Chapter 2 Mhunze Area

2-1 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 north and south with an interval of 500 meters. Interpretation of monochromatic air photographs of 1 to 40,000 scale , taken in June 1964 were also put into practice for an aid of geological mapping. It was very much available to draw the geological map, because the area is almost completely covered by cultivated land and only few outcrops except BIF hills are observed.

The geological data obtained by the field works were incorporated with the results of various laboratory tests for a comprehensive interpretation (Table 2-2-1). 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.

Method of sampling and treatment of samples are the same as those in Igengi area. 642 pieces of soil samples were collected in Mhunze area (Table 2-2-1). Analytical methods of soil sample are shown in Table 2-1-2.

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

	Item	Number	Remarks
Geological survey & geochemical exploration		137km²	
Laboratory test	Assay of soil samples	642	Au,Ag,Cu,Pb,Zn,As,Sb,Hg,Mo,W,Bi
	Assay of ore/rock samples	10	Au,Ag,Cu,Pb,Zn,Pt
	Whole rock assay	1	Al_2O_3,CaO,Cr_2O_3,Fe_2O_3,MgO,MnO, P_2O_5,K_2O,SiO_2,Na_2O,TiO_2,I.OI
	X-ray diffractive tests	1	Bulk
	Observation of thin sections	2	
	Observation of polished sections	4	
	Measurement of resistivity and chargeability of rock samples	4	

2-2 Geology

2-2-1 General geology

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

The geology of this area comprises the Nyanzian System, Granitic Rocks and Superficial Deposits. Mbuga clays, the major superficial deposits, cover the Nyanzian and Granitic rocks in the low flat plains especially in the east and southwest of the area.

The Nyanzian System of the area comprises mainly pelitic metasediments and banded iron stones. The distribution of metavolcanic rocks which are main rock facies of the lower part of the Nyanzian System are not clear in the area , though some floats of metabasalts were found in the northwest part of the area. From a lithological point of view , the Nyanzian rocks of the area is thought to correspond to the lower to middle part of the Nyanzian sequence by Stockley (1936, 1943) .

The Granitic rocks is distributed in the narrow areas in the northeast and south of the area.

Major geological structure of the area is controlled by folding structure trending E-W.

2-2-2 Detail of Geology

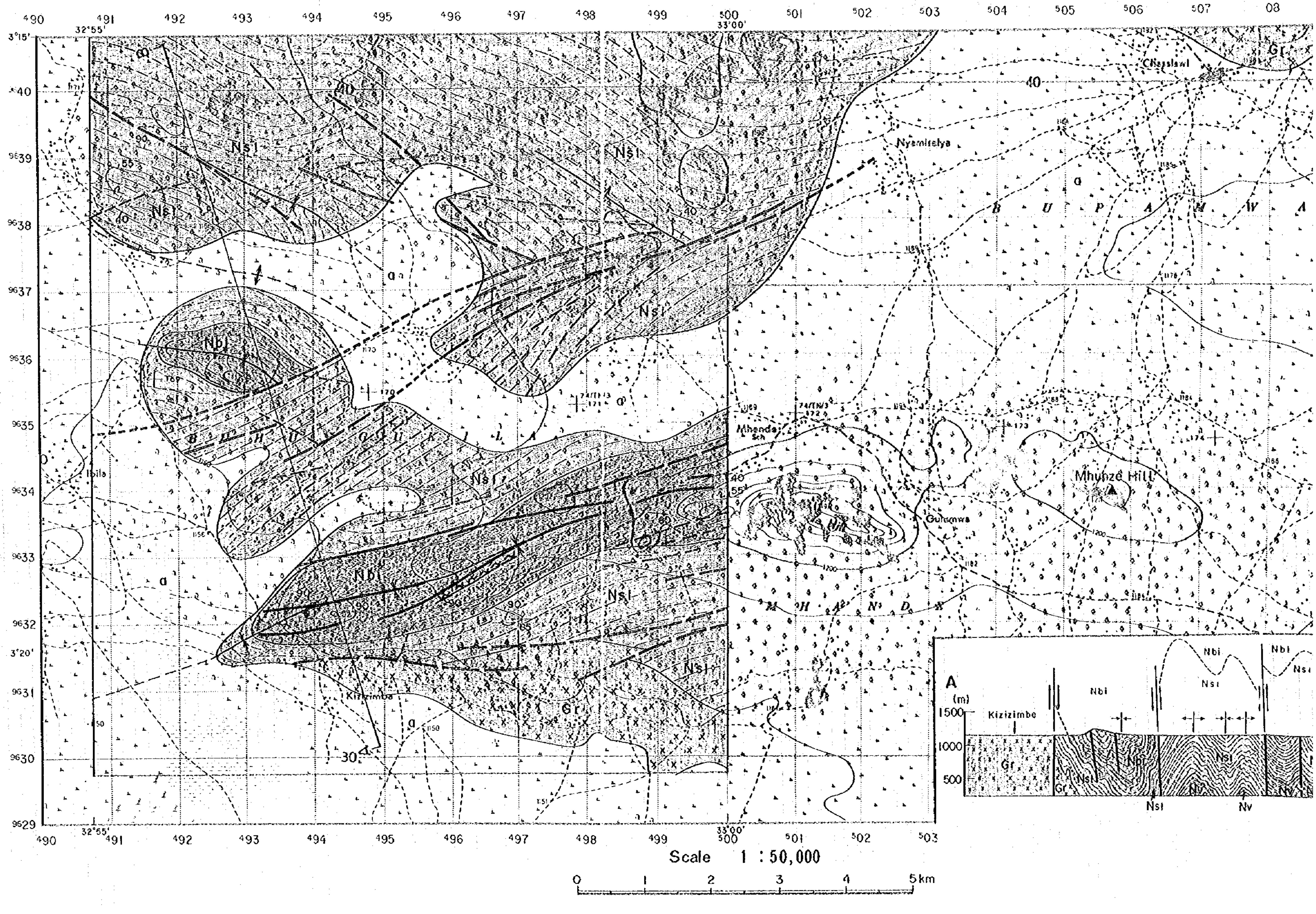
(1) Nyanzian System

Metabasalt (Nv) :

The distribution of the unit has not been clarified by the present mapping, because only several floats of metabasalt were picked up in the area. The unit, as a member of metavolcanics belonging to the lower part of the Nyanzian sequence, may occupy a small area in the northwest end of the area being along an anticlinal axis which is inferred in the same place.

The rocks of the unit are dark grey to dark greenish grey in colour, massive and fine-grained. The judgement of original occurrence of the rocks is very difficult, because the unit lacks certain outcrops.

