

Fig. 19 Results of the geochemical survey of Area A-1 (2)

vii) REE in Xenotime

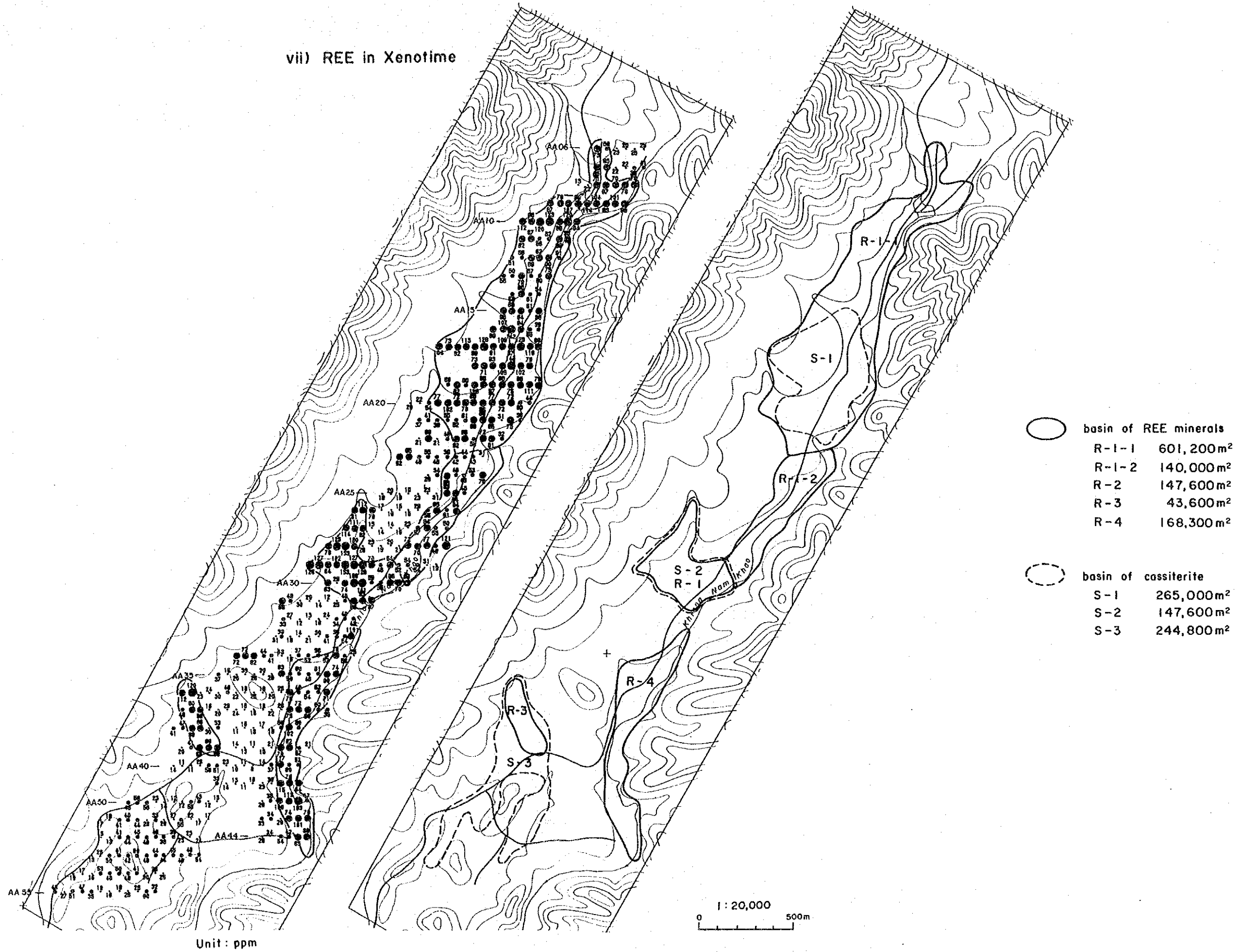


Fig. 19 Results of the geochemical survey of Area A-1 (3)

4-1-4 Consideration

The reserves of ore deposits are estimated on the basis of the assumption that the geochemical anomaly zones would indicate the distribution of placer tin and REE deposits.

The anomalous zones are shown in Fig. 19, and that of Sn are distributed in three places: from S-1 to S-3, and that of Total REE in four places: from R-1 to R-4. The boundaries of each anomaly zone were determined based on the element content distribution maps and the geographical characteristics investigated at the time of the survey.

It is expected that the reserves of monazite and xenotime are 2,200 thousand tons. The reserve of cassiterite is 1,135 thousand tons.

Area A-1 has a relatively high potential for placer deposit.

4-2 Area A-2

4-2-1 Location

Area A-2 is 23 kilometers northeast of Kra Buri town, and located southeast of Area A-1. The center of this area is at latitude $10^{\circ}35'N$ and longitude $98^{\circ}55'E$. The area covers the east granite mass in the northern Kra Buri area.

The main rivers are Chan River running southward in the western part of the area and Noi River running westward in the southern part of the area. Their large tributaries run to the NNE-SSW direction, and their small branches are found to the E-W or N-S direction. This area ranges in altitude from 50 to 230 meters. The southern part of this area consists of dissected and gentle hills whereas the northern part consists of steep mountains, generally ranging in altitude from 50 to 230 meters.

An unpaved road branching from the Route 4 leads northward to U-Chan River by way of the survey area. The distance of the roads from Kra Buri town to the survey area is about 30 kilometers, and it takes about one hour to get there by car.

The results of the first year's stream sediments prospecting revealed the geochemical anomaly of Sn and W on the western side of Chan River, the anomaly of Ce, Sm, La, Nd and Th along the Chan River, and the anomaly of Ta, U, Y, Tb in the area from Chan River to the East granite mass in the northern Kra Buri area. The strong anomaly of REE, U, Y and Th is strong in the section. Primary deposits or adsorp-

tion-type rare earth deposits were expected in the granite mass, because the granite in this area has a deeply argillized and weathered crust.

4-2-2 Geology

The Area A-2 is underlain by Carboniferous Matri Formation in its western half, Cretaceous granite in the eastern half, and Quarternary fluvial sediments found along the rivers (Fig. 20).

The Matri Formation consists of clayey-shale, sandy-shale and black slate, and is distributed in the mountains on the west of Chan River. The Formation is composed generally of argillized and weathered soft rocks, except a hard phyllitic slate between the base points of the AB19-AB22 survey lines and Chan River.

Cretaceous granite forms rather steep mountains on the north of the AB17 line, and forms gentle hills on the south of this line. This granite is medium to coarse-grained two-mica granite (adamellite). This rock is composed mainly of quartz, microcline, orthoclase, plagioclase, biotite, muscovite and tourmaline, with accessories zircon, apatite, sphene and ilmenite.

The granite has been altered by superficial weathering. The weathering crust partially remains on the ridges, but a fresh granite exposes in the valleys.

The greisen-like altered granite occurs on the ridges north of the AB06 survey line, where the granite has been widely subjected to sericitization and partly kaolinization. It is inferred that this altered granite reaches until deep part. Many quartz boulders, ranging from 1 to 3 meter in diameter, are found around the east end of the AB01 and AB02 survey lines on the north of the argillized granite. It can be stated that the granite in this part underwent regional hydrothermal alternation.

Argillized granite is widely distributed on hills near from AB2810 to AB3110 point, and in the area from point No.10 to No.12 on the AB20-AB22 lines. A lot of clay derived from argillized granite have accumulated in valleys between hills.

In the granite mass, roof-pendent of silicified rocks occurs in the NNE-SSW direction near the AB20-AB26 lines in the eastern edge of the survey area.

Fluvial sediments consisting mainly of sand and silt are distributed in the basins of Chan River, its tributaries, and Noi River. White clay consisting mainly of sericite and kaolinite are distributed on gentle

A-2

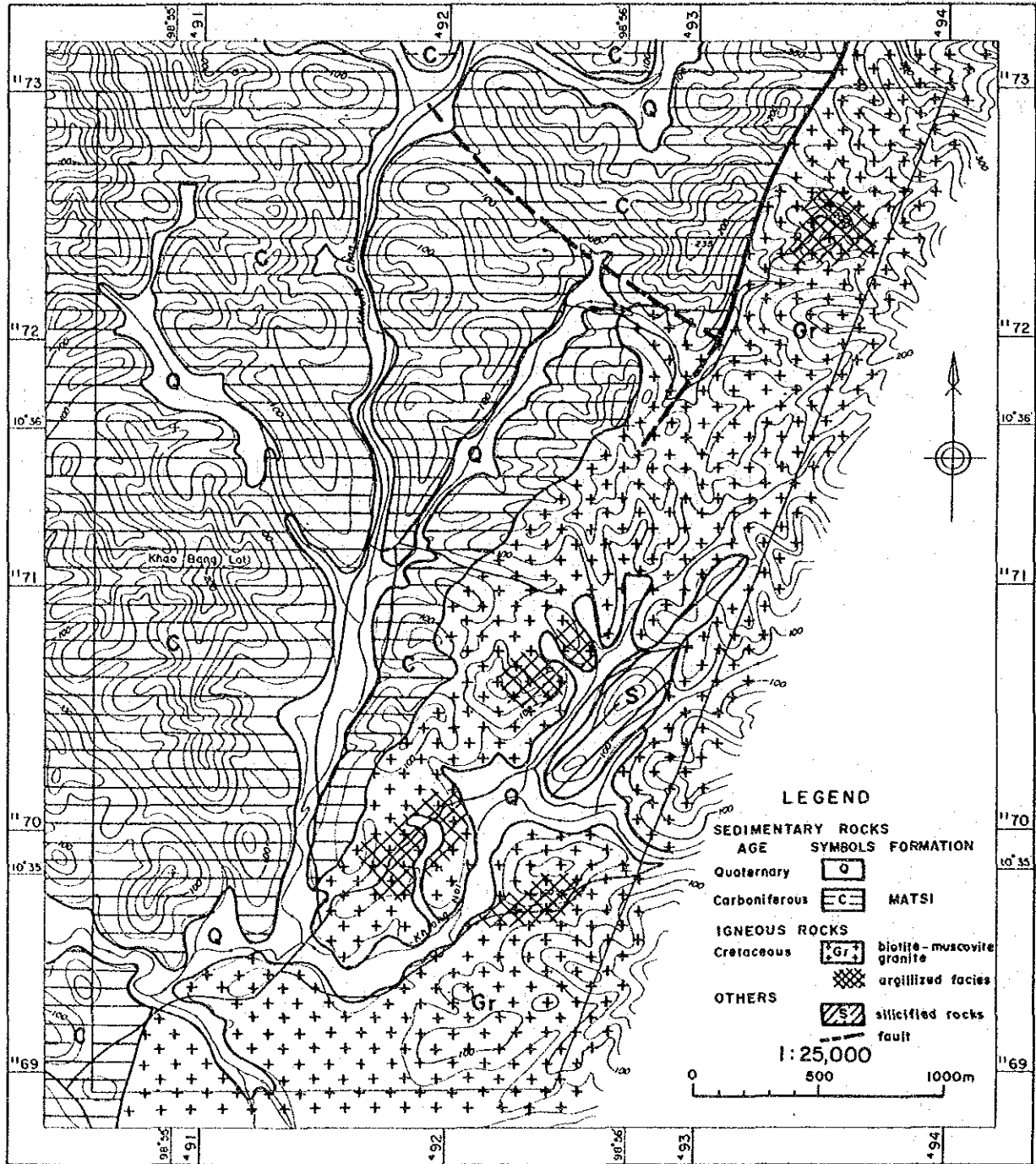


Fig. 20 Geologic Map of Area A-2

hills on the south of the AB20 line.

4-2-3 Results of Geochemical Prospecting

(1) Soil Samples

The threshold of Sn (24.7 ppm). The thresholds of Ta+Nb, Total REE and Th+U are taken 30 ppm, 252 ppm and 48 ppm respectively. The content distribution maps are shown in Fig.21 (1) to (8).

Specially high Sn values are found around AB18 and AB19 lines. High anomaly values on the eastern side of both lines are on the ridge and slope, it may mean that the cassiterite bearing quartz veins or pegmatites exist around these points. High anomaly values on the western side of both lines are in a valley, it may indicate an alluvial basin containing cassiterite. The high concentration zone of Sn almost overlaps with granite area, and the values from 40 to 80 ppm are found in the AB01-AB10, AB20-AB33, AB36-AB37 line areas. Its distribution almost overlaps with that of argillized granite. The Sn content in lowlands stretching along Noi River and its tributaries is lower than that in the neighbor areas. It indicates that alluvial basins containing cassiterite have not been developed. The content of the other elements' groups in this lowlands also tends to be lower than that in the neighbor areas. Anomaly values in the Chan River basin are found to be distributed in a very narrow and long area along the river.

The high W anomaly zones overlap with the distribution of granite. The distribution of W concentration is also in harmony with that of Sn.

There are three Nb-Ta anomaly zone of 50 ppm and over. One of zone overlaps with the argillized granite of the AB01-AB08 and AB26-AB33 lines. The second overlaps with the high Sn anomaly near the AB18-AB19 lines. Other high anomaly zone is distributed on the western side of the AB21-AB lines.

The anomaly values of Total REE, Th-U almost overlaps with the granite body, except the argillized granite in the northern part and the lowlands along Noi River where the contents are low. The high anomaly is distributed in the area of AB10-AB19 lines, where bed rocks crop out along a valley and weathering crust is thin. Though the specially high content samples are distributed along a valley, there are little fluvial sediments and this valley is narrow; thereby the only small reserve can be expected. Another high anomaly is recognized narrowly along the tributary of Chan River on the western edge of the BA12-BA19 lines, and an alluvial basin containing rare earth minerals is expected here.

(2) Sample of Heavy Minerals

Heavy mineral samples were panned from fluvial sediments of Chan River and Noi River. The quantity of heavy minerals are very small in Area A-2. Heavy minerals are fine-grained and well rounded. The highest Sn content is obtained from ABM-04 collected from near the confluence of Chan River and Noi River. The Sn content of Chan River's samples tend to be higher than that of Noi River's samples. Two samples have high Total REE, Th-U content. One sample is collected from the tributaries of Chan River (ABM-01) and the other sample from the gentle stream on the granite (ABT-03).

4-2-4 Consideration

Area A-2 is composed of gentle hills, and the granite is deeply argillized and has a weathering crust. Therefore primary ore deposits and adsorption-type rare earth deposits were expected in the argillized and weathered portion of the granite. However, it has been made clear by this survey that the argillized part of granite shows the low REE content, whereas the fresh granite's area shows the high REE content, and weathering crust is rather thin. Therefore, it hardly seems possible that primary ore deposits and clay adsorption-type rare earth deposits exist in this area.

The calculated reserve of placer deposits are rather small and low grade, because the alluvial basin located along Chan River is on a small scale. Area A-2 has a low potential for placer deposit.

4-3 Area B-1

4-3-1 Location

Area B-1 is about 7 kilometers northeast of Kra Buri town. The center of the area is at latitude 10°28'N and longitude 98°35'E. The area was settled along the upper stream of Wan River in the north of the central granite mass, because of the extension of an alluvial basin.

The river system is a dendriform, and rivers run westward from the central granite mass. The area ranges in altitude from 50 to 300 meters. The western part of the survey area consists of rather steep mountains with narrow valleys, whereas the east part consists of a flat basin.

An unpaved road branches from the Route 4 at Khalong Village, and leads to the survey area. The distance of the roads from Kra Buri Town to Area B-1 is about 17 kilometers. It takes about 40 minutes to get there by car, but it is difficult to get there after raining.

Sn

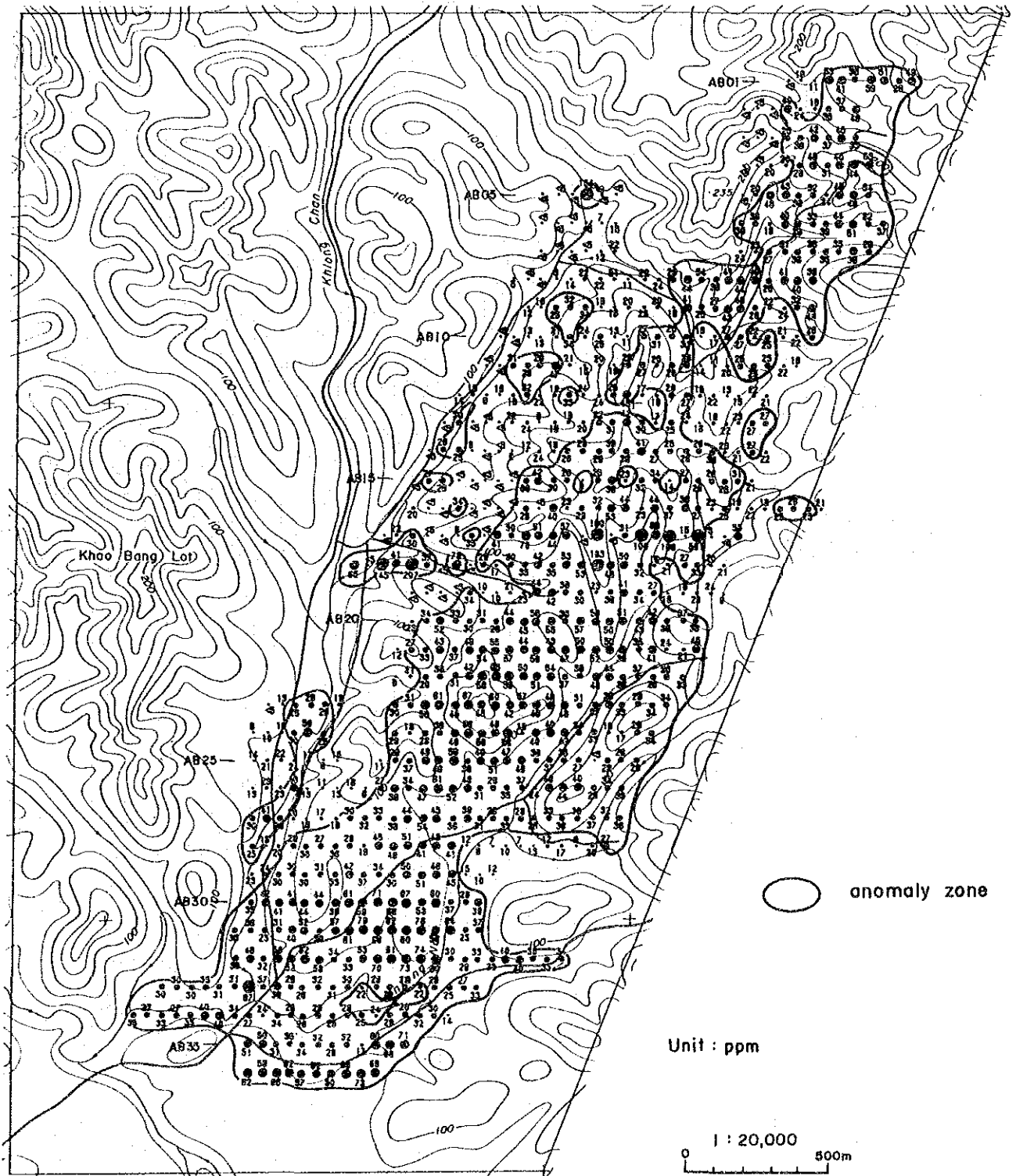


Fig. 21 Results of the geochemical survey of Area A-2 (1)

W

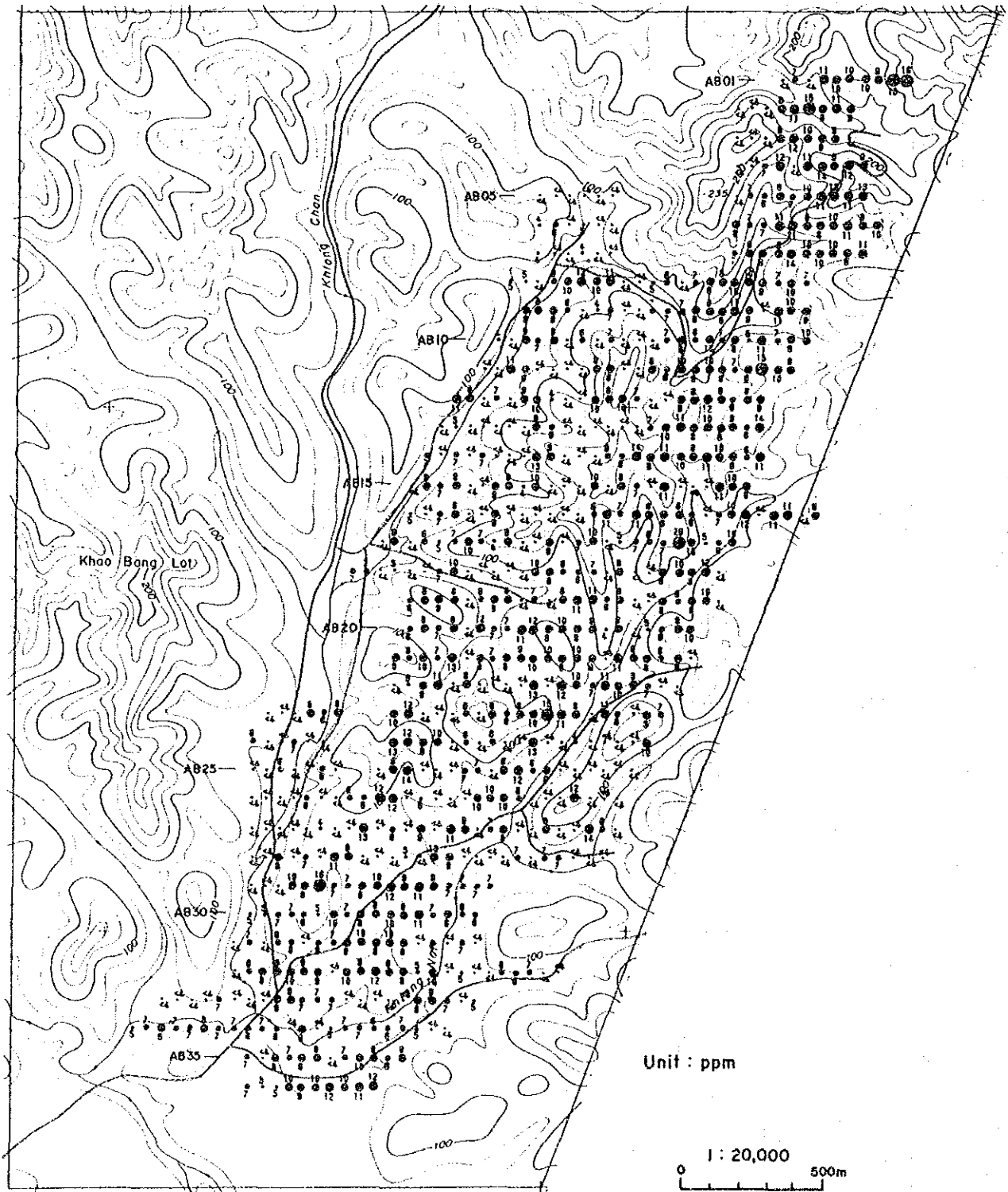


Fig. 21 Results of the geochemical survey of Area A-2 (2)

Ta + Nb

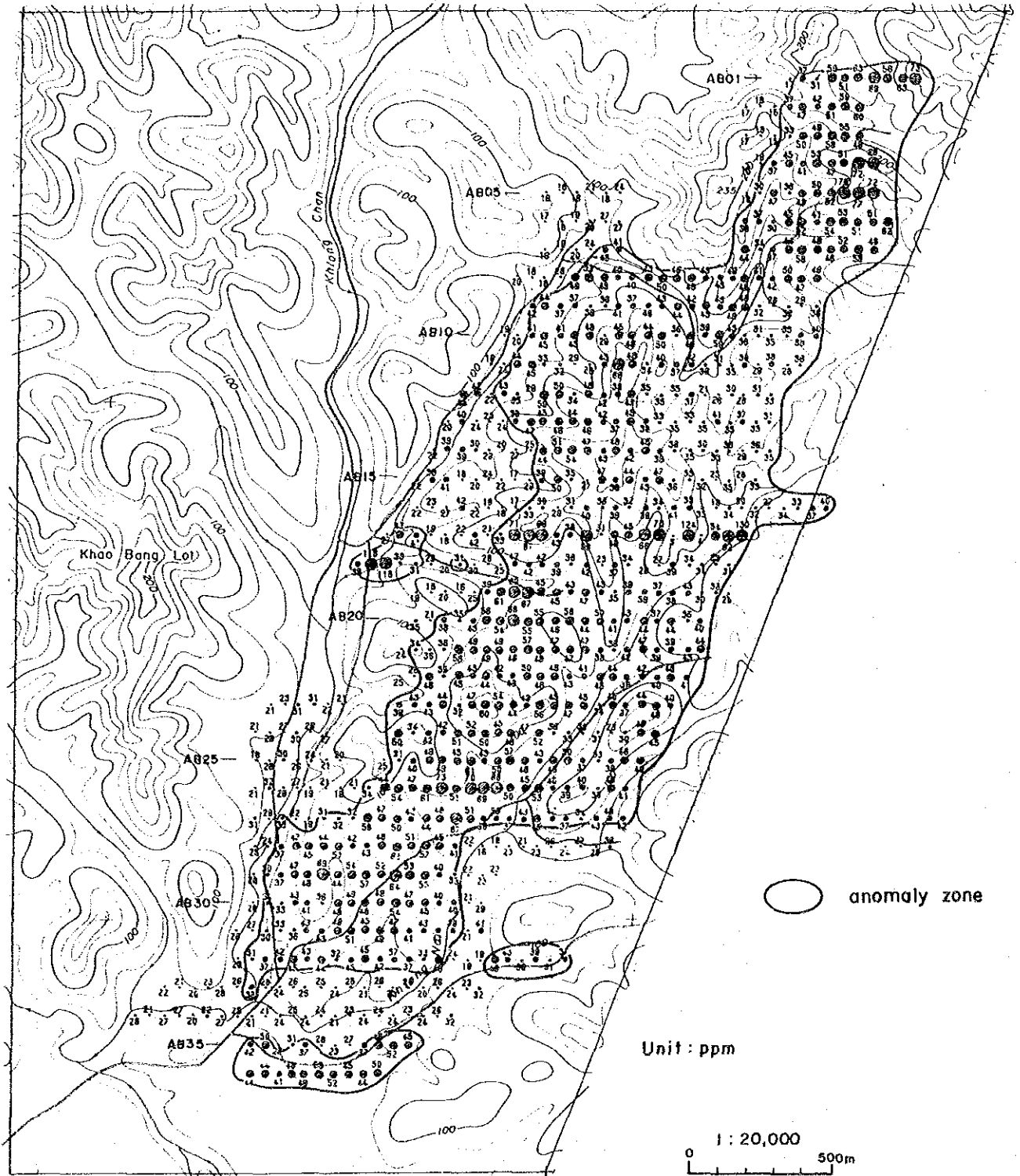


Fig. 21 Results of the geochemical survey of Area A-2 (3)

