REPORT ON THE COOPERATIVE MINERAL EXPLORATION IN THE SOUTHERN LAKE VICTORIA AREA, THE UNITED REPUBLIC OF TANZANIA

PHASE I

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

In response to the Government of the United Republic of Tanzania, the Japanese Government decided to conduct a Mineral Exploration in the Southern Lake Victoria Area and entrusted the survey to Japan International Cooperation Agency (JICA) and Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent to the United Republic of Tanzania a survey team headed by Mr. Haruo WATANABE from 6 December, 1995 to 16 January ,1996.

The team exchanged views with the officials concerned of the Government of the United Republic of Tanzania and conducted a field survey in the Southern Lake Victoria area. After the team returned to Japan, further studies were made and the present report has been prepared.

We hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

We wish to express our deep appreciation to the officials concerned of the Government of the United Republic of Tanzania for their close cooperation extended to the team.

March, 1996

Kimio Fujita

Kimio FUJITA
President
Japan International Cooperation Agency

清滝昌三郎

Shozaburo KIYOTAKI
President
Metal Mining Agency of Japan

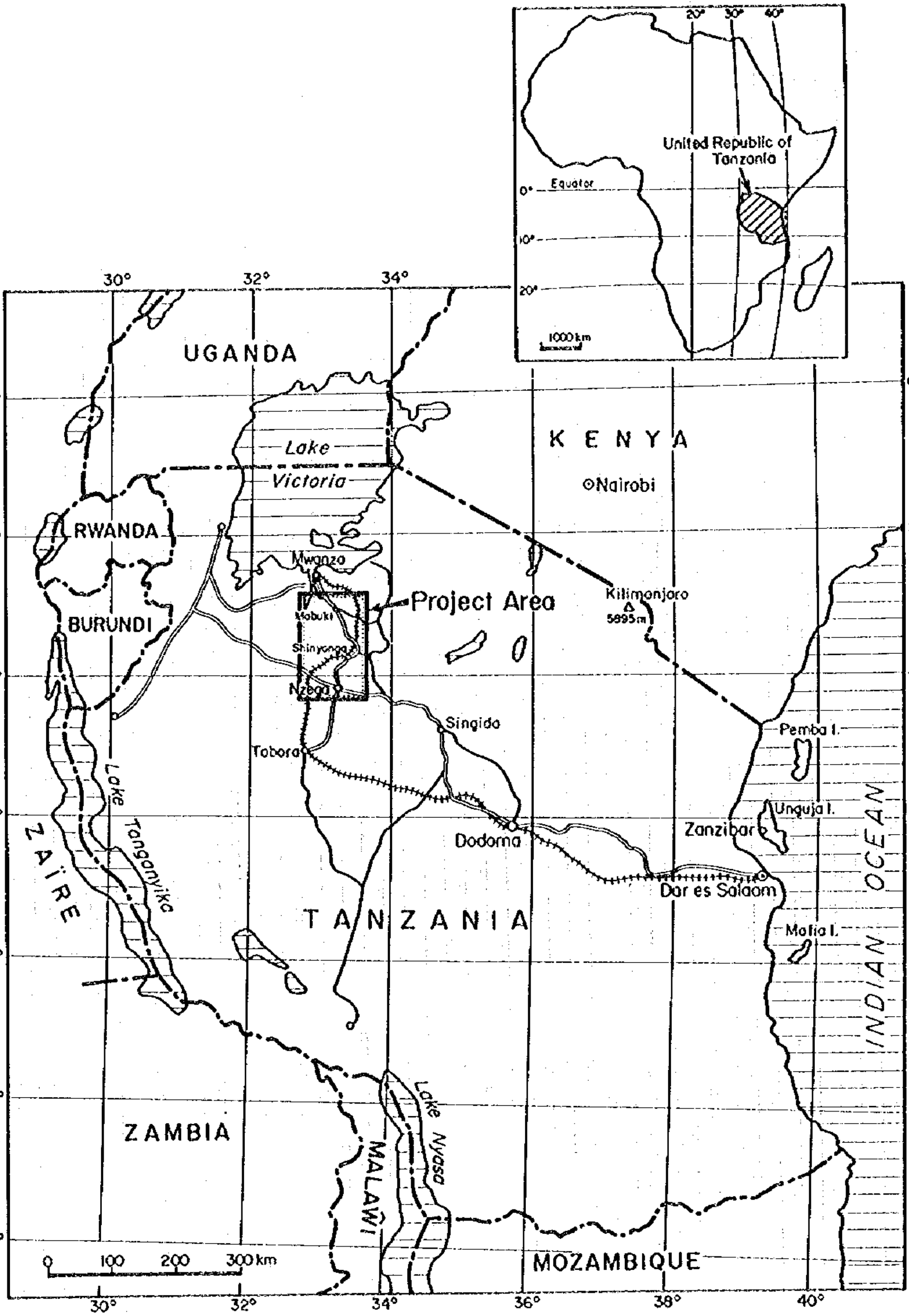

Fig. 1-1-1 Location map of the project area

ABSTRACT

The cooperative mineral exploration project in the Southern Lake Victoria Area in the United Republic of Tanzania is a project commenced in the 1995 fiscal year, and its main objective is to explore and to assess the mineral potential of the project area .

The survey area consists of the Igengi Area (86 km²), the Mhunze Area (137 km²) and the Iborogero Area (257 km²) ,totaling 480 km².

For this year (Phase I) , the effort mainly concentrated on the exploration of gold deposits in Archean Greenstone Belt. The results of the exploration are summarized as follows;

(1) Igengi Area

A major geochemical anomaly indicating mineralization of gold was detected in the Shikungi Hill Area in the northern part of the area and the gold mineralization appear to have occurred in the Kavirondian conglomerates, and in sheared zones of the Nyanzian metabasalts nearby a large fault trending north-northeast and being accompanied by shear zones.

(2) Mhunze Area

A float zone of gold-bearing quartz veins was found to the west of the Chasalawi Village in the center of the area, and a sample of the zone assayed at 2.93g/t Au. There are many faults trending east-northeast in and around the zone, and geochemical anomalies of Au and As overlap the zone .

(3) Iborogero Area

The Mwamilu Showing among the four mineral showings which were newly located by this year's exploration, is in a form of a group of small quartz veins in the Nyanzian metarhyolite. A quartz vein and the wall rocks in the showing showed certain mineralization of gold and silver, and a sample of the vein assayed at 15.9g/t Au and 20.6g/t Ag.

It is concluded that the Mwamilu Showing in the Iborogero Area, the West Chasalawi Area in the Mhunze Area and the Shikungi Hill Area in the Igengi Area are worth for further exploration, as a result of synthesizing the geological and geochemical findings.

In order to explore the three target areas, it is recommended to carry out boring and trenching works and a detailed geochemical and geological exploration for the Mwamilu Showing, boring and detailed geochemical explorations for the West Chasalawi Area , and a geological and geochemical exploration for the Shikungi Hill Area .

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PART 1 GENERAL

PART I GENERAL

Chapter 1 Introduction

1-1 Circumstances and Purpose of the Exploration

The main object of the project is to explore and to assess the mineral potential of the project area, as stated in the Scope of Work for the Mineral Exploration in the Southern Lake Victoria Area.

The Scope of Work was agreed in October 20, 1995 between Government of the United Republic of Tanzania through Ministry of Water, Energy and Minerals (MWEM), and the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ)

The present exploration is a project commenced from the fiscal year 1995. For the year (Phase I), the efforts have mainly concentrated on the exploration of gold deposits in Nyanzian Greenstone Belt.

1-2 Project Area and Works Carried Out

For the Phase I, two types of exploration works have been carried out; one is geological mapping and another is geochemical sampling for three pre-selected areas totaling 480km in the project area.

The project areas are shown in Fig.1-1-1 and 1-1-2, and the outline of the field works and laboratory tests are listed in Table 1-1-1.

Table 1-1-1 Outline of the field survey and laboratory test

Item	Area				Remarks
	Igengi	Mhunze	Iborogero	Total	
Geological survey & Gechemical exploration	86km^2	137km^2	257km^2	480km^2	
Assay of soil samples	293	642	1046	1981	Au, Ag, Cu, Pb, Zn, As, Sb, Hg, Mo, W, Bi
Assay of ore samples	4	10	39	53	Au, Ag, Cu, Pb, Zn, Pt
Whole rock analysis	5	1	14	20	Al_2O_3, CaO, Cr_2O_3, Fe_2O_3 MgO, MnO, P_2O_5, K_2O, SiO_2, Na_2O, TiO_2, LOI
X-ray diffractive test	4	1	15	20	Bulk
Observation of thin sections	5	2	14	21	
Observation of polished sections	1	4	16	21	
Measurement of resistivity and chargeability of rock samples	6	4	11	21	

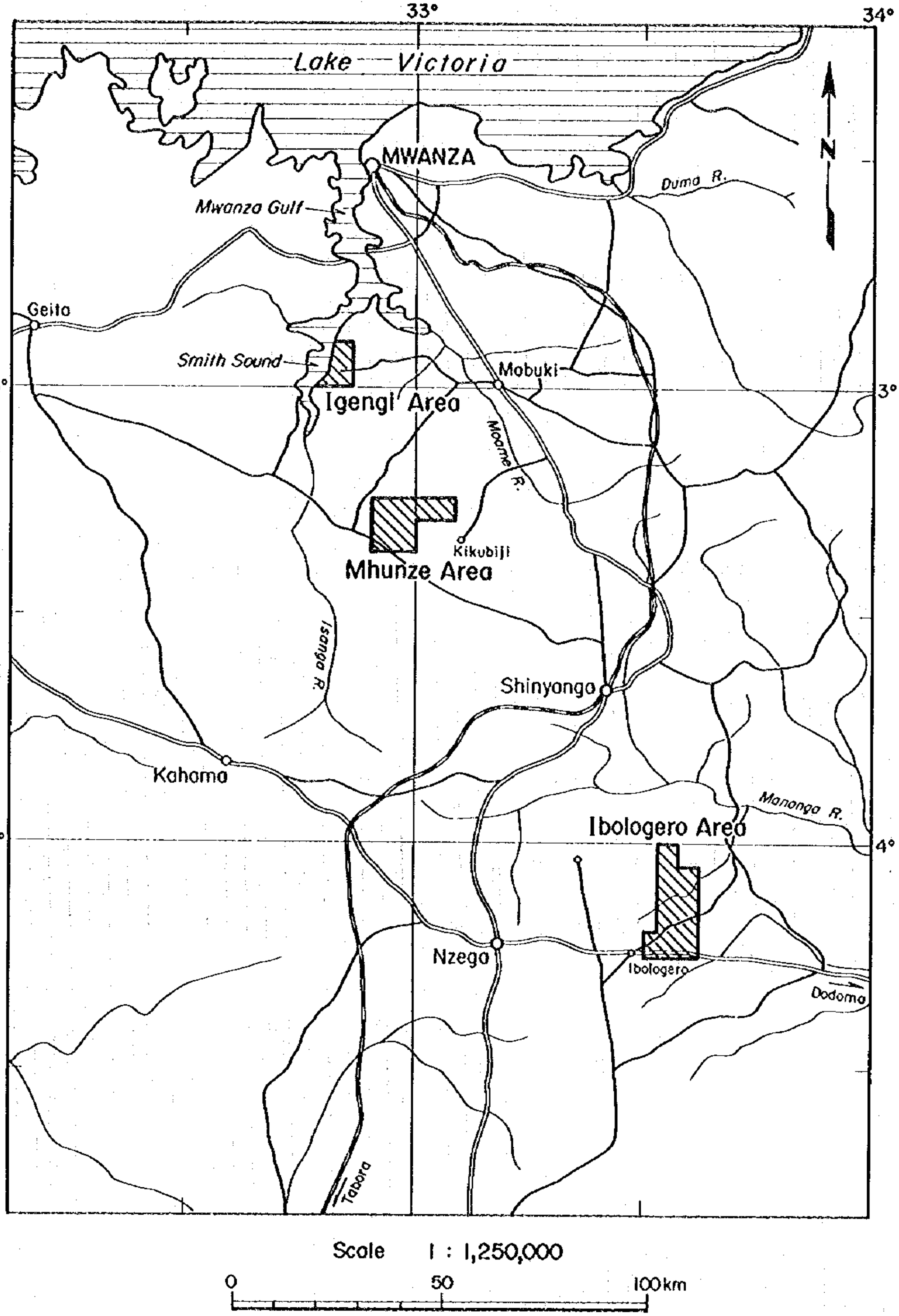


Fig. 1-1-2 Location map of the Igengi, Mhunze and Ibologero Area

1-3 Period of Work

The field work was executed by the field team dispatched by JICA/MMAJ in cooperation with the Mineral Division of Ministry of Energy and Minerals of Tanzania.

The team stayed in Tanzania in a period between December 6, 1995 and January 16, 1996, during which it engaged in the field works in the Southern Lake Victoria Area, from December 10 through January 6 and the compilation of field data at Dodoma from January 7 through 14.

The laboratory tests and preparation of the report were carried out in a period between January 20 and March 5 at Tokyo, Japan.

1-4 Organization

The member of the preliminary mission is listed in Table 1-1-2 together with that from the Tanzanian side. The member list of the field team is shown in Table 1-1-3.

Table 1-1-2 Preliminary mission and Tanzanian personnel attended the meeting

Japanese side	
Kyouichi KOYAMA	Director General, Overseas Activity Department of MMAJ
Kohei MUNAKATA	Mining Division of MITI
Naoki SATO	Deputy Director, Technical Cooperation Division of MMAJ
Yoichi OKUIZUMI	Representative of Johannesburg Office MMAJ
Tanzanian side	
Gray LMWAKALUKWA	Acting Commissioner For Mineral Division, MWEM
Edwin A. NGONYANI	Mining Engineer, MWEM
Reuben O. SWAI	Senior State Attorney, MWEM
Godwin M. NYELO	Acting Assistant Commissioner for Mineral Trade, MWEM

Table 1-1-3 Member list of the field team

Japanese		
Leader	Haruo WATANABE (Geologist)	Sumiko Consultants Co., Ltd.
	Ikuhiro HAYASHI (Geologist)	Sumiko Consultants Co., Ltd.
	Masayuki SAITOU (Geologist)	Sumiko Consultants Co., Ltd.
	Norihiro NAGANO (Geologist)	Sumiko Consultants Co., Ltd.
	Takaaki NAGAO (Geologist)	Sumiko Consultants Co., Ltd.
Tanzanian		
Co-leader	Faustin N. S. PETRO (Geologist)	Ministry of Energy and Mineral
	Samuel Y. AYUB (Geologist)	Ministry of Energy and Mineral
	Philip M. SANGO (Geologist)	Ministry of Energy and Mineral
	Jackson B. SHUBI (Geologist)	Ministry of Energy and Mineral
	Godefrey MSUBA (Geologist)	Ministry of Energy and Mineral
	Frank LEMA (Technician)	Ministry of Energy and Mineral
	Richard NSANGILA (Technician)	Ministry of Energy and Mineral
	Nuru BAUSA (Technician)	Ministry of Energy and Mineral
	Charles MAHONA (Technician)	Ministry of Energy and Mineral

Chapter 2 Geography

2-1 Location and Communication

The project area is located in the northern part of the United Republic of Tanzania; the southern coast area of the Lake Victoria and is spread over three Regions of Mwanza, Shinyanga and Tabora.

