1-1-3 Survey results

In the first year survey, many anomalies from stream sediments and panned samples were detected in the area, but promising mineralized signs were not detected.

The zones where small mineralized sings were observed, are as follows.

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
NE-MANHANZVA	----------	Felsic Granulite Charnockite	pegmatite quartz & K-feldspar

1-1-4 Consideration

There is not a zone proposed for a soil geochemical survey because of poor mineralized sign distribution, and because there is no distribution of Fe-hydroxides indicating a connection with sulphide minerals: considered a characteristic of mineralization in the survey areas. There are many sites topographically levelled, thus no geological proof of the results of the first year geochemical survey could be found.

There is no field environment worth further study in the surveyed area because distribution of outcrops is scarce.

1-2 CHIREZANA AREA

1-2-1 Survey methods

The area was explored to determine the relation between mineralized sign distribution, the nature of the soil and the geological structure. The following were examined: the distribution of floats, with respect to the mineralized zones found in the first year survey (Juwere mineralized zone, Jegede mineralized, and Muchacha mineralized zone), their surroundings and geochemically anomalous regions of stream sediment.

A survey route was selected by considering a geological structure in the area which corresponded to an ENE-WSW system.

1-2-2 Geology

General geology

This area is positioned at the southern side of the surveyed area.

Geological units constituting the area are mainly mafic granulite, felsic granulite, and gneissose granulite (including charnockite). The main outcrops are in the mountains of the northern area, and in an eastern area. These are hardly any outcrops from the center to the southern area because of soil cover. As the geological unit in the area, an ENE-WSW system exists as the main structure but S-N system structures prevail in the eastern area. Gneissose granulite (including charnockite) is most widely distributed and occupies about 60% of the area. It usually has a grayish to pale brownish color, middle to fine grains, dense and hard, and has the remarkable foliation of an ENE-WSW system, and in some cases includes garnet. Also it is distributed over the whole surveyed area.

Felsic granulite can be observed mainly in the north and east of the area and its distribution area occupies about 30%. It has a pale grayish color, and the foliation of an ENE-SSW system is similar to gneissose granulite.

Usually, a pale grayish color is seen, but on weathered surfaces it has a white to pale grayish color, it can be judged to have stronger resistance to weathering than other rocks.

Mafic granulite is also distributed, depending on the structures of an ENE-WSW system, but its foliation is weaker than those of other geological units. It has middle grains and is a massive rock. It forms a reddish soil due to weathering.

Geological structure

Also in the area, the geological structure in which the foliation of an ENE-WSW system prevails, is observed. As principal structural lines, the presence to two approximately parallel structural lines running along a NNE-SSW direction in the area, is predicted. As shown in FIG. 2-1-3, a slight dislocation(the sense of dislocation may be left-lateral and right-lateral) can be postulated to be applied to the geological units.

Other linear structures recognized with Landsat images and aerial photographs may be classified as lineament not accompanied by dislocation. From a microfolding structure recognized in the area, it can be understood that deformations differing in periods have mutually arisen repeatedly, and the geological units were subjected to multi-tectonic movements.

Mineralization

Quartz vein/stockwork and pegmatite quartz & K-feldspar, other than in the Juwere mineralized zone, Jegede mineralized zone and Muchacha mineralized zone, were also observed. The summaries of each mineralized zone are as follows.

Juwere mineralized zone: This is a Juwere mineralized zone (i) positioned to the east of Lake Macdougall and the 2 km northwest of Matara School, and another (ii) positioned to the north about 1 km from Matara School. As country rocks, the former are thought to be mafic granulite, the latter to be gneissose granulite and partly mafic granulite. The extent of the mineralized zones are at N 30 to 40W across to the foliation of an ENE-WSW system, and the dips of the zones are approximately perpendicular. Locally, there are foliated country rocks along the extent of the mineralized zones, and no remarkable oblique relation exists. The width of the mineralized zones can now be confirmed to be 5 m, but further extension can be expected. The length of the zone may be confirmed to be 20 to 30 m, but beyond that is covered with soil.

Microscopic observation shows that in ore minerals in the mineralized zone, sulphide minerals are composed of medium amounts of pyrite and slight amounts of pyrrhotite, chalcopyrite, covelline and marcasite. In many cases pyrrhotite had been transformed to an aggregate of pyrite and marcasite.

With regard to gangue mineral, slight amounts of sericite, chlorite (?) and epidote(?), large amounts of quartz and medium amounts of plagioclase were observed by microscopic observation of polished thin sections.

Analytical results of samples collected from the mineralized zone are shown in TABLE 2-1-2. This table shows that the content of metal elements, Au, Bi and Cu is characteristically high, compared with those in other mineralized zones.

Comparisons between the geometric mean of the analytical results of the samples and the geometric mean of each geological unit of soils in the zone, are shown in the following table (TABLE 2-1-3 (1)).

TABLE 2-1-3(1) Comparison of Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
JUWERE ZONE (ORE)										
ORE	21.23	0.25	1.00	0.22	486	11	68	324	139	12.18
JUWERE ZONE (SOIL)										
R.C.3	0.84	0.47	0.73	0.05	47.05	31.58	75.28	111.66	54.49	5.83
R.C.4	0.74	0.37	0.58	0.05	4.30	71.25	40.92	31.95	4.41	1.70
R.C.5	0.73	0.32	0.66	0.05	12.20	54.70	48.08	62.36	13.28	2.48

This indicates that the contents of Au, Cu, Cr, Ni and Fe in the ore in the mineralized zone, are higher than those in the soils.

Jegede mineralized zone: It is positioned to the east of Lake MaCdougall and 2.5 km south of Matara School. Two mineralized zones of an ENE-WSW system with space of about 200 m are recognized. There may be a high possibility of the presence of mineralized zones of the same type because many floats of Fe-hydroxides between these mineralized zones are recognized. The country rock of the mineralized zones is mafic granulite, the extent of which matches the foliation of an ENE-WSW system. The dip of the zone is approximately perpendicular, but in some sites north and south dips exist. Fine grain sulphide minerals (pyrite and pyrrhotite) are observed along the foliation of country rocks. The width of the mineralized zone can now be confirmed to be 3 m, but further extension can be expected. The length can be confirmed to be 200 m but beyond that is covered with soil.

Microscopic observation shows that ore minerals in the zone are approximately similar to those in the Juwere mineralized zone described above. Sulphide minerals have medium to small amounts of pyrite, and very small amount of pyrrhotite, chalcopyrite, covelline and marcasite. Most covelline arises with peripheral replacement of chalcopyrite.

With regard to gangue minerals, microscopic results from polished thin sections show garnet, orthopyroxene and amphibole, large amounts of quartz, and sericite and chlorite (?) were also recognized.

Analytical results of samples collected from the mineralized zone are shown in TABLE 2-1-2. The table shows a characteristically high content of As compared with those in other mineralized zones.

But the geometric mean of Au is 4.03 ppb, which is somewhat higher than those in other mineralized zones, and in one sample Cu was observed to be as high as 2,130 ppm.

Comparisons between the geometric means of the analytical results of ore samples from the mineralized zone and those of each geological unit of soils in the area, are shown in the following table (TABLE 2-1-3 (2)).

Metal contents of the ore samples, except for Au and As, are recognized to have a similar tendency to rock code 3 of the soil samples.

TABLE 2-1-3(2) Comparison of Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
JEGEDE ZONE (ORE)										
ORE	4.03	0.33	9.55	0.29	157	21	145	206	113	9.29
JEGEDE ZONE (SOIL)										
R.C.3	1.65	0.89	3.73	0.08	102.73	19.37	122.92	169.06	203.74	9.93
R.C.4	0.97	2.58	0.83	0.05	17.93	18.00	45.51	58.70	47.27	2.38
R.C.5	0.92	0.77	1.15	0.06	15.38	22.40	53.97	54.45	37.75	2.81

Muchacha mineralized zone: Positioned to the east, about 2 km from Chirezana b.c. positioned at the central south of the surveyed areas. Some outcrops dotted in the mineralized zone run in the direction of N 80 E, but the direction becomes a WNW-ESEW system by binding the outcrops. The mineralized zone is observed over about 100 m and there is a high possibility of the presence of another mineralized zones of the same type, because many floats of Fe-hydroxides can be observed at the surrounding of this mineralized zone. But in the field only a mineralized zone is recognized. The country rock of the mineralized zone is mafic granulite, the extent of which is observed to cross loosely to the foliation of an ENE-WSW system in the surveyed zone, but this is a phenomenon corresponding to local change in the foliation, and as a whole the extent is presumed to parallel the foliation. The dips are approximately perpendicular, but in some parts north dips exist. In the mineralized zone, fine grain sulphide minerals (pyrite and pyrrhotite) are recognized. The width of the mineralized zone can now be confirmed to be 7 m, but further extension can be expected. The length can be confirmed to be about 100 m, but beyond that is covered with reddish soil.

Microscopic observation of polished thin sections shows that ore minerals in the mineralized zone are similar to those in the Juwere mineralized zone and Jegede mineralized zone described above. Sulphide minerals are composed of pyrite, pyrrhotite, chalcopyrite, covelline, marcasite, etc. in small to very small amounts. A small amount of ilmenite is also observed.

In gangue mineral, garnet, orthopyroxene, clinopyroxene and amphibole can be observed from the results of microscopic observation of polished thin sections. The analytical results of samples collected from the mineralized zone are shown in TABLE 2-1-2. The table shows a characteristically high content of Zn, compared with those in other mineralized zones.

The geometric means of Au and As are 3.44 ppb and 4.45 ppm respectively, somewhat higher than those in other mineralized zones.

Comparisons between the mineralized zone and those of each geological unit of soils in the area, are shown in the following table (TABLE 2-1-3 (3)).

TABLE 2-1-3(3) Comparison of Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
MÜCHACHA ZONE (ORE)										
ORE	3.44	0.25	4.45	0.26	97	10	389	155	115	10.89
MUCHACHA ZONE (SOIL)										
R.C.3	1.50	0.34	5.38	0.09	33.74	25.97	59.03	163.97	75.45	5.09
R.C.4	0.69	0.33	0.58	0.05	5.74	15.24	25.48	77.32	11.48	1.55
R.C.5	0.72	0.46	0.73	0.05	6.55	20.61	22.22	53.07	21.69	1.53

The results of the analyses of ores in the mineralized zone are similar to those of the geometric means of soils of rock code 3. The contents of Cu and Zn are higher in the former.

The others: The distributions of mineralized signs as shown in FIG. 2 - 1-3, other than in the mineralized zones described above, could be confirmed. The zone which appears most ubiquitous, and has a wide distribution area, is Chamburukira area positioned to the east of the area. The recognized district is in the boundary between felsic granulite and gneissose granulite.

1-2-3 Survey results

On the first year survey, multiple geochemical anomalies in stream sediment and panned samples were detected and by the semi-detailed geological survey of Phase II the mineralized zones described above were found. The analytical results of samples from these mineralized zones are summarized below.

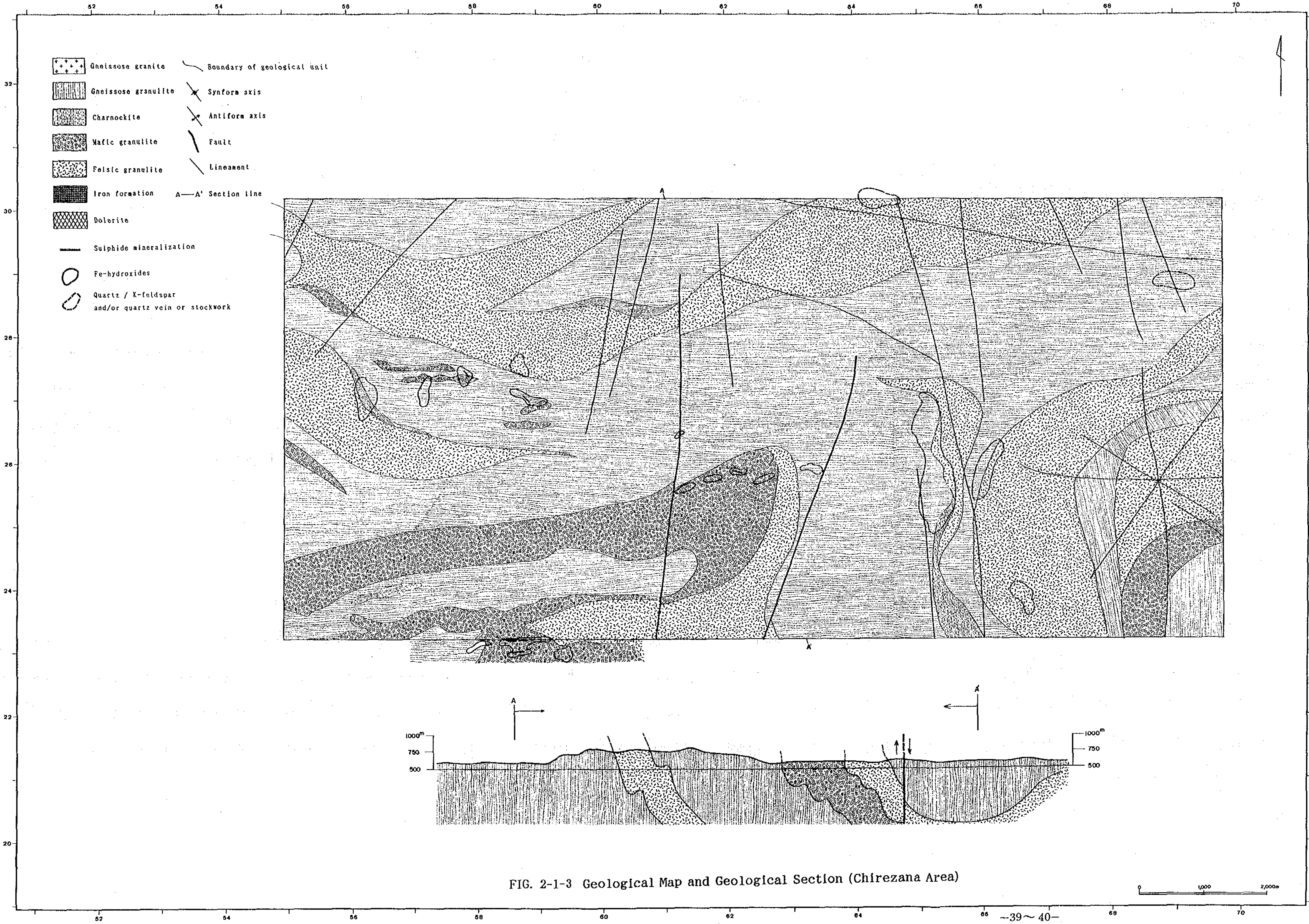

FIG. 2-1-3 Geological Map and Geological Section (Chirezana Area)

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
JUWERE	Au-Bi?-Cu-Cr-Ni?	Gneissose granulite Mafic Granulite	sulphides & Fe-hydroxides
JEGEDE	Au-As-Bi?-Cu?-Zn?-Cr??	Mafic Granulite	sulphides & Fe-hydroxides
MUCHACHA	Au-As-Bi?-Zn-Ni?	Mafic Granulite	sulphides & Fe-hydroxides
CHAMBURUKIRA	------------	Felsic Granulite Gneissose Granulite	pegmatite quartz & K-feldspar

These mineralized zones can be judged to be mutually similar by considering the mode of occurrence of the mineralized zones, kinds of ore minerals and the combination of concentrated indicators.