The results of whole rock analysis of the rock (MAR008) are presented in Apx.9. From the plot of the results on the SiO2 - Na+K diagram (Fig.2-1-3) the rock correspond to basalt. The main normative composition of the rock is Olivine, Diopside, Hyperthine, Ilumenite, Anorthite, Albite and


Nsl
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a
40
B U P A M W A
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M H A N D A
Nyamisiya
Chasalawi
Mhande Sch.
Gulumwa
Mhunze Hill
Kizizimba
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(m)
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1000
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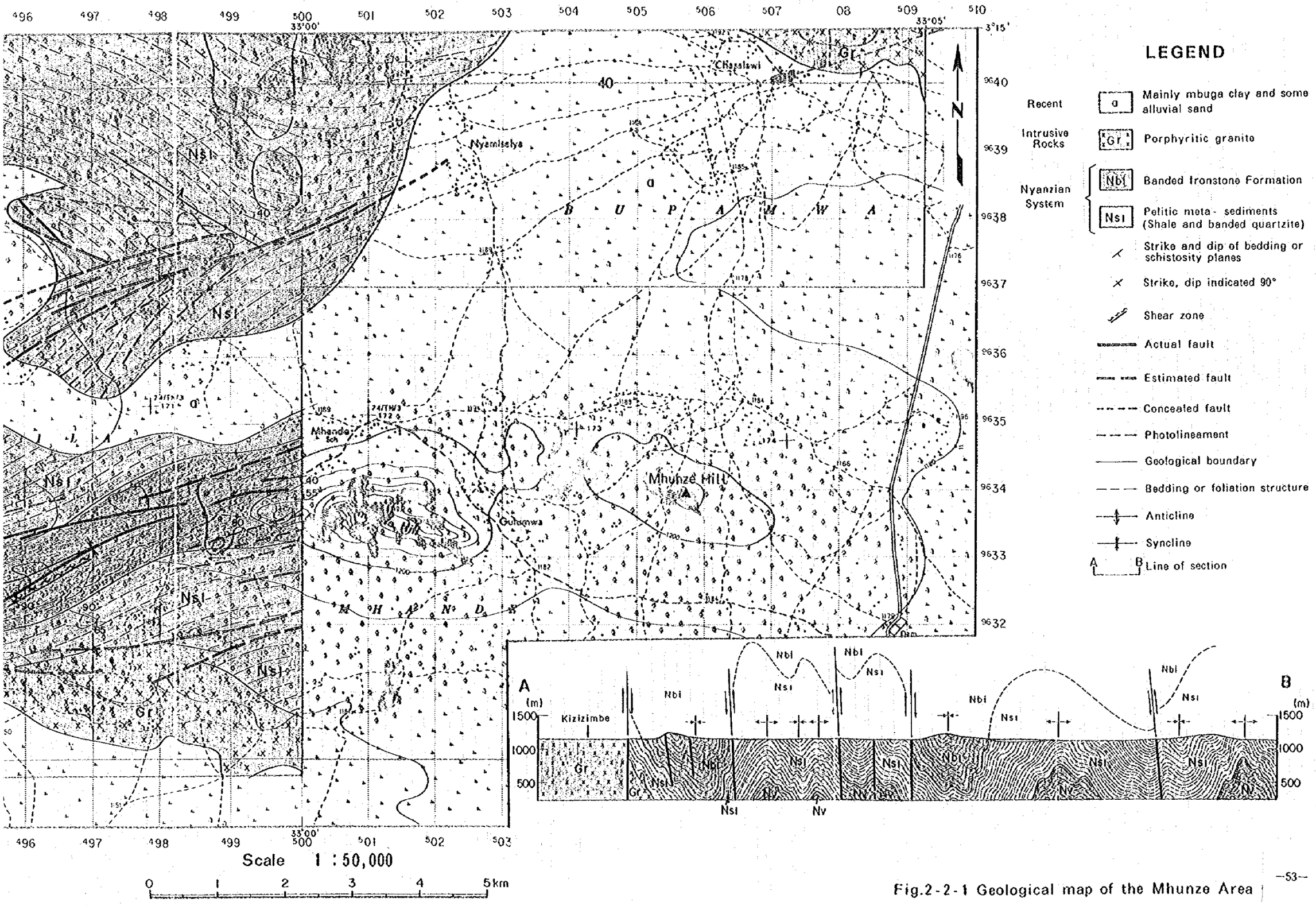


Fig.2-2-1 Geological map of the Mhunze Area

Orthclase, and the plot on the Fe (total) - Al - Mg Cation Diagram (Fig.2-1-4) shows the rocks to be High Fe tholeite basalt.

Pelitic Metasediments (Nsl) :

The unit is distributed extensively in this area. The unit is covered by the unit of Banded Ironstone Formation (Nbi) , and may cover the Metabasalt unit. The thickness of the unit is estimated to be about 1,000 meters, though repetition of strata by intense folding makes the calculation very difficult.

The unit comprises mainly dark grey to brown shales with subordinate thin banded pelitic quartzites. Although metamorphic structures of the shale are weak in general, it shows some tendency that schistose structure becomes clear near the areas of folding axes. Pelitic quartzites, brown in colour, are composed of light grey quartzite, dark grey thin pelitic films and hematite films. The rocks near the boundary with banded iron stones contain abundant films of pelitic materials and hematite, and the rock facies becomes to resemble to that of BIF.

Banded Ironstone Formation (Nbi) :

The unit is distributed in a zone of monadnocks ranging east and west in the south part of the area centering the Mhande Hill. In the western part of the area near the Ibila Hill, the unit also forms a small hill with a relief of about 30m from the surrounding flat.

The unit overlies the Pelitic metasediment (Nsl) conformably and has a thickness of about 400m.

The rocks are dark reddish brown in general, and composed of thin alternating beds of quartz layers (2 to 8 mm thick) and hematite-magnetite layers (5 to 10 mm thick). Micro folding structure is very common in these alternating beds. The rocks show metallic luster in the portion where magnetite is rich in quantity than hematite. Thin intercalating beds of chert are common throughout the unit. The rocks in the area are rich in quartz layers in comparison with the typical one of the Igengi Area.

The results of the laboratory tests of the banded iron rocks: microscopic observation under thin section (MAR006) , polished section (MAR004, MER001) , x-ray test (MCR001) , chemical analysis (MAR001, MAR003, MAR004, MAR006) and measurement of physical properties are presented in

Apx.5, Apx.7 and Apx.10, Apx.12, and Apx.11 respectively.

(2) Granitic Rocks

The Granitic Rocks are distributed in small areas in the northeast part and south part of the area. Only one outcrop of the rocks was found during the present survey, though floats of granites were often seen in the areas. So the areas of the rocks were estimated through the floats and colours of soil.

The rocks comprise mainly light grey porphyritic biotite granite , which correspond to the Porphyritic Granite of Grantham etc. (1945) .

(3) Quaternary

Mbuga clay composed of black soil are widely distributed in the flatland of this area. Mbuga clay is rich in clays and organic matter , so they are highly cultivated as cotton fields in this area.

2-2-3 Geological Structure

The geological structure of the Mhunze area is mostly estimated through an interpretation of air photographs, because the area are extensively covered by superficial sediments. Then the following folding and fault structures are mainly based on air photo lineaments.

Many folds and faults are estimated in the Nyanzian rocks of the area. Trends of the Nyanzian rocks, folds and faults are differ in two areas divided by a fault zone, about 0.5 to 1 km in width, which is bounded by two big faults trending ENE and passing by Ibila Village in the west and Nyamiselya Village in the north of the area.

The area to the north of the fault zone, the trend of strata, faults and folds is NW, on the other hand, EW in the area to the south of the fault zone. In the fault zone, are also observed, several small faults with the same direction with the zone.

In the hill zone of the south part of the area, many faults parallel to the Nyanzian strata and folds trending EW are estimated and among them one shear zone correspond to a photo lineament was confirmed by present field work. The Mhunze gold prospect in the proximate area appears to be situated in the same shear zone.

2-2-4 Mineral Showing

There is no record which indicate that any metaliferous deposits have been exploited in the Mhunze Area, though the area is involved in the "Mabale Greenstone Belt (UNDP, 1991)" and many gold prospects are existing in the Belt. Among these, Mhunze located 6km south, Sima Hill located 9km northeast, Kagula (Mhalo Hill) located 4km north and Luhala Hill Prospects located 15km north of the Chasalawa Village are listed as adjacent prospects to the Mhunze Area (Fig. 1-3-3). Drilling and trenching works were carried out in the Mhunze Hill Prospect, and prospecting shafts and tunnels were excavated in the southwest slope of the Luhala Hill (Williams & Eades, 1938).

Two areas as possible mineral localities; West Chasalawi and Mhunze Showings were located by this year's exploration (Fig.2-2-2).

