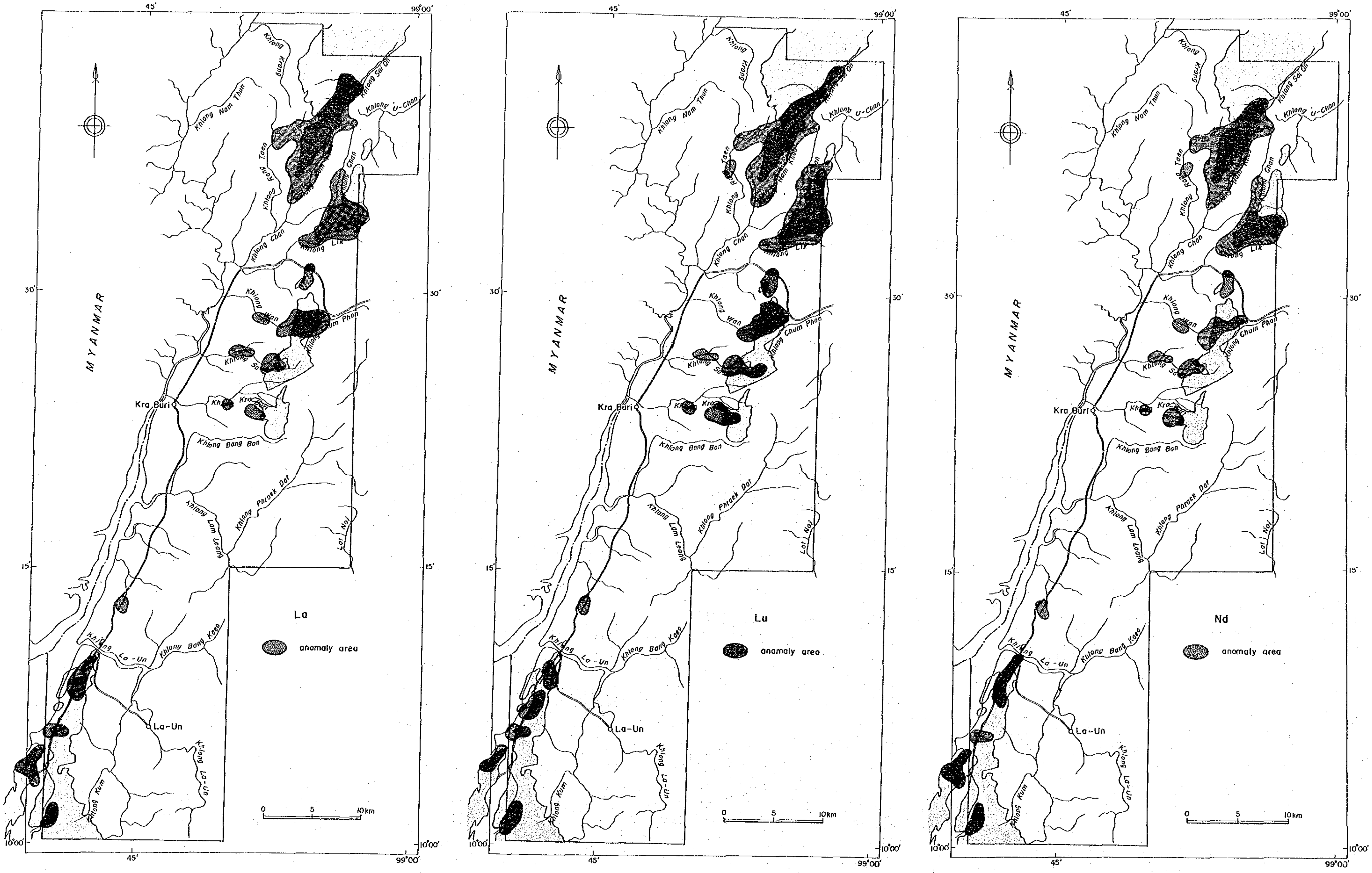


Fig. 23 Geochemical anomaly map of stream sediments (4)

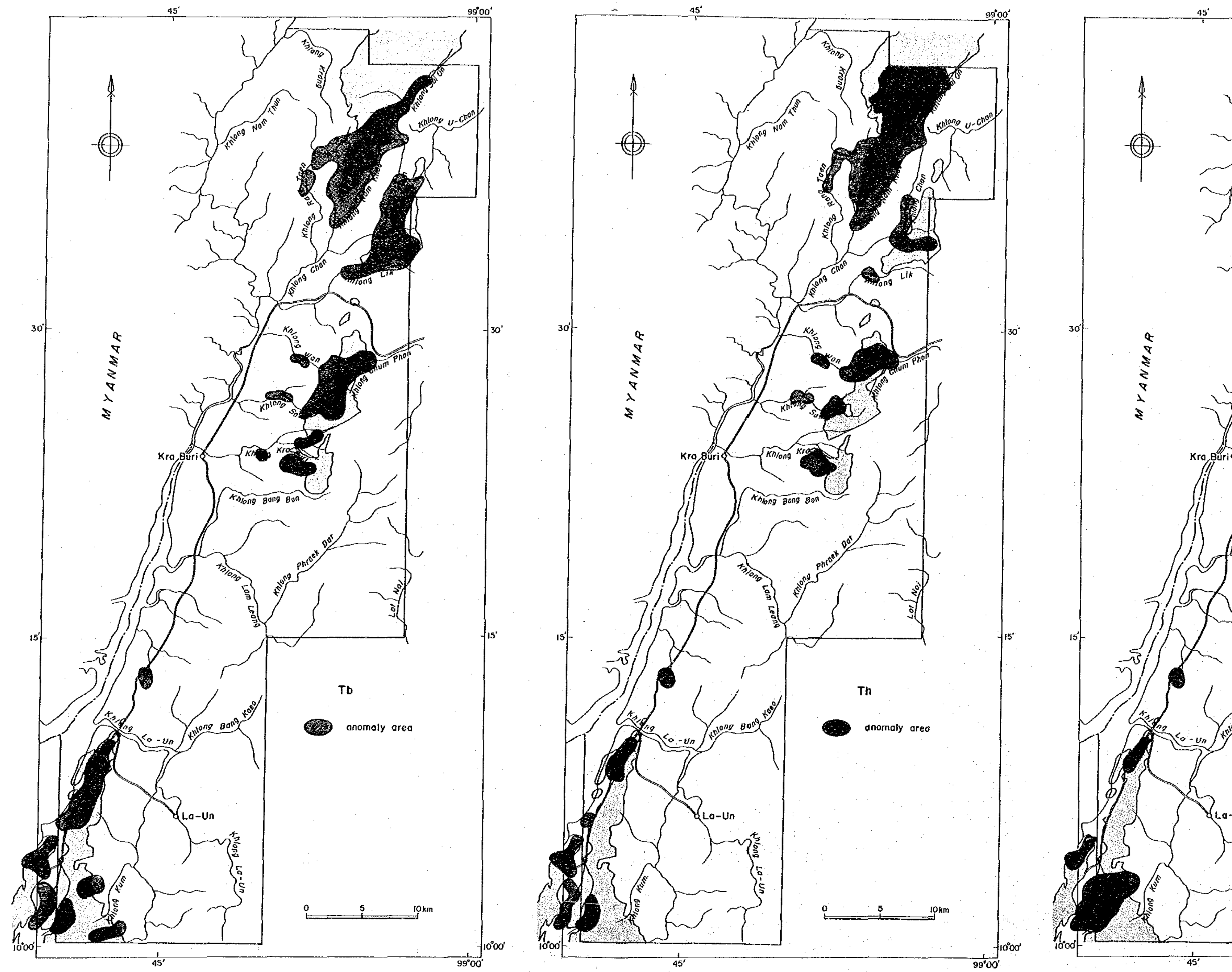


Fig. 23 Geochemical anomaly map of stream sediments (5)

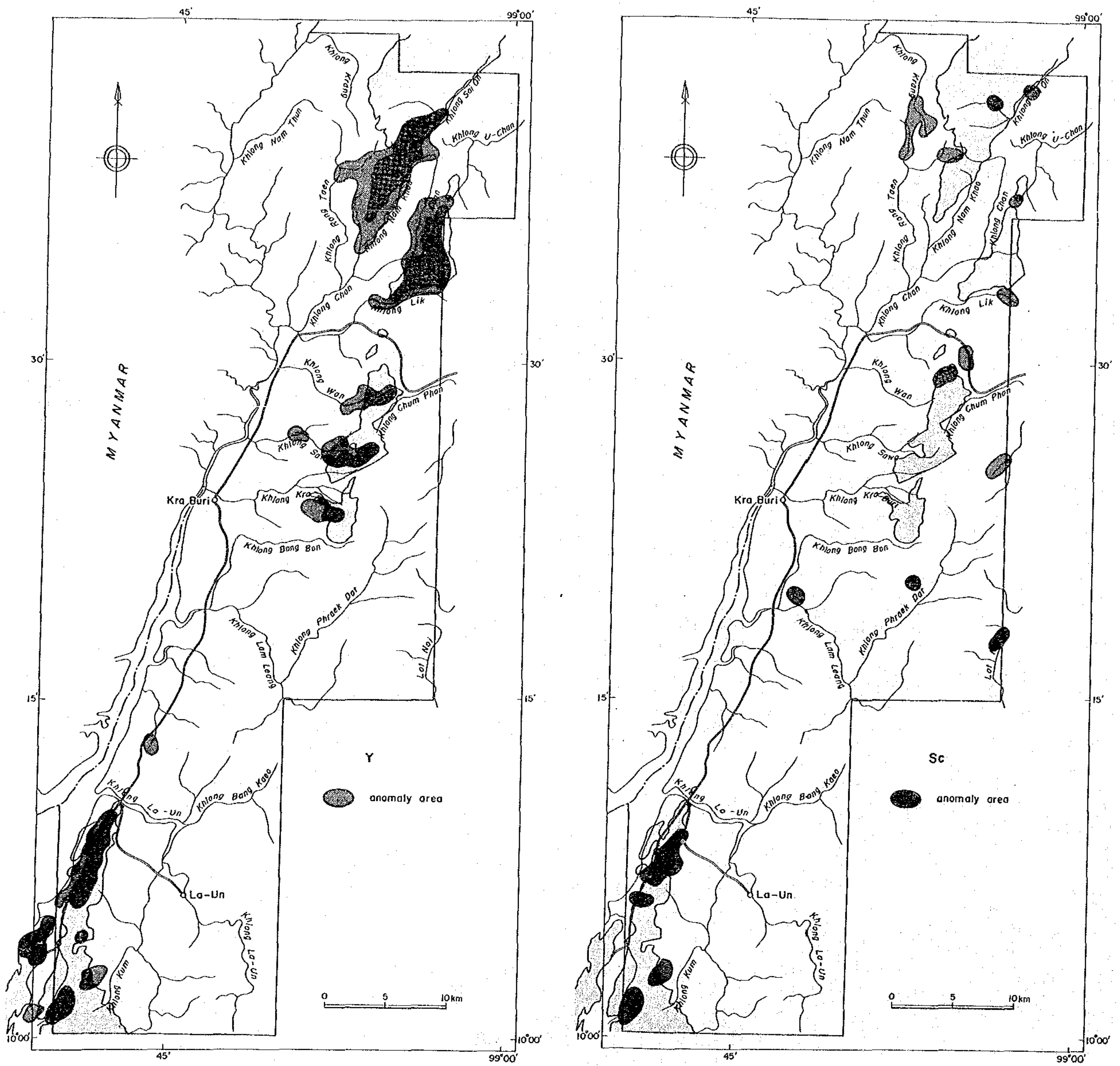


Fig. 23 Geochemical anomaly map of stream sediments(6)

Anomaly zones overlie the whole areas of the northern granite bodies. In the Central mass, anomaly zones are in the Khlong Wan, Khlong Phlu Yai, and upper stream of the Khlong Kra Buri on the west, and middle streams of the rivers. In the Southern mass, An anomaly area is spread in the west, but only small-scale anomaly zones of U, Tb, Y are situated in the east in spite of anomalies of Sn and W are distributed there. A small-scale high intensity anomaly zone is in the upper stream of the Khlong Bang Yai Lang, at the northern end of the Khao Fachi Silicified Zone.

Small-scale anomaly zones for Eu are situated in the Northern east mass in the northern area, Central mass, and the northern part of the Southern mass. Other than those, some samples in the background areas show high contents of the element, over the average figure. These are probably brought from the plagioclase in the sedimentary rocks.

Contents of Mo are clearly higher in the sedimentary areas than in the granite areas, indicating the element is primary rich in the sedimentary rocks. No granite activity associated with molybdenum mineralization has presumably occurred in the area.

Anomaly zones for Au spread over the area as spots. It appears that samples of high Au contents are arrayed in the direction of NNE-SSW, suggesting us that the mineralization has been brought into sheared zones parallel to the Ranong Fault.

3-2 Soil Samples

3-2-1 Sampling

A geochemical sampling program has been performed for the soil in the granite areas to estimate contents of following elements, Sn, W, Ta, Nb, rare earths, U, Th, Y, and Sc, after the geological survey was completed. The sampling areas have been selected mainly in the granite distribution areas, together with surrounding sedimentary rock areas to obtain background values. In addition to those, an alteration zone and a sulphide dissemination zone have been selected. Soil sections on road cutting have been observed prior to take samples, and incases no cutting exists the surface has been dug to take samples from the B or C-horizons.

About 2 to 3 kg of soil has been sampled at each point. After dried up, they have been sieved by 80 mesh screens, and the final products have been divided in two portions, one for the Thailand team and the other for the Japanese team. The samples for the Japanese team have been chemically assayed. The total number of the samples is 207.

3-2-2 Pathfinder Elements

The same 17 elements as those in the case of the stream sediments have been selected, i.e., Sn, W, Ta, Nb, Ag, Mo, Ce, Eu, La, Lu, Nd, Sm, Tb, Th, U, Y, Sc. The assay method and detection limits for each element are also same as those for the stream sediment geochemistry.

3-2-3 Analysis of Geochemical Data

Table 10 shows the maximum, minimum, and average values, and standard deviation for each element, and Table 11 shows the correlation coefficient between each element.

Table 10 Geochemical basic statistic quantities of soil samples

Element	Unit	Max.	Min.	Average	Av.ant-log	Std.Dev.
Sn	ppm	174	<5	1.2043	16.01	0.5759
W	ppm	210	<4	0.8613	7.27	0.4214
Ta	ppm	31	<1	0.5082	3.22	0.3784
Nb	ppm	111	8	1.4814	30.30	0.2050
Au	ppb	14	<5	0.4528	2.84	0.1542
Mo	ppm	15	INT	-0.5170	0.30	0.7421
Ce	ppm	770	20	2.1840	152.76	0.2876
Eu	ppm	2.8	<0.2	-0.1850	1.53	0.3378
La	ppm	320	9	1.7287	53.54	0.3100
Lu	ppm	3.78	0.06	-0.2358	0.58	0.2390
Nd	ppm	220	<5	1.5297	33.86	0.3487
Sm	ppm	35	0.8	0.8050	6.38	0.3244
Tb	ppm	4.6	<0.5	-0.2610	0.55	0.4235
Th	ppm	300	11	1.7842	60.84	0.3309
U	ppm	34	1.5	0.9407	8.72	0.2791
Y	ppm	182	3	1.4648	29.16	0.2917
Sc	ppm	26	4.8	1.0703	11.76	0.1396

The correlation coefficients between each element show same tendency as those in the stream sediment geochemistry, although slightly weaker. Sc generally shows negative correlations with other elements, on the other hand W shows no correlations with Nb, Rare earths, Th, U, and Y. It probably

Table 11 Geochemical correlation coefficients of soil samples

	Sn	W	Ta	Nb	Au	Mo	Ce	Eu	La	Lu	Nd	Sm	Tb	Th	U	Y	Sc
Sn	1.000	0.483	0.684	0.519	0.011	-0.195	0.255	-0.214	0.229	0.239	0.181	0.271	0.278	0.398	0.507	0.340	-0.290
W	0.483	1.000	0.520	0.257	0.008	-0.127	-0.029	-0.186	0.009	0.223	-0.035	0.020	0.034	0.106	0.294	0.162	-0.048
Ta	0.684	0.520	1.000	0.713	0.031	-0.253	0.286	-0.274	0.245	0.315	0.188	0.292	0.338	0.499	0.577	0.434	-0.351
Nb	0.519	0.257	0.713	1.000	0.050	-0.257	0.618	-0.184	0.517	0.304	0.459	0.548	0.476	0.761	0.698	0.546	-0.406
Au	0.011	0.008	0.031	0.050	1.000	0.033	-0.058	-0.082	-0.092	0.095	-0.056	-0.051	-0.016	-0.024	0.027	0.069	-0.004
Mo	-0.195	-0.127	-0.253	-0.257	0.033	1.000	-0.108	0.041	-0.164	-0.129	-0.131	-0.167	-0.247	-0.224	-0.387	-0.169	0.260
Ce	0.255	-0.029	0.286	0.618	-0.058	-0.108	1.000	0.083	0.779	0.140	0.722	0.745	0.417	0.824	0.669	0.346	-0.315
Eu	-0.214	-0.186	-0.274	-0.184	-0.082	0.041	0.083	1.000	0.395	0.147	0.441	0.421	0.139	-0.095	-0.008	0.218	0.117
La	0.229	0.009	0.245	0.517	-0.092	-0.164	0.779	0.395	1.000	0.199	0.941	0.956	0.537	0.661	0.594	0.521	-0.396
Lu	0.239	0.223	0.315	0.304	0.095	-0.129	0.140	0.147	0.199	1.000	0.281	0.373	0.397	0.257	0.350	0.754	-0.021
Nd	0.181	-0.035	0.188	0.459	-0.056	-0.131	0.722	0.441	0.941	0.281	1.000	0.951	0.553	0.600	0.549	0.568	-0.372
Sm	0.271	0.020	0.292	0.548	-0.051	-0.167	0.745	0.421	0.956	0.373	0.951	1.000	0.613	0.665	0.637	0.671	-0.389
Tb	0.278	0.034	0.338	0.476	-0.016	-0.247	0.417	0.139	0.537	0.397	0.553	0.613	1.000	0.460	0.450	0.588	-0.463
Th	0.398	0.106	0.499	0.761	-0.024	-0.224	0.824	-0.095	0.661	0.257	0.600	0.665	0.460	1.000	0.809	0.473	-0.450
U	0.507	0.294	0.577	0.698	0.027	-0.387	0.669	-0.008	0.594	0.350	0.549	0.637	0.450	0.809	1.000	0.520	-0.405
Y	0.340	0.162	0.434	0.546	0.069	-0.169	0.346	0.218	0.521	0.754	0.568	0.671	0.588	0.473	0.520	1.000	-0.300
Sc	-0.290	-0.048	-0.351	-0.406	-0.004	0.260	-0.315	0.117	-0.396	-0.021	-0.372	-0.389	-0.463	-0.450	-0.405	-0.300	1.000

indicates that the geochemical characters of the soil samples are strongly controlled by the rocks of the ground, and the concentration of the minor elements in the rocks varies place by place. On the contrary, minor elements are much concentrated in stream sediments, and possibly show strong correlations each other.

Figure 24 shows columnar sections of geological profiles and soil sampling locations in the cuttings facing the road lead to the TV transmission station on the north of Ban Bang Non in the southwestern end of the area. Table 12 shows the contents of the minor elements in the four sampling points. No significant difference showing leaching or concentration of elements in the A, B, and C soil horizons is recognized in the results. The elements, Sn, Nb, Ta, and rare earths are contained in insoluble minerals such as cassiterite, monazite, xenotime, therefore they hardiy move in the soil. The maximum values of minor elements' contents in the weathered soils in the area range from 0.8 to 3.3 times of those of the granites of the area. It indicates that rare earth elements are not much concentrated in the soil.

Table 12 Geochemical data of soil profile in Ban Bang Non

		Sampling Point			
Element	unit	1	2	3	4
Sn	ppm	89	87	108	104
W	ppm	6	7	<4	<4
Ta	ppm	8	10	9	10
Nb	ppm	53	55	50	62
Au	ppm	7	<5	<5	<5
Ce	ppm	340	250	280	270
Eu	ppm	0.2	<0.2	<0.2	<0.4
La	ppm	27	30	22	32
Lu	ppm	0.6	0.5	0.6	1.08
Sm	ppm	16	16	12	19
Tb	ppm	<0.5	<0.5	<0.5	1.2
Th	ppm	160	130	120	200
U	ppm	11	12	10	15
Y	ppm	33	26	24	48
Sc	ppm	11	8.6	8.8	12

Figure 25 shows the grade distribution of the minor elements in the soil. The grade distributions of Sn, W, Nb, and Ta are significantly concordant each other, as shown in the correlation coefficients. Highly concentrated parts are in the southern end of the Northern west mass in the northern area and the southern end of the Southern mass. Anomalies for Nb appear, in addition to there, in the northern end of the

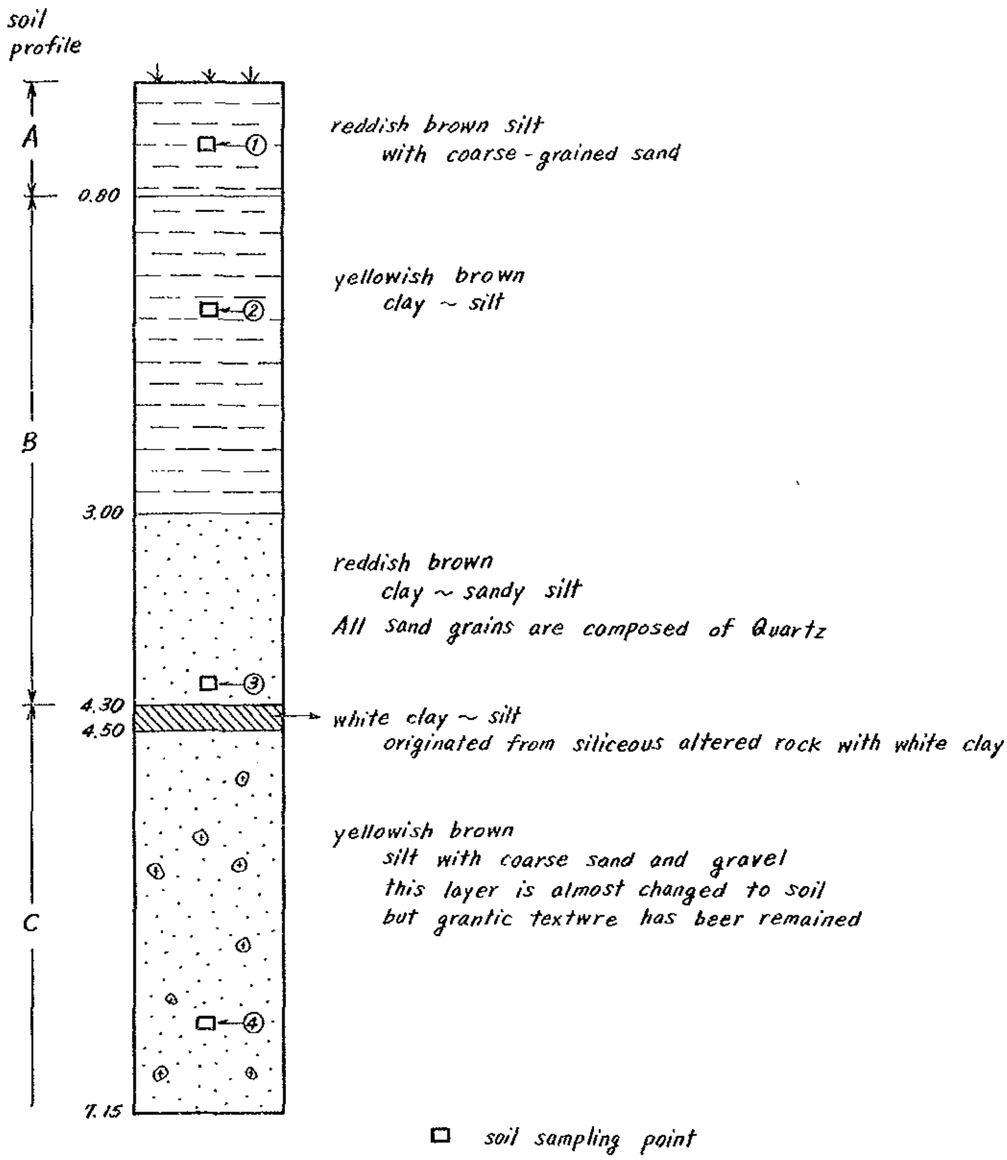


Fig. 24 Soil profile in Ban Bang Non

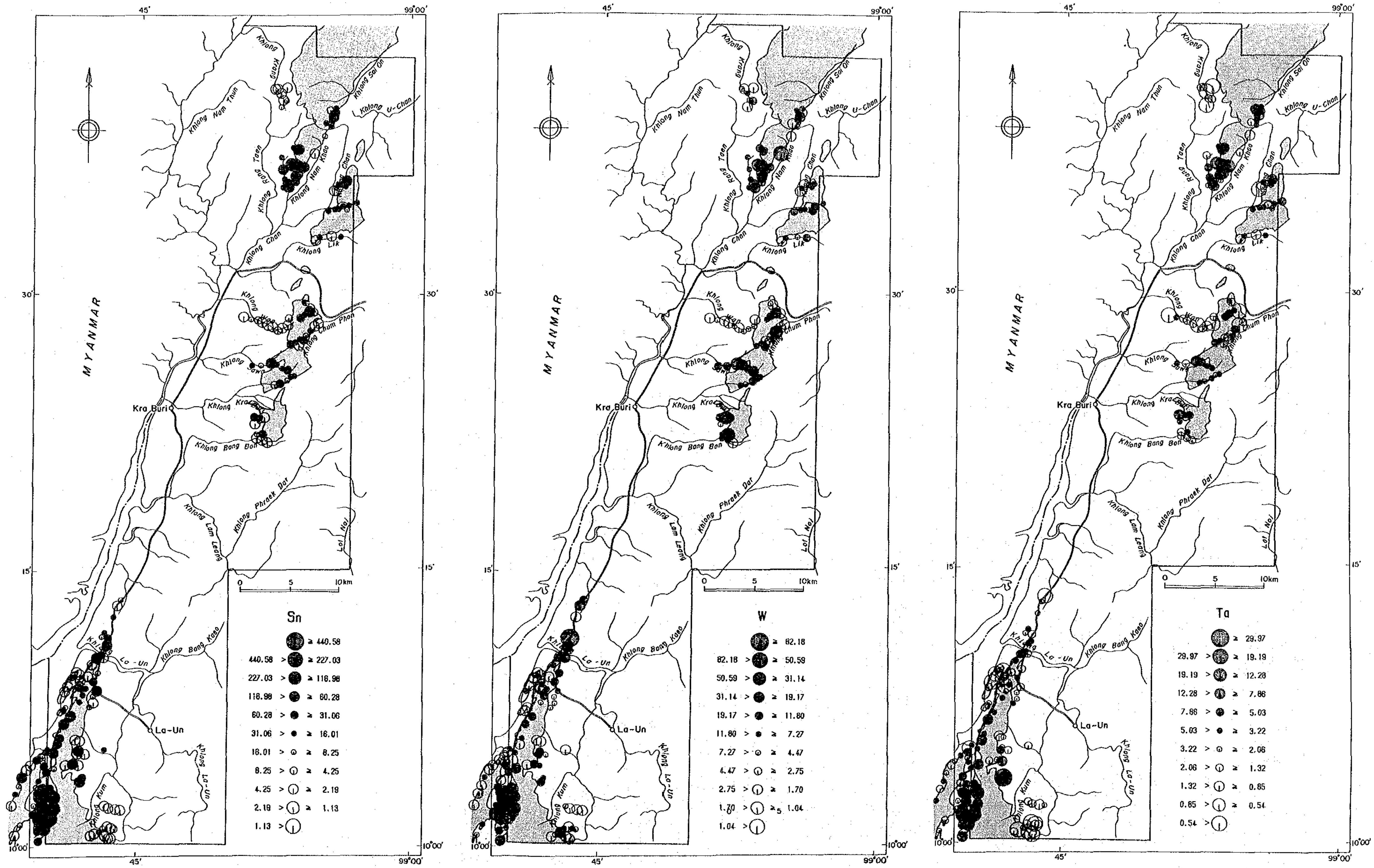


Fig. 25 Content distribution map of soil samples (1)