1-2-4 Consideration

Three mineralized zones described above and many mineralized signs in the area were recognized, but the mineralized sign distributions, except for Chamburukira zone, are scattered and in addition their areas are narrow.

Consequently, as objective zones for soil geochemical survey,

(1) Juwere mineralized zone

(2) Jegede mineralized zone

(3) Muchacha mineralized zone

(4) Chamburukira zone

were selected.

1-3 MATSAI AREA

1-3-1 Survey methods

Also in this area an exploration of marshes and hills was made looking at the distribution of floats and the relationship between mineralized sign distribution, and the nature of geology and geological structures. The survey results showed promising Fe-hydroxide, pegmatite quartz & K-feldspar and quartz vein/stockwork. As the continuity of geological structures in this areas was also an ENE-WSW system, the survey route was selected by considering the geological structure.

1-3-2 Geology

General geology

The geological units in the area consist mainly of mafic granulite, felsic granulite and gneissose granulite (including charnockite). The distribution form of mafic granulite appears to be governed strongly by the foliation of an ENE-WSW system. On the other hand, felsic granulite is not governed by the foliation direction in the center and north of the area, considering the distribution form.

Mafic granulite occupies about 10% of the area. It usually has a dark greenish color and is a massive composed of medium grains. Foliation is weakly developed. Microscopic observations show clinopyroxene as main constituent mineral , and also common occurrence of unknown opaque mineral. The tectonic grade is weak at 1 (framed porphyroblastic texture).

Felsic granulite was mainly observed from the center to the east of the area, occupying about 30% as a distribution area, pale grayish in color, and the extent of geological units are weak as described above, tectonic grade is 0 (isogranular texture), thus the resistance to tectonic movement is thought to be high.

Gneissose granulite (including charnockite) is distributed over the whole range of the area, it occupies about 60% as a distribution area, is brownish in color, and the growth of the foliation of an ENE-WSW system is remarkable. The tectonic grade in the geological unit is as high as 4, compared with lower tectonic grades in other geological units.

Geological structure

Two structural lines of a N-S system, accompanied by dislocation, are recognized in the northeast of the area, and felsic granulite appears to be dislocated by the lines. Some lineaments not accompanied by dislocation exists. A structural line parallel to the direction of mafic granulite is also recognized in the southwest of the area, but its degree of dislocation is not clear.

Mineralization

Floats of Fe-hydroxides, quartz vein/stockwork and pegmatite quartz & K-feldspar are ubiquitously distributed in the Chisave mountains in the southwest and north of the area. They can be judged to be promising by considering their distribution area and their continuities.

In addition, distributions of quartz vein/stockwork and pegmatic quartz & K-feldspar were also recorded in the center and northeast of the area. In particular, the latter exists along the above described structural line.

Analytical results of samples collected from the north of the Chisave mountains in the area are shown in TABLE 2-1-2. The table shows that Au, As and Zn are characteristically high, compared with those in other mineralized zones.

Comparisons between the geometric means of the analytical results of the samples and those of each geological unit of soils in the area, are shown in the following table (TABLE 2-1-3 (4)).

TABLE 2-1-3(4) Comparison of Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
BENZI ZONE (ORE)										
ORE	9.53	0.25	10.54	0.24	136	10	145	125	195	34.43
BENZI ZONE (SOIL)										
R.C.3	3.24	0.57	0.60	0.06	14.88	24.05	37.17	33.32	25.12	3.10
R.C.4	2.00	1.23	0.50	0.05	11.27	26.62	65.97	15.63	12.07	3.77
R.C.5	2.06	0.79	0.59	0.06	10.90	25.27	49.53	25.99	16.16	2.65

The results of the analyzed samples from the area show that the contents of Au, As, Cu, Zn, Cr, and Ni are higher than those of the geometric means of the soils of rock code 3, rock code 4 and rock code 5.

1-3-3 Survey results

As described above, the zone considered to be promising as an objective zone of soil geochemical survey in the area is the northern district of the Chisave mountains where Fe-hydroxides, quartz vein/stockwork and pegmatite quartz & K-feldspar, etc. were observed as mineralized signs. The analytical results of the samples from this zone are summarized below.

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
BENZI	Au-As-Bi?-Zn	Gneissose granulite Mafic Granulite	Fe-hydroxides quartz vein/stockwork pegmatite quartz & K-feldspar

1-3-4 Consideration

The distribution of the mineralized signs described above has an occurrence extending to an ENE-WSW system, expected as a mineralized zone. Because of small amounts of sulphides (pyrite, chalcopyrite and pyrrhotite) were also observed by microscopic observation, the presence of mineralization can be expected.

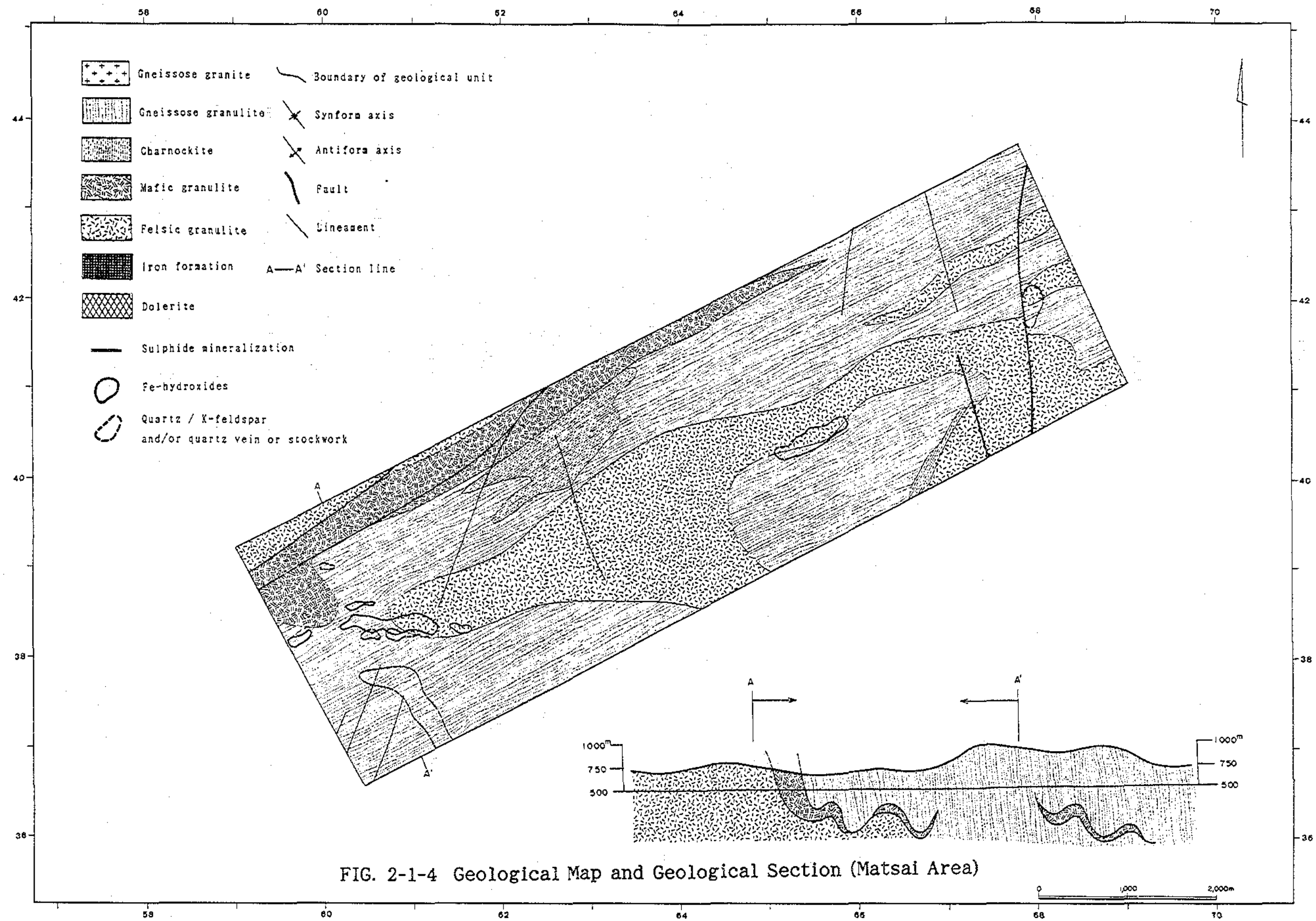

FIG. 2-1-4 Geological Map and Geological Section (Matsai Area)

1-4 MANJIRENJI WEST AREA

1-4-1 Survey methods

The area is mountainous and the condition of outcrops is better than in other areas. An semi-detailed survey was performed in the area, placing emphasis on the relation between the distribution of mineralized signs, and the nature of the geological units and the geological structures.

1-4-2 Geology

General geology

The geological units in the area are mainly constituted of mafic granulite, felsic granulite and gneissose granulite. The lithofacies of each geological unit at the fields are similar to those in a Chirezana area and a Matsai area.

Mafic granulite is distributed from the center to south of the area, and a continuity further to the south is cut by a Murerezi tectonic line. Its distribution area is estimated to be about 5%.

Felsic granulite is distributed extending to an ENE-WSW system at its center, and is leucocratic rock with foliation. Its distribution area is estimated to be about 10%. Resistance to weathering is high, compared with other rocks.

Gneissose granulite is widely distributed, similar to other areas. It occupies about 85% of the area, usually shows a brownish to grayish color, is medium grained, dense and hard, has a remarkable foliation, and is distributed regulated in an ENE-WSW direction. Its color is apt to become paler through weathering.

Geological structure

As a geological structure in the area, the presence of a Murerezi tectonic line deserves attention. But in the field proving the presence is difficult. It can be recognized by Landsat images but the presence can only be known by hindrance of the south extent of mafic granulite.

No characteristics of geological structures worthy of special mention could be found.

1-4-3 Survey Results

On the first year survey, multiple anomalies by stream sediments were recorded, but no promising mineralized signs were observed by the semi-detailed geological survey in Phase II.

1-4-4 Consideration

As described above, there is no distribution of Fe-hydroxides suggesting the presence of sulphide minerals considered characteristic of mineralization in

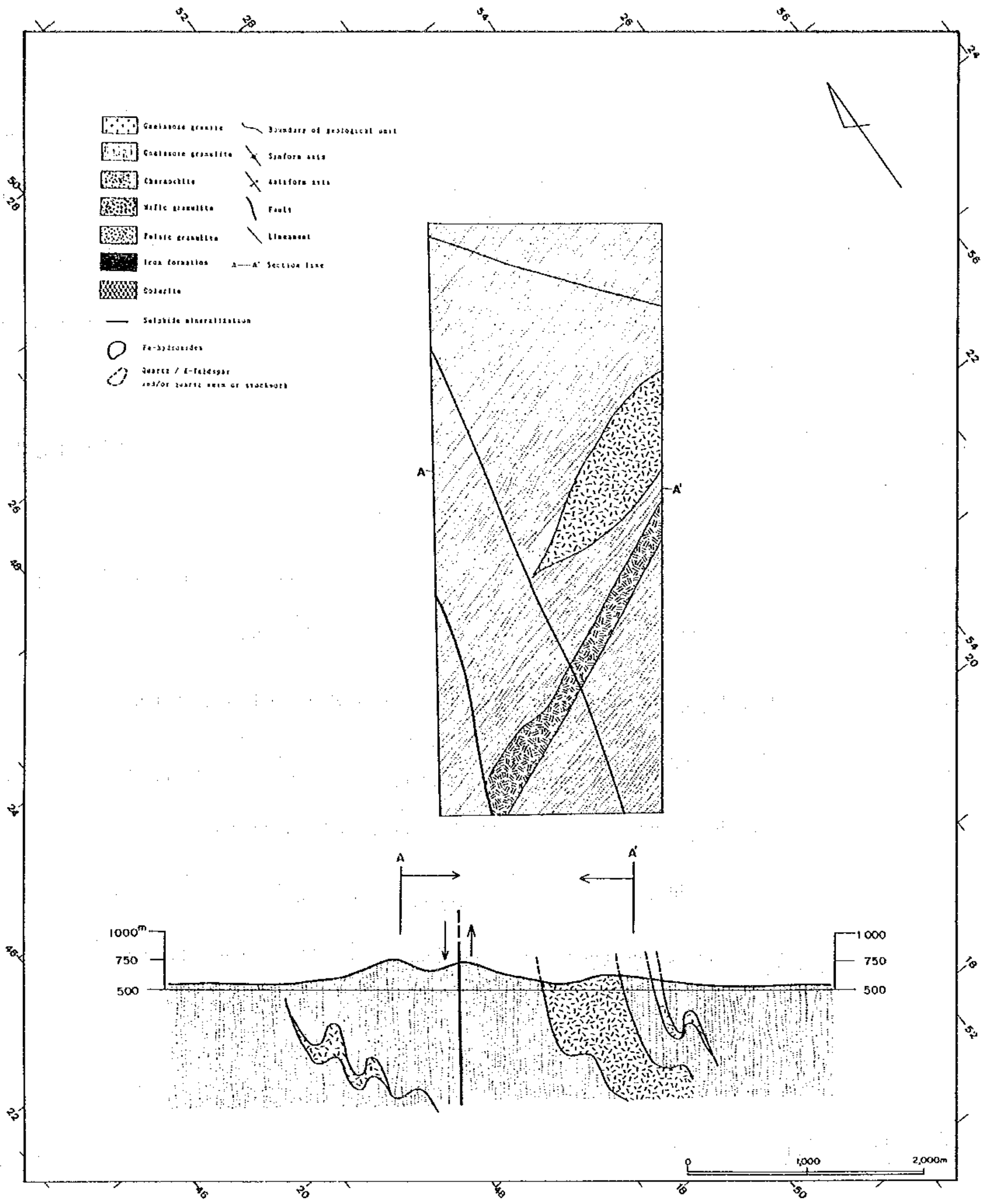

FIG. 2-1-5 Geological Map and Geological Section (Manjirenji West Area)

the area, consequently the area can be judged to be an unsuitable zone for soil geochemical survey.