The target areas for Phase I are following three areas: Igengi (86sq.km) located in the northernmost, Mhunze (137sq.km) in the northern and Iborogero (257sq. km) in the southern part of the project area.

Igengi Area is situated in the Misungwi District of the Mwanza Region, Mhunze Area in the Kwimba District of the Mwanza Region and Shinyanga District of the Shinyanga Region, and Iborogero Area in the Igunga District of the Tabora Region, respectively.

Mwanza, Shinyanga and Tabora the central towns of the three Regions are accessible by car through unsurfaced primary roads from Dodoma, the capital city of Tanzania, which is connected with Dar es Salaam by all weather surfaced roads.

The road distance from Dar es Salaam to Dodoma is about 500km and it takes about seven hours, on the other hand, from Dodoma to Mwanza, the road distance is about 700km and it takes a day and a half by 4WD vehicle, and two days by lorry.

Railway and airway services are also available from Dar es Salaam to Dodoma, Shinyanga and Mwanza, but it is not so convenient because of low frequency of services.

Dry weather road or mortarable tracks lead to the three target areas from those above mentioned primary roads, but access to the areas becomes sometimes difficult during a heavy wet season because of lack of all-weather roads.

2-2 Physiography

The Project area is divided into two units by a main drainage divide which separates water systems into drainages to Smith Sound of the Lake Victoria and to the Lake Eyashi, a part of East African Graven.

Among the three target areas, the Igengi and Mhunze Areas belong to the former and the Iborogero area to the later.

The whole area is characterized by two topographical units reflecting the underlying geology. The one is wide areas of flat lands underlained by Alluvial lake and river deposits usually 1,140-1,200 meters in height from the sea level. The other unit is sporadically distributed granite tors or kopjes, monadocks of BIF (Banded Iron Formation) and smooth hills of green rock, which raise 50 to 250 meters from the surroundings.

Then the two drainage areas are physiographycally not so different though the three target areas have certain individual features.

The outlines of the three areas are as follows.

2-1-1 Igengi Area

This area is largely separated into the eastern, western and coastal sections. The eastern section mainly comprises rugged granite hills, of which the highest point is 1,300 meters. The western section is formed of a gently westerly-sloped plain where small smooth hills of Nyanzian rocks exist. The coastal section is occupied by flat plains of Mbuga clay and swamps which contact to the Smith Sound of the Lake Victoria.

2-2-2 Mhunze Area

This area comprises mainly flat Mbuga plains with a line of monadonocks of BIF extending east-westerly in the southwest part of the area.

The Mbuga plains are 1,150 to 1,190 meters high from the sea level, and the Mbuga is said to represent lake deposits of proto-Lake Victoria.

The monadnocks of BIF form oval hills about 1 kilometer in long-axis and have heights of 30 to 50 meters from the surroundings.

2-2-3 Iborogero Area

This area is characterized by a well developed water system which has being been formed by tributaries of Manonga River flowing eastwards.

The main streams run northerly in the north half of the area, on the other hand northeasterly in the south, which may represent the underlying geology.

The area, though the water systemthe has developed well, is very flat and the most level is within 1,150 to 1,200 meters, which may show a re-erosion of the old peneplain.

There is only one BIF monadnock in the southwest corner of the area.

2-3 Climate and Vegetation

2-3-1 Climate

The climate in the project area is typical of the Lake Victoria region (Igengi and Mhunze Areas) to semi-arid (Ibologero Area) with annual precipitation of about 800 to 1,200mm in the former and 600 to 800mm in the later, though annual variation is said to be big.

At Mwanza, the rainy season is from November to March with maximum monthly precipitation of 180mm in April and the dry season from June to October with minimum monthly precipitation of less than 100mm in June.

The temperature changes little throughout the year. averaging 23℃ and varies between 16℃ to 33℃ daily. Generally the dry season is warm to hot during the day and cool at night. In the wet season, the humidity increases and it sometimes feel cool even during the daytime.

In the semi-arid Iborogero Area, the tendency is almost same as that of Mwanza.

(Information is mainly from TANZANIA SECONDARY SCHOOL ATLAS published at 1989 and data obtained during this field period)

2-3-2 Vegetation

In the Igengi and Mhunze Areas, the natural vegetation is rather poor as the areas is heavily cultivated by the inhabitants because of fertile mbuga soil. Grasslands also occupy wide area for cattle and goat breeding. As an markable vegetation, thick thorny shrubs some of which are thought to be the secondary growth replacing the original forests, are only seen in rugged granite hills and monadnocks of BIF or Greenstone.

Maize , millet, sorghum and cotton, and rice are main crops in low-lands of the areas.

In Iborogero area, thorny shrubs cover almost the whole of the area, but arable lands are expanding rapidly by deforestation.

As the natural vegetation, baobab trees and high trees of genus acacia are prominent. Maize, millet and sorghum are main crops in the area.

Chapter 3 Previous Geological Works

3-1 Geologic Setting of the Project Area

The Southern Lake Victoria Area belongs to the Congo Craton, one of the oldest Archean cratonic shields in Africa. The Archean complex in this region consists of mainly meta-volcanics and meta-sediments of greenschist facies intruded by the Archean granitoids of younger age. These complex are composed of the Dodoman, Nyanzian and Kavirondian Systems.

The greenstones form linear belts of roof pendants in the granitic terrane. According to the summary results of the United Nations Development Program (UNDP,1991), there are eight Greenstone Belts in the Southern Lake Victoria Area ,namely Geita, Mabale, Kahama, Rwamagaza, Nzega, Iramba-Sekenke, Kilimafedha, and Musoma-Mara (Fig. 1-3-3). Among these exploration areas of this year, Igengi and Mhunze Areas are located in the Mabale Greenstone Belt, and Ibologero Area is in the Nzega Greenstone Belt.

Meta-volcanics and the Banded Ironstone Formation of the Nyanzian System are important as host rocks of gold mineralization. Many gold deposits are found in the shear zones of these strata (Fig.1-3-1).

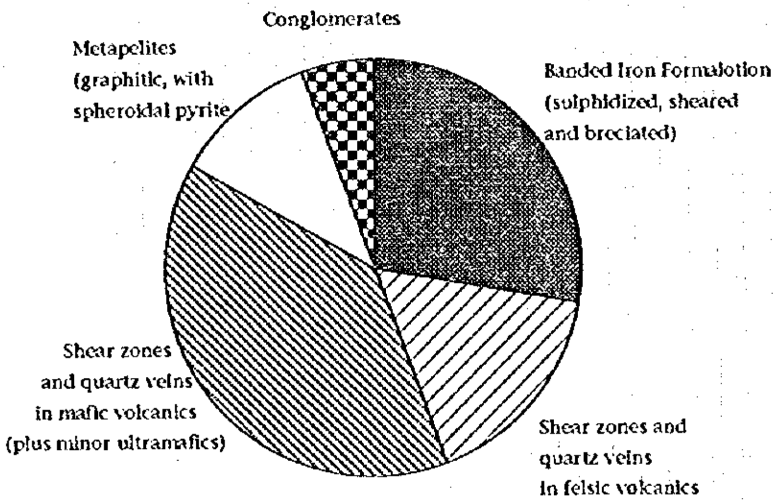


Fig. 1-3-1 Classification of types of gold mineralization and host rocks in the Siga Hills and neighbouring parts of the Sukumaland Greenstone Belt. (Mmbando, J. S., et al. 1992)

There are many data concerning about radiometric age determination of Archean granitic rocks in the Southern Lake Victoria Area. These results of Rb/Sr age dating measured 2.6Ga to 2.5Ga (e.g. Bell & Dodson,1981).

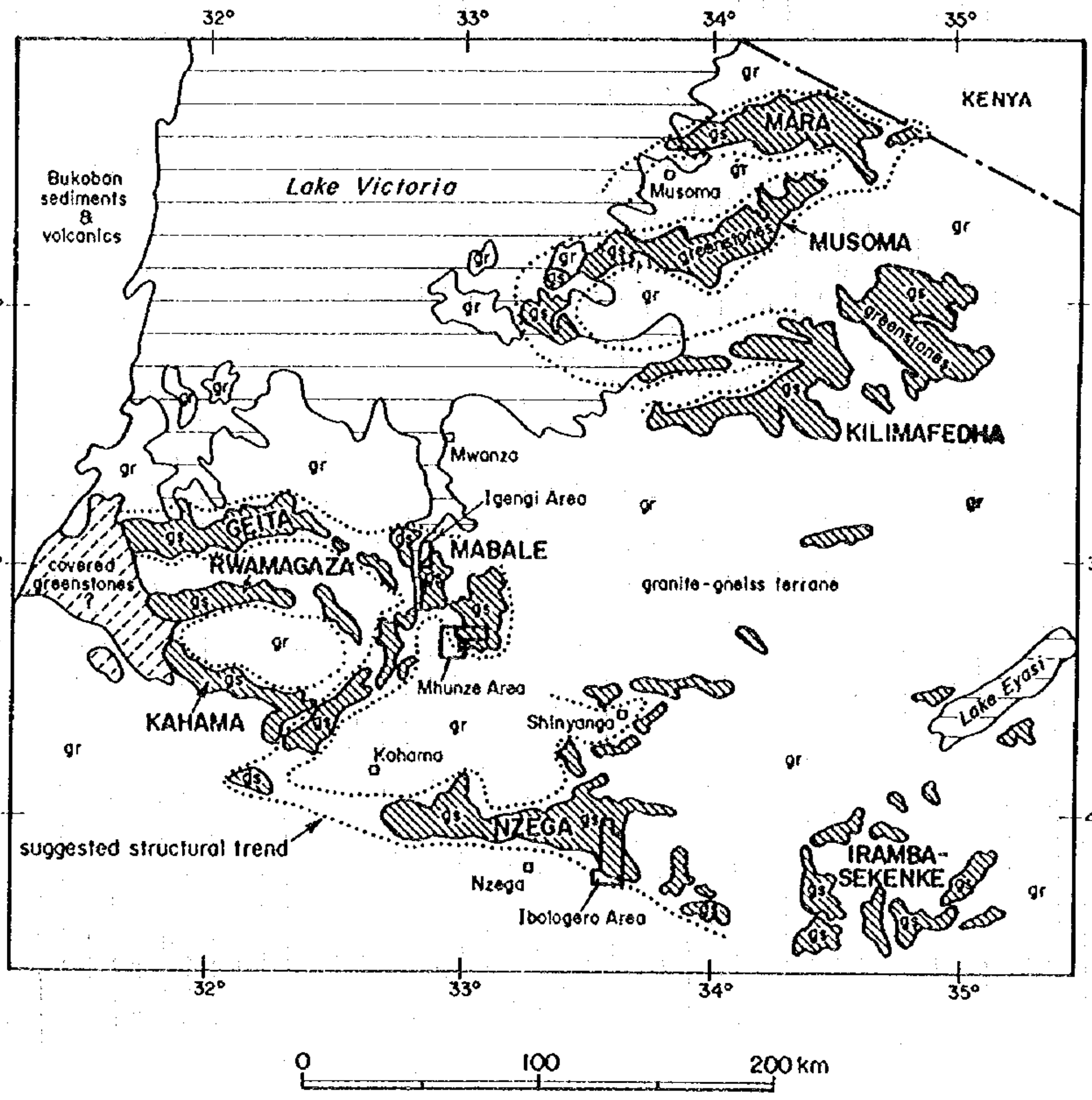


Fig. 1-3-2 Archean greenstone belts in Tanzania
(UNDP 1991)