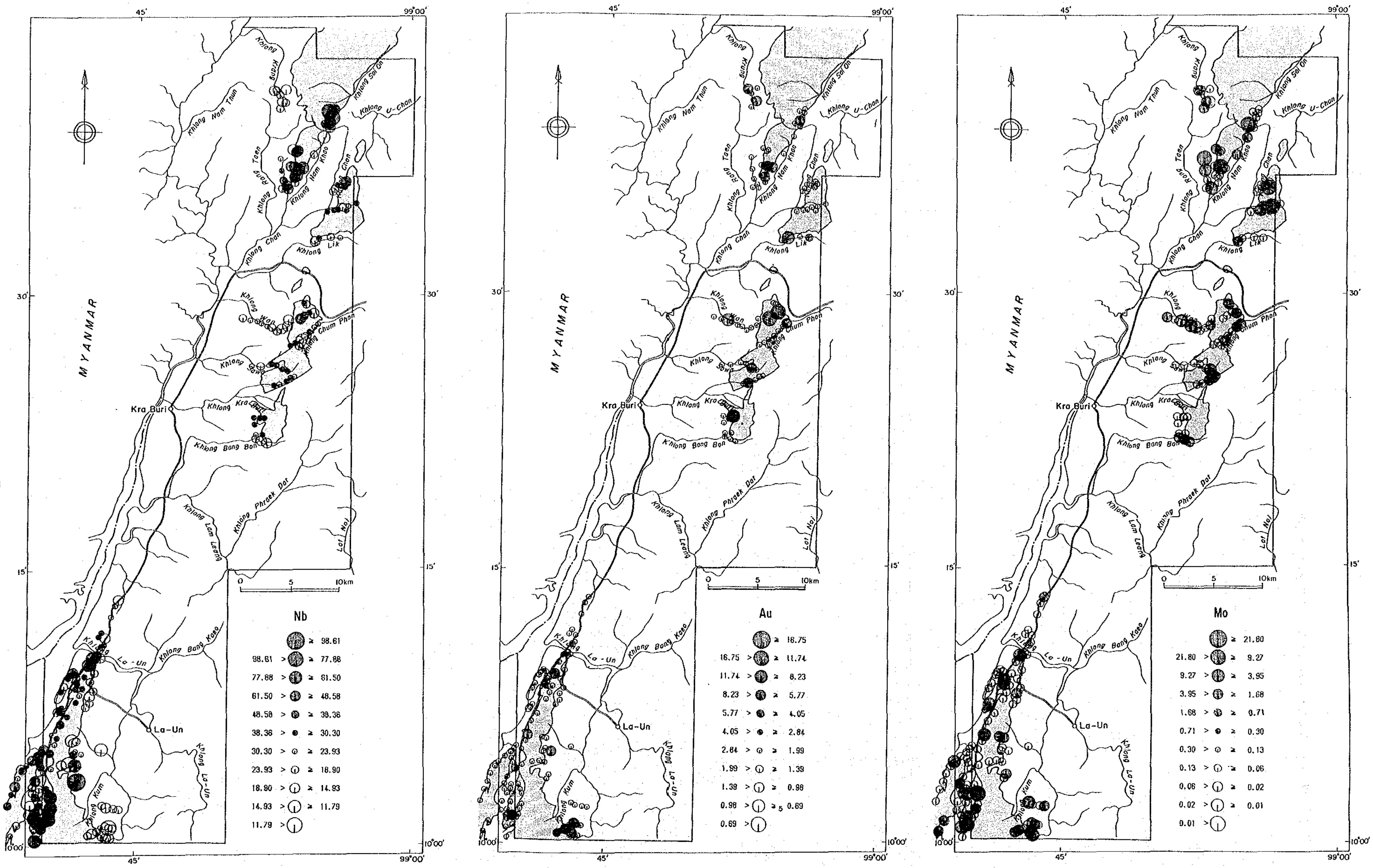


Fig. 25 Content distribution map of soil samples (2)

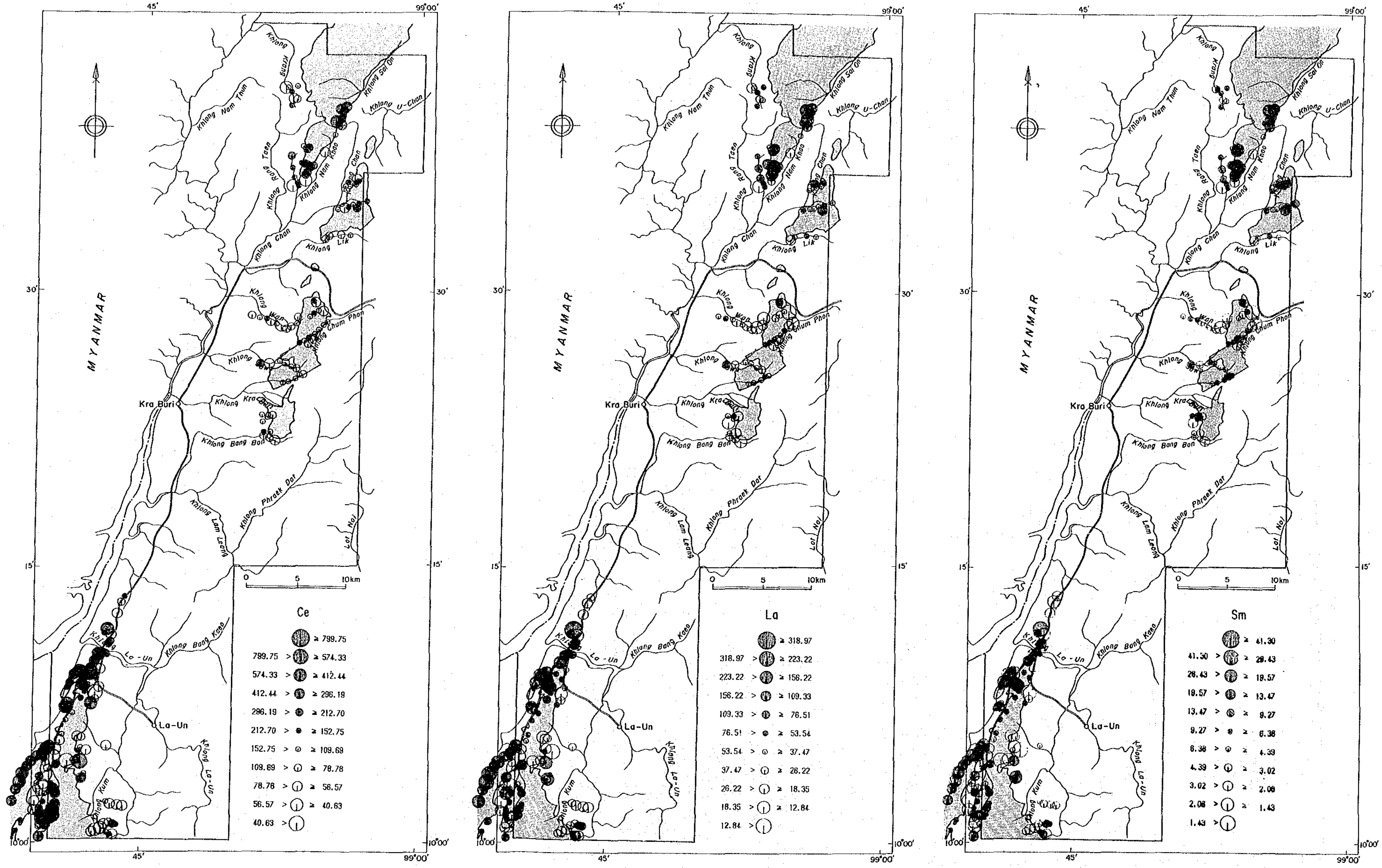


Fig. 25 Content distribution map of soil samples (3)

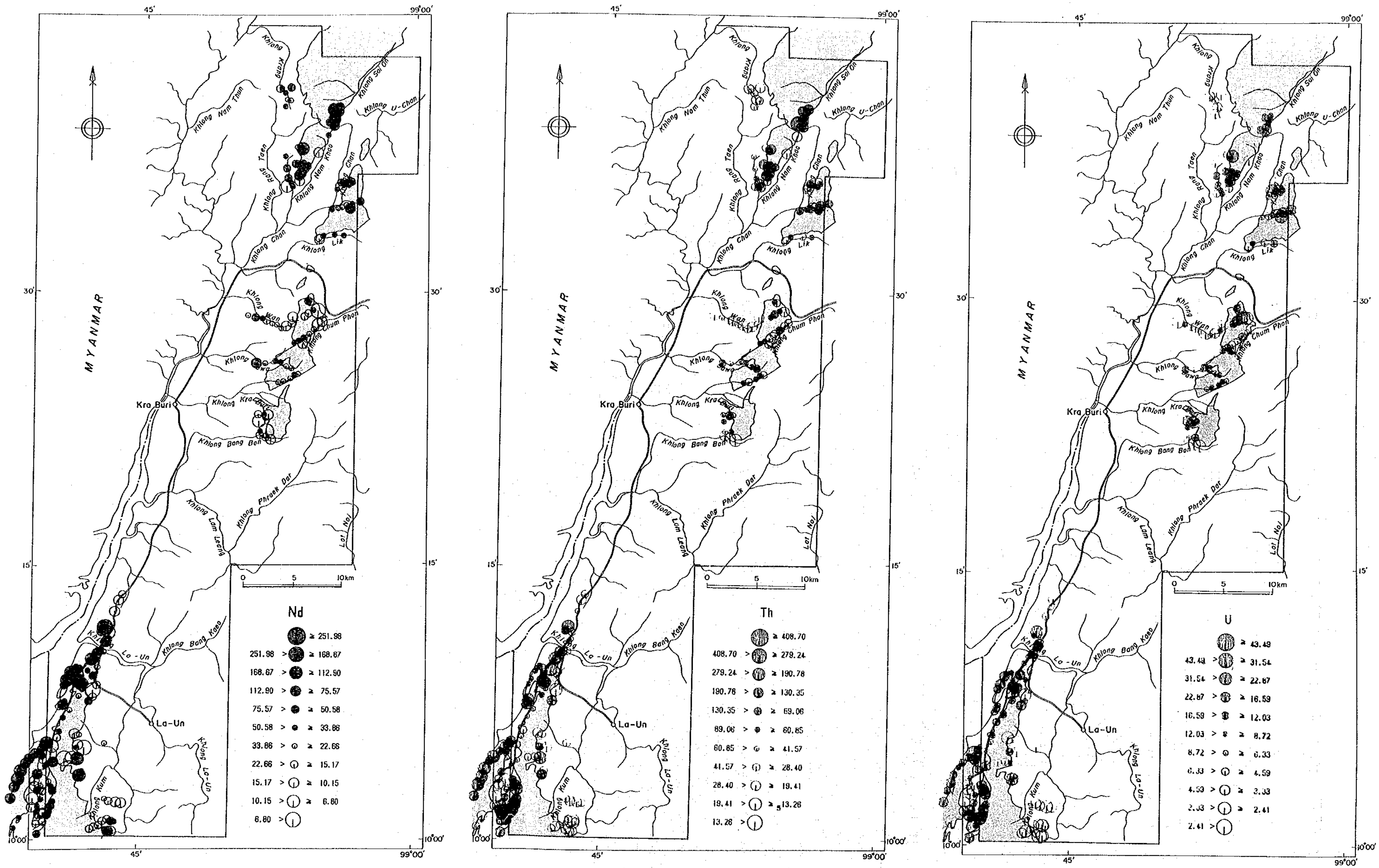
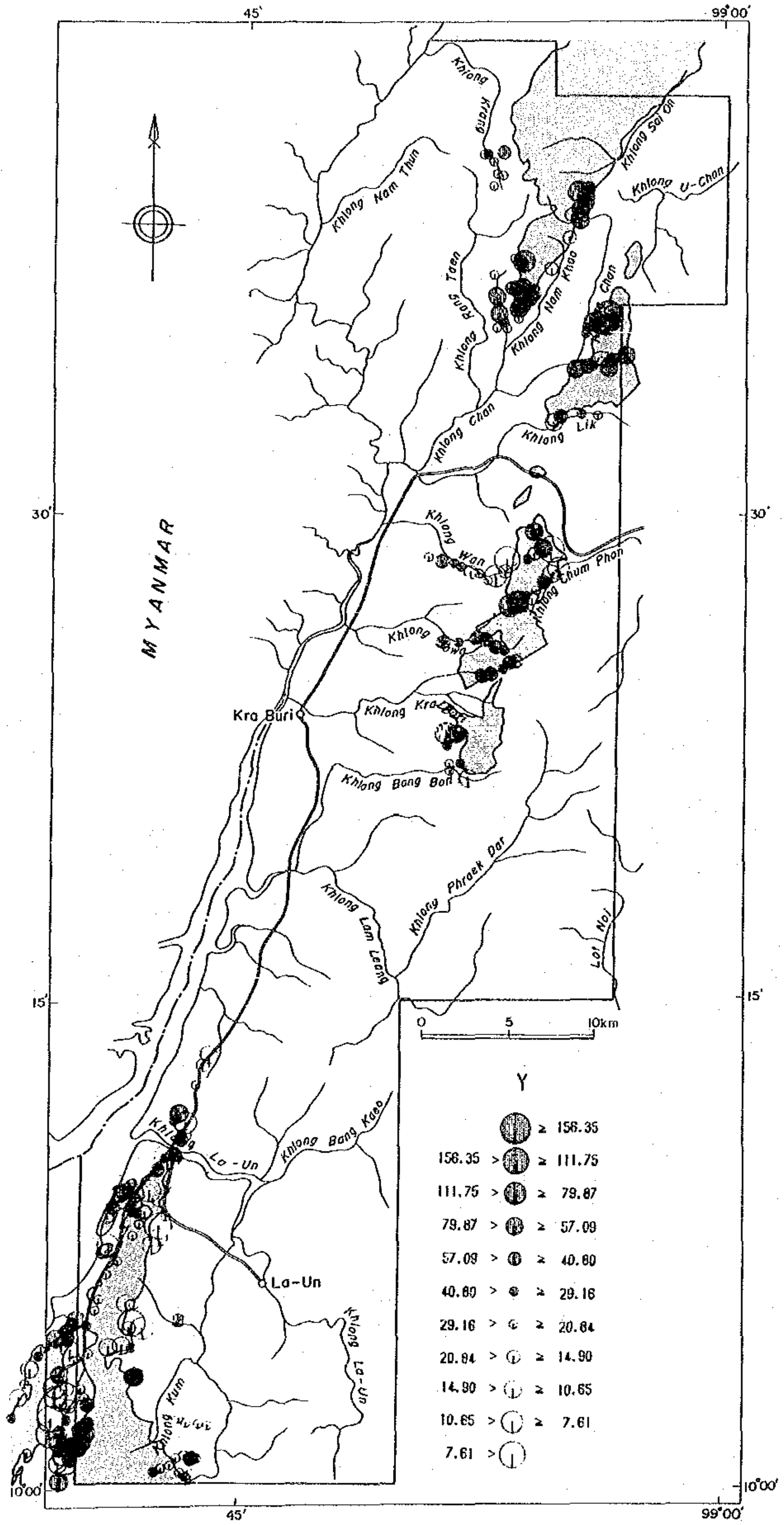


Fig. 25 Content distribution map of soil samples (4)



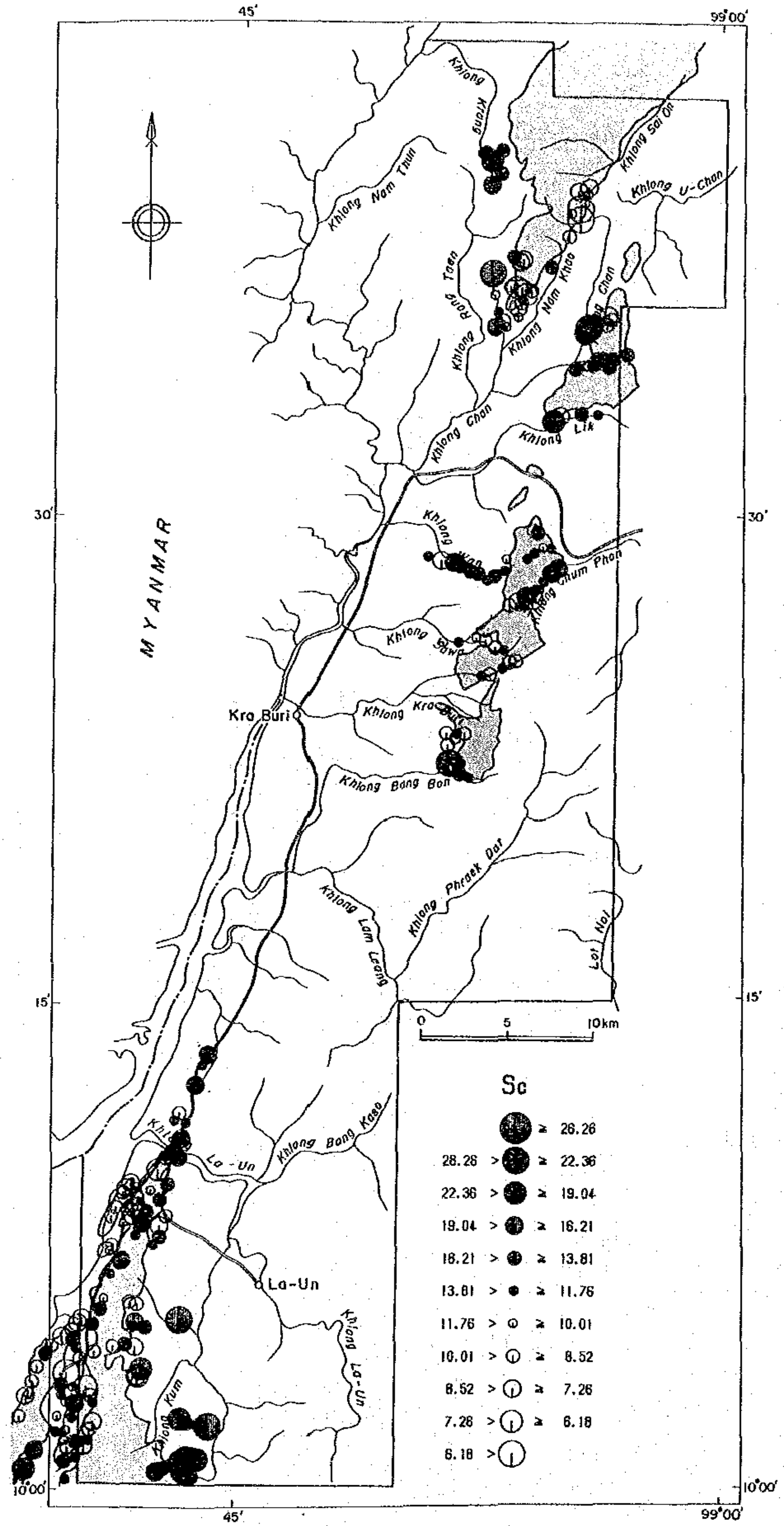


Fig. 25 Content distribution map of soil samples (5)

Northern west mass in the northern area and in the old working area for primary ores in the east side of the Southern mass. These elements are of relatively low grade in the Northern east mass in the northern area and Central mass.

The elements, Ce, Tb, La, Nd, Sm, Th, and U, show similar distribution patterns, showing high concentration along the western rim of the Southern mass, and partly overlapped with Sn group's elements. This group's elements are of low concentration in the Northern east mass in the northern area and Central mass.

The elements, Y and Lu, show duplicated high values together with the Sn group elements. A highly concentrated anomaly exists in the Northern east mass in the northern area. This is shown by a soil sample in the metamorphosed muscovite granite zone, and its accompanied Sn value is as high as 109 ppm. A high contents sample also appears in the Central mass.

The elements, Mo, Eu, and Sc, show high values in the granite, and some high content samples are scattered in the sedimentary rock areas.

Among the minor elements in the soil samples, Sn, W, Ta, Nb, Ce, Tb, La, Nd, Sm, Th, U, Y, and Lu are derived from the heavy minerals in the granites, accordingly show high contents in the granite areas. Ce, Tb, La, Nd, Sm, Th, and U are also highly concentrated into the Khao Fachi Silicified Zone, indicating some potential for the existing of subsurface granite bodies.

The soil in the area is about 20 m in thickness, except that of the deeply weathered Northern east mass, which contains low Sn and rare earth elements. Some well differentiated muscovite granite rich in Y and Sn appears in the granite mass. This mass is situated in a low hilly area, thus the rocks are poorly exposed. Further geological survey is needed to know the detailed geology of the rocks.

Two samples taken from the basal clay in the old working in a branch of the Khlong Nam Khao show lower contents in all elements than those of the samples from the granite areas.

3-3 Panned Samples

3-3-1 Sampling and Analyzed Elements

Panned samples have been taken every four stream sediment samples at the same time. About 20 liters of sand has been reduced to 50 grams by panning using large panning pans at the sampling sites, then concentrated again at the base camp. The final products are 4 to 30 grams in weight, and many of them are less than 10 grams. Additional sampling has been performed when it is necessary. The total number of the samples taken is 560. After observation by a stereo-microscope and a ultra-violet light, 129 samples have been chemically analyzed. Samples of ore concentrate from the Ratana Krathu Mine are included in.

The elements analyzed are; Sn, W, Ta, Nb, Au, Mo, Ce, Eu, La, Lu, Nd, Sm, Tb, Th, U, Y, and Sc, same 17 elements as those for the stream sediment samples, and additional 6 rare earth elements, Di, Er, Gd, Ho, Pr, and T. The assay method for the rare earth elements is of the neutron radioactivation analysis, and the detection limits for each element are; 10 ppm for Di, Gd, and Ho, 100 ppm for Er, and 500 ppm for Pr and Tm.

3-3-2 Megascopical Observation

The panned samples have been megascopically observed at first. The identified minerals are of cassiterite, wolframite, scheelite, zircon, garnet, tourmaline, ilmenite, monazite, xenotime, rutile, and anatase. Figure 26 shows the weight of each concentrated sample from the unit volume of one cubic meter and the distribution of each mineral. Areas rich in heavy minerals are surrounding areas of the Northern west mass and the Southern mass, the old working areas for secondary deposits. Little heavy minerals are contained in the stream sediments in the eastern branches of the Khlong Chan, on the other hand much of them are in the western branches. Small-scale old workings are scattered along the Khlong Chan. The minerals have probably been brought from the western branches as well as the main stream. Much amount of cassiterite sands is distributed around the Northern west mass and Southern mass, especially in the old working areas on the eastern side of the mass. The upper streams of the Ratana Krathu Mine area contain much amount of heavy minerals. A little amount of heavy minerals is found in the streams flowing out from the Central mass, on the other hand much amount of cassiterite is distributed in the conjunction of the Khlong Lam Leang and Khlong Phraek Dat, and along the Khlong Lik.