1-5 RUPIRI AREA

1-5-1 Survey methods

In this area also, it was attempted to determine whether there was any relationship between the mineralized signs, and the nature of the geological unit and the geological structures. Survey routes were selected by considering the geological structure existing an an ENE-WSW system.

1-5-2 Geology

<u>General geology</u>

The area is positioned in the center and somewhat northwest of the survey area. Gneissose granulite (including charnockite) is common. The geological unit mainly consists of mafic granulite, felsic granulite and gneissose granulite (including charnockite). Outcrops of the geological units are common in the north and south of the area, and poor in central portion of the area.

Mafic granulite exists as small rocks (max. 2 km x 0.5 km) in the center of southwest. Its distribution area occupies only about 5%. It is usually a dark greenish color, is massive, and the growth of foliation is weak. Reddish soil is formed by weathering.

There is felsic granulite in the northeast of the area. It has a grayish to white color and is a medium grained rock having well-developed foliation. Its distribution area occupies about 10%.

Gneissose granulite (including charnockite) occupies a distribution area of 85% (charnockite accounts for 5%) in the area. Also charnockite are observed by microscopic observation, but some are too small to be treated as a geological unit, and are thus not illustrated on the geological map in FIG. 2-1-6. Gneissose granulite near a Vurumuku tectonic line contains chlorite to some extent, and suggests a relation between a tectonic line and hydrothermal alteration.

Its tectonic grade is 3 (augenmylonitic), the degree of deformation is high.

<u>Geological structure</u>

A Vurumuku tectonic line extending over a Makambe tectonic line and a Murerezi tectonic line exists in the area, but the sense and degree of dislocation are obscure.

<u>Mineralization</u>

Mineralized signs, namely Fe-hydroxides (including quartz vein/stockwork) were recognized in the northern end (the west of the Mbamba mountain mass) of the mafic granulite existing in the southwest of the area (FIG. 2-1-6). Three others, pegmatite quartz & K-feldspar or quartz vein/stockwork could also be observed. Comparisons between the geometric means of analytical results of samples (Fe-hydroxides and quartz), from the west of the Mbamba mountain mass, and the analytical results of soil samples, are shown as follows:

TABLE 2-1-3(5) Comparison of Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
R U P I R I ZONE (ORE)										
O R E	2.24	0.50	2.45	0.07	68	10	115	29	217	4.45
R U P I R I ZONE (SOIL)										
R.C.3	0.95	0.84	0.64	0.05	28.66	44.04	68.17	145.10	59.52	2.53
R.C.4	----	----	----	----	-----	-----	-----	------	-----	----
R.C.5	0.90	0.69	0.53	0.05	8.23	34.00	26.26	31.91	14.48	1.25

This shows that the contents of Au, As, Cu, Zn and Ni are higher than those of soil samples, and Cr content of soil derived from R.C.5 is high.

1-5-3 Survey Results

From the results of the first year survey, multiple anomalous values indicated by stream sediments were recognized. Mineralized signs considered relating to these anomalies were recognized in the northern end of mafic granulite existing in the southwest of the area, and in other districts. The analytical results of samples from the west of the Mbamba mountain mass are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
RUPIRI	Au-As-Ni	Gneissose granulite Mafic Granulite	Fe-hydroxides (quartz vein/stockwork)

1-5-4 Consideration

The distributions of the mineralized signs described above tend to be scattered, but all exist in connection with mafic granulite. In particular, the distribution of Fe-hydroxides existing in the west of the Mbamba mountain mass can be presumed to originate in sulphides, thus the distribution zone of these mineralized signs were selected as suitable for soil geochemical survey.

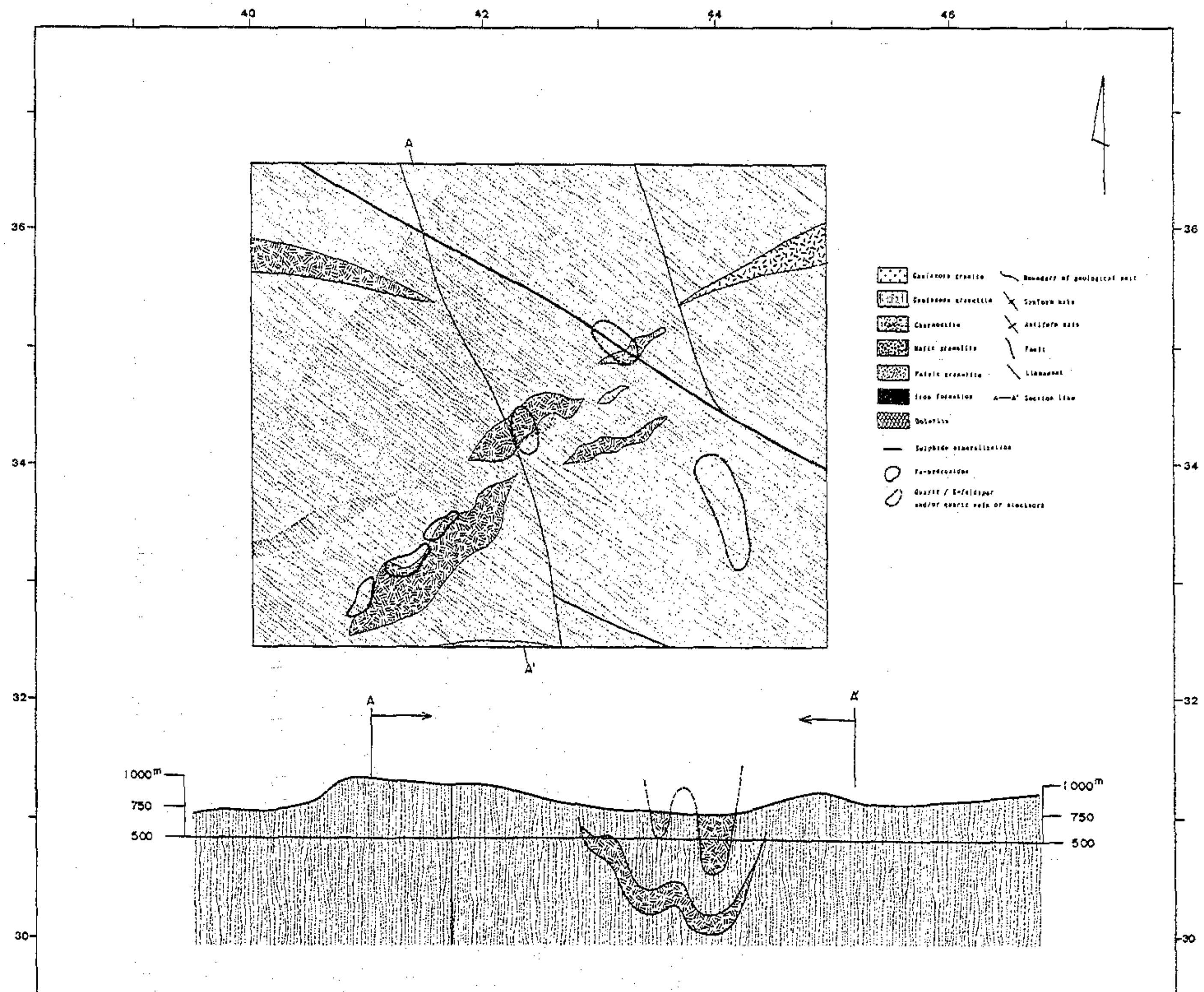

FIG. 2-1-6 Geological Map and Geological Section (Rupiri Area)

1-6 CHEMHONDO AREA

1-6-1 Survey methods

A semi-detailed geological survey was conducted to determine relationship between the distribution of the mineralized signs, and the nature of geological units and the geological structures in the area. The northwest of the area is in the distribution region of Zimbabwe Craton and outcrop conditions are poor because of the advanced weathering.

1-6-2 Geology

General geology

The area, consisting of Limpopo Mobile Belt and Zimbabwe Craton, is situated in the western portion of the survey area. The geological units in the area are dolerite, mafic granulite, felsic granulite, and gneissose granulite, which has the largest extent as same as the other area. The area is characterized by common occrrences of dolerite and tectonic lines(including lineaments).

Mafic granulite distributes in the northern most portion of the area with ENE-WSW extention and is fine to medium grained rock having poorly developed foliation. The extent of mafic granulite is about 2 to 3 % of the area.

Felsic granulite is pale gray in colour, medium grained, compact, and hard rock having foliation. Its body has a dimension of 3 x 0.3 km extended to ENE-WSW direction. Weathered surface shows white in colour but resisitance for weathering is rather higher than that of other geological units. The distribution area is less than 5% in the area.

Gneissose granulite commonly observes in the area. The gelogical unit is gray to dark gray in colour, medium grained, well-foliated and partly garnet-bearing. A medium amount of chlorites are microscopically observed in the rock from northeastern edge of the area.

Its distribution area is estimated to occupy about 75% of the area.

Dolerite is distributed in the center of the area as a form combined by a N-S system and an E-W system. Its distribution area is estimated to occupy 7 to 8% of the area.

Gneissose granite occupies the northwest of the area and the tectonic grade of the area's geological unit is presumed to be high, corresponding to 3 by microscopic observation. Outcrop conditions are poor and the relationship between Zimbabwe Craton and Limpopo Mobile is obscure, even by Landsat images. It has a grayish color and is a medium to coarse grain rock with abundant K-feldspar. Its

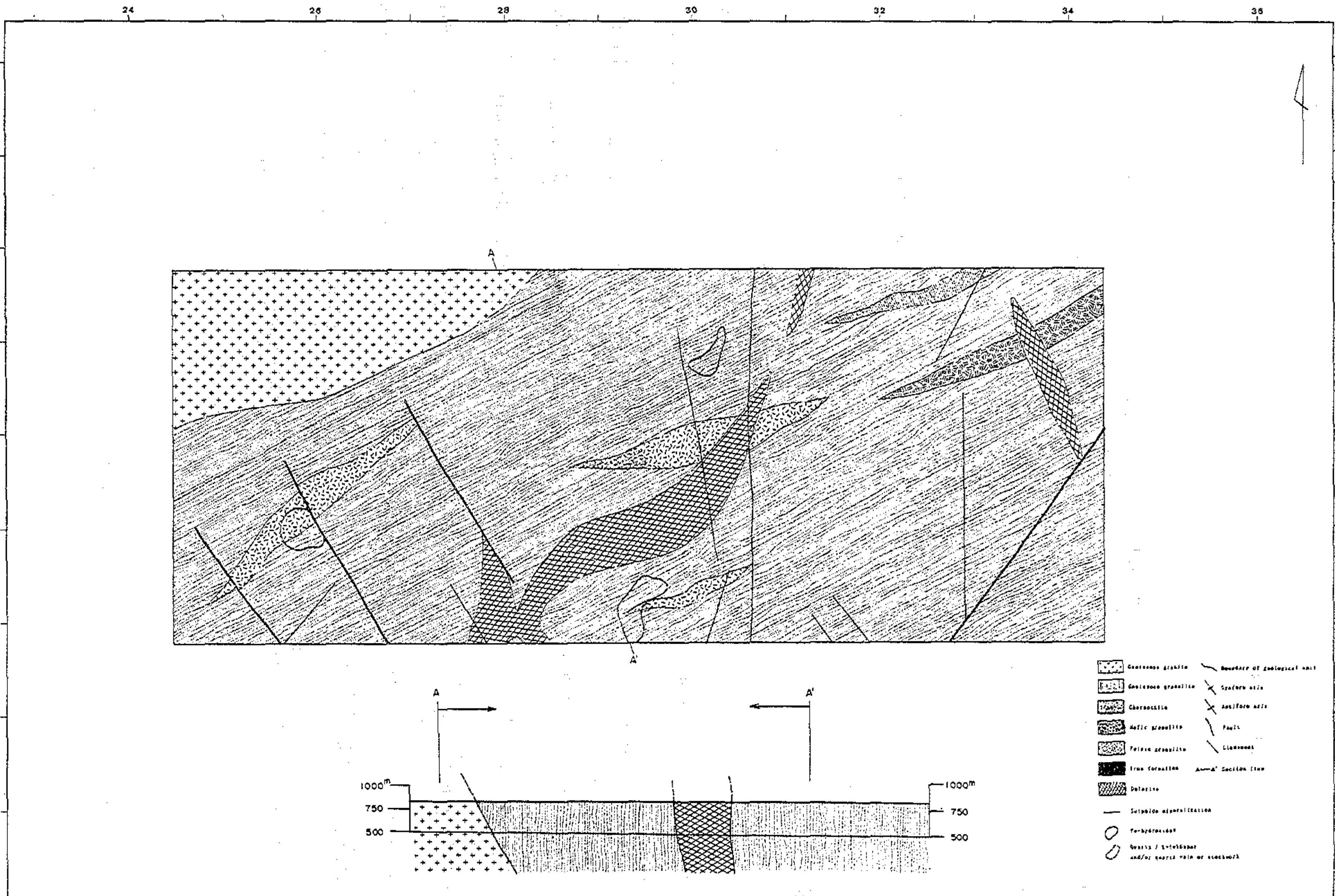

FIG. 2-1-7 Geological Map and Geological Section (Chemhondro Area)

distribution area is about 10%.

Geological structure

The tectonic line, which was postulated by study(Coward et al. 1976) as large and existing at the boundary between a gneissose granite of basement and the Limpopo Mobile Belt, could not confirmed. The tectonic line of a NW-SE system recognized in the west of the area appears to exert a small dislocation on felsic granulite, dolerite and gneissose granulite.