West Chasalawi Showing: A float zone of quartz vein, which occupies an area of 500× 1500m, is located in the west of the Chasalawi Village. The quartz veins, milky to pale brownish grey in colour, contain pyrites and are stained by hematite. Wall rocks of the veins are estimated

to be Nyanzian metasediments (siliceous shale) judging from the floats in the area.

Assay results of 3 samples taken from the zone are presented in the Table 2-2-2. One sample among the three shows mineralization of gold (MER-4, Au:2.93g/t).

From the microscopic observation under a polished section of the sample, electrum grains are identified as inclusions in pyrites (Apx.7).

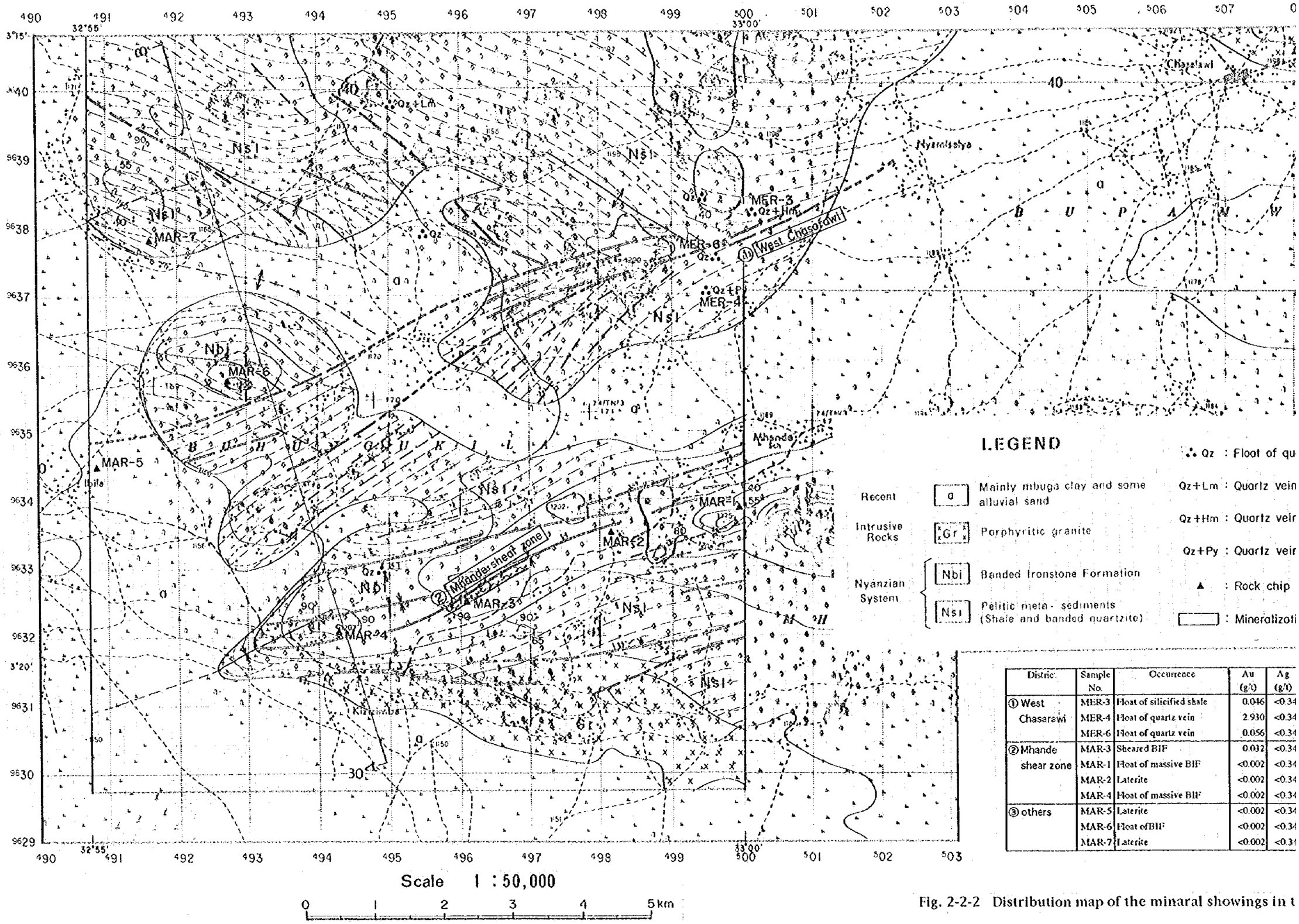
Mhunze Showing: This showing is a western extension of the Mhunze Hill Prospect mentioned above. The geology of the area comprises mainly banded ironstones rocks which forms a series of monadnocks. Many faults trending ENE occur in the zone being accompanied with shearing zone in place.

Assay results of 4 samples of banded iron stones are presented in the Table 2-2-2. One sample among the four shows very weak mineralization of gold (MAR-3;Au:0.032g/t).

Table 2-2-2 Results of Chemical Analysis for the Rock Samples from the Mhunze Area

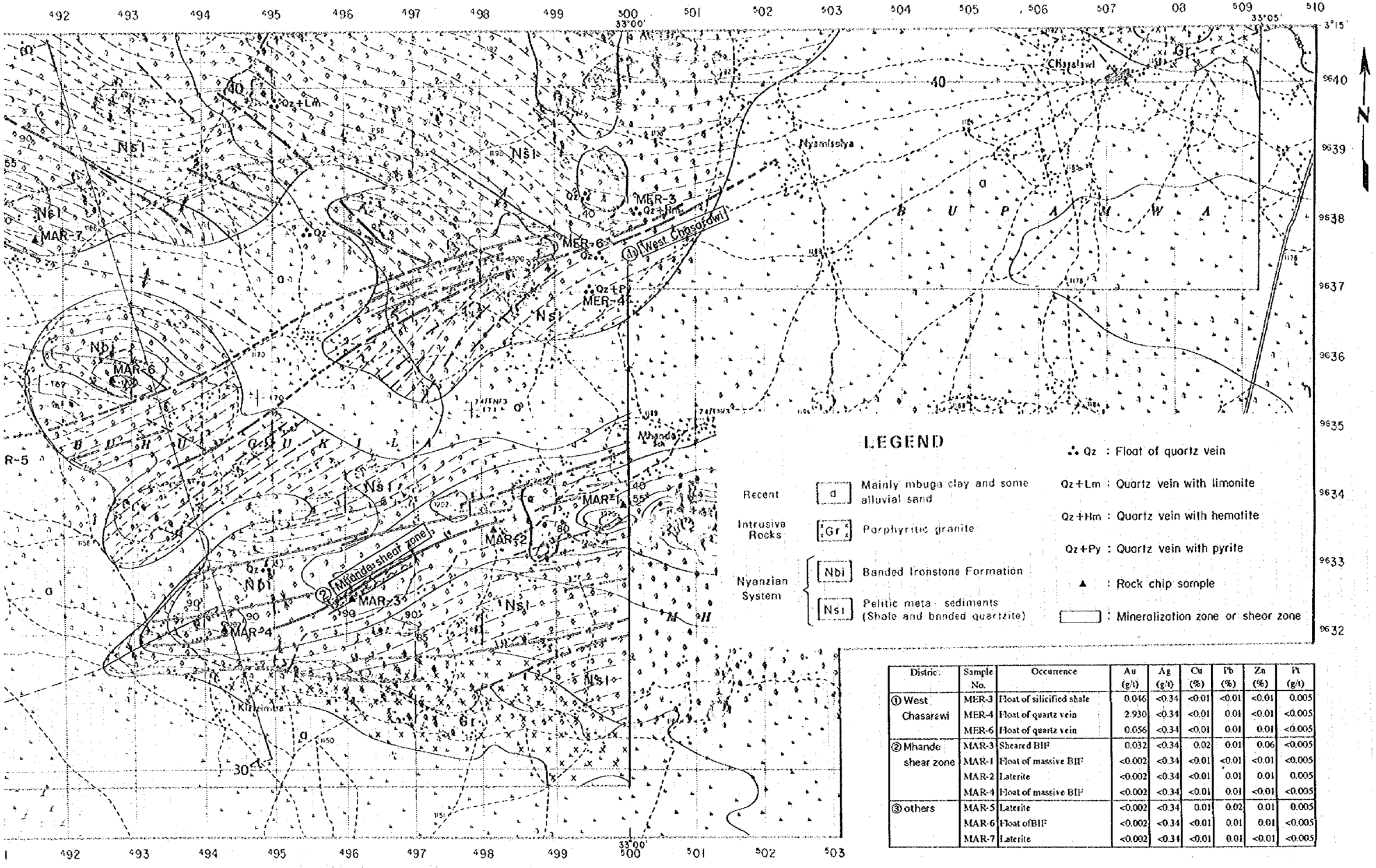
District	Sample No.	Occurrence	Strike and dip	Width (m)	Minerals	Country rock	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Pt (g/t)
① West Chasarawi	MER-3	Float of silicified shale	-	-	Qz	shale	0.046	<0.34	<0.01	<0.01	<0.01	0.005
	MER-4	Float of quartz vein	-	-	Qz, Py, Lm	shale	2.930	<0.34	<0.01	0.01	<0.01	<0.005
	MER-6	Float of quartz vein	-	-	Qz	shale	0.056	<0.34	<0.01	0.01	0.01	<0.005
② Mhande shear zone	MAR-3	Sheared BIF	N50E 90	0.2	-	BIF	0.032	<0.34	0.02	0.01	0.06	<0.005
	MAR-1	Float of massive BIF	-	-	-	BIF	<0.002	<0.34	<0.01	<0.01	<0.01	<0.005
	MAR-2	Laterite	-	0.15	-	BIF	<0.002	<0.34	<0.01	0.01	0.01	0.005
	MAR-4	Float of massive BIF	-	-	-	BIF	<0.002	<0.34	<0.01	0.01	<0.01	<0.005
③ others	MAR-5	Laterite	-	0.2	-	shale	<0.002	<0.34	0.01	0.02	0.01	0.005
	MAR-6	Float of BIF	-	-	-	BIF	<0.002	<0.34	<0.01	0.01	0.01	<0.005
	MAR-7	Laterite	-	0.2	-	shale	<0.002	<0.34	<0.01	0.01	<0.01	<0.005

