REPORT
ON
THE MINERAL EXPLORATION
IN
THE MOMBASA AREA
REPUBLIC OF KENYA
PHASE Ⅱ

MARCH, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY
METAL MINING AGENCY OF JAPAN

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PREFACE

In response to the request of the Government of Republic of Kenya, the Japanese Government decided to conduct a Mineral Exploration in Mombasa area and entrusted the survey to the Japan International Cooperation Agency (JICA) and the Metal Mining Agency of Japan (MMAJ).

The JICA and MMAJ sent to Kenya a survey team headed by Mr. Akira Takigawa from August 6 to October 11, 1991.

The team exchanged views with the officials concerned of the Government of Kenya and conducted a field survey in the Mombasa 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 relation between our two countries.

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

March, 1992

Kensuke Yanagiya
President
Japan International Cooperation Agency

Gen-ichi Fukuhara
President
Metal Mining Agency of Japan

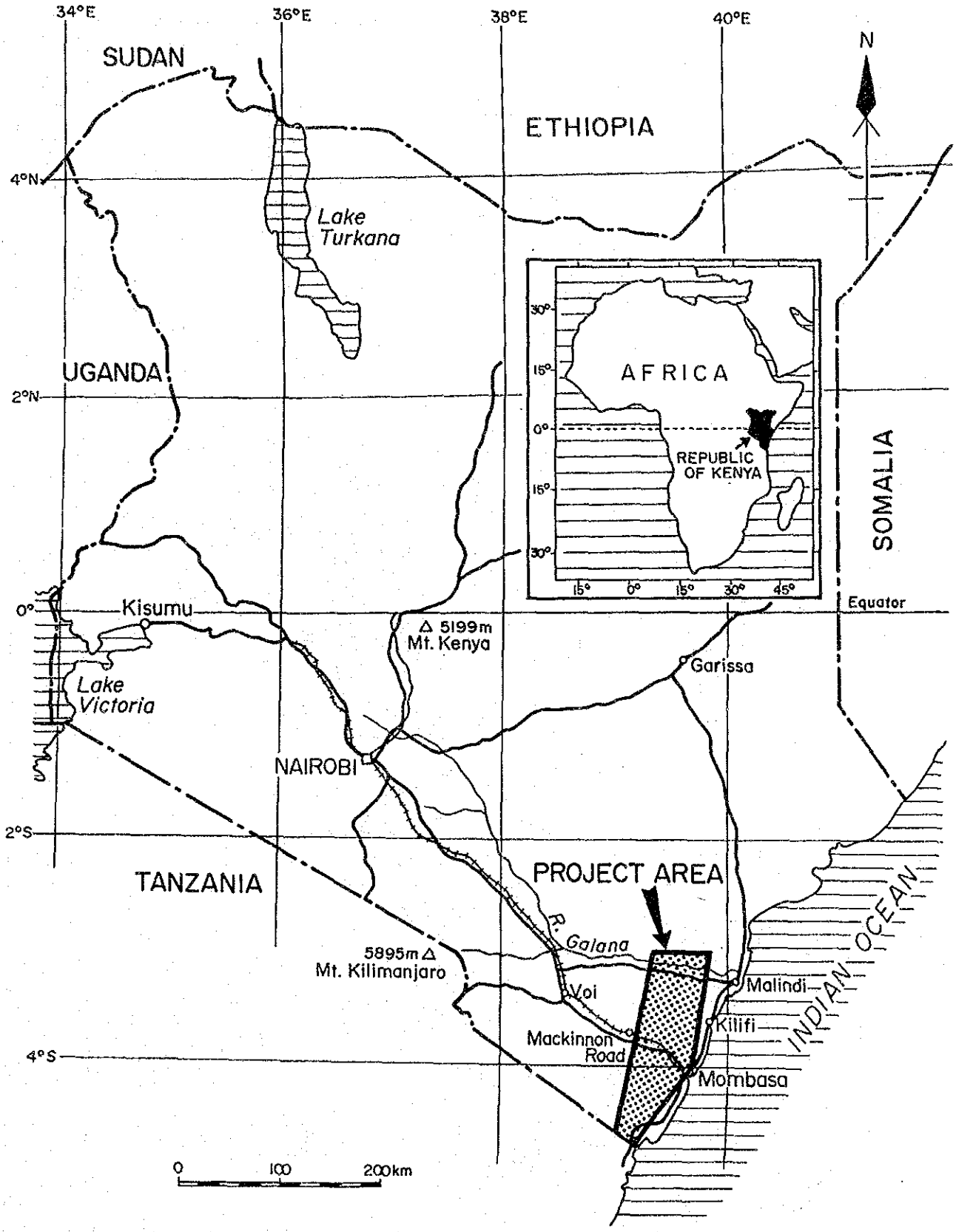

Figure 1 Index Map of Kenya Showing Location of the Mombasa Area

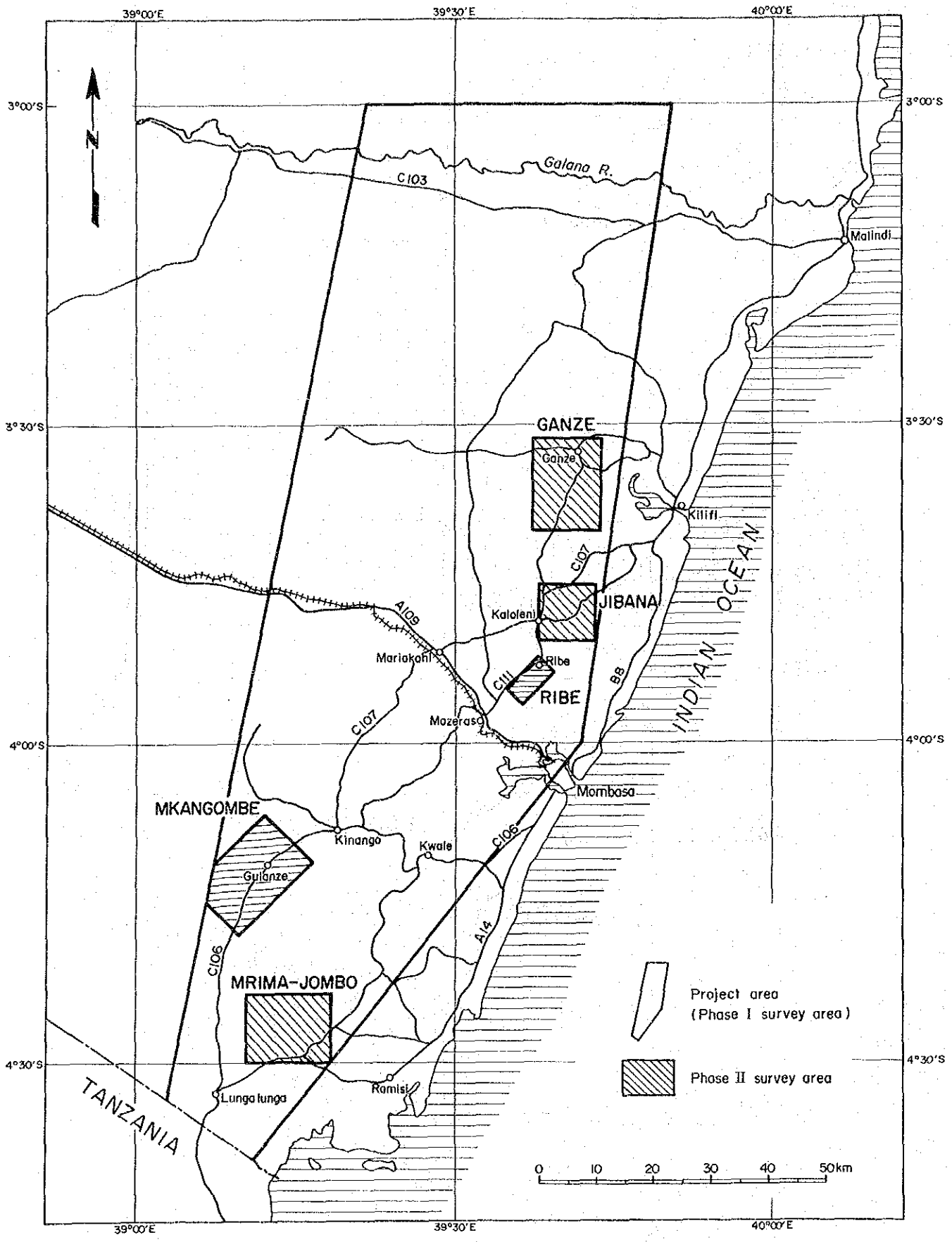

Figure 2 Location Map of Phase II Survey Area

SUMMARY

The Cooperative Mineral Exploration Project in Mombasa Area, Republic of Kenya, has been consecutively implemented in 1991 for the second-year programme for the purposes to specify the mineral occurrences in accordance with an establishment of elucidations of geology and geochemistry in the project area.