Mineralization

The mineralized signs in the area can mainly be recognized in three zones. In particular, gneissose granulite accompanied by pegmatite quartz & K-feldspar is recognized in the east of Chipfuti, and also in the mountain mass about 2 km north from there, and the Chigonbi mountain mass though the degree of concentration of pegmatite quartz & K-feldspar is poor. No zone with Fe-hydroxides was found.

1-6-3 Survey results

From first year survey results multiple geochemical anomalies by stream sediments were recorded, and by further survey of Phase II, the distribution zone of a representative mineralized sign was determined to be the zone east of Chipfuti School. The results are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
E-CHIPFUTI SCHOOL	-----------	Felsic Granulite Gneissose Granulite	pegmatite quartz & K-feldspar

1-6-4 Consideration

The mineralized sign frequently appears in the east of Chipfuti, but was eliminated from objective zone because of their small scale. The zone can be considered reserve zone behind Chamburukira zone for soil geochemical survey.

1-7 FAVERSHAM AREA

1-7-1 Survey methods

As in other areas, a semi-detailed geological survey to determine the relation between the distribution of mineralized signs, and the nature of geological unit and the geological structures, was performed. As the continuity of the geological structure in the area was an ENE-WSW system according to the first year survey, a survey route was selected by considering the geological structure.

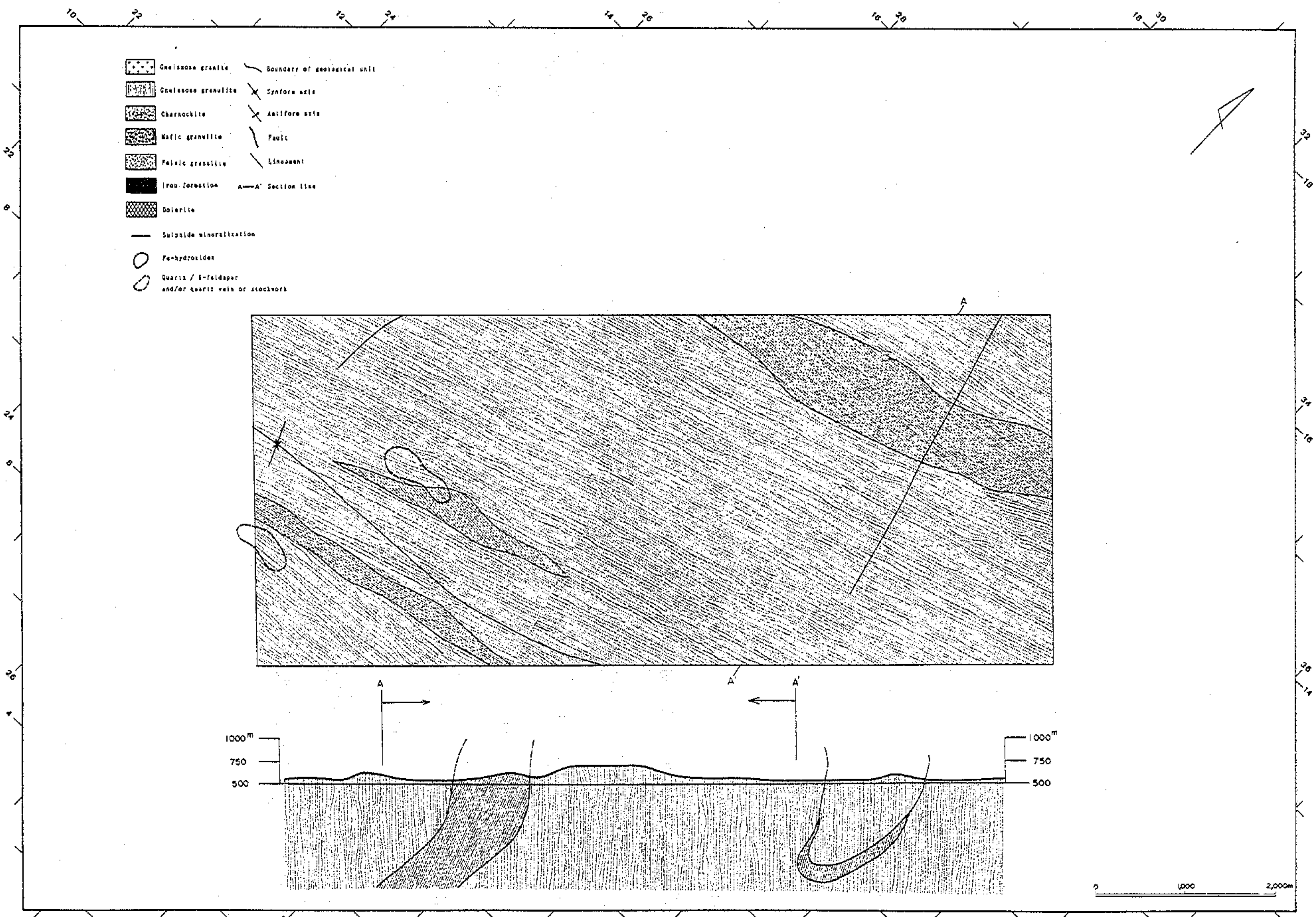

FIG. 2-1-8 Geological Map and Geological Section (Faversham Area)

1-7-2 Geology

General geology

The area positions near the southwest end of the surveyed area consist only of gneissose granulite (including charnockite) and its structure is governed by an ENE-WSW system.

Gneissose granulite is observed over the whole range of the area, it has a dark grayish to grayish color, is medium grained, has a well-developed foliation and partly contains garnet. The distribution area is estimated to occupy above 90% of the area.

Charnockite is known to be distributed in three rock masses in the north and south of the area, petrologically more massive than gneissose granulite with poor foliation. It usually has a dark grayish color, and its distribution area is estimated to be about 10% of the area. Opaque minerals and mineral compositions similar to enderbite having rather high quantity ratios of pyroxenes, microscopically judged as charnockite, exist.

One judged as felsic granulite by microscopic observation, hardly appears, and is not illustrated on FIG. 2-1-8 because a continuity treated as a geological unit is not recognized.

The tectonic grade of the area shows a polygonal to augenmylonitic texture and its variation is great.

Geological structure

There is no remarkable tectonic line and no special characteristic relating to a geological structure. However, there is an anticlinal axis of an ENE-WSW system held between both charnockites and the charnockites are possibly the same rock body.

Mineralization

As mineralized signs, only pegmatite quartz & K-feldspar were observed at the boundary between charnockite and gneissose granulite in the southwest of the area. These zones where mineralized signs are recognized (Faversham 1 and 11) are thought to possibly be the same, considering the presence of the anticlinal axis described above.

1-7-3 Survey Results

On the first year survey, multiple geochemical anomalies by stream sediments were recorded, but no promising mineralized signs were found in Phase II. Faversham 1 and 11 are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
Faversham I&II	------------	Gneissose granulite Charnockite	pegmatite quartz & K-feldspar

1-7-4 Consideration

The area is judged to be unsuitable for soil geochemical survey, because the mineralized signs described above have a medium degree in dimension and the occurrences of pegmatite quartz & K-feldspar are scattered.

1-8 FUMURE AREA

1-8-1 Survey methods

As in other areas, semi-detailed geological survey was also performed. This area is geologically similar to Spot Mine as it is located near.

1-8-2 Geology

General geology

The main geological units in the area are iron formations, mafic granulite and gneissose granulite (including charnockite).

Iron formations occur near the northwest end of the area forming the Fumure mountain. It has a pale brownish to white color with a thin band of Fe-hydroxides in quartz. The distribution area is estimated to be about 2 to 3% of the area.

Mafic granulite is mainly distributed at the center of the area, It is massive rock of a dark greenish color, and the distribution area is estimated to be about 5%. By microscopic observations, more clinopyroxene was found than orthopyroxene, accompanied by a large amount of amphibole. The tectonic grade is as low as 0 (isogranular texture).

The representative felsic granulite, which has a pale grayish color, well-developed foliation and is fine to medium grained, is near Dekeza B. C. By microscopic observations, it was found that K-feldspar prevails with small amounts of plagioclase and garnet. Its tectonic grade is as high as 3. Felsic granulite was microscopically observed also in other places than the distribution areas of felsic granulite in the FIG. 2-1-9, but cannot be illustrated because of its small scale. The distribution area is estimated to be about 2 to 3% of the area.

Gneissose granulite is observed over the whole range of the area. It has a grayish to brownish color, is medium grained and has a well developed foliation.

By microscopic results, very small amounts of sericite and chlorite were recognized. Its distribution area is estimated to be about 90% of the area. The tectonic grade of gneissose granulite is 3, the same as felsic granulite.

Charnockite is known to be distributed in two rock bodys in the north and central of the area. It is petrologically more massive than gneissose granulite with weak foliation. It usually has a dark grayish color, and the distribution area is estimated to be about 1%. There are opaque minerals and mineral compositions in similar to enderbite containing large quantities of pyroxenes in those microscopically judged as charnockite.

Geological structure

The Sazaume-Makambe tectonic line passes through the southeast of the area. This tectonic line appears to be left-lateral and the west side block of the tectonic line appears to dislocate south relative to the east side block. The anticlinal axis of an ENE-WSW system exists from the south to center of the area. It is normal in the west and becomes an overturned anticlinal axis in the east.

Mineralization

As mineralized signs, the distribution of Fe-hydroxides in the south of Fumure mountain (Fumure area) can be specifically mentioned. As floats containing pyrite as well as Fe-hydroxides were discovered here and geochemical anomalies by stream sediments in the Phase I were recognized in the area, the presence of Au mineralization accompanying sulphide minerals can be expected. Consequently, the district was selected as an objective zone (Fumure area) for soil geochemical survey. In samples where pyrite was recognized with the naked eye, chalcopyrite and pyrrhotite were also observed microscopically. The distribution of Fe-hydroxides was recognized also in the north of Fumure mountain, but the distribution of Fe-hydroxides is far more scattered than in the south.

Analytical results of samples collected from the Fumure area are shown in TABLE 2-1-2. This table shows that the contents of metal elements As and Cr are characteristically high, compared with those in other mineralized areas.

Comparisons between the geometric means of the analytical results of the samples from the mineralized zone and the geometric means of each geological unit of soils in the area are shown in the following table (TABLE 2-1-3 (6)).

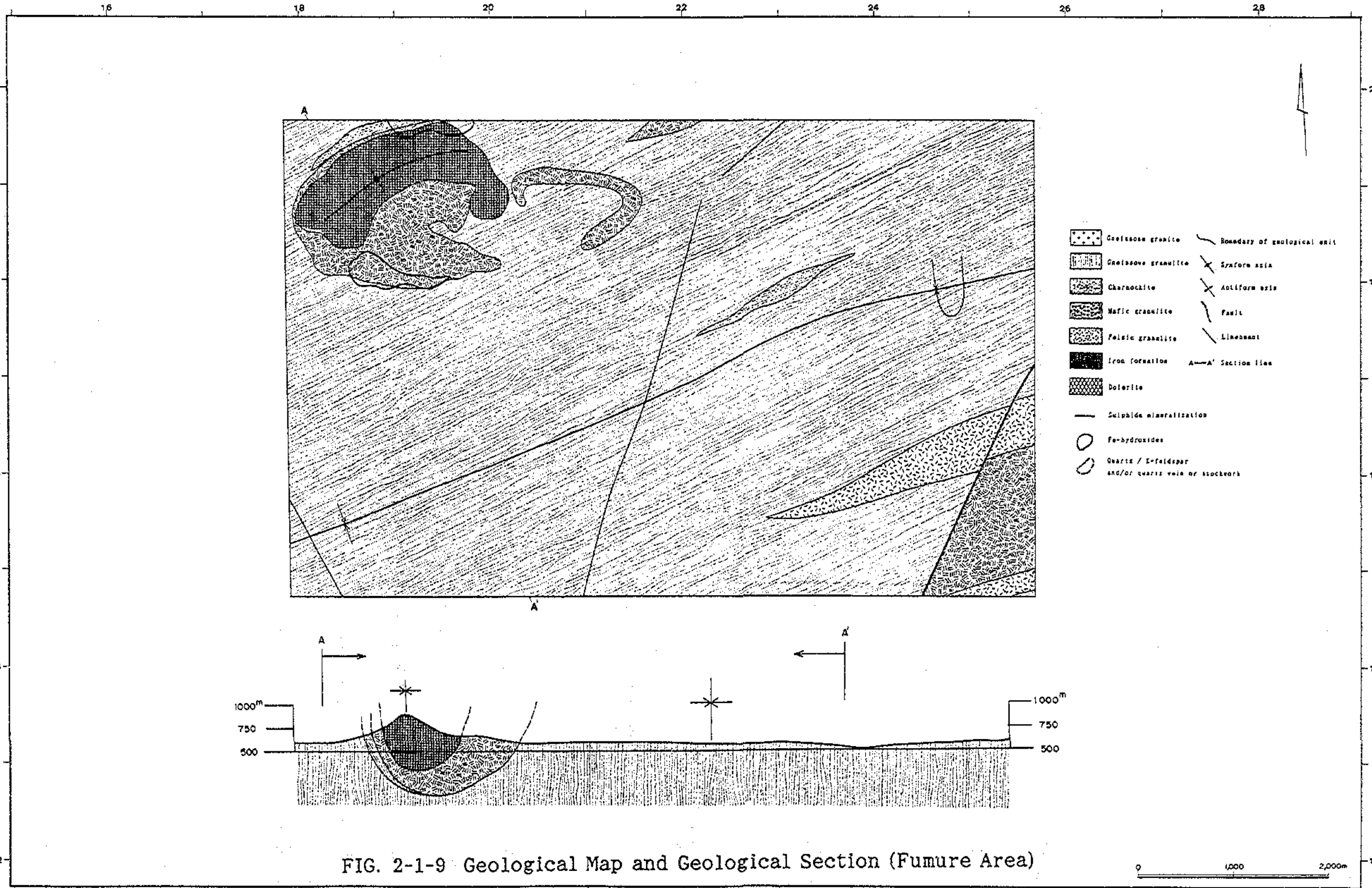

FIG. 2-1-9 Geological Map and Geological Section (Fumure Area)

TABLE 2-1-3(6) Comparison of Metal Content between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
FUMURE ZONE (ORE)										
ORE	0.50	0.25	27.67	0.10	70	10	6	248	130	28.71
FUMURE ZONE (SOIL)										
R.C.3	2.89	0.77	14.29	0.07	66.60	36.17	114.06	518.51	398.48	8.99
R.C.4	----	----	----	----	----	----	----	----	----	----
R.C.5	0.91	0.51	0.97	0.07	12.71	31.23	45.77	49.18	32.85	1.62

The geometric means of the contents of metals in samples from the zone are higher than those in soils, with regard to Au, Zn, Cr and Ni.

