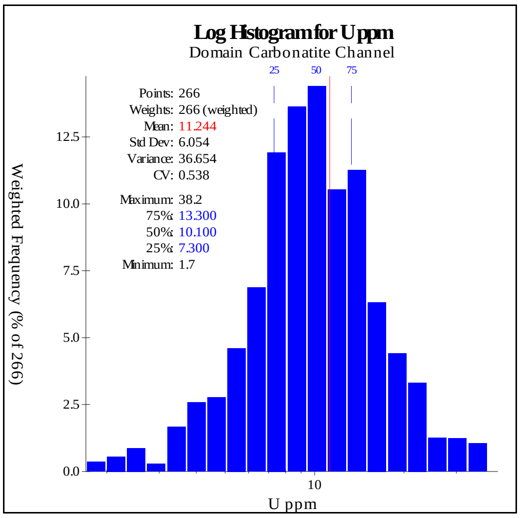


Carbonatite: Channel samples

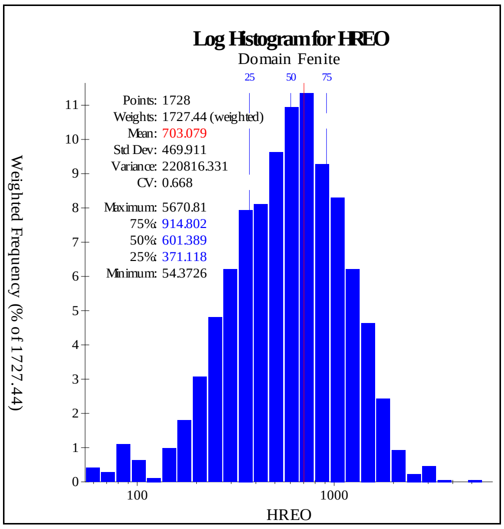


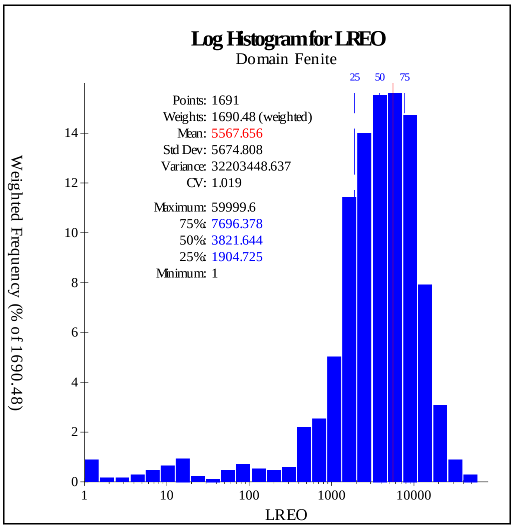


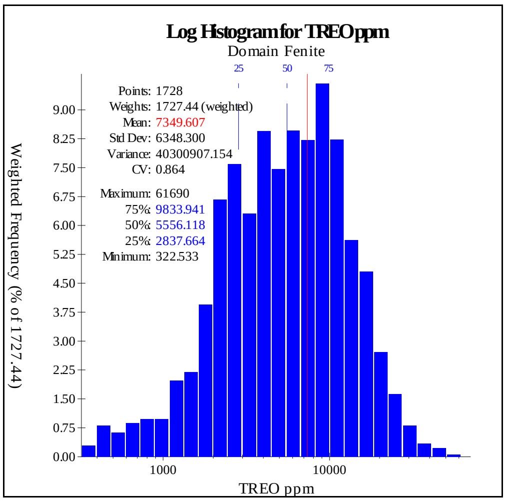


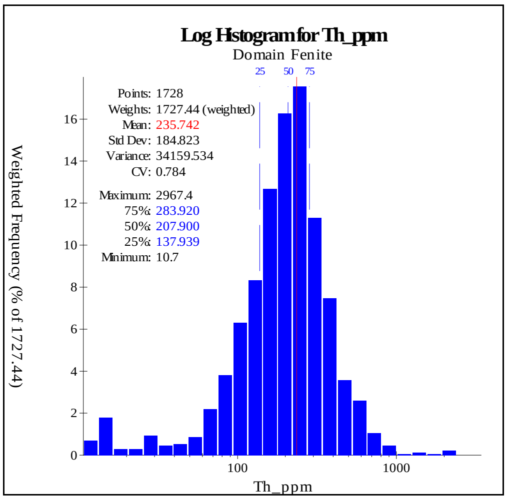


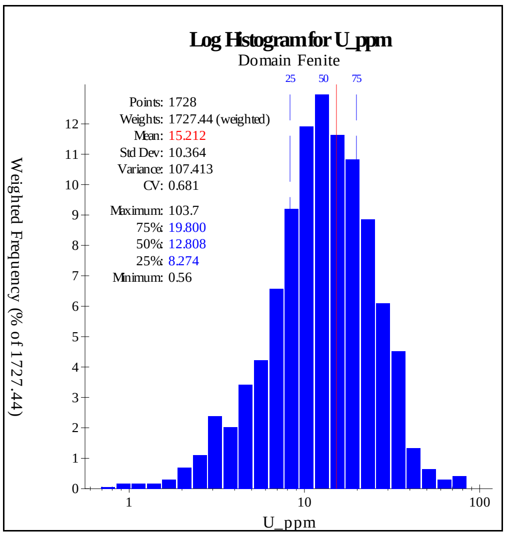
Fenite: Boreholes samples

