

第Ⅲ部 結論および提言

第 III 部 結論および提言

第 1 章 結 論

1-1. 概査地区

地質調査の結果は、既存の地質図、各調査データと整合的である。本地区の地質および鉱化作用は、以下の通りである。

(1) 先カンブリア紀の地層

下位より、Nyanza 系、後Nyanza貫入岩類、Kavirondo 系、後Kavirondo 貫入岩類、Bukoban 系からなる。

Nyanza系：玄武岩、安山岩、デイサイト、流紋岩などの火山岩と堆積岩からなる。玄武岩は特徴的な緑色を呈する。本岩は、始生代のグリーンストーン (Greenstone) 火山岩に相当する。

後Nyanza貫入岩：地域の東方と南方にバソリスまたは岩株として分布する。これ等は、花崗岩、花崗閃緑岩等を主体とし、閃緑岩やドレライトを随伴し、Nyanza系に貫入する。

Kavirondo 系：地区の中央部にNyanza貫入岩類を覆って分布する。礫岩と砂岩からなる。

後Kavirondo 貫入岩：地域の東方に広く分布するほか、西方Kisingiri (=Kaksingri に同じ。以下これを使用) 火山のインライアーとして分布する。花崗岩、花崗閃緑岩等からなり、一部は第三紀のアルカリ岩類の活動により、フェナイト化している。

Bukoban 系：地域の南東隅に分布する。本系は、Nyanza系、Kavirondo 系、後NyanzaおよびKavirondo 貫入岩類のすべてを覆う。主に玄武岩質火山岩からなり、珪岩等の堆積岩やKisii 地方特産のソープストーンなどを伴う。原生代の地層と考えられている。

(2) 第三紀～第四紀の岩石

早期第三紀に始まったアルカリ深成岩活動は、噴出活動を伴い、その活動は第四紀にまで及んでいる。本地域の第三紀～第四紀の岩石の大部分はこの活動の産物である。

調査地域では、5ヶ所のネフェリナイト～フォノライト火山センター、6ヶ所のアイヨライト貫入複合岩体群、8ヶ所の火山底カーボナタイト質センター、および数ヶ所のフェニチゼーションの発達ヶ所が存在する。このうちの主なものは、Kaksingri 火山センター、Wasaki半島アイヨライト～カーボナタイト・コンプレックス、Ruri Hillsカーボナタイト・センター、Iloma Mountain カーボナタイト～アイヨライト複合岩体などである。

これらは、ケニアリフト (=East Africa Rift Vally) から分岐したKavirondo リフト内にすべて分布し、一大カーボナタイト帯を形成する。

Kaksingri(Kisingiri)火山センター： 面積2,000 平方km以上の広い範囲にネフェリナイト質の火山岩類を噴出した西ケニアにおける最大級の成層火山であり、噴火の中央部は陥没しカルデラとなりカルデラ内にカーボナタイトが貫入している（Rangwaカーボナタイトセンター）。本火山の噴出物により調査地区西側の大部分が覆われている。

Wasaki半島、Ruri Hills、Homa Mountain 等のカーボナタイト～アルカリ岩複合岩体： これらは、Kaksingri火山のように大規模な噴出活動を伴わないカーボナタイト～アルカリ岩複合岩体であり、カーボナタイトのコーンシート状の産状で特徴づけられる。カーボナタイトは、アルピカイト、ソーバイト、フェロカーボナタイト等からなり、フェロカーボナタイトは希土類鉱物に富んでいる。

これらについては、準精査の項(1-2)で述べる。

(3) 鉱化作用

小規模ながらカーボナタイト岩脈が4ヶ所、微弱な銅鉱微地が2ヶ所、金採掘地が3ヶ所確認された。これらを第III-1-1表に総括した。Wire Hillの3km南西方の採掘地で採取した石英脈はAu 3.3g/tの分析値を示している。この地区は、緑色岩が分布し、花崗岩の貫入部に近接しているため、胚胎の場としては一応条件が揃っている。組織的探鉱を行えば、小規模な含金石英脈が更に見出だされる可能性がある。

第 III-1-1表 概査地区に於ける鉍化作用関連の知見総括*

産出地	試料番号	岩石ないし鉍化タイプ	脈幅	延長・広がり等	備考		
Gwasi の NW約3km	WR-108	カーボナタイト質岩石	約5m		含磁鉄鉍褐色アルビカイトと暗褐色フェロカーボナタイトがアイヨライトを伴って基盤花崗岩に貫入		
Sindo の SE5km	RT-46		約5m		帯緑白色のフェナイト化したソーバイトが片岩と花崗岩基盤に貫入		
Asego Hill WNW	RT-60				帯褐色白色細粒緻密。弱い葉理を持つアルビカイト又は変成石灰岩		
Homa Bay NE約8km	RT-99		約5m		淡褐色、層理の発達したシンター状アルビカイト～炭酸塩質凝灰岩		
Kendu Bay SE	RT-83	銅二次鉍物			尾根上の赤色石英モンズナイト中の鉍染～割目充填孔雀石		
Wire Hill 鉍微地 Oyugis のNW 約 4～5km		火山性非鉄金属塊状硫化物鉍化		道路沿い約30mに焼けが観察さる	国連回転基金により探鉍。詳細は同報告書参照 (UN Revolving Fund:1978 Final REPORT)。		
《金 鉍 化》 (参 考)					Au g/t	Ag g/t	備考
Wire Hill南方	RT-90	石英脈	5～10cm		3.3	2.0	探掘中。片状変玄武岩中。
Oyugisの 25kmSSW	RT-105	石英脈	3.0m	約5000m間に露頭～転石点在	tr	1.0	大石英脈の南端部。国道A-1の路傍。N10°E, 90°
Rongo 南 範囲外	参考試料	石英脈 含自然金	??		849	59.0	稼行中。Migori Gold Field内。
準精査 Homa Mountain 地区	100205G	石英脈 転石帯	5m+	転石帯から判断して延長 500m	2.0	5.0	Homa Mt.ピーク東方 2.5～3.3km。含aduralia白色石英脈。一部に晶洞質部あり。周囲はNyanza系の酸性変火山岩。
	100206G				31.3	4.0	
	100207G						
	100208G						
	100209G	石英脈露頭			0.7	1.0	
	100222G	石英脈転石	径15cm	??	tr	1.0	それぞれ上記とは別脈
	100224G	石英脈転石	径20cm	??	tr	1.0	

* 金については準精査地区と今回調査範囲外のものも含む。

1-2. 準精査地区

(1) 地質調査

10地区について、第II部に記述した事項の結論を第III-1-2-1表に要約した。なお本表には地化学探査の結果を総合し、各地区の探査余地・価値の評価を下記のようにAからCの3段階に分けて表示している。A:調査を要する。B:検討を要する。C:調査の必要性は低い。

(2) 地化学探査

(A) 単一変量統計解析

解析した14成分の内、相対的に高い値を示し、経済的にも関心が持て、かつ主成分分析により鉍化の主要グループを代表する事が判明した5元素の『平均値』、『平均値+1標準偏差』、『平均値+2標準偏差』を下表に、またこれ等5元素の各地区別の『最高値』、『平均値』、『平均値+1標準偏差以上の試料数』、『平均値+2標準偏差以上の試料』を第III-1-2-2表に示す。なお、下表にBuru HillとNdiru Hillのグリッド試料の平均値も対比した。

《全地区-BURU HILL 鉍微地-NDIRU HILL鉍微地の主要5元素比較》

	全地区 1325試料				Buru Hill 47試料		Ndiru Hill 90試料	
	最高値 (ppm)	平均値 (ppm)	m+1s	m+2s	最高値 (ppm)	平均値 (ppm)	最高値 (ppm)	平均値 (ppm)
Nb	12000	148	620	2600	4800	688	8200	368
Y	1360	63.9	148	344	3100	516	1700	159
La	14300	178	767	3300	19500	3150	14720	700
Ce	17700	283	1240	5460	20000	4960	20800	1370
Nd	3000	97.2	450	2090	2700	1330	1200	373

Nbを除き、多くのREIで、高濃度異常値が、Buru Hillの平均値に、また異常値がNdiru Hillにほぼ同レベルなのが興味深い。

第III-1-2-1表

準精査地区調査結果一覧表

地区名	地質調査結果	地化学探査結果	有望元素	総合評価
Rangwa	カーボナタイトはRanawaの中心の長径2.6km、短径2.0kmの卵形の範囲(カーボナタイトセンター)に分布する。塊状のアルピカイト、ソーバイト、カーボナタイト質角礫岩を主体とする。フェロカーボナタイトは稀である。	希土類元素およびP, Ba, Sr, Nb, Yの異常値は大部分カーボナタイトセンターに分布するがPを除いて頻度は少なく、高濃度異常値は殆んど認められない。Pは全試料のうちの25%が異常値を示すが、高濃度値は少ない。カーボナタイトセンターにおける土壌試料にはNbを除いて顕著な元素の濃集は認められない。Nbは平均値1010ppmである。		C
Sagarume-Nyamgurka	北西部のSagarumeにはアイヨライトを抜く数本のカーボナタイト小岩脈が認められるのみである。南東部のNyamgurkaでは2つの小規模塊状カーボナタイト岩体と小カーボナタイト岩脈が分布するが、フェロカーボナタイトは殆んど分布しない。ここでは、規模の大きいフェナイト帯から周辺の地下浅部にアイヨライトの分布が推定される。しかし、カーボナタイト伏在の予想は困難である。	Nyamguruka付近で、Pおよび軽希土元素に異常値が幾分認められるが、Pを除いて高濃度異常は全く存在しない。Pは全域における最高値(14.5%)を持つものが1試料あるが、1点異常で、異常帯を形成しない。Sagarumeではアイヨライトの2試料を除いて異常値が検出されなかった。		C
South Ruri	直径2.5kmに及ぶ円筒状の塊状カーボナタイトからなり、単独な岩体としては、Homa Bay地域における最大規模のものである。カーボナタイトは、アルピカイト、ソーバイト、カーボナタイト質角礫岩、フェロカーボナタイトからなり、フェロカーボナタイトは岩体の縁辺部に岩脈状に産することが多い。	異常値はSrと希土類元素に多く、高濃度異常は、Y, La, Ceに多い。Y, La, Ceの高濃度異常は大部分フェロカーボナタイト分布域にあり、この中でSouth Ruri東北東1.5kmの付近に高濃度異常がまとまった異常地が検出された。	Y, 希土類元素	A
North Ruri	直径約1.5km、南東部の一部を欠くカーボナタイトコンシートからなり、中央部には基盤岩が分布する。カーボナタイトは主としてアルピカイトからなり、カーボナタイト質角礫岩やソーバイト、フェロカーボナタイトを伴う。フェロカーボナタイトは主として、岩体の縁辺部にリングダイク状に分布する。	South Ruriとほぼ同様な元素の挙動が認められる。Y, La, Ceの高濃度異常はカーボナタイトコンシートの縁辺部に多い。North Ruri頂上部の北方0.8kmと南西方0.9kmの2ヶ所の地域に高濃度異常がまとまった異常地が検出された。	Y, 希土類元素	A
Kuge-Lwala	中央-北西部のKuge Hillにフェロカーボナタイトを伴うカーボナタイトコンシート、南東部にカーボナタイト礫を含む鉄質角礫岩帯があり、フェロカーボナタイトと鉄質角礫岩はともに高い放射能異常を示す。Kuge Hillのカーボナタイトコンシートは貫入の頂部に相当し、地下に塊状岩体の存在が期待される。フェロカーボナタイトは幅30~40m、南北延長450mであり、傾斜は30-50°西である。鉄質角礫岩体は約0.3kmの範囲に露出が認められる。	Kuge Hillのカーボナタイトは、試料の大部分がBa, Y, Th, 希土類元素の異常値を示す。この中で、Ba, Y, Th, Euの高濃度異常がフェロカーボナタイトに集中し、Thの全域での最高値(2360ppm)試料を含む。Lwalaにおける鉄質角礫岩は、Y, Th, Ybの高濃度異常を示す。	Y, 希土類元素	A
Ngou-kuwor Area, Ugongo-Uyi-Kiyanya-Sokolo Area (Sokolo Area)	Sokolo岬を含む北東湖岸部にかけての地域にソーバイト、フェロカーボナタイト、アルピカイトからなるカーボナタイトコンプレックスが分布する。この中でSokolo岬のカーボナタイトは直径600m程度の円筒状の岩体と推定される。他にSokolo地域の南西部および南東部にフェロカーボナタイトの小岩脈、Ngou-Kuworの北西部にアルピカイト小岩体分布する。	5元素及び希土類元素の異常値は、Sokolo岬及び北東湖岸部にややまとまって分布するほか、Sokolo区域の北西湖岸及び南東部に局部的に認められる。Ngou-kuwor地区では全く異常値は検出されなかった。高濃度異常は、Sokolo岬にLa, Ce、また、北東湖岸部にNbの異常が局部的に認められた程度である。		C
Homa Mountain (Ndiru Hillを除く)	Homa Mt.主カーボナタイトコンシート(直径約2.7km)を核として、大小多数のカーボナタイトコンシートまたは岩脈が、長径6km、短径5kmの卵形の地区に分布する。この他、地区の南部にもカーボナタイト岩脈が分布する。カーボナタイトは大部分、環状に配列する岩脈群からなり、まとまった規模の塊状岩体は、Ndiru Hillを除いて少ない。Homa Mountain頂上の約3km東方に石英脈群があり、金、銀の鉱化が認められる。(Au31.3g/t, 最高値)。	5元素、希土類元素は全試料の15~20%が異常値、1~3%が高濃度異常を示す。これらは地区全域に分散して分布し、まとまった異常帯は検出されなかった。この地域には、全域におけるSm(4920ppm)、Nb(12000ppm)などの最高分析値を示す試料があり、注意を要するが、これらはいずれも一点異常である。	Y, Nb, 希土類元素 (Au, Ag)	C (A)
Ndiru Hill (Homa Mountain内)	Homa Mountain頂上の2.5km南方に分布する300m×500mの塊状カーボナタイト岩体で、ソーバイト、アルピカイト、フェロカーボナタイトからなり、この順で貫入している。	希土類およびY, Nbは、最末期のフェロカーボナタイトの周縁に濃集するが、Nbは若干外側のソーバイト中に局部的に濃集する。しかし、前者の濃度はBuru Hillに較べてかなり低い。一方、Nbは局部的に高濃度異常を示すが、割目付近に限定されている。主成分分析の結果Nbと希土類は異なる鉱化を示す。これら早期および後期を表す鉱化が平面的に重複して分布することから深部に対する鉱化の期待は少ない。	Nb	B
Buru Hill	500m×350m、標高差約40mの小丘全体が鉱化。大量の褐鉄鉱を伴い一種の酸化溶脱帯を形成。地表では炭酸塩鉱物を確認しなかったが、旧試錐資料では地表下にソーバイトが産出する。地表部では浅部相を表わすと思われる角礫化と軽希土が普遍的なことから、鉱化の重複が考えられる。鉱石の検鏡により、金鉱物が確認された。	鉱化帯における試料は、希土類元素の大部分とYの平均値が準精査地域の統計値m+2Sとほぼ同じで、非常に高い値を示す。とくに軽中希土元素とYは全域の平均値の10~20倍以上の平均値を示す。主な元素の平均値(Av)と最高値(Max)は次のとおり。 La+Ce+Nd; 1.31%(Av), 3.98%(Max), Y:516ppm(Av), 3100ppm(Max), Nb:688ppm(Av), 3100ppm(Max) } 平均は真数	希土類元素 Y, Nb	A
Legetet Hill	Tindret火山の寄生火山とみなされるLegetet HillのメラネフィリナイトのK-Ar法放射年代は10.7Maを示し、Tindret火山の先駆的活動を示す。Legetet Hillの北及び東山麓、及び北東方にはカーボナタイト質岩石が分布する。これらは、火砕岩、溶岩、砂質凝灰岩からなり、カーボナタイト活動の噴出相、再堆積相である。これらの活動は、Legetet Hillの火山活動に先立つ。	異常値、高濃度異常値はP, Sr, Y, Yb, Luなどの元素に多く、これらはすべてカーボナタイト質岩石の分布域に限定される。Y, La, Ybなどに高濃度異常を示す2試料がLegetet Hill北東山麓部の火砕岩分布域に認められた。この地区は本地域のカーボナタイト質火砕岩の噴出の中心の1つとみられる場所である。しかし試料数に較べて、高濃度異常値の頻度は低い。		C