The second-year programme works include geological and geochemical exploration works in five Areas, such as Ganze, Jibana, Ribe, Mkangombe and Mrima-Jombo Areas of 620 sq.km, which were specified by the results of the first-year works in 1990 to elucidate modes of mineralizations and to evaluate mineral potentials in the Areas.

The major targets of second-year works are lead-zinc-barite vein ore bodies in Ganze, Jibana and Ribe Areas, precious and base metals ore bodies in Mkangombe Area, and precious and base metals ore bodies and niobium, rare earths elements ore bodies in Mrima-Jombo Area.

The major results in respective areas of the current works are stated below:

(1) Ganze Area

Mineral showings of significance, to be deserved to warrant fostering further exploration work programmes, have not yet been specified in the Area.

(2) Jibana Area

Jibana Mineralized Zone, some 100 m wide and some 2 km long with some discontinuity, which is composed of gossanous materials, has been specified in weakly altered sandstone beds. Remarkable concentrations of metallic materials of economic significance have not yet been obtained in gossanous specimens and geochemical samples.

(3) Ribe Area

Mineral potentials in the Area are highly expected on the bases of favourable geological structural situations and general distribution modes of ever-known ore bodies and mineral showings. Ribe Mineralized Zone, more than 300 m by 100 m, which is composed of intensely gossanous materials and occurs in brecciated sandstone beds, has been newly specified by the current works. Chiume Hill Mineralized Zone, for which mineral exploration works have ever limitedly been implemented, is also located nearby the Zone outside of the project area. Therefore, the area from the Kinagoni mine environs toward Ribe is evaluated to be highly deserved for further systematic mineral exploration programmes to be warranted. Considerably high concentrations of economic metal contents have not yet been shown by the chemical assay results of altered rock specimens in Ribe Mineralized Zone, however, a possibility of thorough leaching of economic materials on ground surface to cause a showing of the current geological situation, stated above, is still be interested.

Geochemical anomalies of silver, lead and zinc of small scale, which are estimated to be represented in genetic connections with the occurrence of Changombe North ans Changombe South Mineral Showings, are pointed out by the current works.

(4) Mkangombe Area

Mkangombe North Ore Showing has been specified by the current works to be composed of copper-lead-zinc-quartz veins ore bodies, with strike/dip values of N25° to 30°E/55° to 70°SE, more than 300 m long and more than 20 cm to 1.5 m wide. Abundant quantities of quartz vein ore floats and quartz veining outcrops are distinctively observed in a zone, linearly extended from Mkangombe North Ore Showing toward Mkangombe South Ore Showing, more than 10 km long and N45°E directional, to form a quartz veining mineralized zone.

Geochemical anomalies shown in the Area are scatteredly represented with possibly less genetic connection with the occurrence of mineralized zones.

(5) Mrima-Jombo Area

Geochemical anomalies of precious and base metal elements in the Area are estimated to be represented in genetic connection with the occurrences of carbonatite and agglomerate (vent agglomerate) bodies, while, in less possible relation to the occurrences of mineral ore bodies of economical significance.

Mineralizations of niobium and rare earths elements are represented in the forms of geochemical anomalies in Mrima Hill and also in Kiruku Hill. The mineralizations can be expected in Nguluku where vent agglomerate is distributed similarly in Kiruku Hill.

Based on the results by the current programme works, stated above, following research work programmes are recommended to be implemented on an upcoming level.

(1) The zone, which extends from Jibana Mineralized Zone, through the Kinagoni mine, towards Changombe Ore Showings, in northern three Areas, such as Ganze, Jibana and Ribe, is evaluated to be most-highly mineral-potential. In the zone, diamond drill operations investigating the mineralization at deeper portions are recommended in Ribe and Chiume Hill mineralized zone, where no diamond drill has been carried out by past exploration programme though significant showings of mineralization are present. Detailed geological survey works preceding the drill operations may be desired to locate the drill sites in both the mineralized zones.

In one view, a possible new discovery of ore bodies in the zone is expected to remarkably contribute further toward a local economical development and a considerable extension possibility of the Kinagoni mine life on the bases of existing mine facilities, manpower capability and etc..

The future mineral exploration works in the project area should be implemented with the most emphases laid on this zone.

(2) Implementations of diamond drill operations for deeper portions of Mkangombe North Mineral Showing, in which a most distinct mode of mineralization in the quartz veining mineralized zone has been specified by ground surface mapping, are deserved to be warranted in Mkangombe Area.

(3) Further implementations of detailed geological and geochemical research works (including

trench work) are considered to be deserved to warrant in Kiruku Hill, Mrima-Jombo Area, to produce a thorough evaluation of geochemical anomalies of niobium and rare earths elements in lateral and vertical extensions. Agglomerate body in Nguluku, which is estimated to be under a similar geological situation to that in Kiruku Hill, is also considered to be deserved to warrant a further fostering geoscientific works to elucidate modes of mineralizations in the site.

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PART I GENERAL

CHAPTER 1 INTRODUCTION

1-1 Circumstances of Survey Works

The geoscientific research works in 1991 in the Mombasa Area, Republic of Kenya, following to those in 1990, were implemented as the second-year programme of the entire works of the Cooperative Mineral Exploration Project, which is under the agreement of Scope of Work on March 13, 1990, between the Ministry of Environment and Natural Resources: MENR and the Mines and Geological Department: MGD of Kenya, and the Japan International Cooperation Agency: JICA and the Metal Mining Agency of Japan: MMAJ, Japan.

The precedent first-year programme in 1990 was targeted on to elucidate the geological features of ore showing spots in the entire Mombasa Area, as shown in Figure 1, by studies of existing geological informations to establish a geological concept for further works and to evaluate mineral potentials in the area and by implementation of geological/geochemical research works in the ore showing spots to specify the geological/mineralogical features in the area.

The current second-year programme in 1991 consists of geological mapping and geochemical exploration works in five areas, Ganze, Jibana, Ribe, Mkangombe and Mrima-Jombo, as shown in Figure 2, and is targeted on to elucidate geological structures and geochemical features and to specify the occurrences of mineral ore bodies and mineralized zones in the areas.

1-2 Conclusion and Recommendation by the First-Year Programme Works

The conclusions established by the first-year programme are stated below:

(1) In the Mrima Hill-Jombo Hill area, rare earths elements oxides together with niobium are moderately concentrated in residual soils derived from the Mrima Hill carbonatite plug. This mineralization has been evaluated to be one of the significant resources of these commodity in the world. However, the mining tracts in the area authorized by the Government of Republic of Kenya have been owned by a foreign private firm as at that time, while, active commercial exploitation has never been carried out.

(2) The fault-controlled hydrothermal lead-zinc-silver-barite mineralization is estimated to be related to the major faults parallel to the coast line in the area. The mineral assemblage and the structural settings of this type of mineralization is considered to be an appropriate analogue of the lead-zinc mineralization of the Mississippi Valley type. The significant mineralization ever known in the project area occurs in Vitengeni, Kinagoni, Mwachi River and Lunga Lunga. Among these occurrences, Vitengeni and Kinagoni deposits are currently under mining operations, the former for barite and the latter for lead. Any indications for this type of mineralization should be carefully studied, particularly in an occasion they are located in the proximity of these occurrences.

(3) The results of the geochemistry of pan-concentrated stream sediments indicate that most of anomalous values of either analyzed elements are estimated to align with the direction of major coast-parallel faults. The geochemical anomalies located in the proximity of the mineralization ever known may be of interests, i.e., polymetallic anomalies around Vitengeni, a gold anomaly near the town of Ganze, copper, lead and/or zinc anomalies around Kinagoni, and gold and/or copper anomalies around Mkangombe (Figures 7 and 8) and etc..

(4) The soil geochemistry in Mrima Hill-Jombo Hill area, Mrima Hill in particular, indicates outstandingly high contents of gold, copper, lead, zinc, manganese, iron and sulphur, in comparison with those in other areas. In Mkangombe area, one of the soil samples shows an exceptionally high value of gold, which could be an indication of gold mineralization (Figures 7 and 8).

The recommendations by the first-year programme are as follows:

(1) The Mrima Hill is an interesting prospect not only for rare earths elements and niobium but also for base and precious metals, based on the results of the mineral investigation and the soil geochemistry.

Therefore, further geochemical follow-up work is recommended for Mrima Hill-Jombo Hill area in the scheme of the project.

(2) Among the geochemical anomalies of the pan-concentrated stream sediments, four areas are selected for further investigation, namely Vitengeni, Ganze (the upstream of Mulungu Wa Mawe River, far west of Kilifi), Kinagoni, and Mkangombe. The former three areas are located in the proximity to the major coast-parallel faults and the areas for investigation should include the major fault zones and the upstream areas of the localities of the anomalous values.