Total REE

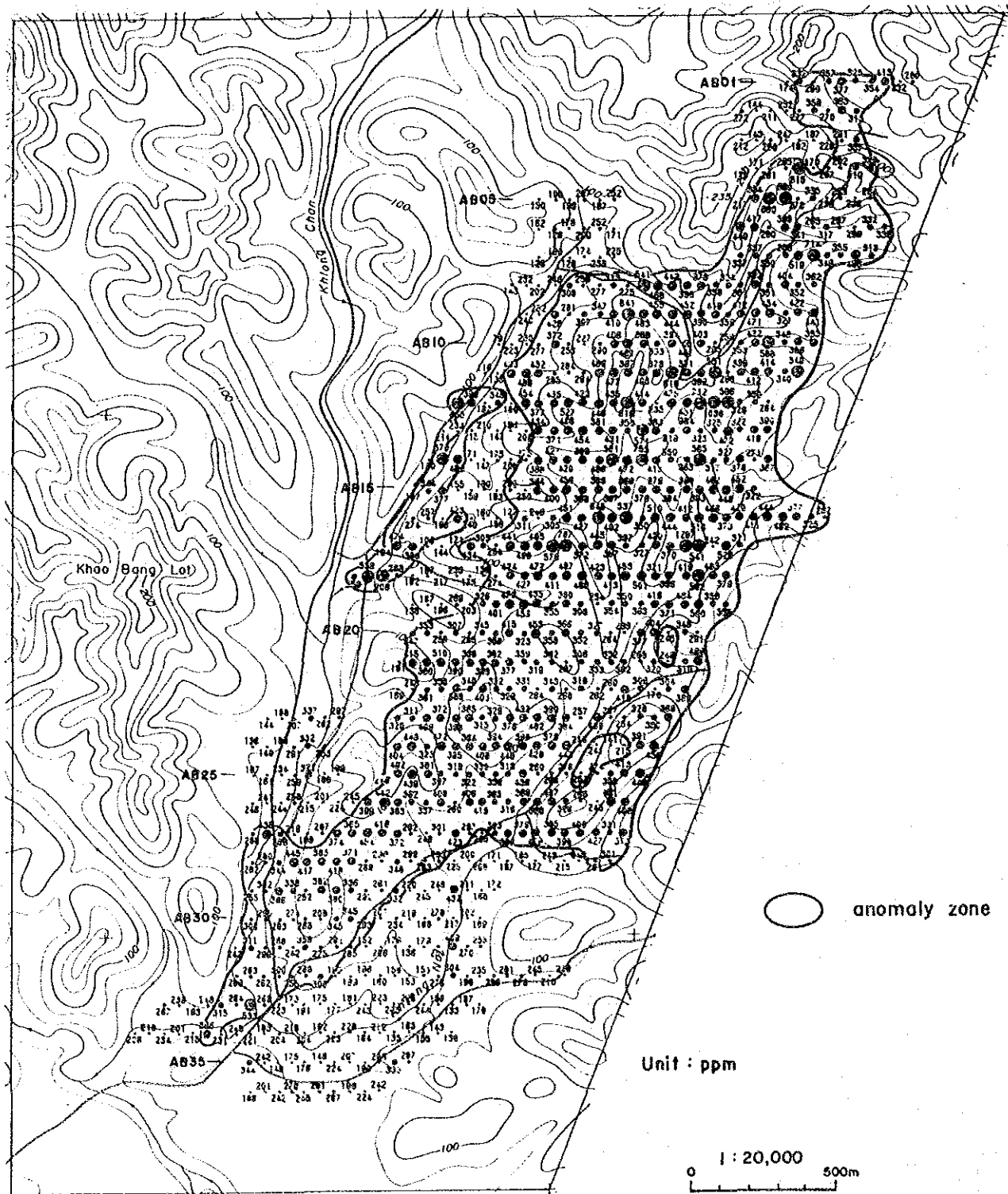


Fig. 21 Results of the geochemical survey of Area A-2 (4)

Th + U

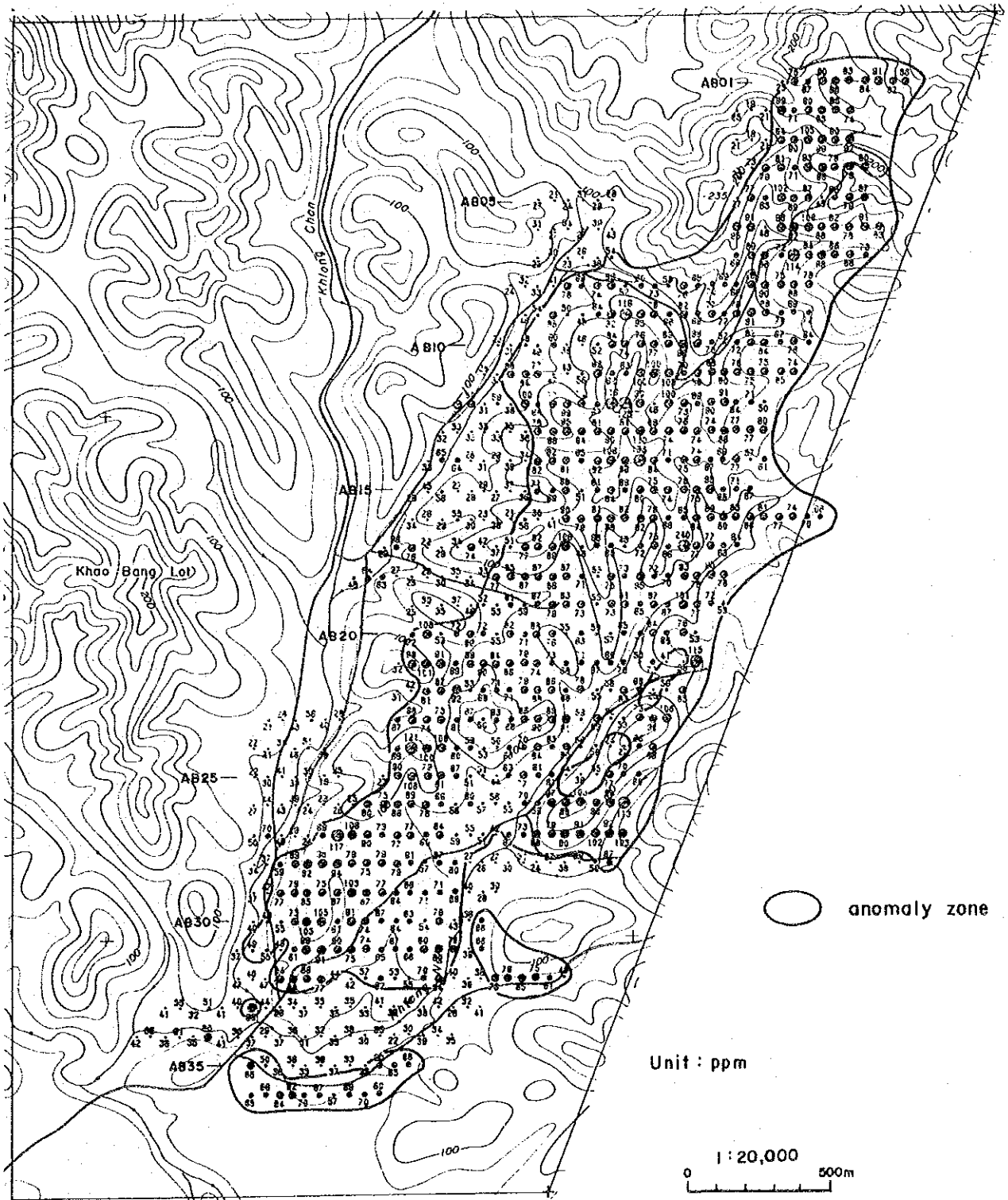


Fig. 21 Results of the geochemical survey of Area A-2 (5)

REE in Xenotime

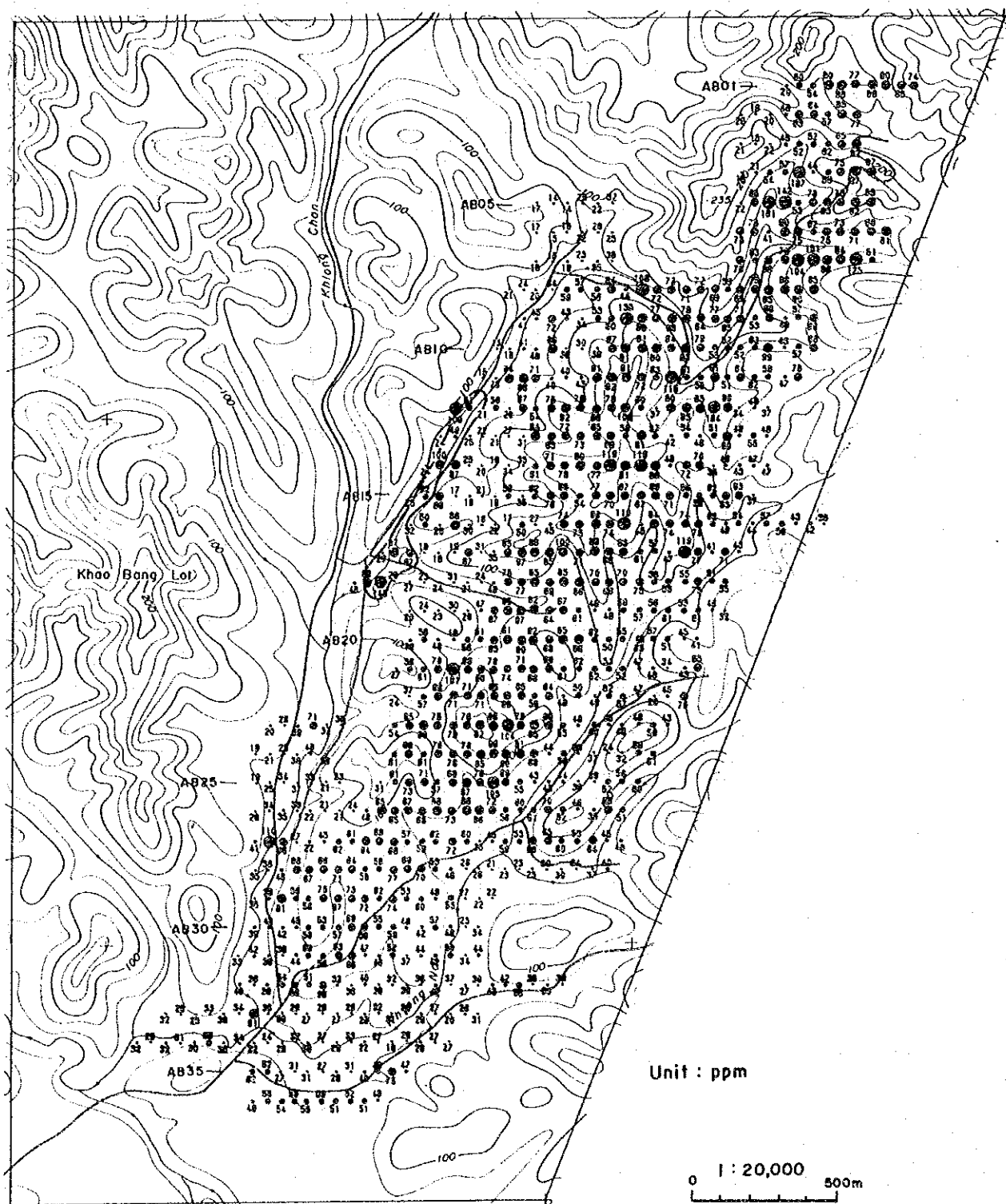


Fig. 21 Results of the geochemical survey of Area A-2 (7)

REE, Th in Monazite

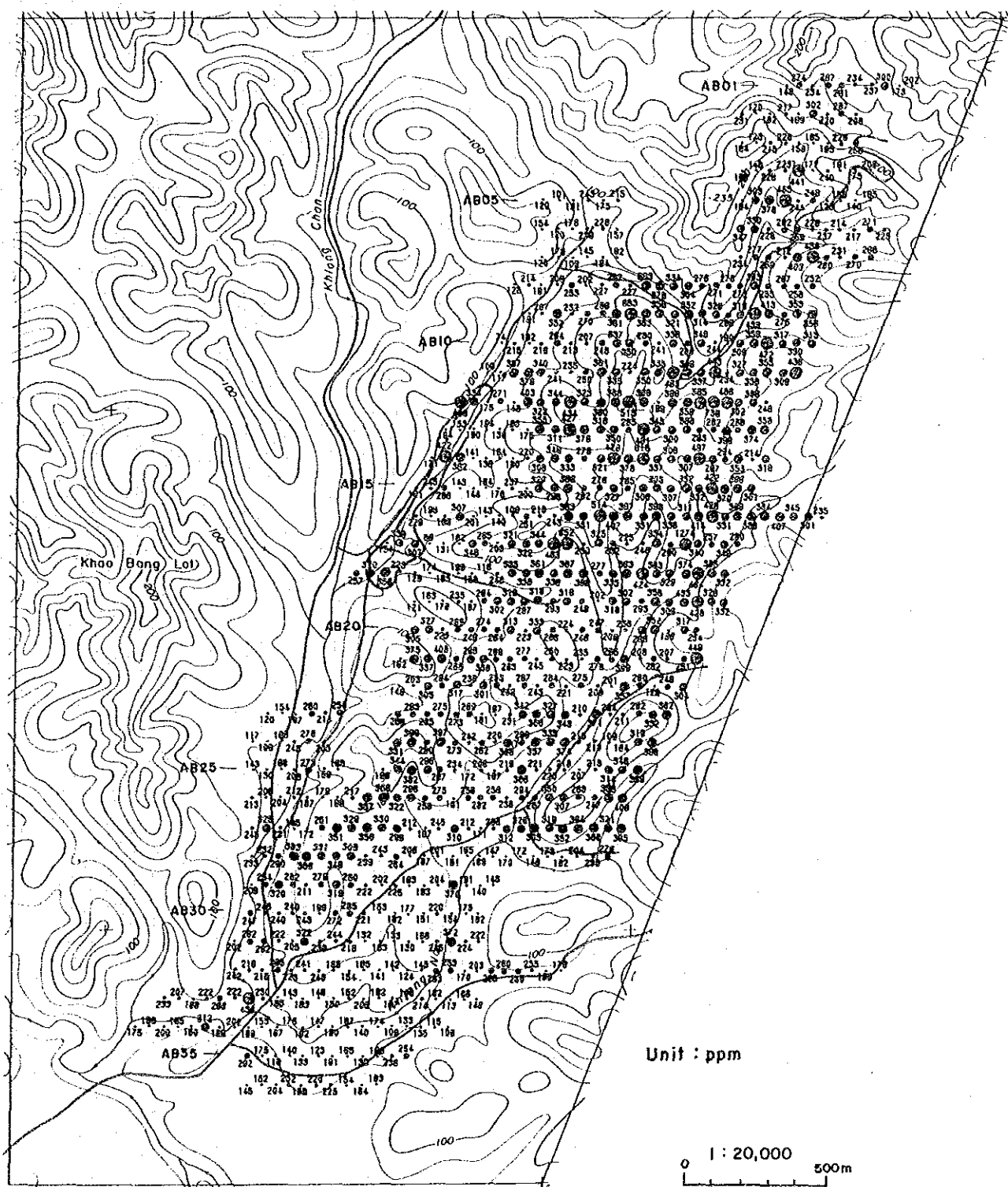


Fig. 21 Results of the geochemical survey of Area A-2 (6)

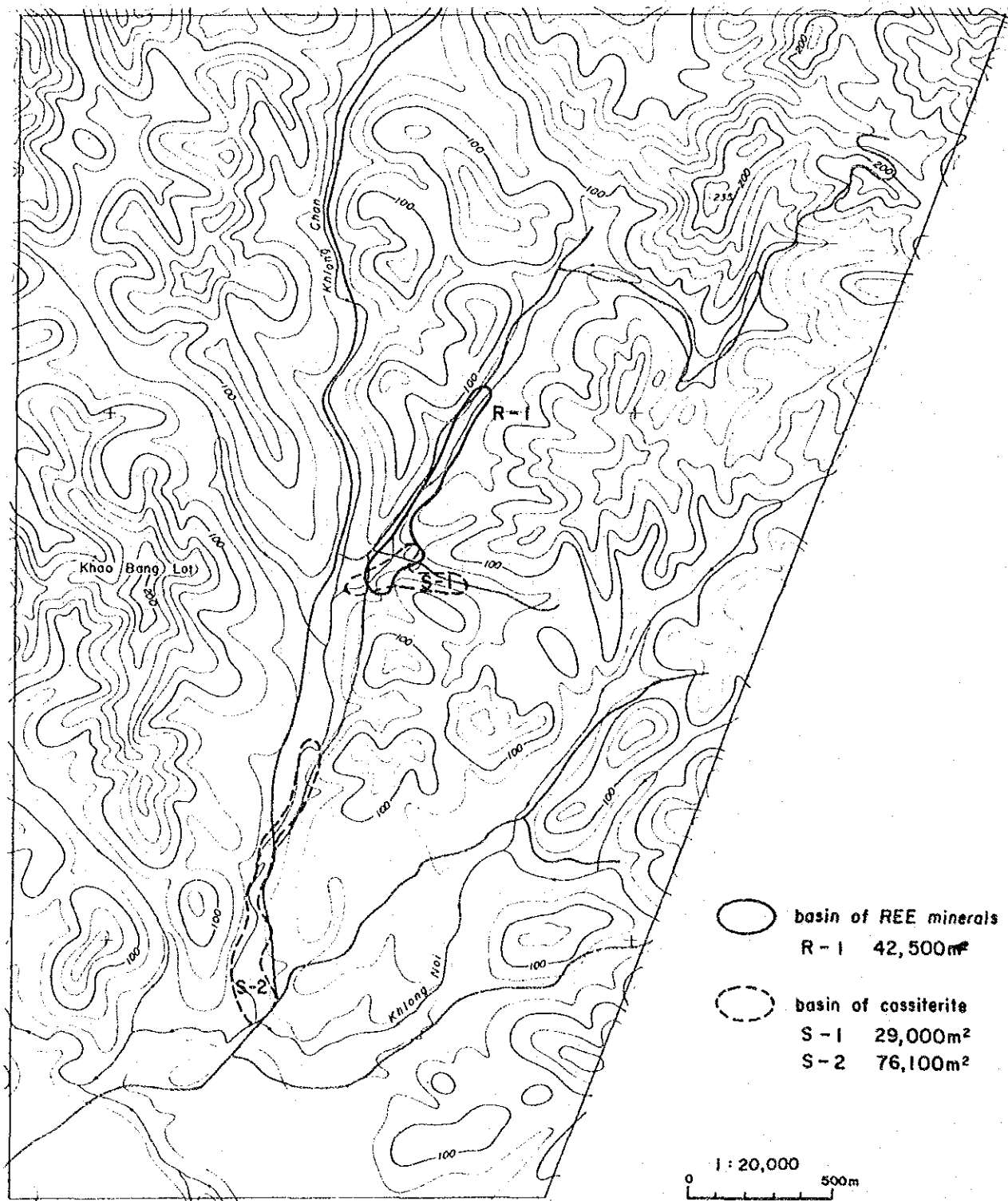


Fig. 21 Results of the geochemical survey of Area A-2 (8)

The anomaly of W, REE, Th, Y and U was detected by the first year's geochemical prospecting of stream sediments, and the anomaly of Sn, REE, Th and U was detected by that of heavy mineral samples.

4-3-2 Geology

Area B-1 is underlain by Silurian-Devonian Kra Buri Formation of the Tanaosi Group, Cretaceous granite and Quaternary sediments (Fig.22).

The Kra Buri Formation is dominant in the survey area and distributed in mountains and hills, which consists of slate, pebble-bearing mudstone and siltstone.

Cretaceous granite is distributed in the mountains in the eastern part of the survey area, and consists of biotite granite containing mega-crystals of potassium feldspar. The mega-crystals reach a maximum size of about 2 by 5 centimeters. The rock is mainly composed of microcline, orthoclase, quartz, plagioclase and biotite, with accessories zircon, apatite, sphene and ilmenite.

The Quaternary is fluvial sediments. A relatively-wide alluvial basin is found near the BA10-BA15 lines. The accumulations of a white clay about 1.5 meters thick and a sandy-silt about 1 meter thick overlies the Kra Buri Formation there. Much quartz gravel is found in the base of this alluvial basin. The small amount of sand and gravel is found along gullies near the BA01-BA03 lines in the northern part of the area. The sediments containing white clay are distributed near the BA05-BA07 lines on a small scale.

4-3-3 Result of Geochemical Prospecting

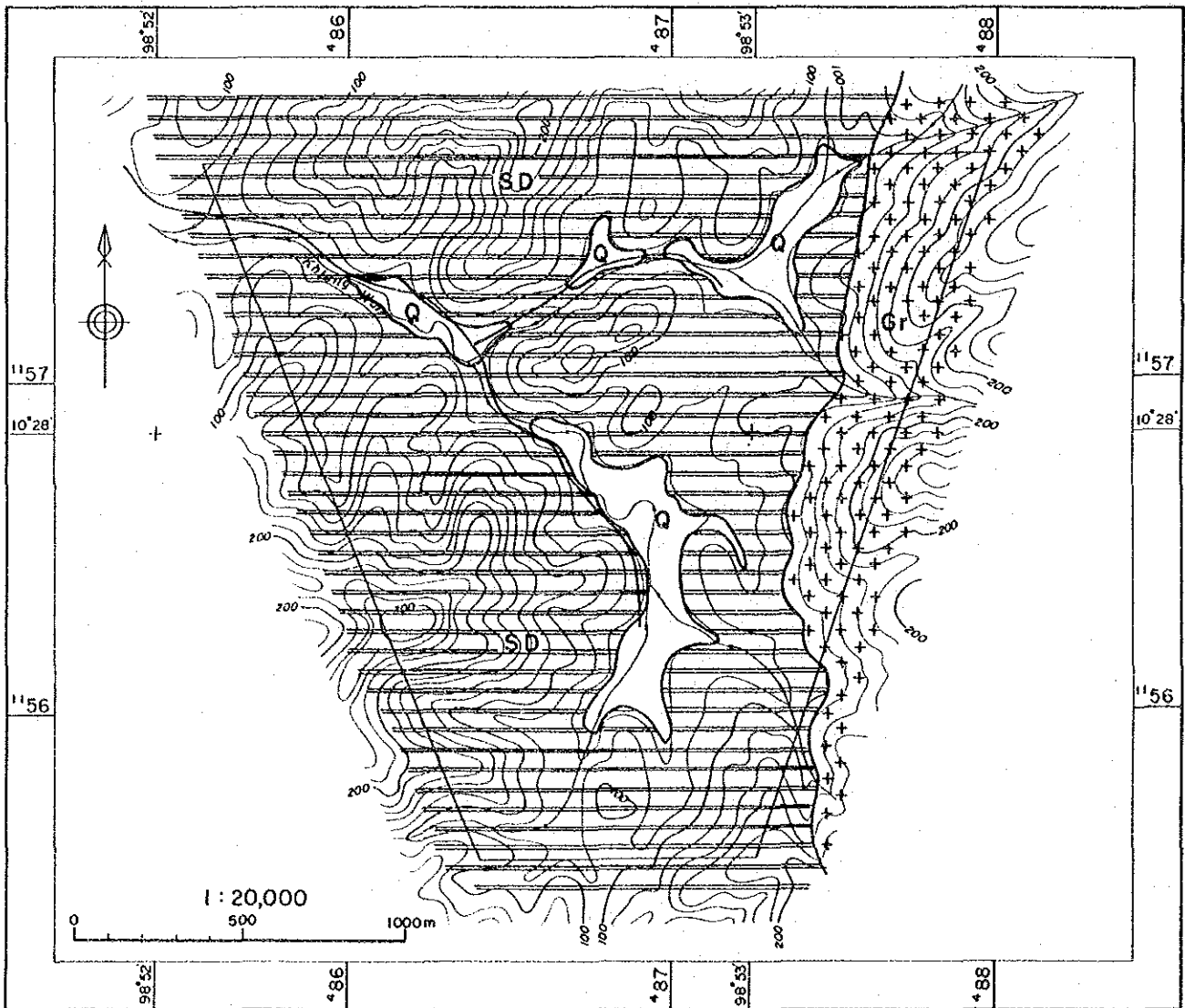
(1) Soil Samples

There is a natural gap in the cumulative probability curve of Sn at $M+\sigma$ (20 ppm); thereby the threshold is taken at this value.

The maximum value of W is 10 ppm, and it means that there are no anomaly values. But the distribution of above-detection-limit values overlaps with that of anomaly values of the other elements' groups on the content distribution maps.

The content maps of the groups are shown in Fig.23 (1) to (4). The cluster of Sn anomaly values is found in the eastern edge of the BA02-BA03 lines and in the area of BA11-BA15 line. Other anomaly values are scattered at the points of BA0707, BA0902 BA1002. The Sn anomaly zone in the BA02-BA03 lines coincides with the talus, alluvial fan and terrace sediments, mainly consisting of sand and gravel, derived from the granite mass. The BA11-BA15 anomaly zone is distributed in a southernmost part of

B-1



LEGEND

SEDIMENTARY ROCKS		
AGE	SYMBOLS	FORMATION
Quaternary	0	
Silurian - Devonian	SD	KRABURI
IGNEOUS ROCKS		
Cretaceous	Gr	biotite - muscovite granite

Fig. 22 Geologic map of Area B-1

the wide alluvial basin. The extension of this anomaly is larger than the BA02-BA03 anomaly. The basin consists mainly of clay and silt, and much quartz gravel accumulates at a base of the basin. The Sn grade is also high in this zone.

The distribution of Ta-Nb is almost same as that of total REE, except some high values on the east of the BA11 line.

The largest anomaly zone of total REE is found in the BA02-BA03 lines, which coincides with talus sediments in the north of the survey area. Other anomaly zones of total REE overlap with terrace sediments consisting mainly of sand and pebble in the BA05-BA07 lines and fluvial sediments along a valley in the southern area.

The anomaly values of Th-U overlap with that of Total REE.

(2) Samples of Heavy Minerals

Four panned heavy mineral samples are collected from Area B-1. The samples from the south basin are more Sn and less REE, Th and U. Those of the west basin tend to be less Sn and much REE, Th and U. The result accords with that of soil geochemical prospecting.

4-3-4 Consideration

The soil geochemical exploration reveals that the alluvial basins for placer deposits are on a small scale in this area; thereby much reserve can not be expected.

The elements of REE, thorium and uranium concentrate in the talus and terrace sediments, consisting of granite sand and gravel, in the north and the south of this area. The sediments in the north concentrate more than that in the south of this area. This may indicate that rare earth minerals in alluvial basin have not been transported much.

The anomaly zones of tin coincide with fine-grained sediments in the south of the survey area, and it is inferred that cassiterite has transported from southeast of the survey area.