BIF:Banded Ironstone Formation, Qz:Quartz, Py:Pyrite, Lm:Limonite



Distric	Sample No.	Occurrence	Au (g/t)	Ag (g/t)
① West Chasarawi	MER-3	Float of silicified shale	0.046	<0.34
	MER-4	Float of quartz vein	2.930	<0.34
	MER-6	Float of quartz vein	0.056	<0.34
② Mhande shear zone	MAR-3	Sheared BIF	0.032	<0.34
	MAR-1	Float of massive BIF	<0.002	<0.34
	MAR-2	Laterite	<0.002	<0.34
	MAR-4	Float of massive BIF	<0.002	<0.34
③ others	MAR-5	Laterite	<0.002	<0.34
	MAR-6	Float ofBIF	<0.002	<0.34
	MAR-7	Laterite	<0.002	<0.34

Fig. 2-2-2 Distribution map of the minaral showings in t



Distric	Sample No.	Occurrence	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	Pt (g/t)
① West Chasarawi	MER-3	Float of silicified shale	0.046	<0.34	<0.01	<0.01	<0.01	0.005
	MER-4	Float of quartz vein	2.930	<0.34	<0.01	0.01	<0.01	<0.005
	MER-6	Float of quartz vein	0.056	<0.34	<0.01	0.01	0.01	<0.005
② Mhande shear zone	MAR-3	Sheared BIF	0.032	<0.34	0.02	0.01	0.06	<0.005
	MAR-1	Float of massive BIF	<0.002	<0.34	<0.01	<0.01	<0.01	<0.005
	MAR-2	Laterite	<0.002	<0.34	<0.01	0.01	0.01	0.005
	MAR-4	Float of massive BIF	<0.002	<0.34	<0.01	0.01	<0.01	<0.005
③ others	MAR-5	Laterite	<0.002	<0.34	0.01	0.02	0.01	0.005
	MAR-6	Float ofBIF	<0.002	<0.34	<0.01	0.01	0.01	<0.005
	MAR-7	Laterite	<0.002	<0.34	<0.01	0.01	<0.01	<0.005

Fig. 2-2-2 Distribution map of the minaral showings in the Mhunze Area

2-3 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.

2-3-1 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 2-2-3 and Apx.12 respectively.

Table 2-2-3 Basic statistics, Mhunze 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	0.50	0.10	1.00	7.00	0.50	0.50	0.10	7.00	5.00	1.00	0.10
Maximum value	100	0.3	124	68	4	32	3.79	70	330	7	0.7
Standard deviation	2.62	1.15	2.33	1.41	1.14	1.66	1.99	1.45	2.25	1.39	1.71
Mean	1.16	0.10	10.26	22.62	0.51	12.93	0.22	29.81	12.21	3.09	0.12
Mean+sd.	3.06	0.12	23.90	31.95	0.58	21.48	0.44	43.15	27.45	4.30	0.21
Mean+2 x sd.	8.02	0.14	55.66	45.13	0.61	35.66	0.88	62.47	61.71	5.98	0.35

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

Au: The maximum value of 100 ppb stands alone in the western side of the southernmost area. The second maximum value of 89 ppb forms small anomalous zone with 2 high values more than 10 ppb. The other high values more than 10 ppb are scattered all over the area and no remarkable anomalous zone is recognized.

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: Supposing the values more than 40 ppm are anomalous values, they are equivalents to roughly 3 % of the total. They form small anomalous zones with some values, in the central part and the central southern part. The maximum value of 124 ppm locates alone in middle southern area, apart from the anomalous zones.

Cu: Supposing the values more than 40 ppm are anomalous values, they are equivalents to roughly 5 % of the total. They form 2 large anomalous zones in the central part and the central southern part. The maximum value of 68 ppm exists in a small anomalous zone in northern margin of the area.

Mo: There are only 10 values more than detection limit value of 1 ppm, equivalents to approximately 1.6 % of the total. The maximum value of 4 ppm and the second maximum value of 3 ppm exist in central area apart from each other.

Pb: Supposing the values more than 25 ppm are anomalous values, they are equivalents to roughly 2.6 % of the total. They concentrate in eastern area and form a large-scaled anomalous zone with 1.5 km in width and 5 km in length. The maximum value of 32 ppm locates in the area.

Sb: The maximum value of 3.8 ppm forms anomalous zone on a small scale with the second maximum of 3.2 ppm. Generally, the analyzed values are quite low so that the characteristic of distribution isn't remarkable.

Zn: Supposing the values more than 55 ppm are anomalous values, they are equivalents to 2.6 % of the total. They form small anomalous zones, in southwest approximately 1.5 km of Kizizimba village and in south southwest approximately 3 km of Chasalawi village. The maximum value of 70 ppm locates in one of the anomalous zones.

Hg: Supposing the values more than 100 ppb are anomalous values, they are equivalents to 2.3 % of the total. They are scattered and forms no remarkable anomalous zone. The maximum value of 380 ppb exists in southwest edge of the area, apart from the other anomalies.

W: W analytical values in the Mhunze area is largely low, being compared to the values in the Igengi area. The maximum value not exceeding 7 ppm exists in southern area. There is no characteristic of distribution to be mentioned more.