(3) The above four targets, which are selected on the basis of the results of the pan-concentrate stream sediment geochemistry should necessarily cover wider areas, some few hundreds square kilometres, since the geochemistry of 100 samples have been studied for an area of some 9,000 sq. km. Consequently, the investigation in these targets should be of semi-regional or semi-detailed operations.

1-3 Outline of the Second-Year Programme Works

1-3-1 Area covered

The entire Mombasa Area, located in south-eastern coastal range of the Republic of Kenya, occupies an area of 9,000 sq. kilometres as shown in Figure 1.

The five work areas of the second-year programme, Ganze, Jibana, Ribe, Mkangombe and Mrima-Jombo, are located in the Coastal Province as shown in Figure 2. Ganze, Jibana and Ribe in central and northern locations are in the Kilifi District, while, Mkangombe and Mrima-Jombo in southern location are in the Kwale District, respectively.

Figure 3 shows a general configuration of access roads network toward the respective work areas and required approximate hours of time by motor vehicle from the City of Mombasa.

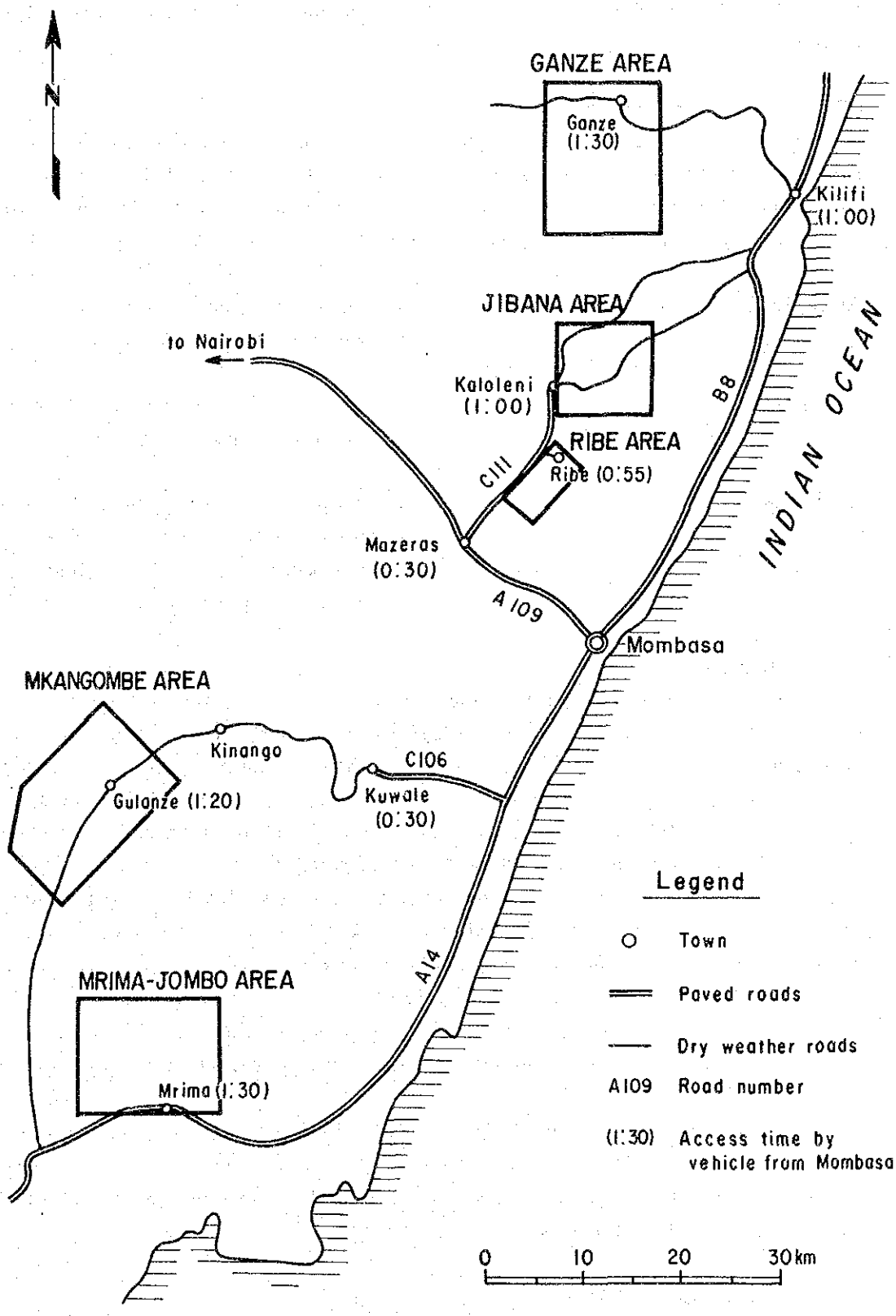


Figure 3 Accessibility of the Survey Areas

Motor roads in the areas are well-developed to be accessible to the respective areas by motor vehicle from Mombasa, by taking within some one and a half hours of time in average on sealed or unsealed roads.

1-3-2 Purpose of the survey works

The major purposes of the current survey works in five areas, the above, are to elucidate geological structures and geochemical features by geological mapping and geochemical exploration works and to specify the occurrences of mineral ore bodies and mineralized zones in the areas.

The major exploration targets in the respective area are stated below:

Ganze, Jibana and Ribe Areas	:	To specify the occurrences of lead and zinc ore veins of Kinangoni type
Mkangombe Area	:	To specify the occurrences of ore veins of precious and base metals
Mrima-Jombo Area	:	To pursue the occurrences of precious and base metals mineralization and to specify the occurrences of niobium and rare earths elements mineralization

1-3-3 Measures of survey work

Geological mapping and geochemical exploration research were covered in five project areas and trench digging for detailed geology and mineralogy was carried out in Mkangombe Area. Type and quantity of the current works are listed in Tables 1 through 3. The results of geological mapping, which were originally made by geological route mapping on topographical maps of one to 10,000 scale, exaggerated from those of one to 50,000 scale, are delineated in the geological maps of one to 50,000 scale, Plates 1 and 2. Field works of geochemical exploration research, which were carried out in simultaneous accordance with geological route mapping progresses, the above, were implemented by taking samples of B-horizon soils on ground surface at the stations of every 300 metres interval along the traversing direction against the major tectonic structure in the areas and of every 350 to 400 metres interval along the parallel direction against that, the above. The collected soil samples, air-dried then afterward in the base camp, were sieved to provide for minus 80-mesh fractional products to be sent to geochemical laboratory.

Exploration pit trench digging for detailed geology and mineralogy was extra carried out in Mkangombe Area to elucidate the location of the outcrop of quartz ore vein, associated with base metal minerals, and to estimate an extension of the above ore vein in and arround the spot, where ore floats lie scattedly.

1-3-4 Organization of survey teams

The attending members of the programming/negotiation/coordination and field survey teams are tabulated in Tables 4 and 5.

Table 1 Amount of Geological and Geochemical Works

Name of Area	Area Surveyed	Survey length Surveyed	Number of Soil Sample collected
	(Km^2)	(km)	
Ganze	192	140.0	451
Jibana	100	80.8	260
Ribe	32	29.6	82
Mkangombe	196	147.0	452
Mrima-Jombo	100	88.9	262
Total	620	486.3	1,507

Table 2 Amount of Trenching Work

Location	Number of trenches	Total length of trenches
Mkangombe-North	4	50 m

Table 3 Amount of Laboratory Works

Mode of analysis	Amount
1. Microscopic observation of rocks in thin section	30
2. Microscopic observation of ores in polished section	10
3. X-ray diffractometer analysis	30
4. Chemical analysis	
(a) Ore (Au, Ag, Cu, Pb, Zn, Mn, Fe, S)	31
(b) Soil-1 (Au, Ag, Cu, Pb, Zn, Mn, Ba, Fe, As, Hg, S)	1,245
(c) Soil-2 (Au, Ba, Sr, Nb, Y, U, Th, La, Ce, Nd, Sm, Eu, Tb, Yb, Lu, Cu, Pb, Zn, Fe, Mn, P)	262

* Soil-1 is applied for Ganze, Jibana, Ribe and Mkangombe Area

* Soil-2 is applied for Mrima-Jombo Area

Table 4. **Member List of Programming/Negotiation /Coordination Teams**

Japanese Delegation	Kenyan Recipients
Yoichi YAMAGUCHI, MMAJ Kyoichi KOYAMA, MMAJ Haruhisa MOROZUMI, MMAJ Nobuyuki OKAMOTO, JICA Katsuichiro SAKAI, Kenya Office, JICA Takahisa YAMAMOTO, Nairobi Office, MMAJ	E.M. MASALE, MENR C.Y.O. OWAYO, MGD J.K. WACHIRA, MGD F.K. MURUGA, MGD

JICA : Japan International Cooperation Agency
MMAJ : Metal Mining Agency of Japan
MENR : Ministry of Environment and Natural Resources of Kenya
MGD : Mines and Geological Department of Kenya

Table 5. **Member List of Field Survey Teams**

Japanese Team	Kenyan Team
Akira TAKIGAWA, SUMICON Leader Toru HIROKAWA, SUMICON Takao SASAKI, SUMICON	I.K. GITHINJI, MGD, Ex-Co-leader S.S. HUSSEIN, MGD, Co-leader M.N. MWANGI, MGD T.N. NDOLA, MGD M. MASIBO, MGD M. GIKUHI, MGD

MGD : Mines and Geological Department of Kenya
MMAJ : Metal Mining Agency of Japan
SUMICON: Sumiko Consultants Co., Ltd.