Some amounts of wolframite minerals are observed in the surrounding area of the Southern mass, especially around the Ratana Krathu Mine. On the other hand, scheelite minerals are largely distributed

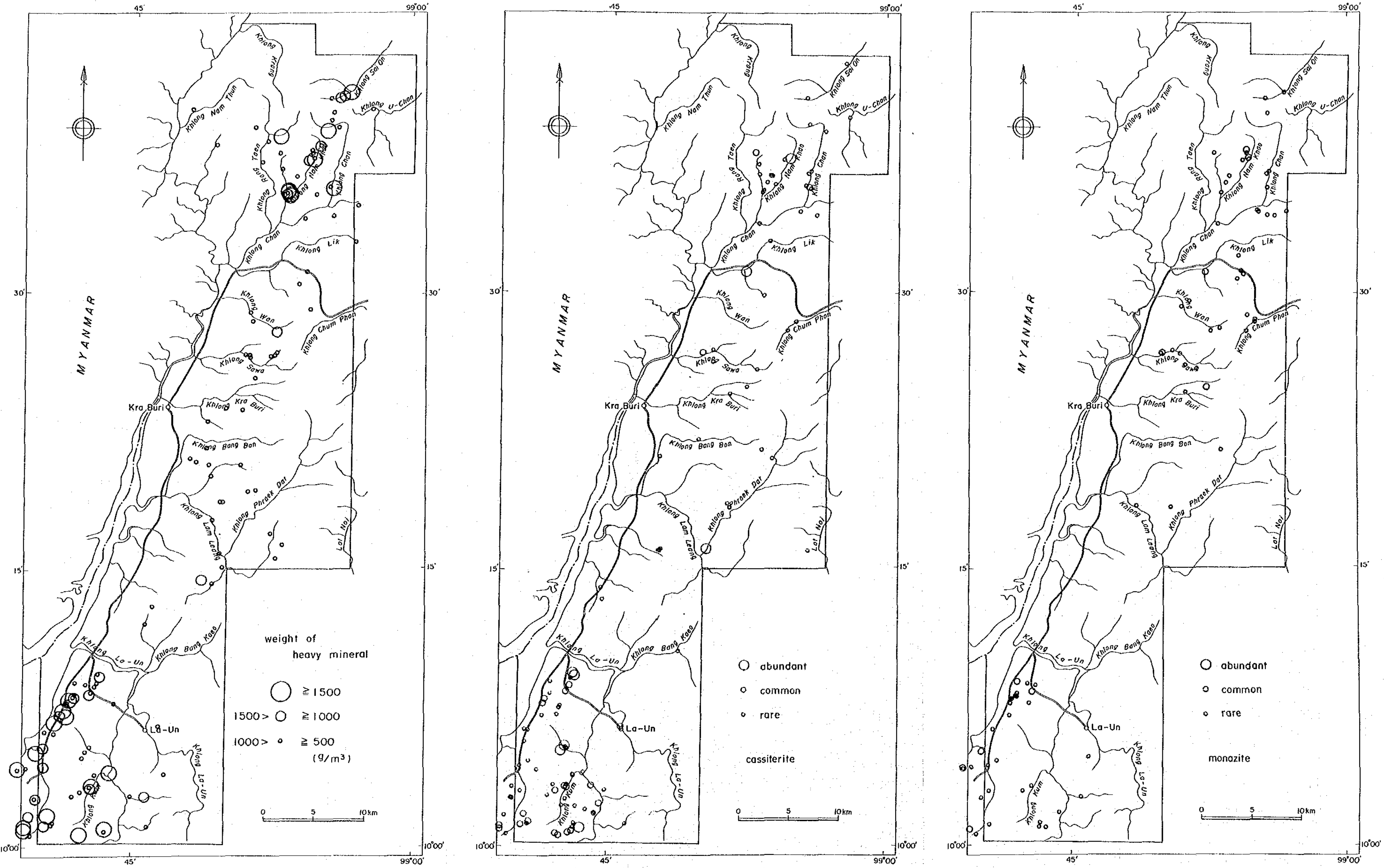


Fig. 26 Distribution of Heavy minerals (1)

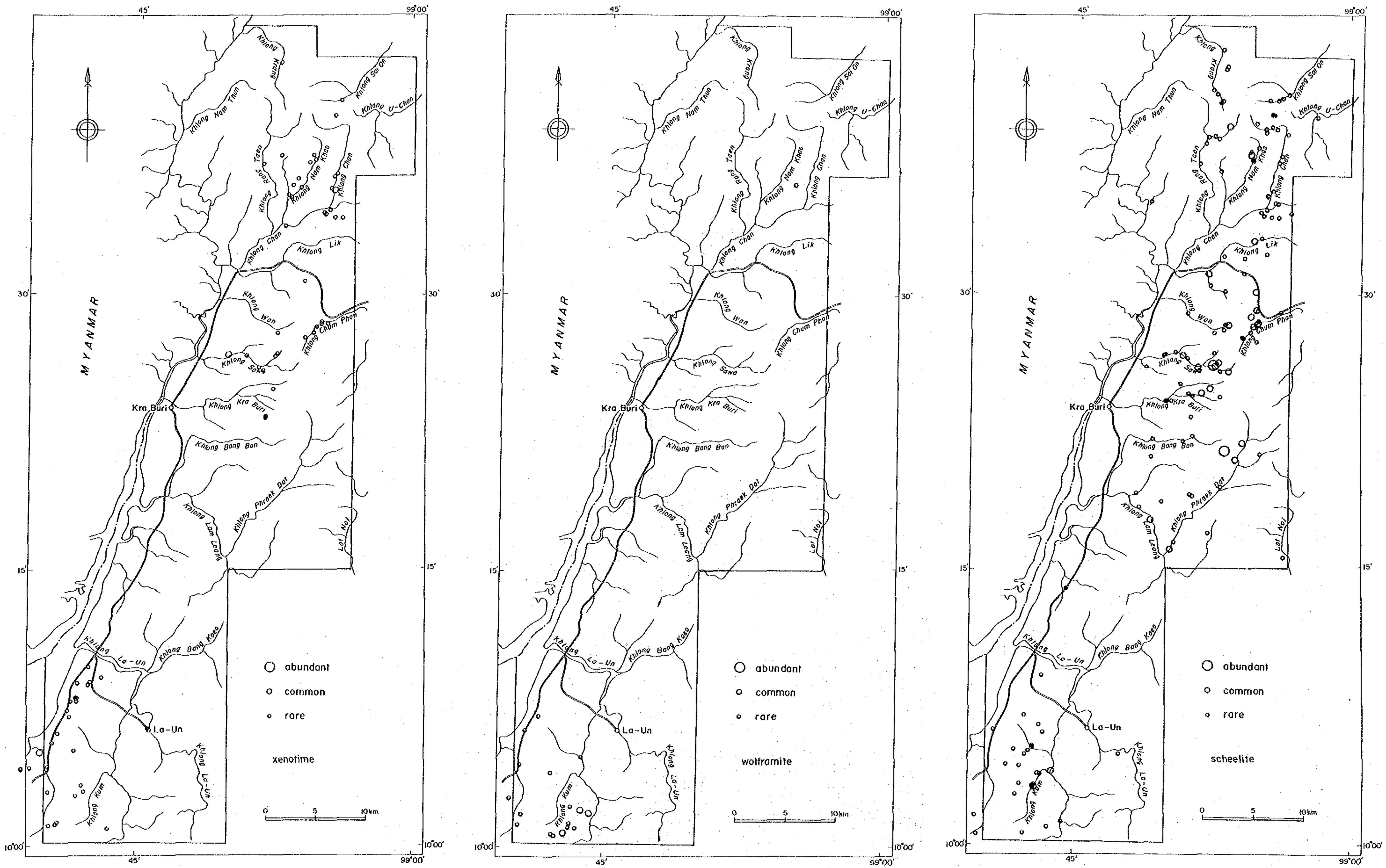


Fig. 26 Distribution of Heavy minerals (2)

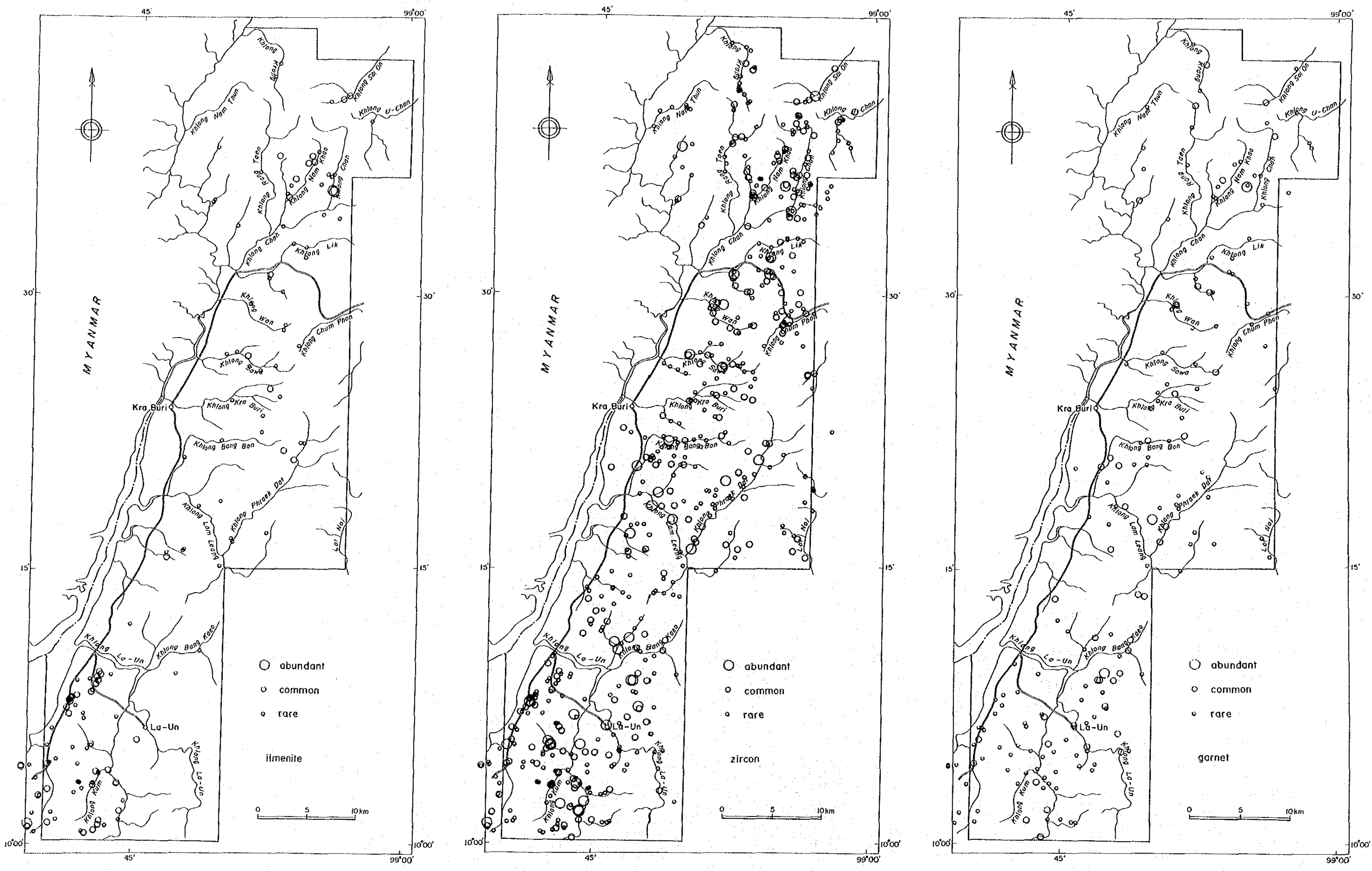


Fig. 26 Distribution of Heavy minerals (3)

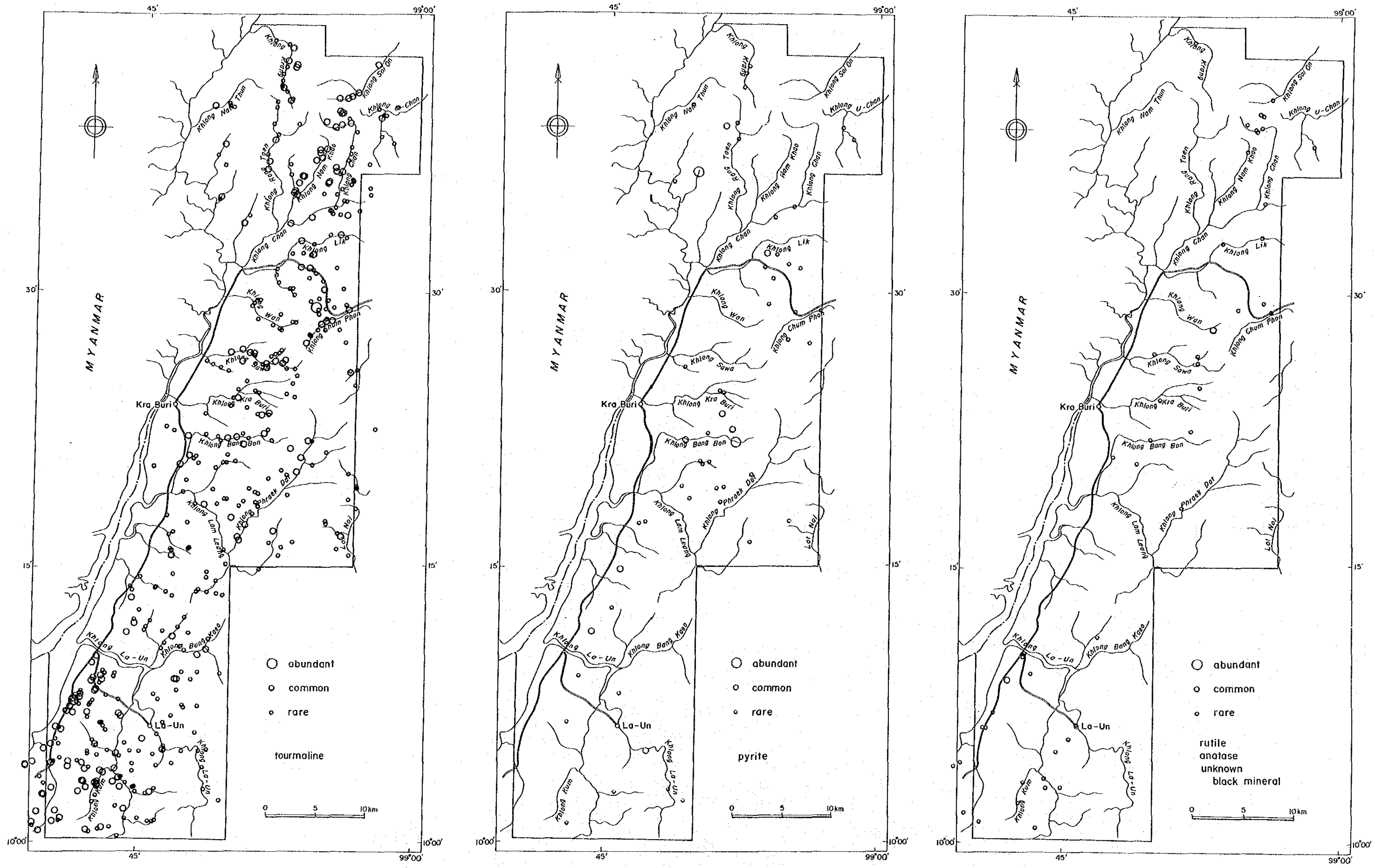


Fig. 26 Distribution of Heavy minerals (4)

around all granite bodies, among them especially around the Central mass. The samples from the old working area in the upper stream of the Khlong Phraek Dat contain much amount of cassiterite, showing 2 to 3 mm in grain size.

A small amount of monazite and xenotime are contained in the surrounding areas of the granite bodies. In the Southern mass, they are more concentrated on the western side than eastern side. In the Central mass, they are concentrated in the streams flowing out from the center body.

The distribution of ilmenite shows the same pattern as that of monazite and xenotime, also appeared in the old working area in the upper stream of the Khlong Phraek Dat.

Little amount of rutile and anatase is contained in the surrounding areas of the granites, showing less frequency.

Zircon, tourmaline, and garnet spread over the area, especially in the sedimentary rock areas. Most of them are of well-rounded grains supposedly originated from sedimentary Origin. Near the granite bodies, euhedral crystals and rounded grains are mixed in some places.

Cassiterite, monazite, and xenotime are concentrated in the foot areas of the mountains, such as the old working areas of secondary tin deposits. These heavy minerals are commonly transported far way, thus topographic features are of important factor for mineral prospecting.

3-3-3 Results of Chemical Analysis

Among the elements assayed, Mo shows out of detection, and Tm shows out of detection limit. Table 13 shows the principal statistics of the contents of the 21 elements assayed. The figures shown on the table are of converted to the equivalent values of grams per one cubic meter.

Table 14 shows the correlation coefficients among the 21 elements. The group consisting of Sn, W, Ta, and Nb, and the group consisting of rare earth elements, Th, Y, and U show strong positive correlations in the group elements, but no correlation exists between the two group's elements.

The principal constituent elements are concentrated in the south end of the Northern west mass and the south end of the Southern mass, the old working area and around the Ratana Krathu Mine. On the other hand, rare earth elements are concentrated around the northern masses, however some slightly high anomalous samples are scattered in the northern coast, north of the Southern mass, showing different pattern from that of the tin group elements. The rare earth elements show different distribution from that of Th, U, and Y, which show low concentration in the Southern mass.

Table 13 Geochemical basic statistic quantities of Panned Samples

Element	Unit	Max.	Min.	Average	Av.ant-log	Std.Dev.
Sn	g/m^3	1,800	0.12	1.0713	11.78	0.8592
W	g/m^3	115	<0.032	-0.5558	0.28	0.8811
Ta	g/m^3	22.55	0.00332	-0.2516	0.56	0.6844
Nb	g/m^3	44.705	0.04204	0.2320	1.71	0.6181
Au	mg/m^3	10.65	0.00546	-1.2102	0.06	0.5283
Ce	g/m^3	25.6	0.0384	0.1672	1.47	0.5698
Eu	g/m^3	0.06	<0.005	-2.8414	0.001	0.6502
La	g/m^3	18.4	0.0256	0.0312	1.07	0.5775
Lu	g/m^3	0.417	0.000023	-1.8177	0.02	0.9768
Nd	g/m^3	8.16	0.0064	-0.3396	0.46	0.5778
Sm	g/m^3	2.24	0.00528	-0.8434	0.14	0.5867
Tb	g/m^3	0.87	<0.05	-1.2626	0.05	0.6185
Th	g/m^3	22.4	0.0272	-0.0072	0.98	0.5940
U	g/m^3	15.6	<0.01	-0.3749	0.42	0.6703
Y	g/m^3	79.425	0.1568	0.4898	3.09	0.5849
Sc	g/m^3	0.345	0.00117	-1.6948	0.02	0.4722
Dy	g/m^3	12.64	0.01168	-0.4239	0.38	0.7009
Er	g/m^3	7.5	<0.5	-0.7140	0.19	0.6439
Gd	g/m^3	8.61	0.0112	-0.4913	0.32	0.6455
Ho	g/m^3	3.196	<0.05	-1.0120	0.10	0.7097
Pr	g/m^3	32	<2.5	-0.2711	0.54	0.5746

3-3-4 EPMA analysis

Some rare earth elements contained in heavy mineral were analyzed with EPMA. Four polished thin sections were selected for analysis. One is GH-001 at an old working along Khlong Nam Khao, northern survey area. One is GH-008 at Khlong Lam Leang, center of survey area. One is SAITHONG-1 at an old working on the west of Southern mass. Another is RATANA-3 at the Ratana Krathu mine on the east of Southern mass.

1. Analytical method

EPMA analysis was carried out with energy dispersion method.

Analytical instrument is Tracor Northern-made EDAX TN-5400 attached with JEOL-made EPMA JXA-7300. Measured condition is as follows: accelerating voltage 20kV, sampled current 4.00 ×

Table 14 Geochemical correlation coefficients of panned samples

	Sn	W	Ta	Nb	Au	Ce	Eu	La	Lu	Nd	Sm	Tb	Th	U	Y	Sc	Dy	Er	Gd	Ho	Pr
Sn	1.000	0.661	0.695	0.564	0.472	0.158	0.065	0.204	-0.321	0.139	0.107	0.091	0.166	0.154	0.125	0.413	0.110	0.081	0.158	0.094	0.173
W	0.661	1.000	0.790	0.703	0.487	0.200	0.090	0.231	-0.190	0.188	0.194	0.179	0.178	0.232	0.175	0.571	0.170	0.143	0.180	0.165	0.206
Ta	0.695	0.790	1.000	0.926	0.549	0.466	0.158	0.492	0.158	0.428	0.492	0.521	0.509	0.580	0.508	0.744	0.502	0.498	0.485	0.502	0.452
Nb	0.564	0.703	0.926	1.000	0.588	0.512	0.160	0.538	0.273	0.457	0.545	0.612	0.587	0.662	0.692	0.731	0.640	0.647	0.623	0.651	0.589
Au	0.472	0.487	0.549	0.588	1.000	0.468	0.250	0.492	0.093	0.456	0.420	0.449	0.479	0.426	0.467	0.525	0.490	0.416	0.503	0.461	0.481
Ce	0.158	0.200	0.466	0.512	0.468	1.000	0.590	0.989	0.698	0.978	0.970	0.919	0.923	0.808	0.815	0.556	0.862	0.804	0.887	0.833	0.828
Eu	0.065	0.090	0.158	0.160	0.250	0.590	1.000	0.556	0.393	0.610	0.521	0.494	0.481	0.317	0.394	0.458	0.427	0.406	0.439	0.404	0.465
La	0.204	0.231	0.492	0.538	0.492	0.989	0.556	1.000	0.667	0.963	0.961	0.913	0.924	0.835	0.817	0.559	0.863	0.817	0.897	0.834	0.834
Lu	-0.321	-0.190	0.158	0.273	0.093	0.698	0.393	0.667	1.000	0.672	0.736	0.784	0.674	0.712	0.719	0.352	0.719	0.734	0.666	0.733	0.584
Nd	0.139	0.188	0.428	0.457	0.456	0.978	0.610	0.963	0.672	1.000	0.933	0.871	0.878	0.740	0.757	0.549	0.817	0.747	0.840	0.780	0.789
Sm	0.107	0.194	0.492	0.545	0.420	0.970	0.521	0.961	0.736	0.933	1.000	0.955	0.921	0.862	0.850	0.528	0.890	0.837	0.905	0.864	0.831
Tb	0.091	0.179	0.521	0.612	0.449	0.919	0.494	0.913	0.784	0.871	0.955	1.000	0.918	0.891	0.925	0.572	0.953	0.912	0.938	0.941	0.837
Th	0.166	0.178	0.509	0.587	0.479	0.923	0.481	0.924	0.674	0.878	0.921	0.918	1.000	0.854	0.862	0.544	0.900	0.854	0.920	0.872	0.842
U	0.154	0.232	0.580	0.662	0.426	0.808	0.317	0.835	0.712	0.740	0.862	0.891	0.854	1.000	0.847	0.496	0.863	0.871	0.859	0.859	0.768
Y	0.125	0.175	0.508	0.692	0.467	0.815	0.394	0.817	0.719	0.757	0.850	0.925	0.862	0.847	1.000	0.542	0.948	0.927	0.948	0.945	0.851
Sc	0.413	0.571	0.744	0.731	0.525	0.556	0.458	0.559	0.352	0.549	0.528	0.572	0.544	0.496	0.542	1.000	0.530	0.580	0.488	0.544	0.476
Dy	0.110	0.170	0.502	0.640	0.490	0.862	0.427	0.863	0.719	0.817	0.890	0.953	0.900	0.863	0.948	0.530	1.000	0.931	0.970	0.984	0.875
Er	0.081	0.143	0.498	0.647	0.416	0.804	0.406	0.817	0.734	0.747	0.837	0.912	0.854	0.871	0.927	0.580	0.931	1.000	0.917	0.933	0.833
Gd	0.158	0.180	0.485	0.623	0.503	0.887	0.439	0.897	0.666	0.840	0.905	0.938	0.920	0.859	0.948	0.488	0.970	0.917	1.000	0.948	0.903
Ho	0.094	0.165	0.502	0.651	0.461	0.833	0.404	0.834	0.733	0.780	0.864	0.941	0.872	0.859	0.945	0.544	0.984	0.933	0.948	1.000	0.846
Pr	0.173	0.206	0.452	0.589	0.481	0.828	0.465	0.834	0.584	0.789	0.831	0.837	0.842	0.768	0.851	0.476	0.875	0.833	0.903	0.846	1.000

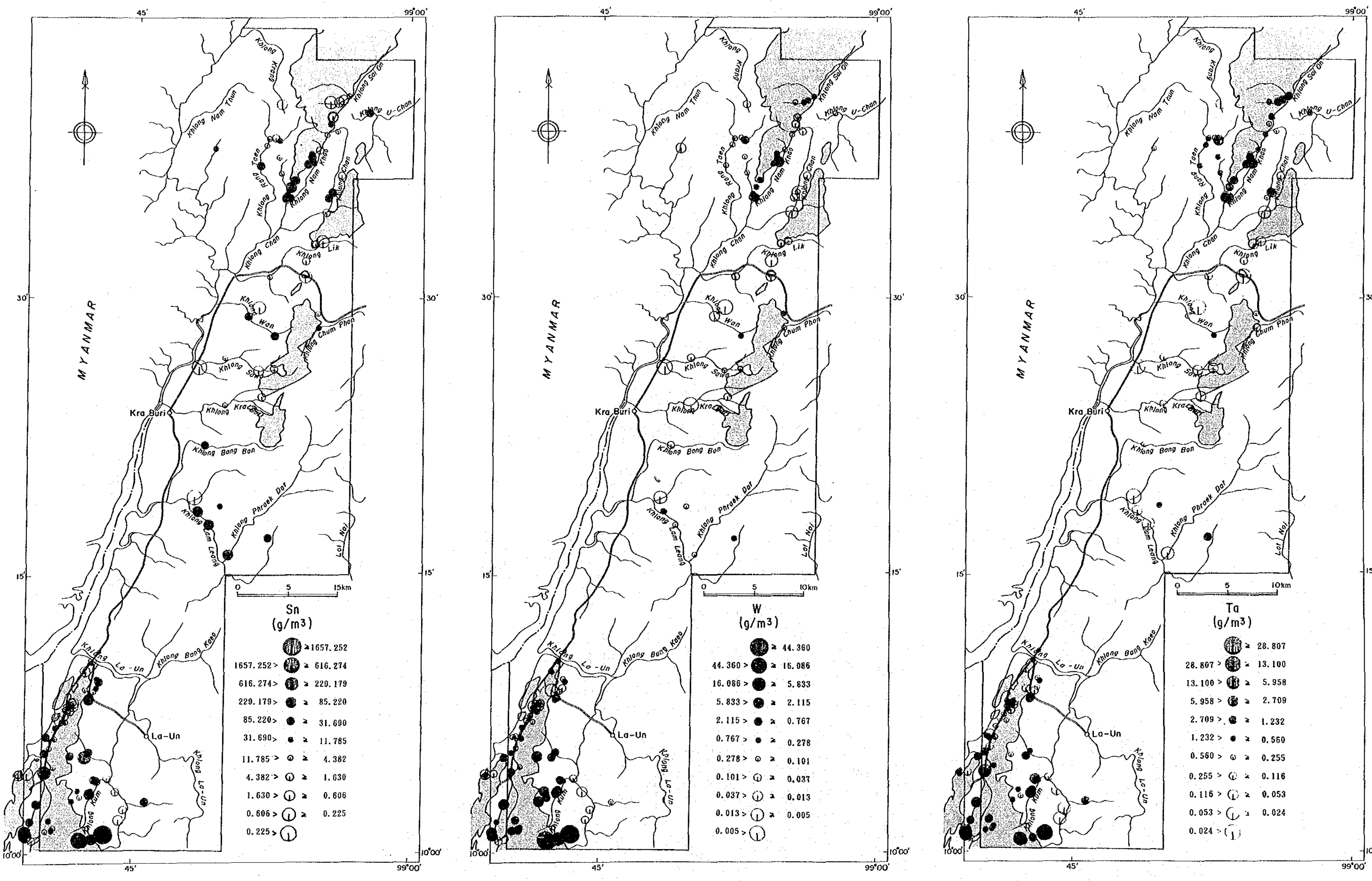


Fig. 27 Content distribution map of panned samples (1)