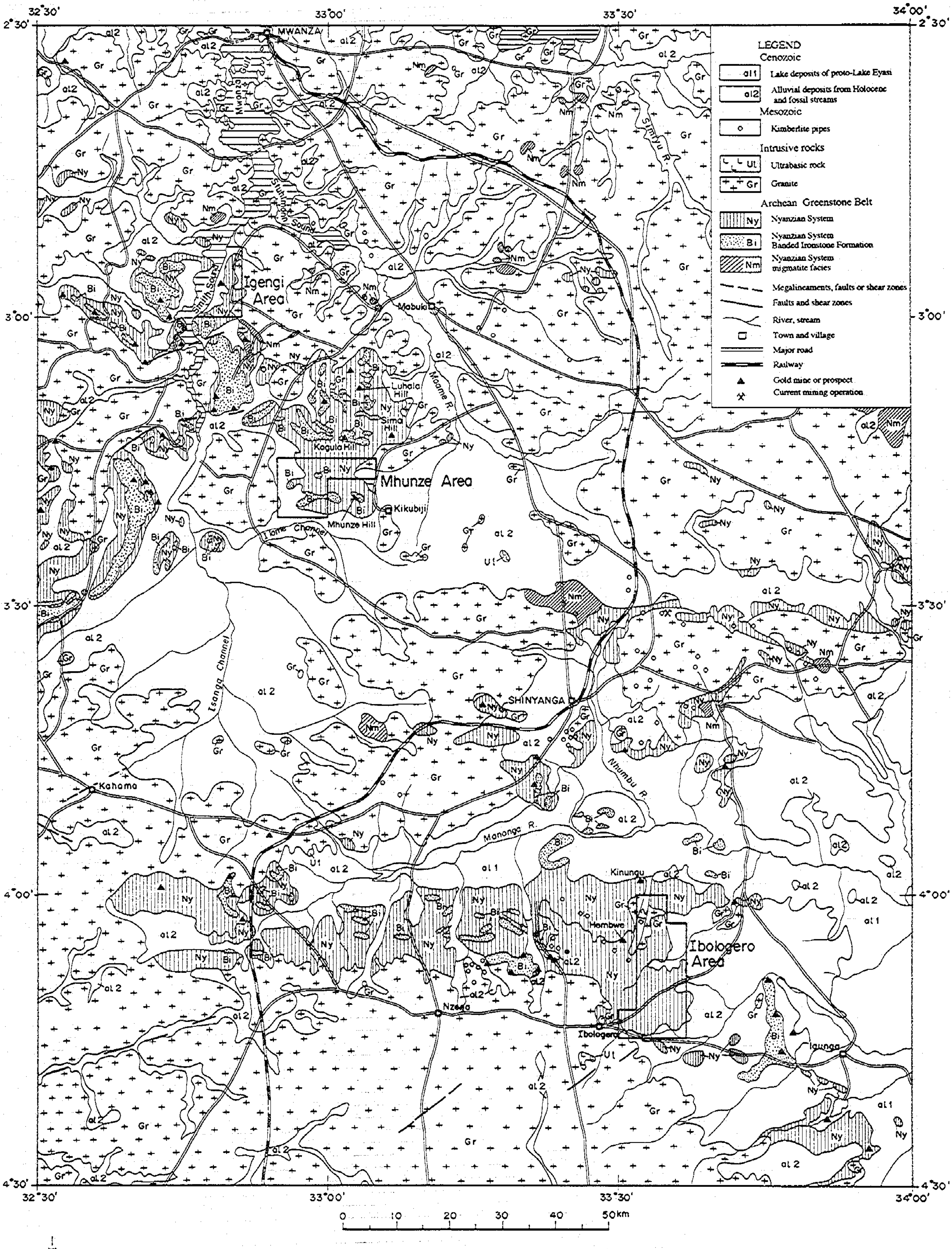


Fig.1-3-3 Simplified geological map of the project area
(from BGR,1990)

3-2 Previous Geological Works and Mining Activities

Stockly (1935,1936) established the basis of the regional geology and stratigraphy of the Archean complex in the Southern Lake Victoria Area. After World War Ⅱ, many geological informations have been provided by the prospectors through the active mineral explorations.

Following reports are useful to understand the general geology and mineral occurrences in the survey area.

(1) Regional geology and mineral occurrence in the project area;

BGR(1990): Provisional Geological Map of the Lake Victoria Goldfields, Tanzania

UNDP(1991): TANZANIA-Opportunities for Mineral Resource Development

(2) Detailed description in the survey area;

<Igengi Area>

Stockley(1947): The Geology of the Country around Mwanza Gulf

<Mhunze Area>

Grantham, etc. (1938): Geologic Map of Degree Sheet No. 17 (Kahama Area) 1:250,000

Williams, etc. (1945): Geologic Map of Degree Sheet No.18 (Shinyanga Area) 1:250,000

<Iborogero Area>

Handley (1956): Geological map of the Mwambiti Area, QDS-81, 1:125,000

Mwakyolile(1992): Report on the ground follow-up exploration work carried out in the East-Nzega and Igunga Areas

There are many opinions about the stratigraphy and the geology of the Archean metamorphic rocks in the Greenstone belts. The stratigraphy of the Archean rocks in this region by recent studies are shown in Table 1-3-1. It is summarized that 1) the greenstones are divided into the Dodoman, Nyanzian, and Kavirondian Systems in ascending order, 2) the Nyanzian System as the important target for gold exploration is divided into two subsystem, the Lower and the Upper Nyanzian Subsystems, 3) the former consists of mafic to felsic volcanics and the latter consists of meta-sediments intercalated with the Banded Ironstone Formation (BIF).

The gold prospecting and mining history of the Southern Lake Victoria Area dates back to the end of 19th century. Current prospecting activities since 1950 are listed in Table 1-3-2. In recent years, some explorations for gold and base metals have been conducted by the aid of UNDP and the United Nations Revolving Fund for Natural Resources Exploration (UNRFNRE). Some explorations have been also done aggressively by some private companies. It is worthy of notice that three gold deposits were found in the Southern Lake Victoria Area by UNRFNRE in 1992-1994.

Current gold production is mostly from artisanal mining that produce gold less than 1 ton/year. Most of these small gold mines are located in the Greenstone belts around the Southern Lake Victoria Area. Annual gold production in Tanzania had been 1 to 4 ton/year before 1966. Though the gold industry had declined to insignificance during 1966 to 1989, gold production has increased again 1 to 5 ton/year after 1990

Table 1-3-1 Comparison of lithostratigraphic subdivisions of the Precambrian strata in the Southern Lake Victoria. (Mmbando, J. S., et al. 1992)

EON	SYSTEM	GRANTHAM et al. (1945)	BORG et al. (1990)	PAULSEN et al. (1991)	BORG. et al. (1992)
PROTERO-ZOIC ?	KAVIRON-DIAN	quartzites, conglomerates and metasediments (Muva-Ankolean or UBC)	conglomerates and quartzites	conglomerates and quartzites	conglomerates and quartzites>300m
		Unconformity	Unconformity	Unconformity	Unconformity
ARCHEAN	UPPER NYANZIAN	Banded Ironstone Suite and Acidic Volcanics (UBC)	rhyolitic flows coarse and massive felsic pyroclastics banded iron formation (BIF) felsic pyroclastics	felsic volcanic flows massive and laminated tuff coarse-grained pyroclastics lapilli tuff tuff/chert BIF	felsic vlocanics <500m massive and laminated tuff <200m coarse-grained pyroclastics <50m lapilli tuff and black shale <50m BIF: tuff/chert lithofacies 200-400m banded chert lithofacies 0-150m magnetite/hematite chert facies 100-500m
			-information gap-	-information gap-	information gap
	LOWER NYANZIAN	Basic Volcanics (UBC)	pillow basalt and gabbro	basal felsic volcanics mafic volcanics	felsic volcanics <300m? graphitic shale <50m mafic volcanics >1000m
		Unconformity	Unconformity	Unconformity	Unconformity
	DODOMAN	Gnessoid Granites	gneiss and migmatite	granite gneiss and migmatite	granite gneiss and migmatite

Table 1-3-2 Major Post-1950 Exploration Ventures

Period	Organization	Activity	Area	Minerals
1947-1961	New Consolidated Goldfields	exploration, mining	various	Au, Sn, kaolin
1959-1963	British Geological Survey	exploration	Geita, Rwamagaza	Au
1965-1968,	UNDP Special Fund	exploration	Buck Reef Mine greenstone belts	Au, Cu, Zn
1966	Hunting Surveys	geophysics airborne	Musoma	Au, Cu, Zn
1970	STAMICO/GEOMIN(Romania)	feasibility	Buck Reef	Au
1970-1974	MADINI/USSR	exploration	Lupa/Mpanda	Au, base metals
1971	Williamson Diamonds Ltd.	exploration	Buck Reef	Au
1973-1974	SIDA(Sweden)	development	Buck Reef	Au
1976-1979	UNDP	exploration	West Lake region	Ni, Sn, etc
1976-1980	MADINI/STAMICO	drilling	Bulyanhulu	Au, Cu
1977-1981	Sala International(Sweden)	development	Buck Reef	Au
1977-1980	Geosurvey Internationl	airborne geophysics	entire country	all minerals
1978-1979	STAMICO	exploration	Bulyanhulu	Au, Cu
1979-1981	MADINI	exploration	Nzega, Geita	Au, Cu, Zn
1980-1981	Geosurvey International	airborne geophysics	Nzega, Geita	Cu, Zn Au
1980-1982	UNDP/MADINI	exploration	N. Tanzania	Ni, Cu, Co, U
1981-1986	STAMICO/Finland	drilling	Bulyanhulu	
1982	STAMICO/Delft University	inventory, exploration	Sekenke	Au, Cu
1982-1986	STAMICO/Finland	feasibility	Bulyanhulu	Au, Cu, Zn
1983-1987	UNDP	exploration	Zanaui, Geita Nyamulilima Canuck	Au, Ni, Cu, Zn
1984-1985	STAMICO/Bulgaria	exploration	Samena/Geita	Au-Cu
1984-1991	Germany	geology	greenstones belts	Au, Ni, PGM
1984-1989	Dar Tadine Al-Umma	exploration	greenstones belt	Au
1989-present	Placer Dome	exploration	Bulyanhulu	Au, Cu
1989-present	Romanex International	exploration	Kagera	Ni
1991-present	UNRFNRE	exploration	Nyamulilima, Geita Canuck(Nzega)	Au

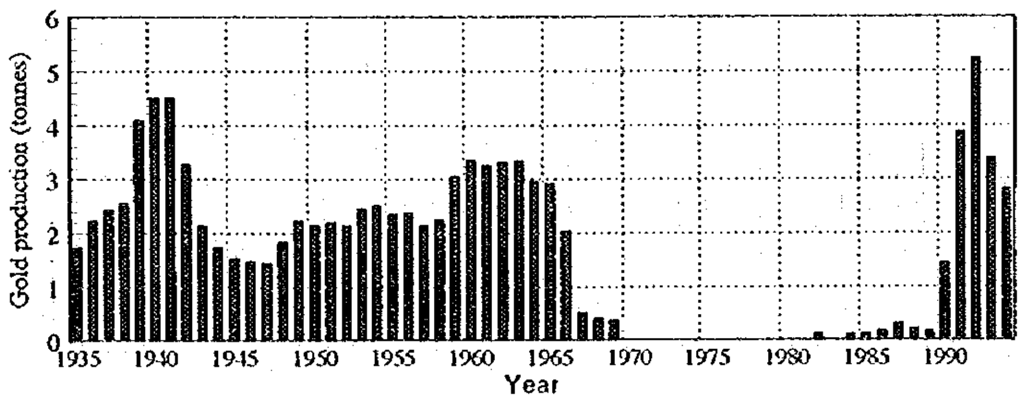


Fig.1-3-4 Gold Production in Tanzania (UNDP 1991 and MMAJ 1993, 1995)

Chapter 4 Summary of Exploration Works

4-1 Igengi Area

Geology: The area is geologically situated in the northeast part of the Mabale Greenstone Belt of the " Lake Victoria Gold Fields". The geology of the area comprises the Nyanzian and Kavirondian Systems of Archean age and the Granitic Rocks which intruded the Nyanzian System.

The Nyanzian System is distributed in the gentle hills occupying the west part of the area, and consists of Metabasalt, Pelitic Metasediments, Banded Ironstone Formation, Pelitic Metasediments and Psammitic Metasediments in ascending order.

The Kavirondian System, consisting mainly of quartzites, is distributed locally in the area, and overlies the Nyanzian rocks unconformably. The Granitic Rocks are distributed in the east part of the area where undulated hills and mountains extend. The rocks consist mainly of medium to coarse-grained biotite granite being accompanied with fine-grained granite porphyry.

Geological structure: Many faults are inferred in the area based on air-photo lineaments. The most major one runs through the area from the Lutalutale Village in the north to the Nyang'homango Village in the south of the area, which is parallel to the direction (NNE-SSW) of the Smith Sound of the Lake Victoria. The fault is estimated to be accompanied by shear zones judging from the existence of sheared shales and milonites near the fault. Main structural trends are N-S or NNE-SSW in the east side of the fault, on the other hand E-W in the west.

Mineral showings: Three mineral showings (Mbanga, Nyanguku and Igengi S howings from north to south) were newly located in the area. In the Mbanga and Nyanguku Showings, milky quartz veins ranging 5 to 10cm in width occur in biotite granites. The Igengi Showing is formed of a float zone of pyrite-bearing quartz veins, which is near the major fault mentioned above. Assay results of the samples taken from the three showings show the values are all under detection limits or near those for all analytical elements (Au, Ag, Cu, Pb, Zn and Pt).

Geochemical exploration: The element which has the highest correlation and similarity with Au turned out to be As as a result of correlation and cluster analyses. Results of the factor analysis show the third factor has the highest possibility to indicate the mineralization of gold. Contents of Au and As are the highest contributors for the third factor, and contents of Sb and Cu follow them.

Au shows higher contents in the area of the Nyanzian and Kavirondian rocks, and lower contents in the area of Granitic Rocks. A high anomaly of Au occupying an area of 1.5 x 2.0 km, and