異常値: $\geq m+1S$, $< m+2S$, 高濃度異常値: $\geq m+2S$

(m: 平均値, S: 標準偏差はともに、Buru Hill 鉱化帯, Ndiru Hill 鉱化帯におけるグリッド試料と土壌試料を除いた全域1325試料の統計値を採用)

5元素 (P, Ba, Sr, Nb, Y)

総合評価の区分, A: 調査が必要, B: 要検討, C: 調査の必要性は低い。

地化学探査の異常地と、地質・構造が対比され、探査余地・価値の評価を行った。結果は第III-1-2-1表に総括した。Buru Hill、Kuge-Lwala、South および North Ruri Hills の4地区が有望地区として抽出された。

《相関分析》

『全地区』1325試料の結果は、第III-1-2-3表に示した。Buru Hillの結果は第II部の第II-2-11-4表に、またNdiru Hillの結果は第II-2-10-2表に、夫々示した。

『全地区』およびNdiru Hillでは、REE、Y、Th間の相関が強いが、Buru Hillでは、軽希土とYとの相関が弱い事が非常に特徴的である。また、Buru HillとNdiru Hillで試験測定を行ったガンマ線は、Th、YやSm、Eu、Tbのような中希土との相関が認められるので、今後希土類鉱物探査の簡便な『道具』として有効と考える。

《コンドライト標準化REEパターン》

分析全試料1509個を43岩種に分類し、岩種別平均値に対するコンドライト標準化REEパターンを作成した。ソーバイト(SO)、アルビカイト(AV)、フェロカーボナタイト(FC)の曲線を第III-1-1 A図に、またアイヨライト(IJ)、ネフェリナイト(NE)、フォノライト(PH)を同図のBに示した。前者には、比較のため、Buru Hillの『鉱石』(OR)47試料平均とアルカリ岩の代表として、上記IJも一緒にプロットした。また、『全地区』試料の地区別平均値のパターンおよびBuru HillとNdiru Hillの代表的試料のパターンを第III-1-2図に示す。

- i) 第III-1-1 A図において $OR > FC > AV > SO > IJ$ の相関関係が非常に明瞭である。また、IJはカーボナタイト類に比し、Tbで上方に多少凸のように見える。AVとFCも、Tbで接近する。
- ii) アルカリ岩類3種はカーボナタイト類より遥かに低いレベルにある。3者間では中・重希土で若干IJおよびPHがNEより高い結果になっている。
- iii) Ndiru Hillでは、SO、AV、FC間にかなり明瞭な傾向の差が認められた。即ち、最も軽いLaでは、 $FC > AV > SO$ であるが、重いYbおよびLu、ならびにYでは、 $AV > SO > FC$ となり、晩期に軽希土が濃集する傾向があるかの如く見える。
- iv) 地区別に比較すると $Buru > Ndiru > Kuge > Ruri$ の関係が明瞭である。

(B) 主成分分析

希土類元素間の相関が非常に強く、主要元素の単一変量のプロットと殆ど同じ傾向になる事が判明した。したがって、スコア分布図の添附を省略し、第4主成分までの解析結果の表を添附した。『全地区』1325試料の主成分分析は、第III-1-2-4表に、またBuru Hill、Ndiru Hillについては第II部の第II-2-11-5表および第II-10-3表に夫々示した。また、これ等3グループの対比を第III-1-2-5表に総括、要約した。

第 III-1-2-2 表 各地区の主要5元素の統計一覧表

地区名	試料数	項目	上1段ppm / 下2段該当試料数					備考 地区内の全地区最高 値を示す試料等
			Nb	Y	La	Ce	Nd	
Rangwa	211	最高値	1470	580	2300	3100	1210	
		平均値	211	51	110	130	37	
		>m+1s	10	3	10	10	12	
		>m+2s	0	1	0	0	0	
Sagarume	76	最高値	735	220	1690	2650	1180	P 14.5%
		平均値	32	43	68	136	52	
		>m+1s	1	3	7	8	12	
		>m+2s	0	0	0	0	0	
North and South Ruri Hills	258	最高値	2100	1360	14300	17700	2500	Tb 44ppm(但しNdiru に100. La:14300, Ce:17700. 但し Ndiru 14720. 20800. Y:1360ppm. 但しBuru 3100ppm
		平均値	127	69	206	364	116	
		>m+1s	19	28	34	45	55	
		>m+2s	0	15	17	15	1	
Kuge-Lwala	51	最高値	4150	680	3970	6750	2310	Th 2360ppm Yb 94ppm
		平均値	278	110	267	604	262	
		>m+1s	14	19	11	15	17	
		>m+2s	1	5	2	3	3	
Soklo-Ngou	109	最高値	5500	550	10000	10000	2120	Eu 163ppm. 但しNdiru Hillに 170ppmの点.
		平均値	273	57	242	359	107	
		>m+1s	9	11	18	16	15	
		>m+2s	2	1	2	3	1	
Homa Mount.	*1 486	最高値	12000	910	10700	16100	2200	Ba 80700ppm Sr 11800ppm 但し Ndiru H. に12590ppm Sm 4920ppm
		平均値	138	68	212	335	124	
		>m+1s	61	66	67	80	94	
		>m+2s	4	9	11	14	2	
Buru Hill	*2 18	最高値	3700	1100	13520	16700	2700	
		平均値	37	66	115	186	62	
		>m+1s	3	0	3	4	3	
		>m+2s	1	6	3	2	3	
Legetet H.	116	最高値	3800	750	3730	7190	1880	
		平均値	204	74	194	335	127	
		>m+1s	6	25	4	4	5	
		>m+2s	1	2	2	1	0	

* 1 : Ndiru Hill 鉍徴地のグリッド試料 90 個を除く。

* 2 : Buru Hill 鉍徴地のグリッド試料 49 個のうち 6個を含む。

第 III-1-2-3表 準精査地区『全地区』相関係数

	P	Ba	Sr	Nb	Y	Th	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu
P	1.000													
Ba	0.319	1.000												
Sr	0.513	0.407	1.000											
Nb	0.336	0.415	0.391	1.000										
Y	0.379	0.597	0.426	0.482	1.000									
Th	0.151	0.547	0.438	0.502	0.675	1.000								
La	0.419	0.643	0.675	0.470	0.695	0.694	1.000							
Ce	0.366	0.599	0.661	0.447	0.683	0.727	0.946	1.000						
Nd	0.354	0.575	0.640	0.426	0.670	0.731	0.894	0.923	1.000					
Sm	0.376	0.584	0.601	0.408	0.751	0.717	0.885	0.907	0.925	1.000				
Eu	0.375	0.550	0.607	0.438	0.754	0.725	0.853	0.876	0.892	0.935	1.000			
Tb	0.393	0.483	0.487	0.419	0.736	0.587	0.709	0.711	0.727	0.803	0.839	1.000		
Yb	0.300	0.383	0.342	0.353	0.760	0.560	0.500	0.492	0.488	0.567	0.588	0.606	1.000	
Lu	0.256	0.425	0.311	0.306	0.760	0.577	0.546	0.550	0.557	0.631	0.650	0.667	0.766	1.000

* 1325 rock-chip samples excluding grid-samples from Buru Hill and Nduru Hill prospects.

第 III-1-2-4表 準精査地区『全地区』主成分分析総括表

Principal Compo.	EIGEN Value	Contribution	Cumm. Contribution	Item	P	Ba	Sr	Nb	Y	Th	La	Ce	Nd	Sm	Eu	Tb	Yb	Lu
1	8.804	0.629	0.629	Eigen vector	-0.158	-0.229	-0.227	-0.188	-0.288	-0.269	-0.309	-0.309	-0.307	-0.316	-0.315	-0.284	-0.235	-0.246
				Factor loading	-0.470	-0.674	-0.559	-0.854	-0.797	-0.916	-0.917	-0.937	-0.934	-0.843	-0.696	-0.731		
				Contribution	0.221	0.455	0.312	0.729	0.635	0.840	0.841	0.878	0.873	0.711	0.484	0.534		
2	1.219	0.087	0.716	Eigen vector	-0.359	-0.074	-0.446	-0.111	0.285	0.135	-0.196	-0.175	-0.151	-0.049	-0.016	0.113	0.470	0.476
				Factor loading	-0.396	-0.983	-0.493	-0.122	0.315	0.148	-0.217	-0.193	-0.054	-0.017	0.124	0.518	0.526	
				Contribution	0.157	0.007	0.243	0.015	0.099	0.022	0.047	0.037	0.028	0.000	0.015	0.269	0.276	
3	0.972	0.069	0.785	Eigen vector	0.701	0.019	0.134	0.318	0.165	-0.234	-0.153	-0.233	-0.253	-0.189	-0.146	0.044	0.292	0.144
				Factor loading	0.691	0.002	0.133	0.314	0.163	-0.231	-0.230	-0.250	-0.187	-0.144	0.044	0.288	0.142	
				Contribution	0.478	0.000	0.018	0.098	0.026	0.053	0.023	0.053	0.034	0.020	0.002	0.083	0.020	
4	0.796	0.057	0.842	Eigen vector	0.248	-0.377	0.153	-0.739	-0.049	-0.321	0.022	0.045	0.081	0.148	0.143	0.192	0.090	0.157
				Factor loading	0.222	-0.336	0.136	-0.659	-0.044	-0.286	0.020	0.040	0.072	0.132	0.127	0.171	0.080	0.140
				Contribution	0.049	0.113	0.019	0.435	0.002	0.082	0.003	0.002	0.005	0.016	0.016	0.006	0.020	

第 III-1-2-5表 主成分分析比較表

	全 地 区 (試料数 1325個)	BURU HILL 鉍鉱地 (試料数 47個)	NDIRU HILL 鉍鉱地 (試料数 90個)	備 考
第1主成分	<p>* 寄与率は82.9%にも達する。Y, Th, およびLaからTbまでのREE が-0.84 から-0.88 もの因子負荷量を示し、Ba, Sr, Yb, Lu も-0.67 から-0.73 を示す。</p> <p>* この成分は、カーボナタイト特に、フェロカーボナタイトの分布に関係すると思われる。</p>	<p>* 寄与率は、左欄の『全試料』に比し速かに低く36.7%である。この成分は、Y(因子負荷量0.83)とSmからLuの中・重希土(0.75-0.88)に強く影響されている。</p> <p>* 本鉍鉱地は『全試料』と異なり、Y-中・重希土とLa-Ceのような一希土とが異なった挙動を示している。</p>	<p>* 寄与率は49%。Ba, Th, およびYb, Lu, を除く全REE の因子負荷量は、-0.72 ~ -0.93 に達する。</p> <p>* ハイロクロア類の鉱化を表すのかもしれない。</p>	
第2主成分	<p>* 寄与率は8.7%で、Sr(-0.49), Tb(0.52), Lu(0.53)の因子負荷量が比較的高い。</p>	<p>* 寄与率は16.7%で、主としてLa(-0.88), Ce(-0.90), Nd(-0.57)により決定されている。</p> <p>* この成分は、浅成変質による軽希土の酸化帯を表すと思われる。</p>	<p>* 寄与率は11.5%で、P(-0.58), Sr(-0.53), Yb(-0.57), Lu(-0.57)の因子負荷量が比較的高い。</p>	
第3主成分	<p>* 寄与率は6.9%で、殆どP(0.69)で決定されている。</p>	<p>* 寄与率は13.5%で、『全試料』と同様に、主としてP(-0.8)により決定されている。</p>	<p>* 寄与率は8.6%で、ガンマ線(0.54), Sr(0.64)が正の因子負荷量を示すのに対し、Nb(-0.62)は負の因子負荷量を示している。</p>	
第4主成分	<p>* 寄与率は5.7%で、殆どNb(-0.66)で決定されている。</p>	<p>* 寄与率は8.5%で、帯磁率(0.57), Nb(0.56)により決定されている。これは磁鉄鉱とニオブの鉱化を代表すると思われる。</p>	<p>* 寄与率は6.8%で、殆どガンマ線(0.61)とNb(0.62)により決定されている。</p> <p>* これは、早期のニオブの鉱化を表すと思われる。</p>	
特徴等	<p>* 上記の結果は、カーボナタイト、特にフェロカーボナタイトと希土類等の鉱化との関係の強さを裏付けていると解釈される。</p>	<p>* 本鉍鉱地の鉱化は、見掛け他のカーボナタイト関連鉱化とかなり異なった様相を持つ。浅成変質・溶液・二次酸化等の影響と思われる。</p>	<p>* 早期の鉱化を表すと思われる第4主成分と後期の鉱化を表すと思われる第1主成分が、フェロカーボナタイトの縁辺部に多い、殆ど同一位置に分布するのは興味深い。恐らく、ステージの異なる鉱化が重複しているのであろう。</p>	