Bi: Bi analytical values in the Mhunze area is also largely low, being compared to the ones in

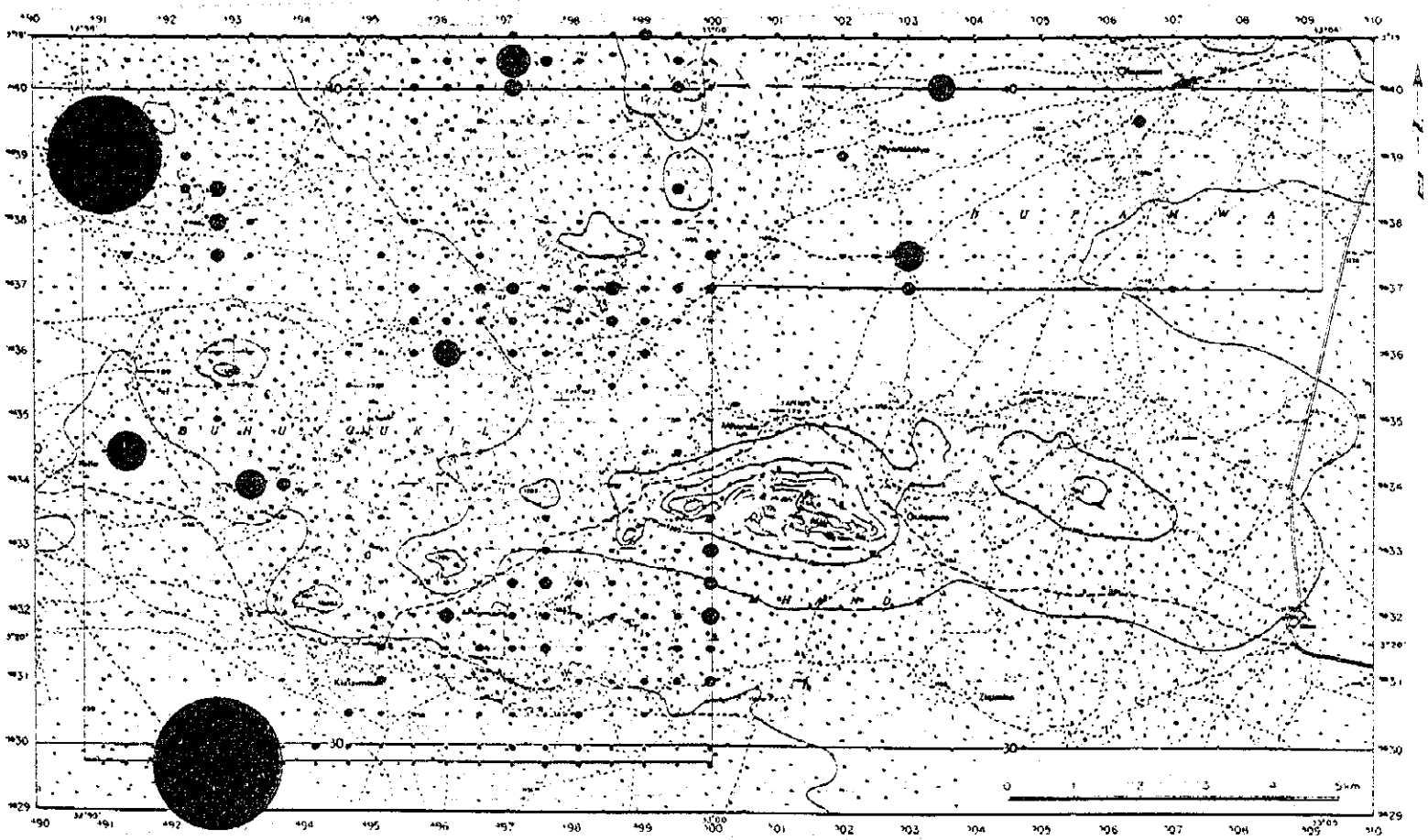


Fig. 2-2-3-(1) Distribution of Au in the Mhunze Area

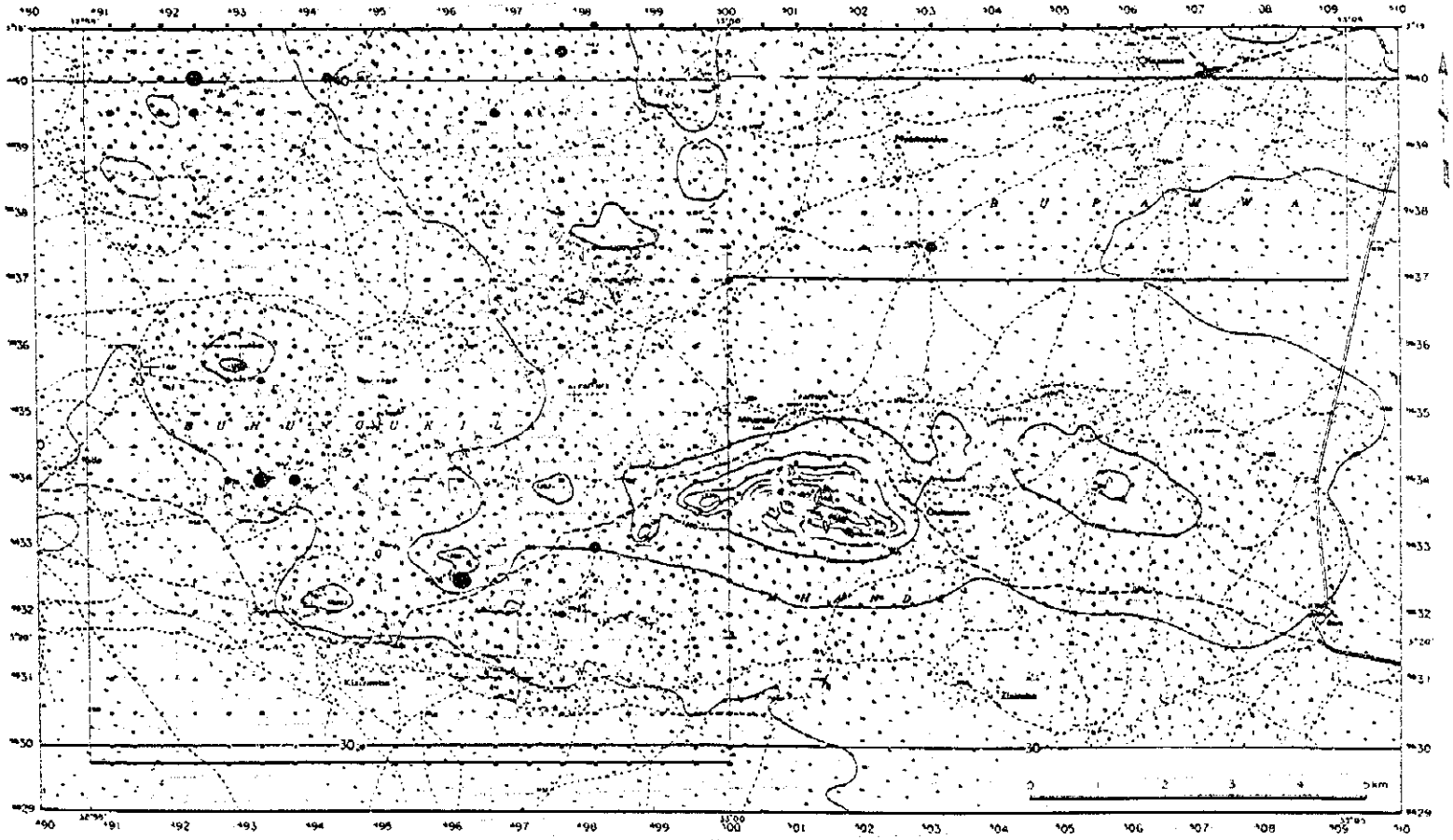


Fig. 2-2-3-(2) Distribution of As in the Mhunze Area

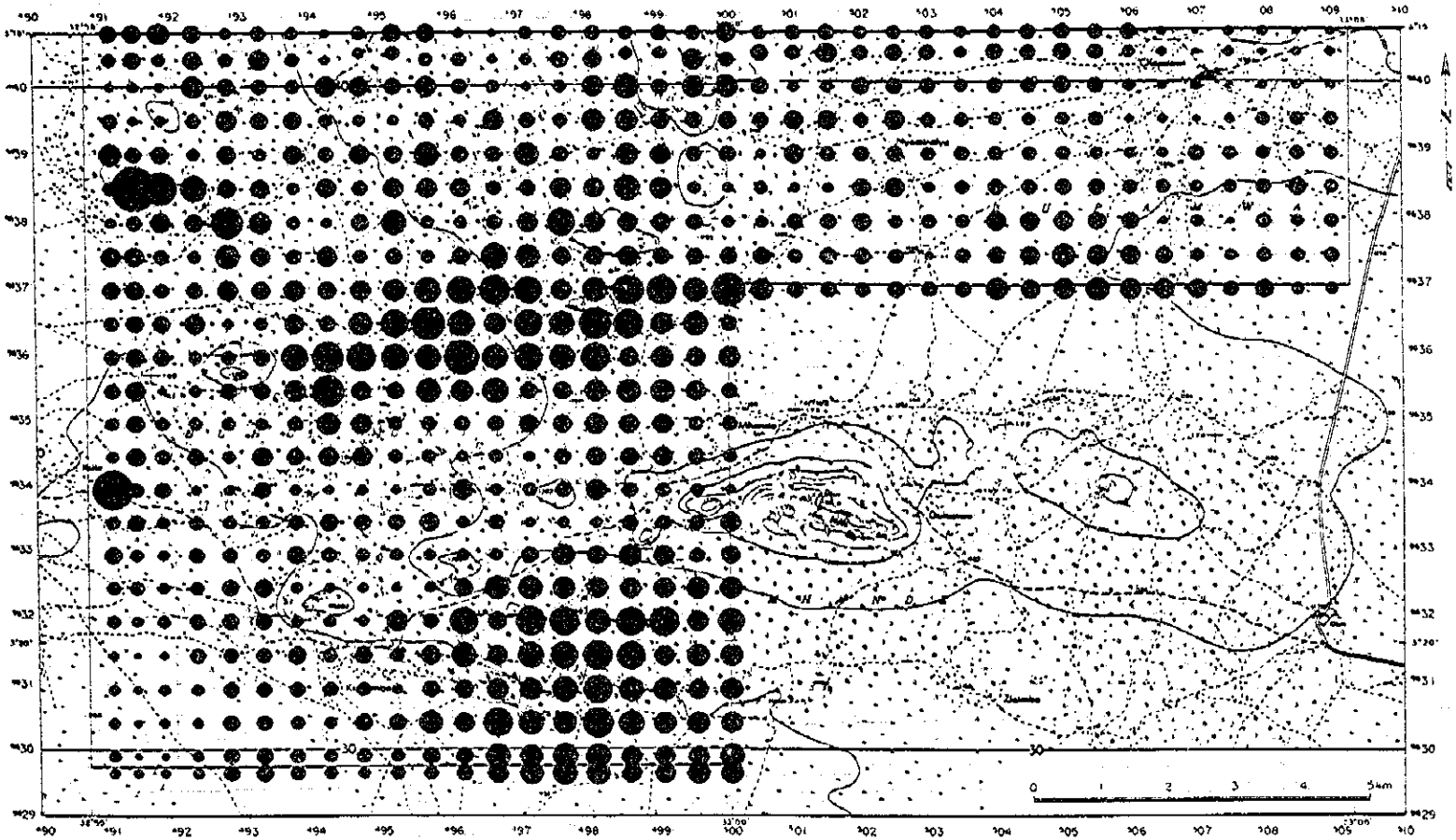


Fig. 2-2-3-(3) Distribution of Cu in the Mhunze Area

the Igengi area. The maximum value is only 0.7 ppm. Supposing the values more than 0.4 ppm are anomalous values, they are equivalents to 1.9% of the total. They are distributed over southern, western and eastern areas. In southern area, 4 anomalous values are gathered up with a trend of N-S. The maximum value of 0.7 ppm stands alone in eastern area and forms no anomalous zone.

2-3-2 Result of Multi-variate Analysis

Correlation matrix among elements provided as a result of correlation analysis is shown in Table 2-2-4. 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 2-2-4 Correlation matrix,Mhunze Area

	Au	As	Cu	Pb	Sb	Zn	Hg	W	Bi
Au	1.000								
As	0.399	1.000							
Cu	0.375	0.449	1.000						
Pb	-0.112	-0.087	0.097	1.000					
Sb	0.206	0.338	0.182	-0.128	1.000				
Zn	0.106	0.249	0.449	0.150	0.084	1.000			