4-4 Area B-2

4-4-1 Location

Area B-2 is 10 kilometers northeast of Kra Buri Town. The center of the area is at latitude 10°26.5'N

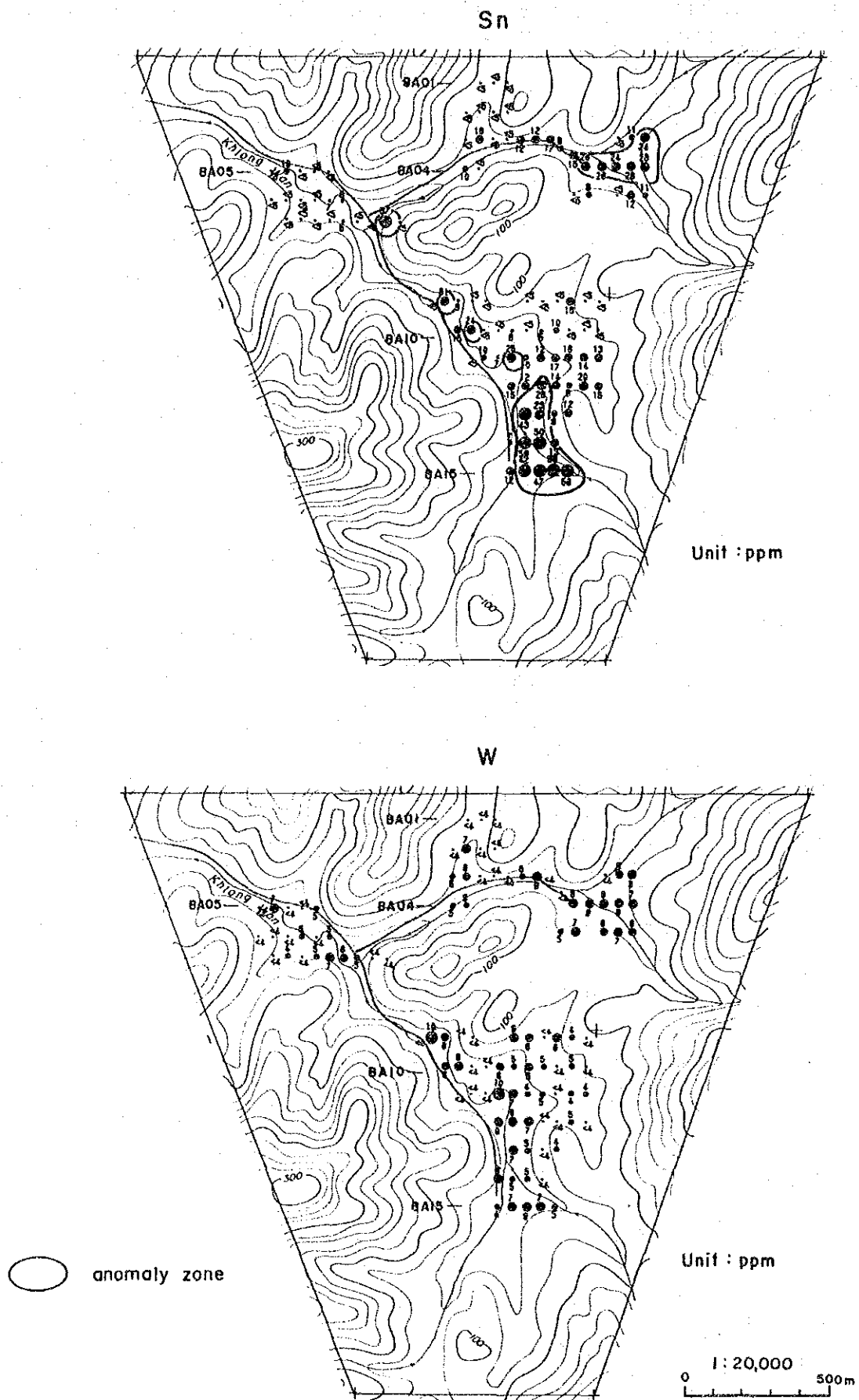
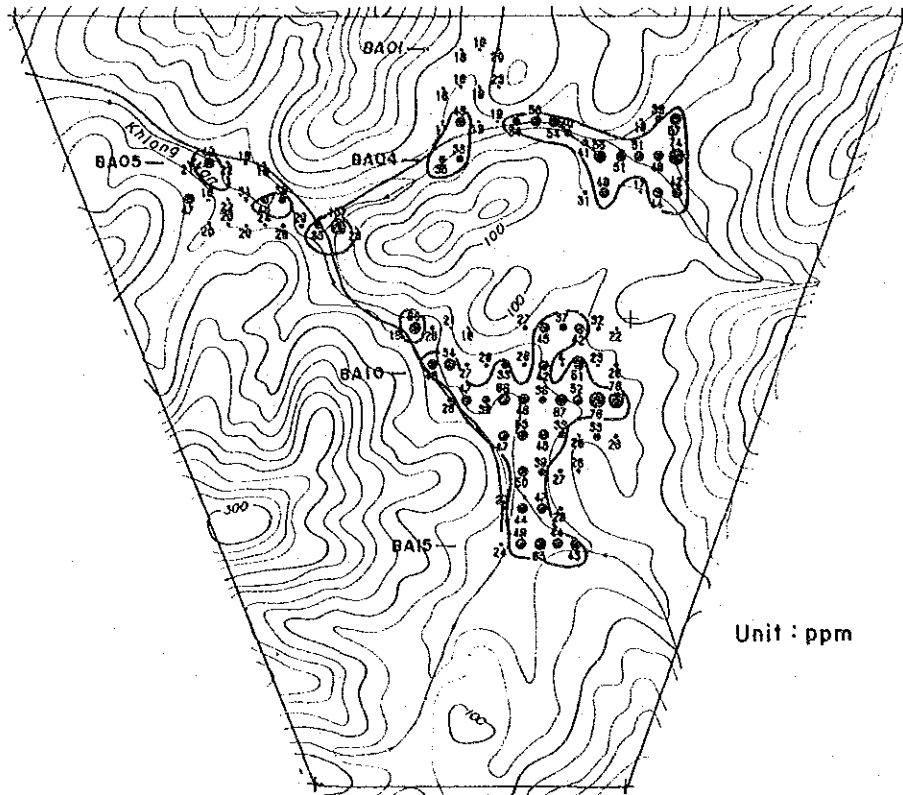


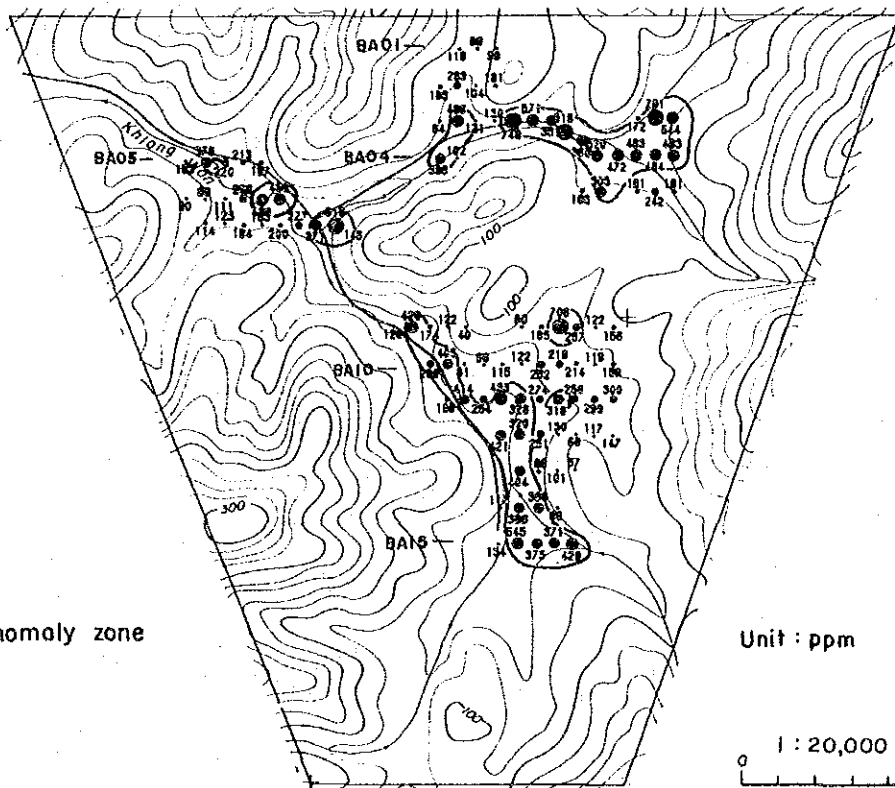
Fig. 23 Results of the geochemical survey of Area B-1 (1)

Ta + Nb



Unit : ppm

Total REE



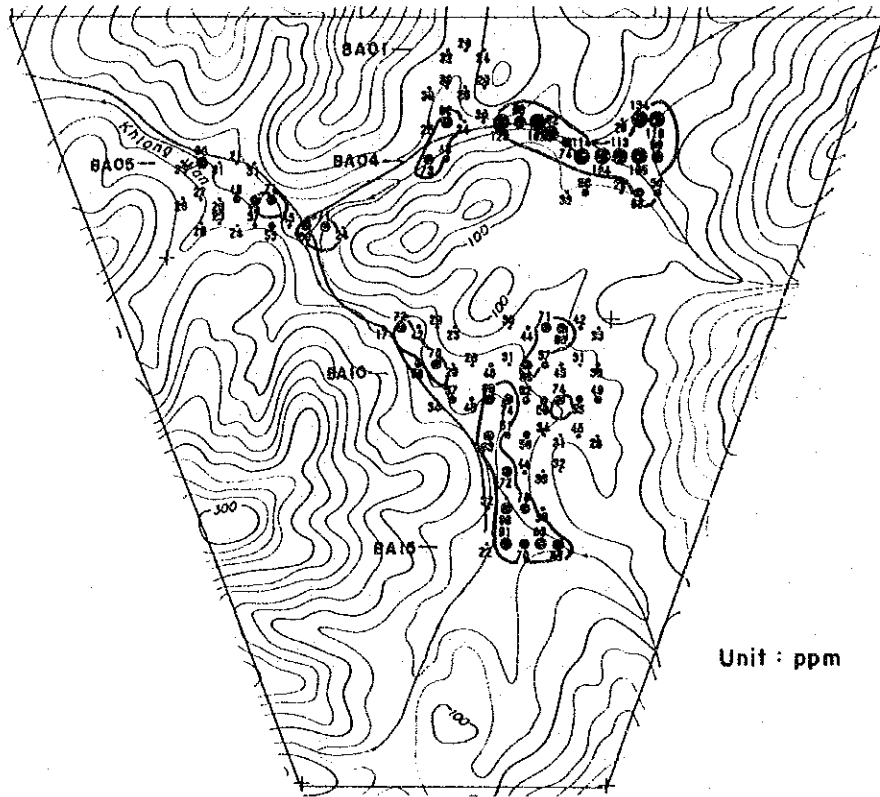
○ anomaly zone

Unit : ppm

1 : 20,000
0 500m

Fig. 23 Results of the geochemical survey of Area B-1 (2)

Th + U



REE, Th in Monazite

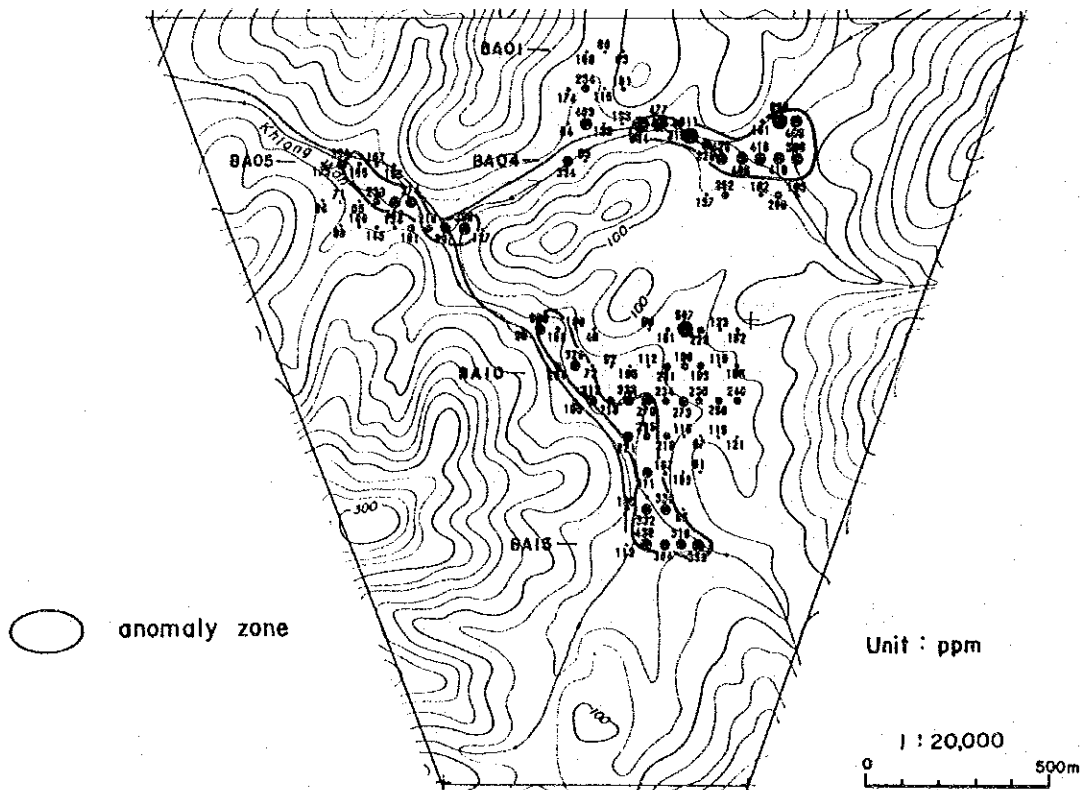


Fig. 23 Results of the geochemical survey of Area B-1 (3)

REE in Xenotime

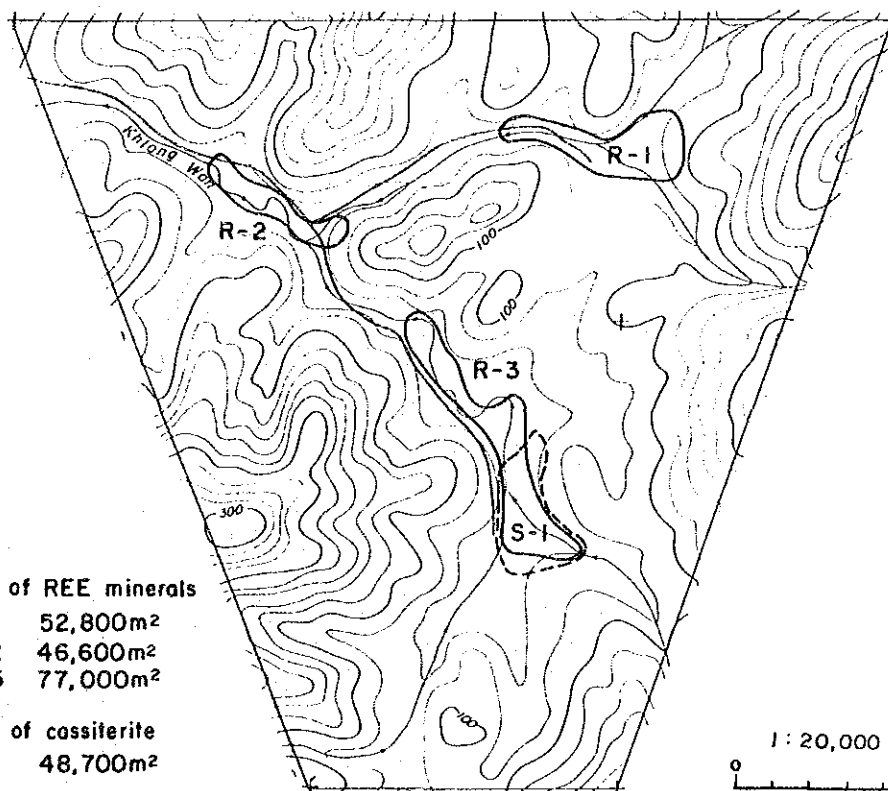
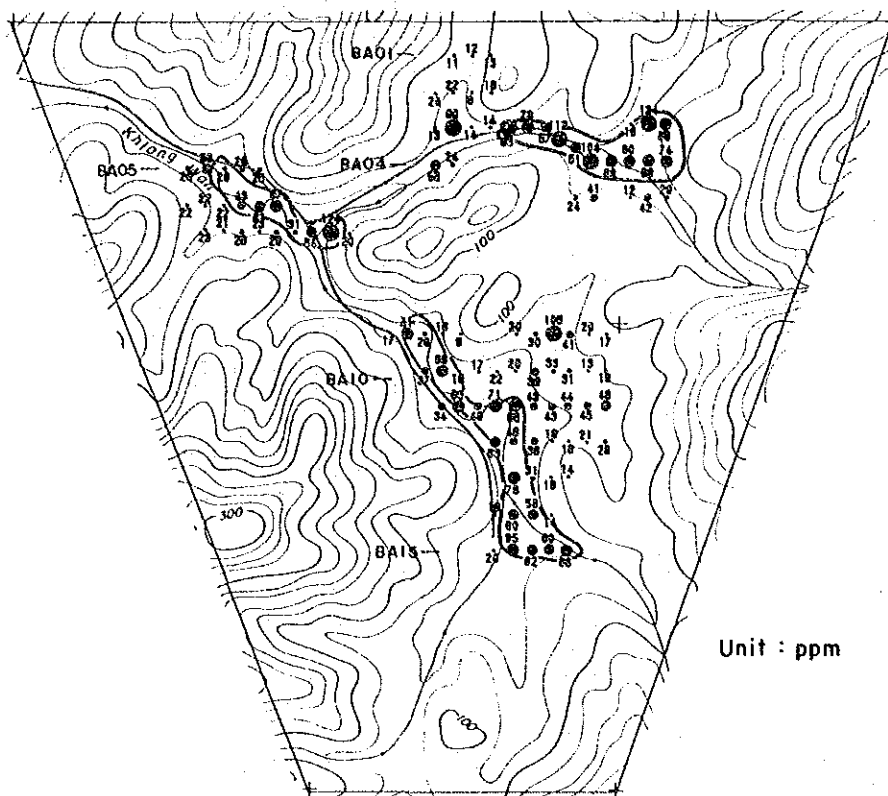


Fig. 23 Results of the geochemical survey of Area B-1 (4)

and longitude 98°52'E. The area was settled on an alluvial basin around the Phlu Yai River, which is the upper stream of Sawa River running westward from the center granite mass.

The river runs nearly in the E-W direction from the central granite mass, and small tributaries develop in a dendriform. The area ranges in altitude from 40 to 200 meters, and consists mainly of dissected hills except for slightly-steep mountains in the north of the area. An unpaved road branches from the Route 4 at Dong Sawa Villedge, and leads to Area B-2 through Area B-4. The distance of the roads from Kra Buri town is about 13 kilometers. It takes about 50 minutes to get there by car, but it is difficult to get there after raining.

The anomalies of W, Nb, Ta and REE W were detected by the geochemical prospecting of stream sediments and soil samples.

4-4-2 Geology

Area B-2 is underlain by Silurian-Devonian Kra Buri Formation, Carboniferous Matri Formation, Cretaceous granite and the Quaternary (Fig.24).

The Kra Buri Formation is distributed on the north of a NNE-SSW fault which in the north of the survey area, and consists mainly of slate and pebble-bearing mudstone.

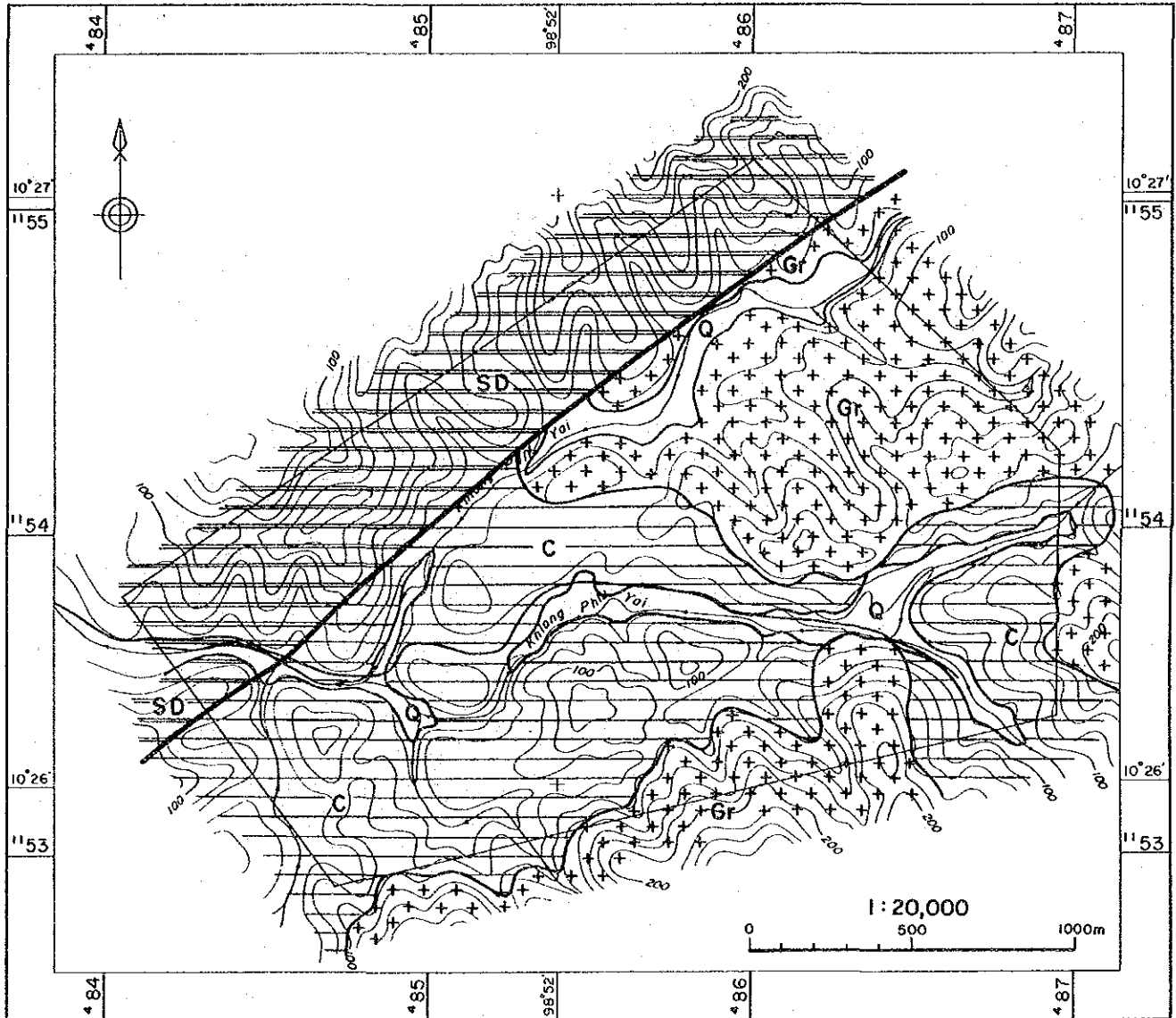
The Matri Formation is distributed in the center of the survey area, and consist of strongly weathered mudstone.

Cretaceous granite is distributed around the Matri Formation, but the intrusion has had no contact metamorphic effect on the surrounding sedimentary rocks. The granite consists of biotite granite and fine-grained two-mica granite. The biotite granite is composed mainly of microcline, orthoclase, quartz, plagioclase and biotite, with accessories zircon, apatite, sphene and ilmenite. fine-grained two-mica granite is found on a small scale near the BB1313 point, and it appears the marginal facies of the central granite mass. Two-mica granite is composed mainly of microcline, orthoclase, quartz, plagioclase, muscovite and biotite, with accessories zircon, tourmaline, and sphene.

The Quaternary is talus and fluvial sediments. Talus sediments are found in the east edge of the area, which consist of silt containing gravel of granite and quartz veins. Fluvial sediments are distributed in narrow terraces along rivers, and consist of sand and silt.

4-4-3 Results of Geochemical Prospecting

B-2



LEGEND

SEDIMENTARY ROCKS		
AGE	SYMBOLS	FORMATION
Quaternary	□	
Carboniferous	▨	MATSI
Silurian - Devonian	▩	KRABURI
IGNEOUS ROCKS		
Cretaceous	⊕	biotite - muscovite granite
OTHERS	—	fault

Fig. 24 Geologic map of Area B-2

(1) Soil Samples

The Sn values shows a bimodal distribution except its below-detection-limit values. The threshold is taken at $M+0.5\sigma$ (15ppm), which is the boundary of two populations. The threshold value of W is taken at $M+0.5\sigma$ (11 ppm) in the same manner. The values of the Ta-Nb group and Total REE group also show bimodal distribution respectively. The threshold is determined to mean values (Ta-Nb; 34ppm, Total REE; 217 ppm), which are the boundaries of two populations.

The values of Th-U group are composed of three populations. The threshold is determined to $M+0.25\sigma$ (61 ppm), which is one of skew points on the cumulative probability curve.

The content distribution maps are shown in Fig.25 (1) to (4).

Generally, most anomaly values are found in the area around BB10-BB13 lines in the east of the survey area. The several anomaly values of Total REE, TH-U are also found in a narrow area near the BB08-BB09 lines in the west of the survey area.

The cluster of Sn anomaly values is recognized in the BB10-BB13 lines. The content in the east side of these lines tends to be higher than that in the west side. The east side is underlain by talus sediments, whereas the west side is by fluvial sediments.

Two anomalies of W are detected in the east of Area B-2. They are the east anomaly and the west anomaly. The east anomaly is smaller than the other, but the W content is high in the east anomaly.

The Ta-Nb anomalies almost overlaps with that of Sn.

In the southwest of Area B-2, one of the anomaly of Total REE is distributed near the BB08-BB09 lines. The anomaly has high values, but is on a small scale. The other high values concentrate in the middle of Area B-2 in the west of the BB11-BB13 lines. They are on the fluvial sediments. On the other hand, the values on terrace sediments in the west are lower than the threshold.

The anomaly values of Th-U are distributed in the BB07-BB09 and BB10-BB13 lines. The anomaly values do not vary markedly, except that slightly higher values are observed in the center of the BB12 line.