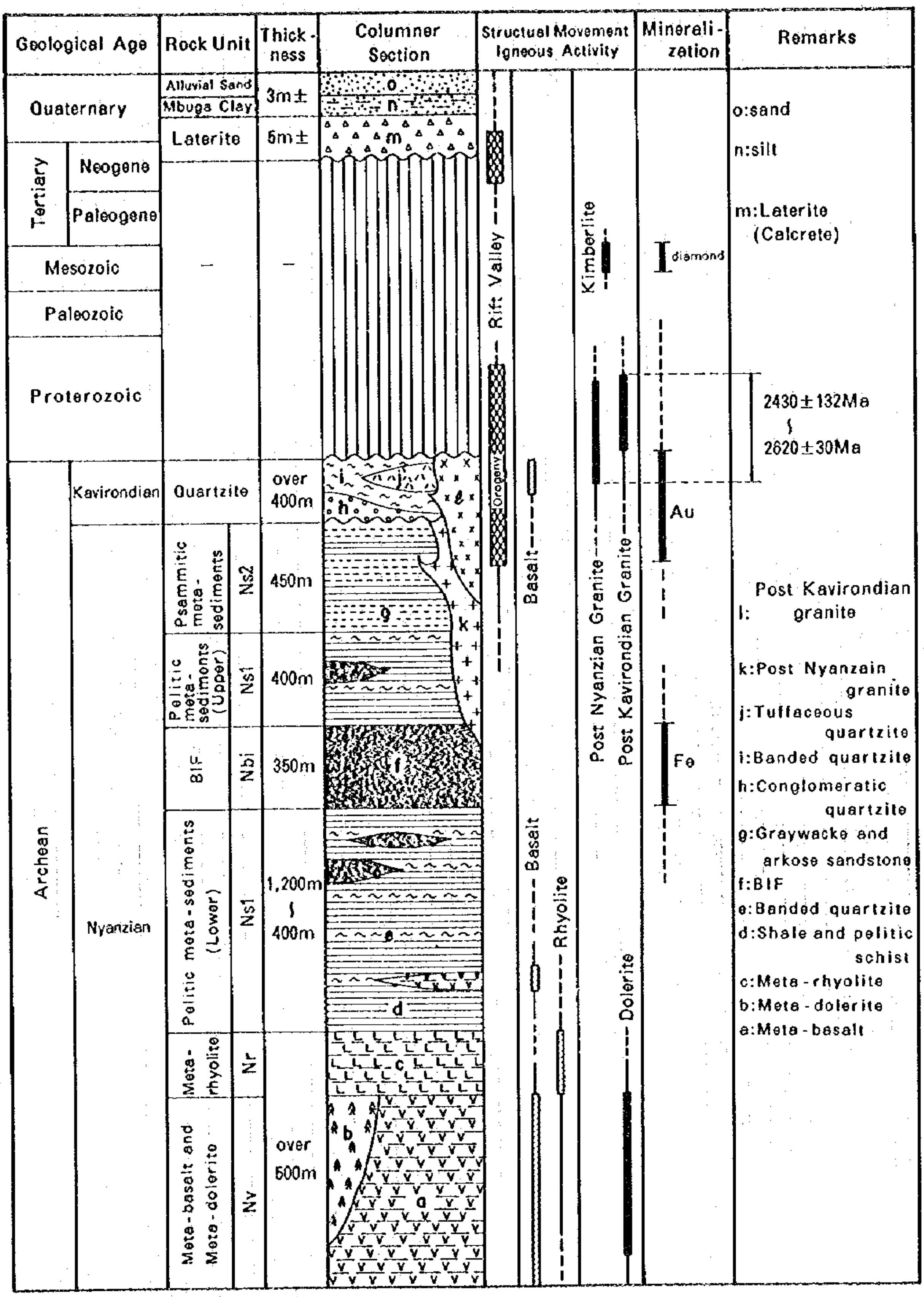


Fig. 1-4-1 Generalized geological columnar section of the survey area

having an intensity of 5 to 30ppb was detected in the Shikungu Hill and the south in the western part of the area. Another high anomaly of Au was also detected in the Bujingwa Hill in the south of the area, but the extent is small (0.5 x 1.0 km). Contents of As show the same behavior as Au, and high anomalies of As are also located in the same places as Au, but it is very interesting that the extension of anomalous zone of As at the Shikunga Hill is much longer in N-S direction (3.5 x 2.0 km) than the area of Au.

The distribution pattern of scores of the third factor well-matched with the high anomalies of Au and As, especially with the distribution pattern of high anomalies of As. Besides the Shikungu and Bujingwa Hills, high scores of the third factor were detected in the northern part of the Nyang'homango Hill, but it is due to the contribution mainly by Cu.

Conclusion and recommendation: The Shikungu and Bujingwa Hills were detected as high possible areas for gold mineralization.

In and around the Shikungu Hill, gold mineralization appear to have occurred along zones of shearing and fracturing of the Nyanzian metabasalts, and Kavirondian quartzites. The area is close to the NNE major fault being associated with shear zones.

At the Bujingwa Hill, gold mineralization appears to have occurred along zones of fracturing in quartzites, but the geochemically anomalous zone is much smaller than that of the Shikungu Hill because the Nyanzian and Kavirondian rocks in the area are narrowly surrounded by granite bodies.

It is recommended to carry out detailed geological mapping and geochemical exploration in the Shikung Hill Area.

4-2 Mbunze area

Geology: The area is geologically situated in the southeast part of the Mabale Greenstone Belt. The geology of the area comprises the Nyanzian System and the Granitic Rocks which intruded into the Nyanzian System in the northeast and south part of the area. The Nyanzian System in the area consists of Pelitic Metasediments and Banded Ironstone Formation.

Geological structure: Many faults parallel to the strikes of the Nyanzian rocks(WSW-ENE) are developed in the area. These faults exist mainly to the west of Chasalawi Village where Nyanzian metasediments are distributed and in the area centering the Mhande Hill where banded Ironstones are distributed. Some shear zones were found in outcrops of a fault of the latter.

Mineral showings: Two mineral showings: West Chsalawi and Mhande Hill Showings were newly located. The West Chasalawi Showing is formed of a float zone of pyrite-bearing quartz vein. A sample among several samples taken from the zone assayed at 2.93g/t Au. The Mhande Hill Showing is formed of shear zones in banded ironstones. Assay results of the samples taken in and around the shear zones show very weak gold mineralization.

Geochemical exploration: The element which has the highest correlation and similarity with Au turned out As as the results of correlation and cluster analyses. Three areas where soils have relatively higher contents of gold, were located to the west of Chasalawi Village, to the north of Ibila Village and in the south of Mhande Hill. The areas where are anomalous for As contents and for high scores of the first factor in the factor analysis were located in the almost same areas to that of Au anomaly.

Conclusion and recommendation: Integrating all the results obtained from the exploration of this year, it is recommended to carry out exploration works in the West Chasalawi Showing for the 2nd phase. It is desirable to execute drilling of short holes to explore the character of the showing, and detailed geochemical exploration to grasp the extent and intensity of the showing.

It is very difficult to asses the Mhande Hill Showing and Ibila anomalous zone from the results of this year's work because they are densely covered with superficial materials such as weathered soil and Mbuga clay, so it may be necessary to explore the depth by drilling though the priority is lower than the West Chasalawi Showing.

4-3 Iborogero area

Geology: The area is geologically situated in the east part of the Nzega Greenstone Belt of the " Lake Victoria Gold Fields". The geology of the area comprises the Nyanzian Metavolcanics and Metasediments, and Granitic Rocks which intruded the Nyanzian rocks.

The Nyanzian System, strongly folded, is distributed in several blocks separated by faults and granite bodies. The System consists of Metabasalt, Metarhyolite, Pelitic Metasediments and Quartzite, and Banded Ironstone Formation in ascending order.

The Granitic Rocks consist of coarse-grained facies distributed in the south part of the area and fine-grained facies in the north, and the area of granites occupies about 40% of all the area of Igengi. These rocks are covered by laterites 0 to 5m in thickness in gentle hill areas and by silty black shales or river sediments in low flat areas.

Geological structure: The area is structurally divided in two sections by a fault which pass 5km southeast of the Nembwe Village in NW direction.

[South section]: In the west part of the section, bounded on the east by a large N-S fault passing the center of the section, various faults of NE-SW, N-S and WNW-ESE directions intersect complicatedly. Granite bodies having E-W and ESE-WNW trends contact strongly folded Nyanzian rocks which are distributed in several blocks separated by these faults and granite bodies. In the east, on the other hand there are no distinct faults except small N-S faults.

[North section]: Many NW-SE faults exist in the area of Nyanzian rocks. The most major one bounds the Nyanzian rocks with a granite body in the central part of the Igengi area, and is estimated to be more than 10km long. There are sheared rocks along the fault and a gold showing (Mwamilu Showing) exists to the 500m north of the fault.

Mineral showings: Four mineral showings; The Kalangale, Nembwe, Mwamilu and Nyadekwa Showings from north to south were newly located by this year's exploration. They consist of white quartz veins or silicified rocks or float zones of them, and occur in the Nyanzian rocks and/or granitic rocks. Assay results of 39 samples taken from these showings indicated the Mwamila Showing as a potential target area for further exploration. A sample of a quartz vein in the showing assayed at 15.9g/t Au and 20.65g/t Ag. The sheared rocks accompanying the vein and altered wall rocks of metarhyolite also show mineralization of gold and silver. Samples taken from other three showings assayed too low to indicate certain mineralizations for gold.

Geochemical exploration: Contents of Au, Ag, As, Sb, Hg, Pb and W in soil samples were all low in comparison with the soil samples in the Igengi and Mhunze Areas, and then no definite anomaly was defined in the area. Especially for Au and Ag, 98 % of total samples were under detection limits. It is thought that the thick surface cover in the area caused the results, and/or mineralized zones in the area are too small to be detected by the wide grid spaces for geochemical sampling.

No definite anomalies indicating mineralization for Cu and Zn were detected, though contents of the elements were high in the area of the Nyanziasn rocks but low in the area of granites, reflecting the geology of bed rocks.

Bi and Mo were clearly anomalous in the Kalangale Showing in the northern part of the area. It may be possible that some genetic relations are exist between quartz veins and the high anomalies of Bi and Mo, because quartz veins are widely distributed in the showing in comparison with other showings.

__Conclusion and recommendation__: The Mwamilu Showing where gold mineralization was confirmed (Au:15.9g/t) is judged to be the most potential target area among four showings. The showing is situated near the most major NW fault being accompanied by sheare zones, so there is a possibility that mineralization of gold has occurred also in these shear zones.

It is recommended that trenching, boring and detailed geochemical explorations are to be carried out to clarify the distribution, occurrence and value of quartz veins and to grasp the size of the mineralized area.

The Kalengale Showing (highly anomalous for Bi and Mo, and weakly anomalous for Au) and the Nyandekwa Showing (very weakly anomalous for Au and As),though exploration priority is low than the Mwamilu Showing, are also possible targets for detailed geological mapping and analysis of ore samples.

PART 2 DETAILED REPORT

Chapter 1 Igengi Area

1-1 Method and Procedure

The geological mapping was done with using the 1 to 25,000 scale map enlarged from the 1 to 50,000 scale map. The survey routes were same as those used for geochemical sampling which were set east and west with an interval of 500 meters. Interpretation of monochromatic air photographs of 1 to 40,000 scale, taken in November 1991 were also put into practice for an aid of geological mapping.

The geological data obtained by the field works were incorporated with the results of various laboratory tests for a comprehensive interpretation (Table 2-1-1). The results of the laboratory tests: microscopic observation under thin section, polished section, X-ray test, chemical analysis and measurement of physical properties are presented in Apx.5, Apx.7 and Apx.10, Apx.12, and Apx.11 respectively.

The geochemical sampling was carried out at the sometime with geological mapping. A grid sampling with an interval of 500m was applied and it meant 4 samples/km^2. Sampling lines were set in E-W direction, and the base points and each sampling points were controlled using handy GPS instruments. Sampling depth was 10 to 30 cm from the surface and the weight was about 1 kg. Details of samples and geology of the sampling points were descried and used for the interpretation of the results. Samples collected in the field were dried at the base camp and sieved out to under 80 mesh. 100 grams of each sieved samples were arranged for analysis. Details of methods for chemical analysis are shown in Table 2-1-2. 293 pieces of soil samples were collected in Igengi area.

Table 2-1-1 Outline of the field survey and laboratory tests in the Igengi Area

Item		Number	Remarks
Geological survey & geochemical exploration		$86km^2$	
Laboratory test	Assay of soil samples	293	Au,Ag,Cu,Pb,Zn,As,Sb,Hg,Mo,W,Bi
	Assay of ore/rock samples	4	Au,Ag,Cu,Pb,Zn,Pt
	Whole rock assay	5	Al_2O_3,CaO,Cr_2O_3,Fe_2O_3,MgO,MnO,P_2O_5,K_2O,SiO_2,Na_2O,TiO_2,LOI
	X-ray diffractive tests	4	Bulk
	Observation of thin sections	5	
	Observation of polished sections	1	
	Measurement of resistivity and chargeability of rock samples	6	

Table 2-1-2 Analytical methods

Element	Analytical method	Detection limit
Au	FA-NAA	1ppb
Ag	AAS-BKGD CORR	0.2ppm
As	AAS-HYDRIDE/EDL	1ppm
Cu	AAS	1ppm
Mo	AAS	1ppm
Pb	AAS-BKGD CORR	1ppm
Sb	AAS-BKGD CORR	0.2ppm
Zn	AAS	1ppm
W	COLORIMETRIC	2ppm
Hg	AAS-FLAMELESS	10ppb
Bi	AAS-BKGD CORR	0.1ppm

FA: Fire assay NAA: Neutron activation analysis
ASS: Atomic absorption spectrometry

1-2 Geology

1-2-1 General Geology

The generalized geological columnar section, and geological plan and profiles are shown in Fig.2-1-1 and 2-1-2 respectively.

The geology of this area comprises the Nyanzian and, Kavirondian Systems, Granitic Rocks, and alluvial and surperficial deposits.

The Nyanzian System is mainly distributed in the western half of the area and the stratigraphic sequence is Metabasalt, Pelitic Metasediments , Banded Ironstone Formation, Pelitic Metasediments and Psammitic Metasediments in ascending order.

The distribution of the Kavirondian System is very small and it comprises mainly quartzite.

The Granitic Rock unit is distributed in the eastern half of the area and occurs as intrusions mainly into the Nyanzian System.

1-2-2 Detail of Geology

(1) Nyanzian System

Metabasalt (Nv) :

The unit occupies the hill ranging north to the west of the Mbalika Village, and exposes well at a small hill rising from the surroundings areas. The unit also occupies the small area near the

Nyang'homango Hill in the southern end of the area. The east rim of the unit in the former area contacts with pelitic rocks bounded by a fault being accompanied with shear zones running NNE. Judging from the structure and the shape of the small hill, the ridge line corresponds to the crest of an anticline which is estimated to be parallel to the fault mentioned above.

The rocks of the unit are dark grey to dark greenish grey in colour, massive and fine-grained, and show rarely a weak shistose structure. The estimation of original occurrence of the rocks is very difficult, though Stockley (1947) and Borg (1992) described that the rocks of the unit had pillow lava structure.

The results of whole rock analysis of two rock chips of this unit are presented in Apx.9. From the plots of the results on the SiO_2 - Na+K diagram (Fig.2-1-3) the rock correspond to basalt. The normative composition of the rocks are Olivine, Diopside, Hyperthine, Ilumenite, Anorthite, Albite and Orthclase, and the plots on the triangular diagram (Fig.2-14) show the rocks to be High Fe tholeite basalt.

Pelitic Metasediments (Ns1) :

The unit occupies a wide area of the eastern part of the area. The unit overlies the Metabasalt unit (Nv) and is intercalated by an unit of Banded Ironstone Formation (Nbi), ranging 300 to 400m in thickness, in the middle of the formation. Then the unit is divided into two subunits, the lower and the upper units bounded by the Banded Ironstone Formation.

The thickness of the both unit is estimated to be about 400 meters, though the strongly folded rocks of the unit make it unclear.