1-3-5 Periods of work

The periods of time of the current works are outlined below:

Mobilization of Japanese team, courtesy visits to related Kenyan Government offices and discussions	:	6 Aug. 1991 – 12 Aug. 1991
Preliminary works and general field excursion	:	13 Aug. 1991 – 15 Aug. 1991
Field survey work, Ganze, Jibana and Ribe Areas	:	16 Aug. 1991 – 2 Sept. 1991
Field survey workd, Mkangombe and Mrima-Jombo Areas	:	5 Sept. 1991 – 20 Sept. 1991
Office work and movement to project field	:	21 Sept. 1991 – 30 Sept. 1991
Examination of diamond drill rigs and preliminary inspection of diamond drill sites	:	1 Oct. 1991 – 6 Oct. 1991
Submit interim report and courtesy visit to related Kenyan Government offices	:	3 Oct. and 7 Oct. 1991
Demobilization of Japanese team	:	8 Oct. 1991 – 11 Oct. 1991

CHAPTER 2 GENERAL GEOGRAPHY

2-1 General Topography and Water System

General topographical features in five project areas are respectively stated below:

Ganze Area: General topography in Ganze Area is characterized by showing a hilly representation, less undulated with an average altitude of 150 metres high above sea level, while 280.8 metres the highest. Most of water system in the Area is integrated to the Ndzovuni River system. The main stream of Ndzovuni River flows gently down easterly across the southern margin of the Area, meanwhile, a distinct gorge-like topography is observed along the river bank, where Kambe limestone beds underlie.

Jibana Area: General topography in Jibana Area is typically divided into two groups, represented in south-eastern part of the Area and the other. The former, which is majorly underlain by Mtomkuu Formation, is topographically characterized by showing a hilly representation, with an average altitude of 50 to metres high above sea level. The latter shows a little undulated hilly mountainous topography, 150 to 300 metres high, while 309.6 metres is the highest. Most of the water system, which is typically represented by flowing down southerly or southeasterly, is majorly integrated to the Mtomkuu River system.

Ribe Area: General topography in Ribe Area is characterized by showing a hilly mountainous representation with an average altitude of 50 to 200 metres high above sea level. The water system in northern half of the Area is integrated to the Tsalu River system, meanwhile, to the Rombeni River system in southern half of the Area. The main stream of Kombeni River meanders down southerly around the western margin of the Area, where a distinct valley topography is formed.

Mkangombe Area: General topography in Mkangombe Area is characterized by showing a less-undulated hilly representation with an average altitude of 150 to 250 metres high above sea level. The water system in northern part of the Area is integrated to the Duma River system, meanwhile, to the Mbadzi River system in sourth-eastern part of the Area and to the Ramisi River system in south-western part. River water in the Area is almost dried in dry season.

Mrima-Jombo Area: General topography in Mrima-Jombo Area is characterized by showing a hilly representation with an average altitude of 50 to 150 metres high above sea level, however, is remarked by being associated with isolated conspicuous hills, which are Mrima Hill, Kiruku Hill and etc.. Jombo Hill shows the highest altitude in the Area, 462.3 m high above sea level. Water system in the Area is barely dissected to merely form Ramisi River, which flows easterly down in northern margin of the Area.

2-2 Climate and Vegetation

The monthly average maximum and minimum air temperature and rainfall in Coastal Province of the Republic of Kenya is shown in Table 6.

Table 6. Monthly average maximum air temperature, minimum air temperature and rainfall in Coast Province, Kenya

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Average maximum air temperature (°C)	32	32	33	31	29	29	28	28	29	30	31	32
Average minimum air temperature (°C)	23	24	24	24	23	21	21	21	21	22	23	24
Average rain fall (mm)	17	10	30	108	149	54	34	47	46	62	66	32

Ganze, Jibana, Ribe and Mrima-Jombo Areas, which are considered to have ever been covered by a forest in old time, are under the humid and high air temperature climate condition. Agricultural development in the Areas are well-organized to exuberantly produce coconuts, cashewnuts, corns, mangos and rice plants. Thick tropical forests are currently reserved in the vicinity of Mrima Hill and Jombo Hill.

Mkangombe Area is under the semi-arid climate condition to be covered by acasia trees, cactuses and thorn bush. Corns are currently produced in cultivated fields in the Area.

CHAPTER 3 GENERAL GEOLOGY

Summarized geological map and representative geological profile sections of the current project areas are shown in Figures 4 and 5, respectively. Areal geological map and profile of the Ganze, Jibana and Ribe Area are shown in PL.1 and those of the Mkangombe and Mrima-Jombo Area are shown in PL.2.

General geology in the entire Mombasa Area consists of the formations of Precambrian to Quaternary ages and is composed of sediments, igneous rocks, metamorphic rocks and unconsolidated sediments. The major geological units in the area are specified to be of Mozambique System in north-western part of Mombasa Area, of Palaeozoic-Mesozoic Groups in major part of the Area and of Tertiary System, associated with later sediments in coastal province in the Area.

Mozambique System is mainly comprized of metamorphic rocks, i.e., gneiss and schist. Permian System is observed in western part of the Area. Permian and overlying Triassic Systems in the Area are composed of a series of the alternations of grit, sandstone and shale. Jurassic System in the Area (Kambe and Mtomkuu Formations) consists of marine limestone and shale beds. Permian-Triassic Systems in the Area (Druma Group, i.e. Taru, Maji ya Chumvi and Mariakani Formations and lower part of Mazeras Formation) are correlated to Karroo System in South Africa, however characteristically show finer facies than that in other area. Karroo System is typically characterized by being associated with coarse-grained sediments, caused by the repeated sedimentations of materials in connection with geotectonism nearby sedimentary basin structure, however, Karroo System in Mombasa Area, the above, is of a lack of coarse-grained facies. Facies change of Karroo System from west toward east in Mombasa Area is more remarkable than that from south-west toward north-east. Non-volcanic Tertiary System and Pleistocene sediments are observed along the coastal province in the area. Uplifted coral reefs along the coast are of pleistocene age.

Limited occurrences of dykes are observed in Palaeozoic and Mesozoic sediments in Mombasa Area. Alkaline rock intrusives are observed in Jombo Hill and nearby, while, carbonatite intrusives are in Mrima Hill.

Faults, extending NNE-SSW to NE-SW directionally and nearly parallel to the direction of sea shore line in Mombasa Area, are well-developed. The major faults among those, which are observed long extendedly along the coast in the area, make the demarcation of Mazeras sandstone and Kambe limestone beds. Another type of faults, which traverse major faults in the Area, the above, and are considered to be formed later than those, are also observed in association with well-developed fissures.

Lead-zinc-barite mineralizations, represented by Kinangoni ore bodies, are considered to be structure-controlled by the major faults, NNE-SSW to NE-SW directional. Geochemical anomalies of the elements, related to lead-zinc-barite mineralization, are also detected nearby the major faults, nearly parallel to the direction of sea shore line in Mombasa Area. The ore showing in Mkangombe North is considered to be a representation of fault-controlled copper-lead-zinc-quartz mineralization, extending NNE-SSW directionally.