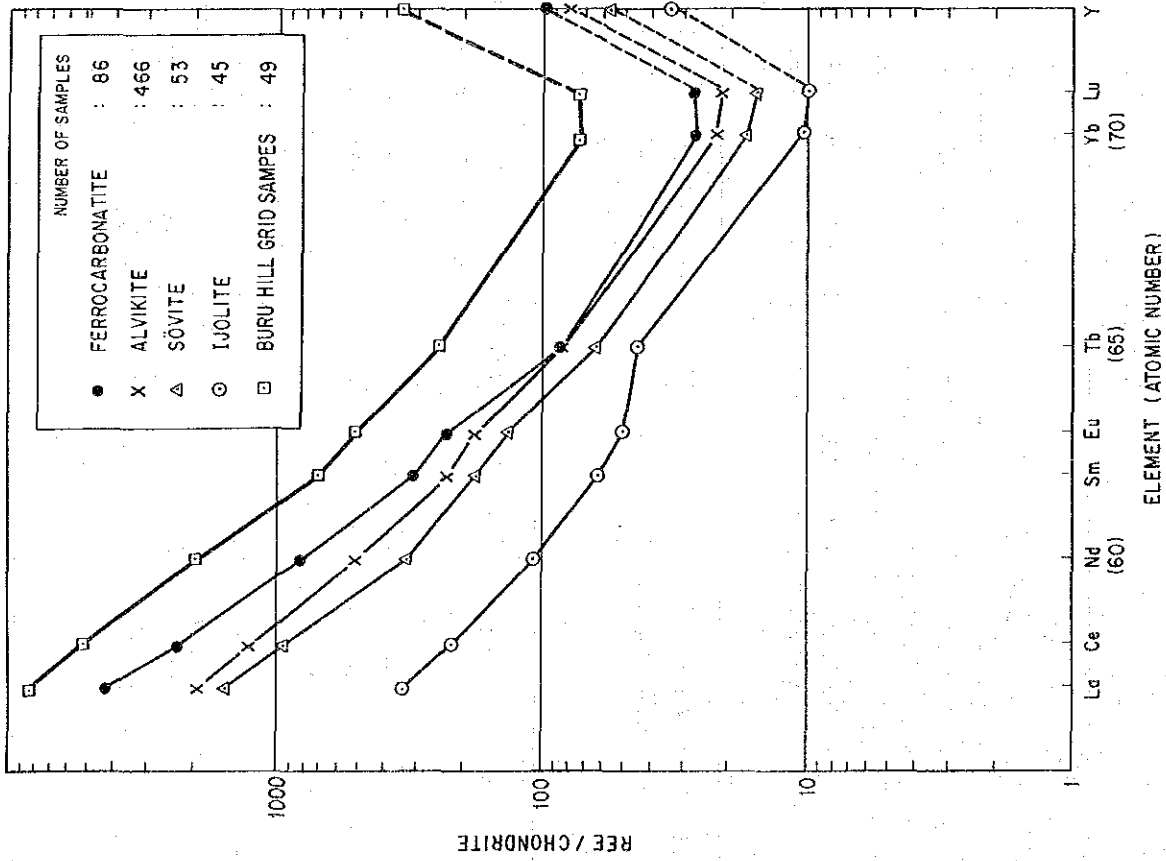
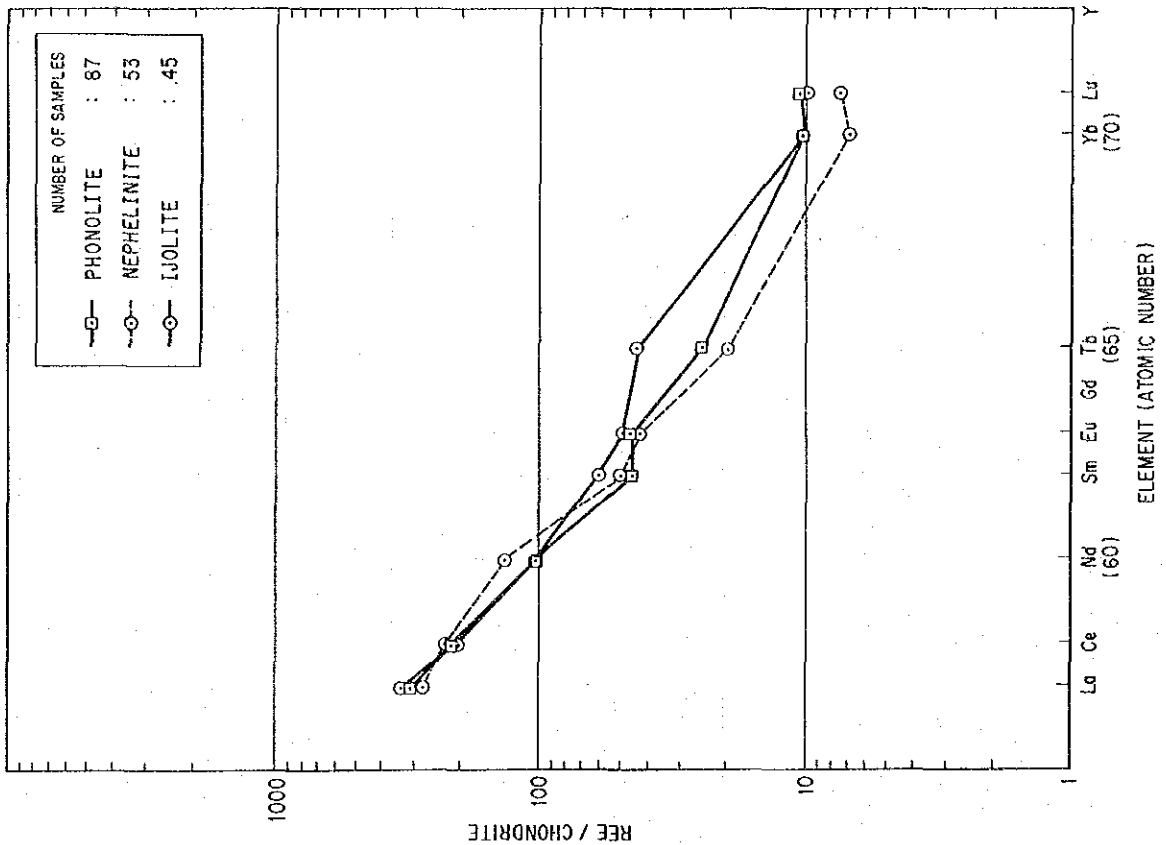


Fig. II1-1-1 Chondrite-normalized abundances of the REE: — Averages of Carbonatites & Alkaline Rocks in the Project Area

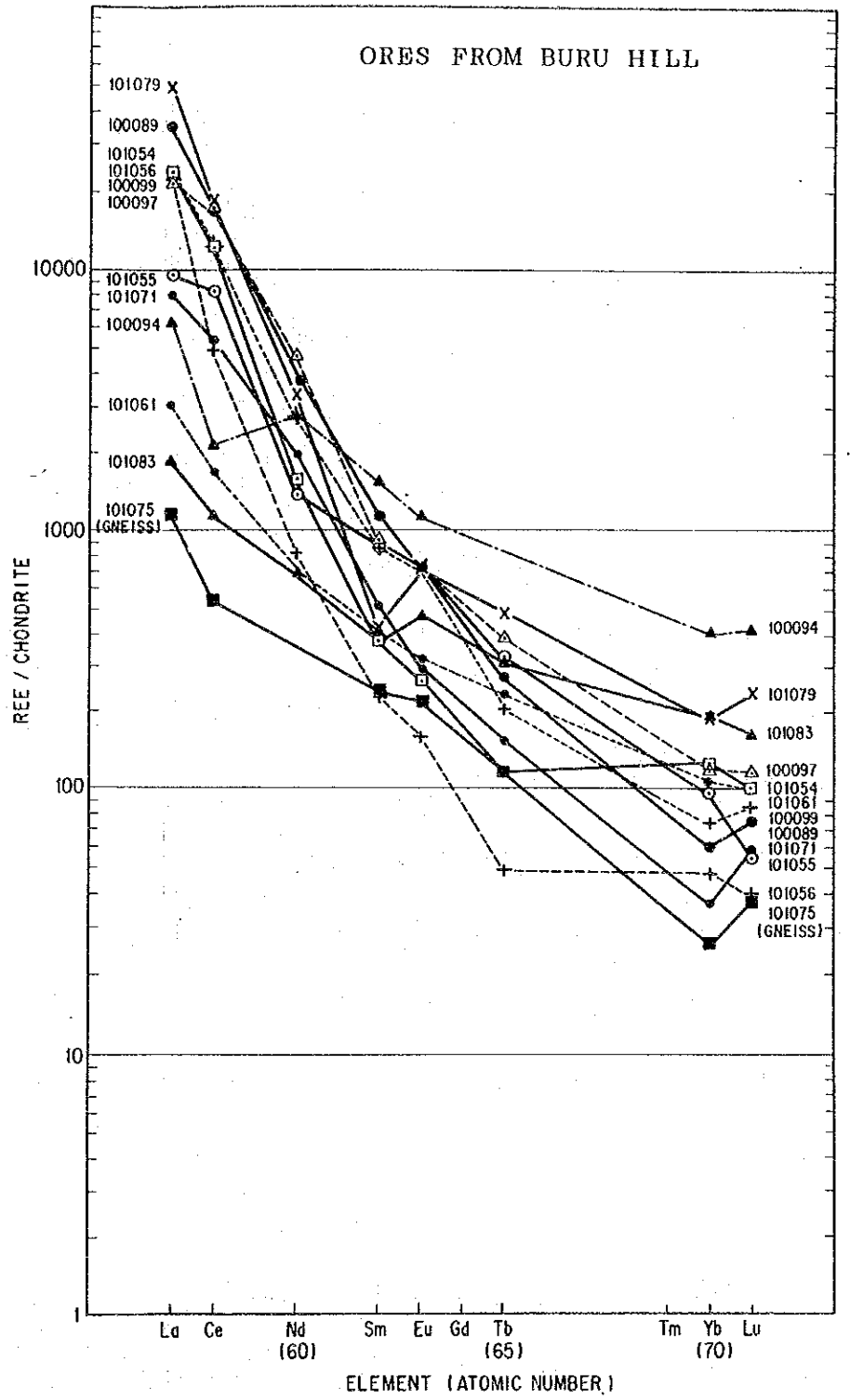
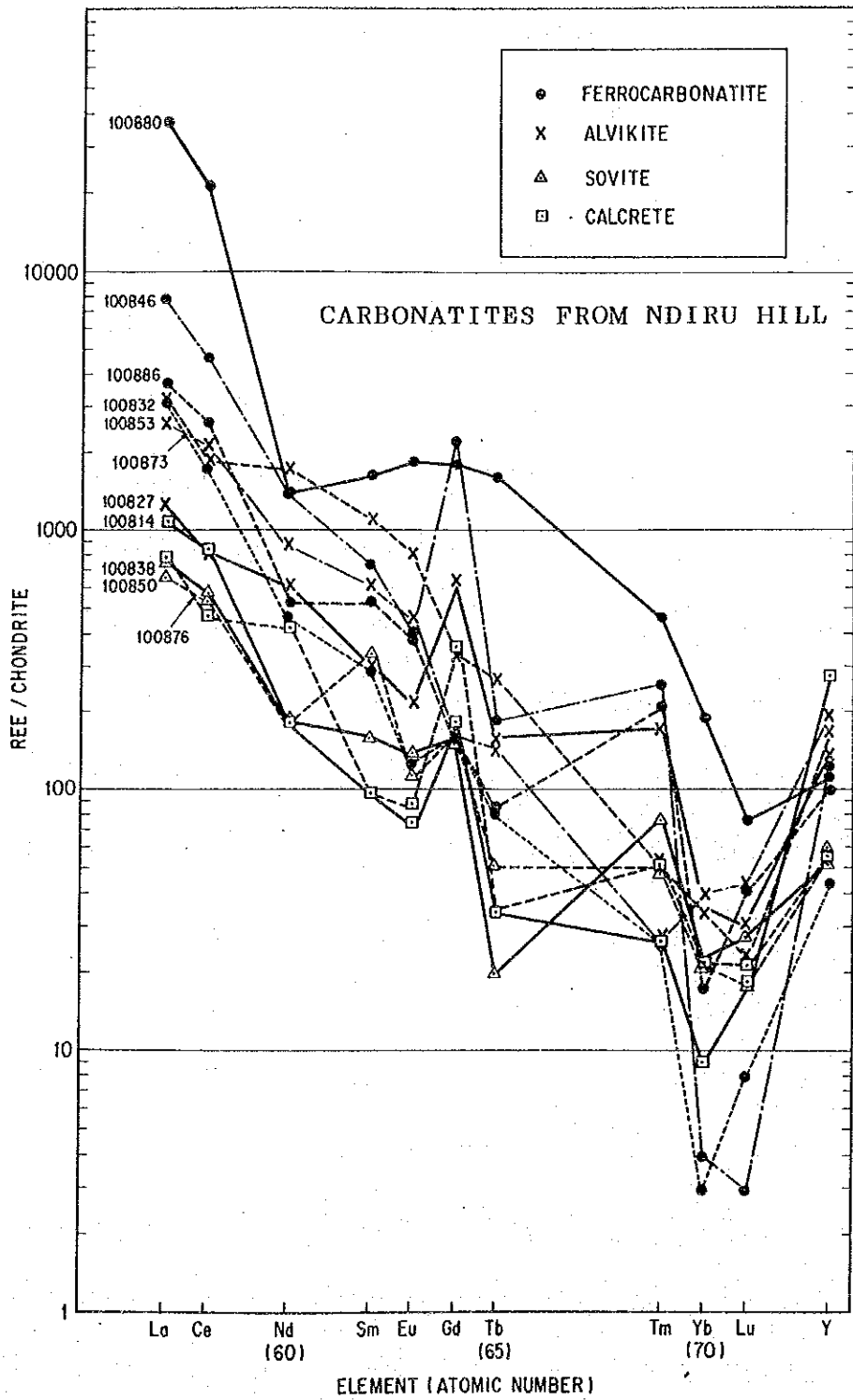
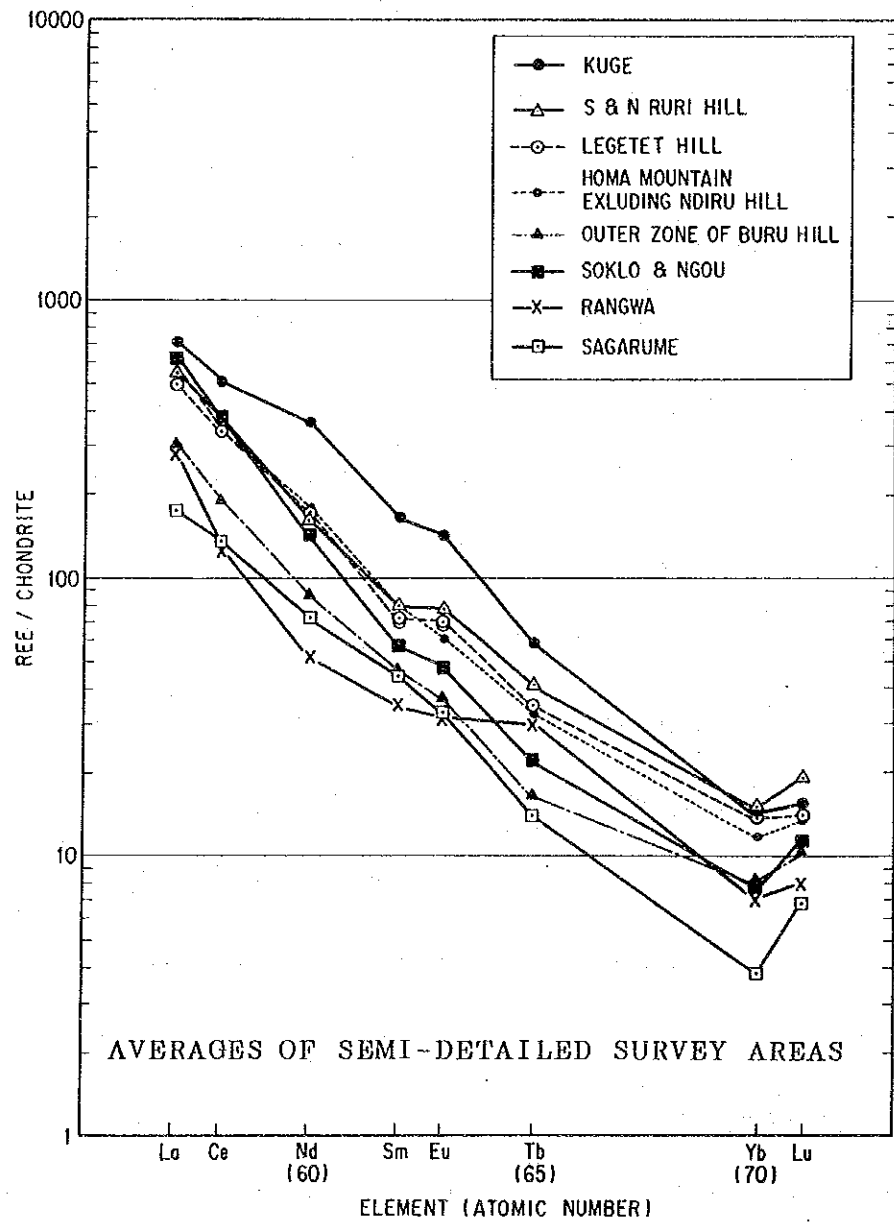