Hg	0.112	0.110	0.069	-0.168	0.141	0.039	1.000		
W	0.017	-0.060	0.269	0.244	-0.152	0.174	-0.136	1.000	
Bi	0.068	0.028	0.172	-0.132	0.031	0.174	0.007	0.256	1.000

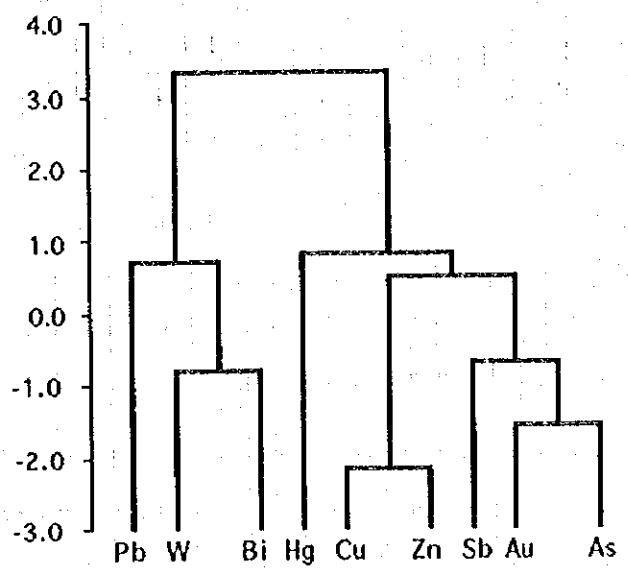


Fig.2-2-4 Dendrogram showing the similarities among the elements, Mhunze Area

Factor loadings, contributions and communality after varimax rotation, provided as a result of factor analysis is shown in Table 2-2-5.

Table 2-2-5 Factor loadings, contributions and communality after varimax rotation, Mhunze area

	Load ings				
	Factor 1	Factor 2	Factor 3	Factor 4	Communality
Au	0.629	0.010	-0.147	-0.022	0.4183
As	0.627	-0.119	0.047	0.277	0.4864
Cu	0.517	0.231	-0.247	0.446	0.5808
Pb	-0.103	0.624	0.212	0.158	0.4670
Sb	0.402	-0.277	0.136	0.180	0.2890
Zn	0.156	0.155	-0.212	0.652	0.5179
Hg	0.180	-0.199	-0.080	0.020	0.0789
W	0.058	0.630	-0.238	0.109	0.4682
Bi	0.036	-0.024	-0.423	0.125	0.1964
Contributions	1.29	0.994	0.435	0.786	

Factor score distribution map, which was constructed after factor score was calculated on the basis of factor loadings, shown with Fig.2-2-5.

Factor 1 (Au-As-Cu), Factor 2 (Pb-W) and Factor 4 (Cu-Zn) are shown with 3 colors, such as cyan, magenta and yellow respectively, and the score is shown by the darkness.