The rocks of the lower unit, comprise dark grey to black shale with subordinate banded quartzites. Metamorphosed structure of the shale is weak in general and it seldom shows phyllitic or schistose structures. Banded quartzites are formed of thin alternating beds of light grey quartzite ranging from several millimeters to several centimeters in thickness, pelitic films and hematite layers of several centimeters in thickness.

The rocks of the upper unit are same as to those of the lower one, but rich in quartzite with hematite films or layers, and have thin intercalating beds of banded Ironstone in same part of the area.

The lithofacies of the both subunits are similar to that of Banded Ironstone Formation judging from the large quantity of ferrugious quartzite layers.

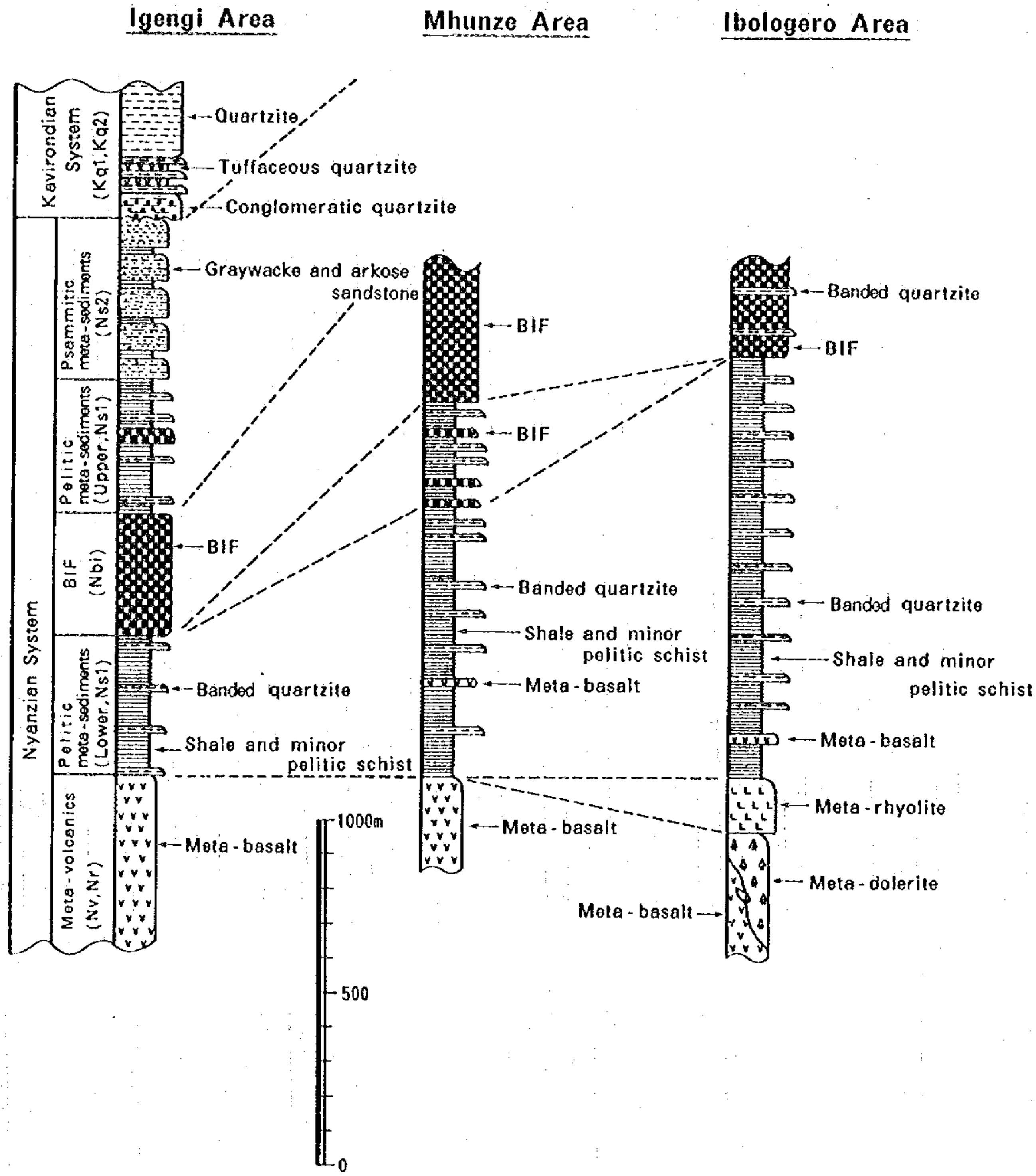
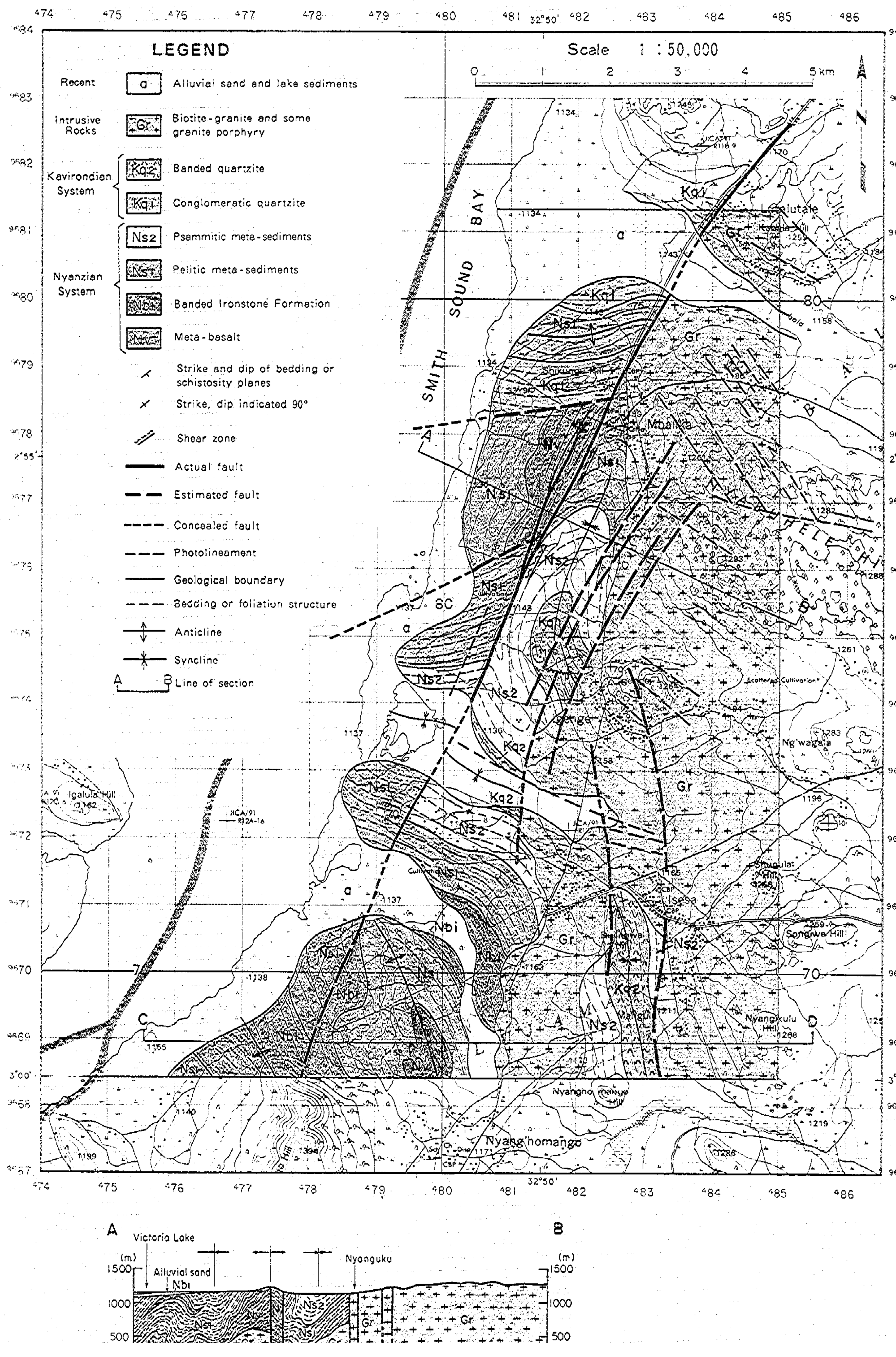


Fig. 2-1-1 Lithostratigraphic succession of the Nyanzian System in the survey area


LEGEND
Scale 1 : 50,000
0 1 2 3 4 5 km
Recent
Alluvial sand and lake sediments
Intrusive Rocks
Biotite-granite and some granite porphyry
Kavirondian System
Banded quartzite
Conglomeratic quartzite
Nyanzian System
Psammitic meta-sediments
Pelitic meta-sediments
Banded Ironstone Formation
Meta-basalt
Strike and dip of bedding or schistosity planes
Strike, dip indicated 90°
Shear zone
Actual fault
Estimated fault
Concealed fault
Photolineament
Geological boundary
Bedding or foliation structure
Anticline
Syncline
Line of section
SMITH SOUND BAY
Mbalika
Isesa
Ng'wagala
Songwe Hill
Nyangkulu Hill
Nyangho'mango
Igalula Hill
Scattered Cultivation
32°50'
2°55'
3°00'
A
B
Victoria Lake
Alluvial sand
Nyonguku
(m)
1500
1000
500

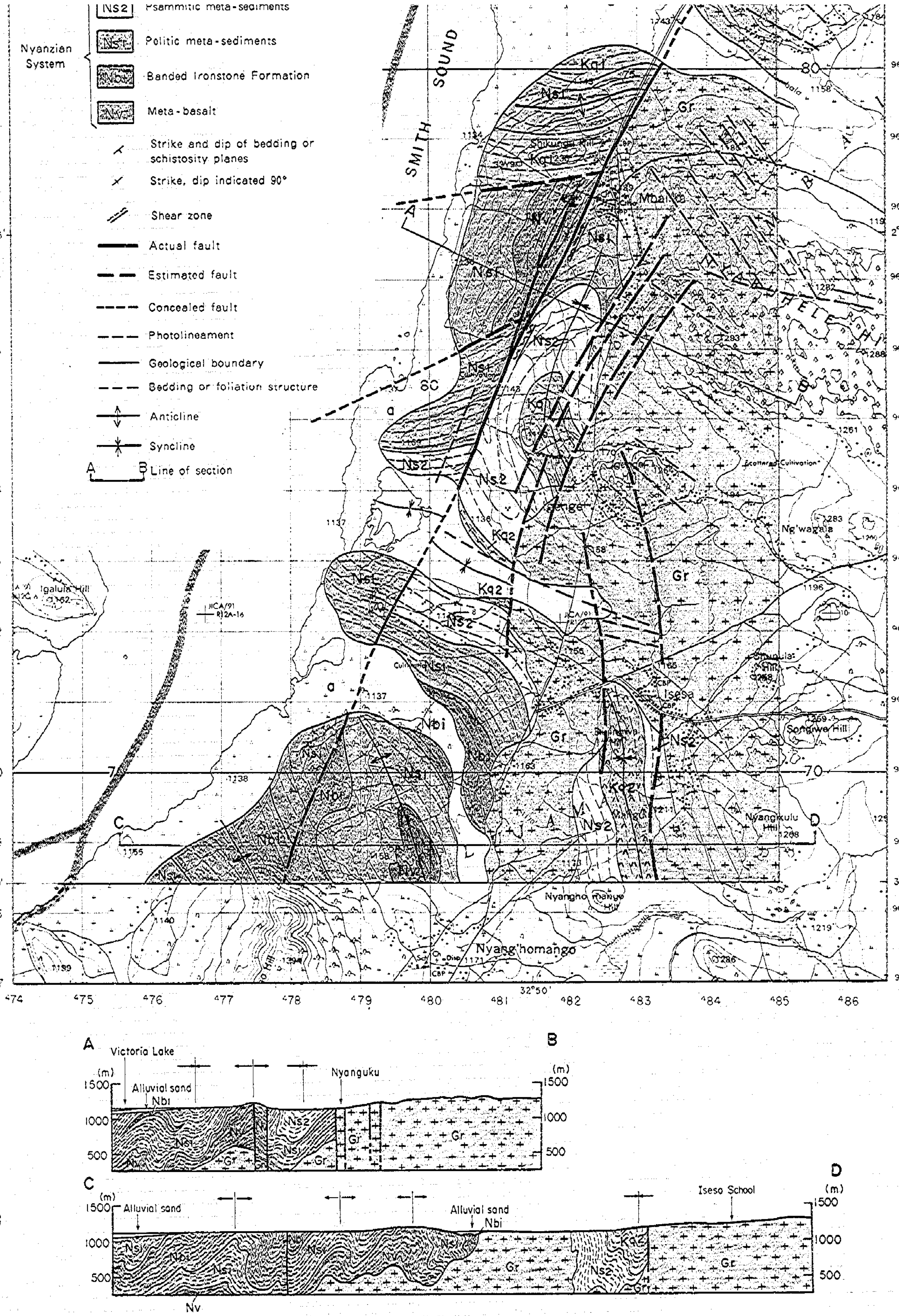


Fig.2-1-2 Geological map of the Igengi Area

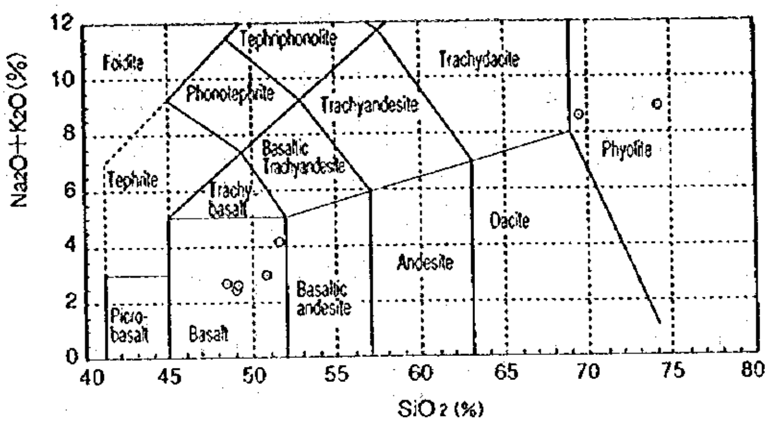


Fig.2-1-3 Classification of the volcanic rocks of the Nyanzian System using the total alkalis versus silica diagram of Le Maitre et al.(1989)