Fig. III-1-2 Chondrite-normalized abundances of the REE:— Comparison of Semi-detailed Areas & 2 Prospects

第2章 第2年次調査への提言

各地区ごとに提言を記す。なお、地区の配列は重点度の順とし、各地区で重点となる手法につき記した。これ等の重点手法の種類に応じ、航測図よりの地形図作成(1/2000-1/5000)。地化学探査・物理探査等の測線の測量、試錐点・ピットの結末、取明けた坑内の測量等の測量作業。上記の測線、ピット・トレンチ、坑内、コア、周辺地域等に対する地質調査、等々のような附随作業の実施が当然必要になる。なお、放射能調査が、今年度の試験的調査により、希土類探査に非常に有効である事が判明したので、今後第2年次を含め、希土類、レア・メタル対象の地質調査、地化学探査、物理探査にこれを併用する事を提案したい。

2-1. Buru Hill 地区

(1) 試錐

下記の目的で、REE、Y、Nb等のアノマリーに対して、地表からの試錐探査を実施する事が望ましい。

- 1) 地表の酸化溶脱帯の下に期待されるY、Nbの2次富化帯探査。
- 2) 深部に対する一次鉍化の垂直的鉍物累帯の確認。
- 3) 酸化溶脱帯の形態および深度の把握。
- 4) 南部に期待されるかもしれぬ潜在プラグの探査。

(2) 物理探査

Buru Hill 本体の南隣接、および南方約500mの片麻岩中の変質帯が潜在するカーボナタイトプラグの地表での表象である可能性があるので、深部構造把握のため精密重力、磁気探査等を実施する事が望ましい。

(3) ピット および/または トレンチ

表土被覆部分の鉍化確認、地表付近での品位の垂直分布等を把握するためピット および/またはトレンチを実施する事が望ましい。

(4) 斜坑取明け

旧斜坑を取明け、深部での鉍化の確認と産状を面的に確認する事が望ましい。なお、坑内作業であるので、現地の法規等の関連もあり、MGD に依頼が望ましいと考える。

(5) 鈳物試験

REEs, Y, Nb が経済的に回収出来るか否かは鈳石の品位と共に、他の金属と比べ、鈳物の種類や、産状が非常に重要である。化学分析による品位が同じでも、鈳物が異なれば全く経済価値が無くなる事はごく普通である。試料の濃集、不純物の溶解や分離機器により前処理・濃集をした後で、EPMA、X-線、顕微鏡鑑定を行う事が非常に重要であろう。出来れば選鈳試験・濃集試験を早い時期に行っておく事が必要と考える。

2-2 Kuge-lwala地区

(1) 試錐

下記の目的で試錐探鈳を実施する事が望ましい。

- 1) 今年度調査でREE、Y、Th、放射能の異常値のあったKugeフェロカーボナタイト岩脈下部での鈳況把握。
- 2) Buru Hill に類似するLwala 鉄質角礫岩の深部でのY, REE 鈳況把握。

(2) 地化学探査 グリッド・サンプリング

ピットおよびトレンチを含む。

2-3 South Ruriおよび North Ruri 地区

今年度の調査で確認されたREE、Y 地化学探査アノマリーに対してピットおよびトレンチおよび地化学探査グリッド・サンプリングと地質精査を主体とした調査を行う。

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APPENDIX-1 LIST OF SAMPLES TESTED

Area	Sample Number	Rock Type	1/50,000 Topo. map Sheet Name	Location		Thin Sect.	Pol-ished Sect.	Assay Silic. #1	Assay Carb. #2	K-Ar Age Date	X-ray Dif-fract	Remarks	
				X	Y								
Regional Mapping Area	RR-126	mic.sch	Gwasi	24+	38+	X							
	RR-139	amp.sch	Gwasi	23+	39+	X							
	RN-230	granite	Oyugis	79+	37+	X							
	RN-284	diorite	Oyugis	86+	42+	X							
	RP-79	nephel.	Rusinga	36+	47+	X		X		X			
	RT-36	nephel.	Gwasi	24+	25+	X		X		X			
	RT-46	fen-sov	Gwasi	35+	38+	X							
	RT-77	rhyol.	Kendu Bay	91+	47+	X		X					
	WR-108	alvik.	Gwasi	25+	34+	X							
WR-122	phonol.	Madiany	55+	46+	X								
WR-136	ijolite	Madiany	55+	43+	X		X		X				
Rangwa	RN-54	ijolite	Gwasi	29+	35+	X		X					
	RO-2	alvik.	Gwasi	28+	37+	X			X				
	40929E	carb-br	Gwasi	28+	35+	X			X		X		
*3 Sagarume	99685G	fenite	Gwasi	32+	41+	X		X					
	99712G	ijolite	Gwasi	29+	43+	X		X		X			
	99729G	alvik.	Gwasi	33+	40+	X			X				
South Ruri	99502G	Fe-carb	Homa Bay	53+	39+	X	X						
	100111G	Fe-carb	Homa Bay	51+	37+	X			X		X		
	100152G	sovite	Homa Bay	53+	38+	X			X		X		
North Ruri	99543G	alvik.	Homa Bay	52+	41+	X			X				
	100127G	sovite	Homa Bay	52+	41+	X			X				
	100132G	nep-syc	Homa Bay	52+	41+	X		X					
*4 Kuge	100051G	alvik.	Madiany	51+	45+	X			X				
	100053G	Fe-carb	Madiany	51+	45+	X	X		X		X		
Ngour *5	100389G	alvik.	Madiany	52+	49+	X			X				
Soklo *6	100303G	Fe-carb	Madiany	56+	48+	X			X				
	100320G	black V	Madiany	56+	49+	X	X				X	in sovite	
	100323G	fenite	Madiany	56+	49+	X		X			X		
	100324G	bi-sov.	Nadanyy	56+	48+	X			X				
Homa Mountain	99599G	Fe-carb	Madiany	66+	59+	X			X				
	99616G	Fe ore	Kendu Bay	69+	52+	X	X						
	100233G	ijolite	Madiany	66+	56+	X		X					
	100490G	Fe-carb	Madiany	66+	60+	X	X		X				
Ndiru Hill	100827G	alvik.	Madiany	66+	55+	X	X		X			Locations are not so accurate, as Area straddles two map sheets	
	100832G	Fe-carb	Madiany	66+	55+	X			X				
	100838G	sovite	Madiany	66+	55+	X			X				
	100846G	Fe-carb	Kendu Bay	67+	55+	X	X		X		X		
	100850G	sovite	Kendu Bay	67+	54+	X			X				
	100853G	alvik.	Kendu Bay	67+	54+	X	X		X				
100873G	Fe-carb	Madiany	66+	54+	X			X					
Buru Hill	100089G	min.op	Muhoroni	40+	79+	X		X				min. =mineralized op=outcrop	
	100094G	min.op	Muhoroni	40+	79+		X	X			X		
	100097G	min.op	Muhoroni	40+	79+		X	X					
	100099G	min.op	Muhoroni	40+	79+	X							
	101054G	min.op	Muhoroni	40+	79+	X							
	101055G	min.op	Muhoroni	40+	79+		X	X			X		
	101056G	min.op	Muhoroni	41+	79+	X		X					
	101061G	min.op	Muhoroni	40+	79+	X	X	X					
	101071G	min.op	Muhoroni	40+	79+	X	X	X					
	101075G	gneiss	Muhoroni	40+	79+	X	X	X					
	101079G	min.op	Muhoroni	40+	79+	X	X	X			X		
101083G	min.op	Muhoroni	40+	79+			X						
RN-401	black V	Muhoroni	40+	79+		X				X			
Legetet Hill	99743G	nephel.	Lumbwa	50+	83+	X		X		X			
	99759G	carb-tf	Lumbwa	52+	84+	X			X			gray	
	101047G	carb-tf	Lumbwa	50+	84+	X			X			black	
TOTAL NUMBER OF SAMPLES TESTED							52	15	21	22	5	11	

*1 Silicate rocks and mineralized materials: SiO₂, TiO₂, FeO, Fe₂O₃, MnO, MgO, CaO, K₂O, Na₂O, Al₂O₃, P₂O₅, H₂O+, LOI. (13 elements).

*2 Carbonatitic rocks: SiO₂, TiO₂, FeO, Fe₂O₃, MnO, MgO, CaO, K₂O, Na₂O, Al₂O₃, P₂O₅, H₂O+, LOI, CO₂ (14) U, Th, La, Ce, Nd, Sm, Eu, Gd, Tb, Tm, Yb, Lu (12 elements). Nb, Sr, Y, Ba (4 elements).

*3 Sagarume: Sagarume-Nyamgurka. *4 Kuge: Kuge, Lwala. *5 Ngou: Ngou, Kwor.

*6 Soklo: Ugonzo, Uyi, Kiyanya, Soklo.

NOTE: UTM Grid in the map sheet is used to indicate approximate location.

*e.g.: X=41+ in Muhoroni Map sheet indicates between 741 and 742.

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS--1 REGIONAL SURVEY AREA-1

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and/or Remarks
				Opaque minerals	transparent min.	
RN-126	Mica schist	<ul style="list-style-type: none"> * Dark grey, compact and hard. * Schistose structure is conspicuous. * Quartz crystals predominate with some plagioclase. Mica crystals are arranged parallel to schistosity plane. 	<ul style="list-style-type: none"> * Quartz: Approx. 40%. Granular; 0.1-0.2mm. * Plagioclase: Approx. 30%. Granular; 0.1-0.2mm. * Muscovite: Approx. 15%. Flaky 0.1-2mm. Some parts comprise aggregate of sericite. * Biotite: Approx. 15%. Flaky; 0.1-0.3mm. * Apatite: Minor amount; Euhedral to subhedral; <0.1mm. * Tourmaline: -, Euhedral to subhedral; <0.05mm. * Zircon: -, Euhedral; <0.04mm. 			
RN-139	Amphibole schist	<ul style="list-style-type: none"> * Brownish due to limonite stain. Compact, hard. * Compositional bandings of hornblende and plagioclase occur alternately. * Schistosity is also observed. * Veinlets of opaque mineral crosscut the schistosity in places. 	<ul style="list-style-type: none"> * Hornblende: Approx. 45%. Euhedral; long prismatic to acicular. Pleochroism; dark green to yellow. * Plagioclase: Approx. 50%. Granular; 0.1mm. * Quartz: Minor amount. 	<ul style="list-style-type: none"> * Magnetite?; 5% Euhedral to subhedral. 	<ul style="list-style-type: none"> * Brownish min. (secondary); microgranular and irregular, crosscutting schistosity. 	
RN-230	Granite	<ul style="list-style-type: none"> * Pink colored, compact and hard. Medium grained. Mafic mineral is scarce. * Typically granitic both in texture and mineral composition. * Hand-specimen tested is penetrated by a fine grained greenish veinlet, which may possibly contain Fe-rich chlorite. 	<ul style="list-style-type: none"> * Quartz: Approx. 35%. 0.5-1mm. * Perthite: Approx. 35%. 1-2mm. Secondary sericite is scattered in some crystals. * Plagioclase: Approx. 30%. 0.5-1mm. * Biotite: Very small amount. * No mafic mineral other than biotite is observed. 			
RN-284	Quartz-diorite	<ul style="list-style-type: none"> * Grey, compact, hard; medium grained. * Quartz is interstitial to the crystals of plagioclase and hornblende. * Peripheries of hornblende grains are fringed with tremolite(?) in places. 	<ul style="list-style-type: none"> * Plagioclase: Approx. 60%. Euhedral granular; 0.5-2mm. A number of crystals are saussuritized to form sericite. * Hornblende: Approx. 15%. Outlines are obscured by fibrous tremolite(?), though hornblende might have originally been euhedral. * Quartz: Approx. 25%. Anhedral, filling interstitially grain boundaries of Pl. &/or Hb. Myrmekite is formed in places. * Chlorite: Associated with tremolite. * Sericite: As altered product. * Apatite: Long prismatic. * Epidote & Zoisite: As Fine granular aggregate. * Carbonate: Very small amount & occurs in irregular aggregates. 	<ul style="list-style-type: none"> * Opaque mineral ? 		