(2) Samples of Heavy Minerals

Four samples of heavy minerals were collected. The samples on the eastern edge of the survey area

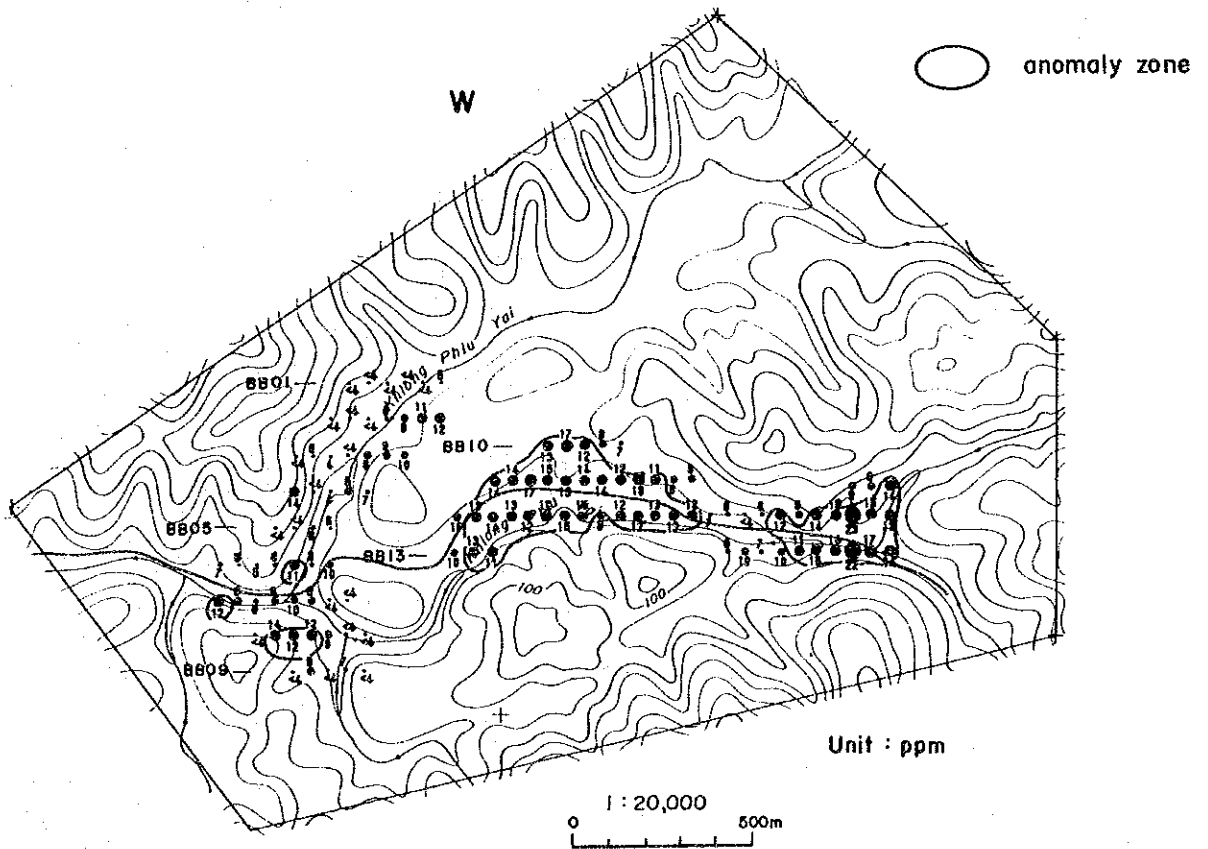
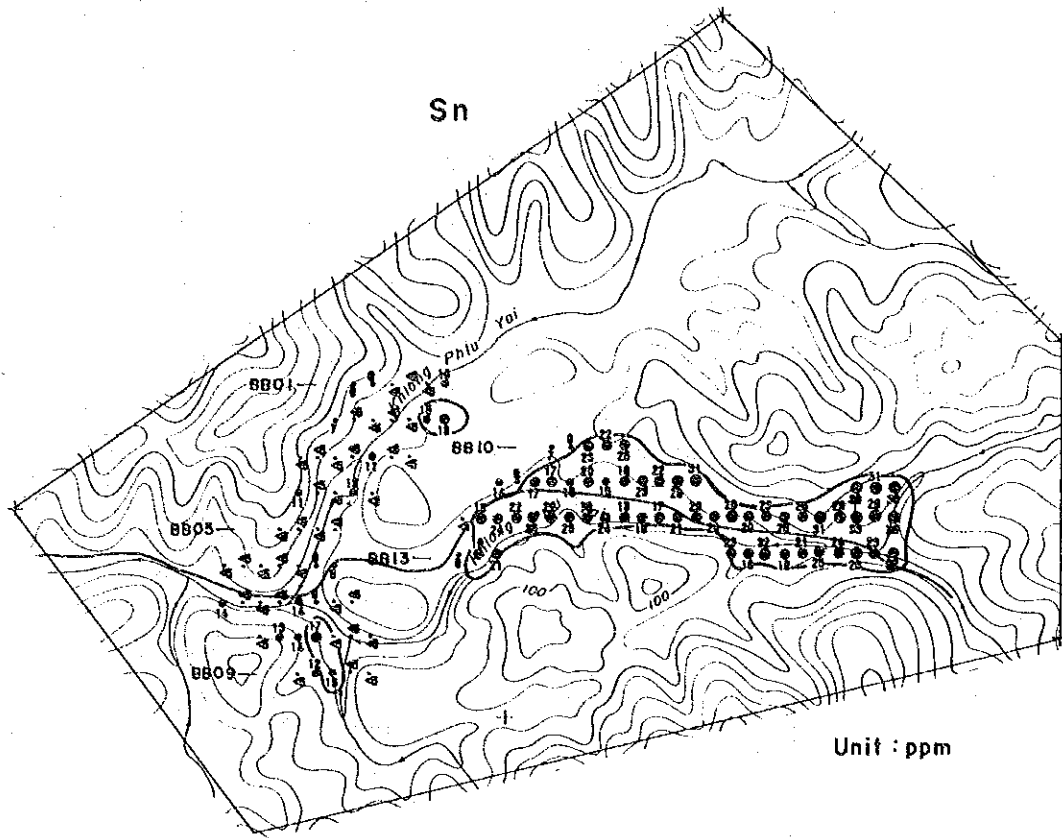


Fig. 25 Results of the geochemical survey of Area B-2 (1)

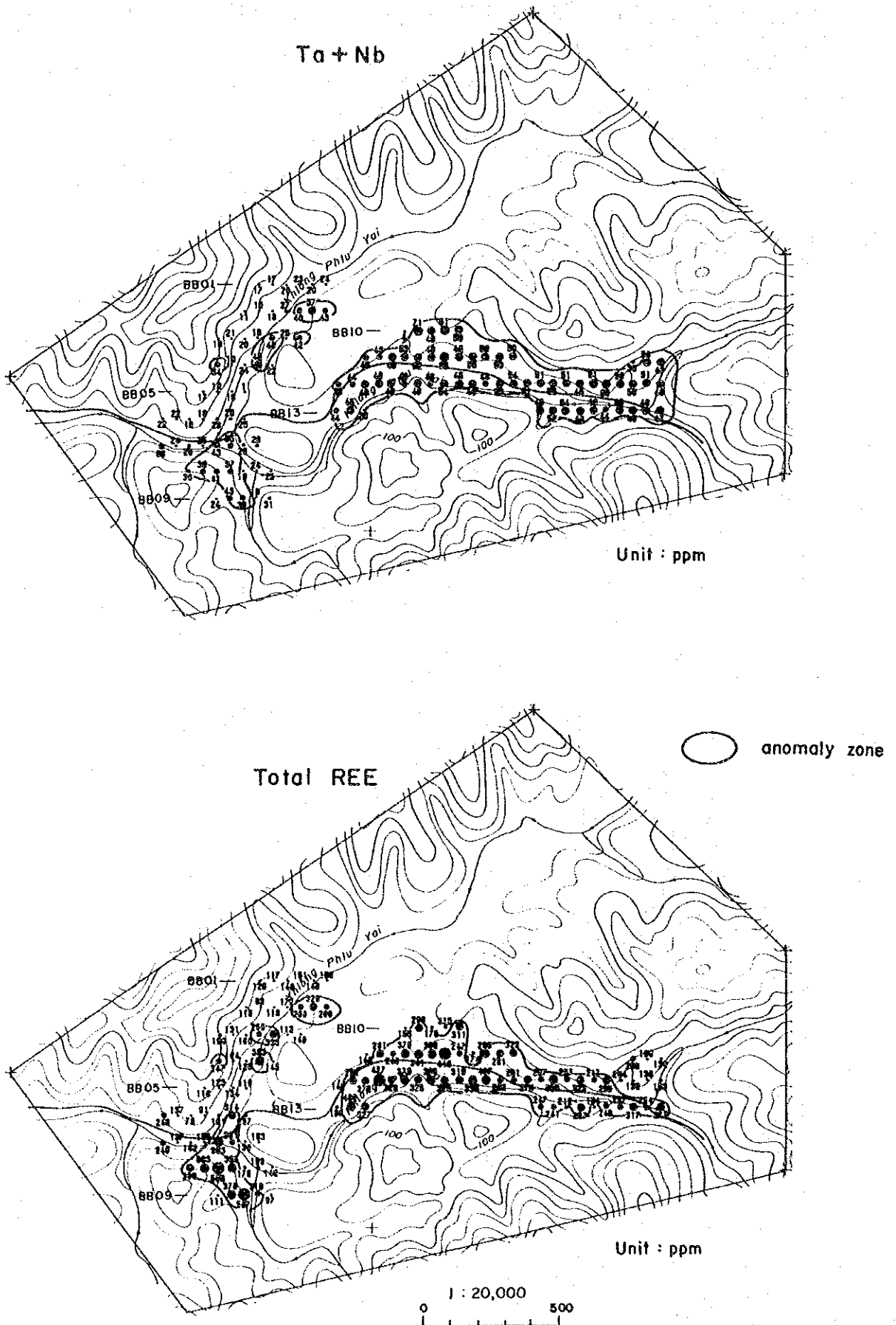


Fig. 25 Results of the geochemical survey of Area B-2 (2)

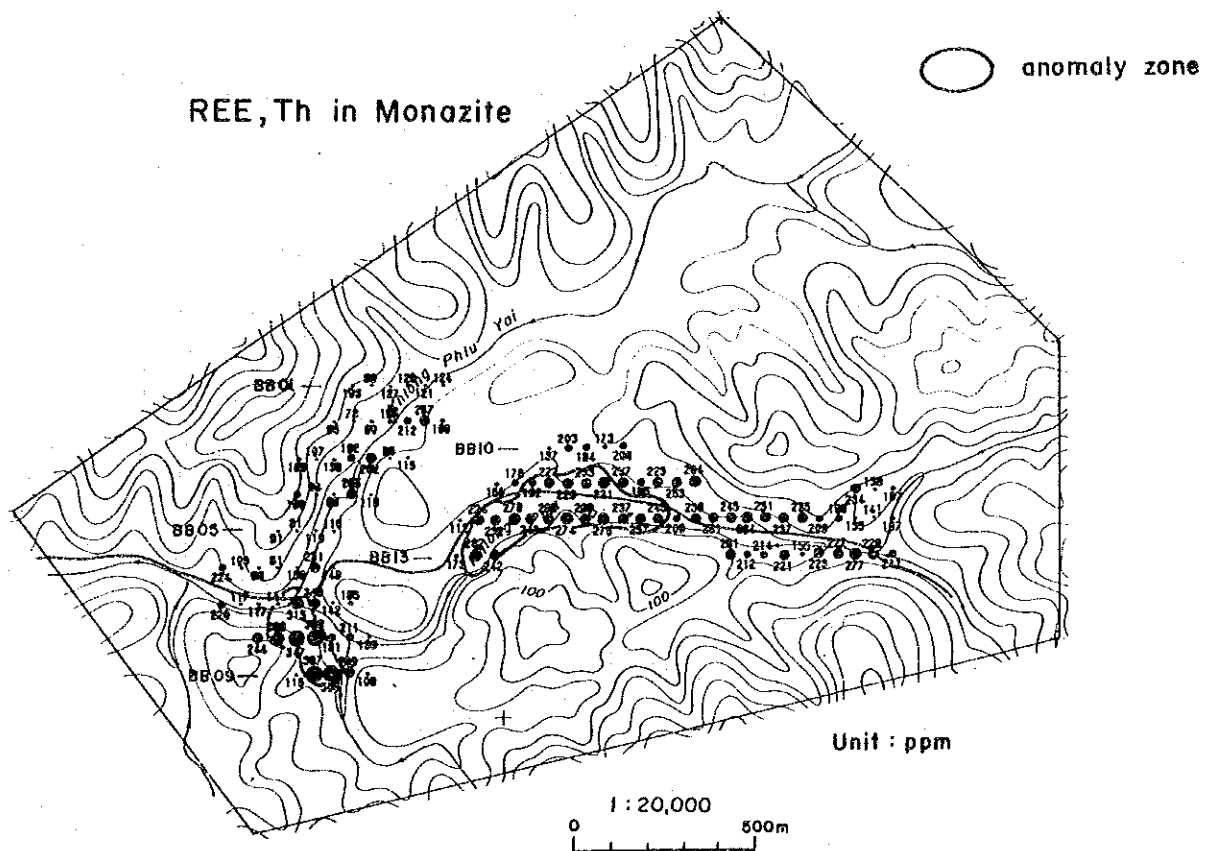
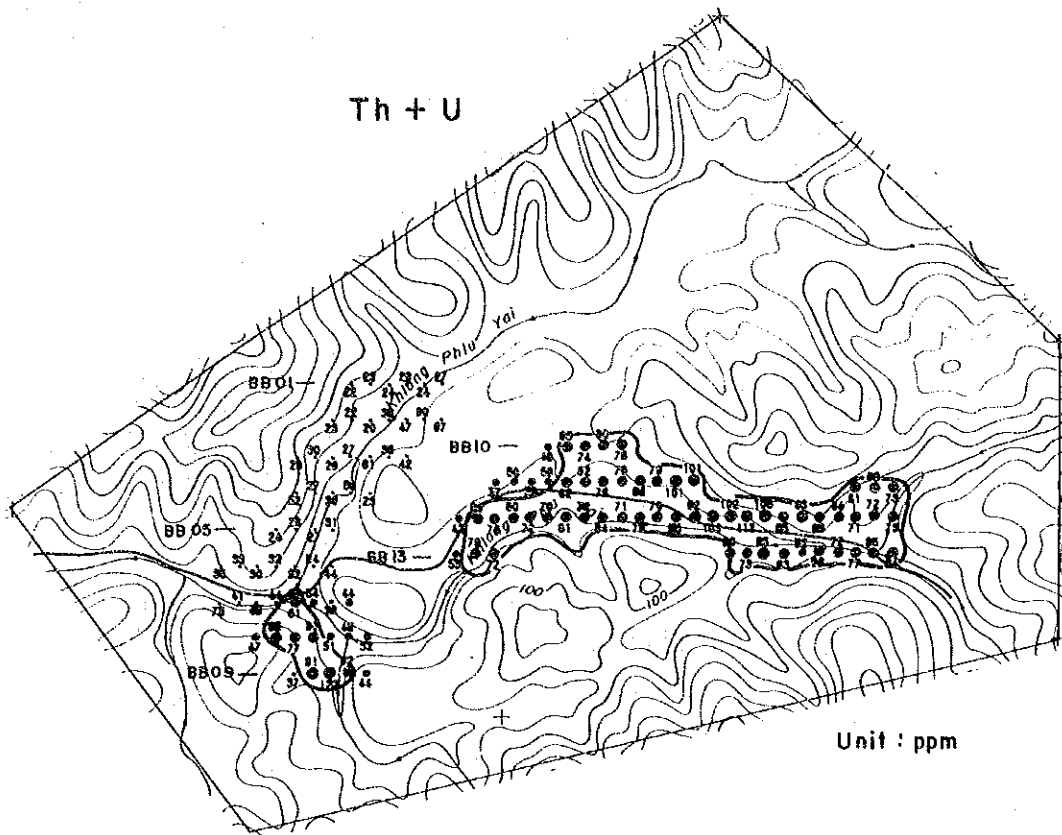
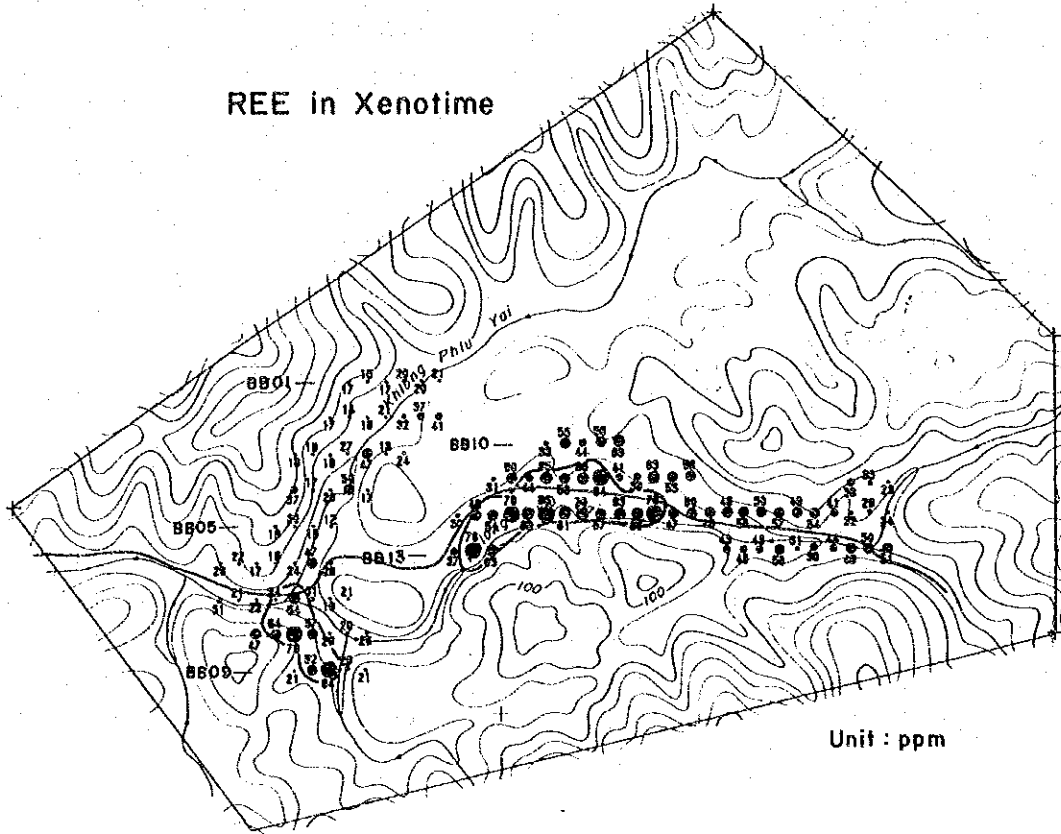


Fig. 25 Results of the geochemical survey of Area B-2 (3)

REE in Xenotime



Unit : ppm

- basin of REE minerals
R-1 28,900m²
R-2 71,400m²
- basin of cassiterite
S-1 122,000m²

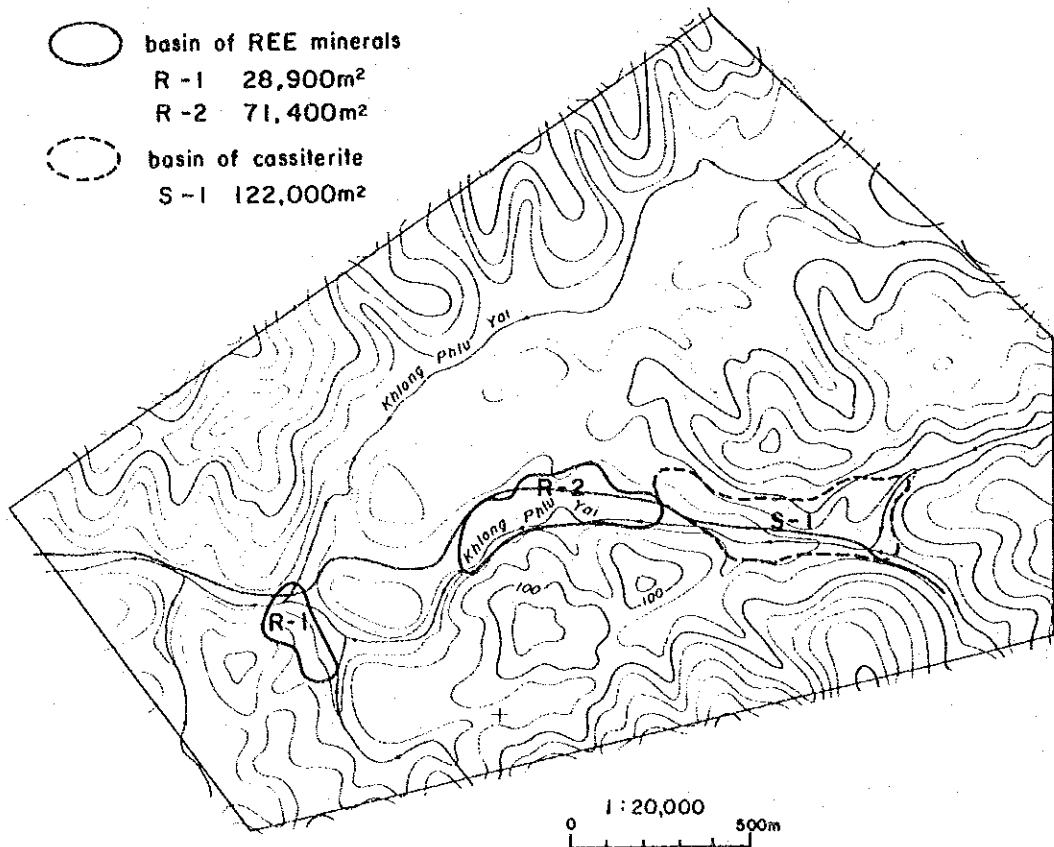


Fig. 25 Results of the geochemical survey of Area B-2 (4)

tend to be more Sn and less REE. The samples in the western side of the BB09 and BB12 lines tend to be more REE and less Sn. These tendencies is in accord with the results of soil geochemistry.

4-4-4 Consideration

The geochemical exploration defined two alluvial basins of placer deposits; the southwest area around the BB07-BB09 lines and the east area around the BB10-BB13 lines. Though southwest basin contains rare earth minerals, but its area is very small. The east basin contains both tin and rare earth minerals. The tin values are rather low in the western half of this basin; it may mean that the actual basin as a placer deposit is only the eastern half.

4-5 Arera B-3

4-5-1 Location

Area B-3 is 8 kilometers east of Kra Buri. The center of the area is at latitude 10°24'N and longitude 98°51'E. The area was settled along the tributaries of Kra Buri River running westward from the south of the central granite mass.

The bent system of tributaries is the S-N and the E-W direction. The area ranges in altitude from 60 to 240 meters. An alluvial basin, and surrounded with relatively-gentle hills and mountains. This basin is topographically desirable to have a placer deposit because of its narrow exit.

An unpaved road leads from Kra Buri Town to Area B-3 along Kra Buri River, and the distance is 10 kilometers. It takes about 30 minutes to get there by car.

The geochemical anomaly of Nb, Ta, REE, Th, U and Y from stream sediments and that of U, Y and W from soil sediments were detected by the first year geochemical prospecting.

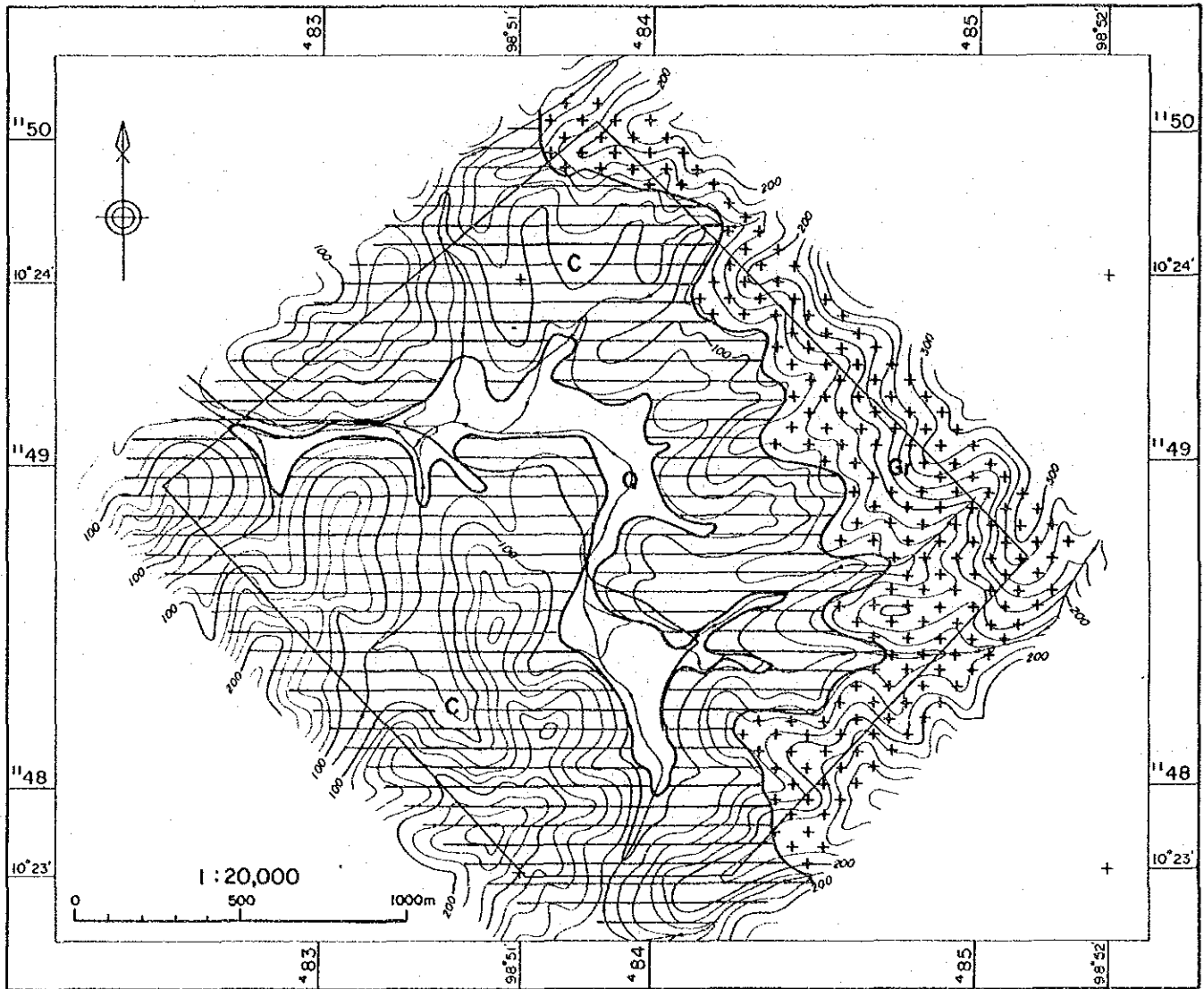
4-5-2 Geology

Area B-3 is underlain by Carboniferous Matri Formation, Cretaceous granite, and alluvium (Fig.26).

Matri Formation is distributed in the mountains surrounding a alluvial basin, and consists of mudstone and siltstone.

An alluvial basin is distributed in a valley, and its exits is narrow. The sediments consist mainly of sand and gravel derived from the granite mass. A white clay layer is distributed in the lowest reaches of the river. Two old open mining pits remain on a small scale near the BC0402 and BC0810 points.

B - 3



LEGEND

SEDIMENTARY ROCKS		
AGE	SYMBOLS	FORMATION
Quaternary	Q	
Carboniferous	C	MATSI
IGNEOUS ROCKS		
Cretaceous	Gr+	biotite-muscovite granite

Fig. 26 Geologic map of Area B-3

Cretaceous granite is coarse-grained equigranular biotite granite (adamellite), and is composed mainly of orthoclase, microcline, quartz, plagioclase and biotite, with accessories zircon, apatite, sphene and ilmenite. Allanite and cassiterite also occur in less abundance.

4-5-3 Result of Geochemical Prospecting

(1) Soil Samples

In this area, the thresholds were taken at $M+0.5\sigma$ (Sn:46ppm, W:11ppm, Ta+Nb:42ppm, total REE:230ppm and Th+U:77ppm respectively) nearby the skew points of respective cumulative probability curves.

The content distribution maps are shown in Fig.27 (1) to (4).

The Sn anomaly zones are distributed in three places; the exit of a basin on the west of the BC02-BC03 lines, the area around the inflection point of the main river on the east of the BC02-BC05 lines, and the vicinity of the main river and its tributaries in the southeast of the survey area. Old mining pits of cassiterite remain in the former two anomaly zones. The latest anomaly zone is the largest among them. The W anomaly zone almost overlaps with the Sn anomaly zones. High anomaly values are also found in the northeast area; the east part of the BC02-BC03 lines and the eastern edge of the BC06 line. It is inferred that the tungsten mineral has been derived from the northeast part of the survey area. The Ta+Nb anomaly zones also overlaps with the Sn anomaly zones. The southeast one has higher anomaly values among them.

The anomaly values of Total REE are also distributed in the above-mentioned three Sn anomaly zones. However, the anomaly zone in the southeast is smaller than that of Sn.

The anomaly values of Th+U almost overlap with the anomaly zones of Total REE.

(2) Samples of Heavy Minerals

Five panned heavy mineral samples were collected in Area B-3. The heavy mineral samples shows high content of Sn and low REE content, compared with that of Area B-1 and B-2 around the central granite mass.

There is a large possibility of the placer deposits of cassiterite in Area B-3, but the scale of the deposits is smaller than that of the southwest of Area A-1.