1-8-3 Survey results

On the first survey, multiple geochemical anomalies by stream sediments were recorded in the area, and by semi-detailed geological survey, a promising mineralized sign was recorded in the Fumure area. The analytical results of samples collected from the mineralized zone are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
FUMURE	As-Cr-Ni?	Mafic Granulite	sulphides & Fe-hydroxides

The content of Au in analyzed samples is low, but as described below the results of soil geochemical survey indicated that the presence of Au mineralization could be expected.

1-8-4 Consideration

Although the analytical results of samples collected from the mineralized zone did not directly indicate Au mineralization, it is presumed to be a promising area according to connections with mineralized signs and Spot Mine.

1-9 NYAHONDO AREA

1-9-1 Survey Methods

A semi-detailed geological survey was performed based on marshes and hills, with the distribution of floats as main targets, in such a way that the relationship between the distribution of the mineralized sings, and the nature of geological unit and the geological structures could be determined. As the continuity of the geological structures in this area was an ENE-WSW system system shown by the previous survey, survey routes were selected considering the

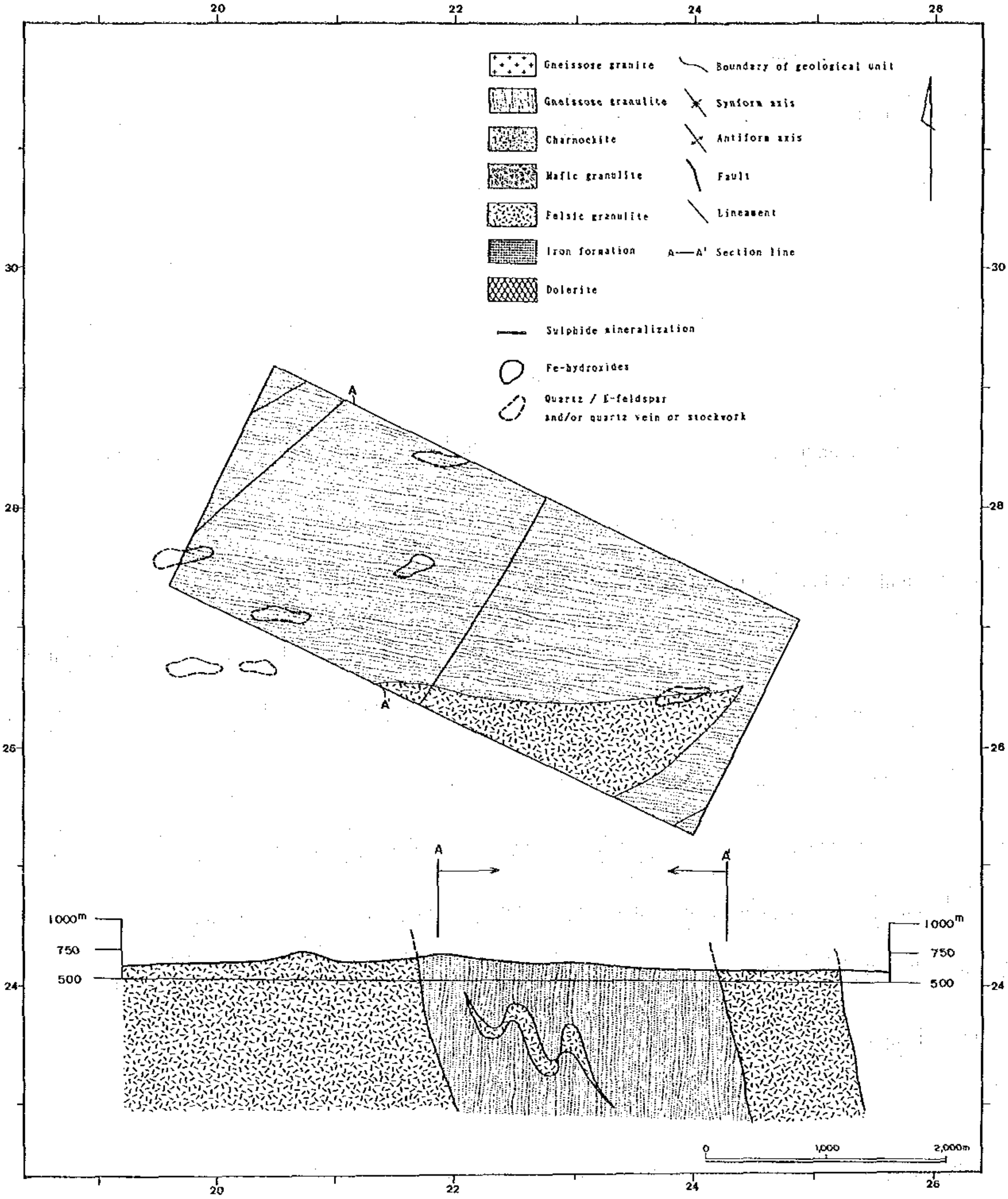

FIG. 2-1-10 Geological Map and Geological Section (Nyahondo Area)

geological structure.

1-9-2 Geology

General geology

The area is located near the northwest end of the surveyed area where gneissose granulite is common. The geological units in this area are mainly felsic granulite and gneissose granulite.

Felsic granulite is distributed in the southeast of the area in an ENE-WSW system, and its distribution area is estimated to be about 15%. The lithofacies are grayish to pale brownish similar to other areas, the rocks are medium grained and have a clear foliation. The results of microscopic observation are as in the appendix A-2. They are very similar to charnockite, recognized in gneissose granulite by the naked eye and by microscope.

Gneissose granulite is most widely distributed and occupies about 85% of the area. It is usually brownish in color, coarse to medium grained, dense, hard, and has a remarkable foliation and is distributed in a NNE-SSW direction. Chlorite, epidote and sericite, considered as products due to hydrothermal alteration, were observed in gneissose granulite at the northwest end of the area.

The tectonic grade in the zone is as high as 3 to 4.

Geological structure

There is geologically no specific structure, but in the Chinyamafiwa river, a NE-SW direction in the northwest end of the area, there is a foliation in this direction grows which may reflect a tectonic line. The tectonic line may be attributed to a tectonic movement after the main metamorphic episode which formed the foliation of an ENE-WSW system prevailing in the surveyed area.

Mineralization

Mineralized signs mainly composed of pegmatite quartz & K-feldspar (accompanied by Fe-hydroxides) are recognized in the west of the area (Nyahondo zone). These are distributed, as shown in FIG. 2-1-10, to an ENE-WSW direction matching the direction of foliation. Analytical results of samples (Fe-hydroxides) collected from the Nyahondo zone, are shown in TABLE 2-1-2. This table shows that the contents of metal elements, As, Cu and Cr are characteristically high, compared with those in other mineralized areas.

Comparisons between the geometric means of the analytical results of the samples from the zone and the geometric means of the analytical results of each geological unit of soils in the area, are shown in the following table (TABLE 2-1-3

(7)).

This indicates that the contents of As, Cu, Cr and Ni in the Fe-hydroxide samples from Nyahondo zone are higher than the contents in soils.

TABLE 2-1-3(7) Comparison of Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
NYAHONDO ZONE (ORE)										
ORE	1.00	0.25	32.06	0.14	308	28	1	481	129	51.93
NYAHONDO ZONE (SOIL)										
R.C.3	----	----	----	----	----	----	----	----	----	----
R.C.4	----	----	----	----	----	----	----	----	----	----
R.C.5	1.05	0.59	0.57	0.05	31.41	38.26	37.74	40.03	19.73	1.79

1-9-3 Survey Results

On the first survey, multiple geochemical anomalies by stream sediments were recorded in the area, and by semi-detailed geological survey, multiple mineralized sings could be confirmed in the west of the area (Nyahondo zone). The analytical results of the samples collected from this zone are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
NYAHONDO	As-Cu-Cr	Gneissose Granulite	pegmatite quartz & K-feldspar (Fe-hydroxides)

1-9-4 Consideration

In Nyahondo area, though the analytical results do not directly indicate Au mineralization, mineralized signs can be recognized in the west of the area, and these are mainly composed of pegmatite quartz & K-feldspar, and in some cases Fe-hydroxides. Consequently, the area was selected as a objective zone of for soil geochemical survey.

1-10 BANGALA AREA

1-10-1 Survey methods

The survey was performed in order to determine the relationship between the distribution of mineralized signs and the geology and geological structure, then the survey route was chosen in consideration of geological structure in the ENE-WSW direction.

1-10-2 Geology

General geology

The area is located in the southwestern extremity of the surveyed area, and an axis of a fold in the ENE-WSW direction is found in charnockite in the central part of the area. Major geological units are gneissose granulite and charnockite, which form monotonous distribution of geological units as shown in FIG. 2-1-11. Minor distribution of mafic granulite, an area about 1% of the total area, is found in the northwestern extremity of the area.

Gneissose granulite, brown-colored coarse grain rock with weak foliation, is distributed in northern and southern parts of the area. Its distribution area is estimated to be approximately 45% of the total area. In addition, charnockite is distributed within gneissose granulite. It is similar to gneissose granulite in terms of its mineral composition, containing slight amounts of orthopyroxene as shown by microscopic examination.

Charnockite with weak foliation, dark gray to gray colored, is distributed in the central part of the area forming small hills. Its distribution area is about 55% of the total area.

The tectonic grade of the area is high at 3.

Geological structure

Sazaume-Makambe tectonic line passes the northwestern extremity of the area. Although it can be estimated that the sense of the tectonic line is left-lateral, and the western block of the tectonic line is displaced to the south, no evidence was obtained in the field. On the other hand, there is a tectonic line of right-lateral sense stretching from the center of the area towards the southwest as shown in FIG. 2-1-11, probably by which the charnockite is displaced.

Mineralization

No mineralized signs was observed.

1-10-3 Survey results

From the first year survey, some anomalies were obtained by geochemical

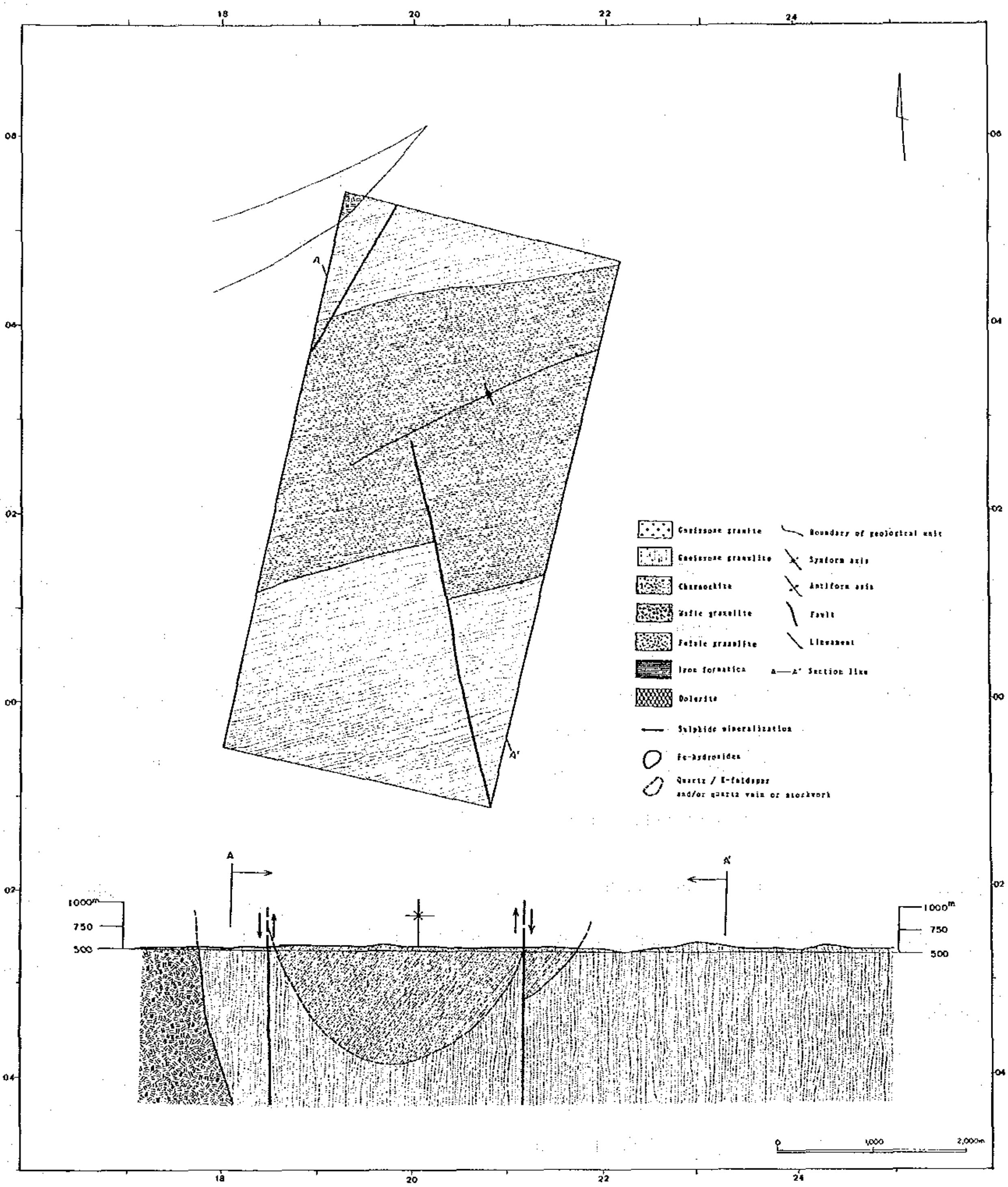

FIG. 2-1-11 Geological Map and Geological Section (Bangala Area)

survey of stream sediments in the area. The semi-detailed geological survey in Phase II, however, indicated no promising mineralized signs.

1-10-4 Consideration

It is determined that this area cannot be an candidate for soil geochemical survey, because no mineralized signs, the principle object of the survey, were verified in the area.