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS--2 REGIONAL SURVEY AREA-2

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and /or Remarks
				Opaque minerals	transparent min.	
RP-79	Nephelinite	* Porphyritic with melillite and clinopyroxene phenocrysts.	<p>PHENOCRYSTS</p> <ul style="list-style-type: none"> * Melillite: Approx. 15%. Euhedral; 1-3mm. This occasionally includes euhedral crystals of clinopyroxene of about 0.4mm long. * Nepheline: Small amount. Anhedral. * Clinopyroxene: Euhedral; 1-5mm. Colorless. c. A. Z=ca. 50. * Magnetite: Approx. 10%. Euhedral to subeuhedral up to 2mm. * Perovskite: Small amount. Euhedral to subeuhedral. Occurs as inclusions of melillite & nepheline-phenocrysts. * Apatite: Small amount. Long prismatic & as inclusions of melillite & nepheline. <p>GROUNDMASS: 60%, with minor amount of secondary chlorite.</p>			<ul style="list-style-type: none"> * K-Ar dating: 4.5 ± 0.5 MA * Bulk chemical analysis: SiO₂=35.32%, Al₂O₃=6.48%, Total iron as Fe₂O₃=16.92%, CaO=18.31%, *NORM Plot: in field.
RT-38	Nephelinite	* Porphyritic with phenocrysts of melillite and opaque minerals. Similar to RP-79, but finer grained.	<p>PHENOCRYSTS</p> <ul style="list-style-type: none"> * Melillite: Approx. 15%. Euhedral; 0.2-1mm. * Clinopyroxene: Minor amount. 0.1-0.2mm. * Perovskite: Minor amount. Polysynthetic twinning is often observed. <p>GROUNDMASS: 80%. 0.01mm. Probably consists of melillite, clinopyroxene and opaque minerals, with a minor amount of chlorite.</p>	<ul style="list-style-type: none"> * Magnetite?: 5%. Cube; <0.05mm. As phenocrysts as well as inclusions in melillite phenocrysts. 		<ul style="list-style-type: none"> * K-Ar dating: 14.4 ± 0.8 MA. * Bulk chemical analysis: SiO₂=34.58%, Al₂O₃=6.72%, Fe₂O₃=15.01% (Total) * NORM Plot: in field.
RT-46	Sovite	* Holocrystalline. * Aggregate of coarse and fine grained carbonates with finer grained carbonate bandings of later stage. * Crystals of coarser grained brown carbonate include microcrystals of apatite and microcline.	<ul style="list-style-type: none"> * Carbonate(calcite?): Coarse grained(1mm). * Carbonate(dolomite?): Fine grained(0.1mm). * Carbonate: Comprises bandings. Total three types of carbonates=100% * Apatite: Minor amount. Granular; <0.2mm. * Chlorite: Fine grained. * Microcline: Anhedral; <0.2mm. 			
RT-77	Altered sandstone or rhyolitic tuff	* White, siliceous, compact and hard. Stained with hematite. * Aggregate of irregularly arranged equigranular fine quartz(0.1mm) with fine micaceous matters.	<ul style="list-style-type: none"> * Quartz: Approx. 85%. Granular; 0.1-0.2mm. * Sericite(?): Approx. 10%. 	<ul style="list-style-type: none"> * Opaque mineral (hematite?): 5%. Irregularly shaped. 	<ul style="list-style-type: none"> * Brown mineral: Irregularly shaped, very fine grained. Scattered throughout 	<ul style="list-style-type: none"> * Bulk chemical analysis: SiO₂=81.86%, Al₂O₃=10.35%, K₂O=2.32% * NORM plot: in "quartz-rich granitoid" field.

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-3 REGIONAL SURVEY AREA-3

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	transparent min.	
WR-108	Alvikite (dyke facies)	<ul style="list-style-type: none"> * Stained with limonite. Light brown with dark brown irregular spots of goethite. Compact, hard and fine-grained. * Aggregate of carbonate grains. 	<ul style="list-style-type: none"> * Carbonate: Approx. 70%. Granulous; 0.1-0.5mm. * Barite : Approx. 10%. Anhedral to subhedral ; <0.2mm. * Apatite : < 3%. Anhedral to subhedral. <p>PHENOCRYSTS</p> <ul style="list-style-type: none"> * Nepheline: Approx. 25%. Euhedral; <2mm. * Sanidine : Approx. 10%. Euhedral; up to 10mm. Optically (-). Twinning is observed. * Chromian diopside(aegirine?): Approx. 15%. Euhedral; <1-2mm. Optically biaxial(+). Some <p>MICROPHENOCRYSTS</p> <ul style="list-style-type: none"> * Spinel(Picotite): Brownish, anhedral to subhedral; <1.5mm. * Sphene: Subhedral to euhedral * Perovskite: weakly brownish. Subhedral; <0.4 mm. High refractive indices. <p>GROUNDMASS: 50%. Cryptocrystalline and may consist of nepheline and aegirine.</p>	<ul style="list-style-type: none"> * <20%. Filling interstitially carbonate grains 		
WR-122	Phonolite (dyke facies)	<ul style="list-style-type: none"> * Greenish grey porphyritic with large phenocrysts of alkali feldspar (up to 10mm). * Compact, hard and fresh. * Phenocrysts; nepheline, sanidine, chromian diopside etc. * Flow structure is observed. 	<ul style="list-style-type: none"> * Nepheline: Approx. 50%. Subhedral to anhedral granular; 1-2mm. * Clinopyroxene(Aegirine): Approx. 30%. Euhedral to subhedral; 0.2-1.5mm. Pale green. Low birefringence, biaxial(-). $c \wedge z = 30^\circ$ * Spinel: Approx. 10%. Irregularly shaped, but some show hexagonal platy form; 0.1-0.3mm. Brownish to opaque. * Apatite: Approx. 5%. Granular or prismatic; <0.15mm. * Natrolite(?): Approx. 10%. Occurs as aggregates of very fine radiating crystals. 			
WR-136	Ijolite	<ul style="list-style-type: none"> * Greenish grey and light brownish white. Coarse grained holocrystalline. Compact & hard. * Major constituent mineral is nepheline, associated with clinopyroxene(aegirine or chromian diopside). 				<ul style="list-style-type: none"> * Bulk assay : NORM plot in field. * K-Ar dating: 16.2 \pm 0.8MA

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-4 SEMI-DETAILED SURVEY-(1) RANGWA

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	transparent minerals	
4929E	Carbonatite breccia	* Orange colored matrix with orange yellow breccia. Penetrated by reticular veinlets of green apatite and calcite.	<ul style="list-style-type: none"> * Carbonate: Approx. 90%. Microgranular. * Opaque mineral (Magnetite): Approx. 5%. Angular; 5mm. Brecciated fragments are filled with carbonate. * Perovskite: Approx. 1%. Euhedral to subhedral or irregular in places. <0.7mm. Twinning is prominent. Brownish, very high indices with low birefringence. * Spinel: Minor amount. Euhedral and fine. * Phengitic mica * Apatite: Not discernible in this section. 	<ul style="list-style-type: none"> * Possible magnetite. As it is strongly magnetic. See left column. 	<ul style="list-style-type: none"> * Mineral-(2) : Minor amount. <0.2mm. colorless. Cubic. High index. Garnet or spinel(?) * Mineral-(1) : Minor amount. Subhedral to Euhedral; <0.2mm. Dark yellow & Cubic. Pyrochlore(?) 	
RN-54	Ijolite	<ul style="list-style-type: none"> * Dark grey, compact and hard. Equigranular, holocrystalline and coarse. * Major constituent minerals are melilitite, nepheline and biotite, with fairly abundant magnetite and a small amount of perovskite. * Micaceous fine grained mineral is formed as a reaction rim at the contact between biotite and melilitite or nepheline. 	<ul style="list-style-type: none"> * Melilitite: Approx. 30%. 0.2-2mm. Yellowish. * Nepheline: Approx. 30%. 0.2-2mm. Colorless. * Reaction rim: Approx. 5%. Fibrous. * Biotite: Approx. 20%. 1-2mm. * Magnetite: Approx. 10%. Perovskite is formed surrounding magnetite crystals. * Perovskite: Approx. 5%. Hexagonal form. Poly-synthetic twinning is prominent. * Apatite: Minor amounts. Euhedral. Twinning is observed, and cleavage is clear. 			<ul style="list-style-type: none"> * Bulk assay. SiO₂= 33.06% Al₂O₃=12.93% Total iron as Fe₂O₃=9.16% Na₂O= 4.87% K₂O= 3.25% * NCRM plot in _____ field
R0-2	Alvikite	<ul style="list-style-type: none"> * Light brown, fine grained, compact and hard. * Dark brown long prismatic to irregularly shaped phenocrysts are arranged in a direction. 	<ul style="list-style-type: none"> * Carbonate: Approx. 90%. Granular; 0.1mm. 	<ul style="list-style-type: none"> * Brown colored matter: Approx. 90%. Irregularly shaped, flaky in places, filling interstitially grain boundaries of carbonate. 	<ul style="list-style-type: none"> * Prismatic colorless mineral in the brown colored matter. cf. Left column. Elongation positive. * Mineral-(2) (Spinel or garnet): Minor amount. Euhedral to subhedral; 0.08-0.4mm. Isotropic. 	<ul style="list-style-type: none"> * Bulk assay Total Fe₂O₃=2.80% P₂O₅=1.88% La= 470ppm Ce=1200ppm Nd= 590ppm

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-5 SEMI-DETAILED SURVEY-(2) SAGARUME

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and /or Remarks	
				Opaque minerals	transparent min.		
996856	Fenitized granite	<ul style="list-style-type: none"> * Light grey to yellowish white with feldspar crystals up to 5mm. Penetrated by closely spaced reticular veinlets of aegirine. * Rich in quartz and K-spar. Quartz occurs in two groups in size; coarser and finer. K-spar occurs as coarse grains. * Micropegmatitic(graphic) texture by K-spar, quartz, and plagioclase is often observed. * Aegirine occurs as veinlets and filling interstitially grain boundaries of minerals mentioned above. 	<ul style="list-style-type: none"> * Quartz: Approx. 40%. 0.1-0.2mm up to 1-2mm. * K-spar: Approx. 40%. Up to 5mm. * Plagioclase: Approx. 15%. Albite-molecule rich as refractive indices are lower than quartz. Polysynthetic twinning is prominent. * Aegirine: Approx. 5%. Aggregate of microcrystals filling interstitially or forming veinlets, implying its secondary origin. 			<ul style="list-style-type: none"> * Bulk assay SiO2= 73.71% Al2O3= 12.18% Total iron as Fe2O3= 2.78% CaO= 0.71% Na2O= 4.24% K2O= 5.69% * NORM plot in _____ field. 	
997126	Ljolite	<ul style="list-style-type: none"> * In this thin section, mineral composition is fairly different in upper and lower halves. In the upper, large crystals of aegirine and nepheline are interstitially filled with carbonate, whereas in the lower only nepheline and spineel are present. 	<ul style="list-style-type: none"> * Aegirine: Approx. 20%. Euhedral up to 6mm. * Augite: Approx. 5%. Subhedral. * Orthopyroxene: Approx. 5%. Anhedral. * Muscovite: Approx. 2%. * Nepheline: Approx. 30%. Subhedral; 3-4mm. * Orthoclase: Approx. Subhedral; up to 4mm. * Calcite: Approx. 10%. Anhedral; 1-2mm. * Apatite: Abundant. Euhedral rounded. * Spinel(chromite or picotite): Approx. 20%. Subhedral to euhedral; 1-7mm. 		<ul style="list-style-type: none"> * Xenotime(?) or sphene(?) of Uniaxial Not identified by X-ray diffraction. 	<ul style="list-style-type: none"> * K-Ar dating: 26.8 ± 1.3 MA * Bulk assay: SiO2= 39.23% Al2O3= 17.32% Total iron as Fe2O3= 6.65% MgO= 1.95% CaO= 15.81% NaO= 8.46% K2O= 3.49% * NORM plot in _____ field 	
997296	Alvikite	<ul style="list-style-type: none"> * Aggregate of coarse grained angular carbonate crystals, being interstitially filled with an opaque mineral and K-spar. * Euhedral quartz crystals are fringed with carbonate in places. 	<ul style="list-style-type: none"> * Calcite: 80%. Euhedral rectangular to granular; Approx. 1mm. * Quartz: Approx. 5%. Fine grained; 0.3-0.7m. * Phengitic mica: Minor amount. * Barite: Minor amount. Anhedral. Associated with possible K-spar. * Apatite: The same as barite. 		<ul style="list-style-type: none"> * Opaque mineral: Approx. 10%. Irregular, some show radiating needle-like feature. 	<ul style="list-style-type: none"> * K-spar(?): Approx. 5%. Euhedral. Some occur as veinlets. Associated with barite and apatite. * Not identified by X-ray diffract. 	<ul style="list-style-type: none"> * Bulk assay & minor elements analysis Nb= 490ppm Y= 210 La= 829 Ce=2110 Nd=1180 Sm= 244.5 Eu= 37.2