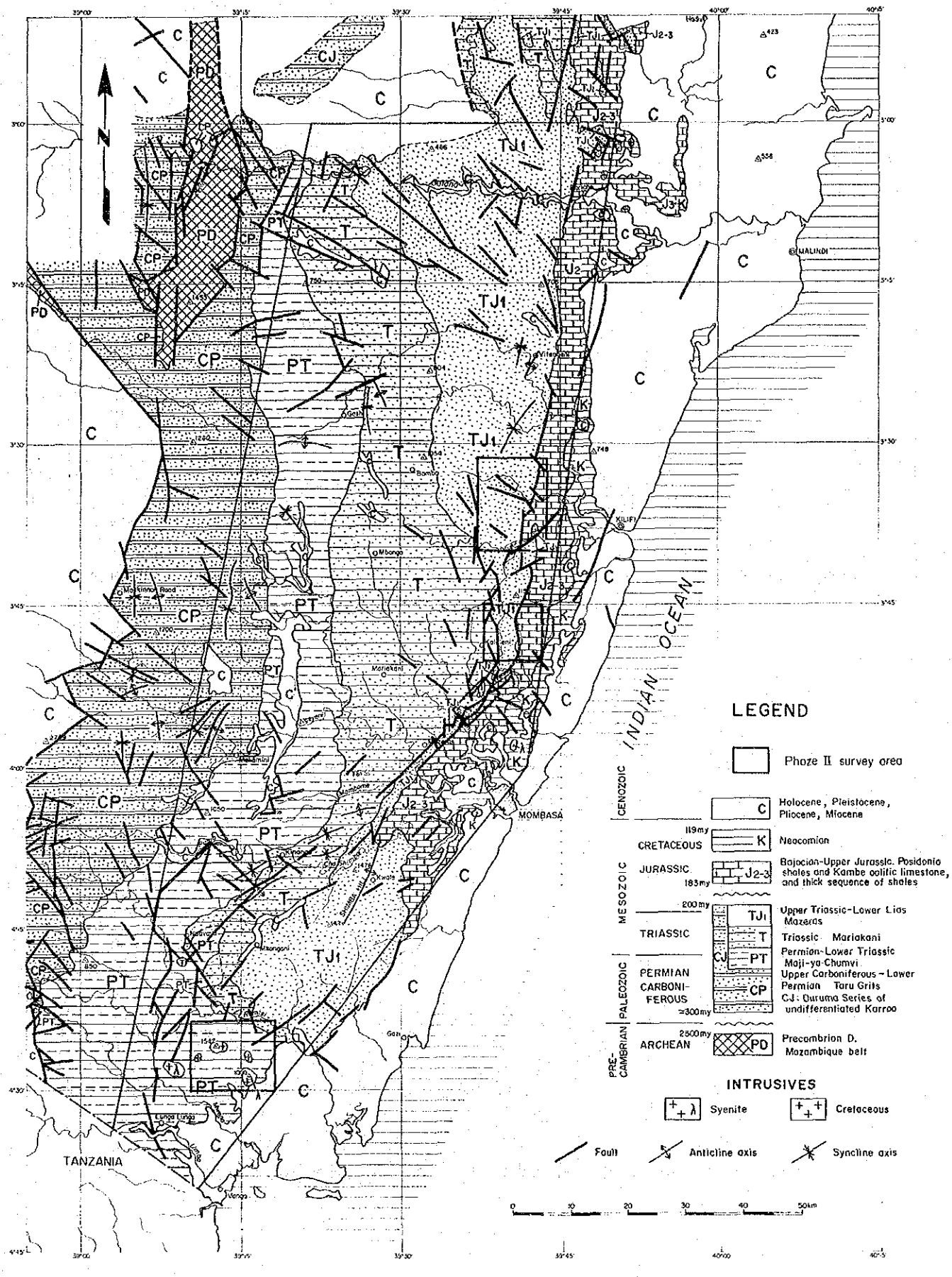


Figure 4 Generalized Geological Map of the Mombasa Area

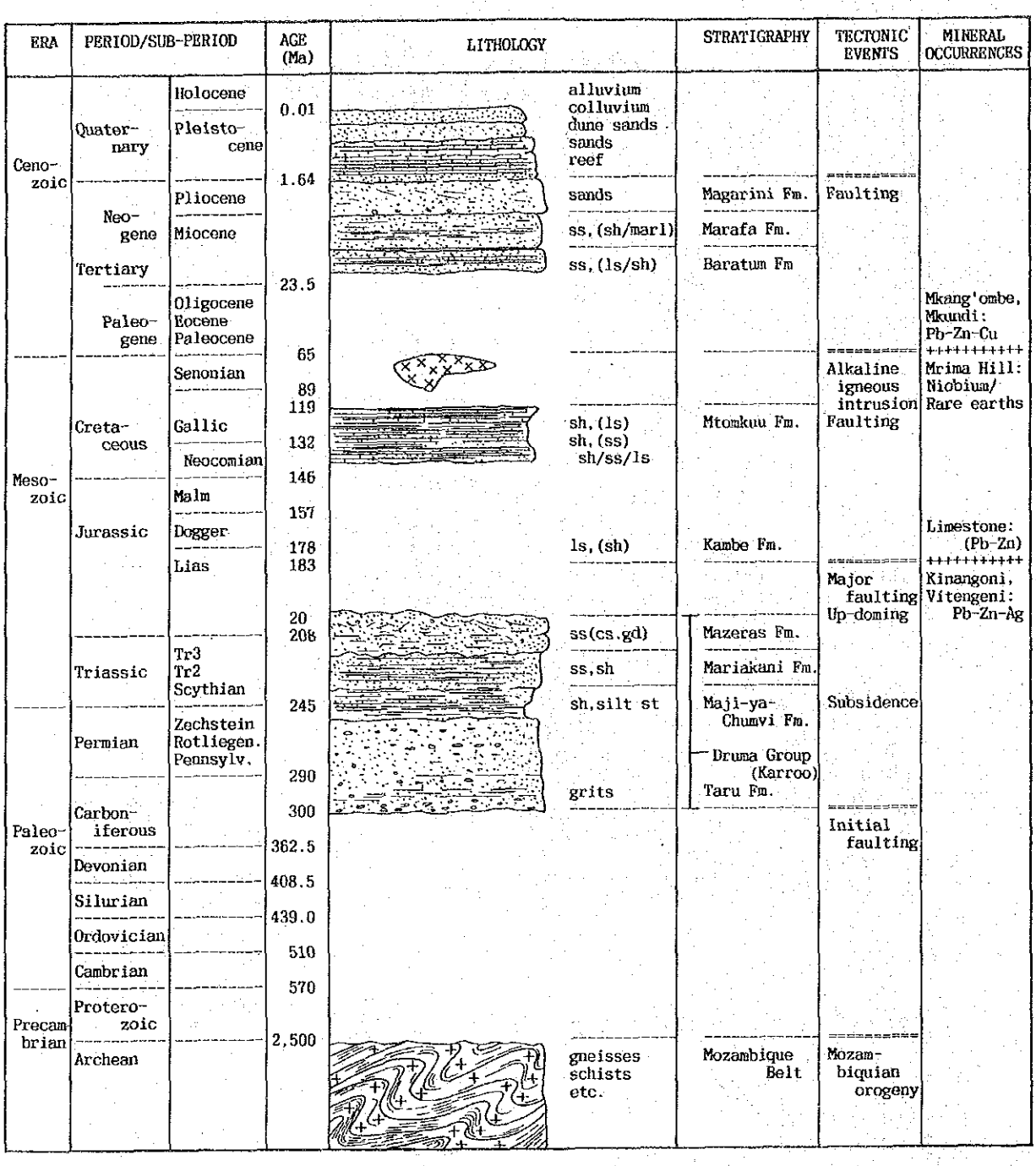


Figure 5 Geological sequence of the Mombasa area

CHAPTER 4 EXAMINATION RESULTS OF THE CURRENT SURVEY WORKS

4-1 Geological Structure, Features of Mineralization and Mineralization Control

The localities of ore showings in the five work areas are shown in PL.5 and PL.6.

Ore showings observed in the current research programme area are divided into three groups below:

(1) Base metals ore vein, associated with gold and silver

(2) Niobium and rare earths elements mineral deposit

(3) Ore showings associated with iron and manganese

Base metals ore vein type includes lead-zinc-barite vein mineralization, represented by Kinangoni ore body and copper-lead-zinc quartz vein mineralization, represented by Mkangombe North. Those are observed occurring under the distinct fault-controls, NNE-SSW to NE-SW directional and approximately parallel to the direction of sea shore line in the area. Hydrothermal alteration associated with mineralization is clearly observed in Kinangoni, however, not clear in Mkangombe North. The related igneous activities to Kinangoni mineralization are still obscure, while, lamprophyric intrusive activity is genetically inferred for the formation of Mkangombe North mineralization. Carbonatite intrusives, associated with manganese minerals, pyrochlore and rare earths elements, are observed in Mrima Hill area. Oxide minerals of rare earths elements in Mrima Hill, concentratedly discernible in residual soils originated from carbonatite body, are composed of pyrochlore, monazite, gorceixite and etc..

Results of the current geochemical survey suggest that niobium and rare earths elements mineralization occurrs not only in Mrima Hill but possibly in Kiruku Hill.