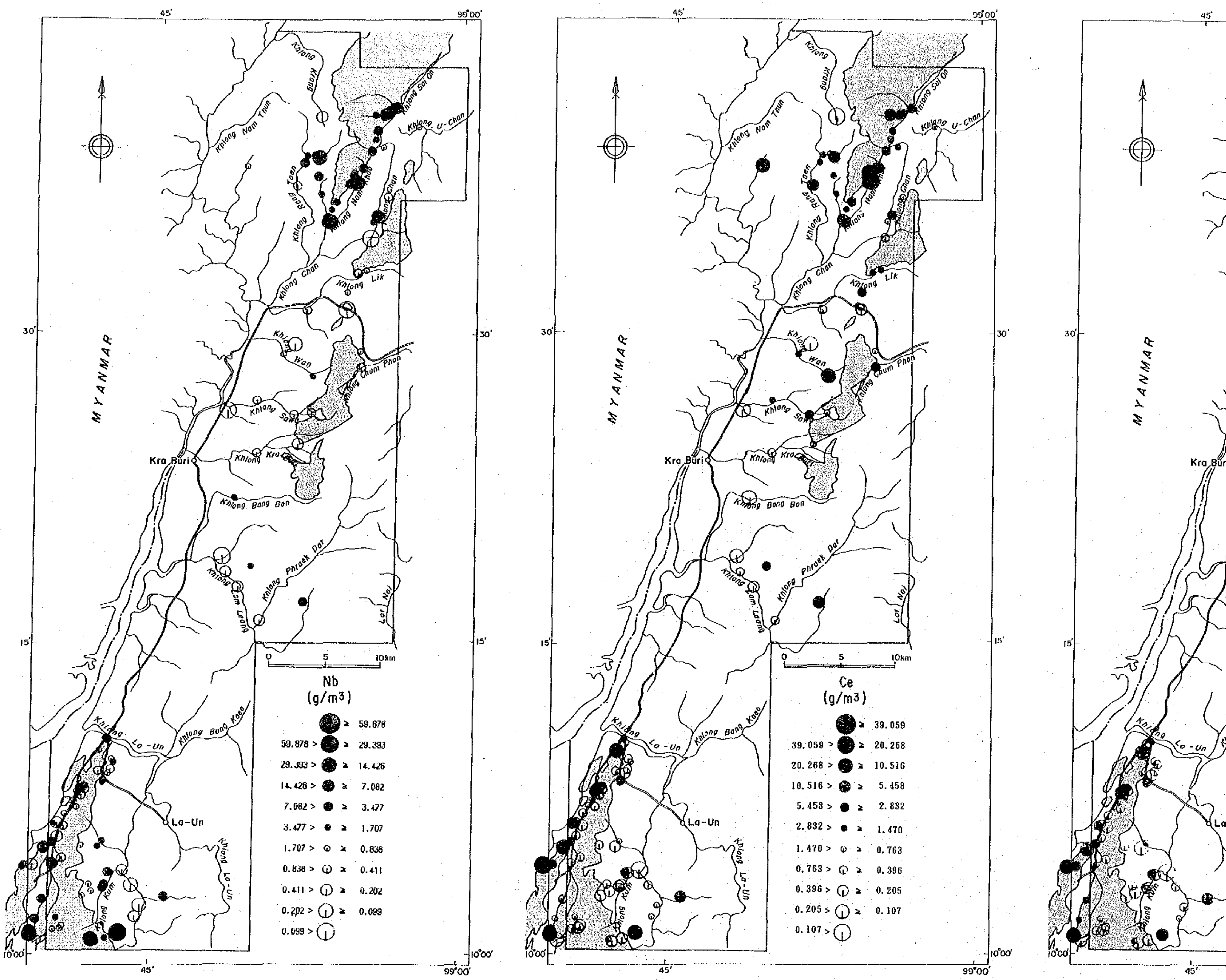


Fig. 27 Content distribution map of panned samples (2)

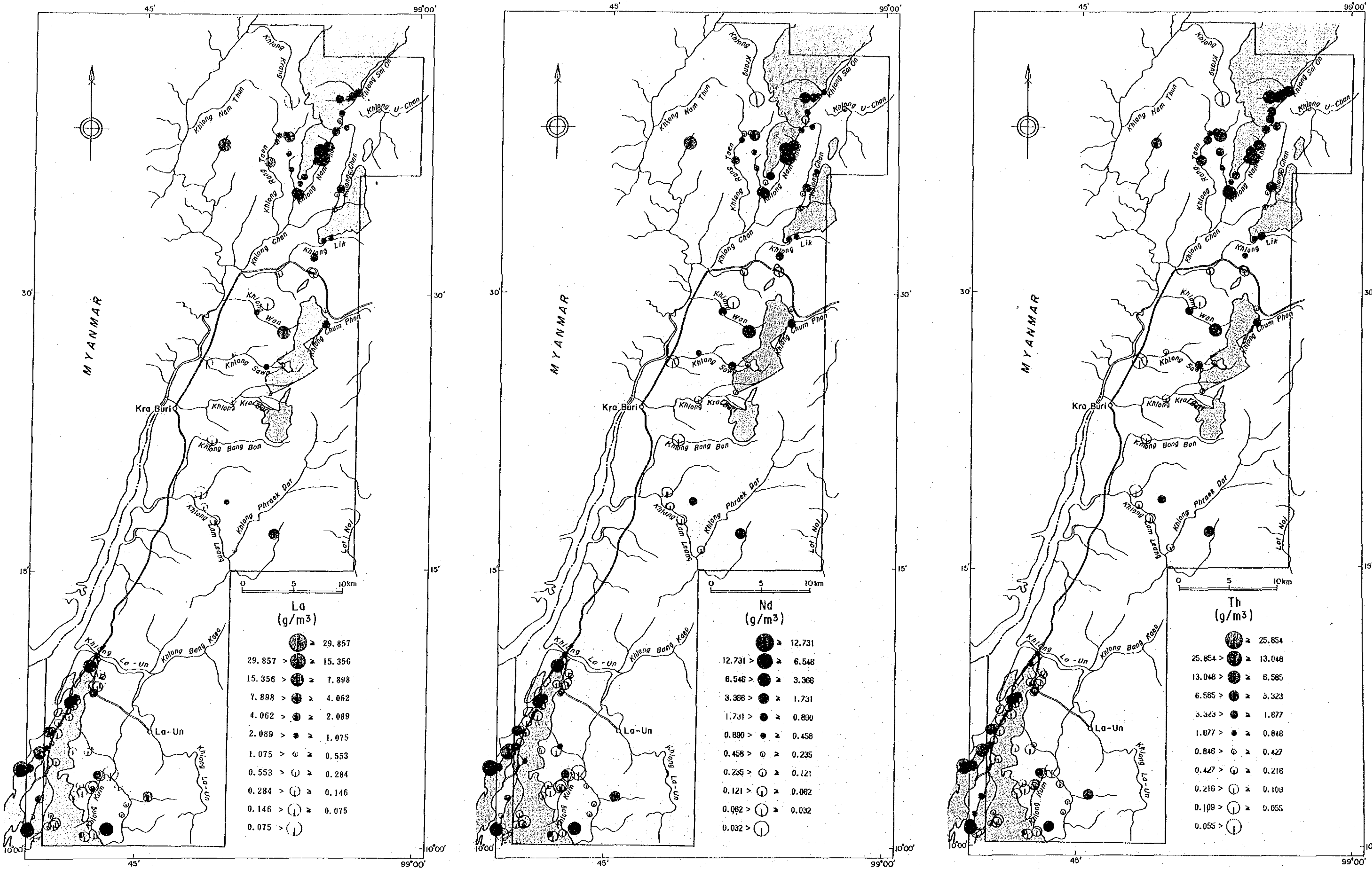


Fig. 27 Content distribution map of panned samples (3)

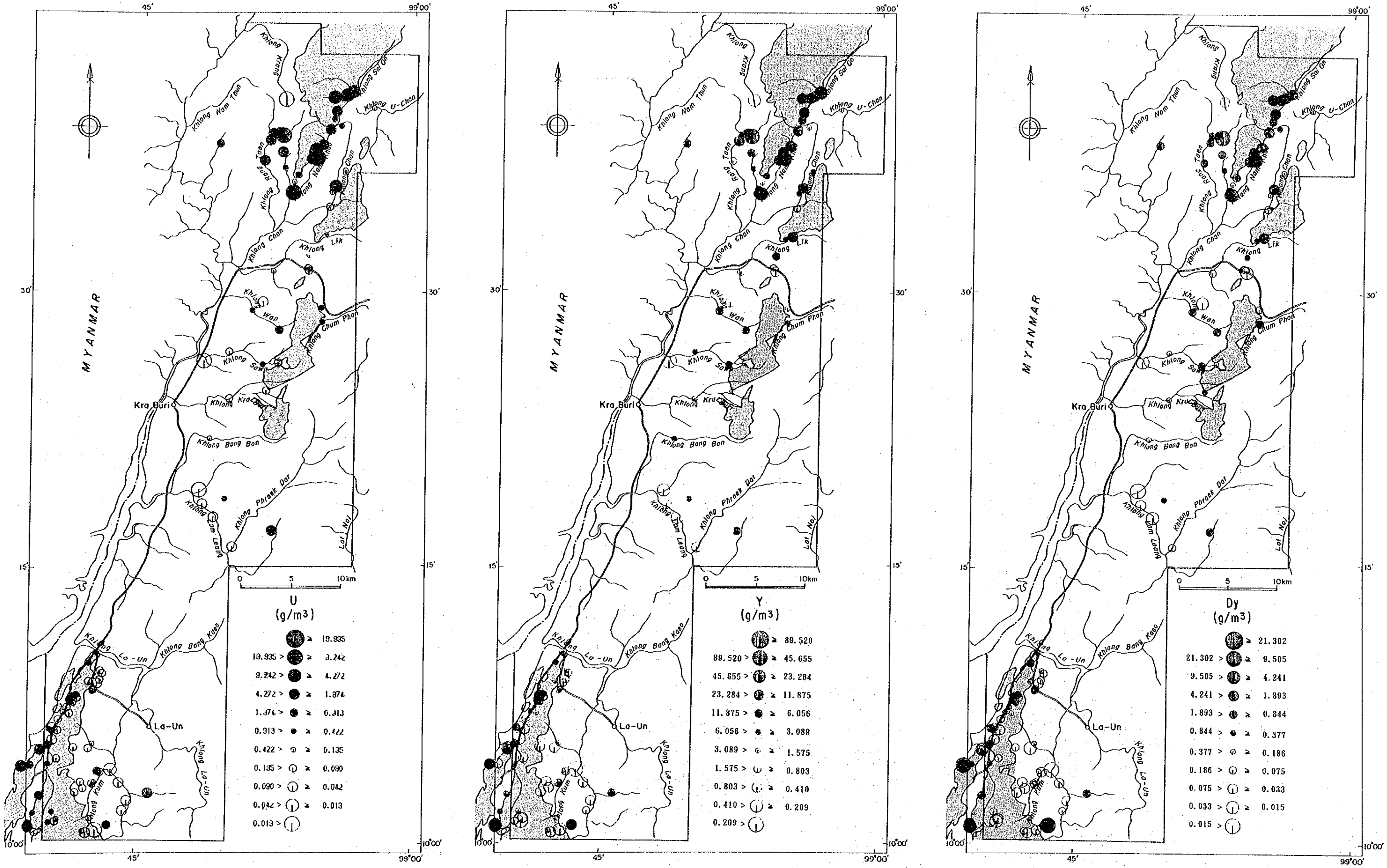


Fig. 27 Content distribution map of panned samples (4)

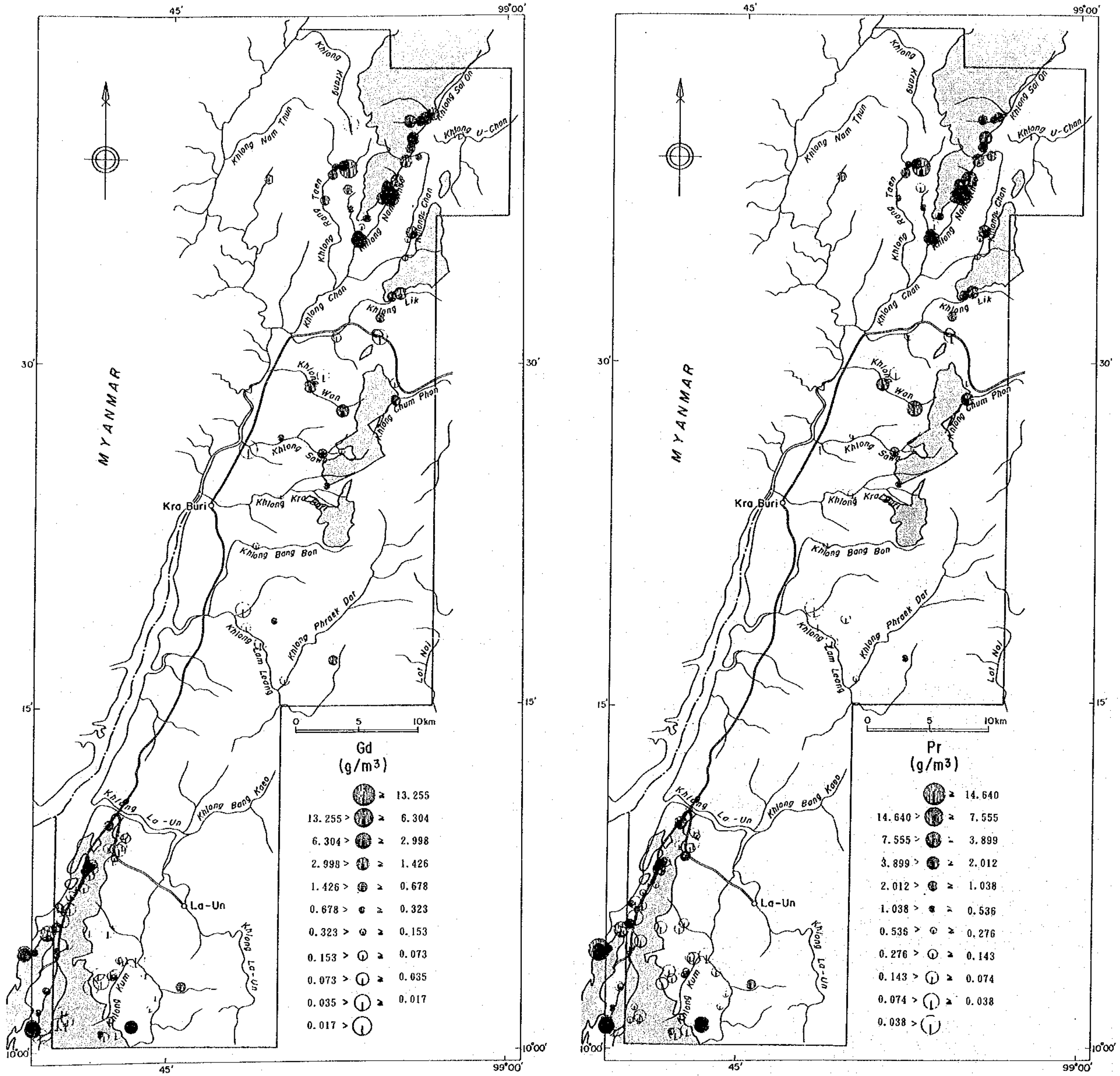


Fig. 27 Content distribution map of panned samples(1)

10^{-10} A, X-ray take off angle 40°, diameter of electron beam 10mm, applied time 100 seconds.

Several points for each of minerals were qualitatively analyzed. A set of characteristic X-ray spectrums were selected for each mineral, and were quantitatively measured according to the result.

At qualitative analysis each spectrums were weighted as the applied time of 400 seconds for increasing accuracy of analysis. Quantitative calculation was carried out by the course of the ZAF correction method using internal spectral data.

2. Result of measurement

Analytical data shows in appendix 6. The measured minerals were cassiterite, monazite, xenotime, polycrase, rutile and zircon. Ilumenite could not be measurable because spectral peak of Ti is very close to peaks of La and Ce. Additionally tourmalines were attempted to measure qualitatively, but rare earth elements were not detected.

(1) cassiterite (SnO_2)

Cassiterites in the survey area are divided into two groups under microscope. One shows high birefrigence and colourless to light amber colour under opened nicol. Another shows light amber to light yellowish green colour under opened nicol and shows anomalous interference colour like chlorite under crossed nicol. The former occurs around Northern and Central mass and contains low amount of minor elements. The later occurs around Southern mass and contains 0.n to n% in Ti,Ta and Ni.

(2) rutile (TiO_2) and anatase (TiO_2)

It is known that rutile and anatase contain rare earth elements in large quantities. Nevertheless the spectral peak of Ti is close to ones of La and Ce, then their quantitative values are low confidence.

These minerals are commonly observed in RATANA-3 of Ratana Krathu mine. These are principal carrier of rare earth elements.

(3) zircon ($ZrSiO_4$)

Zircon contains small amount of Hf and Ta.

(4) monazite ($(Th,Ln)PO_4$)

Monazite is a phosphate mineral composing of thorium and rare earth elements. Monazites in GH-001 contain about 12% of ThO2 and in SAITHONG-1 about 8 to 12%.

Analytical values of yttrium in monazite are lacking in trust. Because characteristic peaks of Y and P are extremely close to each other and automatically calculated into two oxides, in spite of Y contents in monazite is very lower than one of P.

Geochemical anomalies of light rare earth elements in the survey area seem to be caused by monazite.

(5) xenotime ($LnPO_4$)

Xenotime is a phosphate mineral composed mainly Y and heavy rare earth elements. This mineral abundantly exists in SAITHONG-1 on the West of Southern mass. Main component of xenotime is Y, and next abundance is Yb, Er and Dy in the survey area.

Geochemical anomalies of heavy rare earth elements seem to be attribute to this mineral.

(6) polycrase ($(Ln,U,Th)(Nb,Ta,Ti)_2O_6$)

Polycrase and euxenite are each end member of solid solution, the former has high contains in niobium and tantalum and the latter is highly titanium. This mineral commonly occurs in GH-001. It shows tabular habit and dark reddish brown under opened nicol with maximally 1mm length in size. Also it has high reflection under reflected microscope.

Analyzed mineral in the survey area is polycrase because of high Ti contents and have Nb=17-22% and Ta=8-10%.

Geological anomaly of Nb and Ta overlapping with anomaly of rare earth elements is caused by this mineral.

3-4 Discussion

The results of the three kinds of geochemical surveys show that the anomaly zones of those three methods are well coincident each other, although the soil geochemical anomalies are limited in the location of the granite bodies. The contents of the elements analyzed reflect the heavy minerals' distribution derived from the granite bodies, and the large geochemical halos are concentrated around the old working areas for secondary accumulated ore deposits.

In the survey, the 17 elements for the soil and stream sediment survey, and the 23 elements for the panning survey have been selected as the pathfinder elements. The elements showing geochemically high anomalies are grouped into two, the tin group consisting of Sn, W, Ta, and Nb, and the rare earths group consisting of Ce, La, Lu, Nd, Sm, Tb, Th, U, and Y. In the panning survey, Dy, Er, Gd, Ho, and Pr are added in the rare earths group.

In the northern area, the tin group anomaly zones are extensively distributed in the old working area along the Khlong Nam Khao in the southern end of the Northern west mass, and in the old working area along the Khlong Chan between the Northern west and Northern east masses. In addition, some small-scale anomaly zones are in the upper streams of the Khlong Chan and Khlong Phrae Ka Muang. The only one anomaly zone of W is situated along the Khlong Krang on the west side of the Northern west mass, where scheelite minerals are distributed. On the other hand, the anomaly zones of the rare earths group show more extensive than those of the tin group, over the Northern west and Northern east masses including the old working areas, although each element shows slightly different behaviour. This phenomenon indicates that the rare earth elements tend to be concentrated into the early stage granites rather than the later stage well differentiated facies. The rare earths group elements are presumably still being supplied.

In the Central mass, the anomaly zones by both groups are situated in the westward flowing streams from the mass, one is on the boundary between the granite and sedimentary rocks, and the other is in the area changing from the hilly area to the alluvial plain. Some other stream sediment anomaly zones are on the north and northeastern sides of the granite mass. The Central mass is characterized by the Sn and W anomaly zone, not being accompanied by Ta, Nb, and rare earths anomaly, in the upper stream of the Khlong Phraek Dat, far way to the southeast of the mass. The Sn anomaly zone especially widely spreads in the area 5 km x 3 km. This anomaly probably has been brought by the quartz veins in the sedimentary rocks, and suggests that subsurface granite bodies possibly exist underneath there.

In the Southern mass, The tin group's anomaly zones are largely distributed on the southern areas of the granite, from the Ban Bang Non district in the southeastern corner of the area to the Ratana Krathu Mine and old working area in the Khlong Kum basin. On the other hand, the rare earths group's anomaly zones are distributed on the western side of the granite, and only some high contents samples are scattered along the streams on the eastern side of the granite. This is probably caused by the different geological environment on both sides, although both sides show topographically similar steep slopes. On the eastern side, sedimentary rocks still remain on the flank, indicating the depth of the erosion of the granite is still shallower than that of the eastern side, and such difference probably caused the different eroded mineral supply to the surrounding sedimentary basins. The large plain area is distributed on the eastern side, however on the western side, the flat plain is narrow except in the Bang Non district, and the tin group's minerals could be rapidly transported to the sea.

In the Khao Fachi Silicified Zone in the northern extension area of the Southern mass, the both group's anomaly zone overlies the zone. It also suggests that some subsurface granite bodies probably exist underneath there.

The Au anomaly zones sporadically scatter over the area, however, the samples showing over the average value tend to align to the trend of NNE-SSW, parallel to the dominant fault line.

Eu and Sc are of low contents in the geochemical samples, and only small-scale anomaly zones are mainly situated in the granite bodies, but the slightly high contents samples are sporadically distributed in the sedimentary rock areas.

Almost all samples show the Mo contents of less than detection limit, however all samples showing values over the detection limit are in the sedimentary rock areas. It is inferred that molybdenum mineralization is probably not associated with the granites in the area.

Judging from the above mentioned factors, following areas are selected as high potential areas.

For Sn, W, Nb, and Ta

Best potential area;

the old working area to the south of the Southern mass.

Other potential area;

the surrounding areas of the Northern west and Northern east masses in the northern area.

the surrounding areas of the Southern mass.

the offshore to the west of the Southern mass.

For Rare earth elements, Th, U, and Y

Best potential area;

the surrounding areas of the Northern west and Northern east masses in the northern area.

the western side of the Southern mass, coastal area.

Other potential area;

the western side of the Central mass.

For the concealed tin and rare earths primary ores

High potential area;

the western side of the upper stream of the Khlong Phraek Dat.

the Khao Fachi Silicified Zone.

PART III CONCLUSION AND RECOMMENDATION

Chapter 1 Conclusion

In this survey, the geological survey and geochemical prospecting have been performed to select potential areas for minerals from the area of 1,500 square kilometers around the Kra Buri Town, the Peninsular Thailand. The conclusions of the survey are as follows.

1. The tin mineralization in the Malay Peninsula is associated with the granitic activities since Mesozoic age. The granites intruded into the sedimentary formations from Silurian-Devonian to Jurassic time in the area are of Cretaceous age.

2. These granites are stock-like, and divided into four bodies, the West mass and East mass in the northern area, Central mass, and Southern mass.

3. The granites belong to the S-type, ilmenite series granite, and classified into the tin-granite based on their principal chemical components and tin contents.

4. The minor element components of granitic rocks are divided into two groups, the tin group comprising Sn, W, Ta, and Nb, and the rare earths group comprising rare earth elements, Th, U, and Y, based on their chemical behavior. Each granite mass has different ratio of the two groups' contents.

5. In the geochemical investigation, the behavior of the path-finder elements is summarized into the two groups.

6. Following four promising areas have been selected, being based on the results of the integrated interpretation of the geochemical characteristics, mineral occurrences, and alteration zones.

① Northern west mass

The mass shows geochemically high contents of both tin and rare earths groups. This fact shows that this mass has high potentiality germinating tin and rare earth ores. Particularly high geochemical anomaly of the tin group in the southern part. The rare earths group's anomaly overlies whole area of the granite. There is potential for tin ores containing rare earth elements.

② Southern mass

The mass geochemically shows high potentiality for both tin and rare earths groups as same as the Northern west mass. Wide spread of the high geochemical anomaly of the tin group in the southern part. Anomalies of the rare earths group are largely distributed along the west rim of the mass. There is high potential for tin ores containing Nb and Ta in the southern part, and for rare earths ores in the western part.

③ Central mass

The potentiality of the both geochemical groups is low in the mass. However the two group's duplicated anomaly are in the western side of the mass, along a river. There is potential for rare earths ores containing tin there. A large geochemical anomaly of Sn and W as well is distributed in the southeastern side of the mass, where many quartz veins exist. There is some potential for subsurface primary ores on the top of a concealed granite body.

④ Khao Fachi Silicified Zone

This is a silicified zone accompanied with white clay derived from sedimentary rocks in the mouth of the River La-Un. A soil geochemical anomaly of the rare earth group and a stream sediment geochemical anomaly of the both tin and rare earth groups are duplicated in the area. The zone is in the northern extension of the Southern mass. There is potential for subsurface primary ores on the top of a expected concealed granite body.

Chapter 2 Recommendations for the Second Phase Survey

Four promising areas for Sn, Nb, Ta, rare earths, Th, U, and Y have been selected based on the results of this year's surveys. It is recommended that detailed geological and geochemical survey programs to be conducted in the selected four areas to narrower the targets, and at the same time geophysical survey programs to be conducted to ensure the existence and scale of concealed granite cupolas.