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-6 SEMI-DETAILED SURVEY-(3) S. Ruri

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and /or Remarks
				Opaque minerals	transparent min.	
99502G	Ferro-carbonatite (dyke facies)	* Aggregate of fine-grained carbonate and very fine black to brown opaque minerals.	* Carbonate: Approx. 70%. Aggregate of fine-grained crystals.	* Brown matter: Approx. 20%. Weathered product. * Black matter: Approx. 10%. Filling interstitially.	* Apatite(?) and/or barite(?): <3%. High refractive indices.	* Polished section Goethite and two unidentified minerals.
100111G	Sovite or Ferrocarbonatite	* Aggregate of coarse- and fine-grained carbonate, and euhedral aegirine crystals. * Finer carbonate grains fairly predominant, but the texture is not porphyritic.	* Calcite: Approx. 60%. Granular, irregular in size ranging 0.1-2mm. * Aegirine: Approx. 30%. Euhedral; 2-3mm. * Apatite: Approx. 10%. Granular; 0.7mm±. * Chlorite and mica: Minor amounts. * Orthoclase(sandine?): Minor amount; up to 0.9mm. Twinning is discernible.			* X-ray diffraction * Calcite: abundant * Carbonate-hydroxylapatite: scarce. * Magnetite: scarce. * No aegirine is identified in the tested sample. * Bulk assay and minor elements analysis SiO2= 17.83% Al2O3= 5.24% Fe2O3= 9.79% MgO= 1.41% CaO= 30.01% Nb and REEs are low.
100152G	Sovite	* Coarse-grained equigranular.*	* Carbonate (Mostly calcite): Approx. 60%. Granular; 2-3mm. * Zeisite: Approx. 20%. Euhedral, 2-6mm. Colorless. High refractive indices & low birefringence. Biaxial(+) and small 2V. Elongation (-) * Quartz: Approx. 5%. Filling interstices of large crystal grains of other minerals.		* K-spar(?): Approx. 15%. 4mm. Very clear without dusty inclusions and resembles nepheline.	* X-ray diffraction Calcite: abundant Quartz: moderate Epidote: scarce No K-spar identified * Bulk assay and minor elements analysis SiO2= 36.14% Al2O3= 3.98% CaO= 33.02% Na2O= 0.19% K2O= <0.01% All REEs < 5ppm

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-7 SEMI-DETAILED SURVEY-(4) N. RURI

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and /or Remarks
				Opaque minerals	transparent min.	
99543G	Alvikite	<ul style="list-style-type: none"> * Fine to medium grained. * Comprises carbonate that ranges from 0.1 to 0.2mm. Contains a small amount of apatite and altered aegirine. 	<ul style="list-style-type: none"> * Carbonate: Approx. 65%. Granular; 0.1-0.2mm. * Apatite: Approx. 5%. Long prismatic. Contains a fair amount of inclusion. * Aegirine: Approx. 15%. Euhedral to subhedral; 2mm ±. Altered into brown to yellowish mineral with high birefringence and elongation positive. 	<ul style="list-style-type: none"> * ?; Approx. 15%. Hexagonal shaped; 0.5-2mm. 	<ul style="list-style-type: none"> * Aegirine(?) * Mineral-1(Py-rochlorite?): a small amount; <0.15mm. High refractive indices and cubic. 	<ul style="list-style-type: none"> * Bulk assay and minor element analysis SiO₂= 2.30% Total iron as Fe2O₃= 8.95% CaO= 45.90% Nb= 1090ppm U= 130ppm Th= 140ppm
100127G	Sovite	<ul style="list-style-type: none"> * Comprises coarse-grained granular carbonate and euhedral aegirine phenocrysts with a minor amount of apatite. 	<ul style="list-style-type: none"> * Carbonate: Approx. 70%. Granular; 0.5-3mm. * Aegirine: Approx. 20%. Euhedral; 1-6mm. * Apatite: Approx. 10%. Long prismatic; <0.5mm. 		<ul style="list-style-type: none"> * Stiotite(?); 	<ul style="list-style-type: none"> * Bulk assay and minor element analysis SiO₂= 3.61% CaO= 49.88% Sr= 6390ppm
100132G	Nepheline Syenite	<ul style="list-style-type: none"> * Porphyritic with phenocrysts of nepheline, orthoclase, and aegirine. Groundmass consists of fine grains(0.1-0.2mm) of nepheline, aegirine and needle-like unknown mineral that fills interstitially. 	<p>PHENOCRYSTS</p> <ul style="list-style-type: none"> * Nepheline: Approx. 40%. Euhedral; 1-1.5mm. Some include carbonate and a minor amount of aegirine, sphene and zircon at the core. * Orthoclase: Approx. 20%. Euhedral; <2mm. * Aegirine: Approx. 30%. Euhedral; 1-0.5mm. <p>GROUNDMASS</p> <ul style="list-style-type: none"> * Microcrystalline microgranular; consists of nepheline, aegirine, natrolite(?), analcite(?) and cancrinite(?). 		<ul style="list-style-type: none"> * Clinopyroxene (Chromian diopside?): Green. * Natrolite(?): Approx. 10%. Acicular; very fine. Colorless. High birefringence, straight extinction and optically positive. * Analcite(?): Minor. <5% Euhedral and isotropic. Colorless. * Cancrinite(?): As altered product. 	<ul style="list-style-type: none"> * Bulk assay SiO₂= 47.58% Al₂O₃= 17.16% Total iron as Fe₂O₃= 8.22% CaO= 5.52% Na₂O= 8.48% K₂O= 7.05% * NORM plot in _____ field.

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-8 SEMI-DETAILED SURVEY-(5) KUGE & NGOU

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and /or Remarks
				Opaque minerals	transparent min.	
100051G (Kuge)	Alvikite	<ul style="list-style-type: none"> * Banded * Anhedral carbonate fills interstices of euhedral rhombic grains of carbonate. 	<ul style="list-style-type: none"> * Carbonate: Approx. 90%. Euhedral showing rhombic outline: 0.3-1mm. Some are anhedral filling interstices of the former: 0.2-0.3mm. * Apatite: Very minor amount in irregular form 	<ul style="list-style-type: none"> * Opaque min-1: (Granular) * Opaque min-2: (Acicular radiating): Total 5% 	<ul style="list-style-type: none"> * Barite(?): Irregular; minor amount. * Xenotime(?) or sphene(?): Scattered: 0.01-0.05 mm. High indices 	<ul style="list-style-type: none"> * Bulk assay and minor element analysis: SiO₂= 1.57% CaO= 52.69% Nb= 715ppm Y= 185ppm La= 434ppm Ce= 909ppm
100053G (Kuge)	Ferrocronatite	<ul style="list-style-type: none"> * Aggregate of euhedral opaque mineral, being filled interstitially by carbonate. 	<ul style="list-style-type: none"> * Opaque mineral: Approx. 90%. Euhedral, rectangular to rhombic: 0.1-0.5mm. Some part seems to be goethite. * Carbonate: Approx. 10%. Micogramular filling interstices of opaque mineral grains. 	<ul style="list-style-type: none"> * Opaque mineral: See left column and X-ray, polish and chemical analysis results 	<ul style="list-style-type: none"> * Apatite(?): Anhedral fine-grained. Colorless 	<ul style="list-style-type: none"> * Gamma-ray: 9355cps * Polished section: goethite>pyrochlore>hematite>unknown->unknown->rutile. * X-ray diffraction: calcite, barite, fluorite, machemite, hematite * Bulk assay and minor element analysis: Fe2O3= 51.07% CaO= 13.48% HfO= 9.30% BaO= 3.20% Y= 240ppm Th= 2357ppm Sm= 283ppm Eu= 74.9ppm
100389G (Ngou)	Alvikite (Java?)	<ul style="list-style-type: none"> * Shows a unique texture similar to "interstitial" of andesitic rocks. 	<ul style="list-style-type: none"> * Carbonate: Approx. 75%. Lath-shaped or granular: 0.1-0.3mm. * Apatite: Approx. 5%. Granular or long prismatic: 0.1-0.2mm. * Phenegitic malica: A minor amount: 0.5-1.0mm. 	<ul style="list-style-type: none"> * Opaque min.: Approx. 10%. 0.1-0.2mm. 	<ul style="list-style-type: none"> * Brown matter: Approx. 10%. 	<ul style="list-style-type: none"> * Bulk assay and minor element analysis: SiO₂= 4.07% Fe2O3= 3.53% CaO= 50.96% P2O5= 1.76% Nb= 225ppm Y= 77ppm La= 270ppm Ce= 450ppm Nd= 200ppm

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-9 SEMI-DETAILED SURVEY-(6) SOKLO

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major results of other tests and /or Remarks
				Opaque minerals	transparent min.	
100303G	Fine ferro-carbonatite	* Aggregate of equigranular fine-grained carbonate. Fine opaque mineral and brown matter occur interstitially. Some 'eye-like' carbonate grains of 2-3mm are observed in places.	* Carbonate: Approx. 90%. Granular; 0.1mm. * Apatite: Minor amount. * Chlorite:	* Opaque min.: Approx. 5%.	* Brown flaky matter: Approx. 5%. Brown to dark brown; 0.01mm±. May include some chlorite.	* Bulk assay and minor elements analysis: SiO2= 14.90% Fe2O3= 6.89% CaO= 34.23% P2O5= 1.86%
100320G	Carbonate vein in soavite(2-7mm)	* Aggregate of carbonate granules of 0.1-0.2mm. Brown mineral occurs along grain boundaries of carbonate. Sphatite veinlets are observed in places.	* Calcite: Approx. 85%. Granular; 0.1-0.2mm. * Apatite: Approx. 5%. 0.1-0.2mm. Low birefringence. * Biotite: Very minor amount. Euhedral, hexagonal platy; <0.1mm.		* Brown mineral: Approx. 10%.	* Gamma-ray radiation: 2213cps * X-ray diffraction: calcite: abundant carbonate-hydroxyl apatite: scarce * Polished section: Unknown-e and -j>>Magne-tite
100323G	Fenitized rock or nephelinite	* Porphyritic with eye-like nepheline phenocrysts of about 1mm. Groundmass is fine grained holocrystalline.	* Nepheline: Approx. 70%. Euhedral to subhedral; 0.5-1.0mm. * Aegirine: Approx. 20%. Irregular aggregates of fine granules of about 0.01mm. * Biotite: Very small amount. * Carbonate: <20%. Irregular shaped; veinlets of <0.1mm and granules of 0.1-0.4mm. Both are associated with aegirine and fill interstices of nepheline crystals.	* Amorphous matter: Approx. 10%. Microgranules filling interstitially. Limonite(?)		* X-ray diffraction: calcite and K-spar are abundant. * Bulk assay: SiO2= 48.33% Al2O3= 12.15% Fe2O3= 6.49% Mg2= 2.55% K2O= 10.55% * NORM plot in field
100324G	Biotite-sovite	* Coarse grained carbonatite with large crystals of biotite and some round apatite.	* Carbonate: Approx. 80%. Granular; 1-2mm up to 2-6mm in places. * Biotite: Approx. 10%. Sometimes reaches 8mm. * Apatite: Approx. 10%. Rounded granular; 0.1-0.5mm.		* Mineral-2 (Spinel or garnet?): Approx. <1%. Subhedral to euhedral; 0.1-0.2mm.	

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-10 SEMI-DETAILED SURVEY-(7) HOMA MTN.

Sample Number	Rock type	Macroscopical features and microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	Transparent min.	
99599G	Ferrocarnbonatite	* Aggregate of rounded granules of carbonate with opaque matter filling interstitially.	* Carbonate: Approx. 95%. Rounded granulous: 0.4-1.0mm.	* Opaque mineral (magnetite): Approx. 5%. Irregular shaped.	* Mineral-2 (spinel or garnet?): Approx. <3%. 0.1-0.5mm. Cubic. * Spinel(?): Minor amount. High birefringence * Acicular crystals: Colorless.	* Bulk assay and minor elements analysis: Fe2O3= 6.60% CaO= 43.98% La= 1017ppm Ce= 1964ppm Nd= 766ppm
99961G	Massive iron ore	* Black, massive, compact and hard with strong magnetism. * Almost all the part consists of opaque mineral. Dark reddish brown mineral is observed in places. A minor amount of possible biotite(?) also observed occasionally.		* Opaque mineral (magnetite): Approx. 70%.	* Reddish brown mineral: Approx. 20%. Irregular shaped. * Biotite(?): Approx. 10%.	* Polished section: Magnetite>hematite>un-known mineral-b
100233G	Iljolite	* Coarse-grained plutonic rock with euhedral nepheline, anhedral to subhedral aegirine, and other minerals. A small amount of carbonate also observed.	* Nepheline: Approx. 85%. Euhedral; 5-10mm. * Aegirine: Approx. 20%. Subhedral to anhedral; 5-10mm. Contains biotite inclusions. Green. * Clinopyroxene: A minor amount. Colorless. Biotite(-), small 2v, oblique extinction, elongation negative. * Spinel: Approx. 10%. Anhedral; 2-5mm. Brown, zoning observed. * Carbonat: Minor amount and interstitial. * Muscovit: Minor amount. * Biotite: Minor amount of microcrystals as inclusions in aegirine sites. * Apatite: Minor amount. Rounded long prismatic euhedral. As inclusions of larger phenocrysts.	* Opaque mineral		* Bulk assay: SiO2= 40.11% Al2O3= 19.50% Fe2O3= 5.46% HfO= 1.92% CaO= 12.95% Na2O= 9.58% K2O= 5.08% * NORM plot in field
100490G	Ferrocarnbonatite rich in hematite	* Aggregate of carbonate and opaque matter with minor amount of possible apatite in places.	* Dolomite>calcite: Approx. 50%. Small euhedral and large anhedral. * Apatite: Approx. <3%. 0.1mm. Colorless. * Micat(phenic): Approx. <1%. 0.03mm. * Chlorite: Approx. <1%.	* Opaque mineral: Approx. 50%. Irregular and amorphous.	* Mineral-2 (spinel or garnet?) <1%. Euhedral; 0.03-0.08mm. Cubic with high index. Colorless	* Polished section: Magnetite>hematite>un-known-j. * Bulk assay and minor elements analysis: Fe2O3= 18.57% HfO= 11.71% CaO= 24.71% Nb=2200ppm, Y= 1700ppm La= 880ppm, Ce=1804ppm Sm= 88.4ppm, Eu= 24.50ppm