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

Factor 1 (Au-As-Cu): Factor 1 is shown by a yellow color system (yellow, red and the green) on the figure. It resembles with element combination of the Factor 3 in the Igengi area. So it has the possibility that gold mineralization is indicated. The Factor 1 is broadly distributed over slightly elevated hills and its vicinities in central western area. However, it isn't distributed in Chasalawi village and its vicinities in eastern area.

Factor 2 (Pb-W): Factor 2 is shown by a magenta color system (magenta, red and purple) on the figure. It broadly covers eastern and southwestern areas. In northwestern area, it is scattered everywhere but on small scale. It resembles with element combination of the Factor 2 in the Igengi area. So it is probably related to granite.

Factor 4 (Cu-Zn): Factor 4 is shown by a blue color system (blue, the green and purple) on the figure. It resembles with element combination of Factor 1 in the Igengi area. The factor 4 is scattered in the comparatively flat area mostly cultivated. So it is probably related to the cultivation.

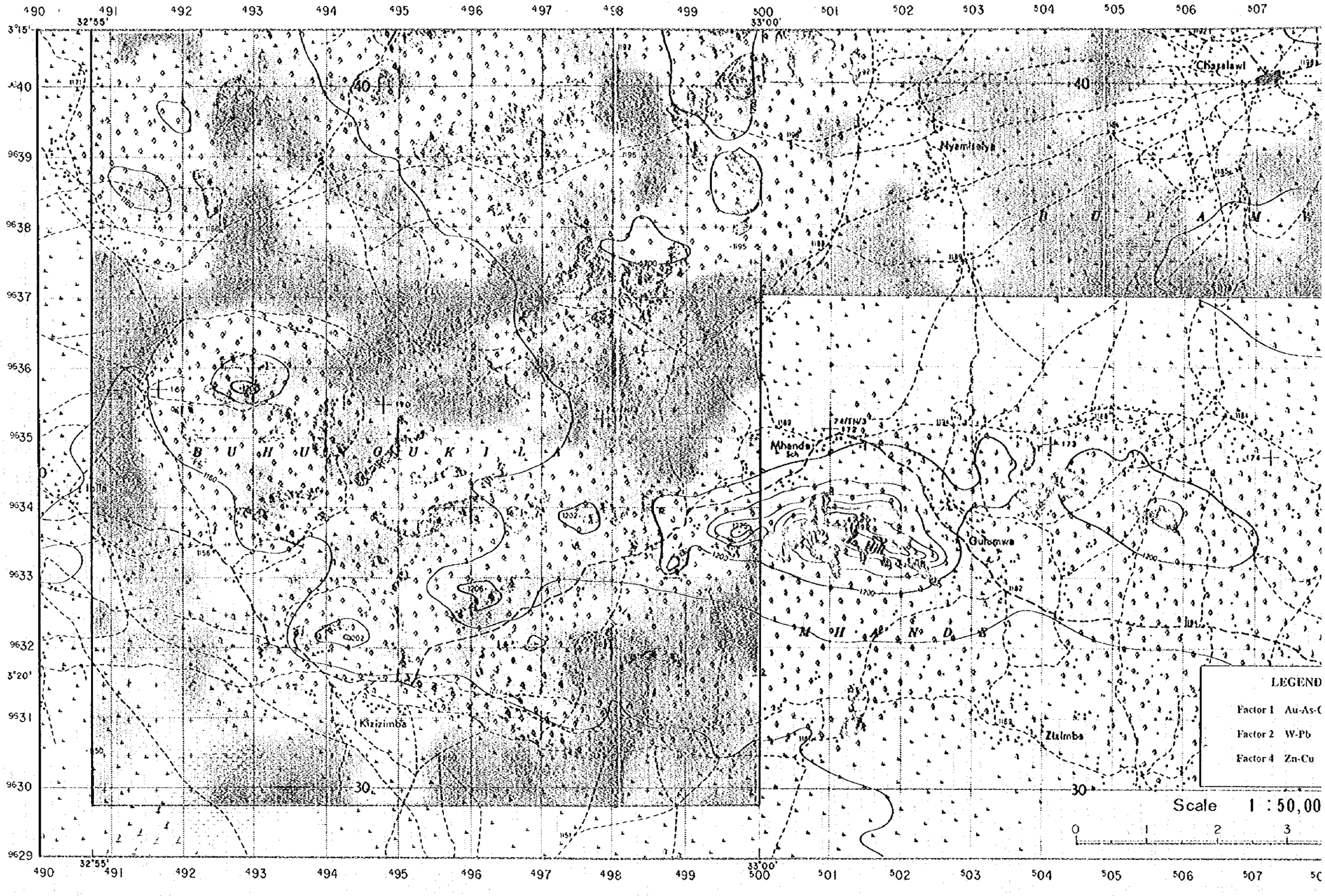


Fig. 2-2-5 Distribution of factor sco

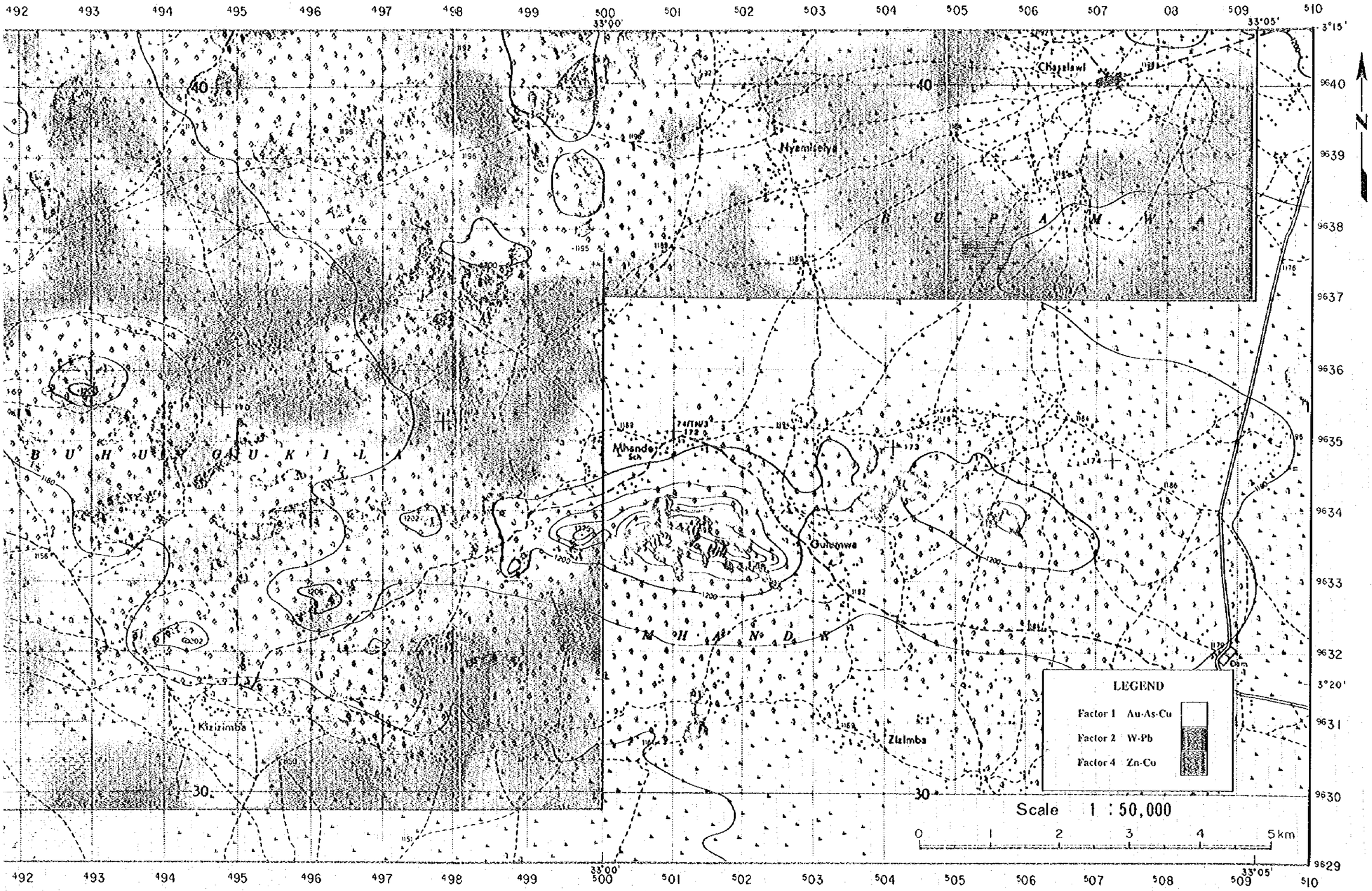


Fig. 2-2-5 Distribution of factor score, Mhunze Area

2-4 Discussion

From the geochemical exploration of this area, it turned out that As had the highest correlation and similarity with Au as the results of correlation and cluster analyses, and that the most important factor related to gold mineralization was the first factor of which high contributors were Au, As and Cu in descending order as the results of factor analysis.

These anomalies are distributed in the area of the Nyanzian rocks and some of them are along faults. Some mineral showings were also located in the same places as geochemically anomalous zones. Many gold deposits in the "Lake Victoria Goldfields" exist along zones of shearing and fracturing of the Nyanzian System, so geochemical Au anomalies along faults in the Nyanzian System are noticeable as a indicator of gold mineralization.

As areas where geochemical anomalies and geological favorable circumstances are overlapping, the West Chasalawi Area, the area north to Ibila Village and the area around the south foot of the Mhande Hill were detected as possible areas for gold mineralization. Any significant geochemical anomaly was not detected in the area of the Banded Ironstone Formation which was the western extend of the Mhande Hill.