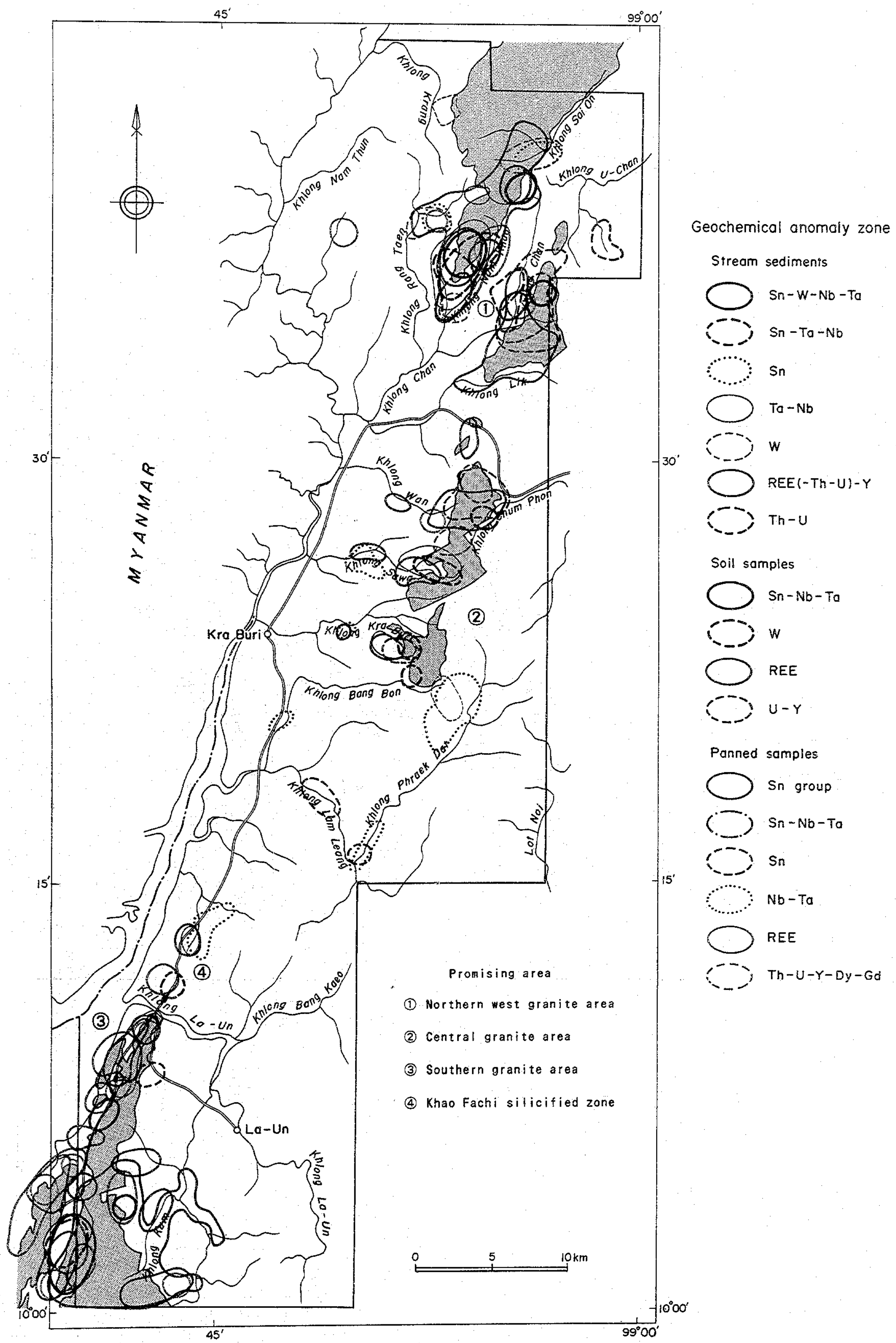


Fig. 28 Geocmemical anomaly zones in the Kra Buri area

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APPENDICES

Appendix 1 Microscopic observation of rock thin sections

(1)

No.	Sample No.	Rock Name	Location	Texture	Principal Mineral										Accessory Mineral					Secondary Mineral						Remarks
					Qz	Pl	Kf	Bi	Ms	Am	Ga	Ch	Ca	Tl	Zr	Ap	Sp	Op	Al	Qz	Ms	Ca	Ep	Ch	Fr	
1	AR-003	two mica granite	Khlong Nam Khao branch	mylonitic	◎	○	◎	∘	∘						∘			∘	∘		∘			∘		
2	AR-006	psammitic hornfels	Khlong Lik branch	decussate	◎	∘	∘	○						∘			∘	∘				∘	∘			
3	AR-007	sandstone	Khlong Lam Liang branch		◎	○			○					∘	∘										∘	
4	AR-008	two mica granite	Khlong Chan branch	granitic	◎	○	◎	∘	∘						∘	∘	∘	∘			∘			∘		
5	AR-009	two mica granite	Khlong Chan branch	granitic	○	○	○	∘	∘						∘		∘				∘			○		
6	AR-011	sandstone	Khlong Wan		◎	○	○		∘									∘			∘				∘	
7	AR-012	psammitic hornfels	Khlong Wi branch	decussate	◎	∘	∘	○		○				∘	∘	∘	∘	∘					∘			
8	AR-014	muscovite tourmaline granite	Khlong Kum branch	granitic	◎	○	○	∘	∘					∘										∘		
9	AR-015	two mica granite	Khlong Kum branch	granitic	○	○	◎	∘	∘						∘		∘	∘			∘			∘		
10	AR-016	biotite granite	Khlong Wan branch	cataclastic	○	◎	◎	∘							∘	∘			∘		∘		∘	∘		
11	AR-017	biotite granite	Khlong Wan branch	granitic	○	○	○	∘						∘	∘	∘		∘	∘		∘			∘		
12	AR-018	psammitic schistose hornfels	Khlong Wan branch	schistose	◎	∘	∘	∘		○					∘		∘						○	∘		
13	AR-019	two mica granite	Khlong Phlu Yai	granitic	○	○	○	∘	∘					∘	∘	∘		∘			∘		∘			
14	AR-020	two mica granite	Khlong Phlu Yai	granitic	○	○	◎	∘	∘						∘	∘			∘		∘			∘		
15	AR-024	sandstone	Khlong Phra Yang branch		◎	∘		∘						∘				∘			∘					
16	AR-025	sandstone	Khlong Phra Yang branch		◎	○		∘							∘						○				∘	
17	AR-026	biotite granite	Khao the Khloo	mylonitic	◎	○	○	∘							∘	∘			∘				∘	∘		
18	BR-033	quartz vein	Khlong Hin Song branch		◎																					

Abbreviations ; Qz:quartz, Pl:plagioclase, Kf:potassium feldspar, Bi:biotite, Ms:muscovite, Am:amphibole, Ga:garnet, Ch:chlorite, Al:allanite, Tl:tourmaline, Zr:zircon, Ap:apatite, Sp:sphene, Op:opeque mineral, Ca:calcite, Ep:epidote, Fr:rock fragment

Symbols: ◎:abundant, ○:common, ∘:rare

Appendix 1 Microscopic observation of rock thin sections

(2)

No.	Sample No.	Rock Name	Location	Texture	Principal Mineral										Accessory Mineral					Secondary Mineral						Remarks
					Qz	Pl	Kf	Bi	Ms	Am	Ga	Ch	Ca	Tl	Zr	Ap	Sp	Op	Al	Qz	Ms	Ca	Ep	Ch	Fr	
19	BR-161	sandy hornfels	Khlong Kum branch	decussate	◎	◦	◦	○		◦				◦				◦					◦	◦		
20	BR-166	two mica granite	Khlong Kum branch	mylonitic	○	○	◎	◦	◦					◦	◦	◦		◦			◦			◦		
21	BR-168	two mica granite	Khlong Kum branch	cataclastic	◎	○	◎	◦	◦						◦			◦						◦		
22	BR-199	two mica granite	Khlong Chumphon branch	granitic	○	○	◎	◦	◦						◦	◦		◦				◦		◦		
23	BR-230	two mica granite	Khlong Bang Bon	cataclastic	◎	○	◎	◦	○						◦		◦	◦						◦		
24	BR-272	two mica granite	Ban Hin Dat Nua	mylonitic	◎	○	◎	○	◦						◦	◦		◦			◦			◦		
25	BR-298	two mica granite	Khlong Kra Buri branch	granitic	◎	◎	○	○	◦						◦	◦	◦	◦			◦			◦		
26	CR-038	mudy sandstone	Khlong Hin Sai		○	◦	○	◦	◦				◦		◦			◦								
27	CR-087	sandstone	Khlong Chan branch		○	◦	◦		◦				◦				◦	◦								
28	CR-109	mudstone	Khlong Uchan branch		○								○													
29	CR-129	pegmatite	Khlong Bang Si Kim	granoblastic	◎	○	◎	◦			◦			○	◦	◦		◦	◦					◦		
30	CR-137	sandy hornfels	Khlong Bang Si Kim	decussate	◎	◦		◎	◦								◦	◦								
31	CR-140	two mica granite	Khlong Bang Si Kim	cataclastic	◎	○	◎	◦	◦									◦			◦			◦		
32	CR-147	two mica granite	Rong Rian Ban Sai Daeng	mylonitic	◎	○	◎	◦	◦						◦			◦			◦	◦		◦		
33	CR-181	two mica granite	Khlong Bang Non branch	mylonitic	◎	○	◎	◦	◦						◦			◦			◦			◦		
34	CR-194	two mica granite	Khlong Phlu Yai	granitic	◎	○	○	◦	◦						◦		◦				◦			◦		
35	DR-078	two mica granite	Khlong Chan branch	mylonitic	◎	○	◎	◦	◦						◦			◦			◦					
36	DR-096	mudstone	Khlong Bang Khong Thong		◦	◦			◎								◦	◦				○				

Abbreviations : Qz:quartz, Pl:plagioclase, Kf:potassium feldspar, Bi:biotite, Ms:muscovite, Am:amphibole, Ga:garnet, Ch:chlorite, Al:allanite, Tl:tourmaline, Zr:zircon, Ap:apatite, Sp:sphene, Op:opaque mineral, Ca:calcite, Ep:epidote, Fr:rock fragment

Symbols: ◎:abundant, ○:common, ◦:rare

Appendix 1 Microscopic observation of rock thin sections

No.	Sample No.	Rock Name	Location	Texture	Principal Mineral										Accessory Mineral					Secondary Mineral						Remarks
					Qz	Pl	Kf	Bi	Ms	Am	Ga	Ch	Ca	Tl	Zr	Ap	Sp	Op	Al	Qz	Ms	Ca	Ep	Ch	Fr	
37	DR-125	sandy hornfels	Khlong Bang Non	decussate	◎			◦	◦	○							◦							◦		
38	DR-132	mylonite	Khlong Bang Non	mylonitic	○	○	○	◦	◦						◦		◦				◦			◦		
39	DR-143	psammitic schist	Khao Phlu Yai	schistose	○	◦		◦	◦				◦				◦	◦								
40	DR-195	two mica granite	Khlong Nam Khao branch	mylonitic	◎	◦	◎	◦	◦						◦			◦			◦			◦		
41	DR-200	two mica granite	Khlong Nam Khao branch	granitic	◎	○	◎	◦	◦						◦	◦	◦	◦			◦			◦		
42	DSR-40	two mica granite	Khlong Chumphon branch	granitic	◎	○	◎	◦	◦						◦	◦		◦			◦			◦		
43	DSR-72	sandstone	Khlong Rawi branch		◎	◦	◦		◦					◦	◦						◦			◦	◦	
44	FR-020	two mica granite	Khlong Chumphon branch	mylonitic	◎	○	◎	◦	◦						◦	◦	◦	◦			◦			◦		
45	GR-031	two mica granite	Khlong Chan	mylonitic	◎	○	◎	◦	◦					◦	◦	◦	◦	◦	◦		◦			◦		
46	GR-032	two mica granite	Khlong Chan	mylonitic	◎	○	◎	◦	◦						◦	◦		◦			◦			◦		
47	GR-165	two mica granite	Khao Hin Chang	mylonitic	◎	○	◎	◦	◦					◦	◦	◦	◦	◦	◦		◦			◦		
48	HR-071	sandy mudstone	Khlong Chumphon branch		◎			◦	◦			◦						◦								
49	HR-093	two mica granite	Khlong Set Takuat branch	mylonitic	◎	○	◎	◦	◦						◦	◦	◦	◦			◦			◦		
50	HR-110	two mica granite	Khlong Kra Buri	mylonitic	◎	○	◎	◦	◦						◦	◦	◦	◦			◦			◦		
51	HR-120	two mica granite	Khlong Kra Buri	mylonitic	◎	○	◎	◦	◦						◦	◦		◦			◦			◦		
52	HSR-26	two mica granite	Khlong Nam Khao branch	mylonitic	◎	○	◎	◦	◦						◦	◦	◦	◦			◦			◦		
53	HSR-32	two mica tourmaline granite	Khlong Nam Khao branch	granitic	◎	○	◎	◦	◦						◦	◦		◦			◦			◦		

Abbreviations ; Qz:quartz, Pl:plagioclase, Kf:potassium feldspar, Bi:biotite, Ms:muscovite, Am:amphibole, Ga:garnet, Ch:chlorite, Al:allanite, Tl:tourmaline, Zr:zircon, Ap:apatite, Sp:sphene, Op:opaque mineral, Ca:calcite, Ep:epidote, Fr:rock fragment

Symbols; ◎:abundant, ○:common, ◦:rare

Appendix 2 Chemical analysis data of major elements in granitic rocks (1)

Sp. No.	AR-020	BR-199	BR-230	BR-232	DSR-040	HR-110	AR-014	AR-015	AR-026	CR-147	CR-181
SiO_2	74.85	69.65	75.59	78.23	74.67	74.18	78.20	75.00	74.80	71.59	71.95
TiO_2	0.24	0.33	0.23	0.25	0.12	0.23	0.07	0.11	0.21	0.64	0.27
Al_2O_3	12.76	13.41	12.01	11.10	13.40	13.70	12.42	13.74	13.10	13.10	13.59
Fe_2O_3	0.00	2.17	0.44	0.11	0.31	0.00	0.12	0.42	0.15	1.81	0.49
FeO	1.93	0.49	1.91	1.75	1.18	1.90	0.85	0.76	1.30	2.11	2.22
MnO	0.05	0.05	0.04	0.03	0.02	0.04	0.05	0.06	0.03	0.07	0.04
MgO	0.42	0.69	0.42	0.39	0.16	0.32	0.08	0.12	0.19	1.11	0.35
CaO	0.78	1.04	0.27	0.13	0.57	0.67	0.14	0.18	0.44	0.76	0.74
Na_2O	2.81	2.99	2.43	1.73	3.88	2.40	3.44	3.00	2.58	2.33	2.30
K_2O	5.24	5.20	5.20	5.32	4.06	5.92	3.64	5.88	5.78	4.50	5.56
P_2O_5	0.14	0.12	0.10	0.08	0.04	0.08	0.06	0.08	0.12	0.22	0.12
BaO	0.04	0.04	0.04	0.03	0.00	0.04	0.00	0.01	0.02	0.05	0.03
LOI	1.05	1.71	0.98	0.92	0.79	1.12	0.97	0.89	1.08	1.78	1.30
total	100.31	97.89	99.66	100.07	99.20	100.60	100.04	100.25	99.80	100.07	98.96

-----Norm-----

Q	35.04	29.41	39.31	45.89	34.42	34.39	43.35	34.25	35.87	37.45	34.00
C	1.36	1.23	2.11	2.43	1.68	2.29	2.71	2.30	2.07	3.51	2.71
or	30.97	30.73	30.73	31.44	23.99	34.99	21.51	34.75	34.16	26.59	32.86
ab	23.78	25.30	20.56	14.64	32.83	20.31	29.11	25.39	21.83	19.72	19.46
an	3.03	4.45	0.76	0.18	2.57	2.87	0.30	0.39	1.44	2.42	2.94
ne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
di	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
en	1.05	1.72	1.05	0.97	0.40	0.80	0.20	0.30	0.47	2.76	0.87
fs	3.24	0.00	2.84	2.77	1.75	3.18	1.44	0.98	1.97	1.45	3.30
fo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mt	0.00	0.79	0.64	0.16	0.45	0.00	0.17	0.61	0.22	2.62	0.71
ht	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
il	0.46	0.63	0.44	0.47	0.23	0.44	0.13	0.21	0.40	1.22	0.51
ru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ap	0.32	0.28	0.23	0.19	0.09	0.19	0.14	0.19	0.28	0.51	0.28
total	99.23	96.15	98.65	99.13	98.41	99.45	99.07	99.35	98.71	98.26	97.64
D.I.	89.79	85.44	90.06	91.97	91.24	89.69	93.97	94.39	91.86	83.76	86.32

central stock | south mass

Appendix 2 Chemical analysis data of major elements in granitic rocks (2)

Sp. No.	DR-078	DR-195	DR-200	GR-032	HSR-032	HSR-026	AR-008	AR-009	AR-016	AR-017	AR-019
SiO2	73.42	74.67	71.55	73.42	72.91	73.20	75.01	75.55	73.17	73.81	72.99
TiO2	0.28	0.15	0.25	0.15	0.21	0.21	0.23	0.15	0.29	0.28	0.22
Al2O3	14.42	13.79	13.35	13.81	13.69	13.36	12.70	12.83	13.54	13.35	13.38
Fe2O3	0.03	0.78	0.19	0.05	0.00	0.00	0.48	0.31	0.01	0.19	0.23
FeO	1.48	0.58	1.57	1.30	1.85	1.48	1.48	1.12	2.02	2.02	1.53
MnO	0.03	0.03	0.04	0.04	0.03	0.03	0.03	0.05	0.05	0.06	0.04
MgO	0.31	0.19	0.34	0.24	0.31	0.22	0.35	0.25	0.60	0.56	0.33
CaO	0.81	1.09	0.90	0.85	0.97	0.46	0.23	0.36	1.31	1.44	0.46
Na2O	2.09	3.10	2.33	2.66	2.49	2.67	2.01	2.77	3.06	2.88	1.82
K2O	6.26	5.52	5.94	5.28	5.94	5.64	5.42	5.18	5.40	5.24	6.02
P2O5	0.08	0.08	0.10	0.10	0.12	0.12	0.08	0.08	0.10	0.12	0.10
BaO	0.02	0.01	0.02	0.01	0.02	0.02	0.04	0.02	0.04	0.03	0.03
LOI	1.44	0.65	0.88	0.96	0.88	0.93	1.68	1.11	1.06	0.76	1.66
total	100.67	100.64	97.46	98.87	99.42	98.34	99.74	99.78	100.65	100.74	98.81
Norm											
Q	34.28	33.01	32.01	34.85	32.06	33.99	40.84	37.93	29.74	31.94	37.08
C	2.91	0.92	1.68	2.41	1.67	2.30	3.27	2.19	0.49	0.59	3.25
or	36.99	32.62	35.10	31.20	35.10	33.33	32.03	30.61	31.91	30.97	35.58
ab	17.69	26.23	19.72	22.51	21.07	22.59	17.01	23.44	25.89	24.37	15.40
an	3.53	4.90	3.85	3.58	4.06	1.53	0.69	1.30	5.92	6.41	1.68
ne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
di	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
en	0.77	0.47	0.85	0.60	0.77	0.55	0.87	0.62	1.49	1.39	0.82
fs	2.29	0.23	2.39	2.17	3.11	2.43	2.00	1.65	3.31	3.20	2.33
fo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mt	0.04	1.13	0.28	0.07	0.00	0.00	0.70	0.45	0.01	0.28	0.33
ht	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
il	0.53	0.28	0.47	0.28	0.40	0.40	0.44	0.28	0.55	0.53	0.42
ru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ap	0.19	0.19	0.23	0.23	0.28	0.28	0.19	0.19	0.23	0.28	0.23
total	99.22	99.98	96.57	97.90	98.53	97.40	98.03	98.66	99.56	99.96	97.13
D.I.	88.96	91.86	86.83	88.56	88.23	89.91	89.88	91.98	87.54	87.28	88.06
Group	northern west mass						northern east mass		central stock		

Appendix 2 Chemical analysis data of major elements in granitic rocks (3)

Sp.No.	DR-132	GR-165	HR-093	AR-004	AR-027	AR-029	AR-011	AR-007	AR-024	AR-025
SiO2	73.80	72.64	74.10	89.57	78.59	86.24	89.97	94.27	88.04	92.01
TiO2	0.14	0.31	0.34	0.17	0.43	0.37	0.12	0.10	0.28	0.18
Al2O3	13.54	13.86	13.52	4.50	7.83	7.47	4.26	2.89	7.72	4.92
Fe2O3	0.49	0.85	0.97	0.07	4.98	0.39	0.55	0.23	0.11	0.09
FeO	1.13	1.03	1.48	0.70	2.47	0.27	0.80	0.80	0.50	0.68
MnO	0.01	0.04	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.00
MgO	0.12	0.41	0.51	0.10	0.39	0.32	0.21	0.16	0.26	0.19
CaO	0.13	0.96	0.04	0.05	0.07	0.02	0.06	0.03	0.05	0.03
Na2O	2.37	2.39	0.63	0.05	0.05	0.02	0.20	0.02	0.06	0.02
K2O	6.60	6.40	5.90	1.00	1.94	1.56	1.44	0.98	2.06	1.38
P2O5	0.08	0.12	0.14	0.00	0.08	0.04	0.00	0.00	0.04	0.02
BaO	0.02	0.03	0.04	0.01	0.02	0.01	0.01	0.01	0.01	0.01
LOI	1.08	0.97	2.83	1.93	3.19	1.88	0.78	0.83	1.68	1.15
total	99.51	100.01	100.54	98.12	100.03	98.58	98.39	100.29	100.80	100.67

---Norm---

Q	33.84	31.55	46.44	84.76	70.29	79.68	82.47	89.58	79.25	85.91
C	2.44	1.52	6.10	3.24	5.65	5.75	2.26	1.74	5.39	3.38
or	39.00	37.82	34.87	5.91	11.46	9.22	8.51	5.79	12.17	8.16
ab	20.05	20.22	5.33	0.42	0.42	0.17	1.69	0.17	0.51	0.17
an	0.16	4.03	0.00	0.27	0.00	0.00	0.32	0.17	0.00	0.04
ne	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
di	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
hd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
en	0.30	1.02	1.27	0.25	0.97	0.80	0.52	0.40	0.65	0.47
fs	1.46	0.75	1.43	0.95	0.00	0.00	0.84	1.11	0.36	0.88
fo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
mt	0.71	1.23	1.41	0.10	6.71	0.00	0.80	0.33	0.16	0.13
ht	0.00	0.00	0.00	0.00	0.35	0.39	0.00	0.00	0.00	0.00
il	0.27	0.59	0.65	0.32	0.82	0.57	0.23	0.19	0.53	0.34
ru	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
ap	0.19	0.28	0.32	tr.	0.19	0.09	tr.	tr.	0.09	0.05
total	98.42	99.02	97.81	96.21	96.87	96.73	97.62	99.48	99.12	99.52
D.I.	92.89	89.59	86.64							

south mass | altered rock | orthoquarzite

Appendix 3 Chemical analysis data of minor elements in grantic rocks

	Sn	W	Ta	Nb	Au	Mo	Ce	Eu	La	Lu	Nd	Sm	Tb	Th	U	Y	Sc	Yb
DR-078	16	<4	7	34	<5	INT	230	0.9	130	0.28	100	18	1.6	130	16	36	4.5	2.3
DR-195	39	18	7	25	<5	INT	110	0.5	63	1.38	51	11	2.3	77	31	77	3.8	9.6
DR-200	25	11	5	27	<5	INT	190	1.7	98	0.99	49	13	2.2	88	34	77	4.4	6.88
GR-032	76	13	5	31	770	INT	86	<0.2	47	0.46	22	7.3	1.9	48	30	43	7.4	3.4
HSR-032	51	<4	6	30	<5	INT	130	<0.2	75	0.7	47	11	0.7	71	32	61	4	5.27
HSR-026	52	<4	4	27	<5	INT	120	0.9	74	0.41	48	12	<0.5	78	29	52	4	4.37
AR-008	14	<4	2	22	<5	INT	62	0.5	35	0.41	20	5.8	0.9	39	12	40	4.6	2.7
AR-009	26	<4	3	20	<5	INT	46	0.4	23	0.78	20	4.8	1	24	11	54	2.3	5.96
AR-016	22	<4	3	19	10	INT	98	1.1	65	1.2	50	10	1.8	50	20	75	6.2	8.41
AR-017	28	<4	3	21	<5	INT	80	0.7	42	0.77	27	7.2	2.1	46	15	53	6.1	5.24
AR-019	20	6	2	22	5	INT	97	0.6	65	0.6	41	8.2	1.6	53	18	49	4.9	3.88
AR-020	29	<4	3	18	<5	INT	88	0.9	47	0.44	32	6.6	1.8	38	11	35	4.3	2.55
BR-199	14	22	4	22	<5	INT	120	1.2	70	1.17	58	9.8	1.4	76	25	61	7.2	8.27
BR-230	27	22	4	19	<5	INT	60	0.6	33	1.12	27	5.6	1.5	52	23	55	4.4	8.87
BR-232	23	13	4	21	<5	INT	77	0.5	43	1.08	37	6.9	<0.5	66	21	55	4.9	7.35
DSR-040	16	<4	5	22	<5	INT	26	0.2	14	1.25	14	5.8	1.3	24	25	67	2.9	10.4
HR-110	8	<4	4	23	<5	INT	110	0.7	61	0.65	48	8.7	1.5	51	16	51	5.7	6.11
AR-014	199	170	14	54	<5	INT	26	<0.2	15	0.53	14	4	1.1	13	12	55	3.7	4.83
AR-015	95	11	6	30	9	INT	59	<0.2	26	0.41	20	4.4	1	33	20	47	3.5	2.70
AR-026	12	<4	4	26	<5	<5	150	1.1	96	0.58	61	11	<0.5	49	10	42	5.3	4.63
CR-147	10	<4	3	18	<5	INT	100	1.6	61	0.63	48	9.2	1.6	32	18	47	9.8	4.77
CR-181	60	31	7	42	<5	INT	210	0.9	130	0.9	110	21	3.7	89	30	77	6.3	6.57
DR-132	46	<4	2	28	<5	INT	110	0.7	64	0.3	51	11	1.5	58	12	78	2.5	2.84
GR-165	12	<4	3	27	10	INT	190	0.8	120	0.2	75	13	1	140	39	23	3.8	3.45
HR-093	23	6	4	21	<5	INT	80	1.3	49	0.28	39	8	1.2	34	18	21	5.8	2.17
AR-004	<5	<4	<1	9	<5	<5	20	0.4	11	0.13	7	1.4	<0.5	4.3	<0.5	9	1.8	1.04
AR-027	<5	<4	2	17	6	<5	65	1	35	0.4	32	5.2	<0.5	14	5.9	17	8.9	0.82
AR-029	<5	21	1	11	<5	<5	68	1.3	38	0.71	28	6.1	<0.5	14	3.4	29	7	5.45
AR-011	<5	<4	<1	4	8	<5	35	0.5	21	0.2	15	2.8	0.7	3.3	1.4	20	2.1	1.28
AR-007	<5	<4	<1	4	20	<5	12	0.3	7	0.09	10	1.5	<0.5	2.3	<0.5	4	1.4	0.82
AR-024	<5	<4	1	7	<5	<5	50	0.9	29	0.25	21	3.4	0.6	7.4	2.9	14	2.7	1.90
AR-025	<5	<4	<1	17	48	<5	37	0.5	25	0.23	15	2.4	<0.5	6.9	3.1	26	3.8	1.60