1-11 CHIPFUNDE AREA

1-11-1 Survey methods

From the first year survey, anomalies were observed by geochemical survey of panned samples of stream sediment. Efforts were made to determine the relationship between the distribution of mineralized signs, which is also noted in other areas, and the geology and geological structure.

1-11-2 Geology

General geology

The area is located in near the central part of the area. Its major geological units are mafic granulite, felsic granulite, gneissose granulite(including charnockite), and dolerite.

Mafic granulite distributes from the north to the middle of the area, and in the ENE-WSW direction in the southern part. It is usually of dark green massive rock but sometimes shows good development of foliation. In mafic granulite with such developed foliation, it seems that a tectonic grade of augenmylonitic texture is also indicated. The distribution area of mafic granulite is estimated to be less than 10% of the total area.

Felsic granulite is distributed in the southern part of the area. It usually forms medium grain rock of a light gray color and with highly developed foliation, in common with that of other areas. Its distribution area is about 5% of the total area.

Gneissose granulite is distributed throughout the area. It is brown or gray rock of wide grain range, from fine to coarse. Its distribution area is about 85% of the total area.

Charnockite is distributed in the central part of the area as rock body stretching in an ENE-WSW direction.

The tectonic grade of each geological unit in this area is high, generally indicating 3.

Geological structure

These are two tectonic lines in this area: a tectonic line which is estimated to slightly displace mafic granulite, gneissose granulite and charnockite in the central part of the area; and the Murerezi tectonic line located in the eastern part of the area. It was not revealed in the field what displacement the Murerezi tectonic line gives to the geological units in this area.

Mineralization

On the southern and northern edges of the area, a mineralized signs, mainly of Fe-hydroxides, was found. Other mineralized signs, probably of pegmatite quartz and K-felspar or quartz vein/stockwork, were found at one point each in the middle and south of the area. Comparing the analytical results of Fe-hydroxides samples of the Chipfunde zone with those of other areas, it is worth notice that the samples from the Chipfunde zone are higher in Cu and Ni content.

Comparison between analytical results of Fe-hydroxides samples and those of soil samples is shown in the following table(TABLE 2-1-3(8)).

TABLE 2-1-3(8) Comparison Metal Contents between Ore and Soil

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
CHPFUNDE ZONE (ORE)										
ORE	2.00	0.25	7.75	0.10	617	28	4	128	324	55.69
CHPFUNDE ZONE (SOIL)										
R.C.3	1.71	0.51	0.88	0.06	98.21	21.86	101.62	330.44	231.47	9.50
R.C.4	----	----	----	----	-----	-----	-----	------	-----	----
R.C.5	1.00	0.56	0.55	0.06	27.77	18.27	51.69	128.59	50.31	3.21

Comparison indicates that the Fe-hydroxide sample is higher in Au and Cu content, while being lower in Zn.

1-11-3 Survey results

The first year survey indicated anomalies by panned samples. As a result, the above mineralized signs in the Chipfunde zone is considered to be promising. The results are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
CHIPFUNDE	As-Cu-Ni	Mafic Granulite Gneissose Granulite	Fe-hydroxides (quartz vein/stockwork)

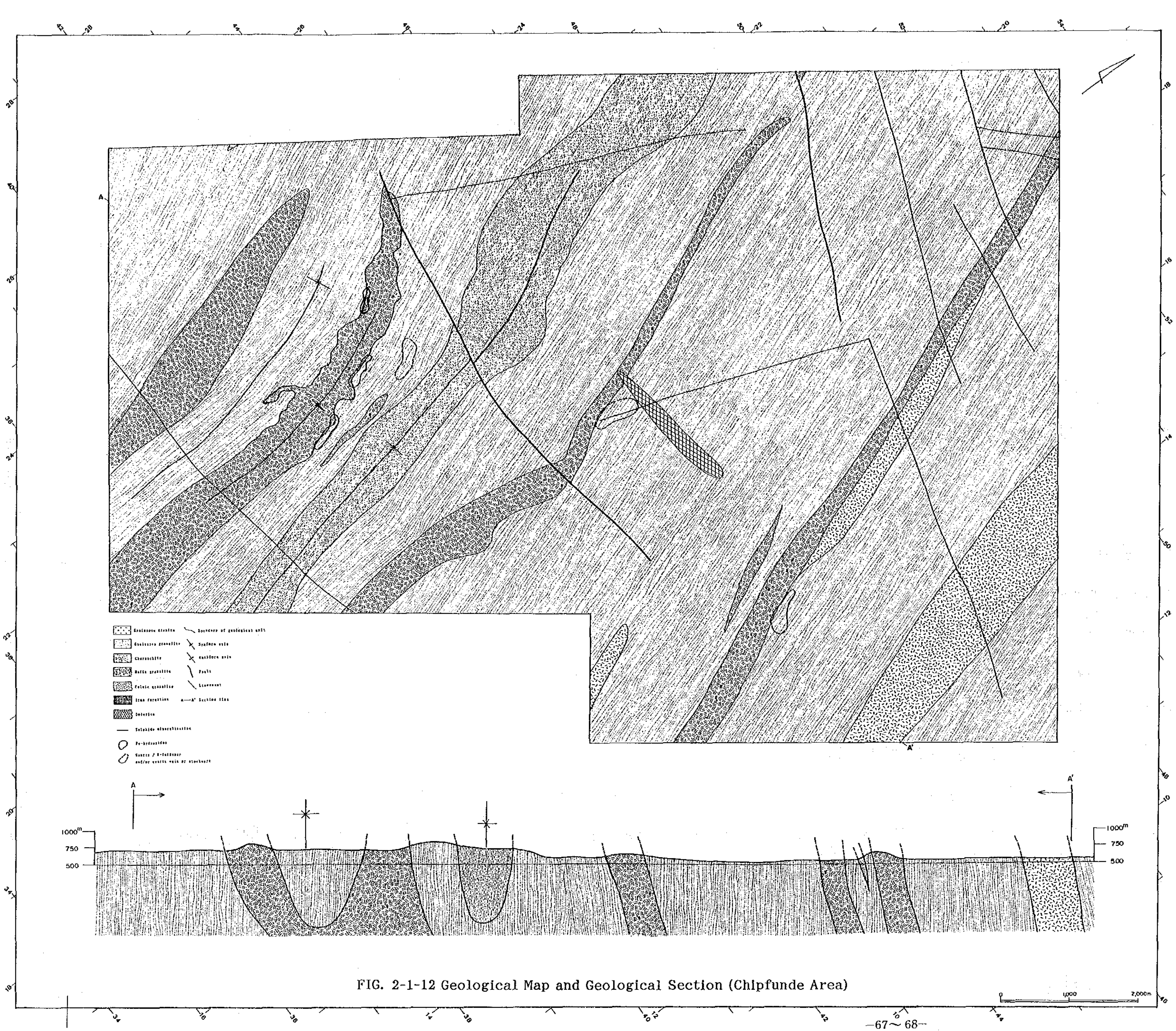

FIG. 2-1-12 Geological Map and Geological Section (Chipfunde Area)

From the analytical results of Fe-hydroxides samples, there is no strong sign of Au mineralization. General discussion in consideration of the results of geochemical soil exploration will be mentioned later.

1-11-4 Consideration

Although analytical results of Fe-hydroxides mentioned above does not provide any especially noticeable information, it can be considered that Fe-hydroxides of the Chipfunde zone accompanied with quartz/stockwork meets the criteria for selection of subject areas for soil geochemical survey.

1-12 MUSHAYA AREA

1-12-1 Survey methods

For this area, the first year survey again indicated anomalies by geochemical survey on panned samples of stream sediment. Efforts were made to determine the relationship between the distribution of mineralized signs, which is also noted in other areas, and the geology and geological structure.

1-12-2 Geology

General geology

This area is located in the western extremity of the surveyed area, being adjacent to the north of the Fumure area. Its major geological units are mafic granulite and gneissose granulite which contains charnockite.

Mafic granulite develops mainly in the northern part of the area, in a form strongly reflecting the structure stretching in the ENE-WSW direction. Its rock is characterized by a dark green color and weak foliation common with those of other areas. Its grain is fine or medium. Mafic granulite is estimated to have a distribution area of about 10% of the total area.

Gneissose granulite containing charnockite forms the bulk of the geological structure of the area. It is a light brown, medium grain rock with highly developed foliation. It is estimated to be distributed over about 85% of the total area. In addition, charnockite, an area about 5%, is distributed in the southern part as small rock body. It contains orthopyroxene at 2-3%.

The tectonic grade is as high as 3.

Geological structure

In this area, too, geological structure in the ENE-WSW direction has clear foliation. Distribution of each geological unit is controlled in this direction. No other noteworthy tectonic line is known.

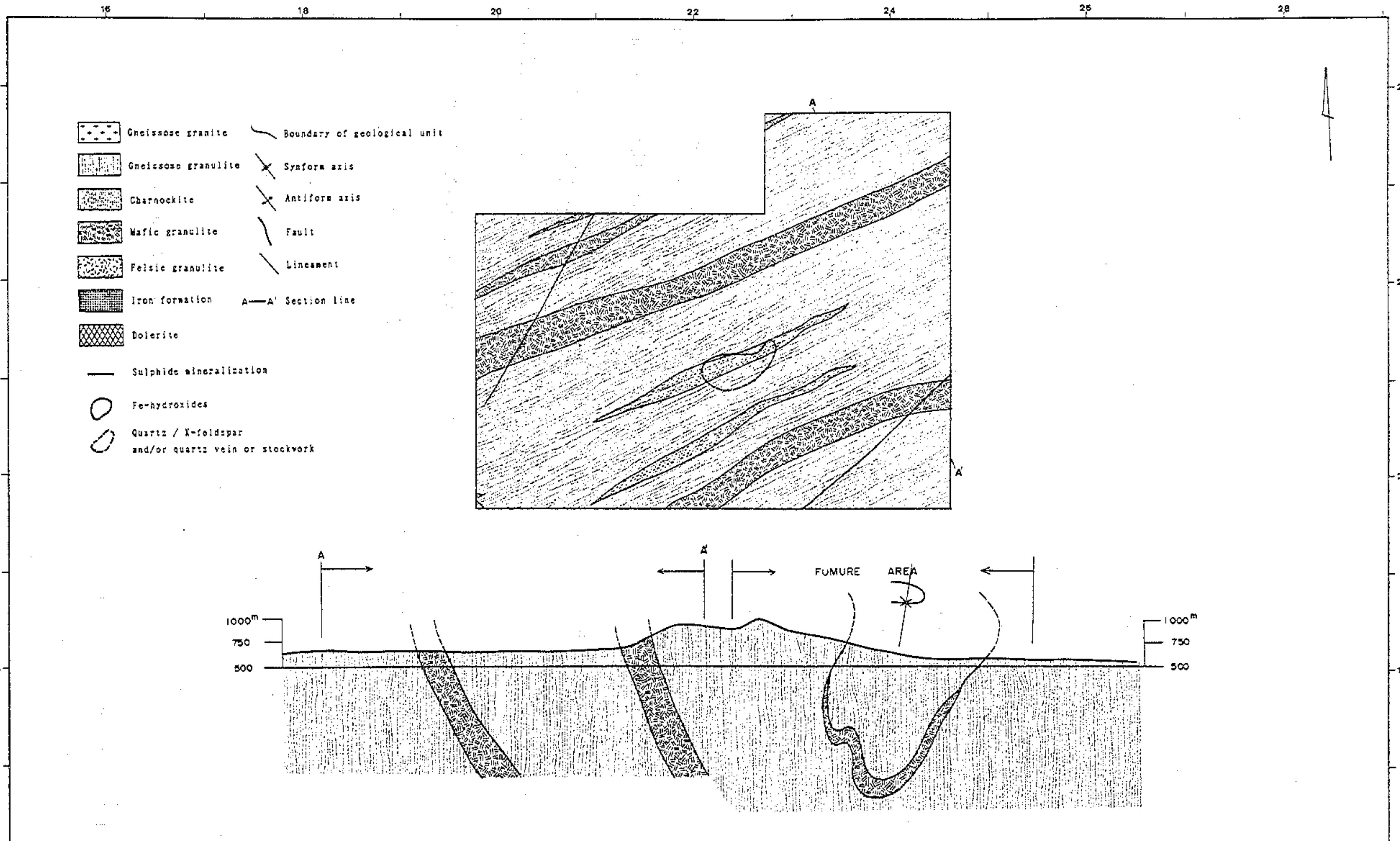

FIG. 2-1-13 Geological Map and Geological Section (Mushaya Area)

Mineralization

Major mineralized signs were found only in charnockite and gneissose granulite to the east of Mushaya school in the Mushaya area, appearing as pegmatite quartz and K-feldspar, or quartz vein/stockwork, which are difficult to distinguish, spreading over mafic granulite and gneissose granulite.

1-12-3 Survey results

Although the first year survey indicated some anomalies by panned samples, it revealed no promising mineralized signs. The obtained results for the Mushaya area mentioned above are summarized as follows:

MINERALIZED ZONE	MINERALIZED METAL	GEOLOGY	MINERALIZED SIGNS
MUSHAYA	--------	Charnockite Gneissose Granulite	pegmatite quartz & K-feldspar (&/or quartz vein/stockwork)

From the field survey, it is difficult to determine which of pegmatite quartz and K-feldspar, or quartz vein/stockwork is the origin of the mineralized signs observed in the Mushaya area.

1-12-4 Consideration

Because of the scattered occurrence of the mineralized signs mentioned above, and because of the absence of Fe-hydroxide distribution, a sign of the relationship with sulfide which is regarded to be a feature of mineralization, it is determined that this area cannot be a candidate for soil geochemical survey. Since a large portion of this area has leveled topography, no geological evidence which may verify the results of geochemical survey of the first year survey was found.

1-13 Other AREA

1-13-1 Survey methods

The survey was performed on seven areas, each with a 2 km^2 area where an anomaly was found in a stream-sediment sample on geochemical survey; MaCdougall-SE. area, MaCdougall-N area, Svuwure-SE area, Svuwure-NW area, Dabwa-SE area, Chivamba-F area and Chivamba-S area. For these areas, the semi-detailed geological survey was conducted in order to determine the relationship between the distribution of mineralized signs and geology or geological structure.

1-13-2 Geology

General geology

The geology of all the above areas is summarized here, because these areas do not seem largely to affect the entire geology due to their small individual areas(FIG 2-1-14).