4-5-4 Consideration

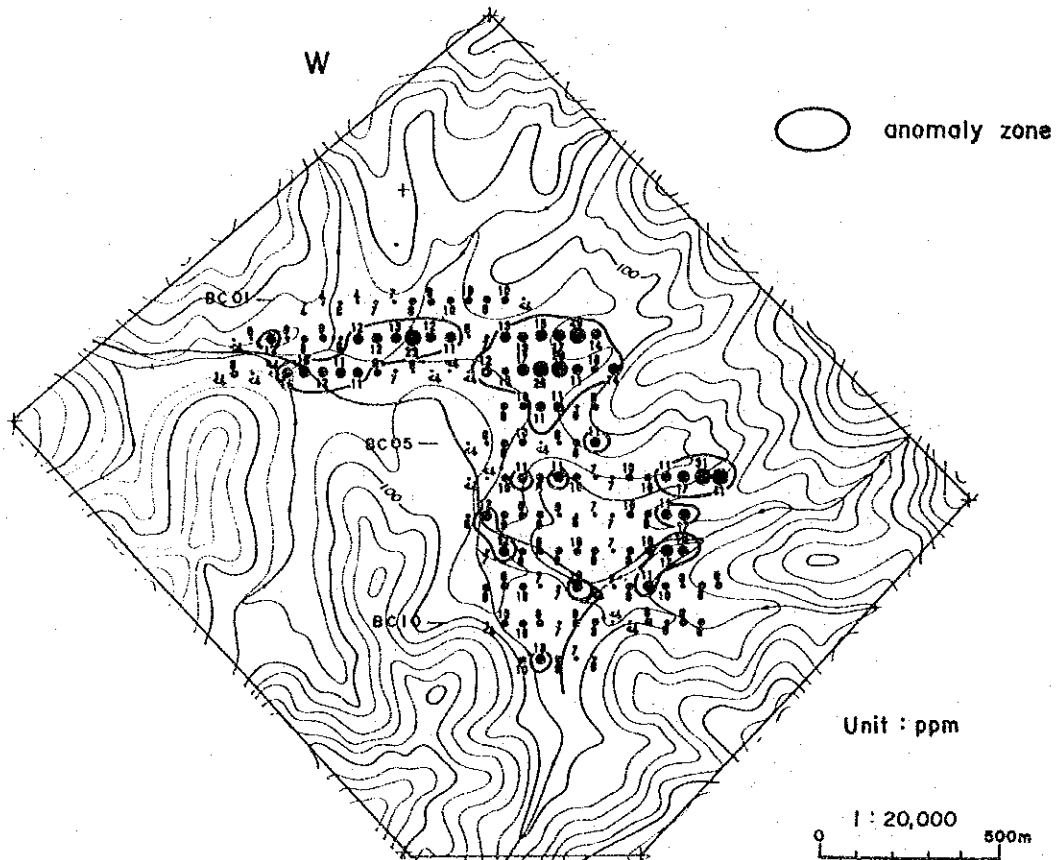
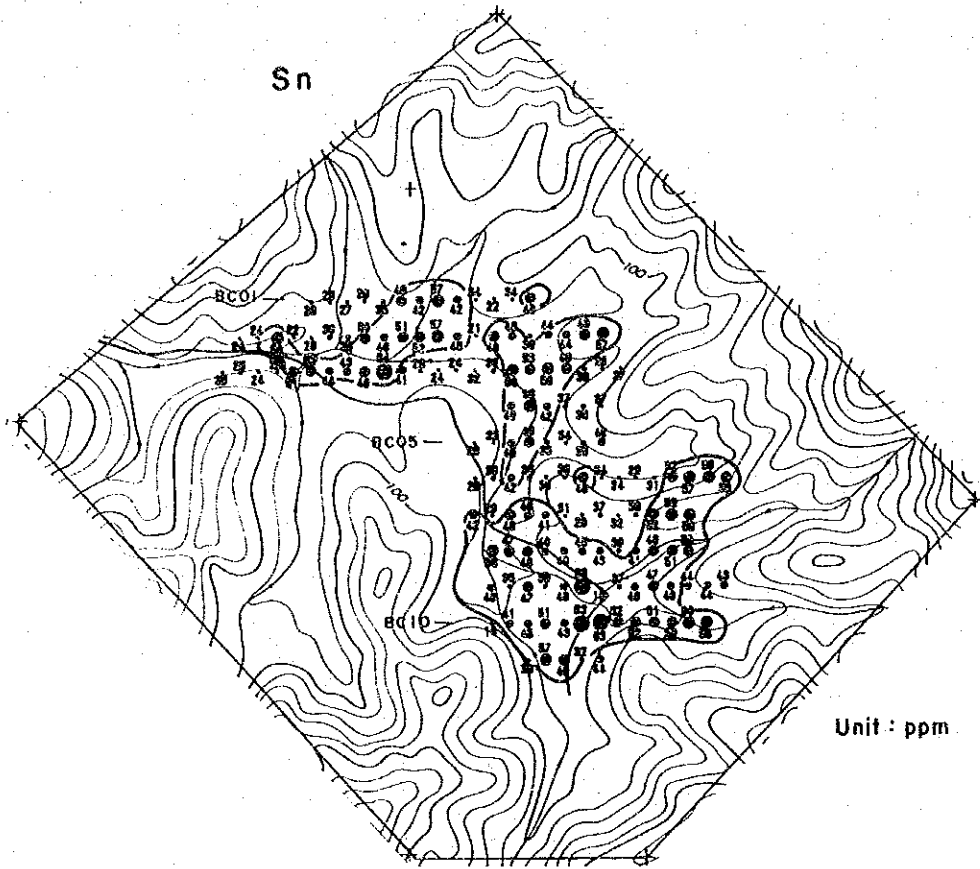


Fig. 27 Results of the geochemical survey of Area B-3 (1)

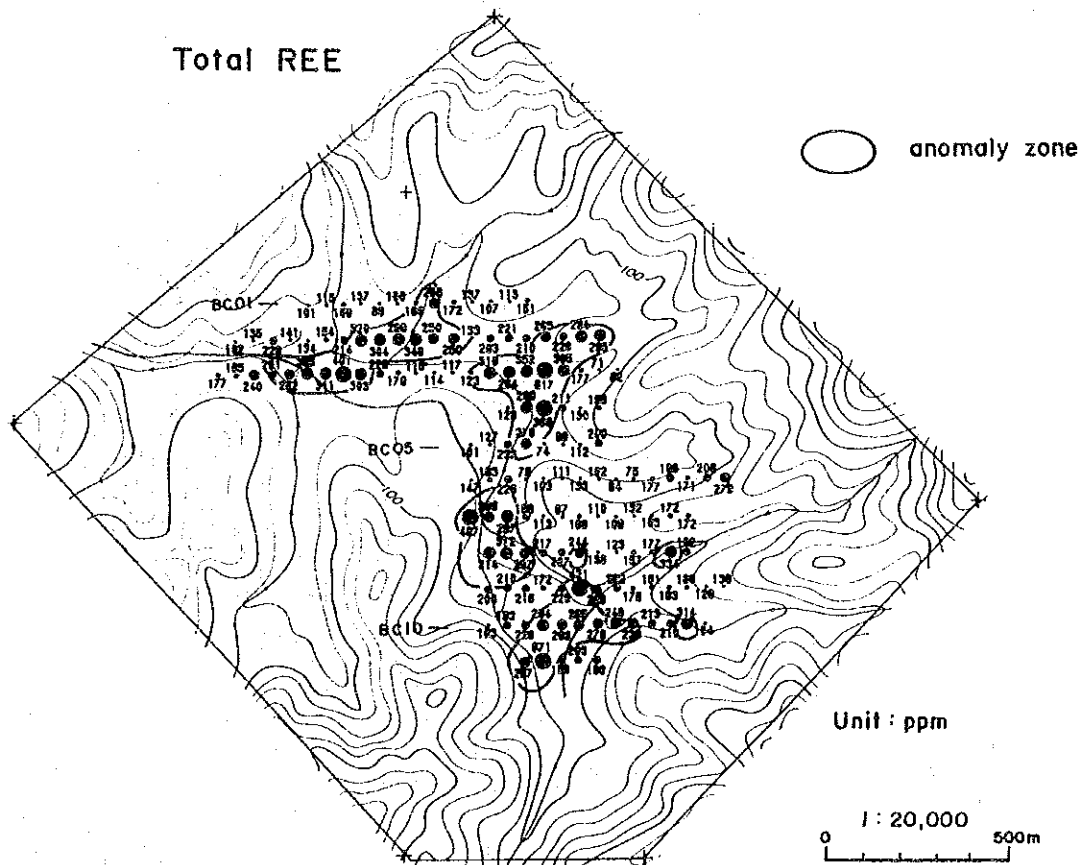
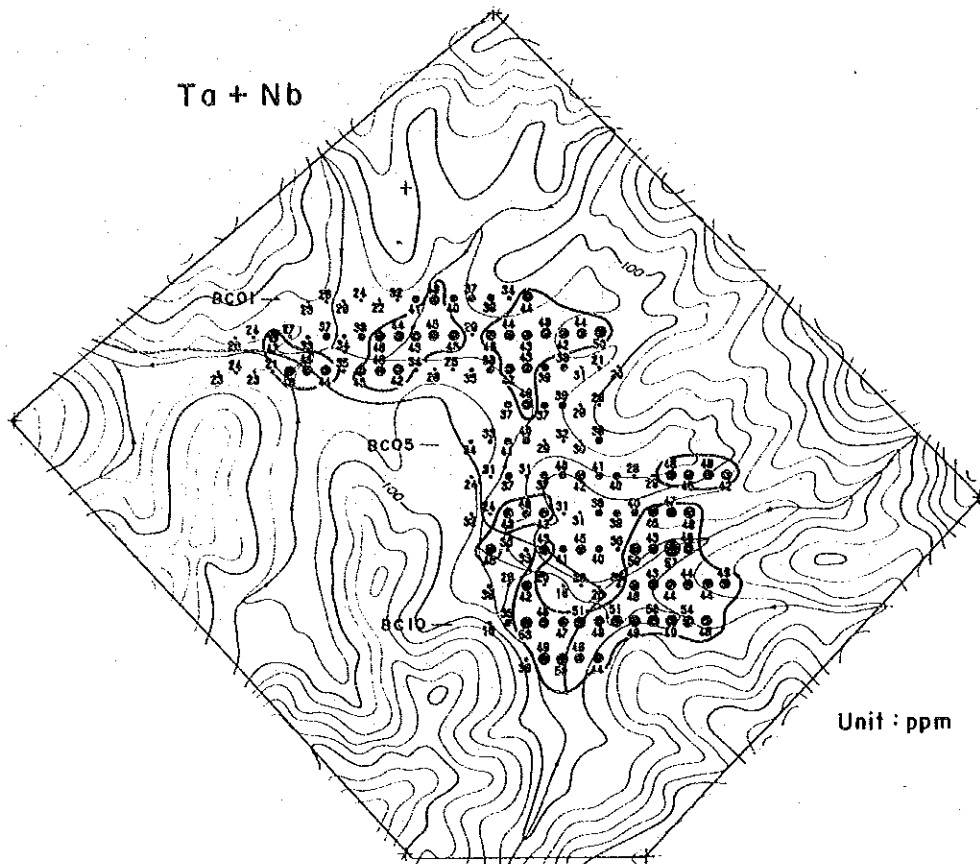


Fig. 27 Results of the geochemical survey of Area B-3 (2)

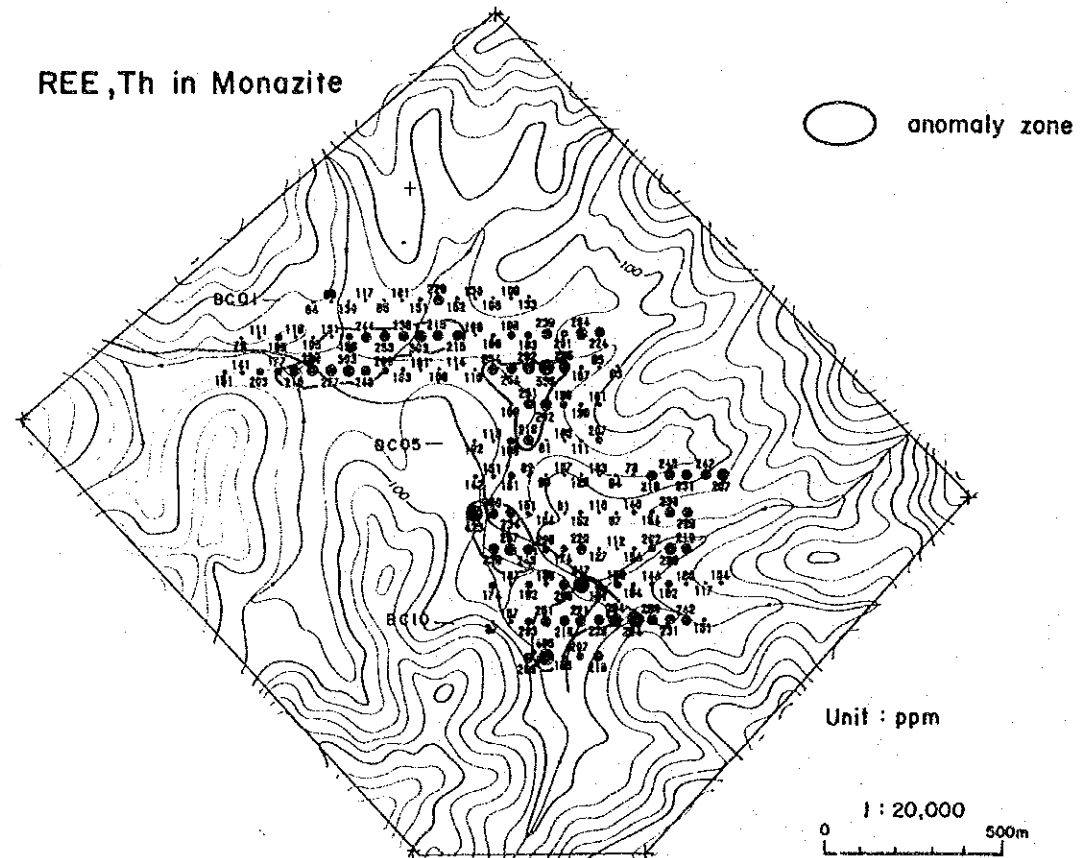
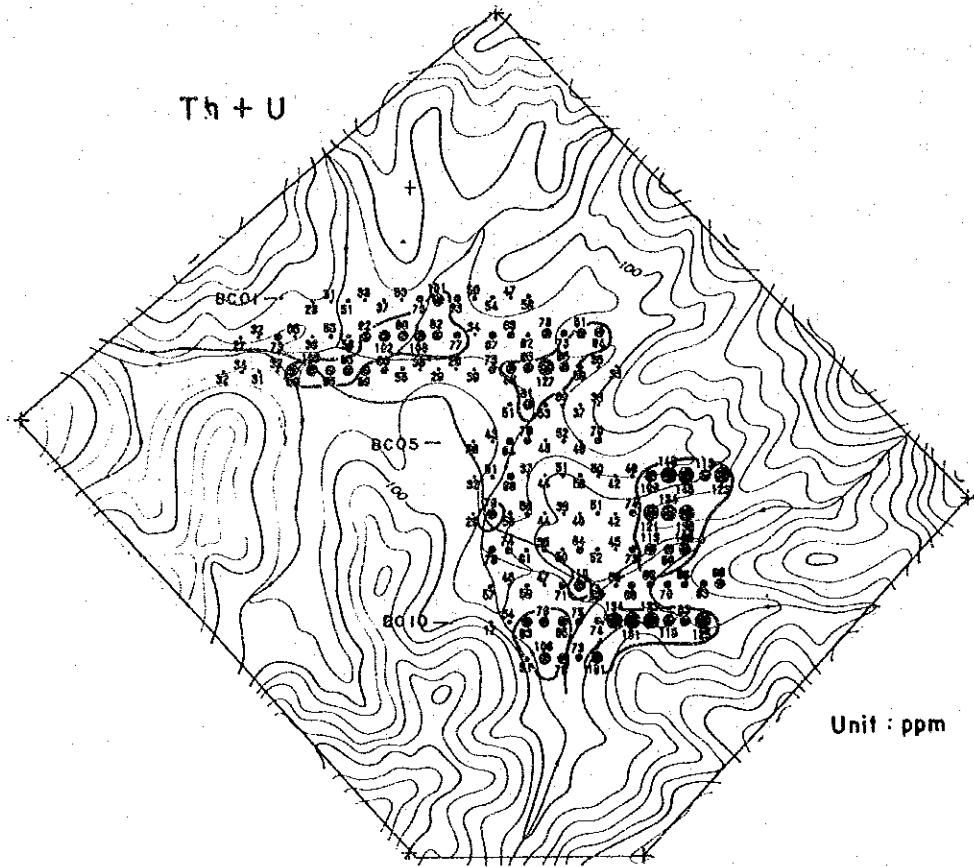


Fig. 27 Results of the geochemical survey of Area B-3 (3)

REE in Xenotime

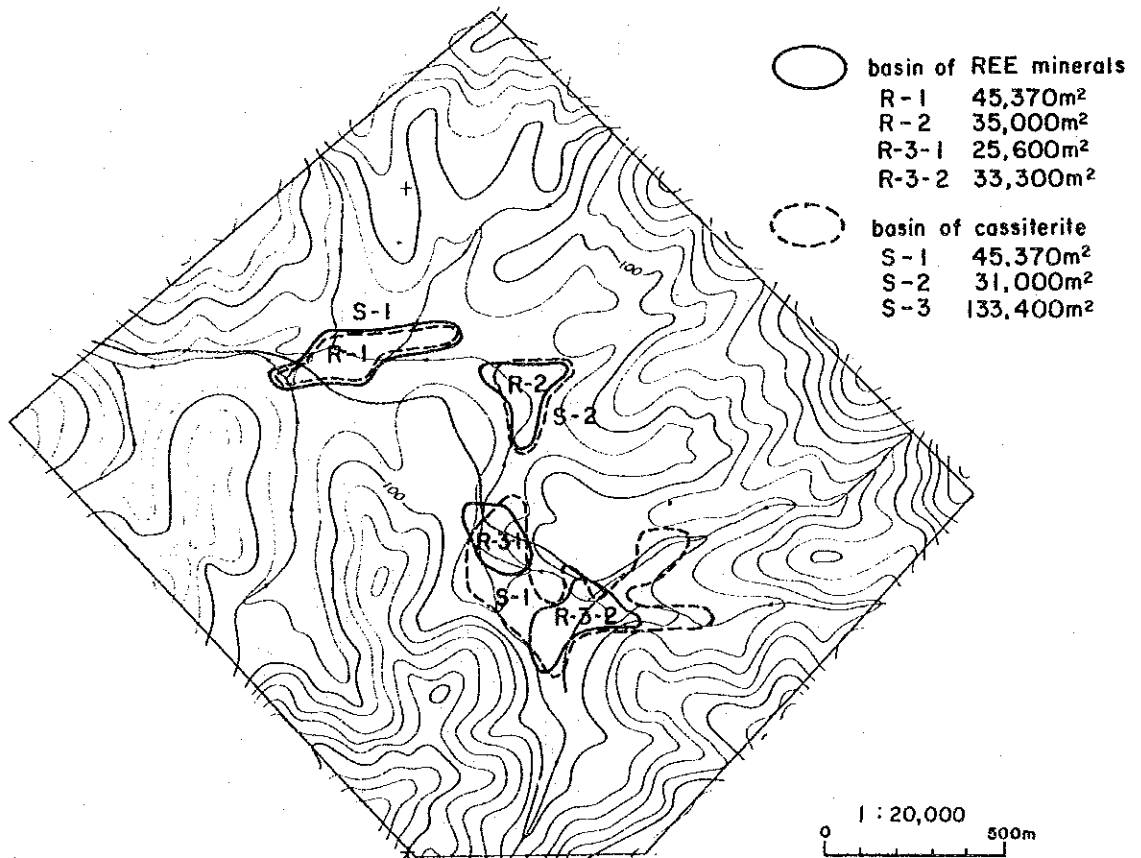
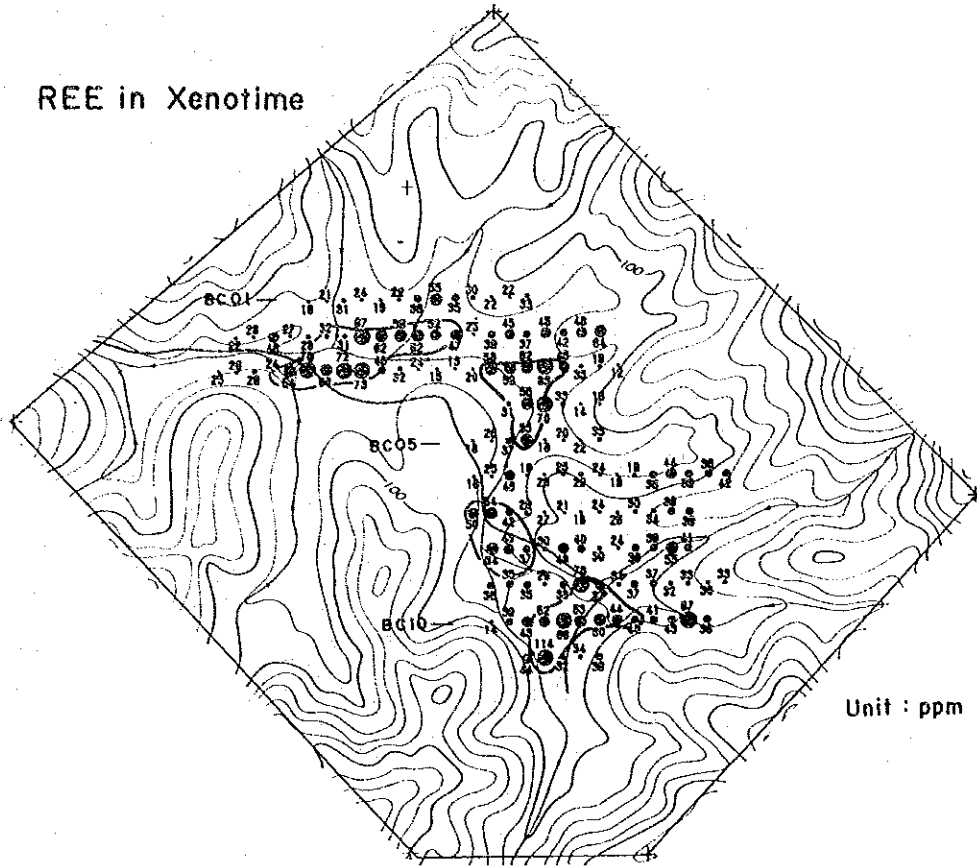


Fig. 27 Results of the geochemical survey of Area B-3 (4)

Area B-3 were assumed to have a large amount of fluvial sediments and talus sediments.

Only three small anomaly zones are detected by the result of geochemical exploration; thereby the reserve of a placer deposit is rather small scale in Area B-3.

The anomaly values of Ta-Nb and W are detected in the talus sediments and on the ridge or slope in the east of the survey area, whereas those of Sn and Total REE are detected only the areas along valleys. Therefore, most cassiterite and rare earth minerals are inferred to have been transported and accumulated on low land.

It is peculiar in the nine survey areas that anomaly of tin and rare earth elements overlap each other in Area B-3. It is inferred to be due to an closed alluvial basin.

4-6 Area B-4

4-6-1 Location

Area B-4 is about 9 kilometers northeast of Kra Buri Town, and is . The center of the area at latitude 10°26.5'N and longitude 98°50.5'E. The area covers Sawa River and its tributary.

Sawa River runs nearly westward in the north of the area, while its tributary in the south run west-northwestward. The area ranges in altitude from 30 to 150 meters, and consists of a large alluvial basin surrounded with gentle hills. The rivers meander through the area.

In the first year survey, the geochemical anomaly of Sn and REE was detected from stream sediments samples.

4-6-2 Geology

Area B-4 is underlain by Carboniferous Matri Formation and the Quarternary (Fig.28). Matri Formation forms gentle hills, and consists of strongly weathered mudstone and siltstone.

Alluvium is distributed only in low land along rivers. Terrace sediments consisting of clay, sand and gravel are found along Sawa River, especially thick on the east end of the BD03-BD04 lines. The area of the tributary is alluvial low land used as rice paddies; a thick white clay layer is found there.

4-6-3 Result of Geochemical Prospecting

(1) Soil Samples

The four groups except W show nearly bimodal distribution. Their respective thresholds were deter-

B - 4

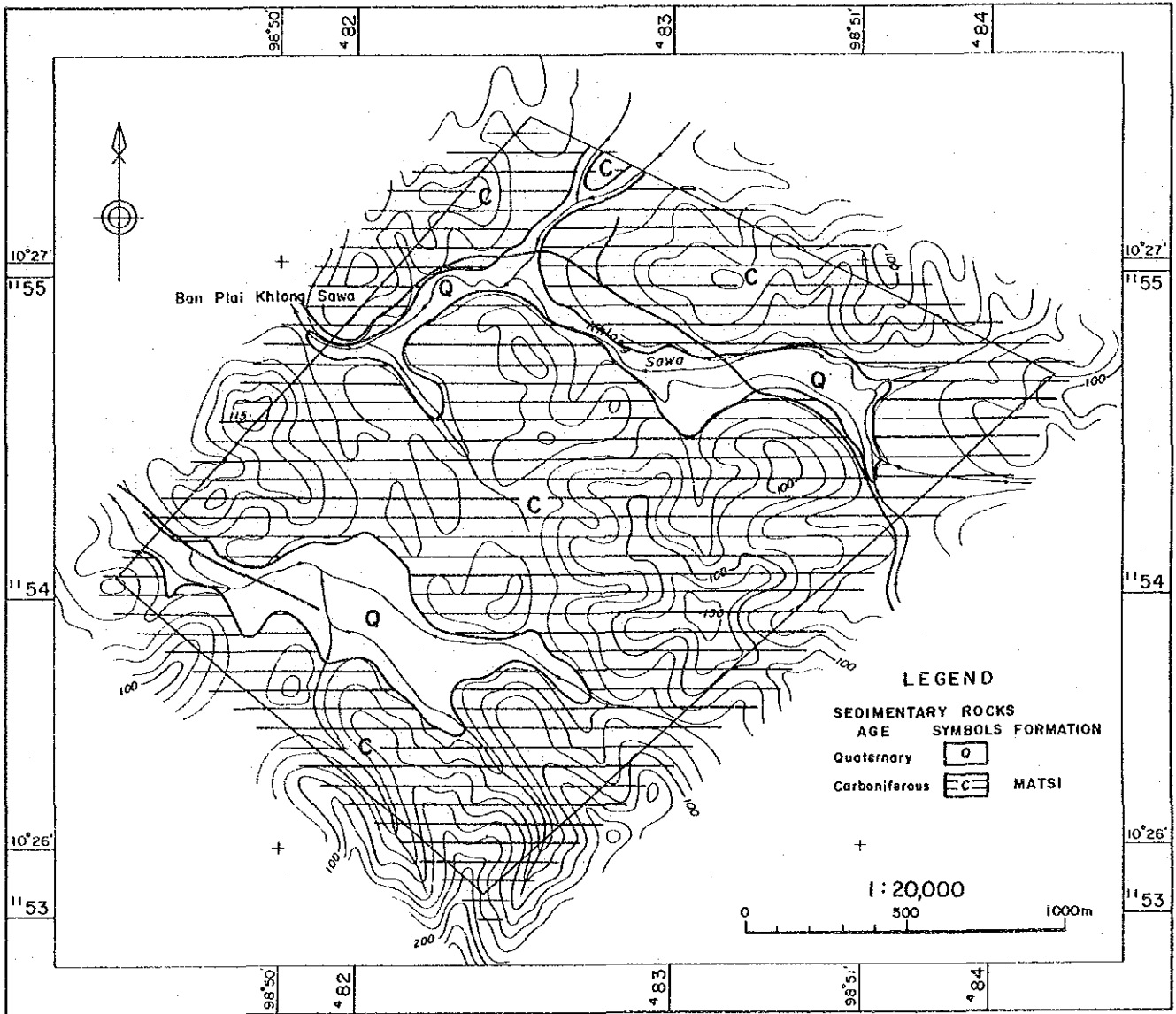


Fig. 28 Geologic map of Area B-4

mined to be $M+0.5\sigma$ (Sn:37ppm, Ta-Nb:30ppm, Total REE:225ppm, Th-U:38ppm). The threshold of W was determined to be $M+0.75\sigma$ (12ppm) in consideration of the skew point of its cumulative probability curve. The content distribution maps are shown in Fig.29 (1) to (4).

The anomaly values of all the groups almost overlap each other. Anomaly zones are distributed on the eastern side of the BD03-BD04 lines and around the DB11 line. The anomaly zones continue to the downstream along Sawa River. These anomaly zones cover terrace sediments. Anomaly values are scattered around the BD05-BD10 lines in the basin of the tributary, though most samples in this area show lower than their respective threshold values.

The contents of Total REE and Th-U in this area tends to be relatively lower than those in the other areas.

(2) Sample of Heavy Mineral

Four heavy mineral samples were collected from places along Sawa River. The highest Sn content is detected at a downstream of the east bank of Sawa River, where the most superior anomaly values are also recognized from soil samples. The contents of REE, Th and U tend to increase toward the lower reaches of the river.

4-6-4 Consideration

Two alluvial basins of placer deposits, the east basin and the west basin, are distributed in terrace sediments along Sawa River. The sediments have accumulated thickly in the east basin, whereas the sediments are narrowly distributed along the river in the west basin. These basins are the biggest of all in Area B-1 to B-4, and contain much heavy minerals. The estimated reserve is lower than 500 thousand m^3 at most.

The south area of the tributary around the BD05-BD10 lines consists of a flat basin. Most parts of this basin are used as rice paddies, and white clay has thickly accumulated. It is impossible to evaluate accurately about this basin, because of the no data about the thickness of a white clay bed. The anomaly values are scattered in this basin; thereby the potential of placer deposits is inferred to exist in the south of Area B-4.