4-2 Mineral Potentials

The potential of base metals ore body(s) is generally inferred to be expected in Ribe and Mkangombe Areas, particularly in the former, since the new mineralized zone (Ribe mineralized zone) was discovered in recent years and also Chiume mineralized zone, nearby the project area, has still been left insufficiently investigated. The possibly mineralizationcontrolling faults, nearly parallel to the direction of sea shore line in Mombasa Area, are also well-developed in Ribe Area. In Mkangombe Area, outcrops of quartz vein ores and abundant quartz ore floats were newly discovered in a zone, quartz veining mineralized zone, NE-SW 45 degrees directional, which includes copper-lead-zinc-quartz ore veins of Mkangombe North Ore Showing.

Potential of niobium and rare earths elements mineralization is estimated to be areally confined in Mrima-Jombo Area. This type of mineralization has been specified to be observed not only in carbonatite bodies in Mrima Hill, but also in agglomerate bodies in Kiruku Hill by the current works, to lead to a notional expansion of the mineral potentials of the above commodities. Mineralizations of niobium and rare earths elements are estimated to occur in agglomerate bodies in Nguluku. An occurrence of subsurface carbonatite bodies, underlying fenitized rock body, about 3 km north of Mrima Hill, is inferred to be possibly potential.

4-3 Relations between Geochemical Anomalies and Mineralization

The localities of geochemical anomalies in Ganze, Jibana and Ribe Area are shown in PL.7 and PL.8, and those in Mkangombe and Mrima-Jombo Area are in PL.9, PL.10, PL.11 and PL.12. The interpretation map of the Phase II survey results in Ganze, Jibana and Ribe Area is shown in PL.13 and that in Mkangombe and Mrima-Jombo Area is in PL.14. Figure 6, 7, 8, 9 and 10 show the interpretation map of the Phase II survey results in the five work areas respectively.

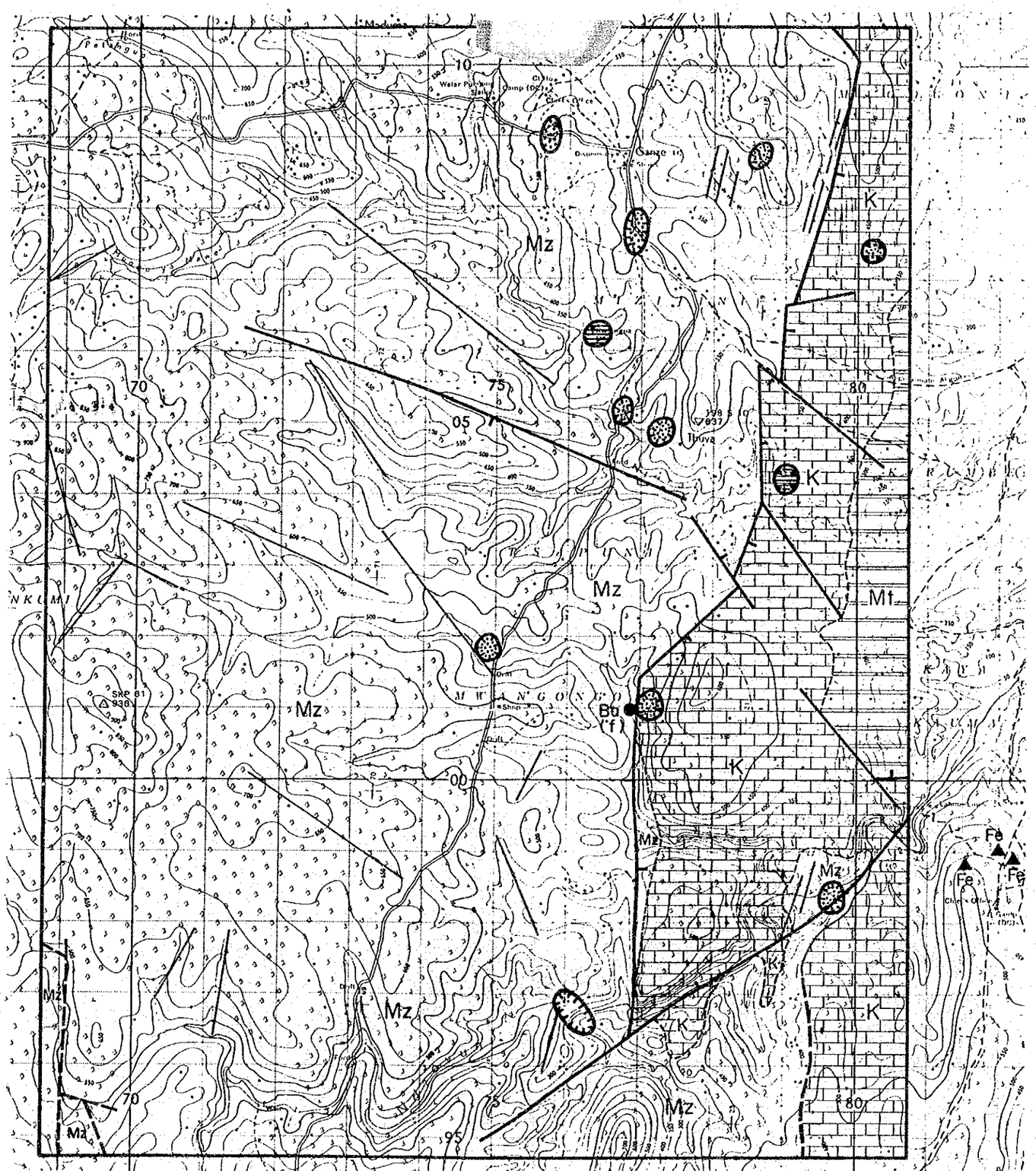
Geochemical anomalies of lead in Jibana Mineralized Zone in Jibana Area and those of silver, lead and zinc in Changombe North and Changombe South Mineralized Zones in Ribe Area, which are descriptively generalized to be represented in genetic relation to the occurrences of lead-zinc-barite ore mineralizations, have been specified by the current works. Those anomalies are of small scale and are scatteredly observed, however, are estimated to be shown in connection with a part of mineralized zones occurrences ever been known.

A geochemical anomaly of barium and sulphur, north-southerly extended, has been specified in Jibana Mineralized Zone, however, the genetic relation to barite ore mineralization is still obscure.

Geochemical anomalies in Mkangombe Area are scatteredly shown to be unlikely related to quartz veining mineralizations. Isolated geochemical anomalous values of copper and zinc are specified in the vicinity of quartz veins outcrops and quartz ore floats.

Geochemical anomalies of the elements for chemical assay treatments of the current works, other than copper, are shown to represent niobium and rare earths elements mineralizations in Mrima-Jombo Area. Geochemical anomalies in connection with mineralization occurrences are specified in the vicinity of carbonatite bodies in Mrima Hill and also nearby agglomerate bodies occurrence in Kiruku Hill.

Copper anomalies in Mtomkuu Formation coverage and iron, manganese, lead and zinc anomalies in Kambe Formation coverage are estimated to be irrelatively represented to the mineralizations. The former is estimated to be relatedly shown in shale beds occurrences of high copper contents, while, the latter is in the concentrations of elements in accordance with the formation of ferruginous concretions in weathered soils of limestone beds.



LEGEND

- Active mine (Kinagoni mine)
- Gossan
- Ba — Barite (f : float)
- Fe — Iron concretion
- Mt — Mtomkuu formation
- K — Kambe formation
- Mz — Mazeras formation
- Mk — Mariakani formation
- Fault, known and inferred
- Photo lineament
- Breccia, shear zone
- Geological boundary

Geochemical Anomaly

Element	Anomaly	Threshold
Ag		≧ 0.2 ppm
Pb		≧ 80 ppm
Zn		≧ 600 ppm
Ba		≧ 1100 ppm
S		≧ 0.025 %