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-11 SEMI-DETAILED SURVEY-(8)NDIRU HILL-1

Sample Number	Rock type	Macroscopical feature/ microscopical texture and structure	Identified minerals		Unidentified minerals		Major result of other tests and /or Remarks
			Opaque minerals	Transparent min.	Opaque minerals	Transparent min.	
100827G	Alvikite with black unidentified mineral	<ul style="list-style-type: none"> * Stained with limonite to brown. Irregular black specks. * Composed of mostly fine-grained rounded carbonate. * Irregular shaped brown matter and opaque mineral occur interstitially. * Transparent matter(apatite) fills interstices of all these mentioned above. 	<ul style="list-style-type: none"> * Calcite: Approx. 70%. Rounded granules; 0.02mm * Apatite: Approx. <10%. Irregular shaped; very fine-grained. Filling interstitially calcite and other matters. * Chlorite and mica: Minor amount. 	<ul style="list-style-type: none"> * Opaque mineral: Approx. 5%. Irregular shaped; micro-granules. 	<ul style="list-style-type: none"> * Brown matter: Approx. 20%. Irregular shaped; micro-granules. * Mineral-2 (spinel or garnet?): Euhedral to subhedral; 0.05-0.1mm. Often with a round hole at core. Yellowish green. * Xenotime(?): Very high index & birefringence. Elongation (+). 0.1mm 	<ul style="list-style-type: none"> * Gamma-ray radiation: 1400cps at the site of sampling. * Polished section: Two unidentified minerals are observed. * Bulk assay and minor elements analysis: <ul style="list-style-type: none"> Fe2O3= 4.21% (total iron) CaO= 47.02% P2O5= 4.21% BaO= 1.07% Nb= 550ppm La= 470ppm Y = 180ppm Ce= 810ppm Nd= 430ppm Th= 290ppm Gd= 200ppm 	
100832G	Ferrocarnonate with black unidentified mineral	<ul style="list-style-type: none"> * Dark brown to black; penetrated by white calcite veinlets. Black spots possibly after magnetite are abundantly occur. * Composed of fine-grained carbonate of two types. One is euhedral to subhedral, showing angular to rhombic shapes. Another is anhedral, filling interstitially grain boundaries of the former. 	<ul style="list-style-type: none"> * Carbonate A: Approx. 65%. Euhedral, rectangular to rhombic in shape; 0.2mm. Colorless & contains abundant inclusions. * Carbonate B: Approx. 20%. Anhedral; very fine. Colorless; but contains less inclusion & clear 	<ul style="list-style-type: none"> * Opaque mineral: Approx. 5%. Irregular shaped; 0.02mm. 	<ul style="list-style-type: none"> * Brown matter: Approx. 10%. Irregular shaped. Concentrated along grain boundaries of carbonate grains. * Barite(?): Approx. 1%. Anhedral. Colorless. 	<ul style="list-style-type: none"> * Gamma-ray radiation: 2050cps at the sampling site. * Bulk assay and minor elements analysis: <ul style="list-style-type: none"> Fe2O3= 8.92% (total iron) CaO= 45.21% P2O5= 0.22% BaO= 1.62% Nb= 240ppm La= 1200ppm Y = 67ppm Ce= 1700ppm Nd= 330ppm Th= 290ppm Gd= <50ppm 	
100838G	Sovite with dark grey to black veinlets	<ul style="list-style-type: none"> * Light brownish, penetrated by dark grey veinlets. * Coarse grained carbonate crystals are surrounded by altered biotite(?). 	<ul style="list-style-type: none"> * Carbonate: Approx. 95%. Granular; 2-10mm. * Apatite: Approx. 5%. Granular; 0.1mm. With abundant inclusions, especially at the core of a crystal. 		<ul style="list-style-type: none"> * Altered biotite (?): Surrounding carbonate grains. 	<ul style="list-style-type: none"> * Gamma-ray radiation: 2400cps at the sampling site. * Bulk assay and minor elements analysis: <ul style="list-style-type: none"> Fe2O3= 3.67% (total iron) CaO= 49.44% P2O5= 1.54% BaO= 0.41% Nb= 65ppm La= 280ppm Y = 81ppm Ce= 570ppm Nd= 130ppm 	

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-12 SEMI-DETAILED SURVEY-(9)NDIRU HILL-2

Sample Number	Rock type	Macroscopical feature/ microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or remarks
				Opaque minerals	Transparent min.	
100846G	Rare-earths-Nb bearing ferro-carbonatite with barite and hematite	* Brown colored weathered rock stained with limonite and clustered with a fine dark mineral. * Composed of brown euhedral (rectangular) carbonate and colorless carbonate that fills interstitially the grains of the former. Grains of an euhedral colorless mineral (possibly barite) are scattered throughout.	* Carbonate-1: Approx. 35%. Euhedral, rectangular; 0.1mm. Siderite or ankerite(?). * Carbonate-2: Approx. 30%. * Barite: Small amount. Anhedral. Low birefringence. As veinlets in places. * Apatite:	* Opaque mineral: Approx. 5%. Scattered throughout. * Brown matter: Approx. 30%. Irregularly filling interstices of carbonate grains.	* Gamma-ray radiation: 6800cps at the sampling site, which is the highest in this prospect. * X-ray diffraction: Calcite; abundant - Barite and hematite; scarce * Polished section: hematite>unidentified-a and -b. * Bulk assay and minor elements analysis: Fe2O3= 12.90% P2O5= 0.26% CaO= 39.33% BaO= 1.52% Nb= 310ppm Th= 410ppm Nd= 1100ppm Y= 185ppm La= 3200ppm Sm= 170ppm U= 26ppm Ce= 4800ppm Gd= 680ppm	
100850G	Sovite or alvikite?	* Moderately stained with limonite to brownish color. * Seams and veinlets of carbonate and limonite occur. * Aggregate of fine grained carbonate being filled interstitially by brown matter and / or micrograins of colorless mineral.	* Carbonate: Approx. 90%. Subhedral; 0.1-1.0mm. Abundantly contains very fine inclusions.	* Brown matter: Approx. 5%. Ore mineral? * Colorless min.: Approx. 5%. <0.1mm. Low birefringence and resembles nepheline. * Mineral-2 (spinel or garnet?): <1%. Euhedral; 0.1-0.2 mm. Isotropic and high refractive index.	* Gamma-ray radiation: 1287 cps at the site of sampling. * Bulk assay and minor elements analysis: Fe2O3= 4.66% P2O5= 0.37% CaO= 51.54% BaO= 0.17% Nb= 450ppm Th= 130ppm Nd= 130ppm Y= 87ppm La= 250ppm Sm= 31ppm U= 19ppm Ce= 550ppm Gd= <50ppm	
100853G	Alvikite	* Brownish grey, fine grained. Aggregate of carbonate of about 0.1mm, containing abundantly irregular shaped brown matter. Coarse carbonate crystals of about 2mm occur as veinlets or bandings.	* Carbonate: Approx. 80%. Equigranular; <0.1mm. Coarser grained (up to 2mm) one in veinlets. * Apatite: Approx. <5%. Irregular shaped.	* Brown matter: Approx. 20%. Irregular shaped. Partly opaque. * Barite(?): <3%.	* Gamma-ray radiation: 1300cps at the sampling site. * Bulk assay and minor elements analysis: Fe2O3= 2.04% P2O5= 0.49% CaO= 53.52% BaO= 1.12% Nb= 105ppm Th= 130ppm Nd= 640ppm Y= 300ppm La= 1000ppm Sm= 140ppm U= <1ppm Ce= 2000ppm Gd= <50ppm	

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-13 SEMI-DETAILED SURVEY (10) NDIRU & BURU

Sample Number	Rock type	Macroscopical feature/ microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	Transparent min.	
100873G (Ndiru Hill)	Alvikite or ferrocyanite	* Moderately limonite-stained orange-brown, compact rock. * Composed of fine carbonate with veinlets of coarser carbonate crystals. Very fine brown matter is widely scattered throughout.	* Carbonate: Approx. 60%. Anhydral; Mostly fine grained, but coarser one occurs in veinlets. * Chlorite: Minor amount. Scattered as aggregates of microcrystals. Colorless.	* Opaque mineral: Minor amount	* Brown matter: Approx. 40%. Dusty microgranules, some parts are yellowish. * Mineral-2 (spinel or garnet?): Isotropic with high refractive index. Shows shagreen texture.	* Gamma-ray radiation: 3000 cps at the sampling site.
Buru Hill 100099G	Weathered, limonitized ore (Rare-earths bearing barite-fluorite-goethite-hematite-magnetite ore)	* Orange brown, compact, hard rock with abundant irregular network veinlets and dissemination of magnetite and its derivatives. /	* Fluorite: Approx. 20%. Occurs filling interstices of grain boundaries of opaque minerals and reddish brown matter. * Barite: Approx. 10%. Microgranulous. * Apatite: Only a grain is observed. Cleavage is developed and finely fragmented. Colorless * Biotite: <10%. Yellow to dark green.	* Opaque mineral: Approx. 30%.	* Reddish brown matter: Approx. 40% Irregularly rounded ones are predominant.	* Gamma-ray radiation: 2602 cps at the sampling site. * Magnetic susceptibility: 31.18 10-3 SIU at the sampling site. * Bulk assay: SiO2 : 4.63% P2O5 : 0.34% Fe2O3: 13.49% MnO : 2.99% CaO : 43.46 BaO : 3.40% * Minor elements (in ppm): Nb: 810 La: 13620 Sm: 260 Y : 560 Ce: 16700 Eu: 63 Th: 400 Nd: 2700
100099G	Weathered, limonitized ore (Rare-earths bearing quartz-barite- goethite rock)	* Dark brownish grey. Flow or foliation structure with angular fragments. Altered gneiss? * Comprises opaque and yellow matters with colorless minerals filling interstitially.	* Barite: Approx. 30%. Filling interstices of other minerals and as veins; Fine <1mm. Colorless. Quartz: Approx. <5%.	* Opaque mineral: Approx. 40%. Irregularly shaped.	* Yellow matter: Approx. 30%. Irregular shaped aggregates: cryptocrystalline to amorphous.	* Gamma-ray radiation: 7606 cps at the sampling site. * Magnetic susceptibility: 0.37 10-3 SIU at the sampling site. Nb= 680 Y=480 Th=530 La=8330 Ce=12300 Nd=2000 Sm=200 Eu=52
101054G	Weathered, limonitized ore (Rare-earths bearing chalcocony-barite-goethite rock)	* Grey-brown with fragments. / * Euhedral crystals of an opaque mineral are surrounded by brown amorphous matter, and acicular radiating chalcocony that fills interstices.	* Chalcocony: Approx. 35%. Radiating aggregates. Elongation (-). Straight extinction. * Barite: APPROX. <5%. Anhydral to subhedral. * Apatite: Approx. <3%. Anhydral and colorless.	* Opaque mineral: Approx. 30%. Euhedral; 0.1mm.	* Brown matter: Approx. 35%. Irregular shaped microcrystalline aggregates.	* Gamma-ray radiation: 3100 cps at the sampling site. * Magnetic susceptibility: 2.70 10-3 SIU at the sampling site. Nb=1410 Y=670 Th=100 La=8920 Ce=12300 Nd=1100 Sm= 85 Eu=23

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-14 SEMI-DETAILED SURVEY-(11) BURU HILL-2

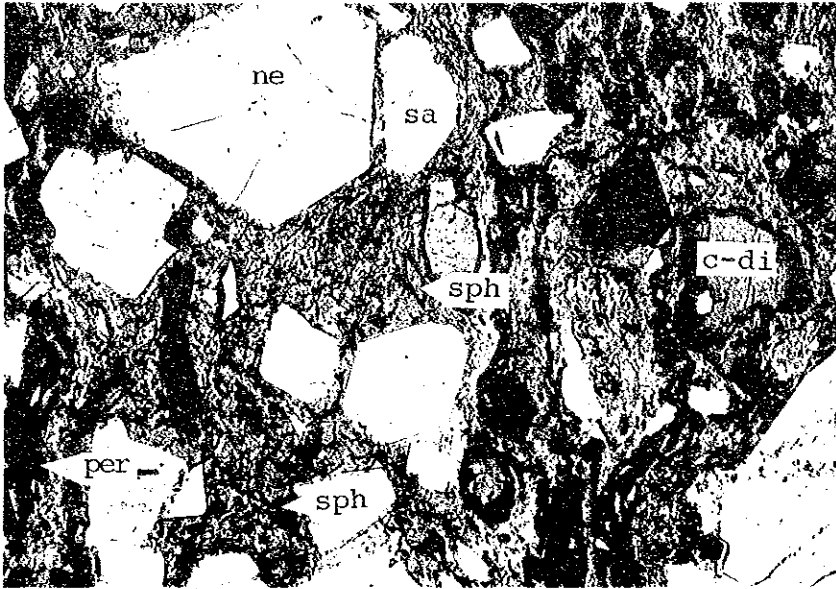
Sample Number	Rock type	Macroscopical feature/ microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	Transparent min.	
101056G	Weakly weathered Bastnaesite(?) bearing siliceous rock(?) (as high La-Ce with low P205)	* Light brown siliceous. Penetrated by chalcidonic quartz veinlets and disseminated with black minerals. * Aggregate of fine-grained minerals with amorphous brown matter and an opaque mineral. * The latter two occur both as interstitial filler and veinlets. * Quartz seems to be secondary origin.	* Quartz: Approx. 70%. Fine grained (<0.1mm) and some as veinlets. * Chalcidony + opal: Small amount. Acicular radiating crystals associated with quartz veinlets. Pale brownish, elongation(-). * Apatite: Small amount. Some occur as rounded crystals. * Fluorite: Small amount. Isotropic.	* Opaque mineral: Approx. 10%. Irregular; microgranular * Brown matter: Approx. 20%. Irregular; microgranular	* Gamma-ray radiation: 3174 cps at the sampling site. * Magnetic susceptibility: 1.01 10-3 SIU at the sampling site. * Bulk assay: SiO2 : 54.82% P2O5: 0.58% Fe2O3: 8.35% MnO : 0.57% CaO : 15.02% BaO : 4.87% * Minor elements (in ppm): Nb: 240 La: 8990 Sm: 53 Y: 210 Ce: 4800 Eu: 14 Th: <40	
101061G	Moderately weathered, limonitized ore	* Light yellow stained to reddish brown to purple. * Penetrated by magnetite and/or hematite veinlets and disseminated by the same. * Interstices of opaque mineral-grains are filled by amorphous matter. No carbonate is discernible.	* Colorless vesicules(?): Approx. 30%. Circular; 0.1-0.3mm. * Fluorite: Approx. 30%. Interstitially filling spaces around magnetite and brown matter. * Barite: Only identified as inclusion in fluorite sites. However, more should be present, being judged from assay result. * Apatite: Occurs as inclusion in fluorite sites. * Vesicles: Approx. 10-20%.	* Pale brown matter (Fluorite?): Approx. 30%. Irregular; microgranular to cryptocrystalline * Brown matter: Approx. 20%. Irregular; microgranular. * Minor elements (in ppm): Nb: 1355 Y: 610 Th: 300 La: 1200	* Gamma-ray radiation: 4362 cps at the sampling site. * Magnetic susceptibility: 1.26 10-3 SIU at the sampling site. * Polished sections: magnetite>unidentified-d->a->g->e * Bulk assay: SiO2 : 1.98% P2O5: 12.36% Fe2O3: 46.78% MnO : 3.16% CaO : 20.82% BaO : 1.29% Ce: 1700 Nd: 500 Sm: 93 Eu: 28	
101071G	Gold-pyrochlore-bearing massive magnetite ore	* Black, compact and hard. * Highest magnetic susceptibility and lowest gamma-ray readings in this prospect. * Aggregate of fine grained opaque mineral (magnetite) and irregular shaped amorphous(?) matter, being filled interstitially by fluorite and barite.	* Opaque mineral (Magnetite): Approx. 30%. From the high magnetic susceptibility and observation of polished section, most of the opaque part are to be magnetite. * Brown matter: Approx. 10%. Irregularly shaped. Barite might be hidden in this matter(?). * Gamma-ray radiation: 997cps at the sampling site. * Magnetic susceptibility: 181 10-3 SIU at the sampling site. * Polished sections: magnetite>pyrochlore>unidentified-a->c>electrum * Bulk assay: SiO2 : 2.53% P2O5: 0.52% Fe2O3: 49.42% MnO : 1.86% CaO : 17.33% BaO : 10.63% * Minor elements (in ppm): Nb: 1070 La: 3300 Sm: 120 Y: 280 Ce: 5600 Eu: 25 Th: 350 Nd: 1600			