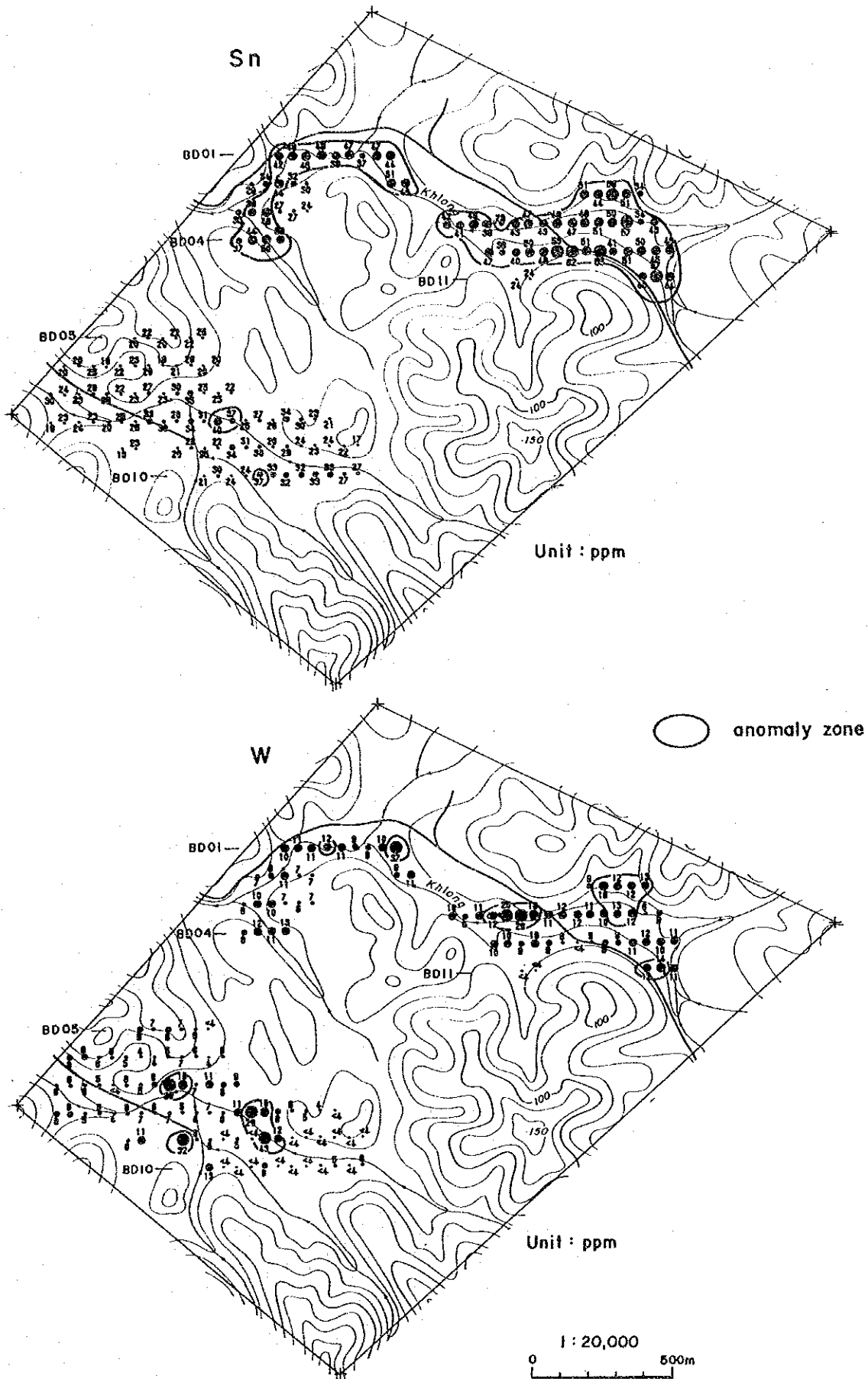


Fig. 29 Results of the geochemical survey of Area B-4 (1)

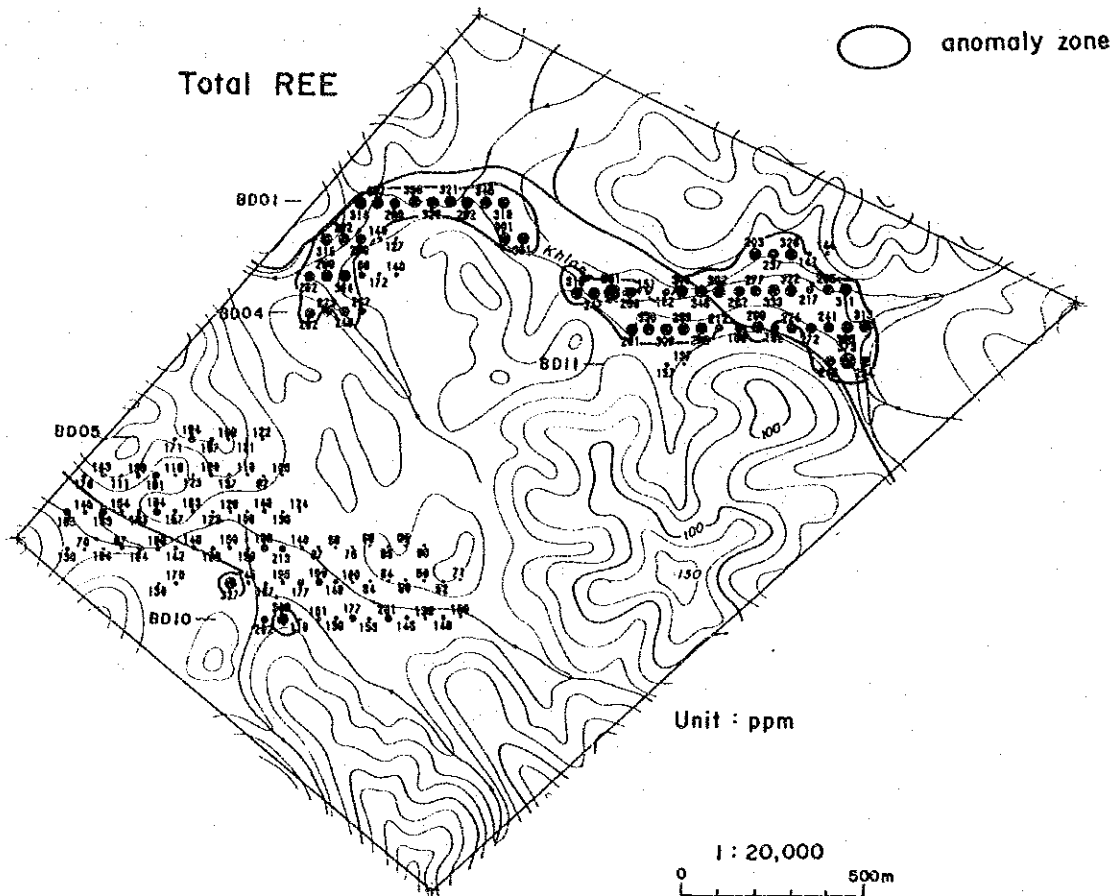
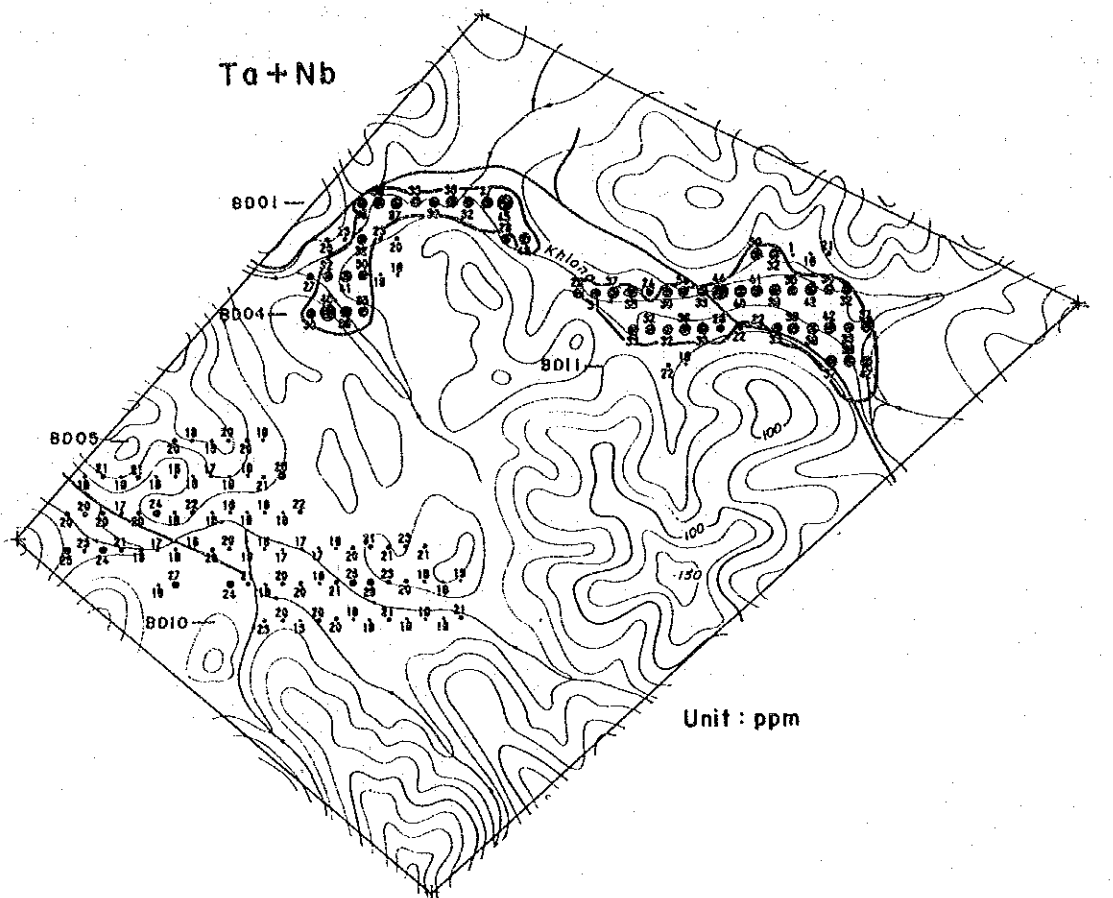


Fig. 29 Results of the geochemical survey of Area B-4 (2)

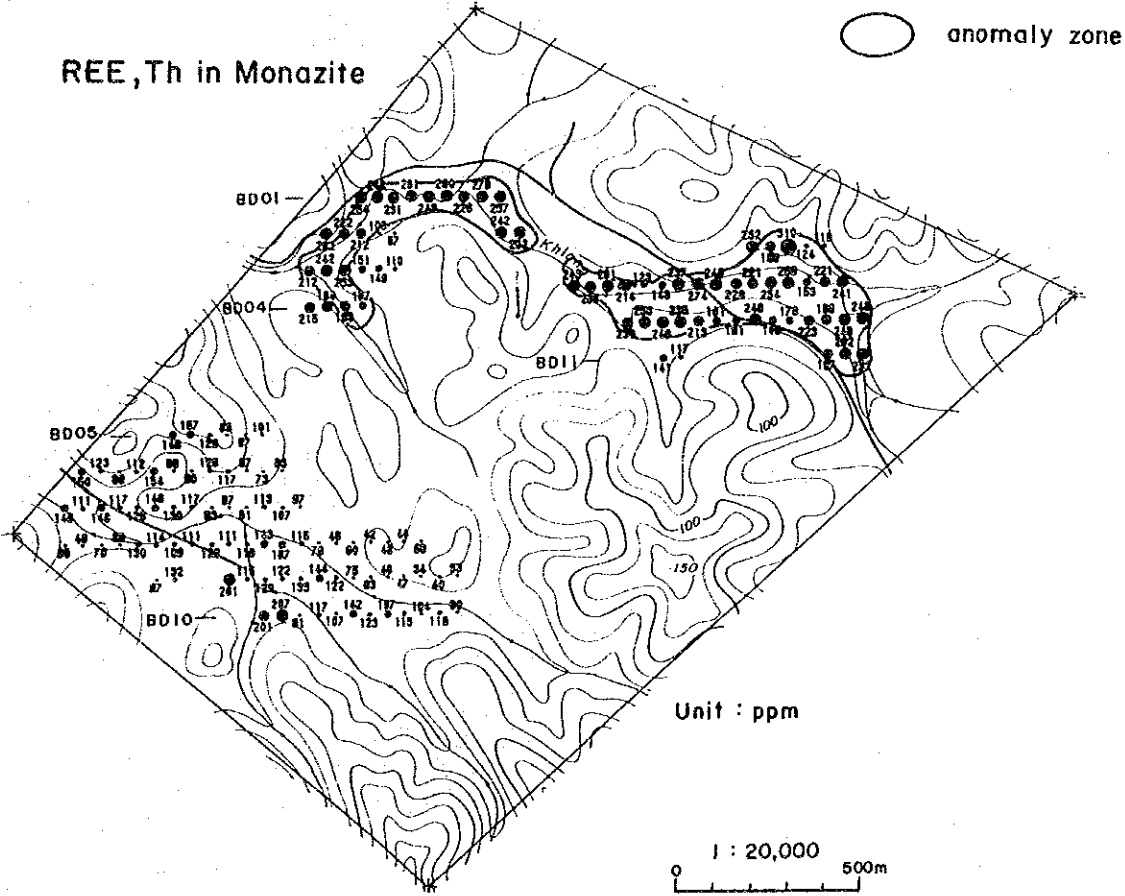
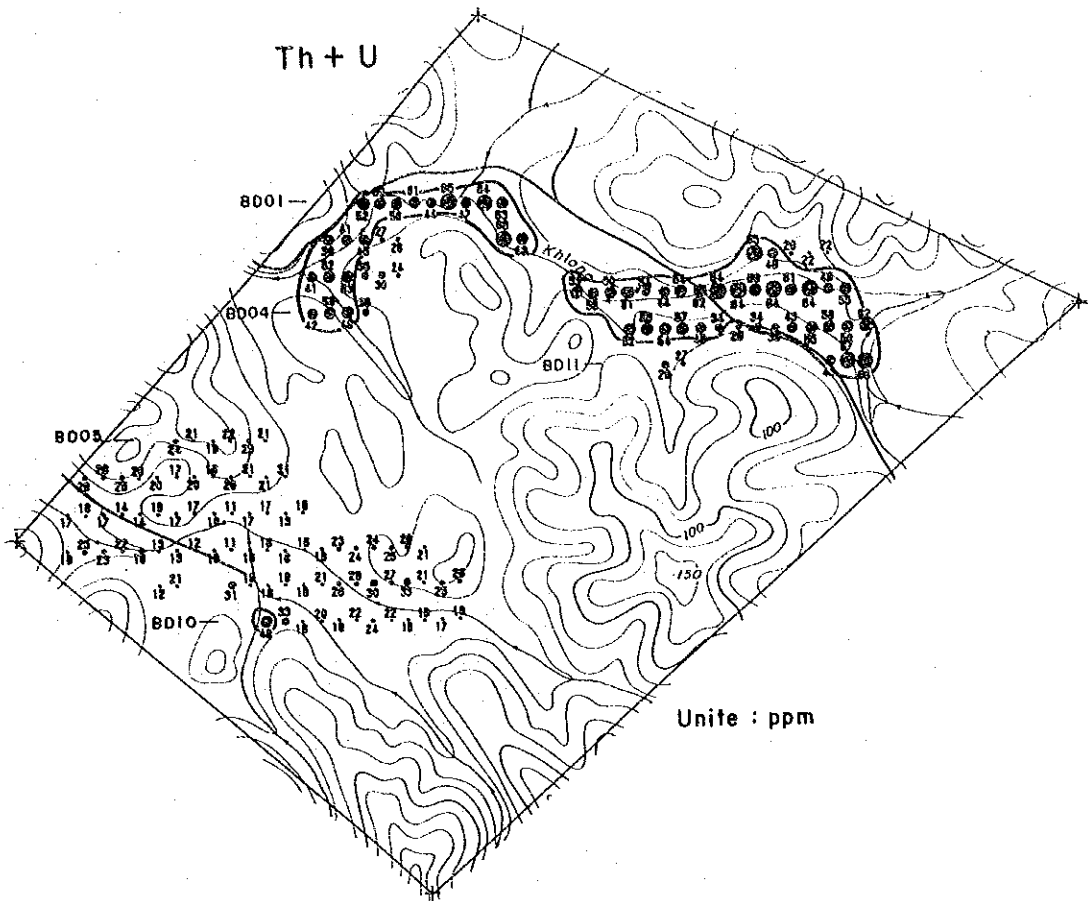
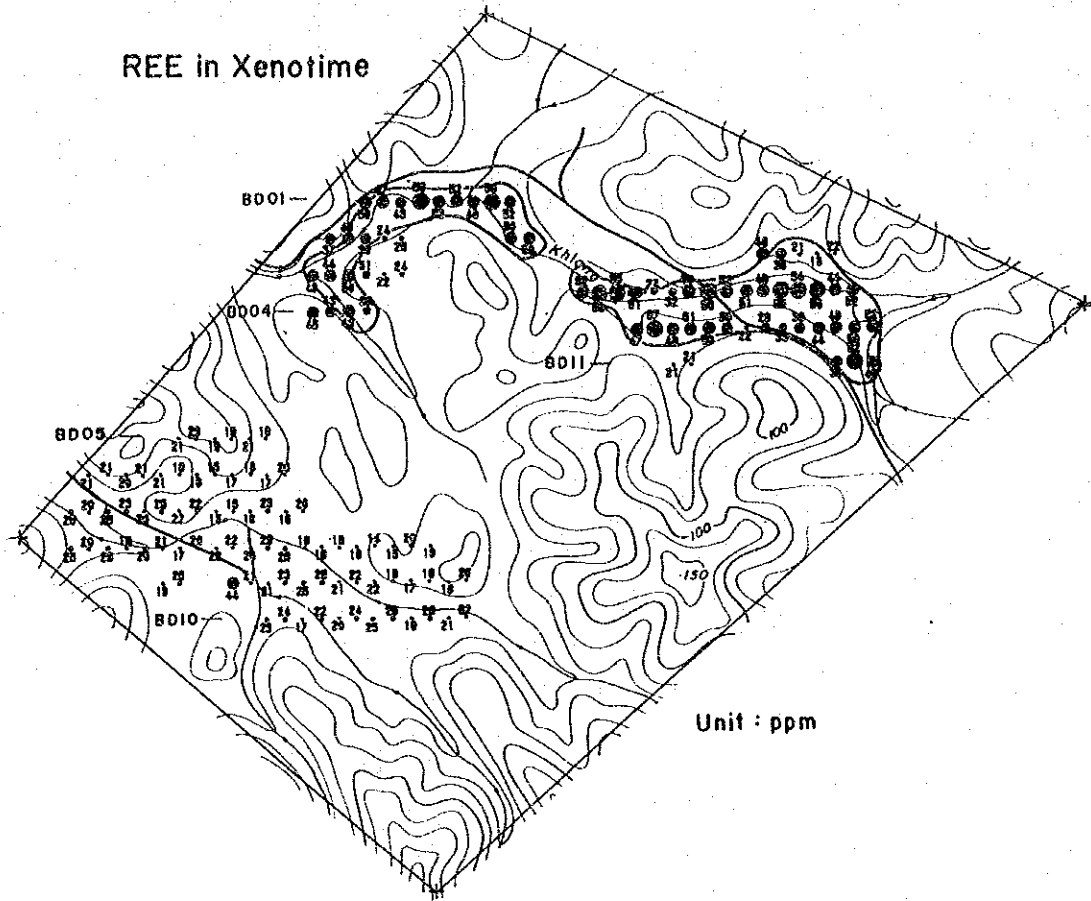


Fig. 29 Results of the geochemical survey of Area B-4 (3)



- basin of REE minerals
 - basin of cassiterite
- | | |
|----------|-----------------------|
| S-1, R-1 | 80,500m ² |
| S-2, R-2 | 151,500m ² |

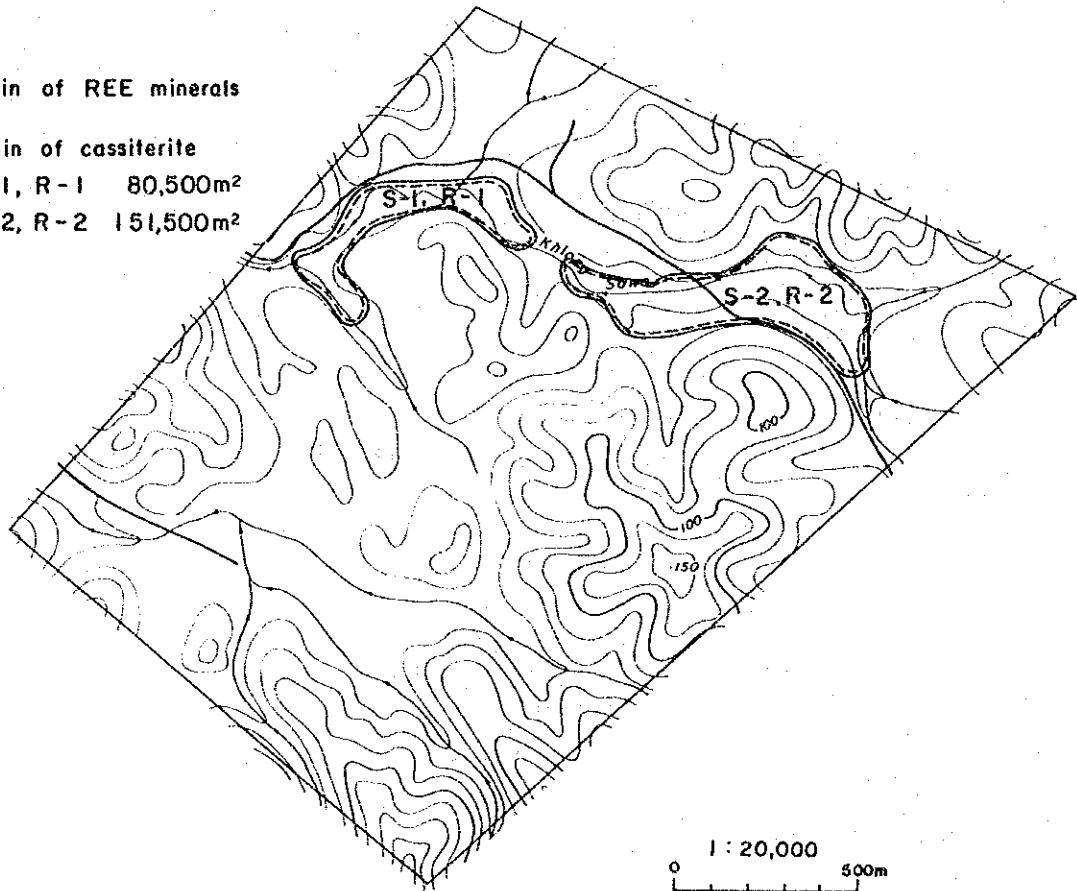


Fig. 29 Results of the geochemical survey of Area B-4 (4)

4-7 Area C

4-7-1 Location

Area C is about 22 kilometers south-southeast of Kra Buri Town on the northern edge of Mt. Fachi Silicified Zone. The center of the area is at latitude $10^{\circ}13.5'N$ and longitude $98^{\circ}44'E$. The area covers Mt. Fachi silicified zone and an alluvial basin on the east of the zone.

Bang Yai Lang River runs nearly northward in the area, and its tributary runs northwestward and joins the main river in the area. The area consists of steep mountains in the west, gentle hills in the east, and the alluvial basin in the north.

The Route 4 passes longitudinally through the area. The distance of the road from Kra Buri Town is 25 kilometers, and it takes about 30 minutes to get there by car.

The geochemical anomaly of Sn, Nb, Ta, REE, Th, U and Y was detected from stream sediments by the first year geochemical prospecting.

4-7-2 Geology

Area C is underlain by Carboniferous Matri Formation, Mt. Fachi Silicified Zone silicified from Matri Formation, and the Quarternary (Fig.30).

Un-silicified Matri Formation forms hills in the eastern half of the area, and consists of strongly weathered mudstone and sandstone.

Mt. Fachi Silicified Zone forms steep ridges in the west of the area. The rocks in this zone has been subjected to weak to medium silicification and white argillization, and the original rocks of this zone have been mudstone and sandstone of Matri Formation. The foliation is common in the silicified rock, and trends N-S or $N10^{\circ}W$ and dips 80 to $90^{\circ}W$. The network quartz veins, ranging in width from several to some ten centimeters, mainly trends $N20^{\circ}E$ and dips $80^{\circ}N$. They cut in the direction of the foliation. They are not observed macroscopically any mineralizations.

Alluvium has thickly accumulated in the basin of Bang Yai Lang River between the CA01-CA12 lines. The alluvium near the CA0713 point consists, from above and downward, surface soil about 1.5 meters, kaolinite clay bed about 1 meter, and sand and gravel bed. The area south of the CA12 line is steep valleys. Fluvial sediments are narrowly distributed along these valleys, and consist mainly of white clay.

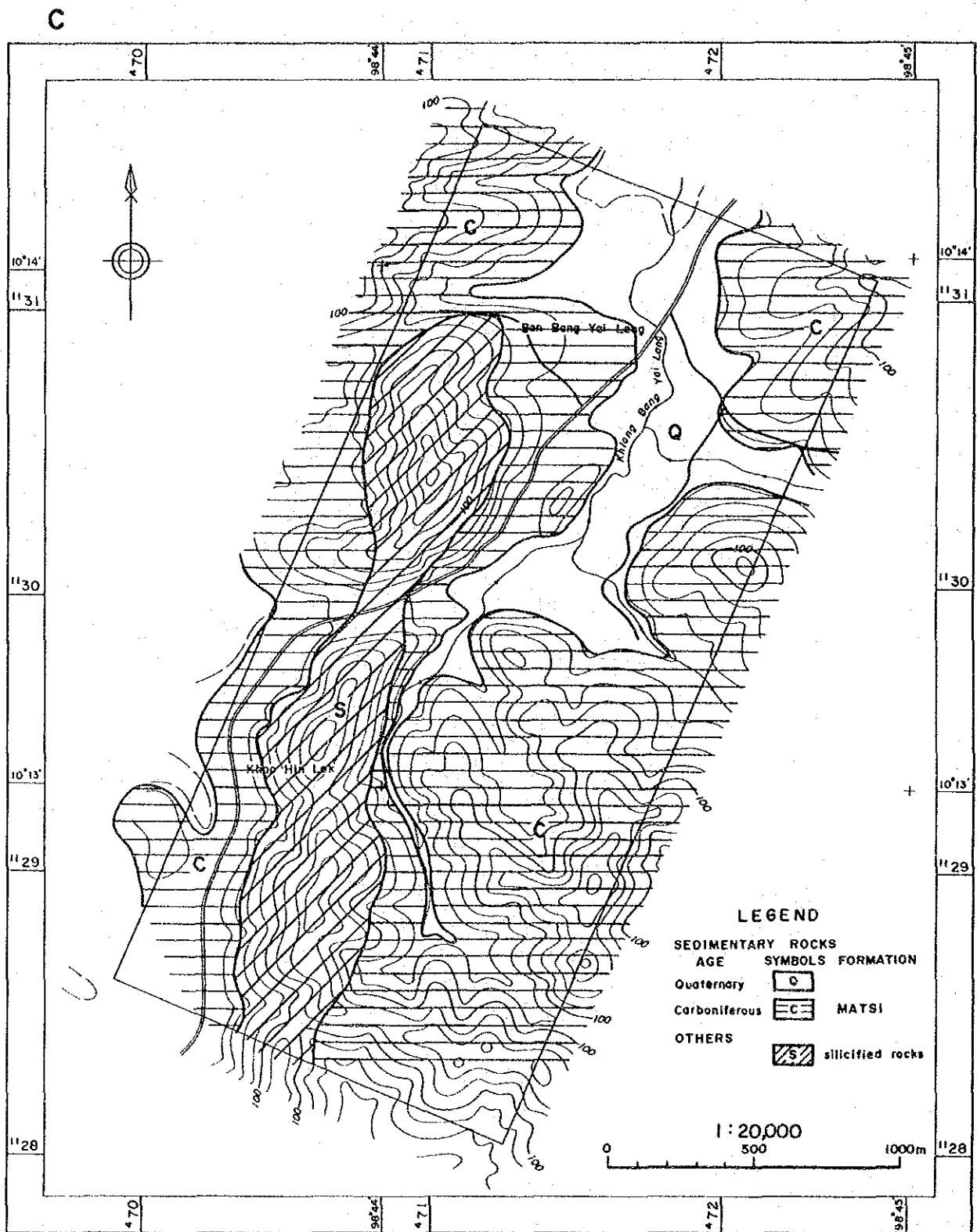


Fig. 30 Geologic map of Area C

4-7-3 Results of Geochemical Prospecting

(1) Soil Samples

The Thresholds of all the groups were determined to be Sn:23ppm ($M+0.75\sigma$), W:17ppm ($M+1.5\sigma$), Ta-Nb:25ppm ($M+0.75\sigma$), Total REE:173ppm ($M+0.25\sigma$) and Th-U:26ppm ($M+0.5\sigma$) respectively based on the histograms and cumulative probability curves.