Appendix 4 Microscopic observation of ore polished sections

No	Sample Number	Locality	Cs	Mz	Xe	Ru	At	Zr	Il	Sp	Wo	Sl	Tl	Qz	Kf	Pl	Remarks
1	RATANA-1	Ratana Krathu mine	◎			○	◦	◎	◦		◦			◦		◦	
2	RATANA-2	Ratana Krathu mine	◎			◦		◦			◦			○			
3	RATANA-3	Ratana Krathu mine	◦		◦	○	◦	◎			○			○		◦	
4	RATANA-4	Ratana Krathu mine	◎	○	◦	○		◎			○		○	○			
5	BAN BANG NON-1	Ban Bang Non mining area	○	○	◦			◦	◎			◦	◦	◎		◦	
6	SAI THONG-1	Sai Thong mine	○	◎		◦			○				◎	◎			
7	EH-006	Khlong Kum	○	◦		◦	○		○	◦			◎	◎			
8	FH-001	Bang Phra mine	◎			◦	◦	○	○					○			
9	FH-004	Bang Si Kim mine	○		◦			◎	◎	◦		◦		○			
10	FH-005	Khlong Chan	○		◦			○	◎					○	◦	◦	
11	FH-014	Khlong Rang Taen branch	○	○	○			◦	◎					◎			
12	GH-001	Khlong Nam Khao	◦	○		○			◎				○	◎			
13	GH-008	Khlong Phraek Dat	◎	◦		◦	◦	◎									
14	KH-003	Khlong Sawa	○	○			◦		◎				◦	◦			

Abbreviations; Cs:cassiterite, Mz:monazite, Xe:xenotime, Ru:rutile, At:anatase, Zr:zircon, Il:ilmenite, Sp:sphene, Wo:wolfranite, Sl:scheelite, Ga:garnet, Tl:tourmaline, Qz:quartz, Kf:potassium feldspar, Pl:plagioclase

Symbols; ◎:abundant, ○:common, ◦:rare

Apenndix 5 Assay of ore samples

sample number	area	mining (area) name	Sn	W	Ta	Nb	Y	La	Ce	Nd	U	Th	OTH.REE	remarks
FH-013	north	up.of Khlong Nam Khao	10.625	0.200	0.938	2.435	4.281	1.125	2.000	0.750	0.475	1.438	2.489	
FH-014	north	up.of Khlong Nam Khao	6.000	0.144	0.960	4.075	10.538	1.440	1.760	0.480	2.160	2.080	4.721	
GH-002	north	dw.of Khlong Nam Khao	9.600	0.240	1.120	4.016	10.013	1.088	1.920	0.512	0.704	1.760	5.971	
GH-003	north	dw.of Khlong Nam Khao	52.000	0.273	1.560	4.674	8.654	1.690	2.340	0.767	1.183	1.950	5.350	
GH-004	north	dw.of Khlong Nam Khao	37.400	0.986	4.420	17.959	24.592	6.120	8.840	1.972	10.200	7.140	18.829	
FH-005	north	md.of khlong Chan	84.375	0.244	2.438	9.459	16.288	3.563	4.313	1.256	4.500	3.563	9.988	
KH-003	middle	Khlong Sawa	6.340	0.043	0.121	0.634	3.113	0.920	1.656	0.573	0.160	0.798	1.625	
GH-008	middle	Khlong Lam Leang	114.800	0.154	0.034	0.232	0.689	0.605	0.560	0.143	0.045	0.308	0.560	
GH-009	middle	Khlong Lam Leang	107.442	0.178	0.046	0.205	0.405	0.274	0.320	0.089	0.046	0.181	0.263	
FH-003	south	Bang Si Kim mine	4.620	0.132	0.210	0.866	0.885	0.258	0.306	0.168	0.060	0.120	0.407	
FH-004	south	Bang Si Kim mine	74.100	0.533	1.157	2.405	1.365	0.702	0.832	0.273	0.143	0.325	0.813	
FH-001	south	Ban Phra mine	243.750	1.500	2.000	3.305	0.486	0.306	0.319	0.094	0.106	0.175	0.339	
FH-002	south	Ban Phra mine	52.858	1.000	1.143	2.501	2.246	1.071	1.357	0.536	0.250	0.579	1.078	
EH-006	south	Khlong Kum area	14.440	2.280	1.254	4.684	1.970	0.209	0.380	0.061	0.304	0.247	0.922	
EH-007	south	Khlong Kum area	120.000	2.040	4.320	4.579	1.778	0.564	0.744	0.180	0.240	0.396	0.821	
EH-008	south	Khlong Kum area	12.666	0.108	0.405	1.232	1.799	0.443	0.583	0.196	0.101	0.222	0.757	
RATANA-1	south	Ratana Krathu mine	1800.000	70.000	22.000	34.415	5.210	2.100	2.450	1.350	0.650	1.500	14.908	middle dressing ore
RATANA-2	south	Ratana Krathu mine	1800.000	42.000	21.000	37.240	2.765	1.250	0.900	0.450	0.350	0.650	2.043	final dressing ore
RATANA-3	south	Ratana Krathu mine	950.000	115.000	21.000	40.295	19.045	8.500	13.000	3.700	1.100	5.500	10.431	wastes of ore
RATANA-4	south	Ratana Krathu mine	1100.000	115.000	22.500	44.705	19.095	10.500	12.000	2.600	1.250	5.500	13.346	low dressing ore
BBN1	south	Ban Bang Non area	296.400	2.964	7.600	22.515	29.325	8.740	11.400	3.496	2.280	5.700	17.035	
BBN2	south	Ban Bang Non area	418.000	4.180	11.780	22.595	30.092	11.780	15.580	5.320	3.648	9.120	17.102	
SAITHONG-1	south	Sai thong mine	3.920	0.136	0.408	1.202	2.254	0.616	1.280	0.416	0.312	0.768	0.849	
SAITHONG-2	south	Sai thong mine	3.600	0.049	0.144	1.262	2.751	0.328	0.664	0.256	0.128	0.376	1.100	
BANHINDAT	south	Ban Hin Dat	16.5	0.390	0.540	1.455	1.193	0.315	0.480	0.120	0.093	0.180	0.779	

unit: g/m^3

Appendix 6 Results of X-ray diffraction of panned samples

No.	Sample Number	Location	Cs	Wo	Sl	Mz	Xe	Ru	At	Zr	Il	Tl	Qz	Ms	Tp	Remarks
1	AP-119	Khlong Phrae Ka Muang	?					∘		○		·	◎			
2	AP-158	Khlong Won				∘		○	∘		·		◎			
3	BP-213	Ban Sai Daeng	·			○	·			·	∘		○			
4	DP-228	Khlong Bang Non branch	·			·						◎	◎	∘		
5	EH-006	Khlong Kum	·					·	∘		∘	◎	◎			
6	EP-077	La-Un	∘			·	·	∘		◎			○			
7	FH-001	Bang Phra mine	◎							·	∘		·			
8	FH-004	Bang Si Kim mine	○		·		·		∘	○	∘	·	∘			
9	FH-005	Khlong Chan	∘	·			∘			∘	○		∘			
10	FH-014	Khlong Rang Taen branch	∘			∘	∘	·			○		○			
11	GH-001	Khlong Nam Khao				∘		∘			○	∘	◎			
12	GH-008	Khlong Phraek Dat	◎			·		·		◎						
13	GH-010	Khlong Lik branch	∘			∘			·	○	∘		∘			
14	GP-166	Ban Hin Chang						·	∘	·	∘		◎			
15	HP-112	Khlong Kra Buri	∘			○	○		○	∘	∘		○			
16	KH-003	Khlong Sawa	○			○	∘			○	·		·			
17	RATANA-1	Ratana Krathu mine	◎	·						○			·			middle dressing ore
18	RATANA-2	Ratana Krathu mine	◎	·												final dressing ore
19	RATANA-3	Ratana Krathu mine	○	∘		○	·	∘					∘			waste of ore
20	RATANA-4	Ratana Krathu mine	◎	∘		∘	·	∘		○			·		∘	low dressing ore
21	Sai Thong	Sai Thong mine	∘			○		·			∘	○	◎			
22	Ban Bang Non	Ban Bang Non mine	○		·	○					○	∘	∘			

Abbreviations; Cs:cassiterite, Wo:wolfranite, Sl:scheelite, Mz:monazite, Xe:xenotime, Ru:rutile, At:anatase, Zr:zircon, Il:ilmenite, Tl:tourmaline, Qz:quartz, Ms:muscovite, Tp:topaz

Symbols; ◎:abundant, ○:common, ∘:rare, ·:trace

Appendix 7 EPMA analysis data of heavy minerals

(1)

Serial No.	1	2	3	4	5	6	7	8	9	10
mineral name	cassiterite	cassiterite	cassiterite	monazite	monazite	monazite	monazite	monazite	xenotime	xenotime
sample No.	RAYANA-3	GH-001	GH-008	GH-001	SAITHONG	SAITHONG	SAITHONG	SAITHONG	SAITHONG	SAITHONG
point No.	2	1	1	3	2	7	8	9	5	6
element wt%										
SiO_2	----	----	----	----	----	----	----	----	----	----
TiO_2	1.11	0.15	0.91	0.00	0.00	0.00	0.00	0.00	----	----
Fe_2O_3*	0.61	0.27	0.00	----	----	----	----	----	2.31	0.08
CaO	----	----	----	0.65	1.16	0.69	1.81	0.45	----	----
NiO	1.24	0.00	0.98	----	----	----	----	----	----	----
P_2O_5	----	----	----	18.67	27.60	24.27	26.81	21.21	44.83	42.91
SnO_2	92.71	98.68	97.43	----	----	----	----	----	----	----
ZrO_2	----	----	----	----	----	----	----	----	----	----
HfO_2	----	----	----	----	----	----	----	----	----	----
Ta_2O_5	3.23	0.91	0.52	----	----	----	----	----	----	----
Nb_2O_5	1.13	0.00	0.00	1.50	0.00	0.87	0.97	0.98	----	----
La_2O_3	0.00	0.00	0.00	13.94	17.30	14.90	14.88	14.23	----	----
Ce_2O_3	0.00	0.00	0.00	28.79	29.84	28.05	27.26	26.43	----	----
Nd_2O_3	0.00	0.00	0.17	12.03	9.93	11.34	11.66	11.58	----	----
Sm_2O_3	0.00	0.00	0.00	2.83	2.77	3.64	2.07	3.28	1.08	0.77
Tb_2O_3	----	----	----	----	----	----	----	----	0.00	0.00
Gd_2O_3	----	----	----	----	----	----	----	----	2.15	1.63
Dy_2O_3	----	----	----	----	----	----	----	----	4.49	5.50
Er_2O_3	----	----	----	----	----	----	----	----	4.14	5.70
Tm_2O_3	----	----	----	----	----	----	----	----	0.00	0.00
Yb_2O_3	----	----	----	----	----	----	----	----	5.64	7.84
ThO_2	----	----	----	12.49	8.79	8.88	8.19	13.23	1.71	0.74
UO_3	----	----	----	0.89	0.00	0.00	1.16	0.00	1.45	0.77
Y_2O_3	0.00	0.00	0.00	8.31	2.71	5.85	5.28	8.73	32.18	34.15
total	100.03	100.01	100.01	100.10	100.10	98.49	100.08	100.12	99.98	100.09
Number of ions	on the basis of O = 2			on the basis of O = 4					on the basis of O = 4	
Si	----	----	----	----	----	----	----	----	----	----
Ti	0.021	0.003	0.017	0.000	0.000	0.000	0.000	0.000	----	----
Fe	----	----	----	----	----	----	----	----	0.052	0.002
Ca	0.011	0.005	0.000	0.032	0.050	0.031	0.078	0.021	----	----
Ni	0.025	0.000	0.020	----	----	----	----	----	----	----
P	----	----	----	0.733	0.949	0.870	0.917	0.800	1.140	1.125
Sn	0.915	0.986	0.968	----	----	----	----	----	----	----
Zr	----	----	----	----	----	----	----	----	----	----
Hf	----	----	----	----	----	----	----	----	----	----
Ta	0.022	0.006	0.004	----	----	----	----	----	----	----
Nb	0.013	0.000	0.000	0.031	0.000	0.017	0.018	0.020	----	----
La	0.000	0.000	0.000	0.239	0.259	0.233	0.222	0.234	----	----
Ce	0.000	0.000	0.000	0.489	0.443	0.435	0.403	0.431	----	----
Nd	0.000	0.000	0.002	0.199	0.144	0.171	0.168	0.184	----	----
Sm	0.000	0.000	0.000	0.045	0.039	0.053	0.029	0.050	0.011	0.008
Tb	----	----	----	----	----	----	----	----	0.000	0.000
Gd	----	----	----	----	----	----	----	----	0.021	0.017
Dy	----	----	----	----	----	----	----	----	0.043	0.055
Er	----	----	----	----	----	----	----	----	0.039	0.055
Tm	----	----	----	----	----	----	----	----	0.000	0.000
Yb	----	----	----	----	----	----	----	----	0.052	0.074
Th	----	----	----	0.132	0.081	0.086	0.075	0.134	0.012	0.005
U	----	----	----	0.009	0.000	0.000	0.010	0.000	0.009	0.005
Y	0.000	0.000	0.000	0.205	0.059	0.132	0.114	0.207	0.514	0.563

*: Total Fe as Fe_2O_3

Appendix 7 EPMA analysis data of heavy minerals (2)

Serial No.	11	12	13	14	15	16	17
mineral name	polycrase	polycrase	polycrase	zircon	zircon	rutile	rutile
sample No.	GH-001	GH-001	GH-001	SAITHONG	SAITHONG	RATANA-3	SAITHONG
point No.	2	6	7	1	4	3	3
element wt%							
SiO_2	----	----	----	35.08	34.61	----	----
TiO_2	29.83	30.56	29.57	0.00	0.00	95.59	96.64
Fe_2O_3*	1.21	1.67	1.55	----	----	0.11	0.58
CaO	----	----	----	----	----	----	----
NiO	----	----	----	0.82	1.14	0.32	0.50
P_2O_5	----	----	----	----	----	----	----
SnO_2	----	----	----	----	----	----	----
ZrO_2	----	----	----	59.05	58.97	----	----
HfO_2	----	----	----	3.09	4.45	----	----
Ta_2O_5	9.65	8.31	8.75	1.61	0.00	0.57	0.00
Nb_2O_5	21.77	19.63	17.23	0.00	0.66	0.25	0.35
La_2O_3	2.10	2.56	5.02	0.00	0.00	3.24	2.02
Ce_2O_3	0.77	1.09	1.68	0.15	0.00	0.00	0.00
Nd_2O_3	0.00	0.58	0.80	0.21	0.00	0.00	0.00
Sm_2O_3	0.00	0.00	0.40	0.00	0.19	0.00	0.00
Tb_2O_3	----	----	----	----	----	----	----
Gd_2O_3	----	----	----	----	----	----	----
Dy_2O_3	----	----	----	----	----	----	----
Er_2O_3	----	----	----	----	----	----	----
Tm_2O_3	----	----	----	----	----	----	----
Yb_2O_3	----	----	----	----	----	----	----
ThO_2	5.06	4.36	4.44	----	----	----	----
UO_3	20.72	23.89	23.85	----	----	----	----
Y_2O_3	8.94	7.39	6.77	----	----	0.00	0.00
total	100.05	100.04	100.06	100.01	100.02	100.08	100.09
Number of ions	on the basis of = 6			on the basis of O = 4		on the basis of O = 2	
Si	----	----	----	1.067	1.057	----	----
Ti	1.327	1.356	1.356	0.000	0.000	0.981	0.983
Fe	0.054	0.075	0.071	----	----	0.001	0.006
Ca	----	----	----	----	----	----	----
Ni	----	----	----	0.020	0.028	0.004	0.005
P	----	----	----	----	----	----	----
Sn	----	----	----	----	----	----	----
Zr	----	----	----	0.876	0.878	----	----
Hf	----	----	----	0.027	0.039	----	----
Ta	0.155	0.134	0.145	0.013	0.000	0.002	0.000
Nb	0.582	0.527	0.475	0.000	0.009	0.002	0.002
La	0.046	0.056	0.113	0.000	0.000	0.016	0.010
Ce	0.017	0.024	0.037	0.002	0.000	0.000	0.000
Nd	0.000	0.012	0.017	0.002	0.000	0.000	0.000
Sm	0.000	0.000	0.008	0.000	0.002	0.000	0.000
Tb	----	----	----	----	----	----	----
Gd	----	----	----	----	----	----	----
Dy	----	----	----	----	----	----	----
Er	----	----	----	----	----	----	----
Tm	----	----	----	----	----	----	----
Yb	----	----	----	----	----	----	----
Th	0.068	0.059	0.062	----	----	----	----
U	0.257	0.298	0.305	----	----	----	----
Y	0.281	0.234	0.220	----	----	0.000	0.000

*: Total Fe as Fe_2O_3

Appendix 8 Chemical analysis data of stream sediments (1)

	Element	SN	W	TA	NB	AU	MO	CE	EU	LA	LU	ND	SM	TB	TH	U	Y	SC
	Units	PPM	PPM	PPM	PPM	PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
	Detection limit	5	4	1	0	5	5	3	0.2	1	0.05	5	0.1	0.5	0.5	0.5	0	0.1
1	A-001	273	45	31	107	6	43	910	1.9	490	11.9	400	73	16	400	73	473	6.5
2	A-002	9	8	2	24	<5	13	81	1	43	0.47	27	5.3	<0.5	18	2.3	21	8.7
3	A-003	9	<4	<1	20	<5	9	78	0.9	42	0.45	23	5	<0.5	19	1.8	20	7.6
4	A-004	<5	<4	2	20	<5	6	70	1	36	0.56	26	4.8	<0.5	17	2.5	19	9.8
5	A-005	<5	<4	<1	16	<5	<5	65	0.7	31	0.33	17	3.6	<0.5	13	1.4	15	8.8
6	A-006	6	<4	<1	19	<5	<5	76	1	39	0.41	28	4.8	<0.5	16	2.6	19	9.9
7	A-007	<5	<4	<1	16	<5	7	60	0.7	29	0.43	22	3.7	<0.5	14	1.8	17	6.7
8	A-008	<5	<4	<1	17	24	<5	61	0.8	31	0.47	20	3.8	0.6	13	2.1	19	6.2
9	A-009	<5	5	1	20	<5	6	76	0.9	40	0.51	22	4.7	<0.5	19	2.6	21	5.8
10	A-010	<5	<4	1	12	<5	<5	62	0.9	31	0.44	20	3.7	<0.5	14	2.7	16	6
11	A-011	<5	<4	2	16	<5	<5	66	0.7	38	0.51	25	4.4	0.9	17	2.6	22	7.7
12	A-012	<5	5	1	15	<5	<5	86	1.2	47	0.56	32	5.8	<0.5	18	2.1	25	9.3
13	A-013	<5	4	1	16	<5	<5	79	1	43	0.5	32	5.3	<0.5	16	2.9	23	9.3
14	A-014	<5	<4	<1	13	5	<5	52	0.7	26	0.33	15	3.2	0.6	12	1.6	15	6.4
15	A-015	6	<4	2	14	<5	<5	78	0.8	39	0.54	30	4.6	<0.5	18	2.5	20	5.4
16	A-016	<5	<4	<1	12	<5	5	58	0.7	32	0.37	24	4	0.7	13	1.2	16	5.8
17	A-017	<5	<4	<1	6	<5	<5	15	0.3	7	0.17	6	0.8	<0.5	4.6	0.7	5	2
18	A-018	178	12	23	70	<5	0	400	1.2	210	3.97	170	32	6.6	180	29	262	4.7
19	A-019	1368	13	54	56	8	0	160	0.5	87	1.74	62	13	2.6	68	13	99	4
20	A-020	254	10	23	56	<5	0	520	0.6	280	3.4	200	41	6.5	240	29	217	3.6
21	A-021	420	23	38	81	<5	0	330	0.9	170	2.33	110	25	4.8	140	21	146	4.9
22	A-022	332	7	21	20	<5	0	73	0.5	36	0.8	25	5.4	1.2	29	5.5	34	2.3
23	A-023	389	16	36	86	<5	0	610	0.8	330	5.42	240	48	9.6	280	35	346	4.5
24	A-024	157	10	22	59	<5	0	350	1	190	3.5	140	28	5.8	150	19	222	3.2
25	A-025	8	4	2	17	<5	0	64	0.6	33	0.7	22	4.1	<0.5	23	6.6	28	5
26	A-026	<5	<4	2	12	<5	<5	59	0.6	31	0.57	25	4.1	<0.5	17	4	24	4.1
27	A-027	<5	<4	<1	9	<5	<5	18	0.2	9	0.16	6	1.1	<0.5	4.3	0.8	3	0.8
28	A-028	<5	<4	<1	11	<5	<5	53	0.5	28	0.42	20	3.2	<0.5	13	2.6	14	1.4
29	A-029	<5	<4	<1	12	<5	<5	91	0.6	51	0.54	36	5.9	0.8	23	3.6	18	1.8
30	A-030	<5	<4	<1	10	<5	<5	34	0.4	19	0.33	14	2.4	0.5	8	1.4	11	2.6
31	A-031	8	4	3	16	<5	0	51	0.6	29	0.95	20	3.4	<0.5	25	9.7	27	4.1
32	A-032	<5	<4	<1	10	<5	<5	29	0.4	15	0.38	12	1.9	0.6	10	3.4	12	2.6
33	A-033	<5	<4	<1	9	<5	<5	23	0.3	12	0.23	10	1.5	<0.5	5.1	1.1	8	2.7
34	A-034	6	<4	<1	12	<5	<5	59	<0.2	30	0.47	25	3.9	<0.5	16	1.7	20	7.1
35	A-035	19	<4	2	11	<5	6	45	0.6	25	0.94	18	2.8	0.7	26	11	24	2.7
36	A-036	16	7	6	26	<5	0	73	0.8	39	2.04	21	4.3	1.1	58	23	52	4.8
37	A-037	14	9	7	29	<5	0	76	0.9	38	2.29	32	4.6	1.1	56	24	56	5.2
38	A-038	6	<4	2	13	<5	<5	29	0.4	13	0.57	9	1.6	<0.5	9.9	4.8	15	2.4
39	A-039	<5	<4	<1	11	<5	<5	33	0.4	17	0.25	12	2	<0.5	6.6	1.2	9	2.8
40	A-040	<5	<4	<1	12	<5	<5	25	0.5	15	0.36	8	1.9	<0.5	8.3	1.6	14	2
41	A-041	<5	<4	<1	9	<5	<5	42	0.5	22	0.29	16	2.7	<0.5	9.1	1.2	12	3.2
42	A-042	<5	<4	<1	11	<5	<5	35	0.4	19	0.24	12	2.3	<0.5	7.5	1.3	10	2.3
43	A-043	<5	<4	1	11	<5	<5	60	0.6	33	0.45	20	3.7	<0.5	13	2	16	1.9
44	A-044	26	19	2	133	<5	140	83	0.8	41	0.76	26	4.5	0.9	24	3.6	26	3.1
45	A-045	<5	<4	<1	8	5	<5	35	0.5	18	0.33	14	2.3	<0.5	7.3	1.1	13	2.2
46	A-046	<5	<4	<1	11	<5	<5	61	0.8	34	0.35	28	4	0.8	12	1.9	17	5.9
47	A-047	<5	<4	<1	10	<5	<5	46	0.6	25	0.45	22	3.3	0.8	11	2.5	18	2.3
48	A-048	<5	<4	<1	9	<5	<5	47	0.6	25	0.44	19	3.3	<0.5	10	1.8	17	3.9
49	A-049	<5	<4	<1	8	<5	5	46	0.5	22	0.4	18	2.9	<0.5	9.5	1.8	16	4.3
50	A-050	<5	<4	<1	9	<5	<5	43	0.7	22	0.37	17	3	<0.5	9.1	1.6	15	3.7
51	A-051	<5	<4	<1	11	<5	<5	54	0.8	29	0.46	21	3.8	0.8	12	2.2	20	5.8
52	A-052	7	<4	<1	9	<5	<5	33	0.4	17	0.32	13	2.2	<0.5	7.7	1.4	13	1.7
53	A-053	<5	<4	<1	9	<5	<5	31	0.5	17	0.34	10	2.1	<0.5	7.1	1.5	13	1.7
54	A-054	<5	<4	<1	10	<5	<5	49	0.6	26	0.45	16	3.3	0.6	10	2.3	19	1.9
55	A-055	<5	<4	<1	10	<5	<5	45	0.5	25	0.45	20	3.3	0.7	10	2	18	2.3
56	A-056	7	<4	<1	12	<5	<5	68	0.8	36	0.5	26	4.5	<0.5	15	2.3	18	3.3
57	A-057	7	<4	1	9	<5	<5	48	0.6	25	0.5	17	3.2	0.6	11	2.2	19	2.2
58	A-058	<5	<4	<1	10	<5	<5	38	0.4	21	0.37	16	2.7	<0.5	9	1.5	14	2.4
59	A-059	<5	<4	<1	8	<5	<5	40	0.5	21	0.38	13	2.8	<0.5	8.5	1.6	15	2.1
60	A-060	<5	<4	<1	9	<5	<5	36	0.5	20	0.36	15	2.5	<0.5	8.6	2	14	2.3
61	A-061	7	<4	<1	9	<5	<5	42	0.5	24	0.46	15	3	0.6	11	2	19	2.8
62	A-062	<5	<4	<1	9	<5	<5	36	0.5	18	0.44	17	2.4	0.8	8.7	2.1	17	1.7
63	A-063	8	<4	<1	9	<5	<5	51	0.5	27	0.52	21	3.5	0.5	12	2.3	22	2.2
64	A-064	<5	<4	<1	7	<5	<5	30	0.4	15	0.29	11	1.9	<0.5	6.5	1.1	11	1.2
65	A-065	<5	<4	<1	10	<5	<5	48	0.5	26	0.43	21	3.2	<0.5	11	1.8	20	1.6
66	A-066	8	<4	<1	12	<5	0	100	0.8	57	0.68	38	6.7	<0.5	23	3.4	31	2.9
67	A-067	7	<4	<1	10	<5	<5	44	0.6	22	0.41	16	2.7	0.6	9.9	1.9	18	2.7
68	A-068	<5	<4	<1	8	<5	<5	37	0.4	20	0.37	14	2.5	<0.5	9	1.9	15	2.1
69	A-069	6	<4	<1	12	<5	<5	51	0.6	28	0.43	21	3.5	0.6	12	2	17	2.1
70	A-070	<5	<4	<1	8	<5	<5	30	0.4	16	0.32	13	2.1	<0.5	7.5	1.2	12	2.5
71	A-071	8	<4	<1	9	<5	<5	38	0.5	19	0.39	17	2.5	<0.5	7.6	1.6	16	2.3
72	A-072	<5	<4	<1	15	<5	<5	64	0.8	36	0.52	23	4.4	0.6	16	2.9	22	4.2
73	A-073	6	<4	<1	11	<5	<5	53	0.5	28	0.36	19	3.5	<0.5	11	1.7	16	4.2
74	A-074	<5	<4	2	9	<5	<5	64	0.7	34	0.46	23	4.3	0.8	14	2.3	21	4.3
75	A-075	29	5	5	33	<5	0	54	0.7	27	1.94	22	4.5	1.3	19	5.6	106	5.8
76	A-076	25	<4	5	30	<5	0	98	0.7	48	2.88	32	7.5	2	35	10	127	4.5
77	A-077	28	7	4	25	<5	7	180	1.2	98	2.47	69	13	2.3	71	14	117	6.9
78	A-078	21	5	3	17	<5	0	65	0.7	27	1.28	22	4.4	0.9	23	6.1	68	4
79	A-079	33	11	7	33	<5	0	43	0.8	15	3.07	9	4.7	2.2	40	13	150	4.9
80	A-080	31	11	11	45	6	0	64	0.8	19	5.77	12	6.2	3.2	51	23	221	4.9
81	A-081	28	8	8	34	<5	0	95	0.8	42	4.6	37	9.4	3.4	48	19	193	5
82	A-082	15	<4	2	16	<5	<5	34	0.4	15	0.93	10	2.5	0.7	11	4	40	2.3
83	A-083	23	<4	4	23	<5	0	110	0.7	47	1.56	36	7.1	1.5	34	6.7	69	5.7
84	A-084	1292	<4	33	44	<5	<5	27	0.5	14	0.25	10	2.2	0.6	7.9	2.2	15	4.6
85	A-085	48	<4	5	19	<5	<5	63	0.7	32	0.81	28	4.6	0.8	22	4	35	3.8
86	A-086	11	<4	1	9	<5	<5	28	0.5	13	0.34	9	1.9	<0.5	7.6	2	19	3.9
87	A-087	65	<4	6	29	<5	0	220	0.7	110	1.78	82	16	3.3	97	12	99	3.7
88	A-088	20	<4	3	17	6	0	94	0.7	48	0.8	37	6.9	1.1	37	5.2	42	5.6
89	A-089	32	<4	2	16	<5	<5	35	0.7	18	0.56	13	2.6	<0.5	9.2	2.3	22	3.7
90	A-090	74	<4	7	15	<5	0	40	0.6	19	0.68	12	2.9	0.6	12	4.6	30	4.1
91	A-091	52	8	5	17	<5	0	65	0.4	32	0.88	23	4.7	1	23	4.5	36	4
92	A-092	79	<4	8	30	<5	0	200	0.6	100	2.27	76	15	3.4	97	13	118	3.3
93	A-093	44	7	5	31	8	0	190	0.5	98	2.04	75	14	2.7	91	12	108	3.3
94	A-094	175	<4	6	26	<5	0	94	0.5	49	1.23	40	7.1	1.7	35	4.9	63	2.8
95	A-095	189	6	9	31	<5	0	220	0.8	120	2.24	75	17	2.9	94	14	123	3.5
96	A-096	15	<4	2	15	<5	0	95	0.8	41	0.72	29	5.3	<0.5	27	4.3	41	6.2
97	A-097	10	<4	<1	10	<5	<5	17	0.2	9	0.27	5	1.1	<0.5	6.2	1.2	8	1.5
98	A-098	10	<4	1	13	<5	<5	15	0.2	7	0.35	<5	0.9	<0.5	5	1.4	13	1.5
99	A-099	58	5	6	12	<5	<5	35	0.4	17	0.59	11	2.1	<0.5	11	3.2	18	2.4
100	A-100	46	<4	1	6	<5	<5	12	0.2	6	0.29	<5	0.7	<0.5	4.5	1.2	10	1.5
101	A-101	39	<4	2	14	<5	<5	29	0.4	14	0.24	11	1.6	<0.5	6.9	1.3	9	3.4
102	A-102	93	6	3	18	<5	0	47	0.7	24	0.44	17	2.8	<0.5	12	3	19	4.4
103	A-103	9	6	<1	12	<5	<5	55	0.9	28	0.46	24	3.4	0.7	12	2.4	21	6.7
104	A-104	6	5	1	10	<5	<5	50	0.7	26	0.38	19	3.1	<0.5	11	1.9	15	6.3
105	A-105	9	<4	<1	13	<5	<5	91	1.1	45	0.53	38	5.7	1.1	16	3	26	7
106	A-106	10	<4	<1	13	<5	<5	53	0.7	27	0.44	17	3.2	<0.5	12	2.1	18	6.5
107	A-107	<5	<4	<1	13	<5	<5	41	0.7	20	0.42	17	2.7	<0.5	10	1.7	18	5.2
108	A-108	<5	5	1	9	<5	<5	38	0.6	19	0.35	14	2.2	<0.5	8.9	1.8	14	4.9
109	A-109	<5	6	<1	10	<5	<5	45	0.6	24	0.35	16	2.8	<0.5	10	2.4	14	5.3
110	A-110	6	<4	<1	9	<5	<5	38	0.6	18	0.37	13	2.2	<0.5	8.9	2.3	15	5.5
111	A-111	141	5	4	13	<5	<5	24	0.4	12	0.61	5	1.5	0.5	7.7	3	21	1.7