MaCdougall-SE area: This area is located in the southern extremity of the central part of the surveyed area. The majority of the area consists of felsic granulite, with minor distribution of gneissose granulite of an area only 30% of the total.

MaCdougall-N area: This area is located near the northwest of the Chirezana area. Its geology consists of felsic granulite and gneissose granulite.

Svuwure-SE area: It is located to the west of Manjirenji West area and the north of the Chipfunde area. In the area, distribution of gneissose granulite, and a minor one of mafic granulite and felsic granulite are shown.

Svuwure-NW area: This area is located in the south of the Chipfunde area. Its geology consists of gneissose granulite only.

Dabwa-SE area: This area is located in the south of the Chipfunde area. Its geology consists of felsic granulite and gneissose granulite.

Chivamba-E area: The geology of this area consists of mafic granulite and gneissose granulite which continue from the Chipfunde area located to the east of this area.

Chivamba-S area: Its geology is substantially the same as that of Chivamba-E area, except for a largely increased distribution area of mafic granulite over that of Chivamba-E area.

Geological structure

MaCdougall-SE area: There is an anticlinal axis in the ENE-WSW direction near the center of the area, and its south wing seems to be a steep slope.

MaCdougall-N area: The Murerezi tectonic line passes the eastern part of the area, displacing felsic granulite and gneissose granulite in the right-lateral sense.

Svuwure-SE area: Its geological structure generally belong to the western block of the Murerezi tectonic line, in which an axis of a fold in the ENE-WSW direction is noted. This axis plunges to the east.

Svuwure-NW area: No noteworthy geological structure was found.

Dabwa-SE area: No noteworthy geological structure was found.

Chivamba-E area: In general, this area belongs to the north wing of an overfolding axis of an anticline, but no remarkable tectonic line was found.

Chivamba-S area: Its geological structure is generally the same as that of Chivamba-E area, except that this area is located nearer the axis of a fold than the Chivamba-S area.

Mineralization

MaCdougall-SE area: No fact indicating any mineralization was found.

MaCdougall-N area: No mineralized signs was noted.

Svuwure-SE area: It was expected to have some mineralized signs in relation of the existence of such phenomena in the Chipfunde area, but none was found.

Svuwure-NW area: Under bad outcrop conditions, no mineralized signs was found.

Dabwa-SE area: Under bad outcrop conditions, no mineralized signs was found.

Chivamba-E area: Although mafic granulite is distributed in this area in the same way as the Chipfunde area, no mineralized signs, such as existence of Fe-hydroxides, was found.

Chivamba-S area: Its geological condition is substantially the same as that of Chivamba-E area, but no noticeable mineralized signs was found.

1-13-3 Survey results

Although anomalies were found by geochemical survey on stream sediment in the above areas, none of them could be determined to be a subject zone for soil geochemical survey from the results of the Phase II semi-detailed survey.

1-13-4 Consideration

The above seven areas correspond to a single anomalous area found by geochemical survey on stream sediment, however, could not reveal the origin of such anomalies. This poses a problem which is also related to the evaluation of the anomalies by geochemical survey on sediment in the surveyed area.

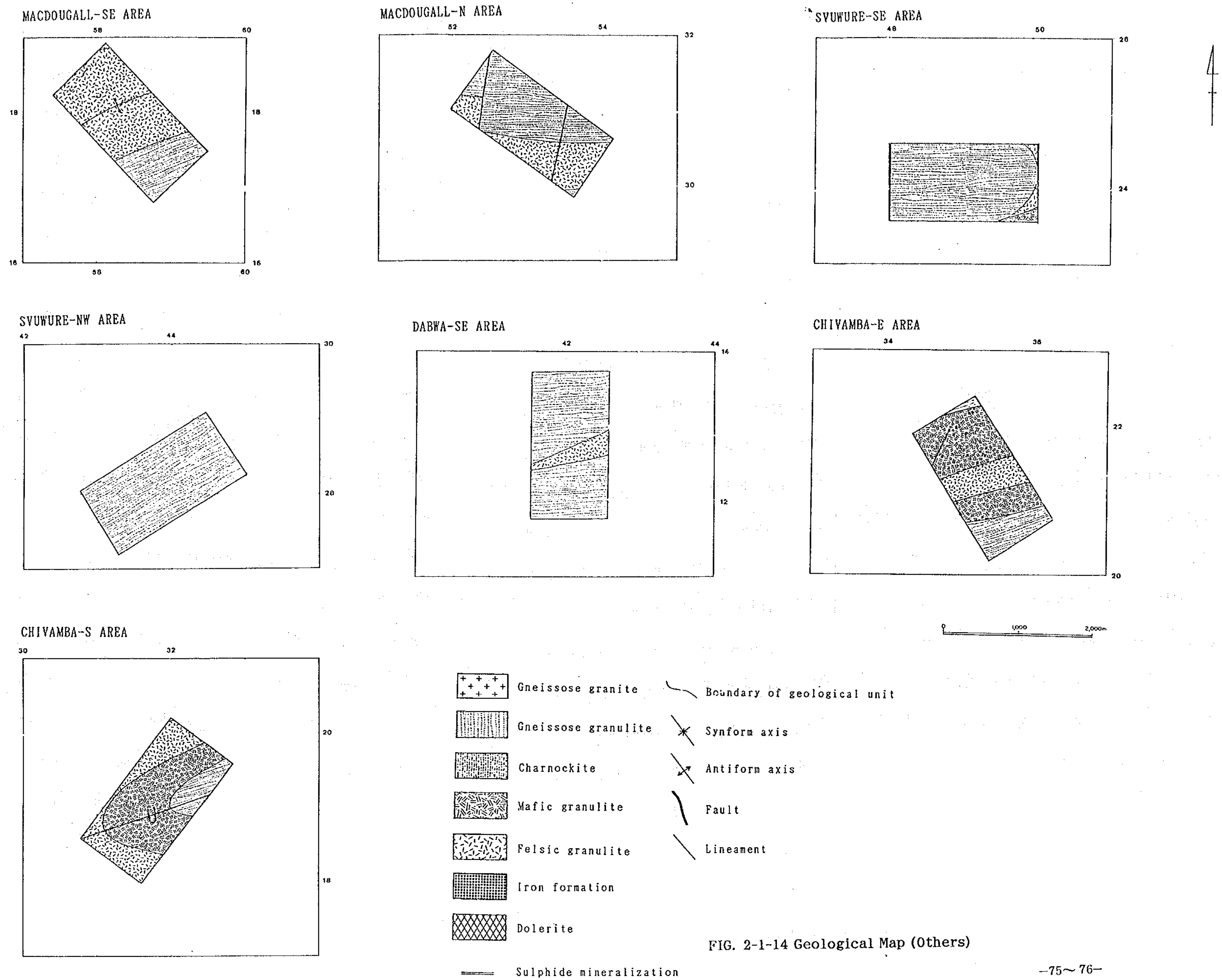

FIG. 2-1-14 Geological Map (Others)

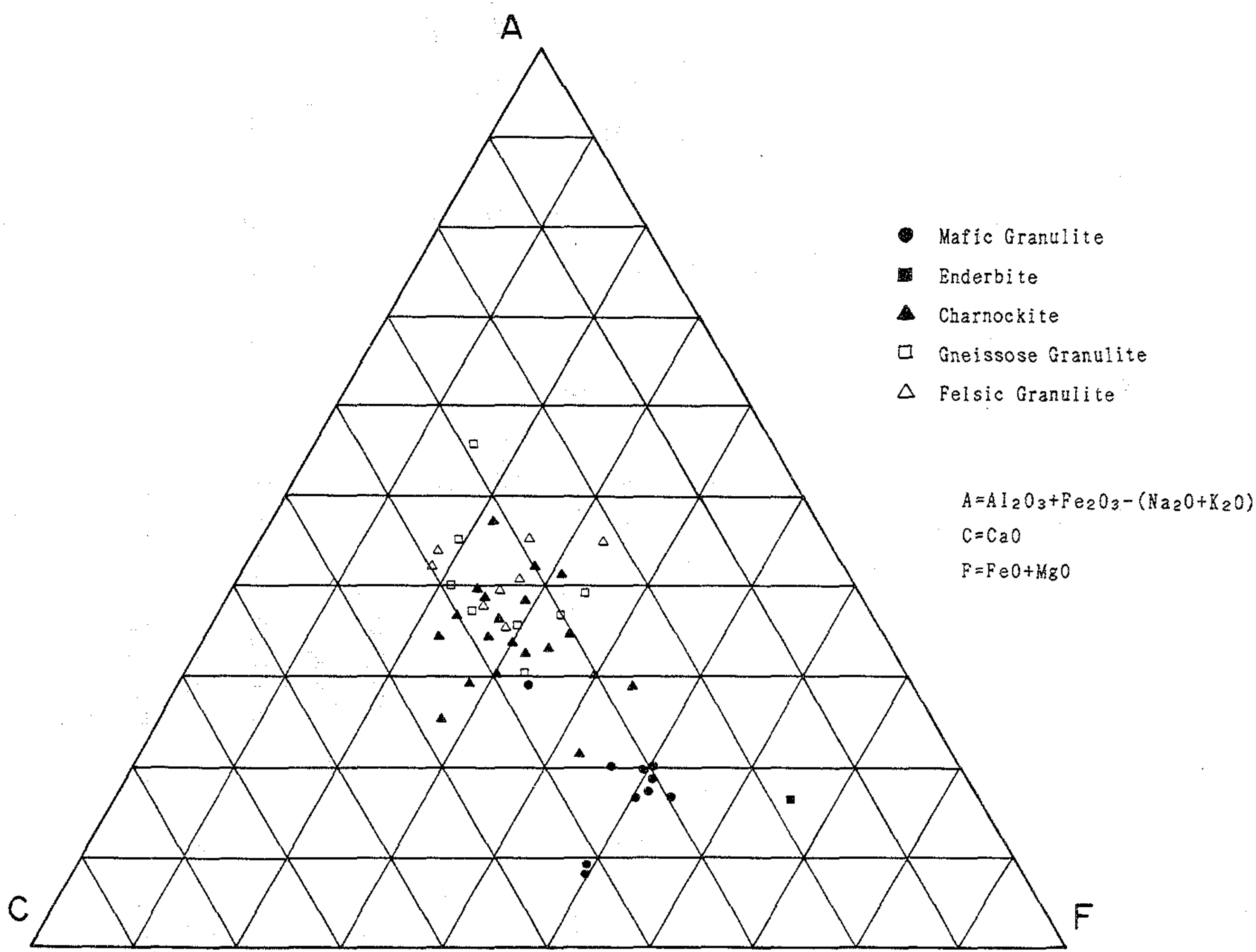

FIG. 2-1-15 A C F Diagram

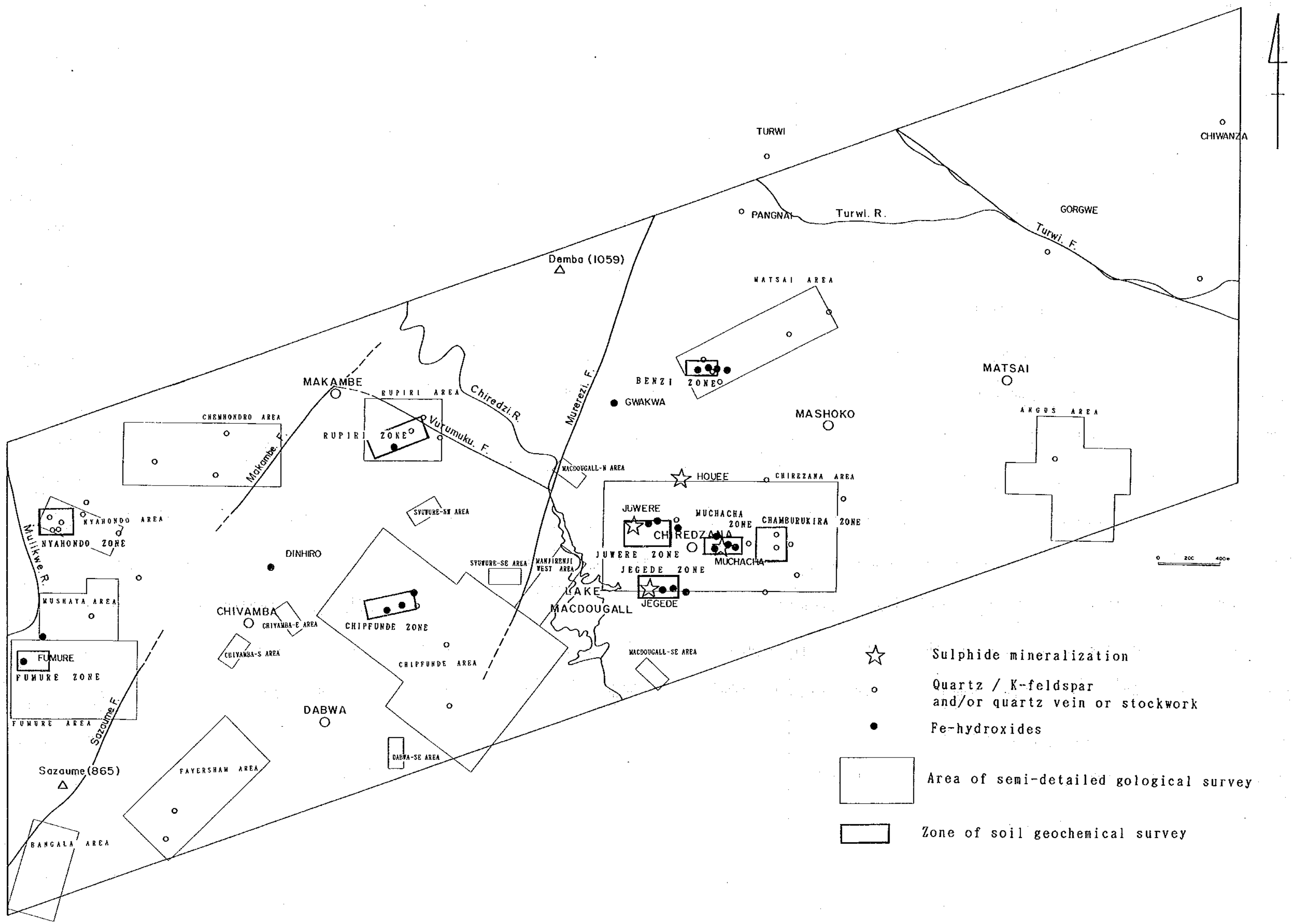

FIG. 2-1-16 Locality Map of Mineralized Zone

CHAPTER 3 GEOCHEMICAL SURVEY

Sample Collection

In the soil geochemical survey, samples were collected checking sample collecting points, which were established previously so as to cover the survey zones by transit and tape. In nine survey zones, 10,047 soil samples were collected on the line of 100-meter line-spacing and 30-meter interval.