0 1 2 3 4 5km

Figure 6 Interpretation Map of the Phase II Survey Results (1), Ganze Area

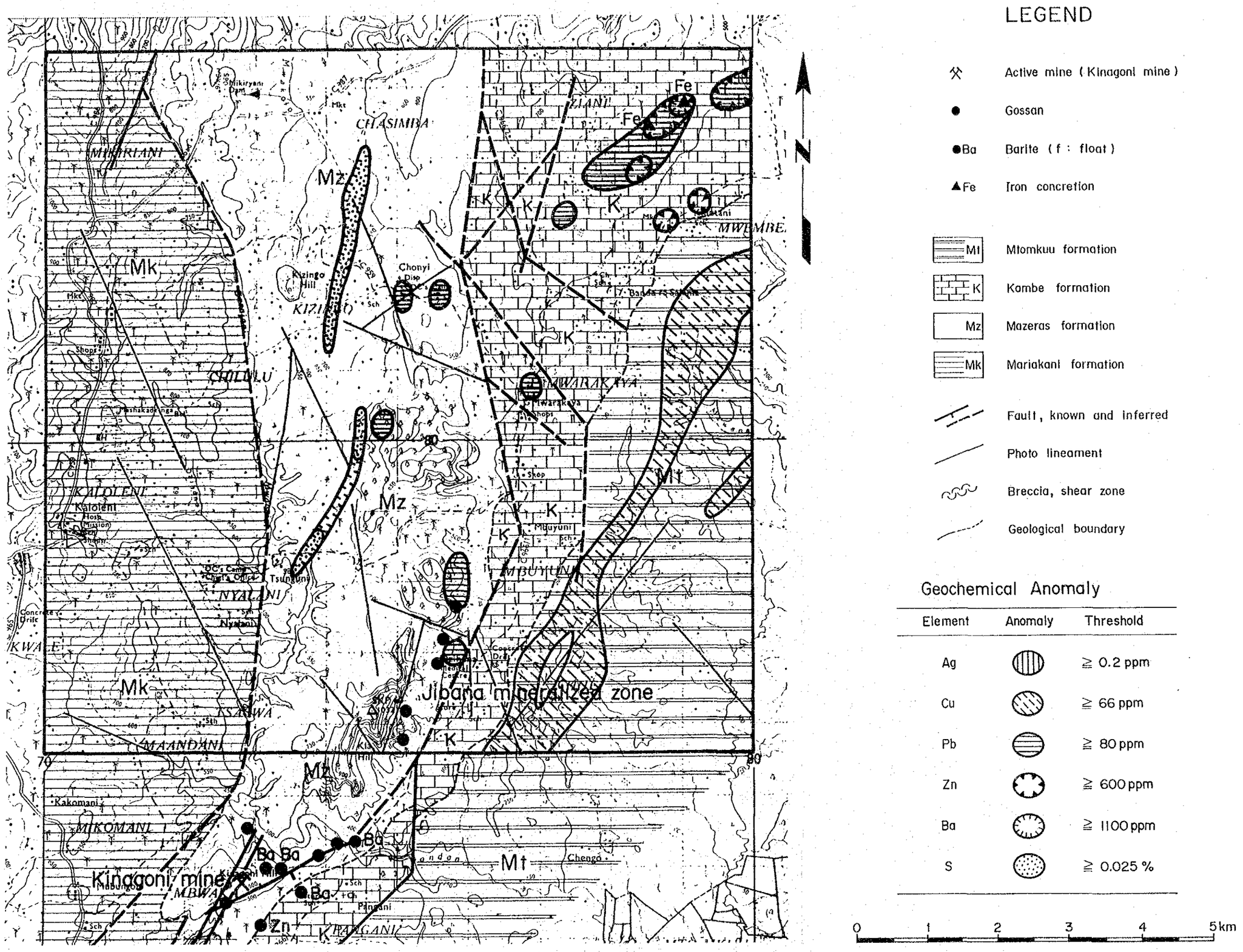
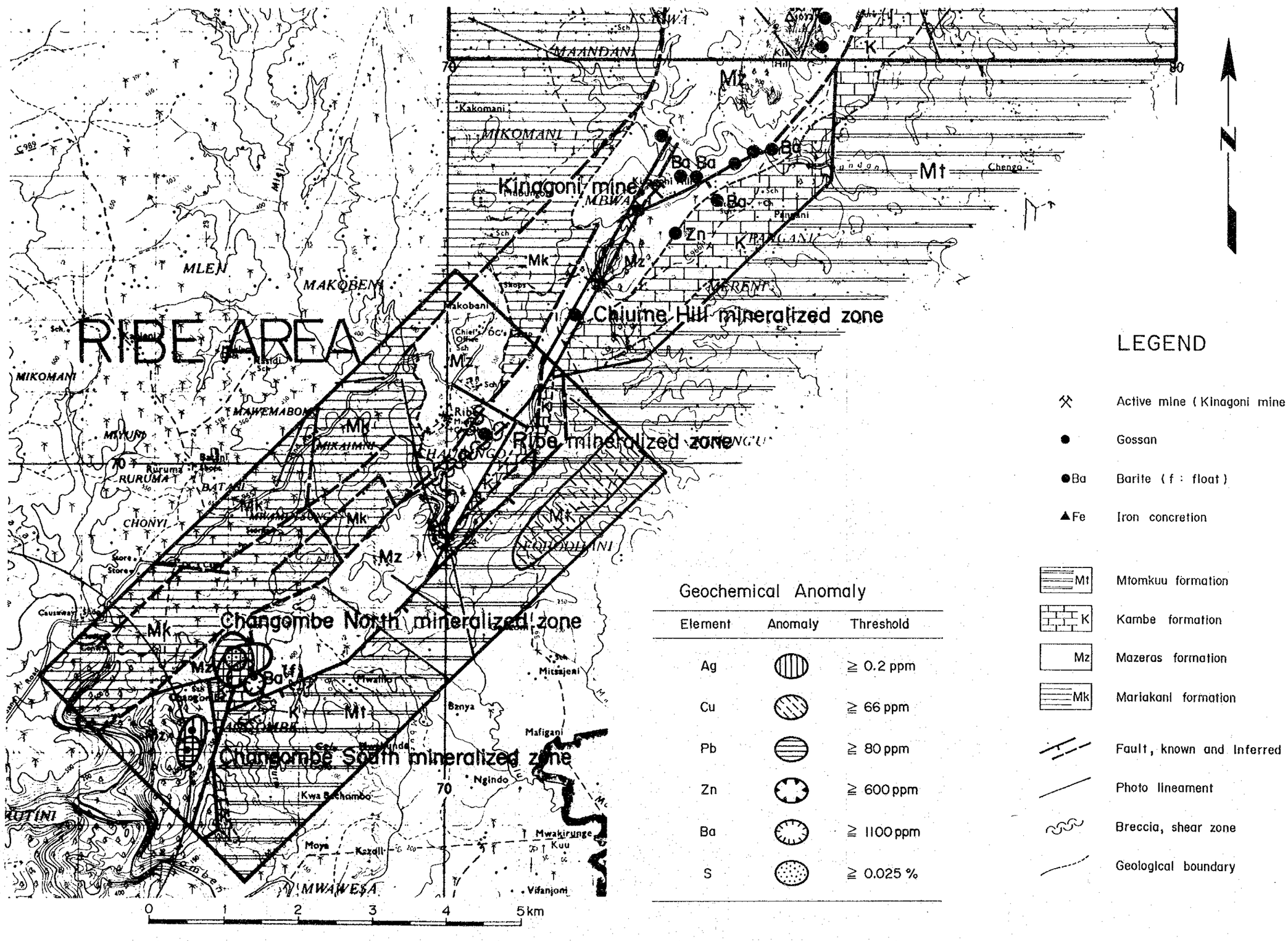