	Element	SN	W	TA	NB	AU	MO	CE	EU	LA	LU	ND	SM	TB	TH	U	Y	SC
	Units	PPM	PPM	PPM	PPM	PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
112	A-112	36	<4	1	14	<5	<5	19	0.3	9	0.47	<5	1.1	0.5	6.3	2.2	17	2.1
113	A-113	13	<4	1	13	<5	<5	18	0.3	9	0.44	5	1.2	<0.5	5.4	2.2	21	1.8
114	A-114	17	<4	1	14	<5	<5	34	0.4	17	0.71	10	2.4	0.8	13	2.6	37	1.8
115	A-115	8	<4	<1	14	<5	<5	19	0.4	9	0.6	6	1.3	<0.5	7.2	2.6	22	1.9
116	A-116	16	4	3	26	<5	0	160	0.7	82	1.06	58	11	1.9	74	10	69	4.7
117	A-117	28	4	3	13	<5	<5	35	0.5	18	0.38	12	1.9	<0.5	8.4	2.6	14	2.9
118	A-118	126	6	2	15	<5	7	45	0.6	25	0.29	18	2.8	0.6	9.8	1.2	14	4.8
119	A-119	2486	11	44	101	<5	0	320	0.6	170	2.02	120	24	4.7	130	13	159	5.1
120	A-120	40	<4	1	12	<5	7	37	0.4	19	0.26	14	2.3	<0.5	9.3	1	12	2.2
121	A-121	6	<4	<1	12	<5	0	84	0.5	45	0.56	29	5.2	0.9	22	3.7	30	1.4
122	A-122	18	<4	3	28	<5	0	310	0.6	160	2.21	120	21	3.2	90	13	110	3.5
123	A-123	12	6	3	24	<5	0	170	0.6	91	1.05	66	12	1.4	50	7.1	62	3.6
124	A-124	34	10	4	30	<5	0	640	1.2	350	3.41	240	44	5.2	200	21	195	3.9
125	A-125	16	<4	1	9	<5	<5	22	0.3	13	0.21	11	1.7	<0.5	6.5	1.3	12	1.9
126	A-126	6	<4	<1	11	<5	<5	46	0.6	25	0.36	17	2.9	0.6	11	2.2	20	2.5
127	A-127	<5	<4	1	13	<5	<5	66	0.8	35	0.49	22	4.2	<0.5	15	2.3	25	4.3
128	A-128	254	24	10	27	<5	0	72	0.6	39	0.8	28	4.8	1.2	24	6.8	36	2.8
129	A-129	75	<4	<1	6	<5	<5	16	0.3	8	0.21	7	1.1	<0.5	4.8	1	10	1.6
130	A-130	56	8	3	12	<5	0	39	0.4	19	0.4	13	2.3	0.5	11	3	22	2.3
131	A-131	42	<4	<1	8	<5	<5	30	0.4	15	0.3	10	1.9	<0.5	7	1.3	14	2.7
132	A-132	13	<4	1	10	<6	<5	20	0.3	11	0.19	8	1.2	<0.5	5.5	1.2	7	1.6
133	A-133	100	7	4	15	7	0	57	0.5	29	0.58	19	3.6	0.6	19	5.9	23	2.3
134	A-134	127	19	7	28	<5	0	52	0.5	27	0.54	19	3.7	0.8	17	5.5	31	3.7
135	A-135	70	5	2	11	<5	<5	33	0.4	20	0.26	15	2.3	<0.5	9.3	1.8	9	2.7
136	A-136	90	16	9	30	<5	0	54	0.7	30	0.55	20	3.7	0.6	21	7.1	24	4.1
137	A-137	553	110	20	58	<5	0	150	0.9	78	2.3	55	11	3.1	48	17	130	6.5
138	A-138	<5	<4	<1	7	<5	<5	27	0.4	14	0.27	11	1.7	<0.5	6.9	1.4	12	1.3
139	A-139	<5	<4	<1	7	<5	<5	56	0.5	29	0.33	16	3.1	<0.5	12	1.8	18	1.8
140	A-140	<5	<4	1	10	<5	<5	78	0.7	40	0.5	26	4.5	0.6	20	2.6	24	1.8
141	A-141	<5	<4	<1	10	<5	<5	100	0.8	54	0.59	35	5.9	0.8	25	3.4	32	1.9
142	A-142	<5	<4	<1	10	<5	<5	58	0.6	29	0.38	21	3.5	0.7	13	2.7	20	2.7
143	A-143	<5	<4	<1	10	<5	0	120	1.1	65	0.7	46	6.9	0.9	27	4.4	32	2.3
144	A-144	<5	5	<1	10	<5	<5	160	1.1	82	0.72	58	8.6	1.2	38	3.9	37	2.3
145	A-145	8	<4	<1	7	<5	<5	38	0.5	20	0.3	17	2.4	<0.5	9.8	2.3	16	1.7
146	A-146	670	350	43	125	<5	0	150	0.7	73	2.45	56	12	3.6	56	19	143	5.7
147	A-147	1165	600	65	188	<5	0	160	0.5	83	2.95	55	14	3.4	71	27	162	6.9
148	A-148	1620	670	95	247	<5	0	270	<0.2	140	3.81	95	22	4.9	120	36	236	7.7
149	A-149	489	150	34	113	<5	0	97	0.4	46	1.71	41	7.7	2.5	46	19	102	5.4
150	A-150	751	220	42	118	<5	0	100	0.5	52	1.63	45	8.4	2.1	50	21	107	5.7
151	A-151	4897	520	180	380	<5	0	330	1.2	160	3.68	110	26	5.8	130	36	262	7.5
152	A-152	128	22	5	20	12	<5	25	0.4	13	0.36	11	1.8	<0.5	8.4	2.1	17	2.5
153	A-153	201	15	5	40	<5	0	550	1.3	310	4.5	230	42	6.2	180	21	265	3.7
154	A-154	26	<4	3	23	<5	6	190	<0.2	100	1.23	78	13	1.6	65	10	65	3
155	A-155	16	<4	<1	7	8	<5	54	<0.2	27	0.45	20	3.4	<0.5	17	3.9	15	1.8
156	A-156	9	4	2	18	<5	0	180	0.6	100	1.01	77	12	2	61	9.6	66	3.2
157	A-157	22	6	3	22	<5	0	230	0.8	120	1.17	85	16	2.1	73	11	69	3.3
158	A-158	22	<4	7	45	<5	0	540	0.9	290	4.32	210	38	5.4	170	24	221	6.6
159	A-159	27	14	6	30	<5	0	910	1.6	520	5.85	360	67	8.7	300	39	292	5.4
160	A-160	22	13	5	25	6	0	860	1.3	470	6.08	400	68	9.3	310	48	264	6.2
161	A-161	34	64	13	59	8	0	1300	1.9	700	6.09	580	96	12	450	49	289	7.6
162	A-162	17	<4	4	26	<5	0	330	0.8	170	1.62	110	23	2.7	120	19	69	4.4
163	A-163	42	16	9	39	<5	0	620	1.3	320	3.05	230	43	4.2	230	34	118	6.3
164	A-164	33	<4	2	10	<5	0	47	0.5	21	0.47	14	2.9	0.8	13	4	16	2.9
165	A-165	20	10	8	40	<5	0	480	1	240	2.55	210	35	4.4	160	18	127	5.3
166	A-166	20	<4	6	35	<5	0	370	0.7	190	2.47	170	27	2.6	93	14	105	4.7
167	A-167	<5	<4	1	7	<5	<5	37	0.4	19	0.31	16	2.6	<0.5	8.3	1.3	12	1.9
168	A-168	<5	<4	1	8	<5	5	36	0.6	19	0.33	15	2.7	<0.5	8.2	<0.5	14	2.8
169	A-169	<5	<4	2	10	<5	<5	66	0.8	32	0.43	22	4.5	<0.5	13	2.3	19	4
170	A-170	<5	<4	<1	9	<5	<5	42	0.6	21	0.32	13	2.9	<0.5	8.3	1.1	14	2.4
171	A-171	<5	<4	<1	10	<5	<5	52	0.7	27	0.38	22	3.8	<0.5	11	1.6	20	4.4
172	A-172	<5	<4	<1	10	<5	<5	53	0.6	26	0.44	19	3.5	<0.5	10	2.1	20	2.2
173	A-173	<5	<4	1	10	<5	<5	45	0.6	23	0.32	19	3	0.6	8.3	1.6	18	3.2
174	A-174	<5	<4	<1	10	<5	<5	33	0.5	15	0.4	14	2.2	<0.5	8.2	1.6	15	2.2
175	A-175	<5	<4	1	10	<5	<5	37	0.5	19	0.31	16	2.7	0.6	8.1	1.2	12	3.2
176	A-176	17	<4	<1	13	<5	<5	54	0.7	26	0.44	21	3.9	<0.5	11	1.3	26	5.2
177	A-177	16	<4	<1	12	<5	<5	49	0.7	24	0.35	14	3.5	<0.5	10	1.9	14	4.9
178	A-178	33	<4	4	18	<5	0	49	0.4	22	1.68	16	3.9	1.4	13	6.8	65	2
179	A-179	<5	<4	<1	16	<5	<5	14	0.4	6	0.36	<5	0.9	<0.5	4.2	1.3	19	2.4
180	A-180	<5	<4	<1	8	<5	<5	17	0.5	9	0.37	7	1.3	0.5	4.6	1.1	19	2.2
181	A-181	60	<4	5	<2	<5	0	110	0.6	48	2.43	37	8.4	1.8	31	10	97	3.3
182	A-182	53	5	2	17	<5	0	27	0.4	14	0.94	9	2.3	0.5	11	6.1	37	2.9
183	A-183	62	<4	7	32	<5	0	160	0.9	77	3.56	55	13	3	44	14	164	2.6
184	A-184	23	<4	10	48	<5	0	290	0.9	130	5.45	110	23	5.2	87	21	276	4.1
185	A-185	7	<4	6	37	<5	0	88	0.7	37	2.96	32	7.7	2	26	9	133	2.6
186	A-186	<5	10	4	27	<5	6	97	0.9	55	1.5	41	8.1	1.8	36	11	63	3.4
187	A-187	25	11	5	28	<5	0	110	1.1	50	2.82	36	8.9	2.1	33	13	134	3.9
188	A-188	<5	12	3	20	<5	0	67	0.6	31	1.42	21	5.1	1.1	23	7.3	73	2.4
189	A-189	<5	16	8	36	<5	0	140	0.4	61	3.82	52	11	3.5	45	18	174	4.4
190	A-190	31	12	7	44	<5	0	130	1.1	51	3.93	37	9.6	2.9	39	11	181	6
191	A-191	<5	21	8	35	<5	0	170	0.9	75	5.26	65	14	3.8	57	17	247	5.3
192	A-192	57	16	9	49	<5	0	260	1.4	120	6.08	77	21	5.7	84	22	244	5.2
193	A-193	12	17	7	28	<5	0	58	1	27	2.12	23	5.3	<0.5	34	22	68	5.6
194	A-194	107	19	10	37	<5	0	82	0.6	37	3.77	25	7.1	1.6	52	36	113	6
195	A-195	69	24	8	47	<5	0	100	0.6	45	3.94	35	8.4	2	56	38	106	6.4
196	A-196	56	5	6	34	<5	0	66	0.5	29	2.27	26	7.1	2.2	21	7.1	126	4.3
197	A-197	116	8	6	19	<5	0	69	0.6	33	0.83	31	5.9	<0.5	16	2.9	42	2
198	A-198	<5	4	<1	14	<5	<5	34	0.6	20	0.33	15	2.4	<0.5	9.7	2.1	15	2
199	A-199	48	<4	1	6	<5	<5	35	0.4	18	0.27	14	2.5	<0.5	7.1	0.6	14	1.2
200	A-200	29	<4	<1	9	<5	<5	18	0.3	9	0.26	6	1.2	<0.5	3.7	0.8	6	1
201	A-201	<5	4	1	9	<5	<5	31	0.4	15	0.33	12	2.1	<0.5	6.9	1.1	15	1.6
202	A-202	<5	6	1	12	<5	<5	66	0.6	27	0.41	20	3.6	<0.5	9.2	2.1	24	1.9
203	A-203	405	73	22	52	<5	5	130	1.1	67	1.12	53	11	1.4	31	5.8	52	2.5
204	A-204	35	6	1	10	<5	<5	52	0.7	27	0.35	22	3.7	<0.5	9.9	2.1	19	2.7
205	A-205	<5	<4	<1	8	<5	<5	79	0.7	43	0.47	28	5.1	<0.5	17	2.5	24	1.4
206	A-206	51	25	3	13	<5	<5	90	0.7	47	0.63	34	6	<0.5	19	2.8	30	1.5
207	A-207	<5	<4	<1	7	<5	<5	33	0.5	16	0.29	11	2.3	<0.5	6.5	1.4	14	2.2
208	A-208	<5	<4	<1	7	<5	<5	31	0.4	16	0.35	10	2.2	0.6	6.7	1.6	15	1.5
209	A-209	<5	<4	<1	10	<5	<5	55	0.8	32	0.32	18	3.8	0.8	7	0.8	18	2.1
210	A-210	46	<4	<1	3	<5	<5	26	0.4	13	0.27	10	1.7	<0.5	5.5	1	10	1.2
211	A-211	213	<4	<1	17	<5	<5	40	0.5	19	0.31	14	2.8	<0.5	7	1.8	27	3.2
212	A-212	45	<4	1	12	<5	<5	59	0.9	29	0.45	23	4.2	<0.5	11	1.9	24	4.7
213	A-213	56	<4	<1	14	<5	<5	64	1	32	0.38	25	4.4	<0.5	11	2.2	22	6.4
214	A-214	18	<4	<1	11	<5	<5	61	0.8	31	0.53	27	4.5	<0.5	10	1.6	26	5.5
215	A-015	38	<4	<1	11	<5	<5	30	0.4	16	0.36	8	2.4	<0.5	7.3	0.9	16	1.9
216	A-216	57	<4	<1	12	<5	<5	30	0.5	15	0.32	11	2.1	<0.5	6.2	1.5	16	2.4
217	A-217	32	<4	<1	10	<5	<5	32	0.6	15	0.41	9	2	<0.5	5.5	1.9	14	2.9
218	A-218	378	<4	<1	12	<5	<5	47	0.7	23	0.31	25	3	<0.5	9.1	2.5	13	4.7
219	A-219	460	<4	<1	13	7	<5	43	0.7	23	0.33	16	3	<0.5	8.1	2	16	4.5
220	A-220	127	<4	<1	10	<5	5	170	0.5	82	1.13	55	11	<0.5	31	6.4	13	18
221	A-221	11	<4	5	14	<5	0	85	1.5	47	0.85	51	6.3	<0.5	15	4.2	16	10
222	A-222	35	<4	<1	9	<5	<5	40	0.7	19	0.42	11	2.8	<0.5	8.9	1.5	13	4.1
223	A-223	16	<4	1	13	<5	<5	25	0.4	12	0.39	10	1.9	<0.5	5.1	1.9	16	3.1
224	A-224	25	<4	<1	11	<5	<5	46	0.7	22	0.41	16	3.2	<0.5	10	2.8	13	5.7