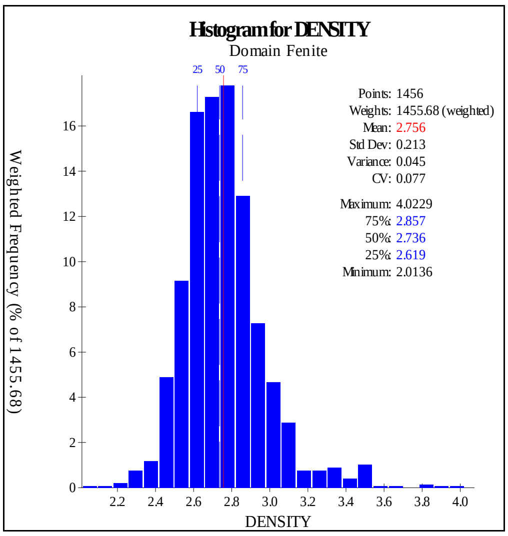




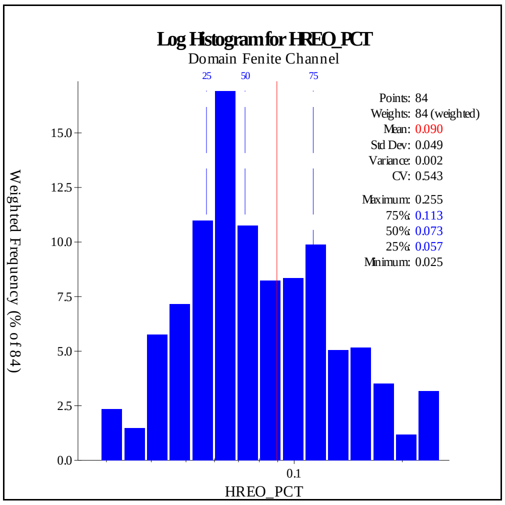


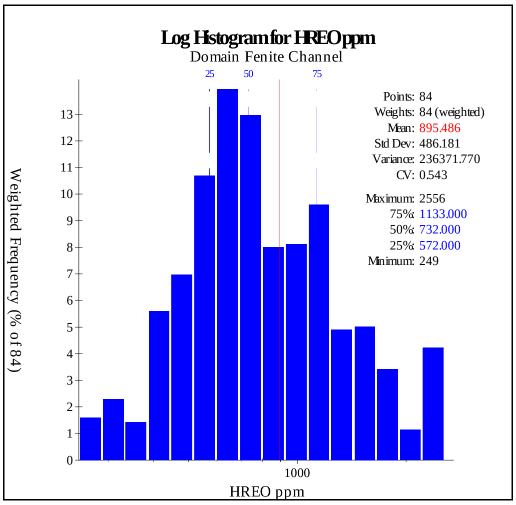


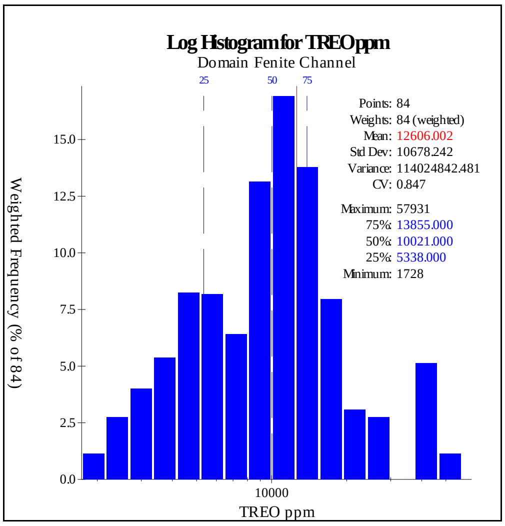


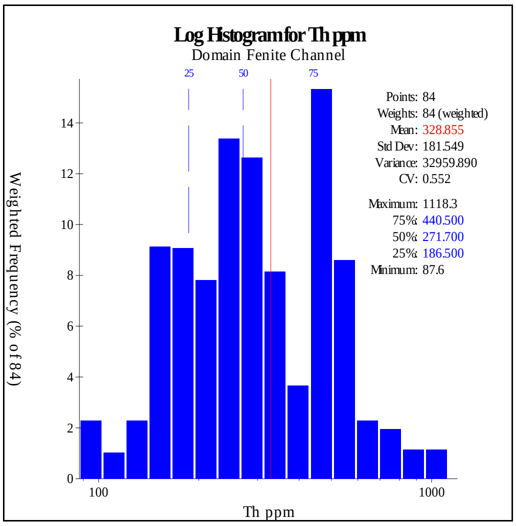


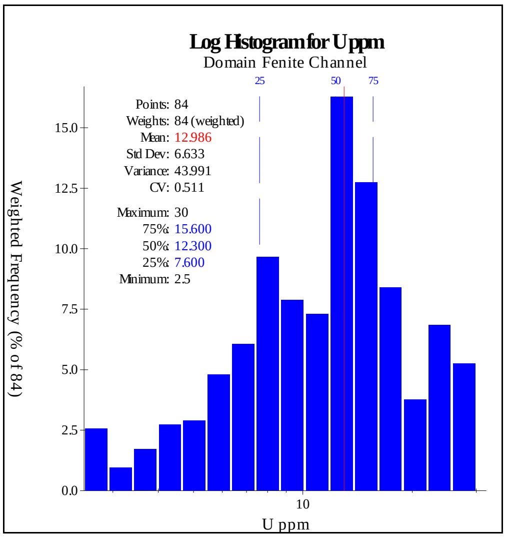
Fenite: Channel samples