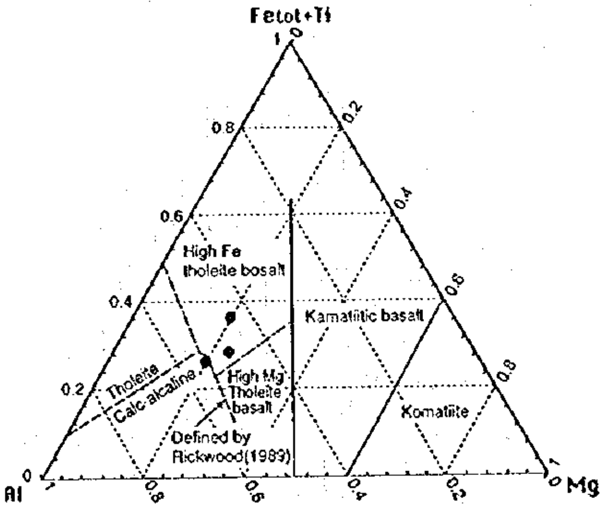


Fig.2-1-4 Classification of meta-basalts in the Igengi and the Mhunze Area according to the cation diagram of Jensen(1976)

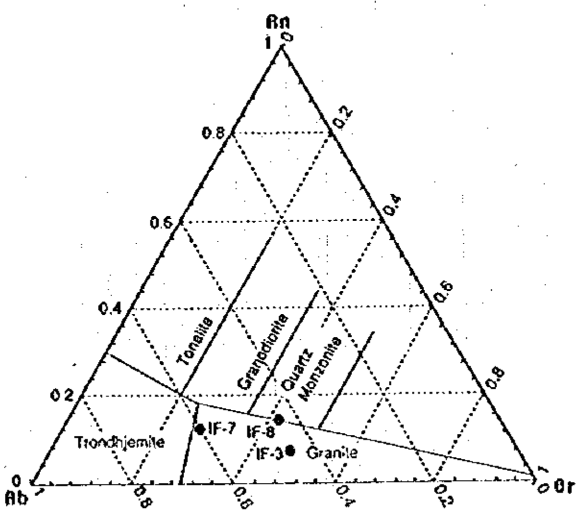


Fig.2-1-5 Classification of granitic rocks in the Igengi Area according to their molecular normative An-Ab-Or composition after Barker(1979)

Banded Ironstone Formation (Nbi) :

The unit is distributed in the adjacent area to the Nyang'homango Village in the south end of the area, forming a high monadnock about 250 meters in relative height. It occurs in the Pelitic Metasediment unit (Ns1) as a thick intercalating bed , about 400 meters thick.

The rocks are dark reddish brown in general, and composed of rhythmical thin alternating beds of quartz layers, and hematite-magnetite layers. The rocks show a dark grey colour with metallic luster in the place where magnetite is rich in quantity than hematite. Thin intercalating beds of chert and shale are common throughout the unit.

Psammitic Metasediments (Ns2) :

The unit is distributed in and around the Igengi Village. It overlies the unit of Pelitic Metasediments (Ns1) and is estimated to be about 500 meters thick.

The rocks of the unit comprise dark-grey massive feldspathic wacke with subordinate arkosic wacke. The feldspathic wacke consists of black argillaceous matrix, rounded quartz and feldsper grains, 1 to 2mm in size, and brecchias of shale, 2 to 5 mm in size. The arkosic wacke is light grey in colour and consists of homogeneous quartz and feldsper grains. The rocks have shistose structure in many places and the rock facies in an area to the west of Igengi Village is psammitic schist.

(2) Kavirondian System

The Kavirondian System is distributed in the Shikungi Hill in the northern part of the area , and in the Bujigwa Hill situated to the southeast of the area. The rocks of the unit comprise conglomeratic quartzite and banded quartzite.

Conglomeratic Quartzite :

The unit is distributed in Shikungi Hill . The rocks consist white massive quartzites with rounded gravels of siliceous shale, 5 to several ten centimeters in size. The rocks contain banded ironstones of the Nyanzian rocks and overlie the Nyanzian System uncorformably according to Stockley (1947) .

Banded Quartzite :

The unit is distributed in the Bujigwa Hill. The rocks consist thin alternating beds of quartz layers and green fine-grained tuff layers, 2 to 10 mm in unit thickness.

The unit is estimated to overlie the wackes of the Nyanzian System unconformably judging from the geological structure in and around the Bujigwa Hill.

(3) Granitic Rocks

The Granitic Rocks occupy a wide area of the east part of the Igengi area where undulating hills are extending. The area is characterized by steep hills or mountainous areas in comparison with the gentle hills of the west part of the Igengi Area where metavolcanics and metasediments of the Nyanzian and Kavirondian Systems are distributed.

The rocks comprise mainly light grey to pinkish grey, medium to coarse-grained biotite granite and their associated dark grey granite porphyry.

The granite porphyry is distributed in a small area of the south of Igengi Hill, but the contact with the biotite granite is not clear, so the granite porphyry is not divided as an independent unit from the biotite granite unit in the present geological map.

In the area, the granitic rocks have intrued into the Nyanzian System.

Radiometric dating by Rb/Sr method of granitic rocks distributed in and around Mwanza, which is thought to belong to the same batholith as the Igengi body, shows 2590 ± 320 Ma to 2430 ± 1320 Ma (Bell & Dodson, 1981), indicating the age of intrusion as post-Kavirondian.

Biotite Granite (Gr) :

The rocks, mostly medium-grained (2 to 5mm in size) partly coarse-grained (5 to 10mm), are composed of euhedral to subhedral plagioclase, potash-feldspar, quartz and biotite. Secondary chlorite is often observed in rims and cleavages of biotites. Hornblende is not observed by naked eyes in the rocks collected.

The results of whole rock analysis of two samples (IF003, IF008) are presented in Apx.9. The main normative minerals are Quartz, Orthclase, Albite, Anorthite, Diopside and Hyperthine, and plots on normative An-Ab-Or triangular diagram show the rocks are in Granite field.

Granite Porphyry :

The rocks are composed of phynochrysts of euhedral plagioclase, potash-feldspar and quartz about 5 millimeters in size, and dark grey fine-grained holocrystalline groundmass of which mineral composition is not identified by naked eyes. Fine veinlets of chlorite are common in the groundmass and cleavages of plagioclases.

The results of whole rock analysis of a sample (IF007) are presented in Apx.9. The main normative minerals are Orthclase, Albite, Anorthite, Quartz, Diopside and Hyperthine, and the plot on normative An-Ab-Or triangular diagram (Fig.2-1-5) shows the rock is in Granite field in the same way as the Biotite Granite (Gr) .

(4) Quaternary

The Quaternary consists of black Mbuga clay and unconsolidated river sediments. Mbuga clay are distributed in the lowland around the Smith Sound of the Lake Victoria and cultivated as ricefields and cotton fields.

1-2-3 Geological Structure

In the area, many faults are inferred through the interpretation of air photographs. Among these faults, the biggest fault passes the area from the Lutulutale Village in the north to the Nyang'homango Village in the south of the area, which has a NNE-trend same as that of the Smith Sound of the Mwanza Gulf.

Though any exposure of the fault has not confirmed yet in the field, existence of floats of sheared pelitic rocks and milonites in and around the estimated position of the fault suggest it has a wide sheared zone.

Main geological structure of the Igengi area is different in two areas; the east and the west which are separated by the fault.

In the east side of the fault, are distributed, the Nyanzian and Kavirondian Systems and Biotite Granites which intruded into the two Systems. In an area about two kilometers in width between the fault and the Igengi Hill, many air photo lineaments trending NNE are drawn. The boundaries between the Nyanzian and Kavirondian rocks, and the Granitic rocks show also NNE trend. Abundant small faults of N-S trend exist in and around the contact parts, some of which coincide with the boundaries between the Nyanzian rocks and Granitic rocks in some place.

The folding structure of the Nyanzian metasediments are dominated by isoclinal foldings with axes of N-S trend, planes of 60 to 90 degree westerly and a wavelength of about one kilometer.

The evidence that the N-S and NNE trends are prominent in the east part of the area in every geological structures, indicate that the structures have locally formed by the intrusion of the granitic rocks taking into the consideration of the distribution of the granitic rocks and that the structures of the surrounding areas being usually E-W trend.

The folding structure of the Nyanzian and Kavirondian metasediments in the west of the Igengi Area is represented by a series of isoclinal folding similar to that of in the east, but the trend of the folding axes are dominated by E-W direction, suggesting that the area are structurally in a same position as the area to the west of the Smith Sound, where the major structures are E-W trend.

The metamorphism and the tectonic movement in and around the Igengi area are thought to be post-Kavirondian because the deformation pattern and metamorphic degree of the Kavirondian rocks are almost same as that of Nyanzian rocks.

1-2-4 Mineral Showing

There is no record which indicate that any metaliferous deposits have been exploited in the Igengi area. In the area, some gold-bearing quartz veinlets were found 3km west of the Igengi Hill in 1936-1937, but any exploration work was executed henceforth, because the gold contents were less than 1 dwt./t (1.7 g/t) (Stockley , 1947) .

Three mineral showings: 1) Mbanga, 2) Nyanguku and 3) Igengi were newly located by this year's exploration (Fig.2-1-6) .

Mbanga Showing: This showings is located on the south slope of the Kabala Hill near the Mbanga Village. Many dark grey or milky white quartz veinlets ranging from 5 to 8cm in width occur in biotite granites with an interval of about 50cm. The veinlets strike N 65 W and dip vertically.

The strikes of the veinlets are parallel to that of air-photo lineaments drawn near the showing. Wallrock alteration and sulphide or oxide minerals were not observed in and around the veinlets.

Nyanguku Showing: This showing is located near the Nyanguku Village in the central part of the area and is situated near the contact zone between biotite granite and the Nyanzian rocks where many faults run in NNE trend. A milky white quartz vein 10cm in width occurs in biotite granites striking N30E, which is the same direction to the faults existing near the vein. The dip of the vein is uncertain. Any alteration indicating mineralization has not been observed yet in the wall rocks.

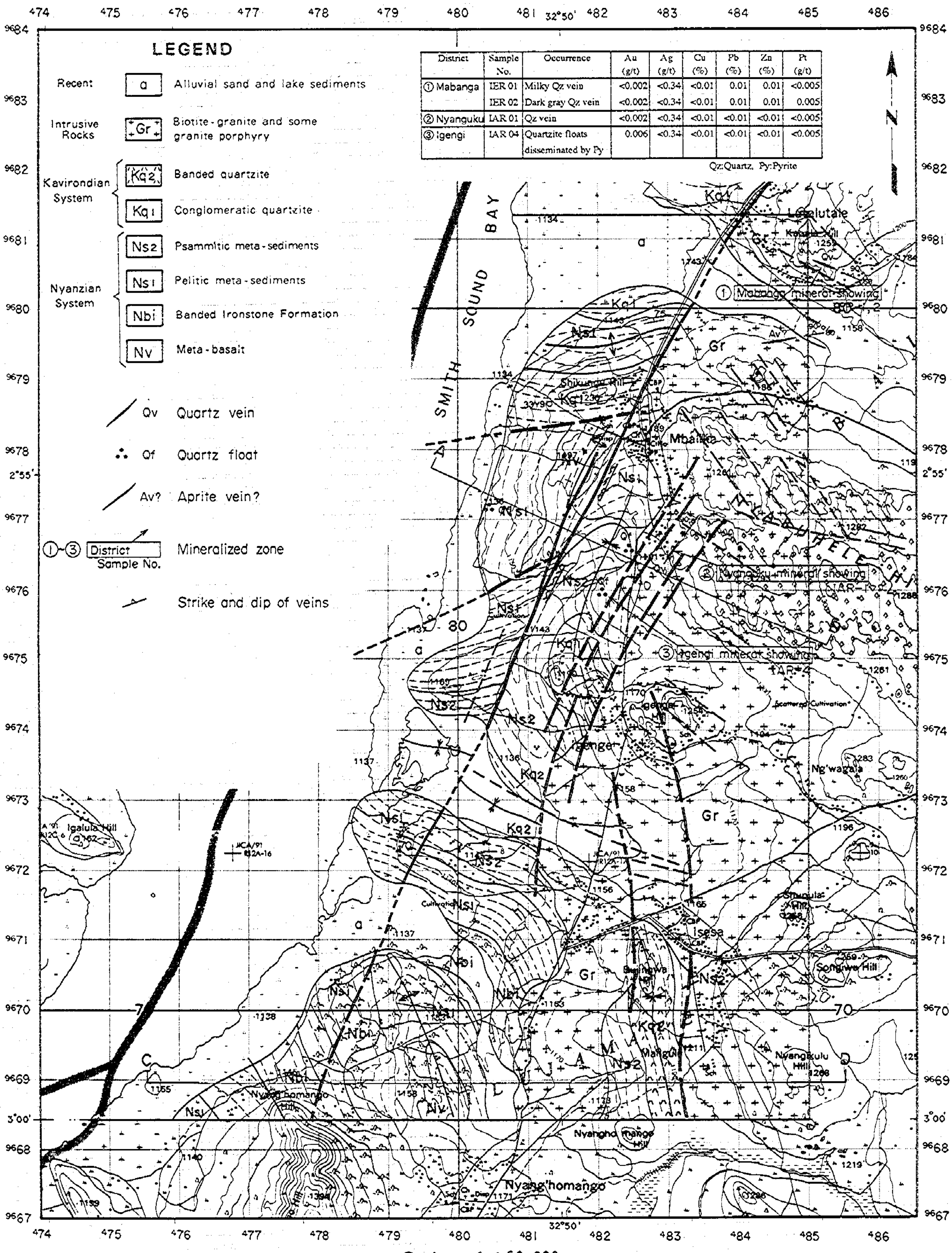
Igengi Showing: This showing is located 1km southeast of the Nyanguku Village, which is close to and on the east side of the largest fault trending NNE. The showings comprises a zone of floats of quartz vein which contain pyrites. Same floats are distributed 500m north of the showing along the fault, indicating some mineralization associated with the fault.

Assay results of five samples taken in these three showings are listed in Table2-1-3. The values of all analytical elements are under detection limits or near those.