Appendix 8 Chemical analysis data of stream sediments

	Element	SN	W	TA	NB	AU	MO	CS	EU	LA	LU	ND	SM	TB	TH	U	Y	SC
	Units	PPM	PPM	PPM	PPM	PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
225	A-225	35	<4	2	38	<5	<5	27	0.4	13	0.4	10	1.9	<0.5	6	2.3	158	3.2
226	A-226	22	<4	8	13	<5	0	77	0.5	30	4.32	27	9.9	3.4	19	13	33	9.9
227	A-227	138	9	4	10	<5	<5	24	0.4	11	1.02	8	2.1	0.6	5.8	3.2	11	3.1
228	A-228	13	<4	<1	6	<5	<5	32	0.5	16	0.26	12	2.4	<0.5	6.1	2	4	4.1
229	A-229	6	<4	<1	14	<5	<5	15	0.3	8	0.1	6	1	<0.5	3.3	0.9	19	1.8
230	A-230	<5	<4	<1	11	<5	<5	22	0.3	11	0.18	10	1.5	<0.5	4.3	1.1	15	2.5
231	A-231	<5	<4	<1	11	<5	<5	47	0.6	21	0.36	16	3	<0.5	8.3	2.4	11	3.9
232	A-232	6	<4	<1	8	<5	<5	36	0.4	19	0.29	19	2.6	<0.5	7.7	1.3	13	3.5
233	A-233	8	<4	<1	10	<5	<5	37	0.5	17	0.23	16	2.4	<0.5	6.5	0.8	15	2.2
234	A-234	<5	<4	<1	9	<5	<5	49	0.7	26	0.44	16	3.8	<0.5	14	1.7	9	5
235	A-235	6	<4	<1	11	<5	<5	27	0.4	14	0.21	10	1.9	<0.5	4.8	1	16	2
236	A-236	6	<4	<1	9	<5	<5	40	0.5	20	0.35	13	2.7	<0.5	8.7	1.6	18	2.7
237	A-237	8	<4	1	9	<5	<5	56	0.7	28	0.42	19	3.9	<0.5	12	2.2	15	2.5
238	A-238	8	<4	<1	12	<5	<5	41	0.6	20	0.37	11	2.9	<0.5	10	1.6	20	1.8
239	A-239	21	<4	<1	15	<5	<5	68	0.6	33	0.43	23	4.4	<0.5	12	2.2	23	6
240	A-240	33	<4	<1	13	<5	<5	74	0.9	36	0.4	22	5.1	<0.5	17	1.9	22	8.5
241	A-241	9	<4	<1	12	<5	<5	73	0.7	38	0.58	28	4.9	<0.5	17	2.3	17	1.6
242	A-242	<5	<4	<1	8	<5	<5	56	0.6	28	0.38	20	3.6	<0.5	12	2.1	13	1.5
243	A-243	11	<4	<1	11	<5	<5	34	0.4	18	0.32	12	2.4	<0.5	8.1	1.1	18	1.2
244	A-244	8	<4	<1	11	<5	0	59	0.6	30	0.48	21	3.9	<0.5	15	3.4	20	2.2
245	A-245	7	<4	<1	8	<5	<5	76	0.7	39	0.48	27	4.9	<0.5	16	2.9	13	2.2
246	A-246	<5	<4	<1	9	<5	<5	40	0.7	19	0.35	15	2.6	<0.5	7.7	1.4	10	1.6
247	A-247	<5	<4	<1	8	<5	<5	23	0.3	11	0.25	<5	1.5	<0.5	5.2	1.8	12	1.2
248	A-248	8	<4	<1	9	<5	<5	34	0.3	17	0.28	15	2.3	<0.5	6.7	1.1	15	1.2
249	A-249	<5	<4	<1	10	<5	<5	28	0.5	13	0.31	12	2	<0.5	5.2	1.2	15	1.3
250	A-250	<5	<4	<1	13	<5	<5	41	<0.2	20	0.42	15	2.8	<0.5	9.6	1.6	20	2.3
251	A-251	<5	<4	<1	13	<5	<5	51	0.7	26	0.48	21	3.5	<0.5	11	2.4	16	3.1
252	A-252	<5	<4	<1	9	<5	<5	42	0.6	20	0.39	16	2.8	<0.5	9.6	2	15	1.9
253	A-253	<5	<4	<1	10	<5	<5	32	0.5	17	0.34	14	2.3	0.7	7.9	0.9	15	2.2
254	A-254	<5	<4	<1	6	<5	<5	23	0.4	11	0.3	12	1.5	<0.5	4.8	1	10	1.2
255	A-255	<5	<4	<1	6	<5	<5	24	<0.2	12	0.29	7	1.4	<0.5	5.6	0.9	11	1.6
256	A-256	<5	5	<1	9	<5	<5	53	0.5	30	0.5	26	3.1	0.6	14	2.6	21	1.7
257	A-257	<5	6	1	13	<5	<5	62	0.5	34	0.53	22	3.5	0.8	18	3.1	24	2.2
258	A-258	<5	5	<1	13	<5	<5	48	0.6	25	0.41	21	2.7	0.5	13	2.5	19	3.3
259	A-259	<5	<4	<1	9	<5	<5	20	0.3	12	0.26	10	1.3	<0.5	5.7	1.7	11	1.5
260	A-260	<5	<4	<1	10	<5	<5	31	0.3	16	0.4	9	1.8	<0.5	8.6	1.8	13	1.4
261	A-261	<5	<4	<1	9	<5	<5	30	0.4	16	0.34	13	1.8	<0.5	8.5	1.9	15	2
262	A-262	<5	4	<1	13	18	<5	31	0.6	17	0.43	19	1.8	<0.5	8.5	2.3	17	2.1
263	A-263	<5	<4	<1	12	<5	<5	42	0.4	23	0.43	15	2.5	<0.5	11	1.9	14	1.7
264	A-264	<5	<4	<1	10	<5	<5	35	0.5	19	0.43	13	2	0.6	8.9	2.3	20	2.3
265	A-265	<5	7	1	12	<5	<5	63	0.7	30	0.48	20	3.2	0.7	14	2.2	19	6.2
266	A-266	<5	<4	<1	7	<5	<5	11	<0.2	5	0.25	<5	0.6	<0.5	3.3	1.2	4	0.9
267	A-267	<5	<4	<1	4	<5	<5	9	0.2	4	0.15	<5	0.5	<0.5	2.8	0.7	3	1.1
268	A-268	<5	<4	<1	12	<5	<5	32	0.5	17	0.37	14	•-2	<0.5	11	2	12	3.6
269	A-269	<5	<4	<1	11	<5	<5	31	0.5	17	0.4	12	2.1	0.6	6.5	<0.5	16	2.5
270	A-270	<5	<4	1	14	<5	<5	53	0.6	28	0.38	24	3.1	0.6	11	1.2	16	4.2
271	A-271	110	<4	<1	10	<5	<5	42	0.5	22	0.34	17	2.4	<0.5	8.3	1.3	14	3.3
272	A-272	22	<4	<1	10	<5	<5	38	0.5	20	0.37	17	2.2	<0.5	7.3	1.4	14	1.9
273	A-273	331	7	<1	13	<5	<5	39	0.5	21	0.37	13	2.3	<0.5	8	1.4	18	3.2
274	A-274	<5	<4	1	10	<5	<5	46	0.6	27	0.42	23	2.9	<0.5	10	1.4	15	3.8
275	A-275	<5	<4	<1	9	<5	<5	43	0.5	24	0.43	19	2.6	0.5	8.9	2.2	17	2.6
276	A-276	<5	<4	<1	11	<5	<5	46	0.6	25	0.4	15	2.8	0.6	11	1.4	17	3.7
277	A-277	<5	<4	<1	9	<5	<5	42	0.6	23	0.34	17	2.5	<0.5	8.5	1.7	15	3.4
278	A-278	123	<4	5	14	<5	5	14	<0.2	8	0.2	6	0.9	<0.5	10	3.2	5	4.8
279	A-279	51	7	6	21	<5	0	70	0.4	35	0.99	30	4.7	0.9	20	6.4	45	2.9
280	A-280	144	14	11	34	<5	0	140	0.7	70	1.65	60	9.1	1.6	42	12	72	4.6
281	A-281	87	14	7	29	<5	0	110	0.6	58	1.47	55	7.4	1.5	36	9.8	68	3.8
282	A-282	73	7	5	24	<5	0	74	0.4	38	0.69	31	4.9	0.9	24	6.5	36	3.2
283	A-283	216	15	14	58	6	0	790	1.1	430	5.79	330	51	9.4	320	28	288	5.3
284	A-284	94	9	7	40	<5	0	320	0.5	170	2.02	140	21	3.6	130	12	120	2.7
285	A-285	26	7	3	25	<5	0	77	0.6	42	0.68	30	5.1	0.8	25	11	30	5.9
286	A-286	39	10	5	26	<5	0	100	0.6	55	1.32	39	7.8	1.8	39	11	62	4.3
287	A-287	39	23	12	58	<5	0	210	1.1	110	6.98	74	18	7.4	74	24	338	8.5
288	A-288	37	14	5	33	<5	0	120	1.1	69	2.33	48	10	2.7	46	16	123	7.5
289	A-289	33	18	6	34	<5	0	160	1.2	89	2.94	60	13	3.5	58	17	149	8.6
290	A-290	<5	<4	<1	10	<5	<5	26	0.5	14	0.33	13	1.7	<0.5	9	2	14	1.5
291	A-291	<5	<4	<1	8	<5	<5	29	0.6	17	0.39	14	2.2	<0.5	11	2.2	16	2.5
292	A-292	<5	<4	<1	8	<5	<5	18	0.4	10	0.29	8	1.2	<0.5	7.7	2.8	11	1.9
293	A-293	<5	<4	<1	9	<5	<5	29	0.4	16	0.31	13	1.9	<0.5	10	2.1	13	2.6
294	A-294	<5	<4	<1	10	<5	<5	39	0.6	20	0.39	13	2.7	<0.5	12	2.5	17	3.2
295	A-295	<5	<4	<1	11	<5	<5	30	0.5	16	0.36	10	2.1	0.6	11	2.4	15	2
296	A-296	<5	<4	<1	10	<5	<5	24	0.4	13	0.25	10	1.8	<0.5	7.5	1.4	10	2
297	A-297	<5	<4	<1	11	<5	<5	33	0.5	18	0.33	16	2.4	<0.5	11	2.2	13	2.4
298	A-298	<5	<4	<1	10	<5	<5	34	0.5	18	0.35	10	2.4	<0.5	11	2.4	15	2.4
299	A-299	<5	<4	1	12	<5	0	34	0.6	20	0.42	15	2.5	0.6	12	3.6	17	2.8
300	A-300	<5	<4	2	14	<5	<5	50	0.7	25	0.46	22	3.3	<0.5	15	2.6	23	3.4
301	A-301	<5	<4	1	12	<5	<5	55	0.7	26	0.4	24	3.6	<0.5	17	2.2	19	7.5
302	A-302	<5	<4	<1	10	<5	<5	41	0.7	23	0.4	20	2.8	0.6	13	2.3	16	3.4
303	B-001	88	22	8	29	<5	0	250	1.4	140	3.21	120	21	4.6	120	23	167	5.6
304	B-002	16	<4	1	13	<5	<5	55	0.8	30	0.39	24	3.7	0.6	16	2.5	17	4.4
305	B-003	234	24	13	38	<5	0	390	1.1	220	4.06	150	35	7.1	210	39	245	3.9
306	B-004	<5	4	2	12	<5	0	63	0.7	35	0.74	27	4.9	1.1	25	4.6	35	3.5
307	B-005	20	7	2	19	<5	0	64	0.8	37	0.8	23	4.5	<0.5	22	5.2	37	3.3
308	B-006	37	8	4	30	<5	0	150	1	82	1.63	62	13	3	72	13	103	3.2
309	B-007	19	6	2	17	<5	<5	61	0.8	35	0.53	20	3.9	0.8	17	2.5	28	4.8
310	B-008	11	<4	4	22	<5	0	120	0.8	64	1.77	48	10	2.6	58	14	94	3.6
311	B-009	<5	5	4	23	<5	0	110	0.8	59	1.79	45	9.5	2.4	55	14	94	3.3
312	B-010	19	<4	4	23	<5	0	150	1	82	2.03	56	13	2.9	76	15	107	3.4
313	B-011	90	14	11	40	<5	0	340	1.3	190	4.29	160	31	6.9	160	35	235	4.3
314	B-012	44	16	11	50	<5	0	280	1.6	150	4.86	120	24	6.5	160	34	248	5.1
315	B-013	52	11	7	27	<5	0	200	1.4	100	2.91	84	17	4.1	100	22	140	4.4
316	B-014	13	<4	4	20	<5	0	89	0.6	46	1.1	39	7.2	1.7	41	11	61	3.2
317	B-015	18	8	4	24	<5	0	140	0.8	72	1.47	68	11	2.4	66	12	80	3.4
318	B-016	<5	<4	<1	7	<5	<5	23	0.3	13	0.28	9	1.4	<0.5	6.4	1.3	9	1.1
319	B-017	<5	<4	<1	10	<5	<5	23	0.3	13	0.36	11	1.5	<0.5	6.5	1.5	10	1.2
320	B-018	<5	<4	<1	10	<5	<5	21	0.4	11	0.28	<5	1.3	<0.5	6.1	1.2	11	1.4
321	B-019	<5	<4	<1	7	<5	<5	32	0.3	17	0.35	14	1.9	<0.5	8.4	1.6	13	1.1
322	B-020	<5	<4	2	9	<5	<5	47	0.5	24	0.42	26	2.7	0.6	12	2.2	16	3.2
323	B-021	<5	<4	<1	13	<5	5	63	0.5	34	0.66	27	3.7	0.8	16	2.9	24	2.2
324	B-022	<5	<4	<1	12	<5	<5	53	0.5	29	0.48	20	2.9	0.7	13	2.5	20	2.3
325	B-023	<5	<4	1	13	<5	<5	54	0.6	31	0.4	22	3.1	<0.5	14	2.7	21	2
326	B-024	9	<4	1	14	<5	<5	54	0.6	30	0.5	20	3.3	0.7	15	2.5	22	3.4
327	B-025	9	<4	1	13	<5	0	63	0.7	34	0.56	23	3.7	0.6	17	3.2	21	3.1
328	B-026	<5	<4	<1	9	<5	<5	41	0.5	21	0.31	13	2.5	<0.5	9.3	1.9	15	2.7
329	B-027	<5	<4	<1	11	<5	<5	38	0.4	18	0.33	18	2.1	<0.5	8.2	1.7	15	2.3
330	B-028	<5	<4	<1	12	<5	<5	42	0.5	22	0.38	21	2.5	<0.5	8.9	1.9	16	2.9
331	B-029	<5	<4	<1	12	<5	<5	46	0.6	26	0.42	24	2.9	0.6	12	1.8	18	4.1
332	B-030	<5	<4	<1	13	10	<5	52	0.6	29	0.39	20	3.1	0.7	11	1.2	22	4.6
333	B-031	<5	<4	<1	10	<5	<5	63	0.6	32	0.87	30	4.2	0.7	19	3	35	2.1
334	B-032	<5	<4	<1	9	<5	<5	34	0.4	16	0.41	18	2	<0.5	8.1	1.3	15	2.1
335	B-033	<5	<4	<1	6	<5	<5	22	0.4	13	0.29	6	1.4	<0.5	5.8	1.2	7	2.6
336	B-034	<5	<4	<1	7	<5	<5	23	0.2	12	0.22	11	1.4	<0.5	6.8	1.2	9	2.1
337	B-035	<5	<4	1	10	<5	<5	26	0.4	14	0.28	12	1.6	<0.5	6.5	1.9	14	2.1

	Element	SN	W	TA	NB	AU	MO	CE	EU	LA	LU	ND	SM	TB	TH	U	Y	SC
	Units	PPM	PPM	PPM	PPM	PPB	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
338	B-036	<5	<4	<1	7	<5	<5	27	0.4	15	0.24	11	1.7	<0.5	6.1	1.1	9	2.7
339	B-037	<5	<4	<1	10	<5	<5	33	0.5	18	0.34	16	2.1	<0.5	8.3	1.9	13	2.6
340	B-038	<5	<4	<1	11	<5	<5	41	0.6	22	0.31	24	2.6	<0.5	8.5	1.4	15	3.7
341	B-039	<5	<4	<1	10	<5	<5	30	0.4	16	0.28	13	1.9	<0.5	7.5	0.6	14	2.5
342	B-040	<5	<4	1	12	<5	<5	62	0.7	33	0.42	28	3.6	0.6	14	2.1	20	2.7
343	B-041	<5	<4	<1	12	<5	<5	56	0.7	30	0.4	23	3.3	<0.5	12	1.8	24	4.2
344	B-042	<5	<4	1	12	<5	<5	52	0.6	28	0.42	21	3.1	<0.5	11	1.8	18	3.6
345	B-043	<5	<4	1	14	<5	<5	78	1.1	41	0.51	30	4.7	0.7	17	2.8	24	6.5
346	B-044	<5	<4	<1	13	<5	<5	65	0.8	36	0.47	26	4	0.6	13	1.6	22	5.3
347	B-045	<5	<4	<1	12	<5	<5	59	0.7	31	0.45	26	3.6	<0.5	13	2	20	5.1
348	B-046	<5	<4	<1	14	<5	<5	69	0.8	35	0.46	30	3.9	<0.5	13	1.7	23	5.3
349	B-047	<5	<4	<1	14	<5	<5	81	0.8	42	0.49	33	4.6	<0.5	15	2.2	24	5.6
350	B-048	<5	<4	1	13	<5	<5	63	0.9	35	0.44	26	4.2	0.8	15	2.1	21	5.3
351	B-049	<5	<4	<1	13	<5	<5	63	1.1	35	0.4	22	4	0.8	13	2.2	20	6.4
352	B-050	6	<4	<1	14	<5	<5	58	1	33	0.39	21	3.9	0.8	13	1.4	21	6.6
353	B-051	<5	<4	<1	10	<5	<5	40	0.7	23	0.34	19	2.8	<0.5	10	2.4	16	2.8
354	B-052	<5	4	<1	8	<5	<5	21	0.3	13	0.21	11	1.5	<0.5	6.4	1.4	9	1.7
355	B-053	5	5	<1	10	<5	<5	44	0.6	24	0.37	18	3	<0.5	12	2.7	19	2.1
356	B-054	<5	<4	<1	9	<5	<5	32	0.5	19	0.33	17	2.3	<0.5	9.1	1.9	15	2
357	B-055	<5	<4	<1	10	<5	<5	43	0.7	25	0.36	16	2.9	<0.5	11	2.5	18	3.3
358	B-056	<5	<4	<1	10	<5	<5	38	0.5	21	0.34	15	2.4	<0.5	9.7	2.4	15	2.6
359	B-057	<5	<4	<1	9	<5	<5	23	0.4	14	0.24	8	1.6	<0.5	6.6	1.4	11	2
360	B-058	<5	<4	<1	8	<5	<5	33	0.6	20	0.31	15	2.4	<0.5	8.9	1.2	16	2.3
361	B-059	<5	<4	<1	9	<5	<5	42	0.7	26	0.37	21	3.1	<0.5	12	2.6	19	3
362	B-060	<5	<4	<1	11	<5	<5	51	0.8	27	0.38	19	3.2	<0.5	13	2.9	19	4
363	B-061	<5	<4	<1	14	<5	<5	64	1	33	0.45	25	4.3	<0.5	16	2.1	25	7.1
364	B-062	<5	<4	<1	10	<5	<5	43	0.7	23	0.38	19	2.8	0.6	11	2.1	17	3.2
365	B-063	757	17	22	73	<5	0	220	1.7	120	4.71	87	16	3.5	66	31	178	4.8
366	B-064	104	<4	7	30	<5	<5	65	0.6	33	1.58	25	4.6	1.1	19	8.8	52	2.9
367	B-065	33	5	4	24	6	0	44	0.7	24	1.15	20	3.3	0.8	12	7	44	2.5
368	B-066	75	5	2	17	<5	0	37	0.6	20	0.79	14	2.5	0.6	10	5	27	2.4
369	B-067	39	<4	3	20	<5	0	39	0.5	20	0.88	14	2.7	0.7	10	5.7	32	2.4
370	B-068	9	<4	2	15	<5	<5	26	0.5	15	0.6	11	2	<0.5	8	4	23	2.3
371	B-069	18	<4	4	23	<5	0	40	0.6	21	1.08	15	3	0.8	12	7.5	39	2.9
372	B-070	28	6	4	20	<5	0	42	0.6	22	1.01	17	3.1	0.7	12	6.8	35	3
373	B-071	<5	<4	1	17	5	0	33	0.5	18	0.52	13	2.3	<0.5	9.6	4.2	18	3.4
374	B-072	22	6	3	18	<5	0	34	0.5	18	0.82	13	2.4	<0.5	10	5.1	30	2.6
375	B-073	<5	4	2	16	<5	0	27	0.5	14	0.74	11	2	<0.5	8	5.3	25	2.6
376	B-074	11	6	3	18	<5	0	37	0.7	19	0.95	13	2.7	1	11	6.9	29	2.7
377	B-075	<5	<4	2	16	<5	<5	25	0.4	13	0.61	5	1.8	<0.5	7.4	3.8	23	2.4
378	B-076	66	<4	4	22	<5	0	39	0.5	20	0.99	8	2.7	0.8	11	7.4	36	2.8
379	B-077	39	5	4	20	<5	0	36	0.6	19	1.03	16	2.8	0.8	12	7.7	37	2.6
380	B-078	<5	<4	3	16	5	0	26	0.5	14	0.72	12	1.9	<0.5	8	5.5	24	2.5
381	B-079	38	<4	3	19	<5	0	31	0.5	18	0.89	12	2.4	0.6	10	5.7	32	2.7
382	B-080	<5	<4	<1	11	<5	<5	36	0.5	20	0.31	17	2.2	<0.5	8.5	1.3	13	2.4
383	B-081	<5	<4	2	15	<5	0	24	0.3	12	0.54	9	1.5	0.5	6.2	3.6	23	2.3
384	B-082	9	<4	3	20	<5	<5	26	0.4	15	0.76	13	2	0.6	7.7	3.6	30	2.5
385	B-083	17	5	5	26	<5	0	45	0.6	22	1.21	18	2.9	0.9	11	6.5	46	2.9
386	B-084	24	4	3	22	<5	0	34	0.5	18	0.93	13	2.3	0.6	8.9	6.2	40	2.5
387	B-085	<5	<4	<1	10	<5	<5	45	0.5	25	0.32	19	2.8	<0.5	8.7	1.3	20	4.4
388	B-086	<5	<4	<1	12	<5	<5	46	0.7	26	0.29	16	2.9	<0.5	9	1.4	19	4.5
389	B-087	<5	<4	<1	11	<5	<5	47	0.5	26	0.28	18	2.8	<0.5	9.4	1.4	18	4.3
390	B-088	<5	<4	1	15	<5	<5	94	1.1	53	0.5	34	5.7	0.9	20	2.2	13	6.1
391	B-089	<5	<4	1	11	<5	<5	63	0.6	27	0.35	21	3	0.7	12	1.7	21	4
392	B-090	<5	<4	<1	13	<5	<5	75	0.8	42	0.44	26	4.6	0.9	15	2.1	27	6.2
393	B-091	<5	<4	<1	10	<5	<5	31	0.5	17	0.33	11	2	<0.5	7.6	1.8	18	2.1
394	B-092	<5	<4	<1	12	<5	<5	54	0.6	30	0.33	16	3.3	<0.5	10	2	22	5.4
395	B-093	<5	<4	<1	11	<5	<5	58	0.7	33	0.44	25	3.8	0.7	15	1.9	24	4.1
396	B-094	<5	<4	<1	14	<5	<5	64	0.8	34	0.44	26	3.8	0.5	15	1.9	29	5.4
397	B-095	<5	<4	<1	13	5	<5	59	0.7	32	0.42	21	3.5	0.6	13	2.2	25	5.2
398	B-096	<5	<4	<1	12	14	<5	54	0.7	27	0.35	18	3.1	0.5	11	2.1	19	4.4
399	B-097	<5	<4	<1	14	<5	<5	61	0.8	33	0.35	24	3.7	0.6	13	2.2	26	6
400	B-098	<5	<4	<1	13	<5	<5	63	0.9	36	0.37	23	4.1	<0.5	13	2	24	6.4
401	B-099	<5	<4	<1	13	<5	<5	65	0.8	36	0.41	26	4.2	0.8	13	2	24	6.7
402	B-100	<5	<4	<1	13	<5	<5	57	0.7	31	0.38	19	3.5	0.8	12	1.7	22	5.3
403	B-101	<5	<4	<1	13	<5	<5	65	0.8	35	0.34	23	4	<0.5	12	1.3	22	6.5
404	B-102	<5	<4	<1	12	<5	<5	62	0.8	33	0.35	24	3.9	0.5	12	1.4	24	6.3
405	B-103	<5	<4	1	14	<5	<5	63	0.7	33	0.4	23	3.9	0.6	13	1.4	23	7
406	B-104	<5	<4	1	11	<5	<5	93	0.7	49	0.86	33	6.1	1	26	4.3	46	2.5
407	B-105	<5	<4	<1	14	<5	0	71	0.5	37	0.95	28	4.9	0.9	21	3.8	52	2.3
408	B-106	8	6	2	22	<5	0	320	1.4	160	3.07	120	21	4	92	11	179	3.3
409	B-107	<5	<4	2	14	<5	0	56	0.4	29	0.95	20	3.8	0.9	19	5.1	46	1.5
410	B-108	<5	<4	2	16	<5	0	100	0.6	53	1.09	37	6.5	1.3	27	5.2	58	2.1
411	B-109	<5	<4	1	14	<5	0	110	0.7	59	1.19	42	7.5	1.3	32	5.3	66	2.4
412	B-110	<5	7	2	17	<5	0	130	0.7	73	1.54	48	9.4	2	41	6	92	2.6
413	B-111	<5	<4	2	16	9	0	150	0.8	83	1.3	53	11	1.7	44	5.3	87	2.6
414	B-112	<5	<4	<1	12	<5	<5	44	0.5	24	0.61	15	3.3	0.7	12	2.2	34	2.2
415	B-113	<5	<4	3	21	6	0	230	1	130	2.2	78	17	3.7	66	8.7	136	3.1
416	B-114	<5	<4	3	21	<5	0	120	0.8	65	1.4	41	9.2	2.2	32	6.7	83	3.5
417	B-115	<5	<4	2	22	<5	0	90	1	50	0.15	30	6	<0.5	22	3.1	31	7.5
418	B-116	<5	<4	<1	13	<5	<5	63	0.8	32	0.35	20	3.9	<0.5	13	1.9	19	5.3
419	B-117	<5	<4	1	21	<5	<5	64	0.8	36	0.4	22	4.2	<0.5	17	2.6	27	5.2
420	B-118	<5	<4	<1	14	<5	0	43	0.5	22	0.47	13	2.8	<0.5	13	3.8	25	3.4
421	B-119	<5	<4	<1	9	<5	<5	48	0.6	24	0.22	19	3.2	<0.5	10	0.7	15	3.6
422	B-120	37	7	2	23	<5	<5	75	1	40	0.5	29	4.7	1.1	18	2.8	32	4.5
423	B-121	<5	<4	1	15	<5	<5	30	<0.2	17	0.25	9	1.9	<0.5	9.4	1.8	14	3.1
424	B-122	<5	<4	1	9	<5	<5	49	0.6	26	0.29	21	3.4	0.5	11	1	19	3.5
425	B-123	<5	<4	<1	7	<5	<5	27	0.3	15	0.21	10	1.8	0.6	5.9	1.3	14	2.2
426	B-124	14	7	1	19	<5	<5	49	0.7	29	0.36	13	3.1	<0.5	19	4.2	21	5.6
427	B-125	<5	<4	<1	11	<5	<5	56	0.6	27	0.29	17	3.4	0.6	11	1.9	18	4.2
428	B-126	<5	<4	<1	15	<5	0	35	0.5	21	0.29	11	2.4	<0.5	15	3.8	16	2.5
429	B-127	<5	<4	1	13	<5	<5	38	0.6	21	0.32	10	2.4	<0.5	15	4	17	3.2
430	B-128	<5	<4	1	14	<5	<5	25	0.3	11	0.29	8	1.4	<0.5	7.5	2	12	2.2
431	B-129	<5	<4	<1	18	<5	<5	35	0.5	20	0.3	13	2.4	<0.5	17	4.5	19	3.4
432	B-130	<5	<4	<1	13	<5	<5	59	0.8	31	0.31	27	4.1	<0.5	14	1.1	20	5.9
433	B-131	<5	<4	<1	15	<5	0	59	0.7	31	0.35	22	3.7	<0.5	14	2.9	21	3.6
434	B-132	<5	<4	<1	12	<5	<5	39	0.4	21	0.26	12	2.4	<0.5	9.2	2.1	16	2.9
435	B-133	6	<4	<1	12	<5	<5	66	0.9	35	0.35	20	4.4	<0.5	14	2	24	6.1
436	B-134	<5	<4	1	13	<5	<5	61	0.8	34	0.35	20	4.1	<0.5	15	2.7	23	5.3
437	B-135	22	<4	2	17	<5	<5	91	<0.2	49	0.83	30	6.4	<0.5	26	4.9	50	4.7
438	B-136	<5	<4	<1	8	<5	<5	23	0.3	12	0.13	9	1.4	<0.5	5.1	1.2	10	1.3
439	B-137	<5	<4	<1	8	<5	<5	37	0.4	19	0.26	14	2.2	<0.5	8.8	1.7	16	3.5
440	B-138	10	<4	1	12	<5	<5	57	0.6	33	0.16	23	3.7	<0.5	14	2.2	22	2.3
441	B-139	<5	<4	<1	10	<5	<5	35	0.6	19	0.27	12	2.5	0.7	8.2	1.7	17	2.2
442	B-140	<5	<4	<1	9	<5	<5	39	0.6	22	0.18	12	2.8	<0.5	9.1	1.3	13	3.1
443	B-141	<5	<4	<1	9	<5	<5	39	0.5	22	0.26	14	2.6	<0.5	8.8	1.6	18	1.9
444	B-142	<5	<4	<1	10	<5	<5	36	0.5	20	0.22	15	2.5	<0.5	7.9	1.2	16	3.7
445	B-143	<5	<4	<1	9	<5	<5	43	0.5	21	0.45	18	2.4	<0.5	11	2.3	18	2.6
446	B-144	<5	<4	<1	12	<5	<5	42	0.6	24	0.47	19	2.6	<0.5	9.7	2.5	17	3.7
447	B-145	<5	<4	<1	14	<5	<5	43	0.6	24	0.45	19	2.6	<0.5	9.8	1.9	19	3.5
448	B-146	42	15	6	24	<5	0	47	0.3	24	0.46	19	3	<0.5	18	5.1	22	2.7
449	B-147	<5	<4	<1	8	<5	<5	22	0.3	11	0.23	10	1.3	<0.5	5.8	1.3	11	1.8
450	B-148	<5	<4	<1	11	<5	<5	28	0.3	14	0.31	12	1.6	<0.5	7	1.6	12	2.7