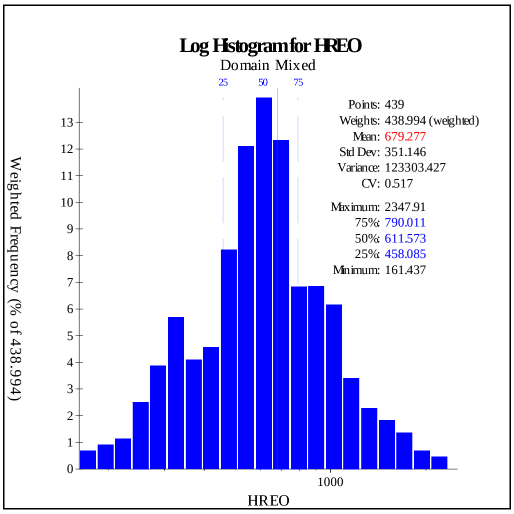


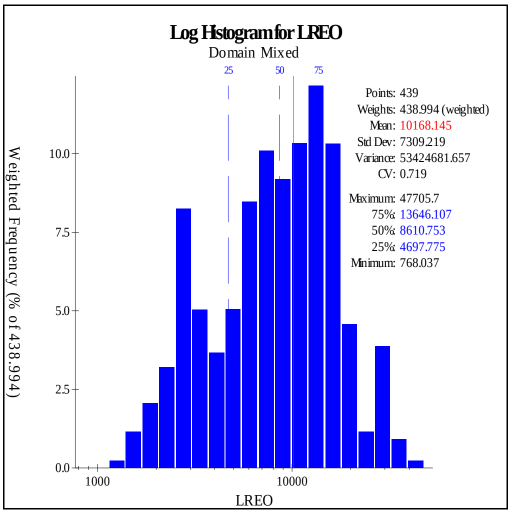


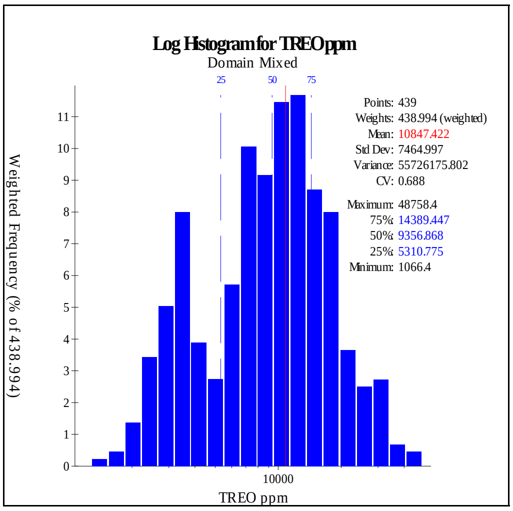


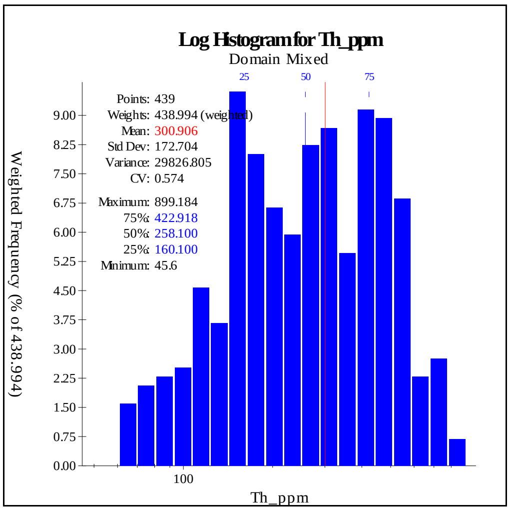


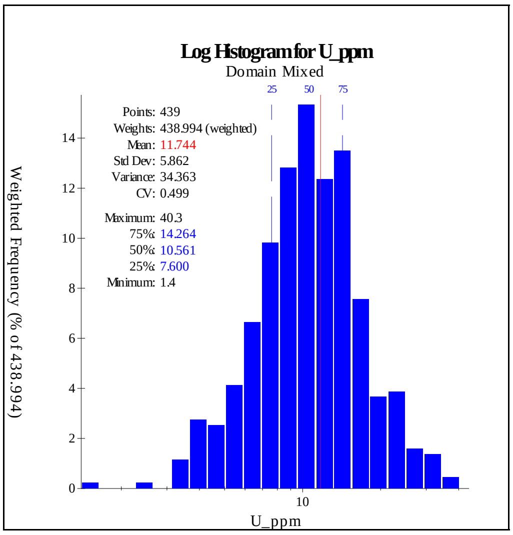
Mixed: Borehole samples

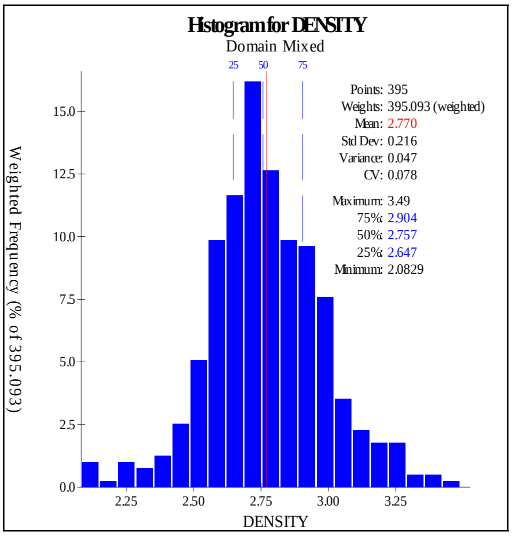




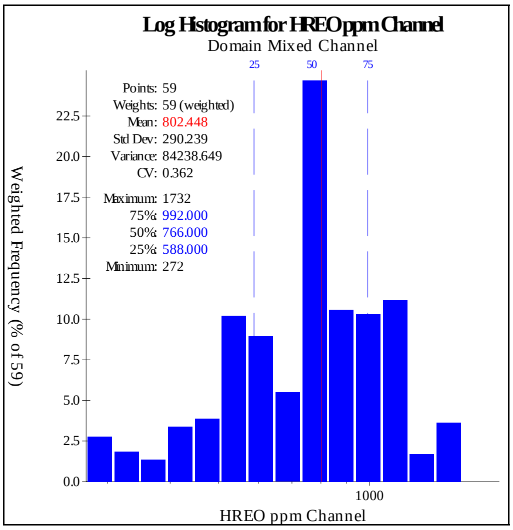