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-15 SEMI-DETAILED SURVEY-(12) BURU HILL-3

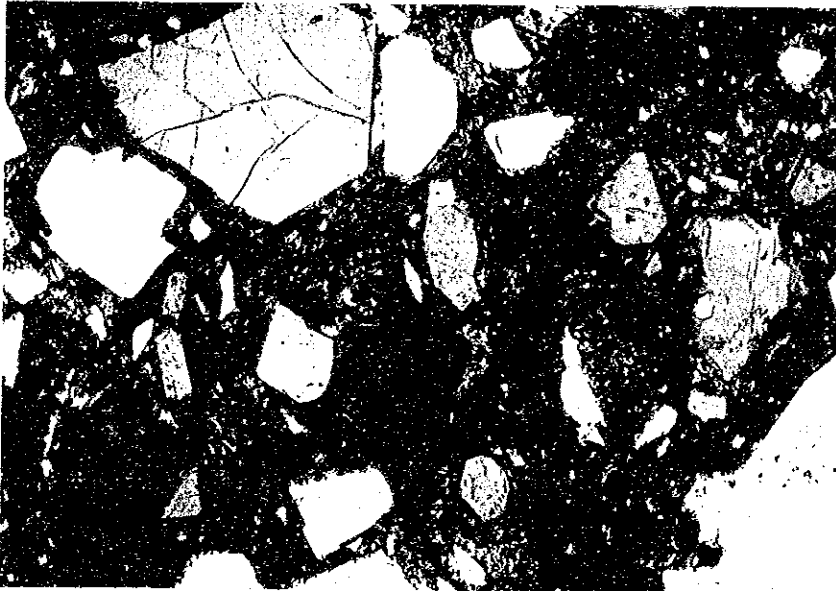
Sample Number	Rock type	Macroscopical feature/ microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	Transparent min.	
101075G	Altered gneiss	<ul style="list-style-type: none"> * Greyish white and greisose with dark colored banding. Fairly sheared. * Very fine opaque mineral and colorless minerals occur showing a banding structure * Some albitic porphyroclasts are present. * Carbonate is very little. 	<ul style="list-style-type: none"> * Quartz: Approx. 40%. Fine -grained. * Sericite: Approx. 20%. Microgranulous. * Plagioclase: Approx. 20%. Euhedral, rectangular; 0.5mm. No zoning is observed. Polysynthetic twinning is prominent. * Carbonate: <1%. Irregular. May be secondary. 	<ul style="list-style-type: none"> * Opaque mineral: Forms compositional bands with sericite. 	<ul style="list-style-type: none"> * Minor elements(in ppm): Nd: 575 La: 430 Sm: 54 Y: 150 Ce: 530 Eu: 19 Th: 380 Nd: 250 	<ul style="list-style-type: none"> * Gamma-ray radiation: 2409 cps at the sampling site. * Magnetic susceptibility: 0.04 10-3 SIU at the sampling site. * Bulk assay: SiO2: 60.79% K2O: 9.86% Fe2O3: 6.58% TiO2: 0.38% CaO: 1.40% BaO: 1.01% * NORH plot in Qz-Or-(Ab-An): In quartz syenite field close to Granite field.
101079G	Weathered limonitized ore Magnetite-magnetite-goethite-fluorite-barite-bastnaesite ore	<ul style="list-style-type: none"> * Dark brown- yellowish white mixture. Rough surfaced and relatively porous. * Penetrated by abundant goethite veinlets. * Macroscopically intergrowth of translucent yellowish white mineral and transparent greyish white mineral is observed. 	<ul style="list-style-type: none"> * Fluorite: Approx. 55%. Irregularly shaped; Fine-grained. Contains microcrystals of unidentified mineral. * Barite: Approx. 5%. Some are radiating. Clear crystals with cleavage and without twinning biaxial (+). * Apatite: <3%. Anhedral to subhedral long prismatic; very fine. * Vesicle: Approx. 30%. * Dolomite: <3%. Irregularly shaped secondary mineral. 	<ul style="list-style-type: none"> * Opaque mineral: Approx. 10%. Irregularly shaped. Microgranulous. 	<ul style="list-style-type: none"> * Gamma-ray radiation: 6126cps at the sampling site. * Magnetic susceptibility: 0.16 10-3 SIU at the sampling site. * X-ray diffraction: Fluorite, bastnaesite and magnetite are identified. * Polished section: magnetite>magnetite>goethite>rutile>unidentified-a * Bulk assay: SiO2: 2.26% P2O5: 0.55% Fe2O3: 16.76% MnO: 5.21% CaO: 40.32% BaO: 1.92% © No assay for F. Total of assayed elements is only 75.42%. * Minor elements(in ppm): Nd: 175 La: 19500 Sm: 100 Y: 730 Ce: 17900 Eu: 61 Th: 1200 Nd: 2400 	

APPENDIX-3 MICROSCOPICAL OBSERVATION OF THIN SECTIONS-16 SEMI-DETAILED SURVEY (13) LEGETET HILL

Sample Number	Rock type	Macroscopical feature/ microscopical texture and structure	Identified minerals	Unidentified minerals		Major result of other tests and /or Remarks
				Opaque minerals	Transparent min.	
997436	Melanephelinite	* A volcanic rock with abundant phenocrysts of pyroxene, showing intersertal texture. Groundmass comprises pyroxene and a colorless mineral (nepheline?).	<p><u>PHENOCRYSTS</u></p> <ul style="list-style-type: none"> * Clinopyroxene: Approx. 25%. Euhedral; 0.1-0.5mm. Pale yellow and virtually no pleochroism. Some part shows greenish color. Biaxial(+). * Perovskite: Approx. 5%. 0.1mm. Brown, zoning, twinning, and shagreen texture are observed. * Sanidine: Minor amount; 0.7mm * Apatite: Minor amount. Euhedral, subhedral & anhedral; 0.7mm. <p><u>GROUNDMASS</u></p> <ul style="list-style-type: none"> * Clinopyroxene and nepheline(?): Approx. 70%. Microgranular. 	* Opaque mineral: Approx. 10% 0.1%.	* Analcite(?) <5%. Euhedral; 0.03-0.2 mm. Colorless.	* K-Ar dating 10.7 ± 0.6 MA
997596	Carbonatitic tuff	* Sandstone-like aggregate of carbonate grains. Apatite crystals are scattered.	<ul style="list-style-type: none"> * Carbonate: Approx. 90%. Granular; 0.1-0.2mm. * Apatite: Approx. 5%. Irregular, rounded and long prismatic; 0.1mm. 	* Opaque mineral: Approx. 10%. Locally concentrated & fills interstitially. May be altered product of one mineral.		<p>* Bulk assay:</p> <p>SiO₂: 10.75% P₂O₅: 0.31% Fe₂O₃: 7.01% MnO: 0.87% CaO: 41.04% BaO: 1.37%</p> <p>* Minor elements (in ppm): Nb: 480 La: 585 Sm: 41.6 Y: 175 Ce: 902 Eu: 14.0 Th: 51 Nd: 315</p>
1010476	Carbonatitic tuff	* Aggregate of rounded and rectangular grains carbonate of about 0.1-0.2mm, showing sandstone-like texture. Grains are cemented by opaque or amorphous matters.	<ul style="list-style-type: none"> * Carbonate: Approx. 90%. Granular to angular; 0.1-0.2mm. 		* Brown matter: Approx. 10% Occurs surrounding carbonate grains. May be alteration product of some mineral.	<p>* Bulk assay:</p> <p>SiO₂: 0.47% P₂O₅: 0.90% Fe₂O₃: 2.55% MnO: 1.12% CaO: 50.69% BaO: 0.47%</p> <p>* Minor elements (in ppm): Nb: 520 La: 777 Sm: 56.6 Y: 210 Ce: 1244 Eu: 18.1 Th: 72 Nd: 406</p>



(in plane-polarized light)



(under crossed polars)

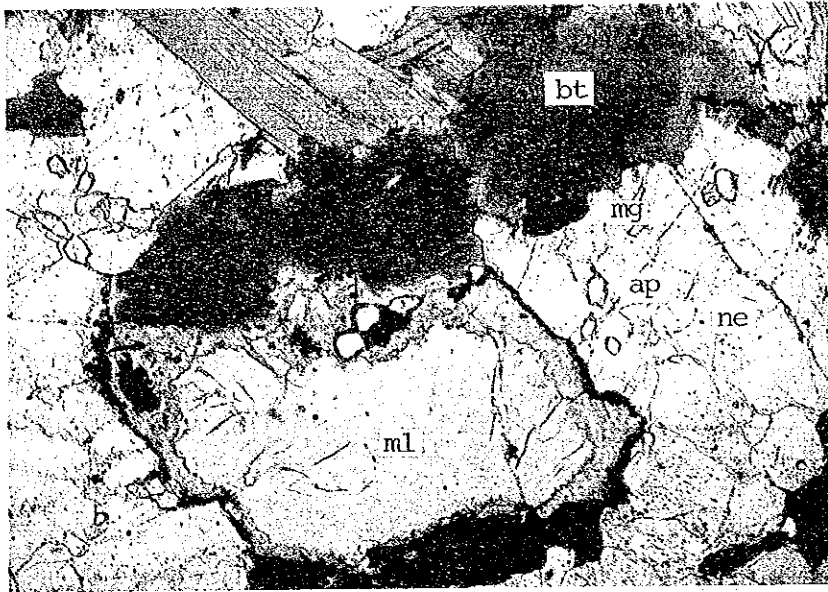
0 1mm

Abbreviation

sd : sanidine
 c-di : chromian diopside
 ne : nepheline
 sp : sphene
 per : perovskite.

Sample No. : WR-122
 Location : Waiga Hill (Madiany Area)
 Rock name : Phonolite

APPENDIX-4 Microphotographs(Thin sections)



(in plane-polarized light)



(under crossed polars)

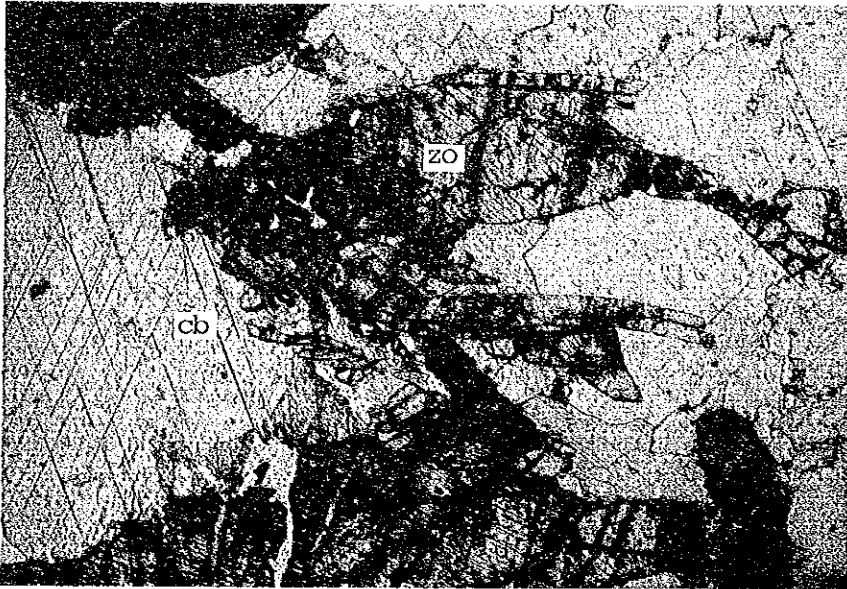


Abbreviation

ne : nepheline
 bt : biotite
 ml : melilite
 ap : apatite
 mg : magnetite

Sample No. : RN-54
 Location : Rangwa Area
 Rock name : Ijolite

APPENDIX-4 Microphotographs (Thin sections)



(in plane-polarized light)



(under crossed polars)

0 1mm

Abbreviation

zo : zoisite
cb : carbonate mineral

Sample No. : 100152G
Location : South Ruri Area,
Rock name : Carbonatite (Sövite)

APPENDIX-4 Microphotographs(Thin sections)