The content distribution maps are shown in Fig.31 (1) to (4).

The Sn anomaly values are distributed around the mountains north of the Route 4 in the northwest part of Area C, and tend to disperse toward an alluvial basin east of the road. High Sn content samples concentrate near Bang Yai Lang Village on the northeast of mountains.

The W anomaly values are found around the mountains, but do not be detected to the east of the road.

The anomaly values of Ta-Nb almost overlap with the Sn anomaly values in the north of the survey area, except other two anomaly zones are found; a small anomaly zone in the silicified zone to the south of the road, and the small anomaly zone in the southernmost part of the survey area which overlaps with the anomaly zone of Total REE.

A strong anomaly zone of Total REE is detected in the mountains southernmost of Area C, and the anomaly values are also found on the other side of its ridge. This anomaly zone is inferred to extend to the further east area. Weak anomaly zones of Total REE are detected along ridges and along Bang Yai Lang River from the northeast to the middle in Area C.

The Th-U content in Area C tends to be lower than that in other areas. No marked anomaly is detected. The tendency of Th-U content distribution is similar to that of Total Ree in the survey area.

(2) Samples of Heavy Minerals

Samples of heavy minerals were collected from sand and gravel bed in the alluvial basin along Bang Yai Lang River between the CA01-CA11 lines. Since sediments along the river, from above to downward, consists of surface soil, Kaolinite clay, and sand and gravel bed; sand and gravel bed is the lowest layer in this alluvial basin.

The Sn content of heavy mineral samples is high near the CA07-CA11 lines, though its amount is small. There are no anomaly values of soil samples along this river, but it is inferred that tin concentrate

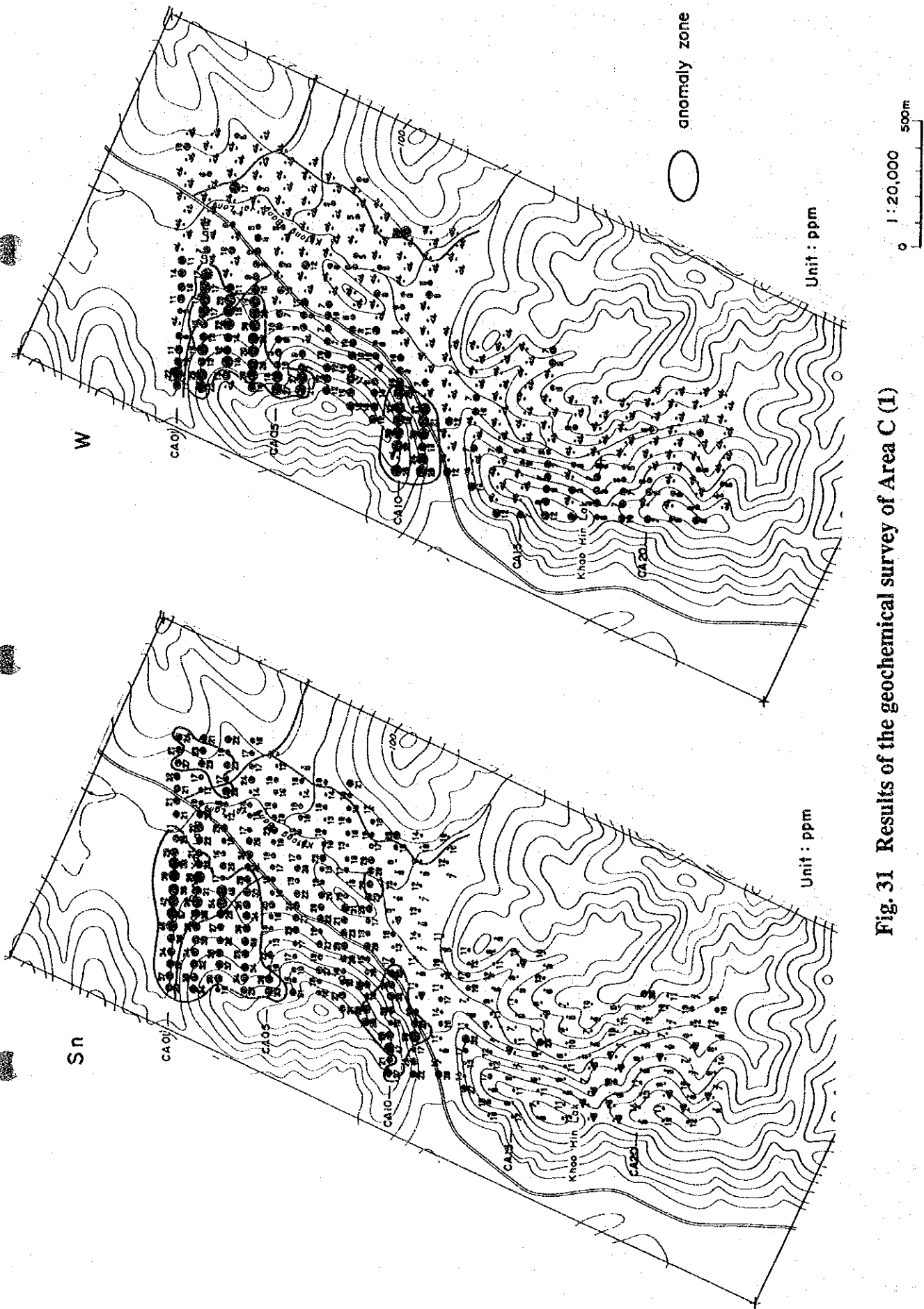


Fig. 31 Results of the geochemical survey of Area C (1)

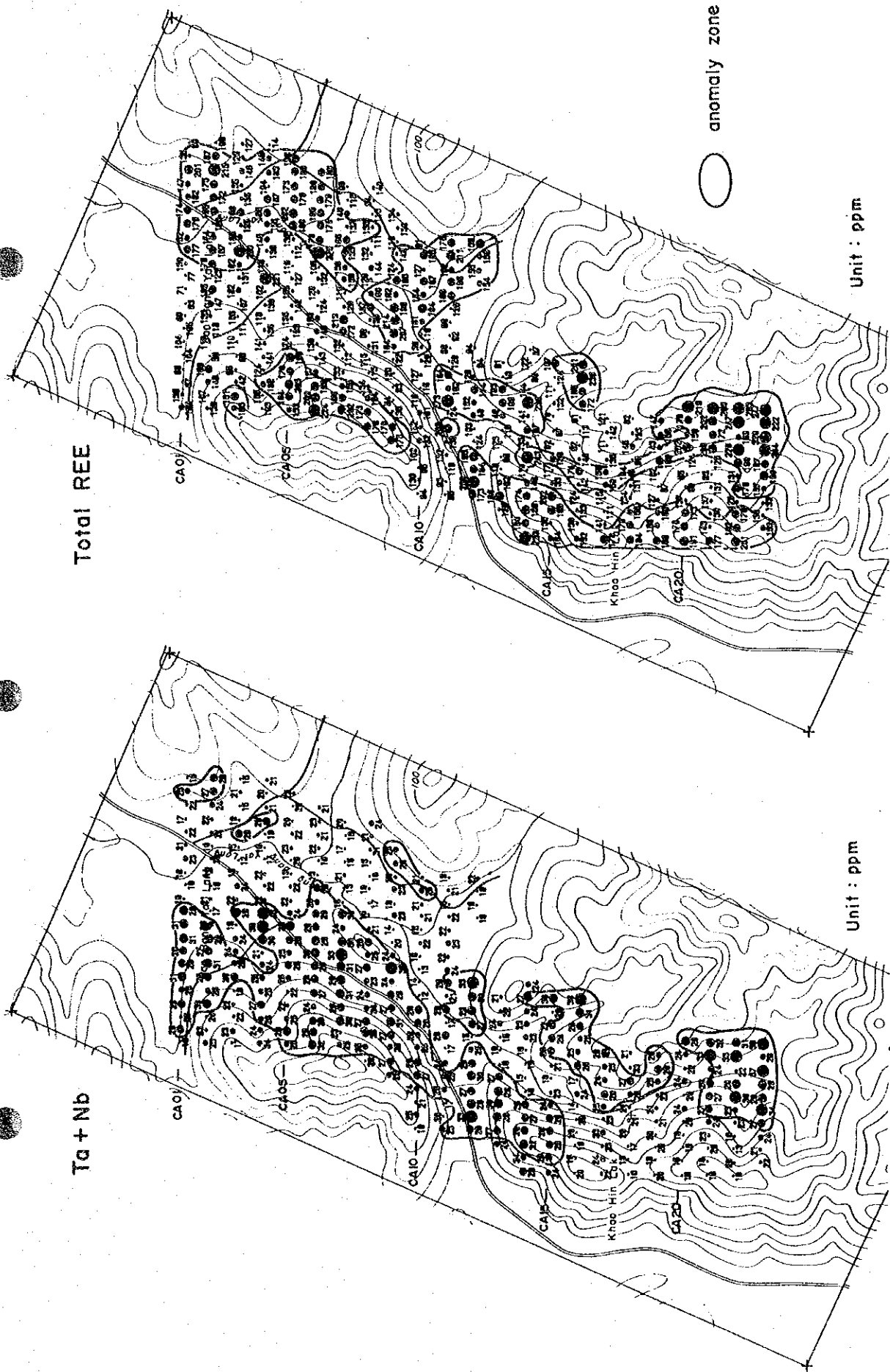


Fig. 31 Results of the geochemical survey of Area C (2)

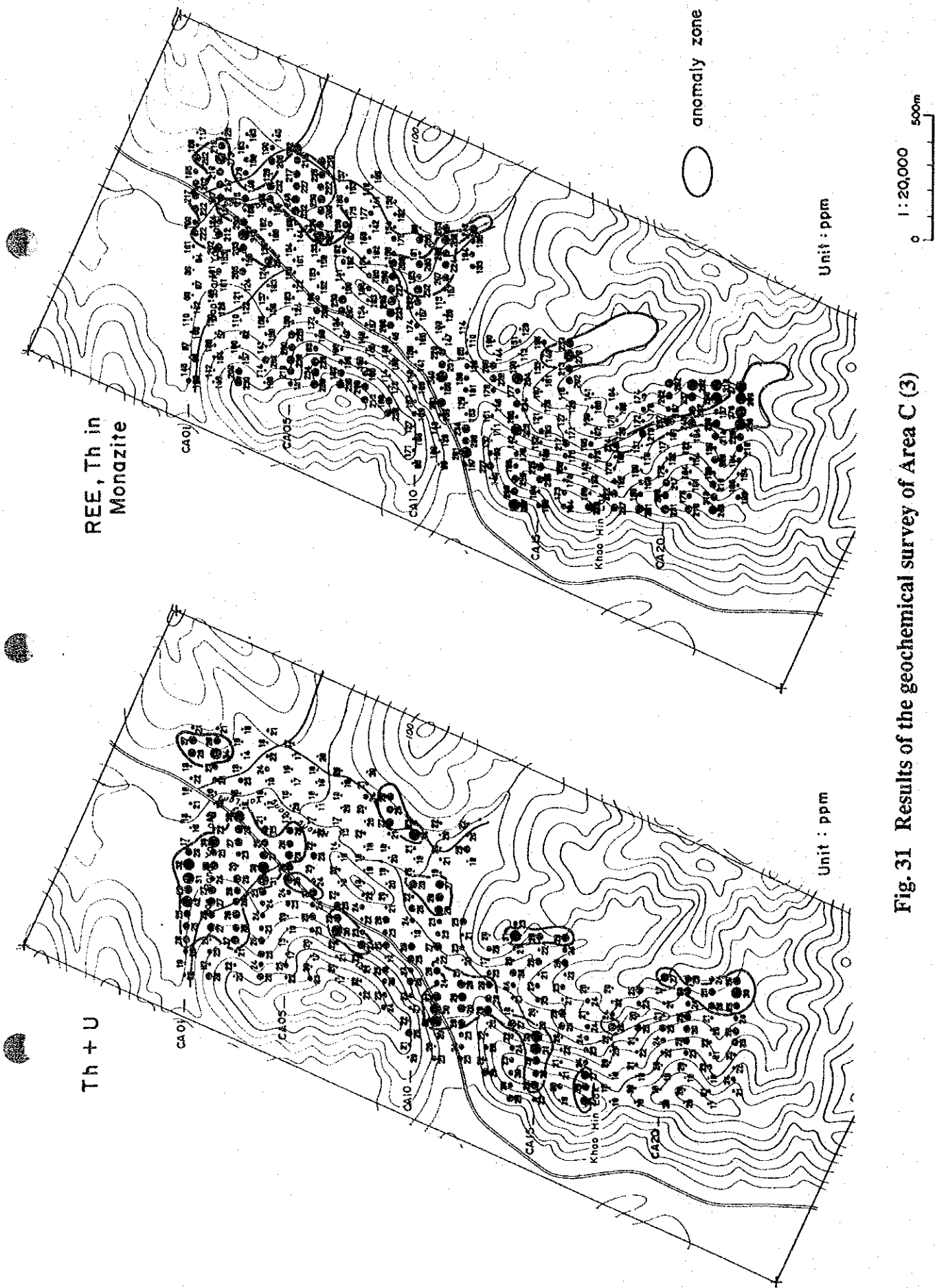


Fig. 31 Results of the geochemical survey of Area C (3)

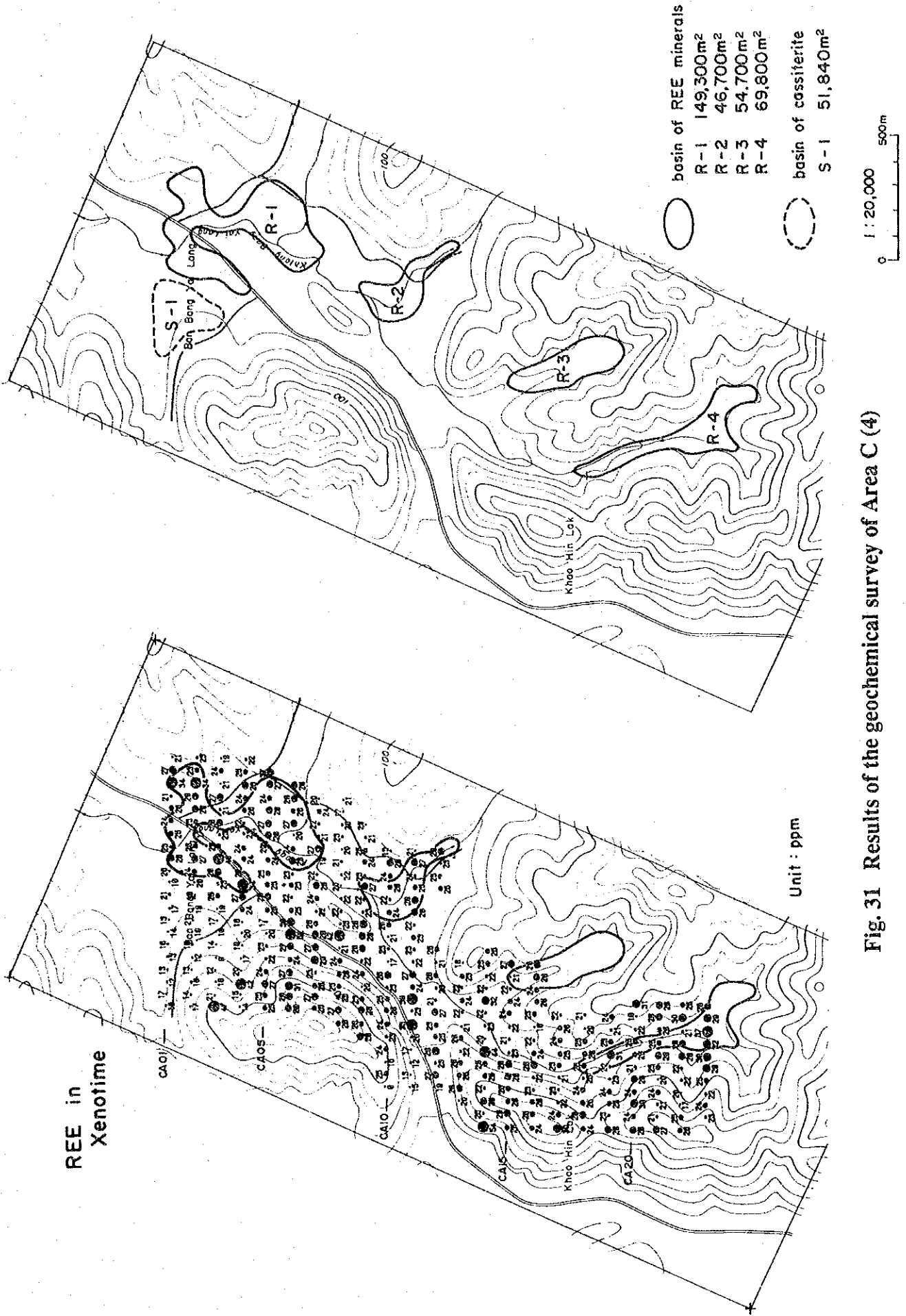


Fig. 31 Results of the geochemical survey of Area C (4)

at the bottom of the alluvial basin.

4-7-4 Considerations

Many tin anomalies are distributed on a slope of the northwest mountains; these tin anomalies are inferred to have been supplied from the silicified rocks in the northwest mountains. The reserve and grade are calculated only in this slope, though soil and weathered material are relatively thin. The reserve of cassiterite is 100 thousand m³.

Another target of a placer deposit is inferred to be a basin extending from near Bang Yai Lang Village to the north. But rice paddies spread in this basin on the north of the CA01 line; thereby the extension of the basin was not confirmed in this survey, though the analysis of heavy mineral samples indicates the potential of placer deposits at the base of the basin in and around Bang Yai Lang.

The high anomaly zone of rare earth elements is detected in the southernmost part of Area C. This anomaly zone has no association with the distribution of silicified rocks. Anomaly values increase eastward in this zone, and are also recognized on the other side of the ridge. Thereby they may indicate that rare earth minerals are derived from the mountains to the southeast of Area C. There is a large possibility that an unknown granite mass intrudes southeast of Area C.

Another anomaly zone of rare earth elements is widely distributed in the northeast. It means the potential of a certain amount of rare earth deposits, though the grade is low. The reserve of rare earth minerals is 640 thousand m³.

4-8 Area D-1

4-8-1 Location

Area D-1 is along the Route 4, is located about 30km south-southeast of Kra Buri. It takes about 35 minutes to get there by car. The area was determined to cover the area from the southern granite body, whose center is latitude 10°10'N and longitude 98°42'E to a mangrove zone stretching on the northwestern side of the rock body as the survey target.

The area mostly consists of the mangrove zone, which has been developed in and around the confluence of Mae Nam Kra Buri and Khlong La-Un. There is no big river in the eastern mountainous district which in the southern part of the area, and they do not exist along valleys in the northern part of the area.

The anomaly values of tantalum and niobium are seen in the eastern part of the area and near the hill district, and not distributed in the zone from the central part to the western part of the area, which is covered with mangrove soil.

The anomaly values of total rare earth, thorium and uranium are distributed in the sedimentary basin in the northeastern part and in the southwestern part of the area as well as granite in the northwestern part of the area.

4-8-2 Geology

Area D-1 is underlain by Cretaceous granite and the Quaternary (Fig. 32).

The granite consists of coarse-grained equigranular two-mica granite often containing mega-crystals of potassium feldspar. The rock is composed mainly of microcline, orthoclase, quartz, plagioclase, biotite and muscovite, with accessories zircon, apatite, sphene and ilmenite. This granite has been subjected to mylonitization. Allanite is often observed in the mylonitized lamella. Strongly sheared and silicified rock crops out on the north of the granite mass. The cement of the brecciated part is composed of quartz, chlorite, sericite and euhedral pyrite. An argillized granite is found on gentle hills in the south, whose plagioclase is completely replaced by kaolinite.

A mangrove mud covers widely in the mangrove zone and overlies the granite sand and partly kaolinite clay bed. The area lacking a mangrove mud is near the border between a slope and the mangrove zone, ranging in width from 20 to 30 meters. The mangrove mud is about 1 meter thick at a distance of 100 to 150 meters from the border of the slopes, and increase the thickness toward Mae Nam Kra Buri.

4-8-3 Result of geochemical prospecting

(1) Soil samples

The thresholds of all the groups were determined to be Sn:31ppm ($M+0.25\sigma$), W:7ppm ($M+0.75\sigma$), Ta-Nb:54ppm ($M+0.5\sigma$), Total REE:477ppm ($M+0.5\sigma$) and Th-U:109ppm ($M+0.5\sigma$) respectively based on the histograms and cumulative probability graphs.

The content distribution maps are shown in Fig.33 (1) to (4).

Most Sn anomaly values are distributed in the granite area, and specially high anomaly values are

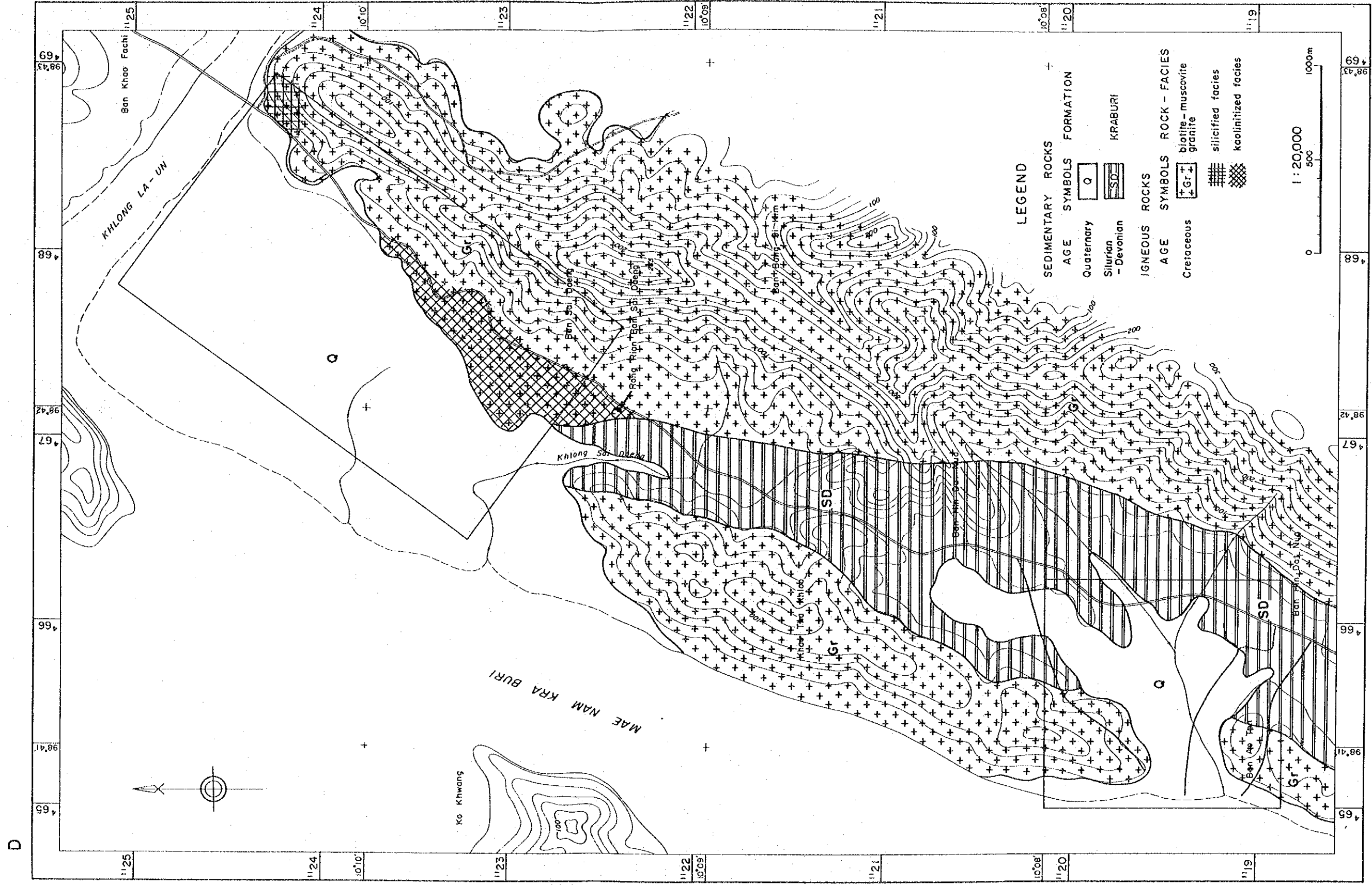


Fig. 32 Geologic map of Area D-1 and D-2

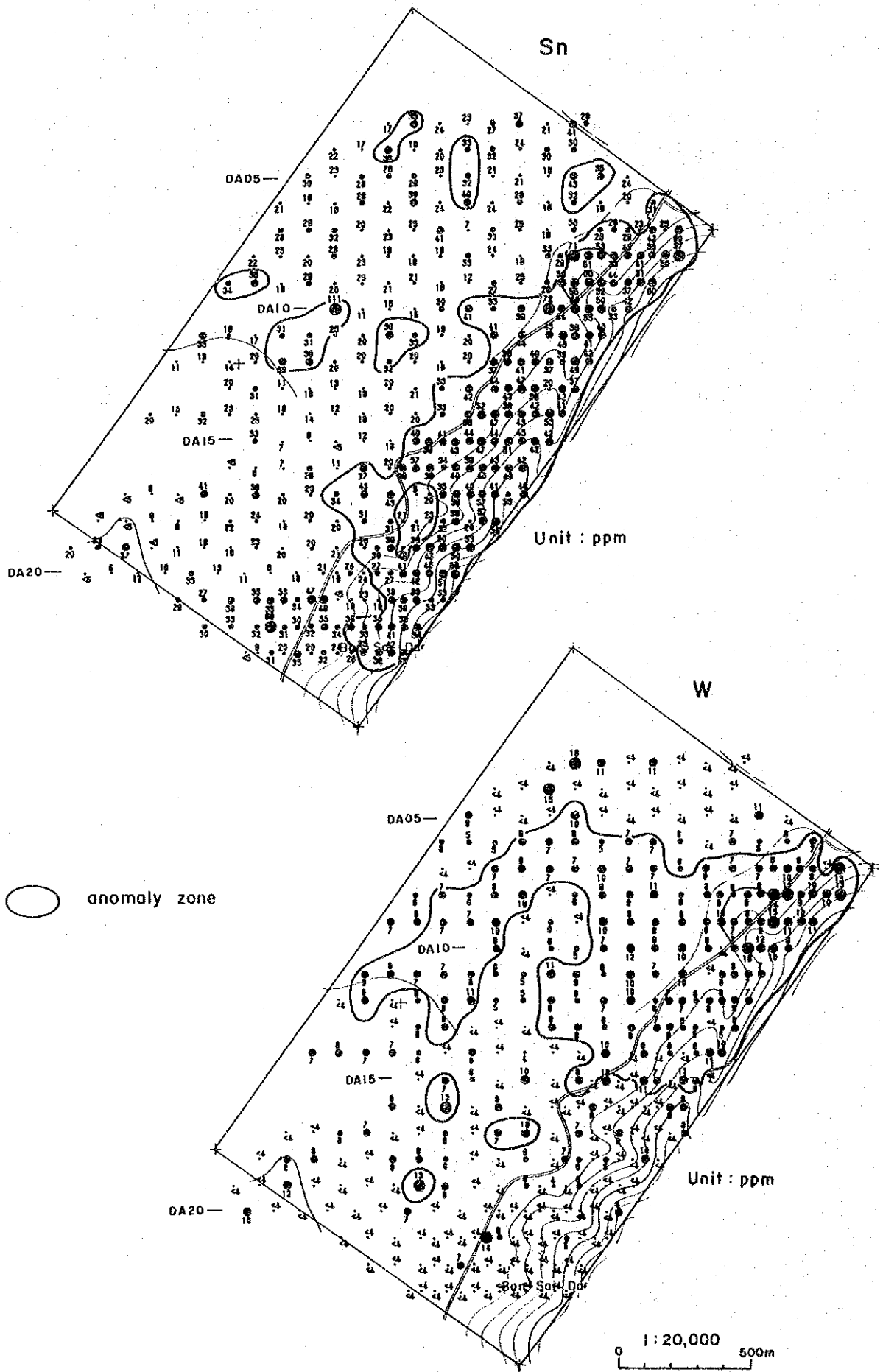


Fig. 33 Results of the geochemical survey of Area D-1 (1)