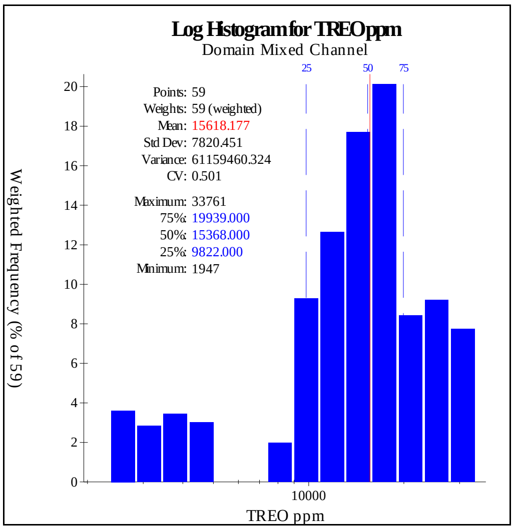


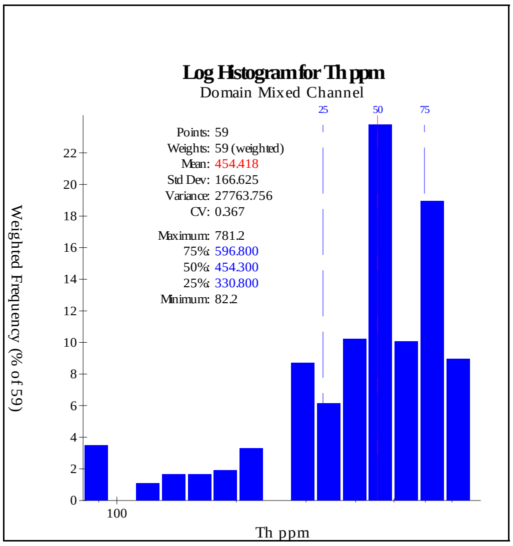


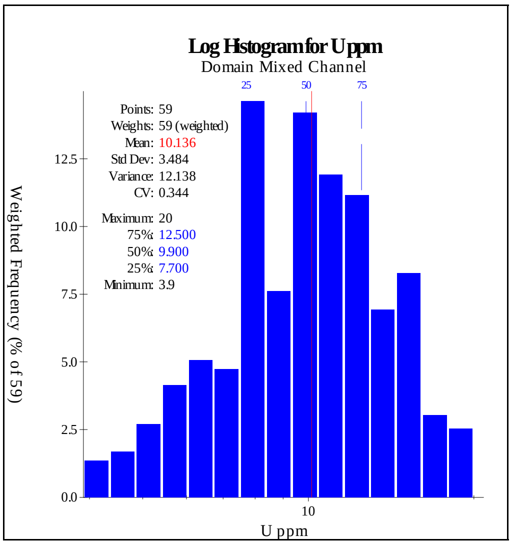


Mixed: Channel samples





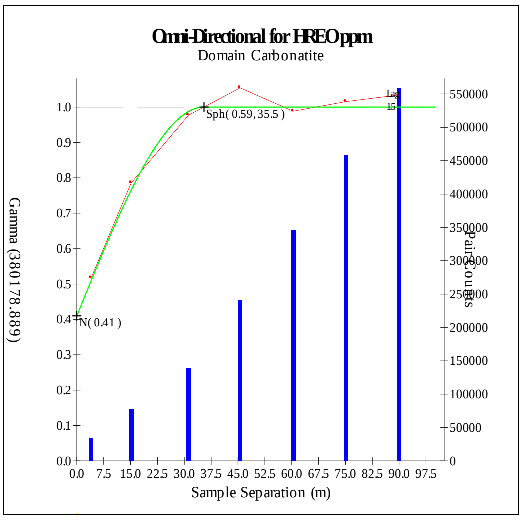


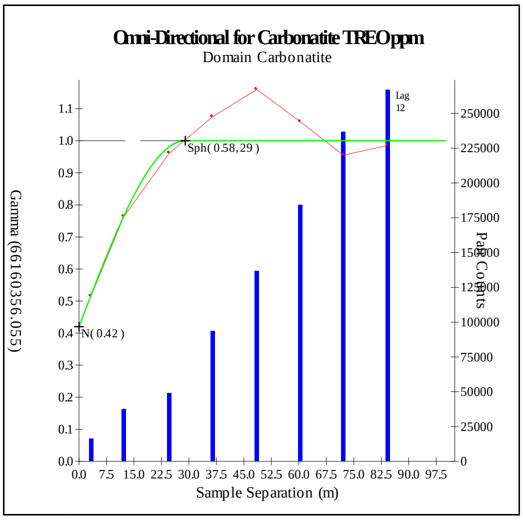


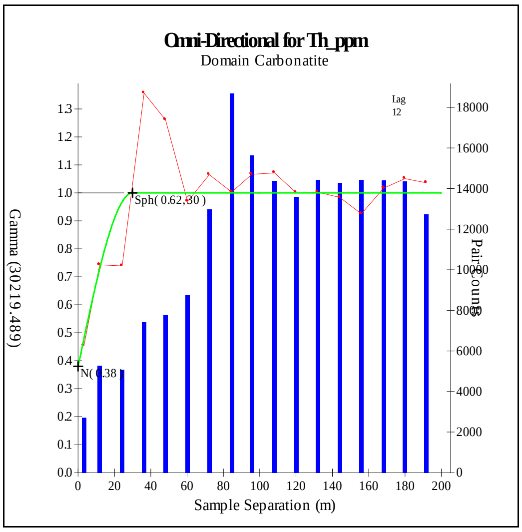
APPENDIX 5:

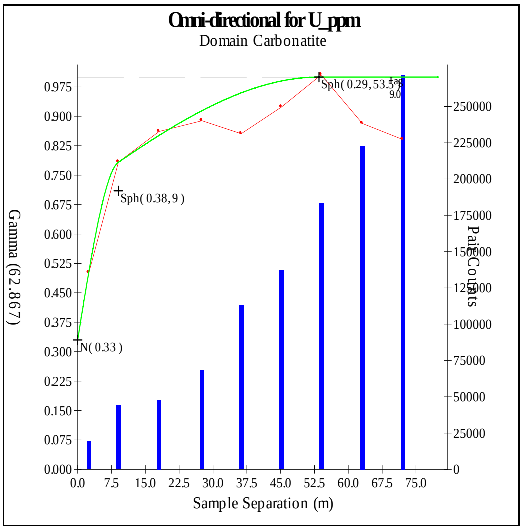
Variograms of 3 Domains

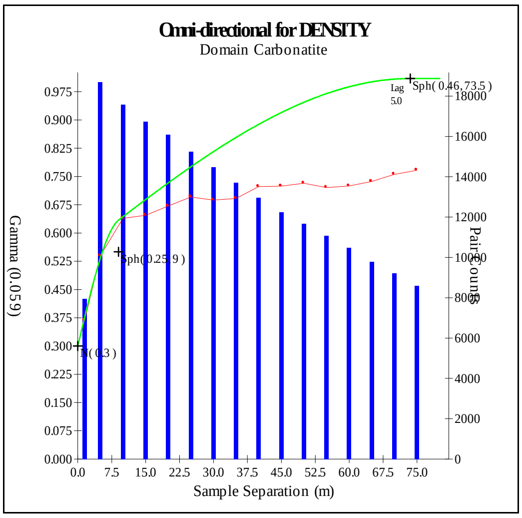
Carbonatite Domain



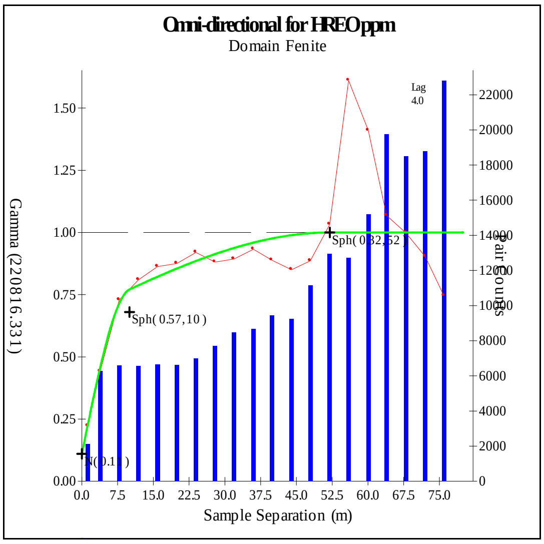


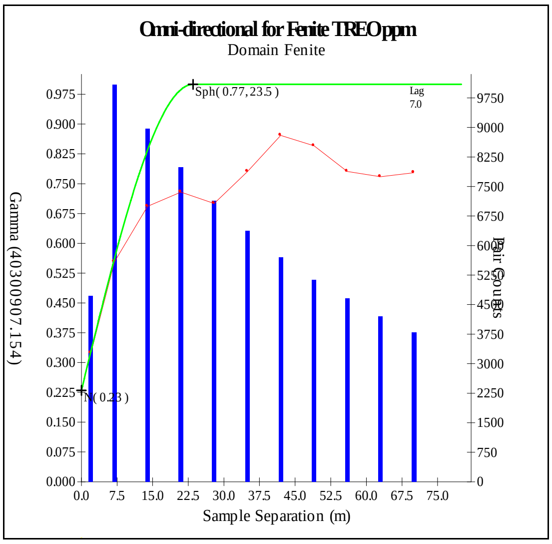


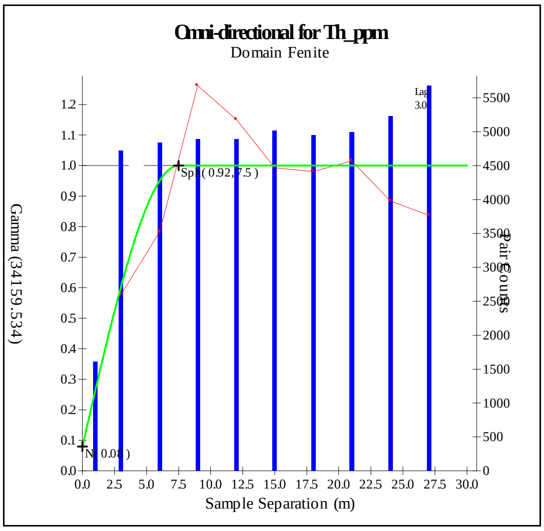


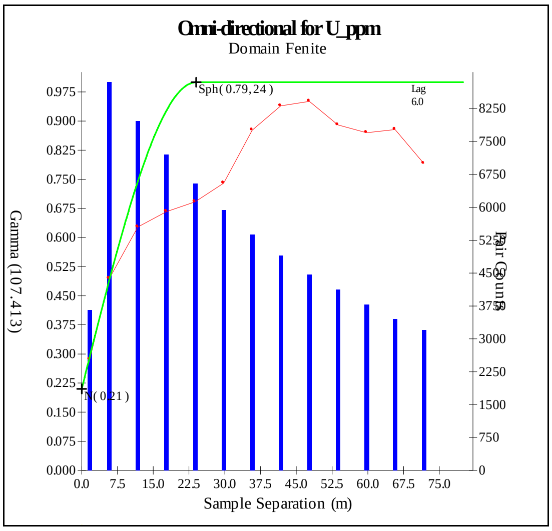


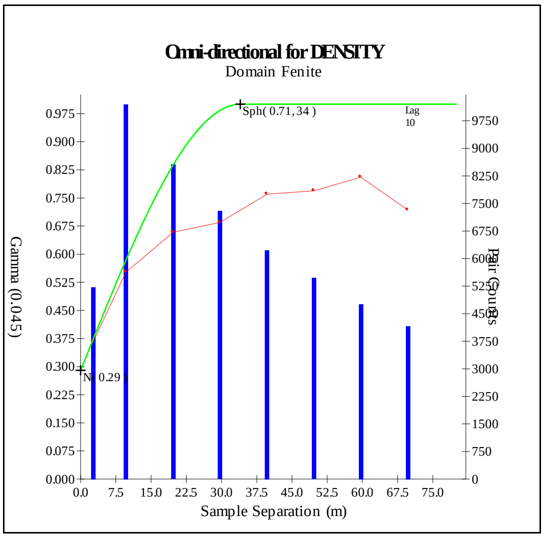
Fenite Domain



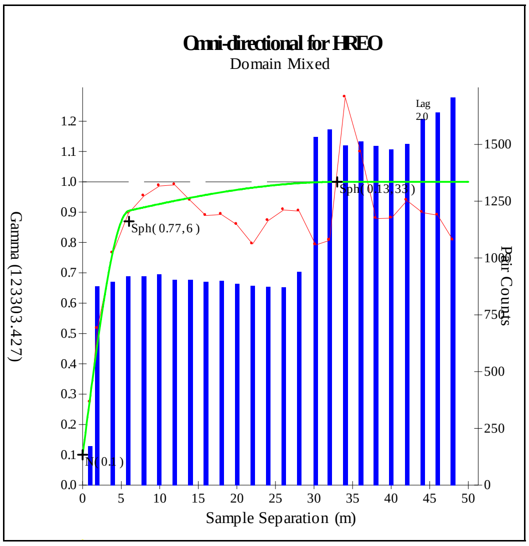


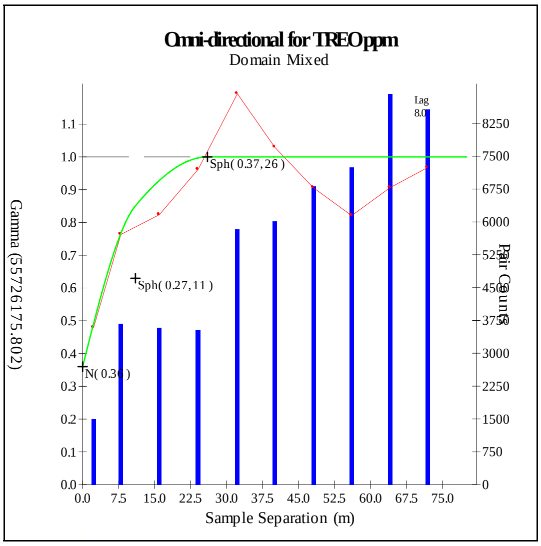


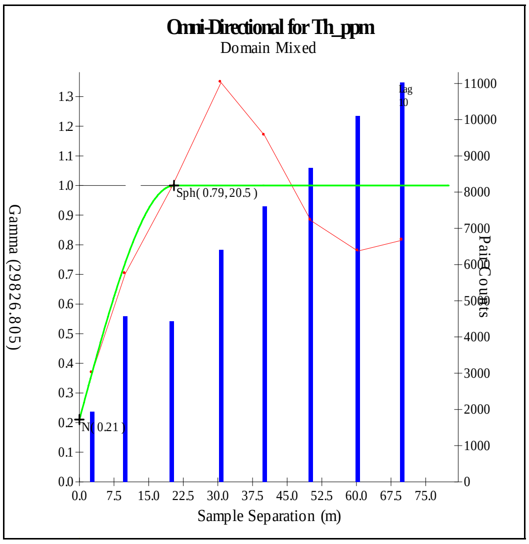


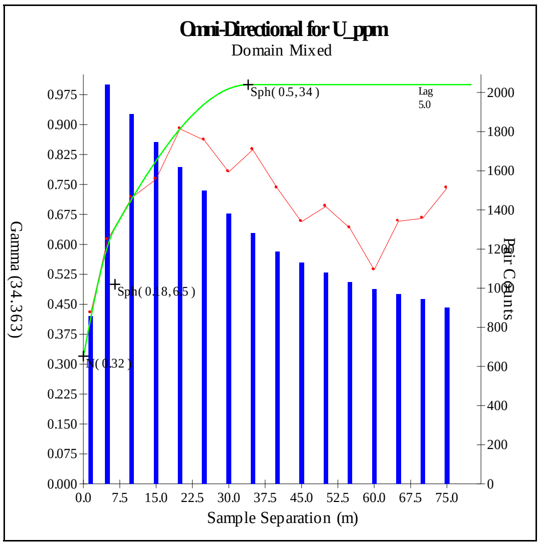


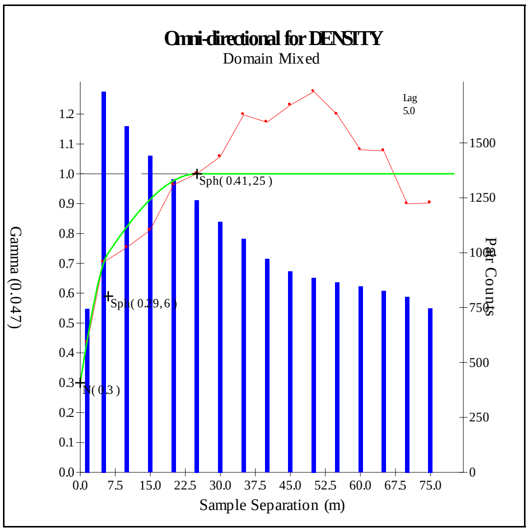
Mixed Domain











APPENDIX 6:

Individual REO Concentrations

REO Concentrations by Domain

In-situ Indicated Carbonatite Mineral Resource

Cut-Off %TREO	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	LREO %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	HREO %	TREO %	Th ppm	U ppm
0.5	16.31	0.3274	0.5973	0.0642	0.2217	0.0321	1.2426	0.0085	0.0200	0.0024	0.0114	0.0018	0.0044	0.0006	0.0032	0.0004	0.0530	0.1058	1.3484	322	12
1	11.10	0.3951	0.7208	0.0775	0.2676	0.0387	1.4997	0.0095	0.0223	0.0027	0.0127	0.0021	0.0048	0.0006	0.0036	0.0005	0.0590	0.1178	1.6175	351	12
1.5	5.26	0.5022	0.9163	0.0985	0.3401	0.0492	1.9063	0.0103	0.0241	0.0029	0.0137	0.0022	0.0052	0.0007	0.0039	0.0005	0.0639	0.1275	2.0338	385	12
2	1.85	0.6582	1.2008	0.1291	0.4457	0.0645	2.4982	0.0104	0.0244	0.0029	0.0138	0.0022	0.0053	0.0007	0.0039	0.0005	0.0645	0.1286	2.6269	429	12