Table 2-1-3 Results of Chemical Analysis for the Rock Samples from the Igengi Area

District	Sample No.	Occurrence	Strike and dip	Width (m)	Minerals	Country rock	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Pt (g/t)
① Mabanga	IER 01	Milky Qz vein	N65W 90	0.05	Qz	Granite	<0.002	<0.34	<0.01	0.01	0.01	<0.005
	IER 02	Dark gray Qz vein	N65W 90	0.05	Qz	Granite	<0.002	<0.34	<0.01	0.01	0.01	0.005
② Nyanguku	IAR 01	Qz vein	N30E	0.1	Qz	Granite	<0.002	<0.34	<0.01	<0.01	<0.01	<0.005
③ Igengi	IAR 04	Quartzite floats disseminated by Py	-	-	Qz, Py	Quartzite and Psammitic schist	0.006	<0.34	<0.01	<0.01	<0.01	<0.005

Qz:Quartz, Py:Pyrite



District	Sample No.	Occurrence	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Pt (g/t)
① Mabanga	IER 01	Milky Qz vein	<0.002	<0.34	<0.01	0.01	0.01	<0.005
	IER 02	Dark gray Qz vein	<0.002	<0.34	<0.01	0.01	0.01	0.005
② Nyanguku	IAR 01	Qz vein	<0.002	<0.34	<0.01	<0.01	<0.01	<0.005
③ Igengi	IAR 04	Quartzite floats disseminated by Py	0.006	<0.34	<0.01	<0.01	<0.01	<0.005

Qz:Quartz, Py:Pyrite

Fig. 2-1-6 Distribution map of the minaral showings in the Igengi Area

1-3 Geochemical Exploration

Analysis result of the soil sample (Apx. 14) input it into a computer for statistics handling of data. Using this input data, a quantity of basic statistics was calculated, and single variate analysis and multi-variate analysis were done. Replaced it in a half value of detection limit value and, about the case, data less than detection limit value, handled it in convenience entirely.

(1) Single variate analysis : Each elemental analysis value was expressed by a diameter of black circle, and a plot was done to collection spot on a topographical map, and the other element place chemistry distribution map was made.

(2) Multi-variate analysis : As multi-variate analysis, correlation analysis, cluster analysis and factor analysis were done.

1-3-1 Results of Single-variate Analysis

Analytical result of the soil samples, basic statistics of each element and their histograms are shown in Apx. 14, Table 2-1-4 and Apx. 12 respectively.

Table 2-1-4 Basic statistics, Igengi Area

	Au	Ag	As	Cu	Mo	Pb	Sb	Zn	Hg	W	Bi
Detection limit	1	0.2	1	1	1	1	0.2	1	10	2	0.1
Minimum value	>1	<0.2	<1	2.00	<1	<1	<0.2	5.00	<10	<2	<0.1
Maximum value	60	0.2	610	92	1	85	36	121	340	90	3.1
Standard deviation	2.63	1.07	3.44	2.47	1.08	1.87	3.10	1.75	1.92	2.11	2.46
Mean	0.92	0.10	13.56	11.63	0.51	10.31	0.41	20.30	9.92	3.15	0.23
Mean+sd.	2.43	0.11	46.68	28.70	0.55	19.31	1.28	35.51	19.03	6.65	0.56
Mean+2 x sd.	6.38	0.12	160.70	70.81	0.59	36.14	3.96	62.09	36.49	14.05	1.38

Each elemental geochemical distribution map is shown with APX. 13. A characteristic of each elemental distribution is shown below;

Au: The maximum value of 60 ppb is located in the western foot of the Bujngwa Hill in southwestern area, and the values more than 10 ppb exist in the northwest side of this location. The other 10-30 ppb values concentrate in the southwestern side of Shikungu Hill in northwestern area.

Ag: There are only 3 samples that show the values more than 0.2 ppm of detection limit. The values all are 0.2 ppm. They are distributed in the relatively low land, western area.

As: The high values more than 10 ppm, including the maximum value of 13.6 ppm, are concentrated in Mbalika village and the West. Around the Bujngwa Hill in southwest area and the Nyango mango Hill in the southern margin of the area, the high values more than 10 ppm are gathered up several locations.

Cu: The 15 high values more than 50 ppm, including the maximum value 92 ppm, are distributed in the west of Mbalika village. Of the values, 3 values are located on the northwest foot of the Igengi village and 2 values exist in a location, approximately 3 km to the east-northeast of the Nyang homango Hill.

Mo: There are only 4 values more than the detection limit, besides the values do not exceed 1 ppm. These samples are scattered 3-5 km apart mutually in the area.

Pb: The maximum value of 85 ppm stands alone in southeast edge of the area. The comparatively high values of 20-30 ppm are widely distributed over the lowland of the northern end of the area, the Southeast of the rocky hill of Mbalika village and the lowland of the Southwest of the area.

Sb: The high values more than the detection limit of 0.2 ppm don't exceed 40 % of the total, but these are distributed mainly in the western side of the area. The maximum value of 36 ppm and the second maximum of 26 ppm to be anomalous high values are located at the northern foot of the Nyango mango Hill in southernmost area.

Zn: The maximum value of 121 ppm is located in northwestern area, approximately 1 km of Mbalika village. There are 11 high values more than 50 ppm, including the second maximum value of 61 ppm. They are scattered in the whole area.

Hg: The maximum value of 340ppb is located in a part, approximately 1.5 km to Mbalika village. There are 3 high values more than 100 ppb. They are distributed in the parts covered by granite, in the eastern margin of the area.

W: There are 3 high values more than 30 ppm, including the maximum value of 90 ppm. They are distributed over northeast approximately 1.5 km of Mbalika village. The values more than 10 ppm, are relatively concentrated in some locations. They are southwest foot of the Kabala Hill, to the East of the Igengi Hill, around the Bujngwa Hill in southwestern area and the northern foot of the Nyango mango Hill.

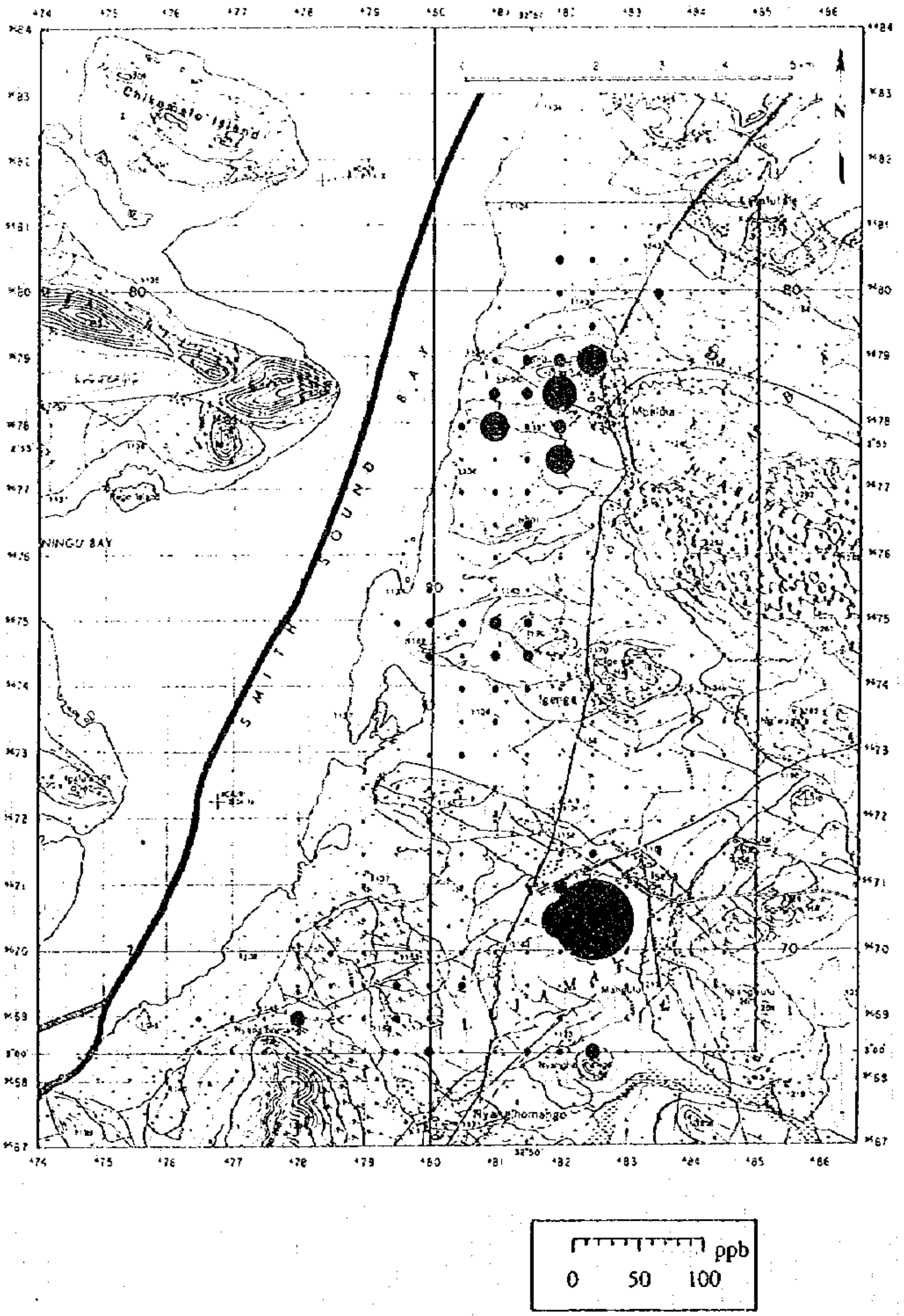


Fig. 2-1-7-(1) Distribution of Au in the Igengi Area

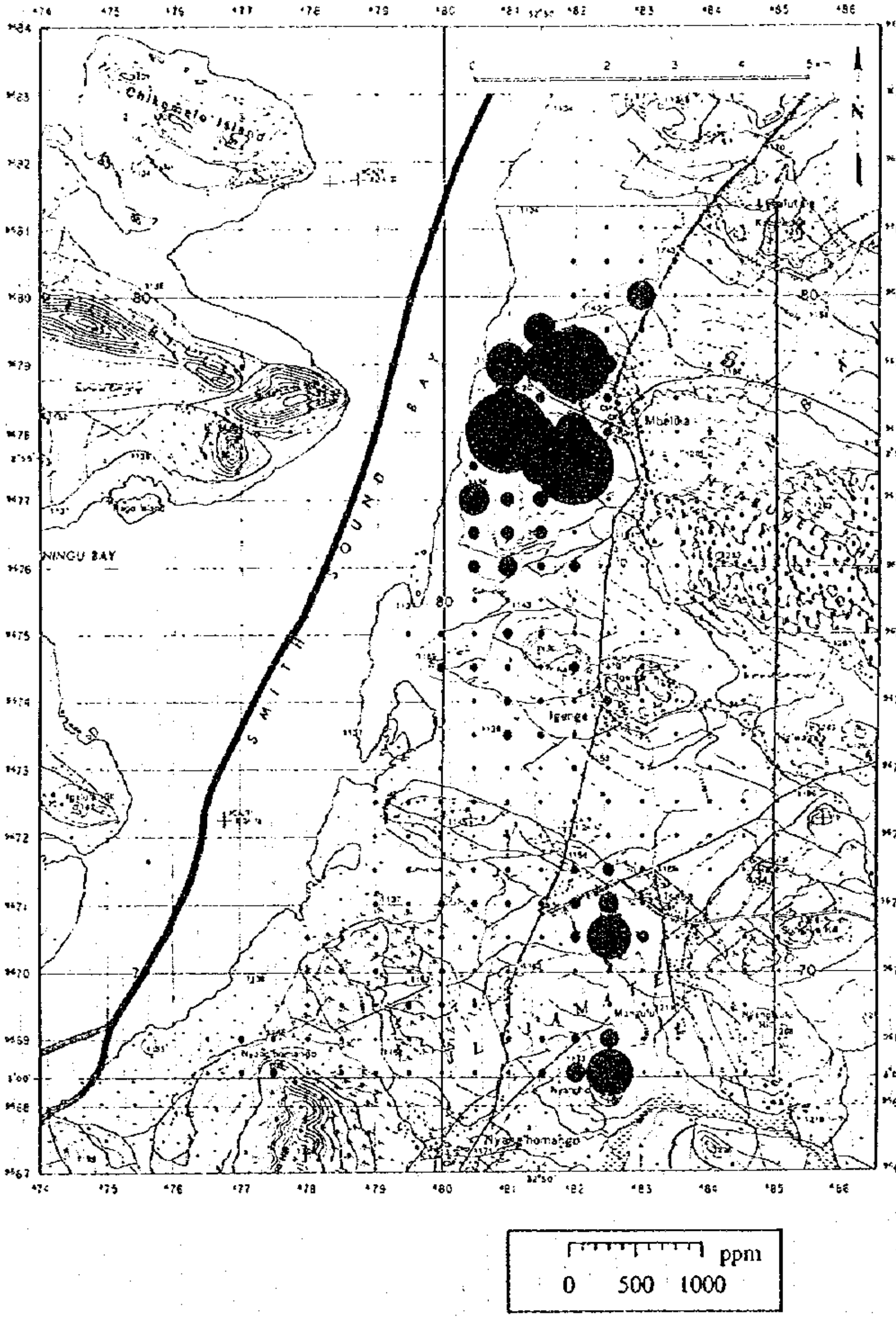


Fig. 2-1-7-(2) Distribution of As in the Igengi Area

Bi: The maximum value of 3.1 ppm is concentrated in northeast approximately 1.5 km of Mbalika village, with 3 values more than 1.0 ppm. Generally, the values in the northern central area show comparatively higher than the ones in the southern area.

1-3-2 Result of Multi-variate Analysis

Correlation matrix among elements provided as a result of correlation analysis is shown in Table 2-1-5. The Ag and Mo data sets, which the values less than the detection limit occupy more than 90 % of the total, is excluded from a calculation in advance.