Figure 7 Interpretation Map of the Phase II Survey Results (2), Jibana Area



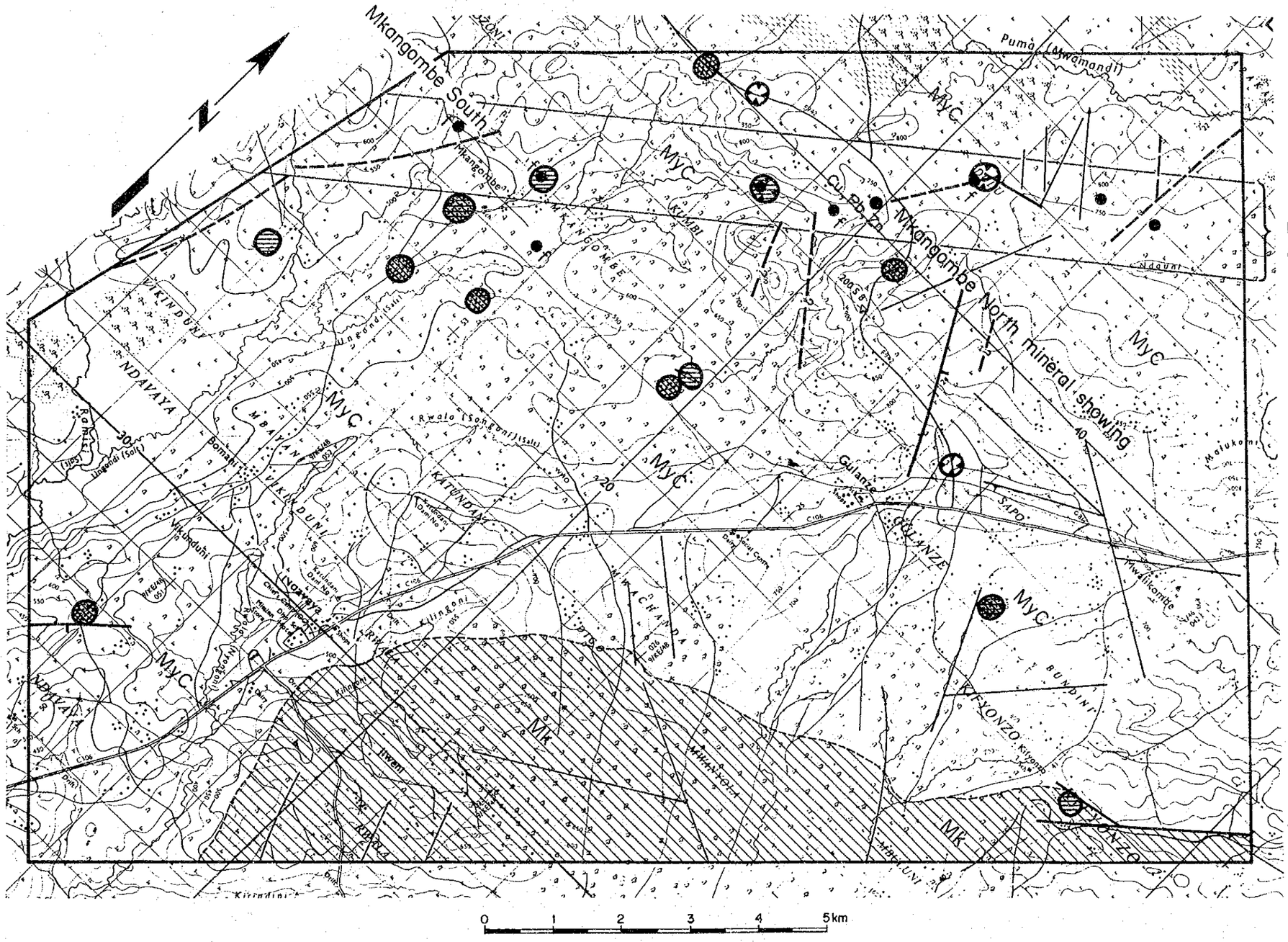
Geochemical Anomaly

Element	Anomaly	Threshold
Ag		≧ 0.2 ppm
Cu		≧ 66 ppm
Pb		≧ 80 ppm
Zn		≧ 600 ppm
Ba		≧ 1100 ppm
S		≧ 0.025 %

LEGEND

- Active mine (Kinagoni mine)
- Gossan
- ●Ba Barite (f : float)
- ▲Fe Iron concretion
- Mt Mtomkuu formation
- K Kambe formation
- Mz Mazeras formation
- Mk Mariakani formation
- Fault, known and Inferred
- Photo lineament
- Breccia, shear zone
- Geological boundary

Figure 8 Interpretation Map of the Phase II Survey Results (3), Ribe Area



Mkangombe
Quartz Vein Zone

LEGEND

- Quartz vein (f : float)
- Cu,Pb,Zn — Metalliferous quartz vein
- Mk — Mariakani formation
- MyC — Maji-ya-Chumvi formation

Igneous Rocks

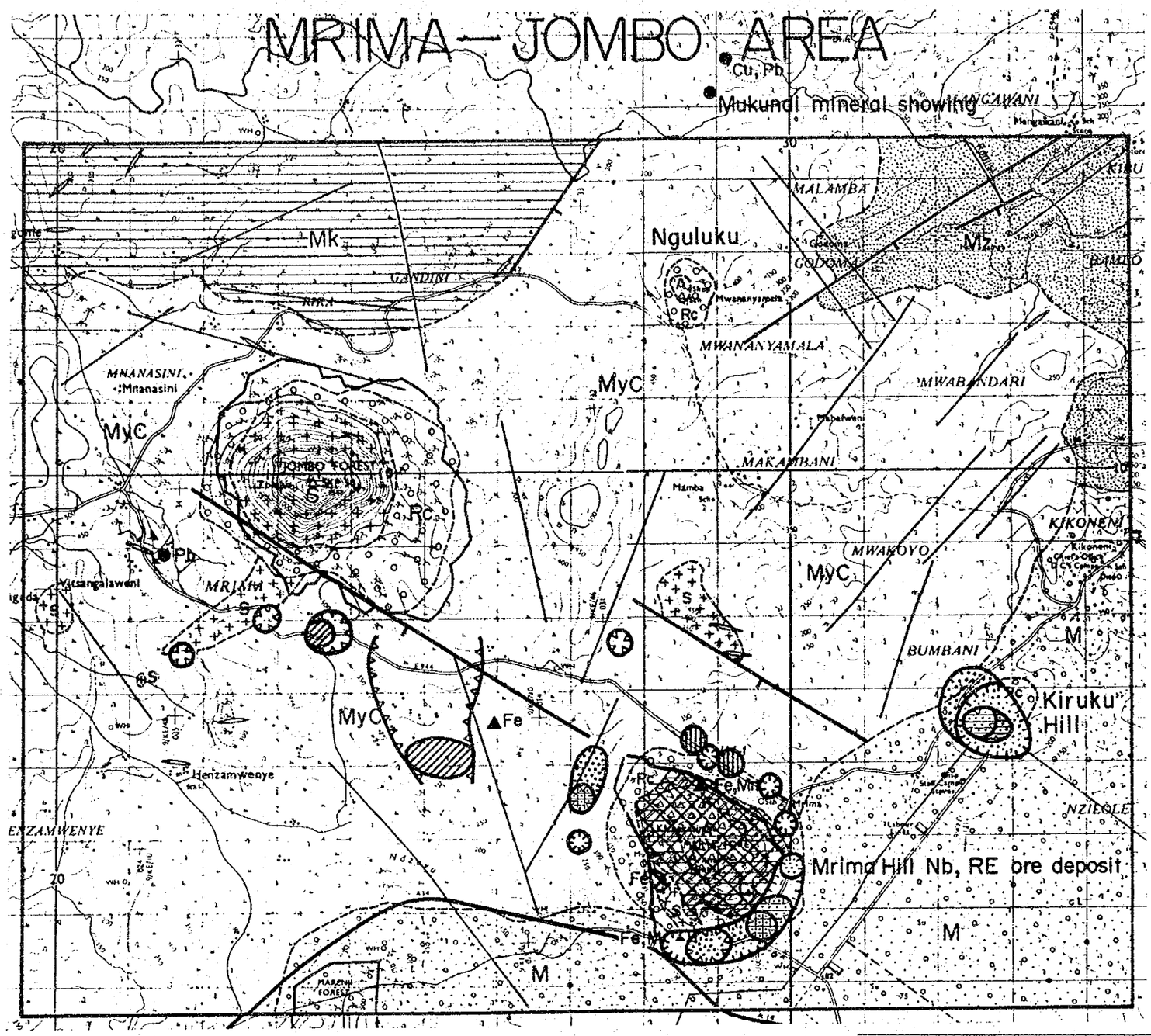
- Lamprophyric dyke
- Fault, known and inferred
- Photo lineament
- Geological boundary

Geochemical Anomaly

Element	Anomaly	Threshold
Cu		≧ 31 ppm
Pb		≧ 8 ppm
Zn		≧ 80 ppm

Figure 9 Interpretation Map of the Phase II Survey Results (4), Mkangombe Area

MRIMA – JOMBO AREA



LEGEND

- Quartz vein (f : float)
- Cu, Pb, Zn — Metalliferous quartz vein
- Fe, Mn — Iron – Manganese concretion
- Fe — Abandoned Iron Mine
- Niobium, rare earth elements mineralization accompanied with carbonatite
- Rc — Colluvium and residual soils
- M — Magarini formation
- Mz — Mazeras formation
- Mk — Mariakani formation
- MyC — Maji-ya-Chumvi formation

Igneous Rocks

- A — Agglomerate
- C — Carbonatite
- S — Alkaline holocrystalline rock
- Lamprophyric dyke
- Fault, known and inferred
- Photo lineament
- Geological boundary

Contribution Elements of the First Principal Component (Factor loading ≧ 0.834)

Ba, Mn, P, Sr, Zn, Nb, Y, Ce, Eu, La, Lu, Nd, Sm, Tb, Th, Yb

Geochemical Anomaly

Element	Anomaly	Threshold
Au		≧ 10 ppb
Cu		≧ 120 ppm
Pb		≧ 100 ppm
Fe		≧ 10 %
U		≧ 10 ppm

Figure 10 Interpretation Map of the Phase II Survey Results (5), Mrima-Jombo Area

(2) Implementations of diamond drill operations for deeper portions of Mkangombe North Mineral Showing, in which a most distinct mode of mineralization in the quartz veining mineralized zone has been specified by ground surface mapping are deserved to be warranted in Mkangombe Area.

(3) Further implementations of detailed geological and geochemical research works (including trench work) are considered to be deserved to warrant in Kiruku Hill, Mrima-Jombo Area, to produce a thorough evaluation geochemical anomalies of niobium and rare earths elements in lateral and vertical extensions. Agglomerate body in Nguluku, which is estimated to be under a similar geological situation to that in Kiruku Hill, is also considered to warrant a further fostering geoscientific works to elucidate modes of mineralizations in the site.

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