In-situ Inferred Carbonatite Mineral Resource

Cut-Off %TREO	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	LREO %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	HREO %	TREO %	Th ppm	U ppm
0.5	17.09	0.2568	0.4686	0.0504	0.1739	0.0252	0.9748	0.0077	0.0180	0.0022	0.0102	0.0017	0.0039	0.0005	0.0029	0.0004	0.0476	0.0949	1.0698	304	12
1	8.64	0.3275	0.5974	0.0642	0.2218	0.0321	1.2430	0.0090	0.0211	0.0025	0.0120	0.0019	0.0046	0.0006	0.0034	0.0005	0.0559	0.1115	1.3545	324	11
1.5	1.90	0.4539	0.8281	0.0890	0.3074	0.0445	1.7228	0.0099	0.0233	0.0028	0.0132	0.0021	0.0051	0.0006	0.0037	0.0005	0.0616	0.1230	1.8458	349	11
2	0.39	0.6280	1.1457	0.1232	0.4253	0.0615	2.3837	0.0096	0.0224	0.0027	0.0127	0.0021	0.0049	0.0006	0.0036	0.0005	0.0593	0.1183	2.5020	358	11

In-situ Indicated Mixed Mineral Resource

Cut-Off %TREO	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	LREO %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	HREO %	TREO %	Th ppm	U ppm
0.5	1.01	0.3749	0.6369	0.0642	0.2051	0.0278	1.3088	0.0061	0.0144	0.0017	0.0076	0.0012	0.0029	0.0004	0.0022	0.0003	0.0351	0.0717	1.3805	318	12
1	0.69	0.4520	0.7678	0.0774	0.2473	0.0335	1.5780	0.0063	0.0148	0.0017	0.0079	0.0013	0.0029	0.0004	0.0022	0.0003	0.0362	0.0739	1.6519	335	12
1.5	0.31	0.6051	1.0280	0.1037	0.3311	0.0448	2.1127	0.0069	0.0163	0.0019	0.0087	0.0014	0.0032	0.0004	0.0025	0.0003	0.0399	0.0816	2.1943	387	14
2	0.15	0.7440	1.2640	0.1275	0.4071	0.0551	2.5977	0.0069	0.0162	0.0019	0.0086	0.0014	0.0032	0.0004	0.0024	0.0003	0.0395	0.0808	2.6784	420	17

REO Concentrations by Domain

In-situ Inferred Mixed Mineral Resource

Cut-Off %TREO	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	LREO %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	HREO %	TREO %	Th ppm	U ppm
0.5	1.90	0.4289	0.7287	0.0735	0.2347	0.0318	1.4976	0.0053	0.0125	0.0015	0.0066	0.0011	0.0025	0.0003	0.0019	0.0003	0.0305	0.0624	1.5600	251	11
1	1.68	0.4559	0.7746	0.0781	0.2495	0.0338	1.5918	0.0053	0.0125	0.0014	0.0066	0.0011	0.0025	0.0003	0.0019	0.0003	0.0304	0.0622	1.6541	248	11
1.5	1.43	0.4802	0.8158	0.0823	0.2628	0.0356	1.6766	0.0053	0.0124	0.0014	0.0066	0.0011	0.0025	0.0003	0.0019	0.0003	0.0302	0.0618	1.7384	243	11
2	0.11	0.6573	1.1167	0.1126	0.3597	0.0487	2.2950	0.0057	0.0134	0.0016	0.0071	0.0011	0.0027	0.0003	0.0020	0.0003	0.0327	0.0668	2.3618	255	11

In-situ Indicated Fenite Mineral Resource

Cut-Off %TREO	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	LREO %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	HREO %	TREO %	Th ppm	U ppm
0.5	2.71	0.2876	0.5228	0.0563	0.1936	0.0292	1.0895	0.0064	0.0158	0.0020	0.0098	0.0016	0.0039	0.0005	0.0027	0.0004	0.0459	0.0889	1.1784	288	13
1	1.37	0.3980	0.7235	0.0779	0.2679	0.0404	1.5077	0.0076	0.0186	0.0024	0.0116	0.0019	0.0046	0.0006	0.0032	0.0004	0.0542	0.1050	1.6127	301	11
1.5	0.59	0.5236	0.9517	0.1025	0.3524	0.0531	1.9833	0.0088	0.0217	0.0028	0.0135	0.0022	0.0053	0.0007	0.0038	0.0005	0.0633	0.1226	2.1060	334	10
2	0.24	0.6478	1.1774	0.1268	0.4360	0.0657	2.4538	0.0101	0.0248	0.0032	0.0155	0.0025	0.0061	0.0008	0.0043	0.0006	0.0724	0.1402	2.5940	378	10

In-situ Inferred Fenite Mineral Resource

Cut-Off %TREO	Tonnes Million	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	LREO %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	HREO %	TREO %	Th ppm	U ppm
0.5	17.47	0.2564	0.4661	0.0502	0.1726	0.0260	0.9713	0.0062	0.0153	0.0019	0.0095	0.0016	0.0038	0.0005	0.0026	0.0004	0.0446	0.0863	1.0577	271	13
1	8.27	0.3286	0.5973	0.0643	0.2212	0.0333	1.2448	0.0073	0.0180	0.0023	0.0112	0.0018	0.0044	0.0005	0.0031	0.0004	0.0523	0.1014	1.3462	295	12
1.5	1.73	0.4631	0.8417	0.0907	0.3117	0.0470	1.7541	0.0088	0.0215	0.0027	0.0134	0.0022	0.0053	0.0007	0.0037	0.0005	0.0627	0.1215	1.8756	331	11
2	0.41	0.5998	1.0901	0.1174	0.4037	0.0608	2.2719	0.0099	0.0243	0.0031	0.0151	0.0025	0.0060	0.0007	0.0042	0.0006	0.0707	0.1370	2.4089	350	11