The West of Chasalawi Area: The geology of the area consist of the Nyanzian quartzite and many faults trending ENE exist there. Many geochemically anomalous points of Au ranging from 10 to 20 ppb were located along these faults and the distribution pattern of scores of the first factor well-matched with this area. One of quartz vein samples collected from this area assayed at 2.93g/t Au, and fine electrum grains were identified by microscopic observation under polished thin section of this quartz vein. These facts indicate certain existence of gold mineralization in this area. But it is difficult to confirm detailed occurrence and scale of the mineralized zone due to poor exposure of bed rocks.

The area north to Ibila Village: The Nyanzian quartzite is distributed and a float of metabasalts esist in the area. Anomalous zones for high contents of Au and As and for high scores of the first factor are situated in the south of a fault trending NW in this area. It is difficult to asses the mineralization of this area due to densely weathered soil.

The south of the Mhande Hill: An anomaly of Au with an intensity of around 10 ppb was detected with high scores of the first factor. But the distribution of these geochemical anomalies shows an irregular pattern being not concordant with the geological favorable structure. It is very

difficult to know the relations between the detailed geology and mineralization of this area, because the area are covered with Mbuga clay.

Synthesizing all the results of geological and geochemical explorations, it is concluded that the West Chasalawi Showing is a possible target area for further exploration works. To explore the area it is recommended to carry out a detailed geological and geochemical work and drilling of short holes.

It is very difficult to asses the Mhande Hill Showing and Ibila anomalous zone from the results of this year because they are densely covered with superficial materials such as weathered soil and Mbuga clay. It is necessary to explore the depth by drilling though the priority of these two areas is lower than that of the West Chasalawi Showing.

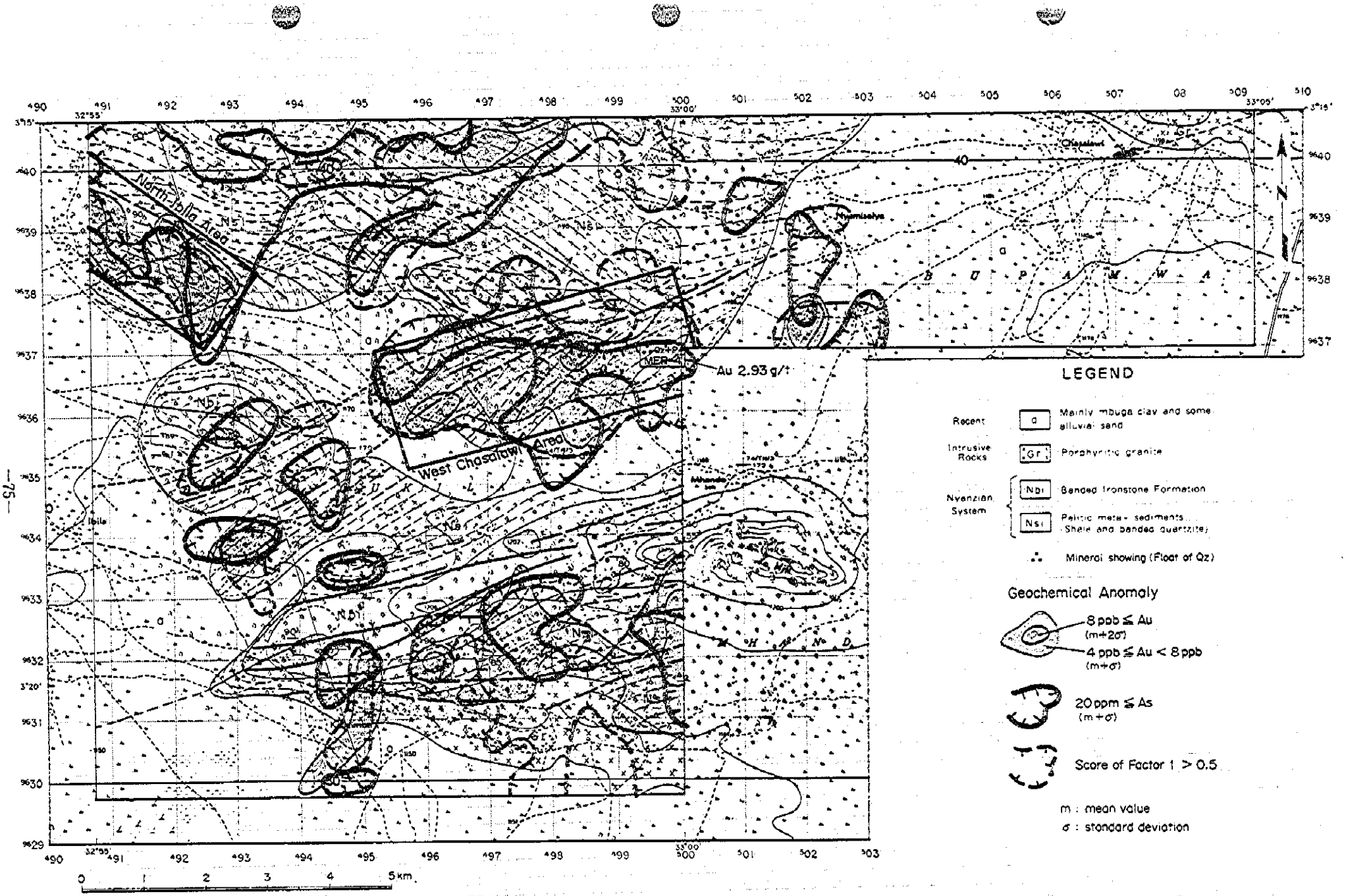


Fig. 2-2-6 Interpretaion map of the geological and geochemical survey in the Mhunze Area