Table 2-1-5 Correlation matrix, Igengi Area

	Au	As	Cu	Pb	Sb	Zn	Hg	W	Bi
Au	1.000								
As	0.638	1.000							
Cu	0.505	0.719	1.000						
Pb	-0.163	0.024	0.171	1.000					
Sb	0.505	0.601	0.580	-0.086	1.000				
Zn	0.333	0.580	0.791	0.425	0.466	1.000			
Hg	0.186	0.157	0.267	0.001	0.240	0.251	1.000		
W	0.195	0.311	0.136	0.230	0.077	0.279	-0.680	1.000	
Bi	-0.038	0.098	-0.066	0.373	-0.266	0.190	0.008	0.381	1.000

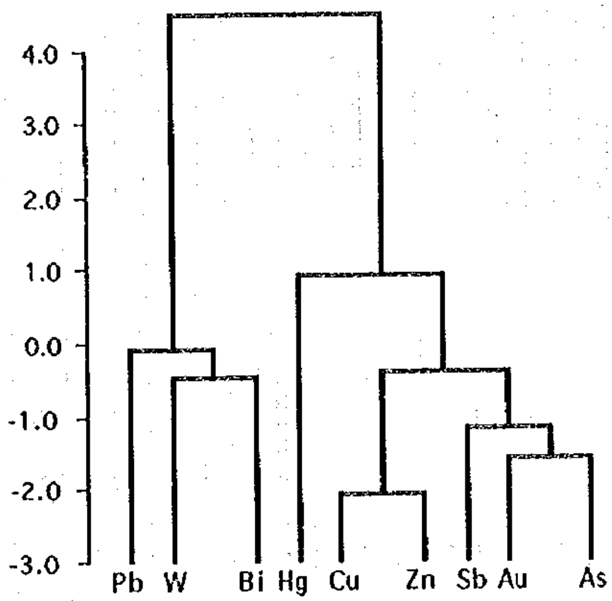


Fig.2-1-8 Dendrogram showing the similarities among the elements, Igengi Area

Factor loadings, contributions and communality after varimax rotation, provided as a result of factor analysis is shown in Table 2-1-6.

Table 2-1-6 Factor loadings, contributions and communality after varimax rotation, Igengi area

	Loadings			
	Factor 1	Factor 2	Factor 3	Communality
Au	0.226	-0.023	-0.756	0.623
As	0.445	0.194	-0.723	0.758
Cu	0.791	0.079	-0.430	0.816
Pb	0.298	0.555	0.265	0.467
Sb	0.514	-0.209	0.538	0.597
Zn	0.805	0.382	-0.212	0.840
Hg	0.337	-0.086	-0.084	0.128
W	-0.030	0.558	-0.298	0.402
Bi	-0.076	0.656	0.039	0.438
Contributions	1.995	1.292	1.78299	

Factor score distribution map, which was constructed after factor score was calculated on the basis of factor loadings, shown with Fig.2-1-9.

The Factor 1 (Zn-Cu-Sb), the Factor 2 (Bi-W-Pb) and the Factor 3 (Au-As) are shown with 3 colors, such as cyan, magenta and yellow respectively, and the score is shown by the darkness.

A Characteristic of each factor distribution that can be read from this figure is mentioned below;

Factor 1 (Zn-Cu-Sb): Factor 1 is shown by a blue color system (blue, the green and purple) on the figure. It is widely distributed along the lake side to southwest of the Mbalika village and also everywhere in granitic hills on a small scale in eastern area.

Factor 2 (Bi-W-Pb): Factor 2 is shown by a magenta color system (magenta, red and purple) on the figure. It extensively covers granite hills in eastern area and lake side in northeastern area. These distributions are closely related to distribution of granite and granite sand, so that the Factor 2 appears to be a factor related to granitic rock.

Factor 3 (Au-As): Factor 3 is shown by a yellow color system (yellow, red and the green) on the figure. It covers all over the West of Mbalika - Igengi villages and the western Bujngwa Hill. It also extends from the west slope of Nyango mango Hill to the northern slope of the Nyang mango Hill. The Factor 3 is probably a factor related to gold mineralization.

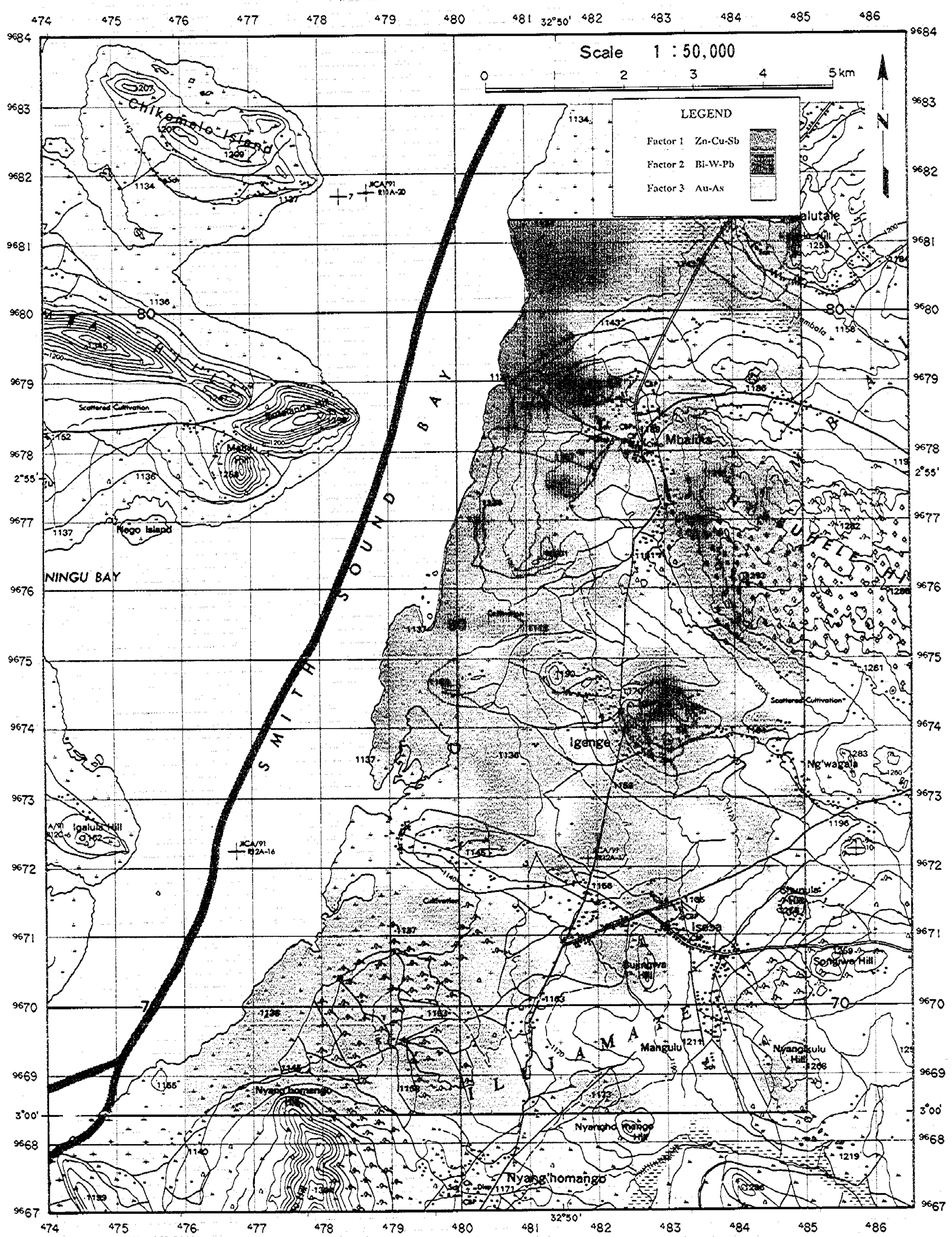


Fig. 2-1-9 Distribution of factor score, Igengi Area

1-4 Discussion

Some high possible areas for gold mineralization were detected by synthesizing all the results of geochemical and geological explorations.

From the results of geochemical exploration, the element which has the highest correlation and similarity with Au turned out to be As as a result of correlation and cluster analyses. Results of the factor analysis show the third factor has the highest possibility to indicate the mineralization of gold. Contents of Au and As are the highest contributors of the third factor, and contents of Sb and Cu follow them.

Then distribution of Au and As contents and scores of the third factor are concluded to be most important for detecting high possible areas for gold mineralization.

Au: Au shows higher contents in the area of the Nyanzian and Kavirondian rocks, and lower contents in the area of Granitic Rocks. A high anomaly of Au occupying an area of 1.5 km x 2.0 km, and having an intensity ranging from 10 to 30 ppb was detected in the Shikungu Hill and the south in the western part of the area. Another high anomaly of Au with more than 10 ppb was also detected in the Bujingwa Hill in the south of the area, but the extent is small (0.5 km x 1.0km).

As: Contents of As show the same behavior as Au, and high anomalies of As were also located in the same places as Au. It is very interesting that the extension of anomalous zone of As at the Shikunga Hill is much longer in N-S direction (3.5 x 2.0 km) than Au.

Third factor: The distribution pattern of scores of the third factor are concordant with the high anomalies of Au and As, especially with the distribution pattern of high anomalies of As. Beside the Shikungu and Bujingwa Hills, high scores of the third factor were detected in the northern part of the Nyang'homango Hill, but it is due to the contribution mainly by Cu.

Thus the Shikungu Hill and Bujingwa Hill Areas were detected as high possible areas for gold mineralization (Fig. 2-1-10).

In and around the Shikungu Hill, the Nyanzian metabasalts and metasediments are distributed in the southern part and the Kavirondian quartzites in the northern part. The Nyanzian metabasalts are bounded to the Kavirondian quartzites by a estimated fault trending EW. The eastern margin of high anomalous zone of Au and As is coincides with a major fault trending NNW being accompanied by shear zone. The high anomalies of Au in and around the Shikungu Hill are thought to reflect gold mineralization. Though any mineral showing was not found by the geological mapping operated along survey lines with an interval of 500m , it is very possible that gold mineralization have occurred along zones of shearing of the Nyanzian metabasalts nearby the major NNE fault and in the Kavirondian quartzite.

In the Bujingwa Hill area, the Nyanzian Metasediments and the Kavirondian quartzite are distributed extending in NS, with 1km in width and the rocks are surrounded by granitic bodies. Fault trending NS direction is estimated to bound these metasediments and the granitic bodies. The high anomalies of Au and As and the high scores of the third factor are detected in the western slope of the Bujinguwa Hill along these faults. Although no mineral showing was founded in this hill through geological mapping of this year, mineralization of gold may have occurred in the fracturing zones of the Kavirondian quartzites along the fault like those in the Shikungu Hill. But the area being associated with gold mineralization is estimated to be smaller than that of the Shikungu Hill, because the area of the Nyanzian and Kavirondian rocks is very small.

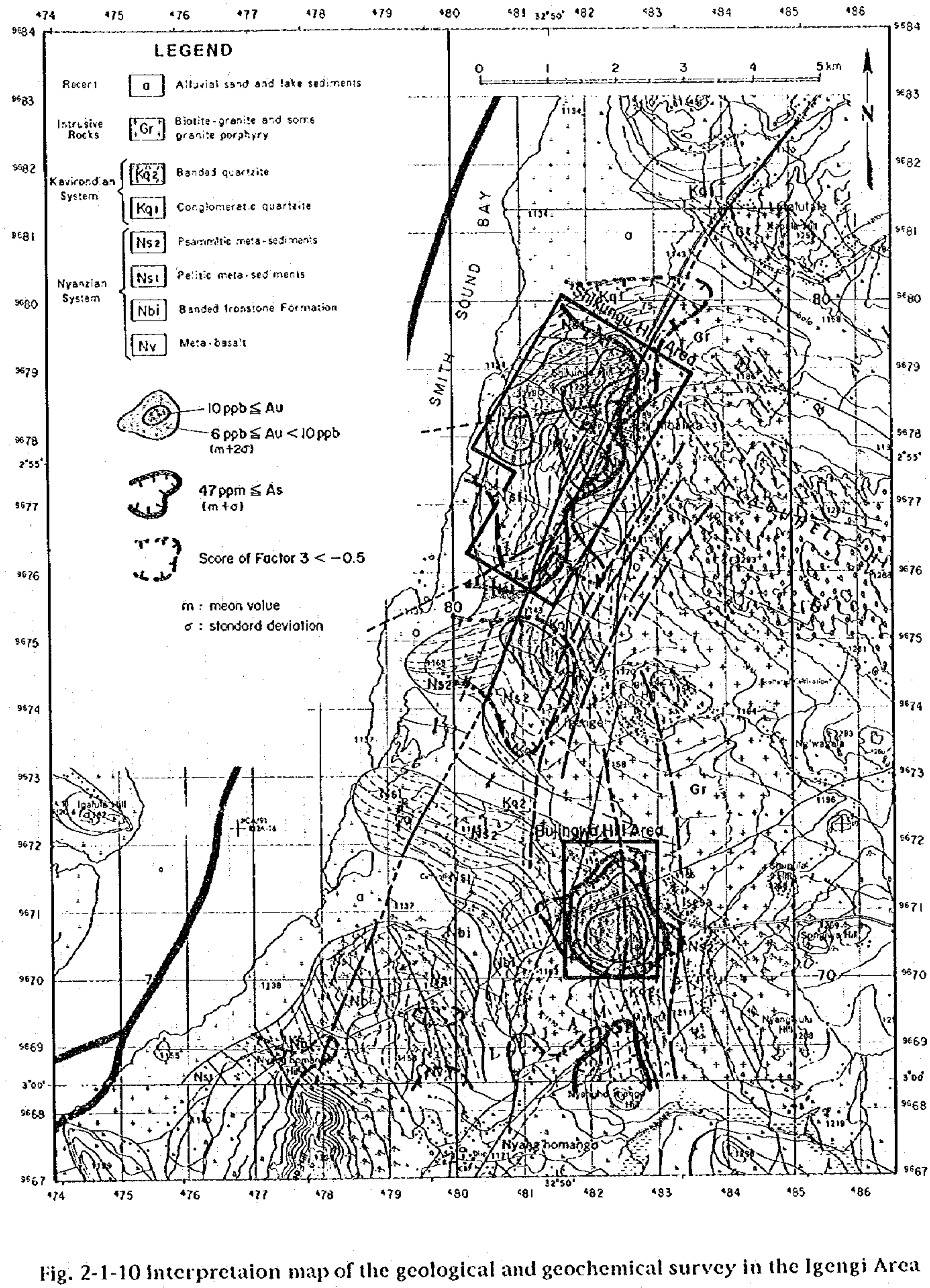


Fig. 2-1-10 Interpretaion map of the geological and geochemical survey in the Igengi Area