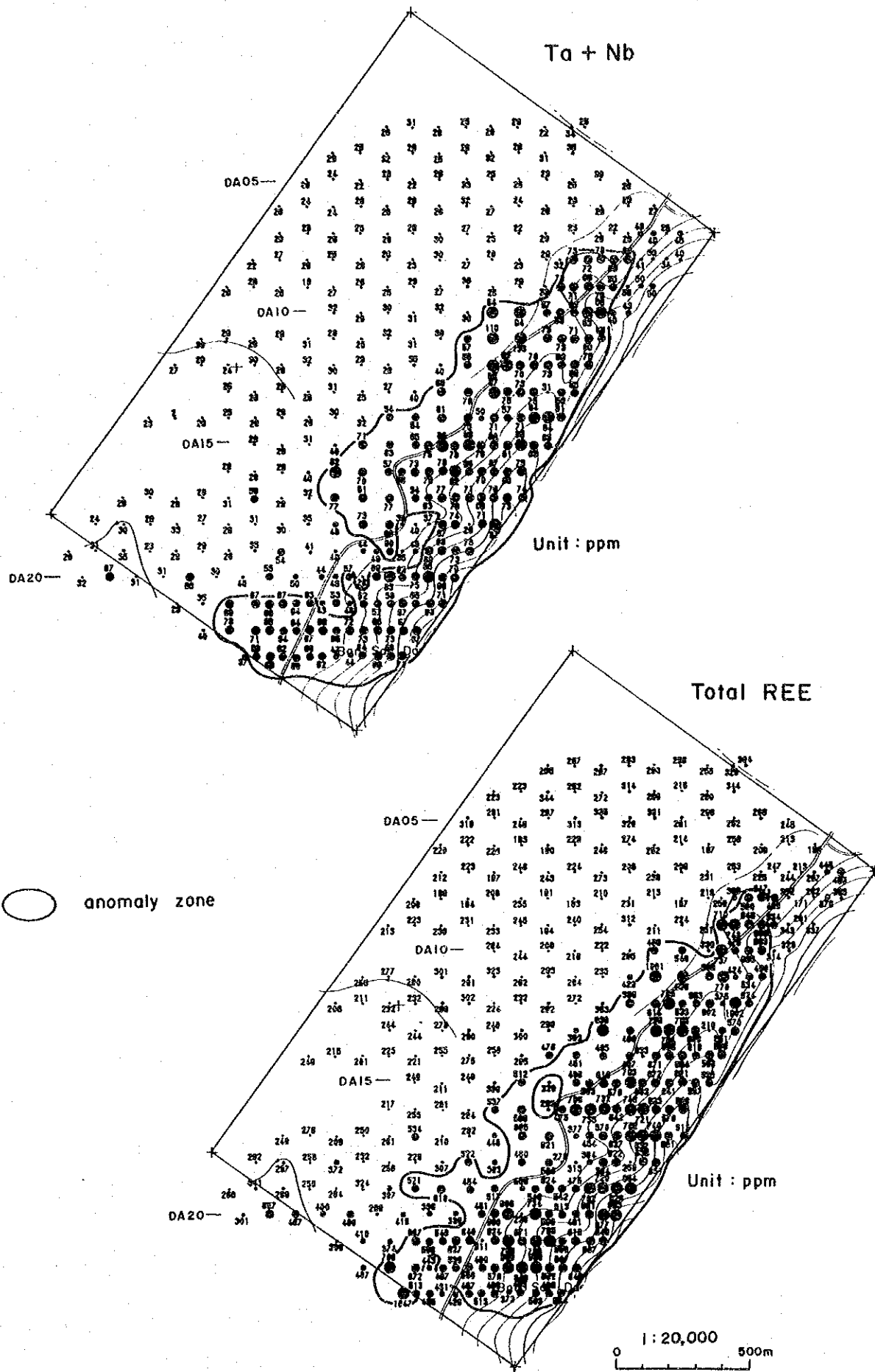


Fig. 33 Results of the geochemical survey of Area D-1 (2)

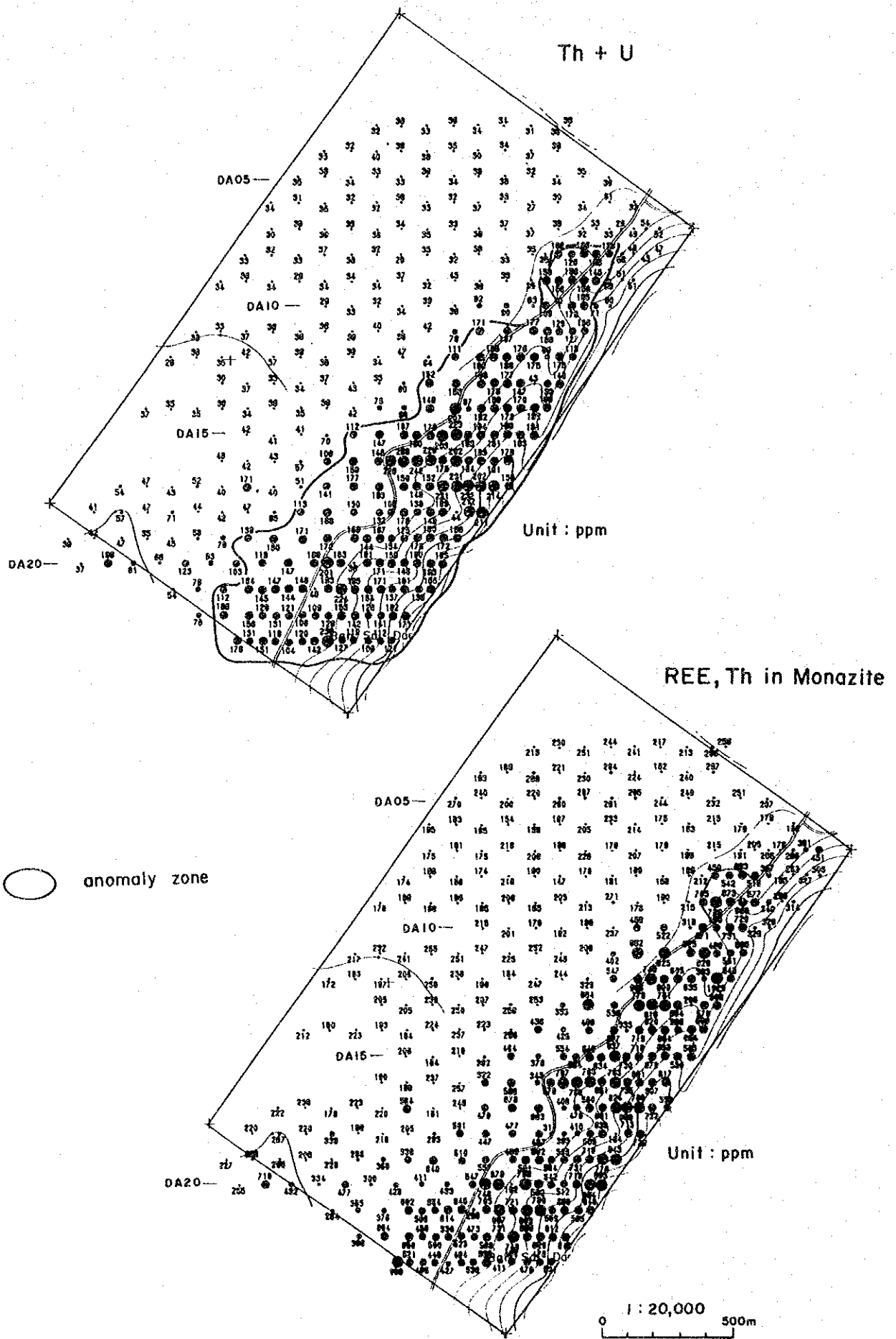


Fig. 33 Results of the geochemical survey of Area D-1 (3)

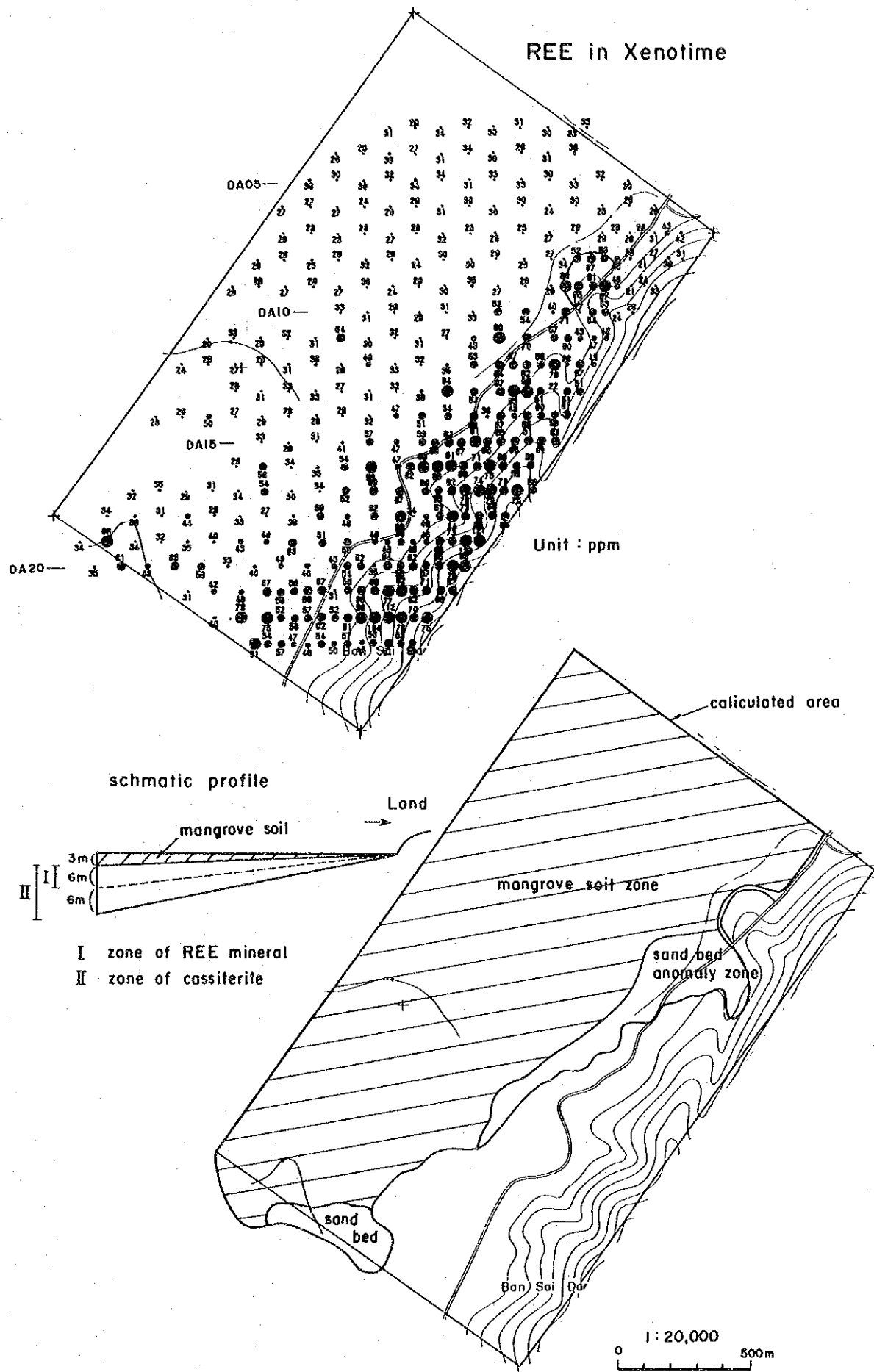


Fig. 33 Results of the geochemical survey of Area D-1 (4)

found in the silicified granite in the north of the mass; thereby these facts indicate that the granite mass has caused tin anomalies in soil samples, and tin has concentrated in the granite mass during the process of silicification. On the contrary, the argillized granite shows a low Sn content in the south of the survey area.

In the mangrove zone, the soil samples are not variable in the Sn content and few samples show low content. The anomaly values are scattered in the mangrove area, and they were collected from the deeper part, e.g., a bottom of a creek. The DA1006 sample with the highest Sn content, was also collected at a depth of 2 meters near the bottom of a large creek. The Sn content tends to increase downward. The high Sn values are also observed in the area, where a mangrove mud is absent, along the valleys on the east of the DA10-DA11 lines.

All the W values are low and the maximum value is only 16 ppm. The distribution of relative high values overlaps with the silicified zone in the north of the granite mass.

The anomaly zones of Ta-Nb, Total REE and Th-U are the same shape as the granite mass, and almost overlap each other. But only few high anomaly values are found in the silicified zone contrary to the Sn values and only lower anomaly values are distributed in an argillized granite; thereby the content of these elements in the silicified or argillized rock tends to be lower than that of the center of granite mass. High anomaly values are distributed in slopes and foot of the mountains rather than ridge. Other anomaly zone overlaps with the area around the DA10-DA17 lines, where the sand bed exposes on the gentle slope between the mountains and alluvial flatland and a mangrove mud is absent. Some of the anomaly values are higher than those in the granite area; thereby it is inferred that these elements concentrate in the alluvium. Samples with a high Th-U content are distributed near the DA15-DA17 lines in the center of the survey area, and their distribution is different a little from that of Total REE and Ta-Nb.

(2) Heavy mineral samples

Six samples of heavy minerals were collected from a sand bed. The amount of monazite is remarkably large, and the amount of heavy minerals follows that in Area A-2. The contents of rare earth elements, thorium and uranium are the highest among all the survey areas, but the content of tin is the lowest.

The distribution of tin content is contrary to that of rare earth elements content. The content of rare

earth elements tends to increase southward, whereas that of tin tends to decrease.

4-8-4 Discussion

Most geochemical anomaly values fall in with the distribution of granite. These anomaly values are almost homogeneous except for thorium and uranium having especially high anomaly values.

In the silicified zone, tin anomaly values are slightly higher than those of the other portion of the granite, whereas the anomaly values of other elements groups show lower, almost a half of the average values.

In the argillized granite, all the elements groups show lower values than those in un-altered granite; thereby there is little possibility of the adsorption-type rare earth deposit.

Topographically, the content of pathfinder elements in a slope and foot is slightly higher than those in a ridge. Some samples in the sand bed area with a lack of mangrove soil show higher content values than the samples in the mountains. These facts indicate that heavy minerals have been transported toward a mangrove zone and accumulated there, resulting of the erosion of the granite.

In the mangrove area, tin anomalies are sporadically found. Some anomaly values of the elements groups except tin are recognized in the area covered by a mangrove mud, though anomaly values of those groups are mostly distributed in the sand bed area between mountains and the mangrove area. These anomaly samples in the mangrove area were collected from the deeper part, e.g., the bottom of a creek; thereby there is a large possibility that a placer deposit exists below a mangrove mud.

The reserve was calculated in Area D-1. The total thickness of an alluvial basin was determined to be 15 meters by assuming the incline of the base of an alluvial basin 1° and the total extension of an alluvial basin 850 meters from the border between a land and the mangrove zone. The reserve excludes a very fine-grained mangrove mud of the uppermost of an alluvium, assumed ranging up to 3 meters thick from surface to downward in the western edge of Area D-1. It is assumed that the upper portion of the sand bed contains rare earth minerals and the content of REE is a mean value of soil samples, and the lower portion contains only cassiterite and the content is 111 ppm obtained from the bottom of a creek (Fig.34 (4)).

The reserve of rare earth ore is estimated at 7.5 million m^3 (at a monazite content of $1.480kg/m^3$ and a

xenotime content of 0.167kg/m^3) and that of tin ore at 14.55 million m^3 (at a cassiterite content of 0.222kg/m^3). This reserve is the largest in this program.

4-9 Area D-2

4-9-1 Location

Area D-2 is about 35 kilometers south of Kra Buri Town, and the west of the Route 4. The area is south of Area D-1. It takes about 40 minutes to get there by car.

The area consists of a mangrove zone, which is an alluvial basin surrounded by hills. The rivers run west-southwestward in the center and at the foot of the northern hills. Much creeks form a network in a mangrove zone. This alluvial basin is topographically desirable to have a placer deposit because of its narrow exit.

The geochemical anomaly of Nb, REE, Th and Y from stream sediments and that of Ta, Nb, REE, Th, U and Y from soil samples were detected by the first year geochemical prospecting.

4-9-2 Geology

Area D-2 is underlain by Silurian-Devonian Kra Buri Formation of the Tanaosi Group, Cretaceous granite and the Quaternary (Fig.32).

Kra Buri Formation is surrounded by a granite, and consists mainly of strongly-weathered mudstone. The west contact of granite mass is metamorphosed to amphibolite.

Cretaceous granite consists of medium or coarse grained equigranular two-mica granite, and is foliation conspicuously. The rock is composed mainly of microcline, orthoclase, quartz, plagioclase, biotite and muscovite, with accessories zircon, apatite, sphene and ilmenite.

A mangrove mud covers widely in the mangrove zone and overlies the coarse sand bed. The area lacking a mangrove mud is on the west of the Route 4, ranging in width from 200 to 300 meters. The mangrove mud is only ranging from 1 to 2 meters thick even on the western edge of the survey area.

4-9-3 Result of geochemical prospecting

(1) Soil samples

The thresholds of all the groups were determined to be Sn:30ppm ($M+0.25\sigma$), W:8ppm ($M+0.75\sigma$),

Ta-Nb:35ppm ($M+0.5\sigma$), Total REE:309ppm ($M+0.5\sigma$) and Th-U:62ppm ($M+0.5\sigma$) respectively based on the histograms and cumulative probability graphs.

The content distribution maps are shown in Fig.34 (1) to (2).

Most anomaly values of Sn and W are found in the south of the survey area, and no anomaly values are detected along valleys in the north.

The anomaly values of Ta-Nb are detected in the east of the survey area and near hills. No anomaly values are distributed in the area covered by mangrove mud from the central part to the western part of the survey area.

The anomaly values of Total REE and Th-U are detected in the northeast and the southwest of the alluvial basin and granite in the northwest of the survey area.

(2) Samples of Heavy Minerals

Eight samples were collected. Panning samples were collected mainly from the sand layer area, and the amount of heavy minerals was relatively large, and the anomaly values of monazite are remarkably seen in some places.

The concentration of elements in samples is harmonious with the distribution of their concentration in soil samples. While the concentration of elements is higher, the concentration of their respective heavy minerals tends to become higher.

4-9-4 Considerations

In this area, the concentration of minerals in samples does not differ from each other except several samples with a high concentration. No superior anomaly values are not seen in all the groups. The distribution of tin, tantalum and niobium anomaly values and that of rare earth, thorium and uranium are different from each other, but no anomaly values of both of them are not recognized in the distribution zone of mangrove soil in the same way.

As for the calculation of the amount of minerals, the entire alluvial sedimentary basin was considered to be the survey target since geochemical anomaly values could be imagined to be distributed below mangrove soil. The average depth was assumed to be about 2.5m, which was the maximum head from the surface of the mangrove zone to the bottom of waterways.

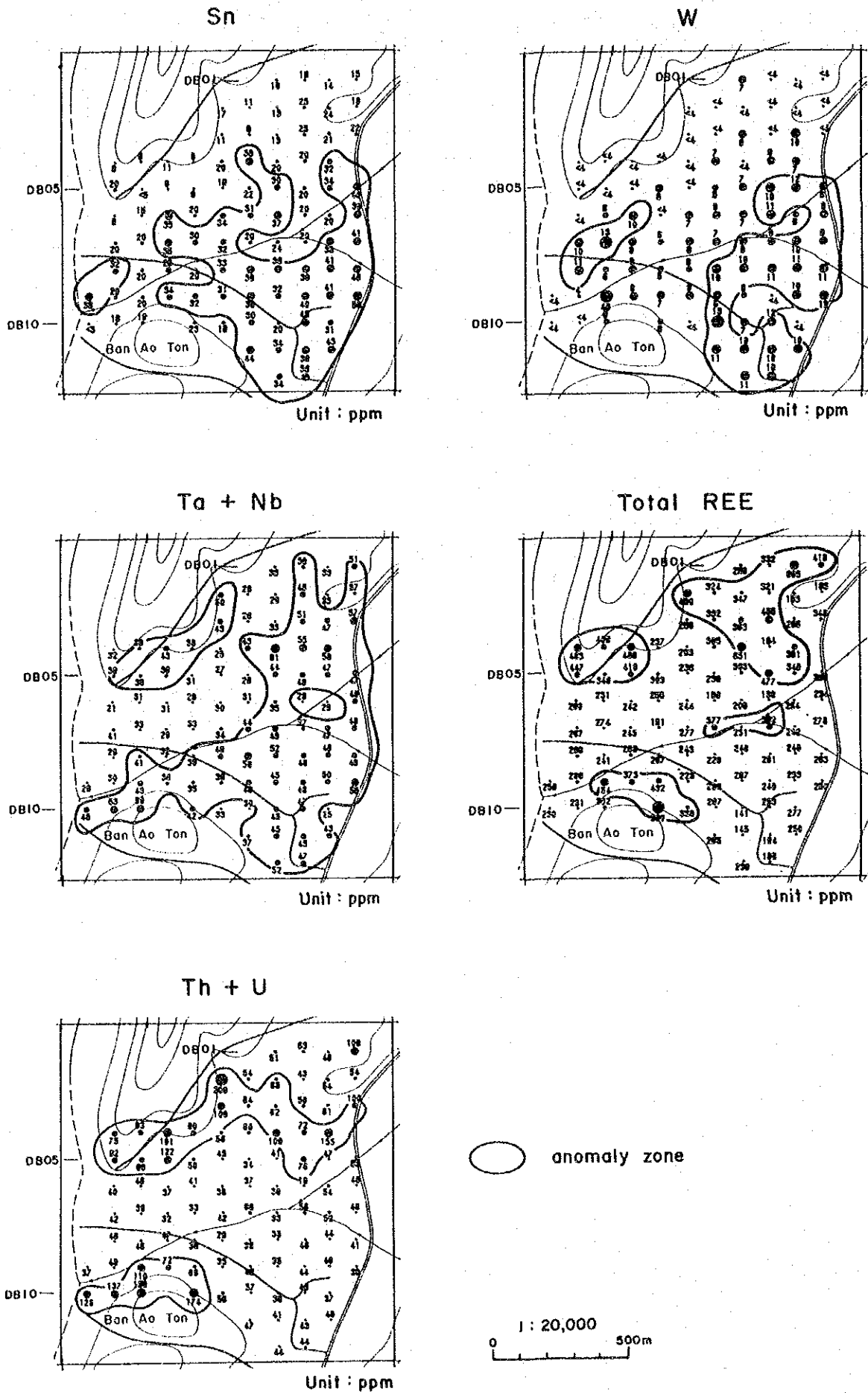
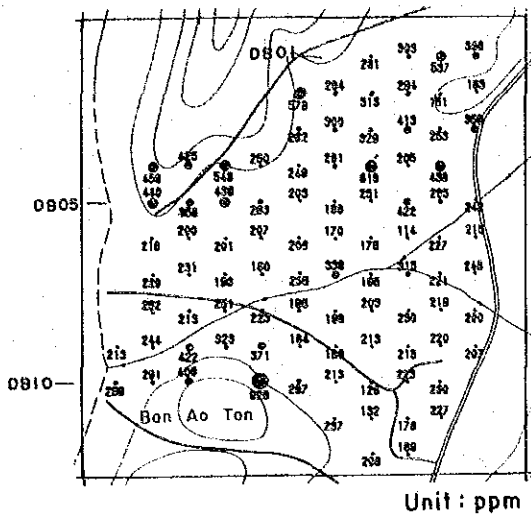
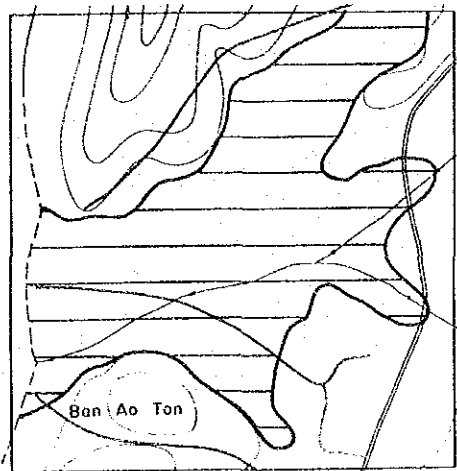
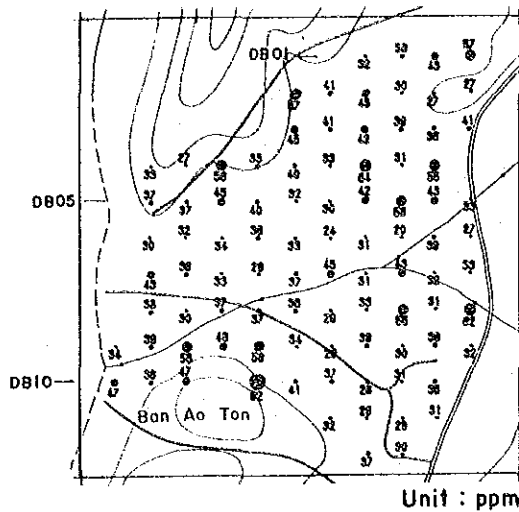


Fig. 34 Results of the geochemical survey of Area D-2 (1)

REE, Th in Monazite



REE in Xenotime



assumed basin of cassiterite
and REE minerals

651,500 m²

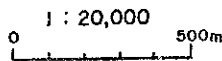


Fig. 34 Results of the geochemical survey of Area D-2 (2)

Chapter 5 Pit and Drilling Survey

5-1 Area A-1, Pit and Drilling Survey

5-1-1 Selection of Location

The pit and drilling surveys have been conducted to confirm its reserves and grades of expected ores in the zones selected by the second phase programs. The second phase programs consisted of soil geochemical survey and revealed that there existed potential for promising secondary ores in several zones.

The A-1 area is situated in the inner mountain alluvial basin along the valley of the Khlong Nam Khao. Geochemical anomalies consisting of tin and rare earths are distributed in four zones, northern, central, southwestern, and southeastern parts of the area. These anomalies are corresponding to the distribution of talus deposits brought from granite terrains in the western area and river sediments along the Khlong Nam Khao and its tributaries. Fig. 35 shows the locality of survey site.

The northern geochemical anomaly zone consists of R-1-1, S-2, and R-1-2, which spread over a large area along the Khlong Nam Khao. The anomalies are of rare earths, but of rare earths and tin at the central part. The zone is mostly underlain by colluvial and redepositional residual sediments derived from the granites distributing to the west. It was expected potential for weathered residual ores and secondary ores in river beds along Khlong Nam Khao.

The northern geochemical anomaly zone consists of R-2 and S-2, which are distributed in a fan shape along the tributaries of the Khlong Nam Khao, surrounded by small hills being composed of the Matri Formation of the Carboniferous. The anomaly is of tin and rare earths. It was expected potential for secondary ores in river beds.

The southwestern geochemical anomaly zone consists of S-3 and R-4. The former is of tin, and situated in a large area along the tributaries of the Khlong Nam Khao, in the same geological situation as the central anomaly zone. The latter is of rare earths, and distributed in a small area in the upper stream area of a tributary of the Khlong Nam Khao. The main target in this zone is secondary ores in river beds for tin.

The southeastern geochemical anomaly zone consists of R-4, which is coincident with the distribution of the stream sediments along the Khlong Nam Khao. The anomaly is of rare earths. It is expected potential for secondary ores.