A sample of about 50g of -80 mesh size was collected in each place. The analytical results of these samples are shown in APPENDIX A-1 together with the geology which was determined based on the origin of each sample, collected position, etc..

Preparation of Sample and Detection Limit of Analysis

The samples were dried at the survey base. About a quantity of 20g was separated from each sample for analysis, and after preparing sample lists, samples for analysis were shipped to Iijima Laboratory, Akita, Japan.

Analytical detection limits were as follows;

Au	1 ppb
Ag	0.5 ppm
As	1 ppm
Bi	0.5 ppm
Cu	1 ppm
F	20 ppm
Zn	1 ppm
Cr	1 ppm
Fe	0.01 %

As the frequency of appearance of value below the detection limit was high for Au, As and Bi, statistical treatment was carried out by assuming the values below the detection limit as 0.5 ppb, 0.5 ppm and 0.05 ppm, respectively.

Statistical Treatment of Analytical Value

Single variate and multivariate analyses were carried out for the ten elements(Au, Ag, As, Bi, Cu, F, Zn, Cr, Fe) of 10,047 samples collected during this survey. In geochemical data analyses, it has been known empirically that the frequency distribution of the contents of minor elements contained in geochemical samples assumes log normal distribution (Lepeltier, 1969). Accordingly, it has been the general method of determining anomalous values to pay attention to the deviation (anomalous population) from the log normal distribution (background population) shown by the major part of a certain indicator. The population handled in geochemical survey is usually the composite population of the background population and anomalous population, and it becomes important to divide these two in conformity with actual conditions. Apart from the case where the object composite population assumes log normal distribution, particular consideration is required. In the past, a method to determine background values and threshold values using a cumulative frequency distribution curve by Lepeltier (1969) and Sinclair (1976) has been used as a method to solve this problem.

In this survey, however, background and threshold values were determined on the basis of geometric mean and geometric standard deviation as same as that of phase I. The calculation was made on each geological units as possible as one can. The geological units were divided into three categories:

Mafic granulite : Rock code 3

Felsic granulite : Rock code 4

Gneissose granulite : Rock code 5

Determination of Threshold Values

Threshold values were determined on the basis of statistical calculation. Determination of threshold is as follows:

Threshold(1) = GM(m) + 1 geometric standard deviation(1δ)

Threshold(2) = GM(m) + 2 geometric standard deviation(2δ)

Threshold(3) = GM(m) + 3 geometric standard deviation(3δ)

Attributions of geochemical indicators are shown in TABLE 2-3-1.

Threshold values are summarized for each geological unit as follows:

Correlation Coefficient between Indicators

The correlation coefficients between indicators on a logarithmic base were calculated for the all geological units. In the geological units, correlation coefficients between respective indicators were generally small, suggesting that the origins of individual indicators are different from each other.

Background Geology and Indicator Content

The contents of indicators in soils depend upon the geological conditions and the degrees of mineralization and alteration of the background area from which soils came from. Accordingly, geochemical characteristics for respective geological units are shown in TABLE 2-2-1 and others. A comparison on the content of indicators between the area and other area based on data by Flanagan(1976) and Vinogradov(1962) was made.

Principal Component Analysis

After determining the correlation coefficients between indicators, which cannot be extracted by single variable analyses, from multi-dimensional distribution characteristics, these were applied to the determination of character and the evaluation of geochemical anomalies. Results of analysis are considered on survey zones, each geological units and indicators.

Au Concentration and Principal Component Scores

Contrasts were calculated and tabulated for each indicators. Although principal component scores relating to Au were shown as figures in the soil geochemical zones. In general, no anomalous zones with good continuity were found for any indicators except Au, notes were added to records of some surveyed zones which produced noticeable results.

The figures were made on the basis of the geometrical mean and standard deviation for each geological unit, as shown below. Principal component scores were shown in the figures essentially in the same manner, except for the Nyahondo zone where negative principal component scores are represented after converting them into their positive, absolute values.

① $> GM + 3\sigma$

② $> GM + 2\sigma \sim GM + 3\sigma$

③ $> GM + 1\sigma \sim GM + 2\sigma$

④ $> GM \sim GM + 1\sigma$

⑤ $> GM - 1\sigma \sim GM$

⑥ $< GM - 1\sigma$

Machine contouring using minimum curvature by Briggs(1974) was applied for making contour maps of soil geochemical results.

As for contrast, the note "high contrast indicators" was added to elements when their soil $GM+\sigma$ was higher than the corresponding rock by a factor of 10 or more.

2-1 JUWERE ZONE

2-1-1 Sampling

Soil sampling lines were set on east-west direction due to north-south occurrences of Juwere mineralized zones and B-horizon soil was taken. Soil colour in the zone reflects the basement geology. In general, gray and brown soils were predominant in the western, northern, and eastern portions of the zone and red

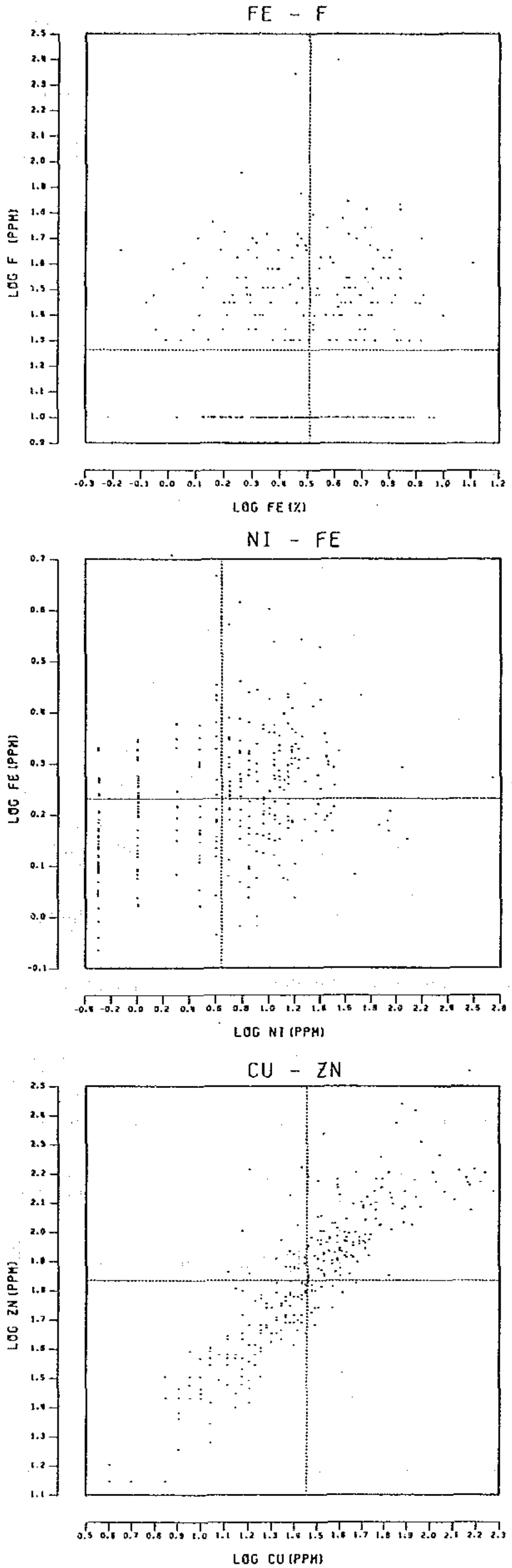

FIG. 2-2-1 Scatter Diagram (Fe-F, Ni-Fe, Cu-Zn)

soils in the central portion.

Soils taken over the mafic granulite, felsic granulite, and gneissose granulite were 82, 324, and 1,153 respectively.

2-1-2 Geochemical Indicators

Two mineralized zones were found within the zone. Analytical results of the soils poorly agreed with the observations which confirmed the sulphide mineralization in the field.

The contents on geochemical indicators compared with all zones studied and Juwere zone are shown as follows;

ROCK CODE	Au (PPB)	Ag (PPM)	As (PPM)	Bi (PPM)	Cu (PPM)	F (PPM)	Zn (PPM)	Cr (PPM)	Ni (PPM)	Fe (%)
ALL ZONES										
R.C.3	1.73	0.63	2.25	0.06	61.57	26.42	90.47	215.97	153.32	6.89
R.C.4	0.98	0.48	0.58	0.05	8.82	23.02	40.41	30.92	11.77	1.96
R.C.5	0.93	0.53	0.66	0.05	12.86	30.30	37.45	44.07	19.23	1.90
JUWERE ZONE (SOIL)										
R.C.3	0.84	0.47	0.73	0.05	47.05	31.58	75.28	111.66	54.49	5.83
R.C.4	0.74	0.37	0.58	0.05	4.30	71.25	40.92	31.95	4.41	1.70
R.C.5	0.73	0.32	0.66	0.05	12.20	54.70	48.08	62.36	13.28	2.48

Background Geology and Indicator Content

Accordingly, geochemical characteristics for respective geological units are shown in TABLE 2-3-1. According to this table, geochemical characteristics on each indicator are summarized as follows:

Au : Geometric means(GMs) of rock code 3, rock code 4, and rock code 5 of all zones are 1.73, 0.89, and 0.93 ppb, respectively but rock code 3 in the zone has the largest value of 0.84 ppb. On the other hand, the smallest GM is 0.73 ppb of rock code 5. A comparison on the contents of indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) was made. Au contents in the zone can be pointed out to be rather low. The maximum value in the zone is 115 ppb.

Ag : GMs of rock code 3, rock code 4, and rock code 5 of all zones are 0.63, 0.48, and 0.53 ppm, respectively but rock code 3 in Juwere zone has the largest value of 0.47 ppm. On the other hand, the smallest GM is 0.32 ppm of rock code 5. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) was made. Ag contents in the zone rather high, with a maximum value of 11 ppm.

As : Since approximately 70 % of data indicated the contents below its detection limit(1.00 ppm), it is difficult to clarify its geochemical character in the zone. GMs of rock code 3, rock code 4 and rock code 5 of all zones are 2.25, 0.58, and 0.66 ppm, respectively but rock code 3 in the zone has the largest value of 0.73 ppm. On the other hand, the smallest GM is 0.58 ppm of rock code 4. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) was made. As contents of the zone is fairly low, with maximum value of 240 ppm.

Bi : Since approximately 95 % of data indicated contents below its detection limit(0.10 ppm), it is difficult to clarify its geochemical character in the zone. GMs of all zones are 0.06, 0.05, and 0.05 ppm, respectively. There is no difference among the GMs of rock codes. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) was made. Bi contents in the zone is nearly the same. Maximum value in the zone is 1.10 ppm.

Cu : GMs of rock code 3, rock code 4, and rock code 5 of all zones are 61.57, 8.82, and 12.86 ppm, respectively but rock code 3 in the zone has the largest value of 47.05 ppm. On the other hand, the smallest GM is 4.30 ppm of rock code 4. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) was made. Copper contents of the zone is fairly low. The maximum value in the zone is 432 ppm.

F : GMs of rock code 3, rock code 4, and rock code 5 of the zone are 26.42, 23.02, and 30.30 ppm, respectively but rock code 4 in the zone has the largest value of 71.25 ppm. On the other hand, the smallest GM is 31.58 ppm of rock code 3. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) was made. F contents in the zone is fairly low, with maximum value of 650 ppm.

Zn : GMs of rock code 3,rock code 4, and rock code 5 of the zone are 90.47, 40.41, and 37.45 ppm, respectively but rock code 3 in the zone has the largest value of 75.28 ppm. On the other hand, the smallest GM is 40.92 ppm of rock code 4. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) made clear that Zn contents in the zone is rather low. The maximum value in the zone is 5,050 ppm.

Cr : GMs of rock code 3, rock code 4, and rock code 5 of the zone are 215.97, 30.92, and 44.07 ppm, respectively but rock code 3 in the zone has the largest value of 111.66 ppm. On the other hand, the smallest GM is 31.95 ppm of rock code 4. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) made clear that Cr contents of the zone is almost same. However, the indicator's values fluctuate greatly for rock types according to Flanagan's data. The maximum value in the zone is 5,400 ppm.

Ni : GMs of rock code 3, rock code 4, and rock code 5 of the zone are 153.32, 11.77, and 19.23 ppm but rock code 3 in the zone has the largest value of 54.49 ppm. On the other hand, the smallest GM is 4.41 ppm of rock code 4. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) made clear that Ni contents of the zone is almost the same for the area compared. However, values of Flanagan's data fluctuate greatly for various rock types. The maximum value in the zone is 621 ppm.

Fe : GMs of rock code 3, rock code 4, and rock code 5 of the zone are 6.89, 1.96, and 1.90 %, respectively but rock code 3 in the zone has the largest value of 5.83 %. On the other hand, the smallest GM is 1.70 % of rock code 4. A comparison on contents of the indicator between the zone and other areas based on data by Flanagan(1976) and Vinogradov(1962) made clear that Fe contents in the zone is normal. The maximum value in the zone is 22.09 %.

Determination of Threshold Values

An interpretation was conducted on the cumulative frequency curve of Au in each geological unit. The results are summarized as follows:

Rock code 3 : Au shows a kind of dual distribution as shown in FIG.2-2-2. Geochemical values principally consist of two populations, that is cumulative frequency of each population is about 70 %, and 30 %. The threshold value(GM + 2 δ)determined statistically correspond to the upper 3 % level of the second population.

Rock code 4 : Au also shows a kind of dual distribution as shown in FIG.2-2-2. Geochemical values principally consist of two populations, that is, cumulative frequency of each population is about 70 %, and 30 %. The threshold value(GM + 2 δ)determined statistically indicates near the median value(upper 5 % level) of the second population.

Rock code 5: The cumulative frequency curve shows almost same characteristics to that of rock code 4, as shown in FIG. 2-2-2.

Correlation Coefficient between Indicators