APPENDIX 7:

Individual REO Distribution

REO Distribution by Domain

***In-situ* Indicated Carbonatite Mineral Resource - REO Distributions at 0.5%, 1.0%, 1.5% and 2.0% TREO Cut-Offs**

Cut-Off %TREO	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
0.5	24.28	44.29	4.76	16.44	2.38	0.63	1.49	0.18	0.84	0.14	0.32	0.04	0.24	0.03	3.93	100
1	24.43	44.56	4.79	16.54	2.39	0.59	1.38	0.17	0.78	0.13	0.30	0.04	0.22	0.03	3.65	100
1.5	24.69	45.05	4.84	16.72	2.42	0.51	1.19	0.14	0.67	0.11	0.26	0.03	0.19	0.03	3.14	100
2	25.06	45.71	4.91	16.97	2.45	0.40	0.93	0.11	0.53	0.09	0.20	0.03	0.15	0.02	2.45	100

***In-situ* Inferred Carbonatite Mineral Resource - REO Distributions at 0.5%, 1.0%, 1.5% and 2.0% TREO Cut-Offs**

Cut-Off %TREO	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
0.5	24.01	43.80	4.71	16.26	2.35	0.72	1.68	0.20	0.95	0.15	0.37	0.05	0.27	0.04	4.45	100
1	24.18	44.11	4.74	16.37	2.37	0.67	1.56	0.19	0.89	0.14	0.34	0.04	0.25	0.03	4.12	100
1.5	24.59	44.86	4.82	16.65	2.41	0.54	1.26	0.15	0.72	0.12	0.27	0.04	0.20	0.03	3.34	100
2	25.10	45.79	4.92	17.00	2.46	0.38	0.90	0.11	0.51	0.08	0.19	0.02	0.14	0.02	2.37	100

***In-situ* Indicated Mixed Mineral Resource - REO Distributions at 0.5%, 1.0%, 1.5% and 2.0% TREO Cut-Offs**

Cut-Off %TREO	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
0.5	27.15	46.13	4.65	14.86	2.01	0.44	1.04	0.12	0.55	0.09	0.21	0.03	0.16	0.02	2.54	100
1	27.36	46.48	4.69	14.97	2.03	0.38	0.90	0.10	0.48	0.08	0.18	0.02	0.13	0.02	2.19	100
1.5	27.58	46.85	4.72	15.09	2.04	0.32	0.74	0.09	0.40	0.06	0.15	0.02	0.11	0.02	1.82	100
2	27.78	47.19	4.76	15.20	2.06	0.26	0.60	0.07	0.32	0.05	0.12	0.02	0.09	0.01	1.47	100

REO Distribution by Domain

In-situ Inferred Mixed Mineral Resource - REO Distributions at 0.5%, 1.0%, 1.5% and 2.0% TREO Cut-Offs

Cut-Off %TREO	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
0.5	27.50	46.71	4.71	15.05	2.04	0.34	0.80	0.09	0.43	0.07	0.16	0.02	0.12	0.02	1.96	100
1	27.56	46.83	4.72	15.08	2.04	0.32	0.75	0.09	0.40	0.06	0.15	0.02	0.11	0.02	1.84	100
1.5	27.62	46.93	4.73	15.12	2.05	0.30	0.71	0.08	0.38	0.06	0.14	0.02	0.11	0.02	1.74	100
2	27.83	47.28	4.77	15.23	2.06	0.24	0.57	0.07	0.30	0.05	0.11	0.01	0.09	0.01	1.38	100

In-situ Indicated Fenite Mineral Resource - REO Distributions at 0.5%, 1.0%, 1.5% and 2.0% TREO Cut-Offs

Cut-Off %TREO	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
0.5	24.41	44.36	4.78	16.43	2.48	0.54	1.34	0.17	0.83	0.14	0.33	0.04	0.23	0.03	3.89	100
1	24.68	44.86	4.83	16.61	2.50	0.47	1.15	0.15	0.72	0.12	0.28	0.04	0.20	0.03	3.36	100
1.5	24.86	45.19	4.87	16.73	2.52	0.42	1.03	0.13	0.64	0.11	0.25	0.03	0.18	0.02	3.01	100
2	24.97	45.39	4.89	16.81	2.53	0.39	0.96	0.12	0.60	0.10	0.24	0.03	0.17	0.02	2.79	100

In-situ Inferred Fenite Mineral Resource - REO Distributions at 0.5%, 1.0%, 1.5% and 2.0% TREO Cut-Offs

Cut-Off %TREO	La_2O_3 %	Ce_2O_3 %	Pr_2O_3 %	Nd_2O_3 %	Sm_2O_3 %	Eu_2O_3 %	Gd_2O_3 %	Tb_2O_3 %	Dy_2O_3 %	Ho_2O_3 %	Er_2O_3 %	Tm_2O_3 %	Yb_2O_3 %	Lu_2O_3 %	Y_2O_3 %	Total %
0.5	24.25	44.07	4.75	16.32	2.46	0.59	1.45	0.18	0.90	0.15	0.36	0.04	0.25	0.03	4.21	100
1	24.41	44.37	4.78	16.43	2.48	0.54	1.33	0.17	0.83	0.14	0.33	0.04	0.23	0.03	3.89	100
1.5	24.69	44.88	4.83	16.62	2.50	0.47	1.15	0.15	0.71	0.12	0.28	0.04	0.20	0.03	3.34	100
2	24.90	45.26	4.88	16.76	2.53	0.41	1.01	0.13	0.63	0.10	0.25	0.03	0.17	0.02	2.93	100